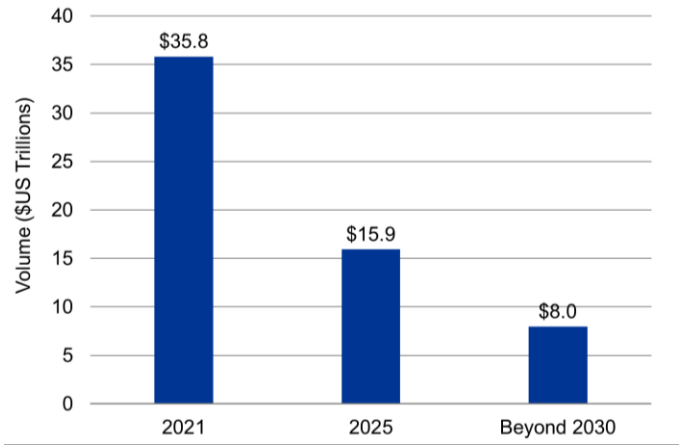
TBAC Charge

Please comment on developments regarding the transition away from LIBOR and toward the Secured Overnight Financing Rate (SOFR). How should market participants evaluate the risks of continued use of financial instruments linked to LIBOR? Summarize developments in SOFR derivative markets, the introduction of SOFR-linked issuance, and your expectations going forward.

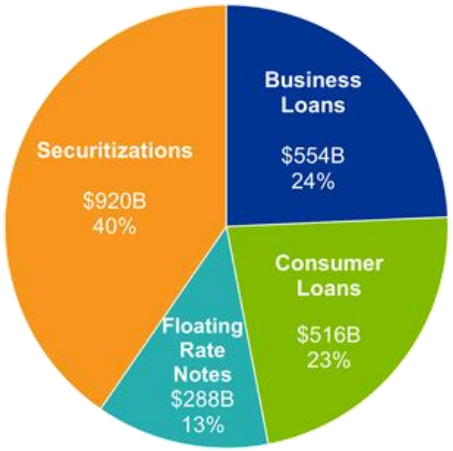
LIBOR Exposure

- In July 2017 Andrew Bailey, the Chief Executive of the Financial Conduct Authority (FCA), announced a plan to no longer sustain LIBOR through the current mechanism, by which the FCA persuades or obliges panel banks to submit contributions to the benchmark, beyond the end of 2021
- The Alternative Reference Rates Committee (ARRC) chose SOFR to the be the standard overnight financing rate
  - Following Andrew Bailey's timeline the ARRC broadened its goals to help facilitate the transition of end-user cash products such as floating rate notes, CLOs, mortgages and consumer loads, etc
- ISDA has been leading an industry wide effort to implement robust fallbacks for derivative contracts referencing interbank offered rates (IBORs)
  - ISDA launched a market-wide consultation on technical issues regarding the new benchmark fallbacks for derivative contracts that reference interbank offered rates (IBORs)

USD LIBOR-Related Notional Outstanding: 2021 and Beyond



Breakdown of USD LIBOR Notional Outstanding Not Maturing by 2022 (ex Derivs.)



Source: Member firm calculations, NYFRB, Second Report of The Alternative Reference Rates Committee, March 2018.

Taking Stock of LIBOR's Broad and Ongoing Usage

- Over $200T in financial instruments currently reference LIBOR
- An estimated $36T notional of LIBOR-linked instruments will remain outstanding after 2021 assuming there are no new transactions referencing LIBOR
  - Many new trades continue to reference LIBOR and the calculation does not consider replacement risk
  - After this date, the FCA will no longer compel banks to provide LIBOR submissions
- Interest rate derivatives represent the largest portion of the notional outstanding beyond 2021, but LIBOR has a much broader asset class reach
- LIBOR remains an important reference rate as evidenced by new issue markets
- LIBOR transition plans have not meaningfully altered issuance behavior – many deals continue to reference LIBOR

LIBOR footprint by asset class

		Volume (Trillions USD)	Share Maturing By: End 2021	End 2025	After 2030	After 2040
Over-the-Counter Derivatives	Interest rate swaps	81	66%	88%	7%	5%
	Forward rate agreements	34	100%	100%	0%	0%
	Interest rate options	12	65%	68%	5%	5%
	Cross currency swaps	18	88%	93%	2%	0%
Exchange Traded Derivatives	Interest rate options	34	99%	100%	0%	0%
	Interest rate futures	11	99%	100%	0%	0%
Business Loans[2]	Syndicated loans	1.5	83%	100%	0%	0%
	Nonsyndicated business loans	0.8	86%	97%	1%	0%
	Nonsyndicated CRE/Commercial mortgages	1.1	83%	94%	4%	2%
Consumer Loans	Retail mortgages[3]	1.2	57%	82%	7%	1%
	Other Consumer loans	0.1	---	---	---	---
Bonds	Floating/Variable Rate Notes	1.8	84%	93%	6%	3%
Securitizations	Mortgage -backed Securites (incl. CMOs)	1.0	57%	81%	7%	1%
	Collateralized loan obligations	0.4	26%	72%	5%	0%
	Asset-backed securities	0.2	55%	78%	10%	2%
	Collateralized debt obligations	0.2	48%	73%	10%	2%
Total USD LIBOR Exposure:		**199**	**82%**	**92%**	**4%**	**2%**

Source: ARRC

Critical Steps Towards LIBOR Transition Are Already Underway

Alternative Reference Rates

- **Smooth functioning markets must exist for Alternative Reference Rates**
  - In the US, the NYFRB began publishing Secured Overnight Financing Rate (SOFR) in April 2018
  - CME launched trading in SOFR Futures (1-month and 3-month) on May 7, 2018 and clearing for OTC SOFR Swaps on October 1, 2018; LCH started clearing OTC SOFR swaps on July 16, 2018
  - SOFR-linked issuance began in July 2018
  - Increased SOFR-linked issuance will be another key driver towards building SOFR derivative liquidity
  - There is a need for collaboration across jurisdictions

Alternative Reference Rates by Jurisdiction

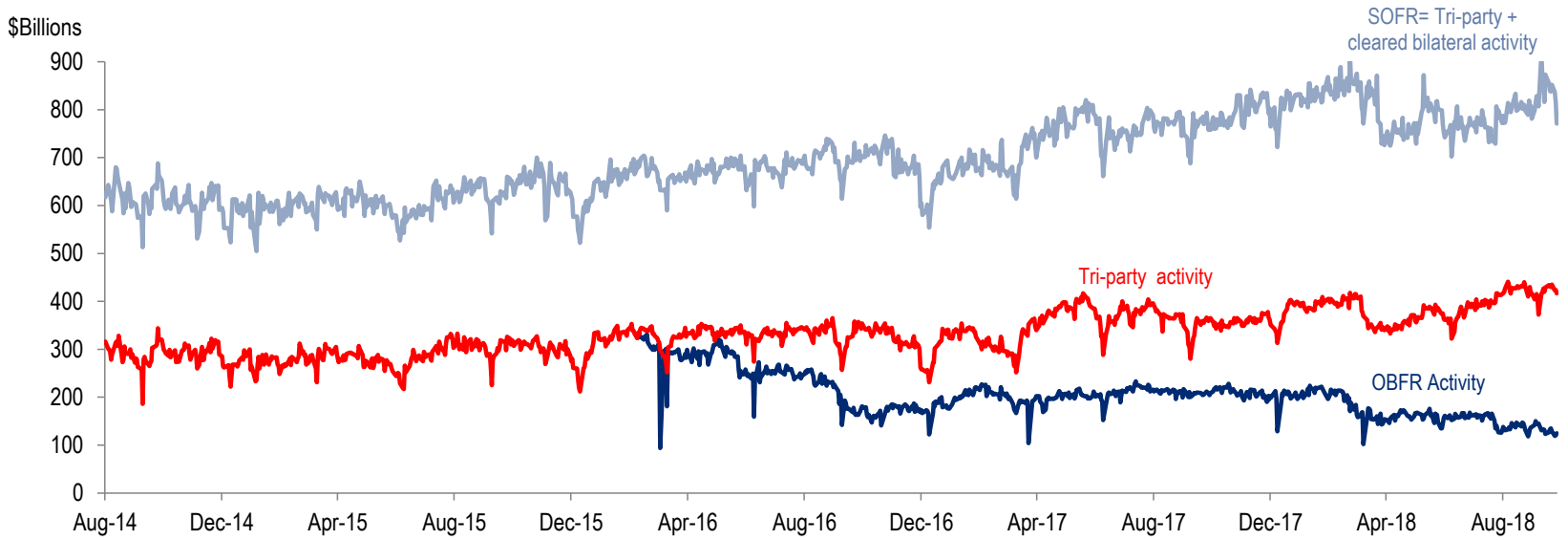
Jurisdiction	Working Group	Public Sector	Alternative RFR	Rate Administrator	Secured vs. Unsecured	Tenor	Expected Launch Date
	Alternative Reference Rates Committee	Federal Reserve	**SOFR** *Secured Overnight Financing Rate*	Federal Reserve Bank of New York	Secured	Overnight	Currently published
	Working Group on a RFR Rate for the Euro Area	European Central Bank	**ESTER** *Euro Short-Term Rate*	European Central Bank	Unsecured	Overnight	October 2019
	Study Group on Risk-Free Reference Rates	Bank of Japan	**TONA** *Tokyo Overnight Average Rate*	Bank of Japan	Unsecured	Overnight	Currently published
	National Working Group on Swiss Franc Reference Rates	Swiss National Bank	**SARON** *Swiss Average Rate Overnight*	SIX Swiss Exchange	Secured	Overnight	Currently published
	Working Group on Sterling Risk-free Rates	Bank of England	**SONIA** *Sterling Overnight Index Average*	Bank of England	Unsecured	Overnight	Currently published

Source: ISDA.

What is SOFR?

- The Alternative Reference Rate Committee (ARRC) identified the Secured Overnight Financing Rate (SOFR) as its preferred rate
- SOFR is a transaction based rate, calculated from a broad universe of o/n UST repo activity. SOFR is based on three different repo segments:
  - Tri-party US Treasury general collateral (GC) repo, cleared and settled by Bank of New York Mellon, excluding transactions with the Federal Reserve
  - Tri-party US Treasury GC repo within the FICC GCF repo framework, where FICC acts as a central counterparty
  - Bilateral Treasury repo transactions cleared through the FICC Delivery-versus-Payment (DVP) service

Aggregate Volumes underlying select MMF rates



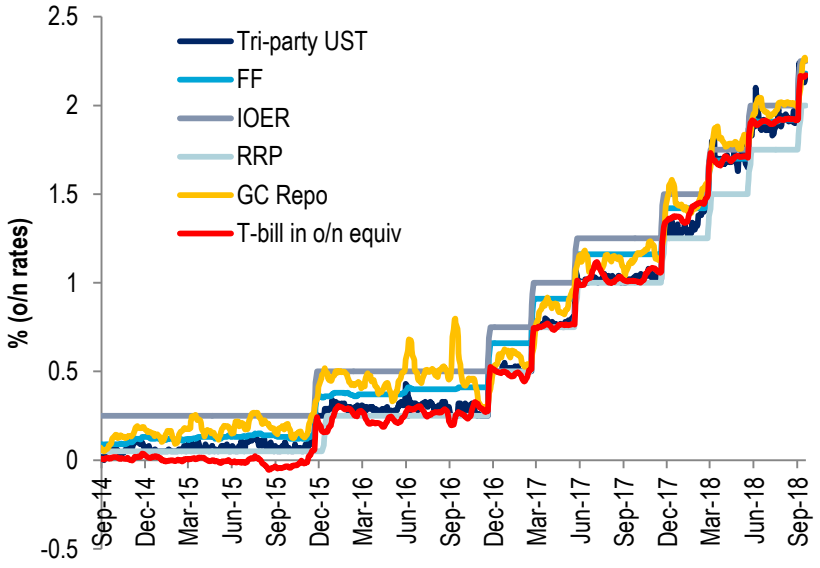
Source: ARRC, New York Fed

What drives SOFR?

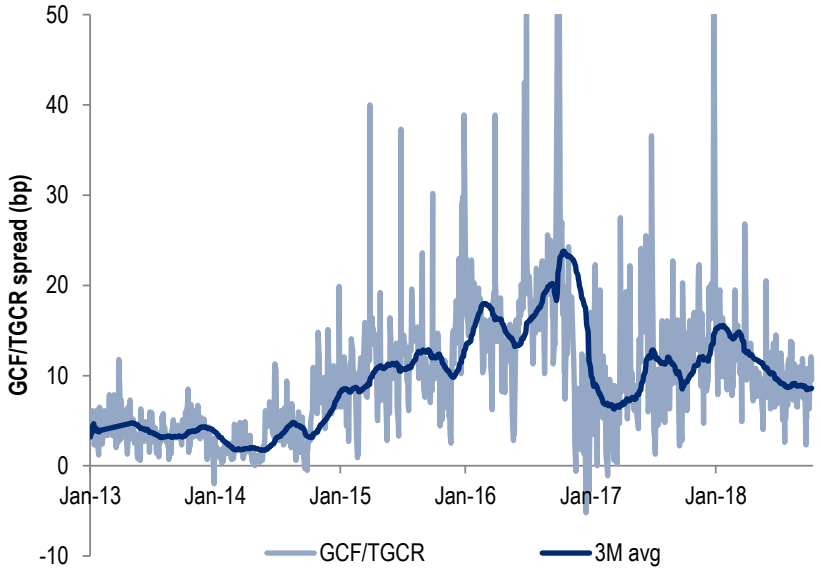
- **SOFR moves with T-bill yields:**
  Higher T-bill issuance brought all o/n rates higher, including tri-party repo rates, as a competing asset for US MMFs

- **SOFR moves with dealer B/S cost of repo:**
  Bilateral/GCF and BNYM Tri-party repo rates are linked as a bid-ask for dealers to intermediate repo between MMF and end-users (e.g. hedge funds). We have seen repo spreads widening from 2014-2016 as LCR / SLR phased-in. Since then, we saw it tightening with more competitive repo intermediation post the US MMF reform

Cheapening of T-bill brought all o/n rates higher…



GCF/Tri-party repo spreads tend to reflect bid-ask of repo from dealer's perspective

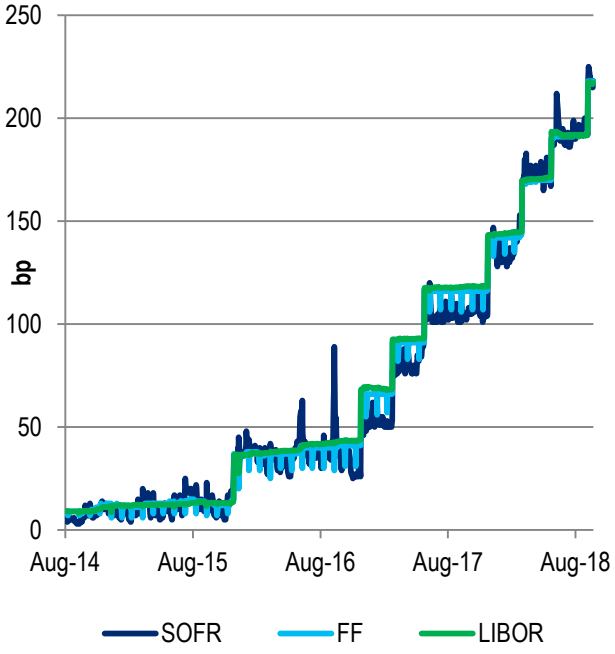


Source: Bloomberg, NYFed
Note: T-bill in o/n equivalents are calculated as 1M T-bill yield – (1M FF OIS – O/N FF)

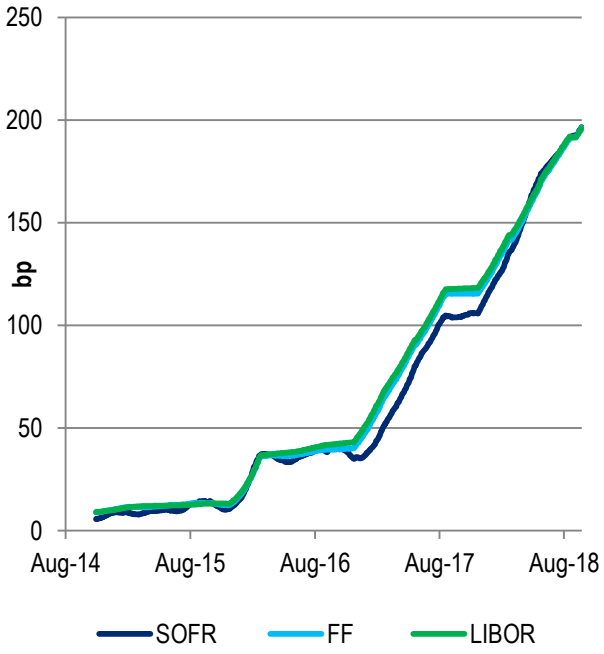
How do SOFR and LIBOR differ?

- 3M LIBOR and o/n SOFR differ in two aspects:
  - SOFR is secured and LIBOR is unsecured. LIBOR is inherently bank-credit sensitive, pro-cyclical asset whereas SOFR is collateralized and largely cleared, hence a counter-cyclical asset
  - 3M LIBOR is a term rate vs SOFR is an overnight rate. We find this difference to be more salient, as noted by volatility in 3M LIBOR / 3M FF OIS basis
- 3M LIBOR/OIS tend to widen on funding "stress" scenarios. This is not the case for SOFR

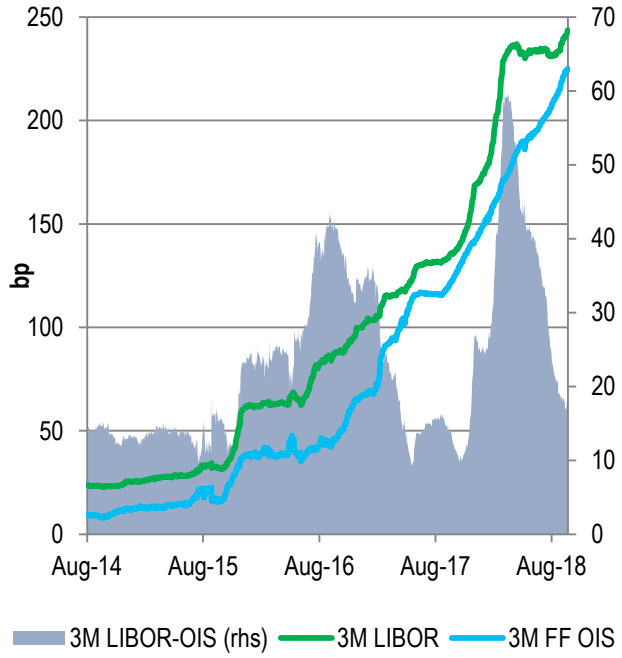
Overnight MMF rates tend to behave similarly on o/n basis …



As well as in longer frames (3m rolling geometric average)…



However, behavior of OIS vs term rate such as 3M LIBOR can be quite different…

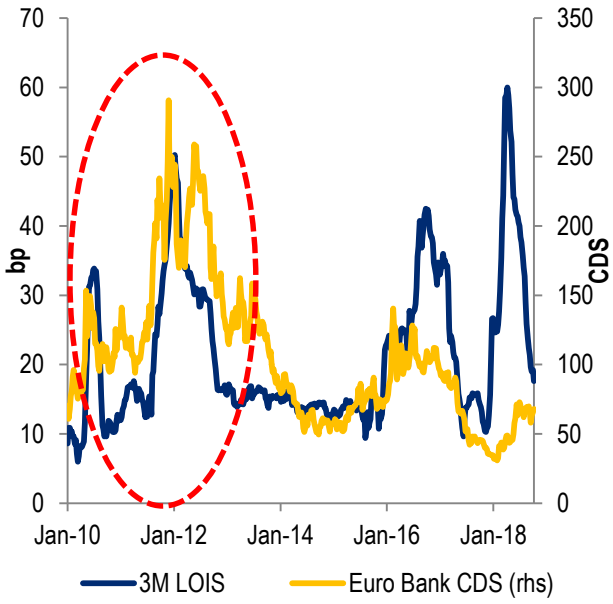


Source: Bloomberg

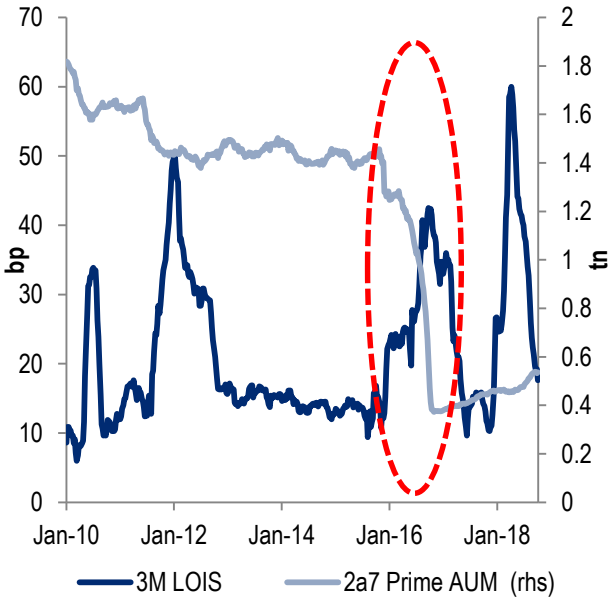
LIBOR/OIS tend to widen on funding shock episodes

- Since the crisis, LIBOR/OIS basis has experienced 4 widening episodes
  - **In 2010 and 2011/2012**, European debt crisis intensified to put bank's creditworthiness in question
  - **In 4Q2016**, the basis widened on US MMF reform – which caused a pullback on 2a7 Prime funds to cause a demand shock in funding markets
  - **In 1Q2018**, rapid T-bill issuance and shortening of WAM of repatriated cash after the tax reform led LOIS wider

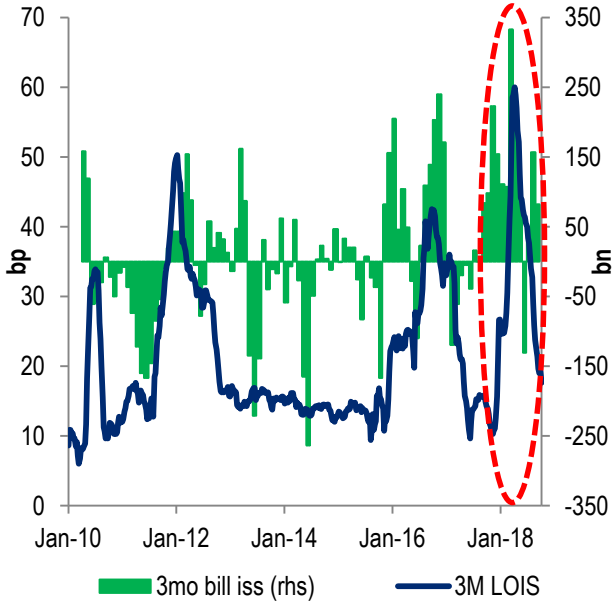
Credit "shock" caused LOIS widening in prior years…



MMF reform "shock" caused LOIS widening in 2H2016…



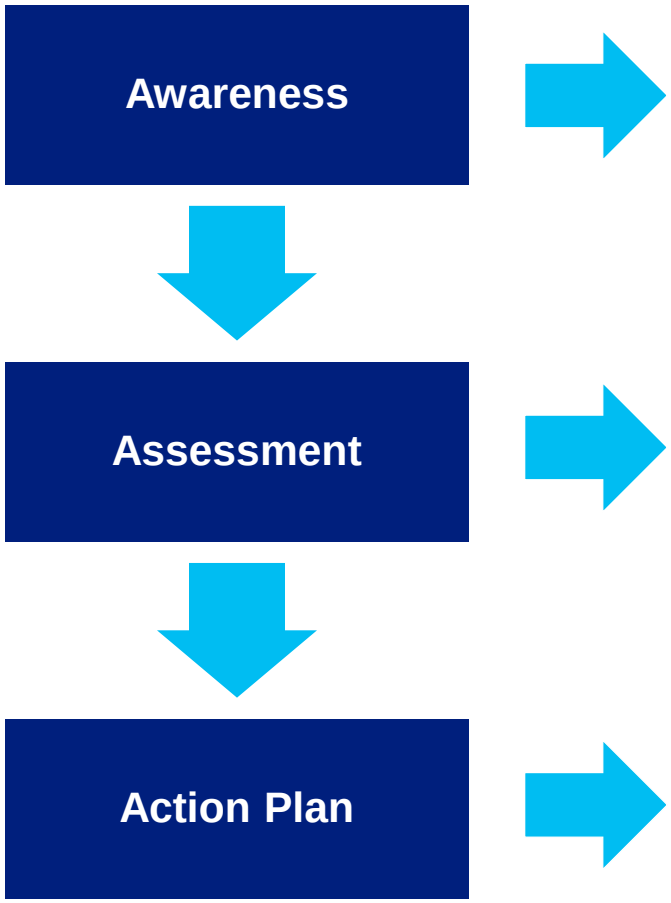
Bill issuance & repatriation "shock" caused LOIS widening in 1H2018…



Source: Bloomberg

Preparing for LIBOR Transition

Preparation is key and requires engagement across multiple stakeholders within every firm



Education is Critical -- from Main Street to Wall Street

- Households:
  - Need to understand impact on mortgages, consumer loans, student loans
- Industry:
  - Collaboration is underway - Alternative Reference Rate Committee (ARRC) includes representation across industry groups
  - Trade associations are promoting global coordination

Evaluate existing exposures to LIBOR

- Compress existing positions to simplify exposures where possible

Carefully review fallback methodologies:

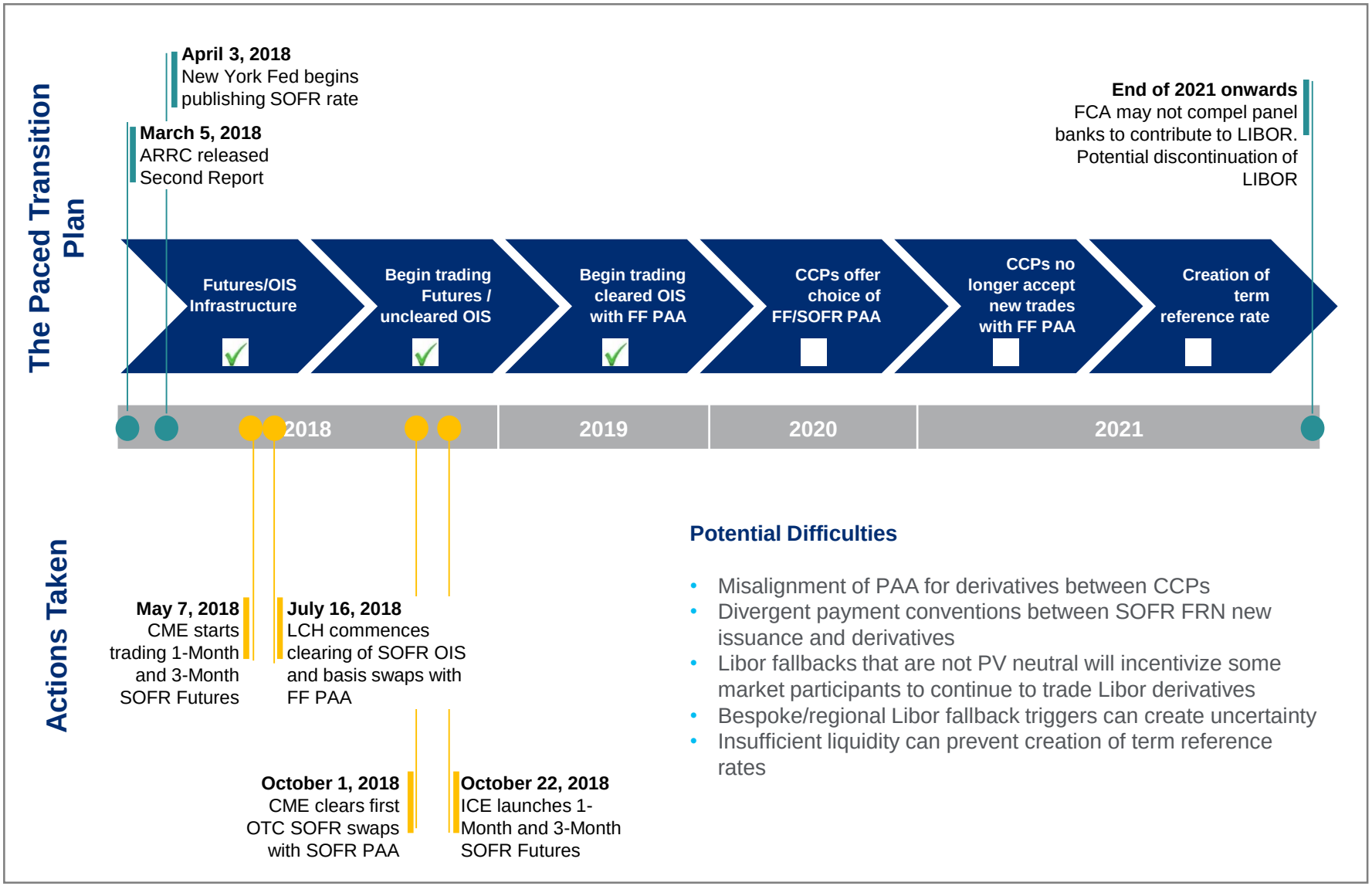
- Assess inconsistencies or lack of sufficient fallbacks within existing agreements
- Require stronger fallback language be incorporated into new LIBOR-referenced instruments
  - ISDA consultation underway for derivatives
  - ARRC consultation for cash products
- Facilitate growth of SOFR markets and LIBOR/SOFR basis through more concrete fallback methodologies

Analyze Systems Readiness

The ARRC published a "Paced Transition Plan", but all investors and market participants will need to make the appropriate preparations

Markets are highly interconnected - there will be implications both cross-asset and cross-currency

Paced Transition Milestones



Potential Difficulties

- Misalignment of PAA for derivatives between CCPs
- Divergent payment conventions between SOFR FRN new issuance and derivatives
- Libor fallbacks that are not PV neutral will incentivize some market participants to continue to trade Libor derivatives
- Bespoke/regional Libor fallback triggers can create uncertainty
- Insufficient liquidity can prevent creation of term reference rates

Libor- vs SOFR-linked Liabilities – Banks' Perspective (i)

Suitability for Financial Institutions and Other Borrowers

- Likely suitable for majority of floating rate borrowers seeking exposure to secured funding rate
- Potential operational/system challenges, particularly for smaller institutions and if compounding becomes standard

Risks

- Persistent limited liquidity in cash and derivatives markets
  - Inadequate investor pool for new issuances and secondary trading
  - Restricted ability to perform dynamic ALM
  - Long-dated callable issuances may require references to illiquid/long-end parts of the SOFR curve
- May not match performance of Libor-based assets
- Limited ability to hedge general bank funding risk due to secured nature of SOFR

Benefits

- SOFR issuances may provide greater transparency for investors (clearer delineation of credit risk)
- Can closely match performance of certain secured investments
- Potentially represents new balance sheet management tool in combination with Libor instruments
- Certain investors may see additional utility in SOFR-based investments – potentially offsetting premium demanded by other investors

Libor- vs SOFR-linked Liabilities – Banks' Perspective (ii)

Considerations following the Crisis of 2007 and Outlook

- Banks generally responded to increased regulation and improved liquidity risk management with the extension of maturity profiles of unsecured borrowings
- Post-crisis shifts towards deposit funding (commercial/demand deposits) increased the relative size of certain short- to medium- duration liabilities

  ➡ Overall the exposure to funding spread resets of liabilities arguably has been reduced

- However banks still have to manage funding spread risks due to spread duration gaps between assets with longer re-pricing cycles and shorter-dated liabilities – exposing banks to a sudden widening of sector credit spreads

  ➡ There is still a need for ALM instruments whose performance is linked to unsecured bank credit spread such as Libor

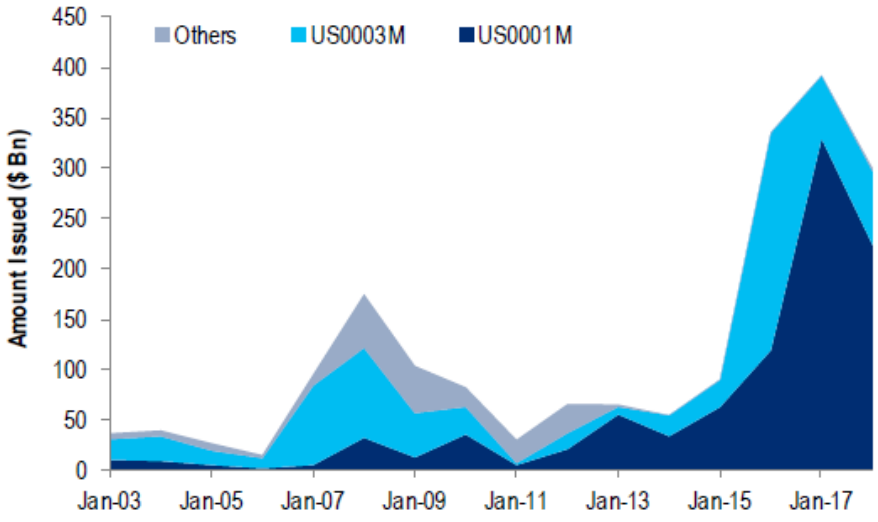
- On the other hand unsecured inter-bank lending volumes have collapsed since the crisis resulting in Libor being less representative of actual bank funding costs

  ➡ Will the banking industry require new hedging instruments based on unsecured benchmarks?

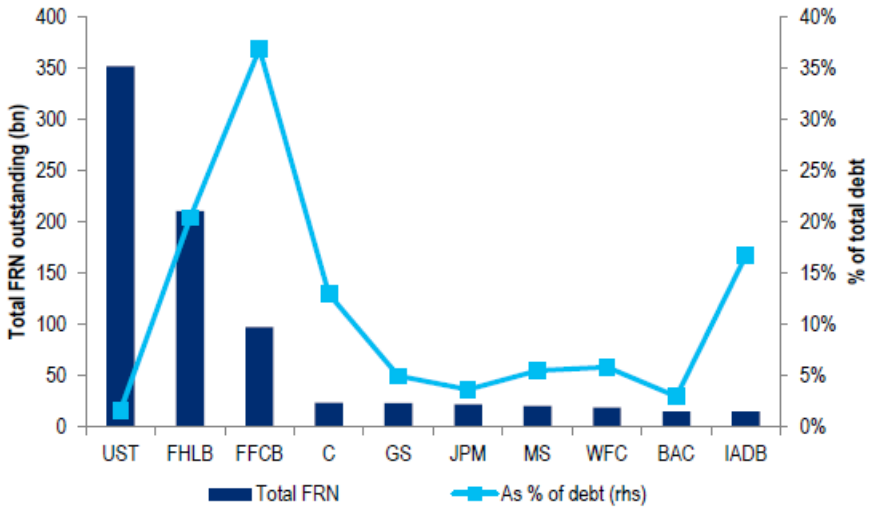
SOFR can allow GSE Issuers to diversify out of LIBOR

- FHLBs are the second largest issuer of USD FRNs as of end of Q3 2018, after the US Treasury. SOFR floaters would allow FHLBs to diversify their LIBOR exposure upon the cessation/fallback risk
  - FHLBs may have been issuing more floaters over the years as (1) increase in Government-only fund AUM post the US MMF reform increased demand for GSE papers and (2) hiking cycle made floaters more attractive to fixed from the investors without derivative access
- SOFR FRN issuance by GSEs is the natural starting place to test and develop the demand base for cash SOFR products, as end-users often won't require derivative markets
  - Fannie Mae have issued the most SOFR FRNs so far ($11bn)
  - The survey notes that investors are likely to be more receptive to SOFR FRNs issued by GSEs

FHLBs have increased LIBOR FRN issuance after the US money market reform



FHLBs are the second largest issuer of USD FRNs (as the end of Q32018)



Source: Bloomberg

Managing LIBOR Risk

Risks of existing Libor contracts without fallbacks

- Inadequate legacy fallback language increases risk of litigation
- Partial adoption of new fallbacks

Risks of Libor references with fallbacks

- SOFR market not sufficiently developed at time of cessation could lead to market disruption
- Fallback rate calculation causes valuation impact upon cessation
- Accounting/Tax/Margin/Clearing impact from Libor cessation and fallback adoption could lead to litigation risk and liquidity risk
- Regional or product specific trigger events lead to partial cessation increasing market fragmentation

Risks of new SOFR contracts

- Sluggish adoption of SOFR as new standard
- Insufficient liquidity in longer tenors

- Market participants establish risk metrics for active management of net exposure to Libor
- Active banking and public sector outreach to amend existing contracts
- ISDA protocol amendment approach with limited optionality
- Dealers and FMUs support development of liquid SOFR derivative term markets
- ISDA/ARRC may recommend market-neutral fallback language in derivative and cash markets
- ARRC regulatory advocacy for no action relief and exemptions
- Bank-wide “Libor offices” contribute to global and cross-product coordination to align trigger language; exposure management by product
- Industry coordination with CCPs to align market conventions and cessation triggers

Critical Steps Towards LIBOR Transition Are Already Underway

Fallback Methodologies

An appropriate "fallback methodology" must be established

Permanent cessation of LIBOR is generally not consistently contemplated in documentation

Contract language is not standardized across corporates, mortgages, FRNs, and loans, raising risk of fragmentation

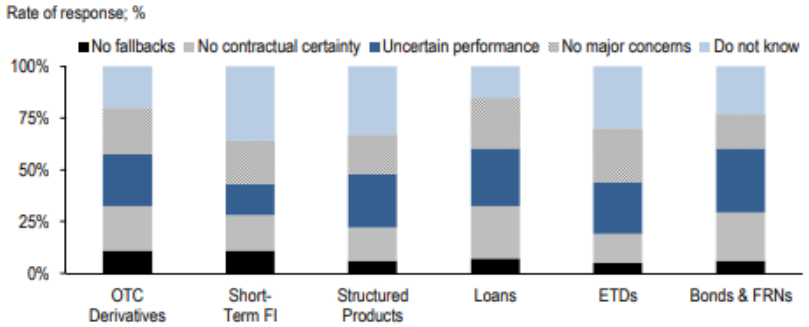
- For example: "in the event of LIBOR cessation…"

  "…the security can change to a fixed rate based off the last setting"

  "…the security converts to a fixed instrument based on the first setting"

  "…the issuer, in its sole discretion, can name a successor rate"
- In some cases there is no fallback mentioned at all

Recent ISDA survey highlights fallback provisions as a key concern in the event LIBOR is permanently discontinued



Note: Full response options are: (1) There are no fallback provisions, (2) Fallback provisions will not provide contractual certainty, (3) Fallback provisions will provide contractual certainty but the trade/position will not continue to function as originally intended, (4) Fallback provisions will provide contractual certainty and the trade/position will continue to function as originally intended, and (5) Do not know. For details, see *IBOR Global Benchmark Transition Report*, June 2018.

Source: ISDA

A "fallback methodology" should:

- Define what constitutes LIBOR cessation event
- Outline a methodology to capture the spread between LIBOR and SOFR
- Methodologies should be consistent across asset classes to mitigate market disruption and fragmentation

ISDA and ARRC are undertaking industry-wide consultations with numerous methodologies being considered for various products

- Upon update of ISDA definitions, new LIBOR derivatives would reflect the final fallback methodology
- New fallback language will not necessarily apply to legacy products, but ISDA contemplates a protocol approach to amend legacy derivatives
- ARRC Guiding Principles for More Robust LIBOR Fallback Contract Language in Cash Products:

Shift from discretion to specificity; Consistency between asset classes; Feasibility and fairness of implementation; Rate, spread and term structure adoption

Ultimately, clarity on the selected methodology will create a path forward and introduce potential for more active trading of basis swaps between these markets

Market disruption is a risk if LIBOR prematurely ceases publication

Defining major risks and market implications

Market participants are working to define major risks

- Inconsistent legal interpretations could lead to contract frustration
- Inconsistent fallback language and calculation methodology could drive market fragmentation and asset hedge misalignments
- Breadth of jurisdictional oversight, if not aligned, could drive market fragmentation
- Inconsistent accounting / tax implications could factor into fallback adoption
- Market participants could use economic impact from fallback to drive protocol adoption decisions

Potential market implications of a LIBOR cessation

- Rotation from LIBOR based derivatives to OIS, or SOFR and a move from IRS instruments to Treasury futures
- Reduction of the CCP delta mismatch could shift the CME/LCH basis
- Market pricing of LIBOR forwards will also be a function of the selected fallback approach

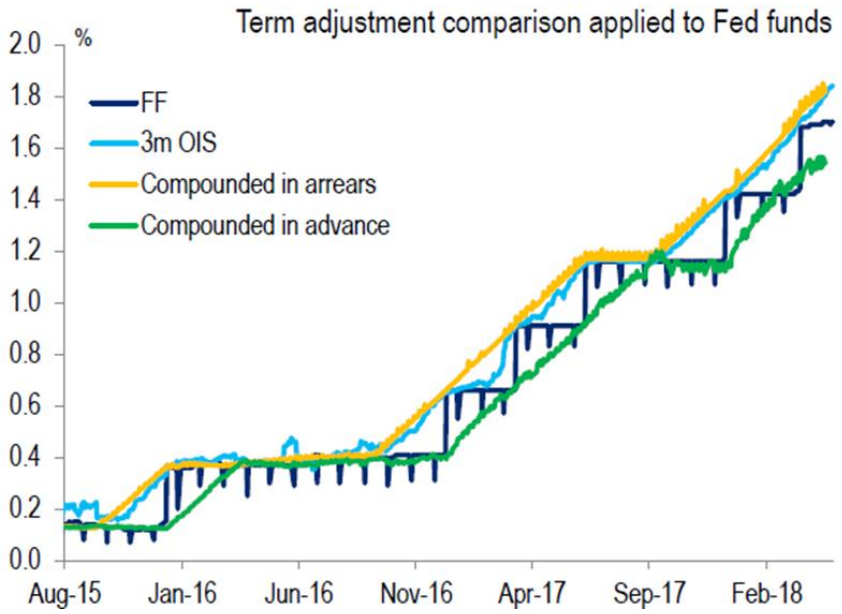
How firms can quantify LIBOR cessation risk

- For derivatives: firms can estimate their exposure by quantifying their LIBOR projection risk, in dv01 terms, under different fallback scenarios
- For cash products: the notional amount for instruments referencing LIBOR can be analyzed under different fallback scenarios

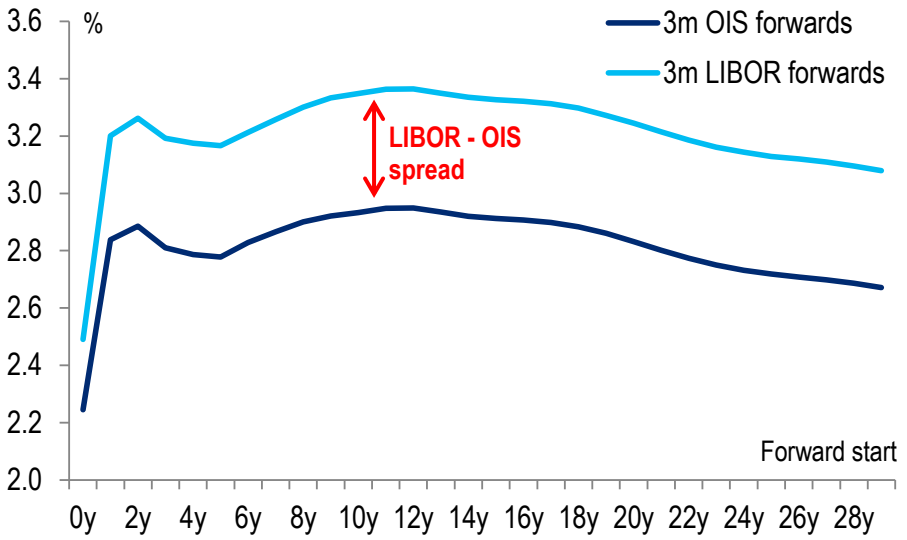
LIBOR fallback process

- Two step process to apply SOFR as LIBOR replacement:
  - Term adjustment: Transform SOFR, which is an o/n rate, to a term rate
  - Spread/Credit adjustment: Apply a spread on top of the SOFR rate to take into account LIBOR's credit premium component
- Potential term adjustment methodologies: Spot o/n SOFR, Convexity adjusted o/n SOFR, Compounded in arrears, and Compounded in advance
- Potential spread adjustment methodologies: Forward curve, Historical mean/median, Spot spread

We benchmark term adjustment methodologies to 3m OIS forwards



Spread adjustment captures the basis between LIBOR and the risk free rate

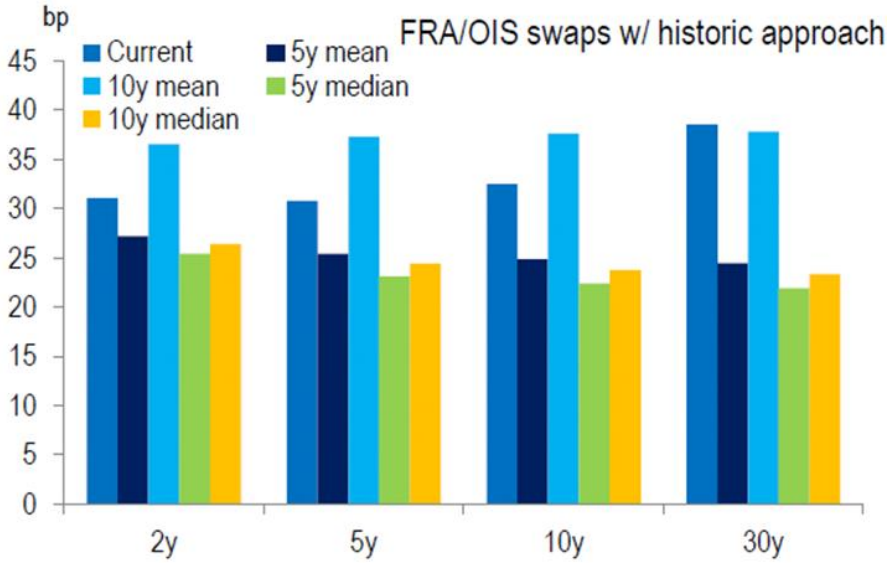


Source: Bloomberg

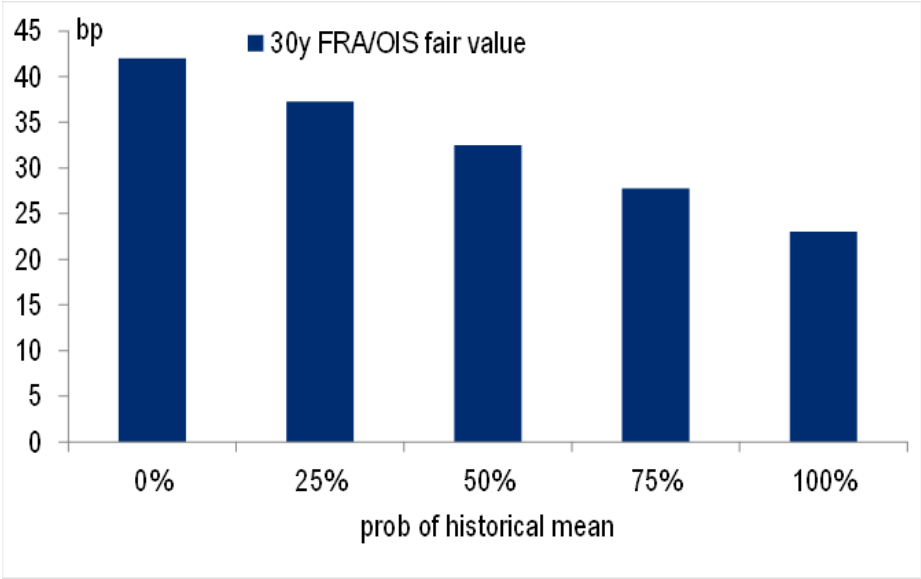
Market implications from LIBOR fallback

- Choosing the historical mean approach as fallback would likely flatten the LIBOR-OIS basis swap curve
  - This is especially true for 5s30s and 10s30s
- The probability that the historical mean approach will be implemented, on a cessation of LIBOR, can be implied from 30y FRA/OIS spreads
- We can approximate the fair value of 30y FRA/OIS to be ~23bp assuming:
  - Historical mean approach is used in the fallback process with a 10y window
  - A 20% chance of LIBOR discontinuation each year from 2021-2025

FRA/OIS will likely flatten with the historic approach



LIBOR cessation estimates can be derived from current 30y FRA/OIS levels



Source: Bloomberg

SOFR Adoption

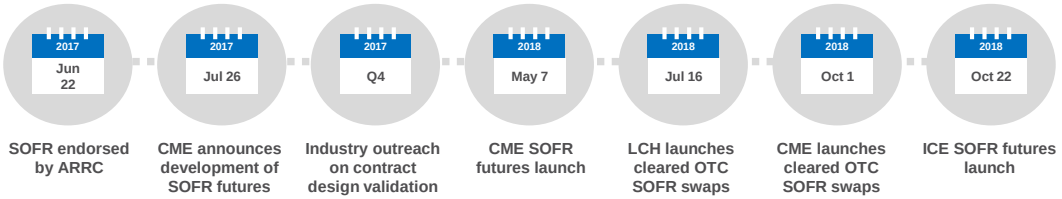
Trading Begins

CCPs Launch Futures and Swaps

Fannie Mae issues first SOFR-linked debt deal

Broader adoption of SOFR-linked issuance is gaining momentum

SOFR Product Development Timeline



Maturities	Amount	Pricing
6-month	$2.5B	SOFR + 8 bps
12-month	$2.0B	SOFR + 12 bps
18-month	$1.5B	SOFR + 16 bps
Total	**$6.0B**	

Source: Fannie Mae

Issue Date	Issuer	Notional ($M)	Tenor (years)
07/30/18	Fannie Mae	$6,000	1.5, 0.5, 1.0
08/21/18	World Bank	$1,000	2.0
08/21/18	Credit Suisse AG/NY	$100	0.5
08/28/18	Barclays	$525	0.25
09/07/18	MetLife	$1,000	2.0
09/20/18	Triborough Bridge & Tunnel	$107.28	13.5
09/21/18	Wells Fargo	$1,000	1.5
09/25/18	Wells Fargo	$125	1.0
10/05/18	Credit Suisse	$1,056	0.5, 1.0
10/19/18	JP Morgan	$800	2.0
10/24/18	Toyota	$500	0.25
10/30/18	Fannie Mae	$5,000	0.5, 1.0, 1.5
10/31/18	L-Bank (SSA in Germany)	$12	1
	Total	**$17,225**	

- **Fannie Mae successfully issued a three-tranche, $6B SOFR debt transaction on July 26, 2018**
- **The deal was met by demand from a broad and diverse investor base**
- **Over $10 billion in SOFR floaters have been issued**
- **Investors should read the fine print:**
  - **Compounding differences can occur between deals**
  - **LIBOR and SOFR can be expected to behave differently in different market environments**

SOFR Adoption

Going Forward

We have identified several areas of further development that we expect would help build activity and liquidity

Official Sector Guidance	
Regulators	• Could provide relief on central clearing mandate for legacy LIBOR positions • Could assess ways to encourage banks to move away from using LIBOR • Consideration of effects across jurisdictions given global nature of the swaps market
LIBOR Oversight	• Guidance on conditions under which LIBOR will no longer be representative (or produced at all)

Market Structure Developments	
Yield Curve	• Build liquidity beyond 2 years • Build out of the long-dated SOFR curve - this will require issuer / derivative market participation
CCPs	• SOFR-based PAA
Options/ Swaptions	• Developed options market on SOFR futures • Eventual growth of SOFR swaptions
Bilateral agreements	• Thoughts on other ways bilateral counterparties can choose to incorporate SOFR discounting
Issuers	• Treasury should evaluate issuing FRNs off SOFR

SOFR Survey to Short-end investors

- We performed a front-end survey around SOFR FRN issuance in September 2018
  - 100 respondents covered 2a7 funds (government and prime), non-2a7 money market funds such as offshore, security lenders and corporate treasurers

- Key results:
  - **LIBOR cessation risk**:
    50% chance of cessation beyond 2021*(25% of the respondents)*
  - **SOFR FRNs would be considered over LIBOR:**
    for cheaper levels *(27%)*, and for diversification of floating benchmarks *(24%)*
  - **LIBOR FRNs are still attractive over SOFR :**
    given the better liquidity in cash markets *(18%)* and derivative markets *(16%)* and volatility of the underlying rate *(16%)*
  - **Preferred issuers of SOFR FRNs:**
    GSEs *(25%),* Financials *(22%)* and US Treasury *(15%)* would be more receptive
  - **SOFR FRNs would take up significant portion (more than a quarter) of their FRN portfolio:**
    beyond 2021 *(38%)*

Source: Bloomberg