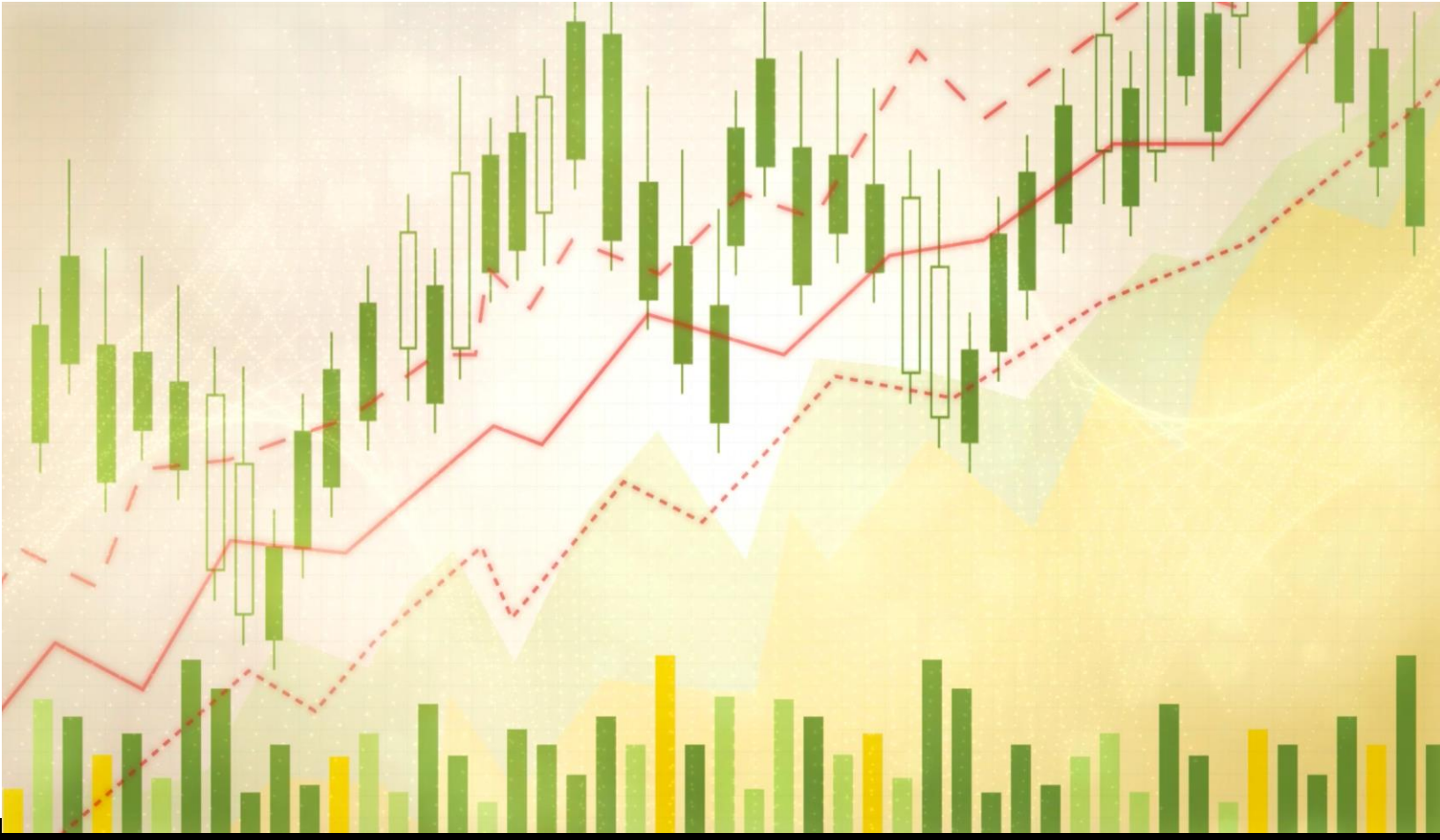


SIFMA Insights:

Secured Overnight Financing Rate (SOFR) Primer

The transition away from LIBOR

July 2019

sifma®

Contents

SIFMA Insights Primers

The SIFMA Insights primer series is a reference tool that goes beyond a typical 101 series. By illustrating important technical and regulatory nuances, SIFMA Insights primers provide a fundamental understanding of the marketplace and set the scene to address complex issues arising in today's markets.

The SIFMA Insights primer series, and other Insights reports, can be found at: https://www.sifma.org/resources/news/primers-by-sifma-insights/

SIFMA is the leading trade association for broker-dealers, investment banks and asset managers operating in the U.S. and global capital markets. On behalf of our industry's nearly 1 million employees, we advocate on legislation, regulation and business policy, affecting retail and institutional investors, equity and fixed income markets and related products and services. We serve as an industry coordinating body to promote fair and orderly markets, informed regulatory compliance, and efficient market operations and resiliency. We also provide a forum for industry policy and professional development. SIFMA, with offices in New York and Washington, D.C., is the U.S. regional member of the Global Financial Markets Association (GFMA). For more information, visit http://www.sifma.org.

Executive Summary

The transition from the London Interbank Offered Rate (LIBOR) to alternative interest rate benchmarks is well underway, but much work lies ahead in order to implement a successful reference rate change by the end of 2021. At this time, markets will no longer have certainty of LIBOR publication.

In this primer from SIFMA Insights, we provide an overview of the LIBOR transition, with a focus on the proposed U.S. alternative reference rate, Secured Overnight Financing Rate (SOFR). Highlights from the primer include:

- **What Is LIBOR?** LIBOR is the most commonly used benchmark for short-term interest rates, often referenced globally in derivative, bond and loan documentation.

- **Why Is LIBOR Important?** It is estimated $200 trillion of financial contracts and securities are tied to USD LIBOR and that matters to everyone – small businesses, corporations, banks, broker dealers, consumers and investors.

- **Why Transition Away from LIBOR?** LIBOR is based on relatively few transactions – the most active tenor (three months) posts less than $1 billion transactions per day – and relies heavily on expert judgement in determining the rate. The scarcity of underlying transactions makes LIBOR potentially unsustainable, as banks may eventually choose to stop submitting altogether.

- **What Is The Role of The ARRC?** In the U.S. in 2014, the Fed & New York Fed established the Alternative Reference Rates Committee (ARRC) to lead the transition away from LIBOR. The ARRC continues to lead the transition from LIBOR to SOFR – as well as encourage the development of the SOFR futures market – and its Paced Transition Plan for a smooth transition away from LIBOR is ahead of schedule.

- **What Is SOFR?** The ARRC selected SOFR as the recommended alternative reference rate for the U.S. While LIBOR is not fully transaction based, SOFR is based on the overnight repo markets with ~ $1 trillion of transactions per day. Publication of the SOFR rate began in April 2018. Trading and clearing of SOFR-based swaps and futures began in May 2018.

- **How Is SOFR Calculated?** SOFR is calculated as a volume-weighted median of transaction level tri-party repo data, GCF Repo transaction data & data on bilateral Treasury repo transactions cleared through FICC's DVP service (from DTCC Solutions). SOFR is published each business day on the New York Fed's website.

- **How Is Market Uptake of SOFR?** As of June 2019, 27 institutions have issued more than $136 billion notional in floating rate securities tied to SOFR, with a record $24 billion in June. Outstanding SOFR-linked notional across all products has grown from less $100 billion in May 2018 to over $9 trillion as of April 2019, >9,000%. The jump in February 2019, +35% month/month, implies increased interest and involvement from market participants.

- **How Does SOFR Differ from LIBOR?**

SOFR	LIBOR
Risk free rate (no credit risk)	Bank lending rate (includes credit risk)
Overnight (backward looking)	Forward looking
Secured (collateralized)	Unsecured (uncollateralized)
Calculated & published daily by the NY Fed	Calculated & published daily by ICE Benchmark Administration
Transaction based	Based on LIBOR bank submissions & expert judgement
Based on ~$1T transactions pd (repo markets)	Based on ~$1B transactions pd (3-month LIBOR)
No term structure	Term structure

- **The Path to Building a Strong Futures Market.** The smooth transition to SOFR is dependent upon the development of strong SOFR futures (and swaps) markets; a strong futures (and swaps) market is also necessary to build a SOFR term structure. In this section, we analyze the growth of the SOFR futures markets using CME product data, comparing SOFR to other contracts volume growth trajectories.

- **IBOR Global Benchmark Transition Checklist**: Assess exposures to IBORs; comprehend how a permanent cessation of IBORs impact you and your clients; mobilize a formal IBOR transition program; define a transition road map; and develop an external communication strategy.

- **Global Efforts to Transition to New Reference Rates.** The Financial Stability Board (FSB) aims to ensure transition plans are consistent and coordinated and interest rate benchmarks are robust and appropriately used by market participants. We highlight key work being performed across the globe.

The Transition Away from LIBOR

What is LIBOR?

The London Interbank Offered Rate (LIBOR, ICE LIBOR) is the most common benchmark interest rate index series used to adjust a multitude of financial instruments and contracts. An indication of the average rates at which LIBOR panel banks can obtain wholesale, unsecured funding (borrowing from other banks, commercial paper, uninsured certificates of deposits, etc.), LIBOR is a widely used benchmark for short-term interest rates, often referenced globally in derivative, bond and loan documentation, as well as in consumer lending instruments (mortgages, student loans, credit cards, etc.).

LIBOR is administered by the ICE Benchmark Administration (IBA) and is calculated and published daily across five currencies (USD, GBP, EUR, JPY, CHF) serving seven maturities (overnight, one week, and 1, 2, 3, 6 and 12 months). Historically, LIBOR panel banks based their submissions on the following question: “At what rate could you borrow funds, were you to do so by asking for and then accepting interbank offers in a reasonable market size just prior to 11:00 GMT?” Responses to the question were determined based on data from a range of relevant transaction types, which could also utilize qualitative criteria such as the expert judgement of the submitter. Each LIBOR panel bank was tasked to ensure submissions were determined using an effective methodology based on objective criteria and relevant market information.

LIBOR Panel Banks

	USD	GBP	EUR	CHF	JPY
Bank of America (London Branch)	X				
Barclays	X	X	X	X	X
BNP Paribas (London Branch)		X			
Citibank (London Branch)	X	X	X	X	
Rabobank	X	X	X		
Crédit Agricole Corporate & Investment Bank	X	X			
Credit Suisse (London Branch)	X		X	X	
Deutsche Bank (London Branch)	X	X	X	X	X
HSBC Bank	X	X	X	X	X
JPMorgan Chase (London Branch)	X	X	X	X	X
Lloyds	X	X	X	X	X
Mizuho		X	X		X
MUFG	X	X	X	X	X
National Westminster Bank	X	X	X	X	X
Royal Bank of Canada	X	X	X		
Santander UK		X	X		
Société Générale (London Branch)		X	X	X	X
Sumitomo Mitsui Banking Corporation Europe	X				X
Norinchukin Bank	X				X
UBS	X	X	X	X	X

Source: ICE Benchmark Administration website (as of June 2019)

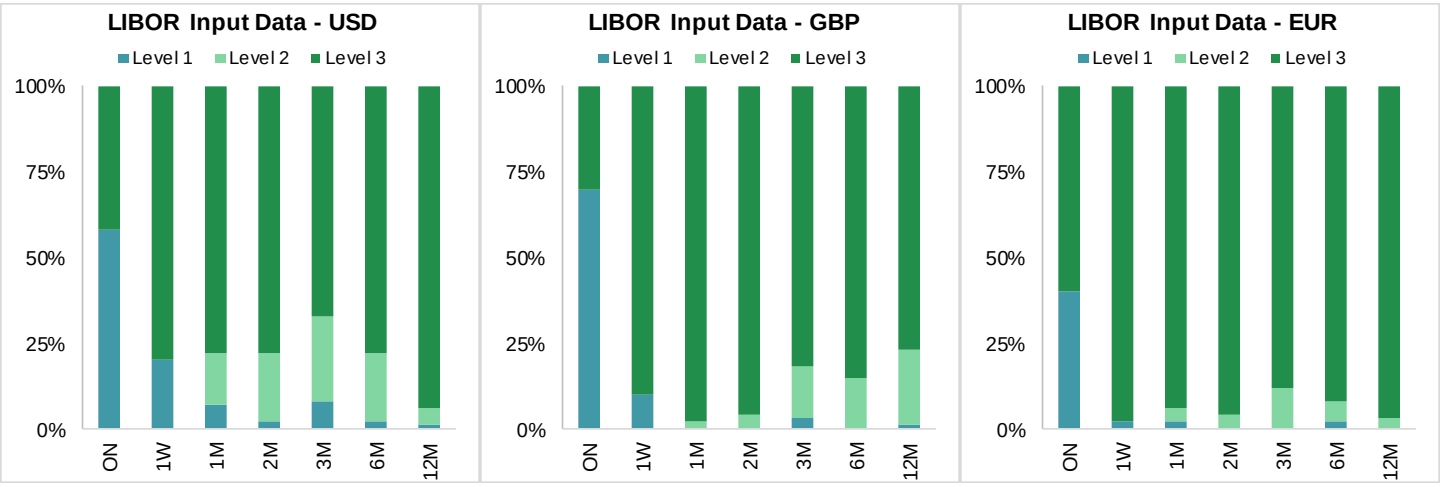
By April 2019, all LIBOR panel banks had completed the transition to the Waterfall Methodology, which can be summarized as follows:

- **Level 1, Transaction-Based** – A VWAP of eligible transactions, with a higher weighting for transactions booked closer to 11:00 GMT
- **Level 2, Transaction-Derived** – Transaction-derived data (or interpolated data), including time-weighted historical eligible transactions adjusted for market movements, and linear interpolation
- **Level 3, Expert Judgement** – Market and transaction data based expert judgement, using the bank's own internally approved procedure (based on a permitted set of inputs and agreed with IBA)

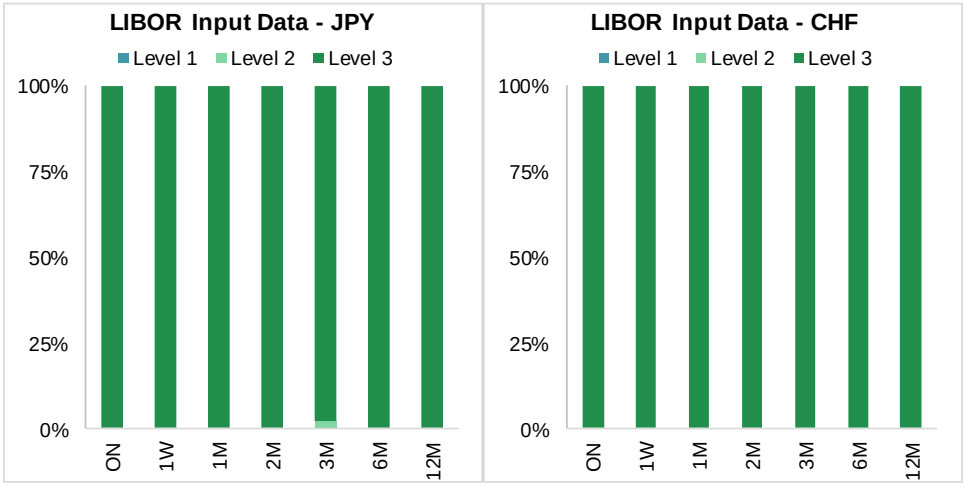
LIBOR panel banks' submissions for each currency and tenor combination are then ranked by IBA and the upper and lower quartiles are excluded to remove outliers. The relevant rate is calculated as the trimmed arithmetic mean of the remaining submissions, rounded to five decimal places. Each LIBOR panel bank's submission carries an equal weight, subject to the trimming.

A June 2019 speech by Bank of England Executive Director, Markets Andrew Hauser showed the dominance of expert judgement use in determining various LIBOR rates, as shown in the charts below and on the next page:

- Reliance on expert judgement grows as you extend out maturity
- JPY and CHF based rates are more reliant on expert judgement than USD, GBP or EUR based rates



Source: Estimated from a Bank of England presentation (as of June 2019)

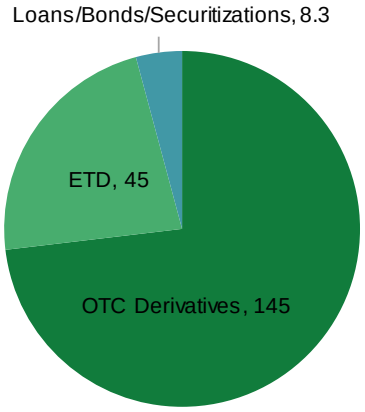


Source: Estimated from a Bank of England presentation (as of June 2019)

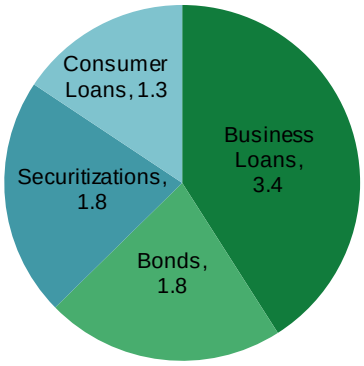
Why Is LIBOR Important?

It is estimated $200 trillion of financial contracts and securities ($190 trillion in derivatives; ~$10 trillion in corporate bonds, mortgages, securitized products, credit card receivables, etc.) are tied to USD LIBOR and that matters to everyone – small businesses, corporations, banks, broker dealers, consumers and investors. In fact, even some vendor contracts for corporations reference LIOBOR in contract terms.

LIBOR Market Breakout ($T)…



…Loans/Bonds/Sec Split ($T)



Source: Fed, BIS, Bloomberg, CME, DTCC, Shared National Credit, JPMorgan Chase (as of 2018, business loans gross notional as of 2016)
Note: OTC = IRS $81T, FRA $34T, IR options $12T, x-FX swaps $18T. ETD = IR options $34T, IR futures $11T. Bus loans: syndicated $1.5T, non-syn $0.8T, non-syn commercial mortgages $1.1T. Bonds = FRNs. Cons loans: mortgages $1.2T, other 0.1T. Sec = MBS (including CMO) $1.0T, CLO $0.4T, ABS $0.2T, CDO $0.2T

Why Transition to New Reference Rates, Away from LIBOR?

As unsecured, wholesale borrowings by banks declined since the global financial crisis, LIBOR became increasingly based on the expert judgment of panel banks. As LIBOR is based on thinner markets and is not fully transaction based – the most active tenor (three months) posts less than $1 billion transactions per day – submitted rates typically include expert judgement from market participants when determining the rate. The scarcity of underlying transactions makes LIBOR potentially unsustainable, as many banks have grown uncomfortable in providing submissions based on expert judgment and may eventually choose to stop submitting altogether.

In response to concerns regarding the reliability and robustness of LIBOR and other reference rates across the globe, the Financial Stability Board (FSB) and Financial Stability Oversight Council (FSOC) called for the development of alternative risk-free benchmark interest rates supported by liquid, observable markets. Importantly, the regulator of LIBOR, the Financial Conduct Authority (FCA) in the UK, has stated it has reached a voluntary agreement with LIBOR panel banks to continue submitting rates through 2021 but will not compel banks to continue to submit beyond that time. The FCA further advised that even if LIBOR continues to be produced, the FCA may deem it not representative, a determination that has significant implications for a firm's ability to acquire new exposures to LIBOR.

Thus, LIBOR's future is uncertain, and the market needs to prepare for the scenario where it ceases production. The FCA has advised firms to treat LIBOR's end as something that will occur, not as a remote black swan event (an event that deviates beyond what is normally expected of a situation and is extremely difficult to predict). It is, therefore, unclear if and for how long the various LIBOR rates will continue to be published post-2021.

Who Is Impacted by the Transition?

As discussed above, the transition away from LIBOR to new reference rates will impact a wide array of financial market participants:

- Investment banks underwriting, issuing and making markets in LIBOR-based instruments
- Investors managing portfolios of swaps, bonds and loans tied to LIBOR
- End users hedging risk with LIBOR-based derivatives
- Corporate and municipal borrowers financing operations with LIBOR-based floating rate bonds
- Consumers with mortgages or student loans tied to LIBOR

As such, the financial services industry continues to dedicate significant resources to the transition away from LIBOR to more robust reference rates. LIBOR is everywhere, both externally in financial contracts and also internally in systems, models and other agreements. Many existing contracts would be affected by the cessation of LIBOR. Fallback provisions that deal with the absence of the interest rate benchmark will need to be implemented (if they exist), and terms and conditions may need to be renegotiated (if permissible).

Yet, fallback provisions in many current transactions were not structured to account for the long-term cessation of the LIBOR. This has driven the focus of the industry on ensuring future contracts have robust contingencies for the cessation of reference rates. The ARRC is working on fallback language for cash products, with the first step in the transition waterfall using term SOFR, or potentially a simple average for cash products. ISDA is working on fallback language for derivatives, utilizing overnight SOFR (SOFR OIS) in the first step of its transition waterfall.

(Please see the global efforts to transition to new reference rates section for updates on alternative reference rate selections by other countries.)

US Transition Plan

Establishing the ARRC

In the U.S. in 2014, the Fed and the New York Fed established the Alternative Reference Rates Committee (ARRC) to lead the transition away from LIBOR. The ARRC is a public/private partnership, with representatives from investment banks, exchanges, trade associations, asset managers, corporate treasurers and regulatory agencies.

Its objectives are designed to facilitate an orderly transition to new reference rates, including:

- Creating model fallback language for new transactions in cash products (FRNs, syndicated loans, securitizations, business loans and adjustable-rate mortgages)
- Exploring regulatory, tax and accounting obstacles to the transition
- Developing a term structure for the new reference rates

ARRC Structure

The ARRC's membership is comprised of a broad set of private market participants and official sector ex-officio members. Additionally, the ARRC is supported by 10 working groups, each tasked with specific objectives to help enable a smooth transition from USD LIBOR. The working groups' recommendations help the ARRC to facilitate discussions and make informed decisions (and may include other interested parties beyond ARRC members, in order to provide broad coverage of applicable markets and required expertise).

(Please see the tables on the following pages for members and working groups.)

ARRC Members	
Chair	**Ex Officio Members**
Tom Wipf, Morgan Stanley	Commodity Futures Trading Commission
	Consumer Financial Protection Bureau
Members	Federal Deposit Insurance Corporation
American Bankers Association	Federal Housing Finance Agency
AXA	Federal Reserve Bank of New York
Bank of America	Federal Reserve Board
BlackRock	Office of Financial Research
Citigroup	Office of the Comptroller of the Currency
CME Group	U.S. Securities and Exchange Commission
CRE Finance Council	U.S. Treasury
Deutsche Bank	
Fannie Mae	
Freddie Mac	**Observers**
GE Capital	Bank of Canada
Goldman Sachs	BNP Paribas
Government Finance Officers Association	Cadwalader
HSBC	Morgan Lewis
Intercontinental Exchange	Venerable
International Swaps and Derivatives Association	
JPMorgan Chase	
LCH	
MetLife	
Morgan Stanley	
National Association of Corporate Treasurers	
Pacific Investment Management Company	
Prudential Financial	
Structured Finance Association	
TD Bank	
The Federal Home Loan Banks, through the Federal Home Loan Bank of New York	
The Independent Community Bankers of America	
The Loan Syndications and Trading Association	
The Securities Industry and Financial Markets Association	
Wells Fargo	
World Bank Group	

Source: ARRC website (as of June 2019)

ARRC Working Groups	
Accounting/Tax	Identifying and working with relevant authorities to address accounting and tax issues to minimize potential disruptions associated with the transition away from USD LIBOR
Business Loans	Developing recommended contract language that would provide more robust fallbacks for syndicated business loans and bilateral business loans in the event that USD LIBOR is no longer usable; working on strategies to address risks in legacy contracts that will not roll off before end-2021
Consumer Products	Developing recommended contract language that would provide more robust fallbacks for consumer loans in the event that USD LIBOR is no longer usable and working on strategies to address risks in legacy contracts that will not roll off before end-2021
Floating Rate Notes	Developing recommended contract language that would provide more robust fallbacks for floating rate notes in the event that USD LIBOR is no longer usable and working on strategies to address risks in legacy contracts that will not roll off before end-2021
Legal	Identifying and working with relevant parties to address legal issues that could hinder the transition away from USD LIBOR; serving as a resource on legal issues that may arise in the course of the ARRC's transition efforts
Market Structure and Paced Transition	Making recommendations for integrating structures of futures and other derivatives referencing SOFR; consulting with committees in other jurisdictions in order to facilitate close coordination; tracking progress in the ARRC's Paced Transition Plan and considering strategies to facilitate the uptake of derivatives referencing SOFR on a voluntary basis
Outreach/Communications	Coordinating the ARRC's public engagement and education efforts in order to inform market participants and other interested parties about ARRC-related work and about the risks associated with USD LIBOR
Regulatory Issues	Identifying potential regulatory hurdles that could hinder the transition away from USD LIBOR, highlighting these issues to regulatory agencies and self-regulatory organizations in order to help facilitate the uptake of SOFR or to help minimize potential disruptions in the event that USD LIBOR is no longer usable
Securitizations	Working to develop recommended contract language that would provide more robust fallbacks for residential mortgage-backed securities, commercial mortgage-backed securities, asset-backed securities and collateralized loan obligations in the event that USD LIBOR is no longer usable; working on strategies to address risks in legacy contracts that will not roll off before end-2021
Term Rate	Developing and evaluating various options for the construction of SOFR term rates to help some cash products transition away from USD LIBOR; considering how term rates would be integrated with trading in the derivatives markets referencing SOFR.

Source: ARRC website (as of June 2019)

ARRC Paced Transition Plan

The ARRC has selected the Secured Overnight Financing Rate (SOFR) as the recommended alternative reference rate for the U.S. While LIBOR is not fully transaction based (as discussed above), SOFR is based on the overnight repo markets. This moves the reference rate from being based on ~$1 billion transactions per day (the most active tenor of LIBOR, three months, posts less than $1 billion transactions per day) to the repo market with around $1 trillion of transactions per day.

Publication of the SOFR rate began in April 2018. Trading and clearing of SOFR-based swaps and futures began in May 2018. (Please see the Path to Building a Strong Futures Market section for more detail on the SOFR futures market.) The ARRC will continue to lead the transition away from LIBOR to SOFR – as well as encourage the development of the SOFR futures market – and its plan for a smooth transition away from LIBOR is ahead of schedule.

(Please see the following pages for the ARRC's Paced Transition Plan and 2019 incremental objectives.)

ARRC
Paced Transition Plan
Ahead of Schedule

As exchanges/CCPs launch futures trading and swaps clearing earlier than anticipated

Source: ARRC website (as of June 2019)
Note: OIS = overnight index swap
EFFR = effective Fed Funds rate PAI = price alignment interest
(1) W/ PAI & discounting linked to EFFR
(2) In current EFFR or SOFR PAI/discounting
(3) As PAI/discounting; except to close out legacy contracts
(4) Dependent upon sufficient liquidity in SOFR derivatives market to determine a robust rate
(5) ISDA Timeline for Implementation of IBOR Fallbacks

ARRC 2019 Incremental Objectives

SOFR Liquidity & Demand

- 2Q19: FRB published indicative compounded & forward-looking SOFR term rates with transparent calculation methodology
- 2Q19: ARRC launched Infrastructure & Operations Working Group & host vendor workshop
- 2019: Continue to grow liquidity & build SOFR-linked instruments (loans, securitizations, FRNs, derivatives)

Robust Fallbacks

- 2Q19: ARRC issued final recommended fallback contract language for new securities issuances
- 2H19: ARRC to assess fallback spread adjustment methodologies for cash products
- End-2019: ISDA to finalize fallbacks in new derivative contracts & to offer amended definitions in legacy contracts
- 2019: ARRC to continue identifying regulatory relief & tax/accounting requirements for use of ISDA protocol
- 2019: ARRC to explore options for legislative relief from New York State for legacy products

Consumer Working Group

- 1Q19: Consumer Products Working Group (including CFPB) launched to gain input to find SOFR models that will work for all key parties & prepare fallback processes & communications
- 2Q19: ARRC to consult on consumer product fallbacks & describe applications & uses of SOFR in consumer products

Education & Outreach

- 2019: ARRC to continue engagement through trade associations, industry conferences & media with policymakers to ensure participants understand LIBOR will cease to exist & to coordinate transition
- 2019: ARRC to continue to issue best practices, FAQs & consultations for public input
- 2019: ARRC to publish bi-monthly newsletter to promote transparency & awareness of developments

Coordination

- 2019: ARRC to continue regular communication with other NWGs & cross-currency work streams to share best practices, identify risks created by differences in rate selection & implementation timing
- 2H19: NWGs to provide update on implementation progress & plans

Source: ARRC website (as of June 2019)
Note: FRB = Federal Reserve Board. NWG = national working group

The Development of SOFR

As discussed above, the ARRC has selected SOFR as the recommended alternative reference rate for the U.S. While LIBOR is not fully transaction based.

What is SOFR?

SOFR is a measure of the cost of borrowing cash overnight collateralized by Treasury securities. SOFR includes all trades in the Broad General Collateral Rate (BGCR)[1] plus bilateral Treasury repurchase agreement (repo) transactions cleared through the Delivery-versus-Payment (DVP) service offered by the Fixed Income Clearing Corporation (FICC, a DTCC subsidiary), which is filtered to remove a portion of transactions considered specials. In the DVP repo market, counterparties identify specific securities to settle each trade, rather than a population of acceptable collateral as in the tri-party repo market. As a result, the DVP repo market can be used to temporarily acquire specific securities. Repos for specific-issue collateral may be executed at rates below those for general collateral repos if cash providers are willing to accept a lesser return on their cash in order to obtain a particular security, i.e. trading special. DVP repo transactions with rates below the 25th volume-weighted percentile rate are removed from the distribution of DVP repo data each day to eliminate some (not all) trading special transactions.

How Is SOFR Calculated?

SOFR is calculated as a volume-weighted median of transaction level tri-party repo data collected from the Bank of New York Mellon, GCF Repo transaction data and data on bilateral Treasury repo transactions cleared through FICC's DVP service (from DTCC Solutions). SOFR is published each business day on the New York Fed's website around 08:00 EST. The volume-weighted median is the rate associated with transactions at the 50th percentile of transaction volume. This rate is calculated by ordering the transactions from lowest to highest rate, taking the cumulative sum of volumes of these transactions, and identifying the rate associated with the trades at the 50th percentile of dollar volume (rounded to the nearest basis point). The 1st, 25th, 75th, and 99th percentiles for each rate are also calculated using the same volume-weighted methodology (rounded to the nearest basis point).

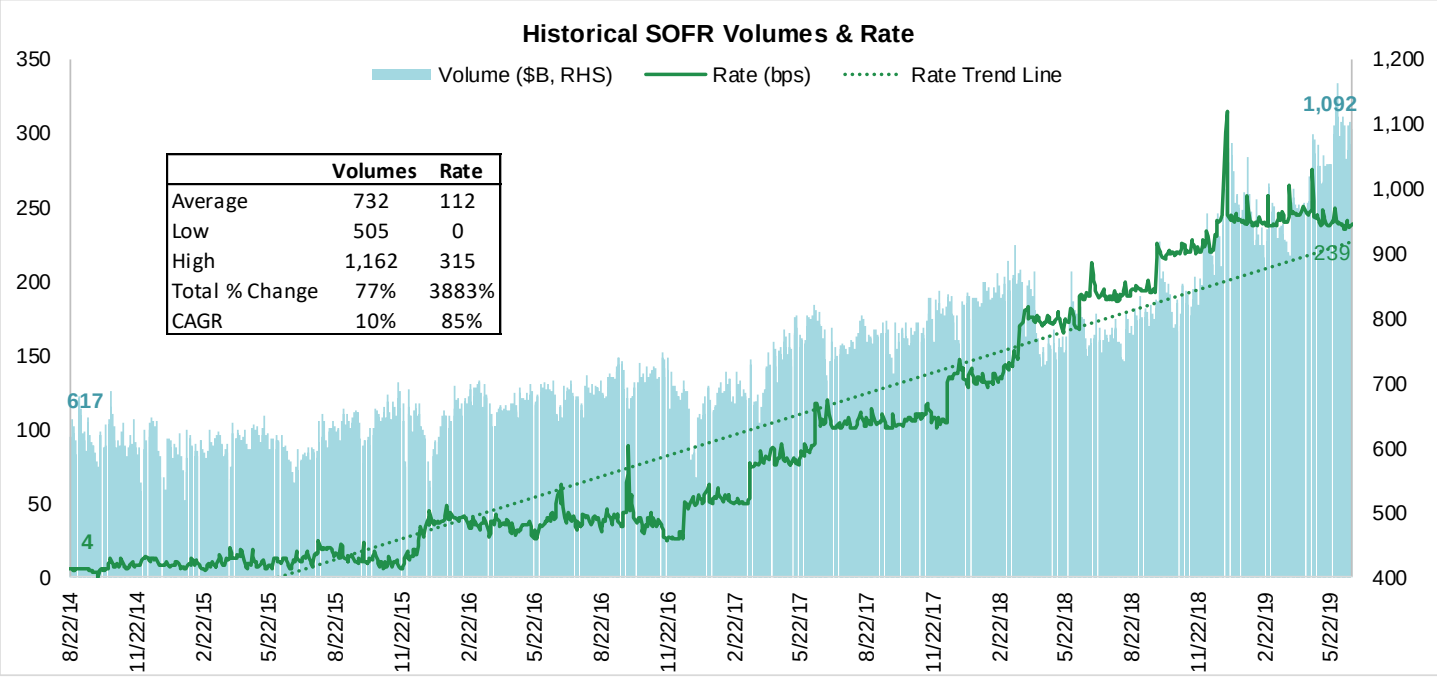
Volume is calculated as the sum of overnight transaction volume used to calculate each reference rate, rounded to the nearest $1 billion. These additional summary statistics reflect the inputs included in the rate calculation and will only be revised if amendments to the data result in a revision to any of the rates. For each rate, the New York Fed excludes trades between affiliated entities (if relevant and data is available). Open trades, where pricing resets daily similar to overnight transactions, are included in the calculation of rates. The New York Fed will review the data to assess whether there are any transactions that should be excluded from the rate calculations for a given day, such

[1] BGCR measures rates on overnight Treasury general collateral repo transactions, those for which the specific securities provided as collateral are not identified until after terms of the trade are agreed. BGCR includes all trades in the Tri-Party General Collateral Rate (TGCR) plus GCF Repo transactions and is calculated as a volume-weighted median of transaction-level tri-party repo data from Bank of New York Mellon and GCF Repo transaction data obtained from DTCC Solutions. It is published on the NY Fed website around 08:00 EST each business day.

as those that appear not to have been conducted at arm's length, or that seem anomalous or potentially erroneous. The New York Fed may exercise expert judgment in making such determinations.

Statistics on SOFR Volumes and Rates

Publication of the SOFR rate began in April 2018. Trading and clearing of SOFR-based swaps and futures began in May 2018. (Please see the Path to Building a Strong Futures Market section for more detail on the SOFR futures market.) As of 6/24/19, daily SOFR volumes were at $1,092 billion and the rate was 2.39%. Since the beginning of the data set (8/24/14), SOFR volumes have grown at roughly a 10% CAGR. In other words, SOFR is now based on around 1 trillion per day in overnight Treasury repo transactions.



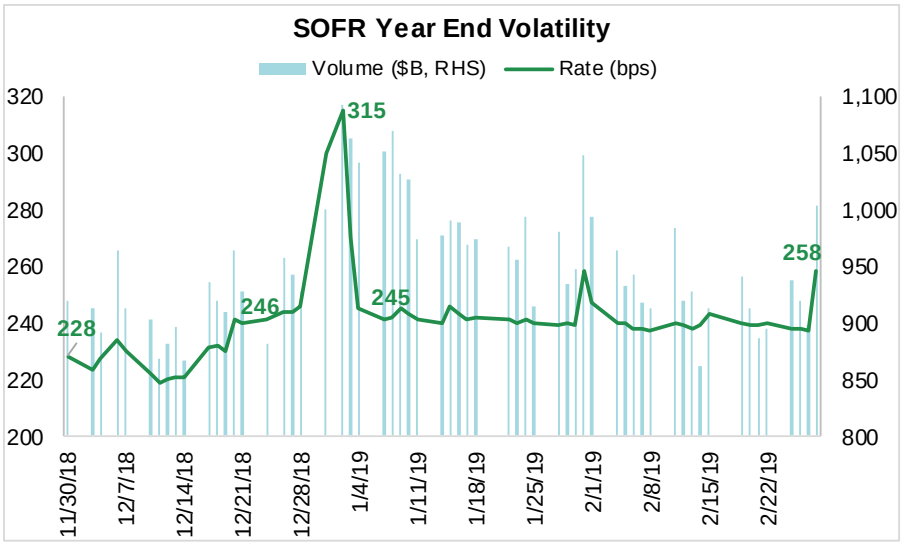
	Volumes	Rate
Average	732	112
Low	505	0
High	1,162	315
Total % Change	77%	3883%
CAGR	10%	85%

Source: Federal Reserve Bank of New York website (as of June 24, 2019)
Note: Volumes = time-series of overnight Treasury Tri-Party including GCF and FICC-cleared bilateral repo volumes ($ billions); rate = time-series of overnight Treasury Tri-Party including GCF and FICC-cleared bilateral transactions volume-weighted median rate (bps)

SOFR Year End Volatility

At the end of 2018, the SOFR rate experienced an unexpected year-end surge (technically, rates on overnight Treasury repos jumped, and this is the market supporting SOFR):

- On 12/28/18 the rate was 246 bps, averaging 243 bps over the last five days
- The rate jumped to 300 on 12/31/18, +22.0% (+54 bps)
- The rate jumped again to 315 on 1/2/19, +5.0% (+15 bps) to the prior peak and +28.0% to the pre spike average (+69 bps)
- On 1/3/19, the rate dropped back down to 270 bps, -14.3% from the prior day
- The rate moved back in line with the pre spike average on 1/4/19 to 245 bps, -9.3% to the peak and -22.2% to the spike



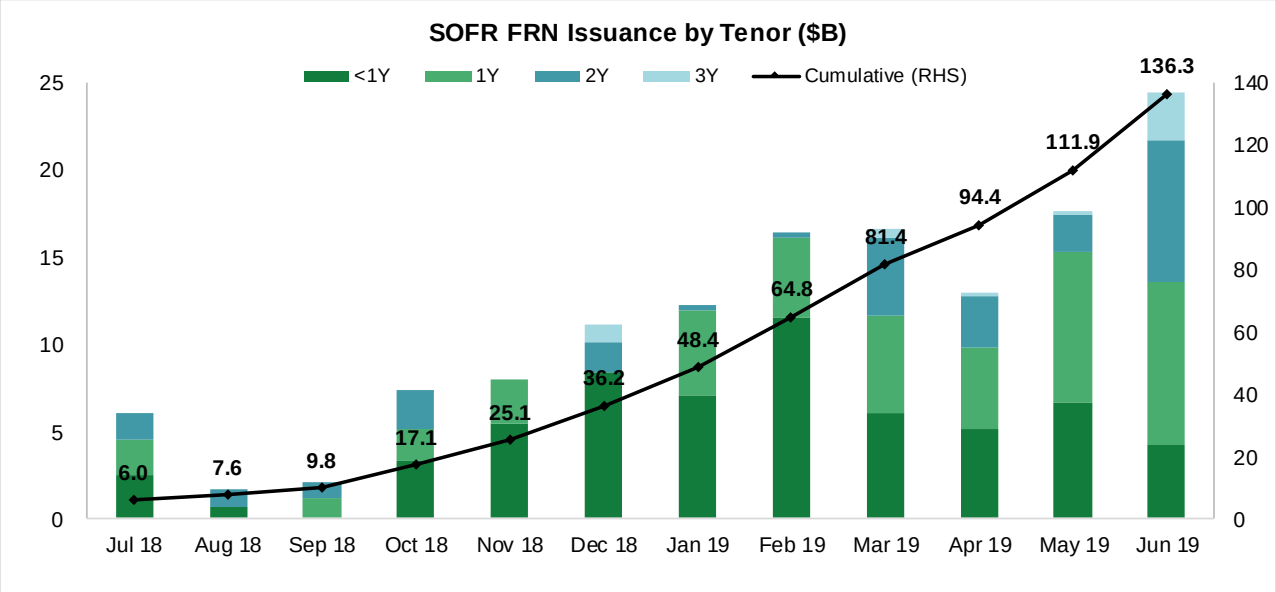
Source: Federal Reserve Bank of New York website (as of June 24, 2019)

Market participants are assessing whether more volatility is possible, given both repo and SOFR are susceptible to swings in Treasury-bill issuance and supply expectations. Additionally, since SOFR is derived from overnight repo transactions, there is no term structure like that with Libor-based derivatives. SOFR futures are derived from a compounded calculation over the prevailing period, meaning these nascent contracts may not have the depth and liquidity of mature LIBOR peers. The ARRC indicated in its Paced Transition Plan that increased trading activity in derivatives tied to the benchmark will facilitate the creation of an indicative term structure.

Further, the use of an average of SOFR rates – which is what most FRNs do – should smooth out short-term volatility spikes.

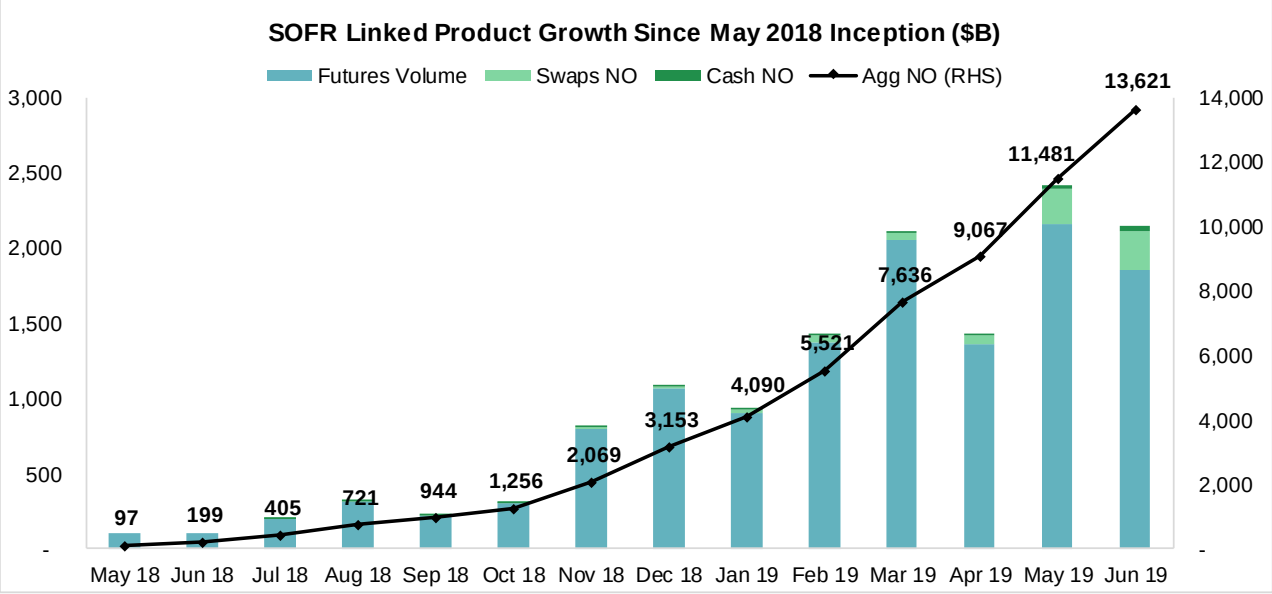
Market Uptake of SOFR

As of June 2019, 27 institutions have issued more than $136 billion notional in floating rate securities tied to SOFR, with $86 billion issued in 2019 alone, including a record $24 billion in June.



Source: CME Group website (as of June 18, 2019)

Outstanding SOFR-linked notional across all products has grown from less $100 billion in May 2018 to over $9 trillion as of April 2019, >9,000%. The jump in February 2019, +35% month/month, implies increased interest and involvement from market participants.



Source: ARRC, CME Group, ICE, LCH, SIFMA estimates (as of end June 2019)
Note: CME trading in May '18, ICE Oct '18. LCH clearing in Jul '18, CME Oct '18. NO = notional outstanding. Cash = issuance. Agg = aggregate

SOFR Product Offerings by Exchange

Today, both CME Group and ICE facilitate trading and clear SFOR futures, while both CME Group and LCH clear SOFR swaps:

Exchange	Products
CME Group	1-Month SOFR Futures
	3-Month SOFR Futures
	3-Month SOFR vs. Eurodollar 1:1 Spread
	1-Month SOFR vs. 30-Day Fed Funds 1:1 Spread
	1-Month SOFR vs. 3-Month SOFR 10:6 Spread
	30-Day Fed Funds vs. 3-Month SOFR 10:6 Spread
	OIS Swaps, Fixed vs. SOFR (clearing)
	Basis Swaps, USD LIBOR vs. SOFR (clearing)
	Basis Swaps, EFFR vs. SOFR (clearing)
ICE	1-Month SOFR Futures
	3-Month SOFR Futures
	1-Month SOFR vs. 3-Month SOFR Spread
LCH (clearing)	Basis Overnight/IBOR Swaps, LIBOR vs. SOFR
	Basis Overnight/IBOR Swaps, Federal Funds - H.15-OIS-COMPOUND vs SOFR
	OIS Swaps, SOFR

Source: Company websites (as of June 2019)

How Does SOFR Differ from LIBOR?

As SOFR is fully transaction based (it does not rely on expert judgment), it is regarded as more robust than any tenor of LIBOR. However, SOFR and LIBOR are not economic equivalents and, as such, differ in many characteristics. For example, SOFR is an overnight, secured risk-free rate, while LIBOR is an unsecured rate with a term curve. Below we highlight key differences and how this might impact market participants.

SOFR	LIBOR
Risk free rate (no credit risk)	Bank lending rate (includes credit risk)
Overnight (backward looking)	Forward looking
Secured (collateralized)	Unsecured (uncollateralized)
Calculated & published daily by the NY Fed	Calculated & published daily by ICE Benchmark Administration
Transaction based	Based on LIBOR bank submissions & expert judgement
Based on ~$1T transactions pd (repo markets)	Based on ~$1B transactions pd (3-month LIBOR)
No term structure	Term structure

- **Backward vs. Forward Looking** – Contracts that are currently based on forward looking term rates will need to be re-formulated to accommodate compounded, backward looking overnight rates.
- **No Credit vs. Credit** – As SOFR does not have a credit-sensitive component, unlike LIBOR which is an unsecured lending rate, it may perform differently. This may impact whether and when market participants elect to begin using SOFR in some traditional bank lending products (mortgages, business loans).
- **Valuation** – SOFR should generally be lower than LIBOR, making compensation necessary to be agreed between counterparties changing existing contracts from LIBOR to SOFR (adjustment spread or one-time payment to provide for an equal transition). Contracts that move to SOFR upon triggering of fallback language are expected to include an adjustment spread that is added to the fallback risk-free rate.
- **No Term vs. Term** – Some market participants have expressed concerns about the lack of term structure (for example, 30-, 60- or 90-day rates) for SOFR, as a term structure is needed to increase the uptake of SOFR linked financial products. The growth of SOFR futures and swaps markets will be important to the development of a SOFR term structure.

  The ARRC has set a goal of seeing forwarding-looking term SOFR rates produced, once the SOFR derivatives markets develop sufficient depth. Although the timing of when those rates may become available cannot be guaranteed, it is reasonable to expect forward-looking term rates to be published. The ARRC is targeting a term rate by the end of 2021.

The Path to Building a Strong Futures Market

The smooth transition to SOFR is dependent upon the development of strong SOFR futures (and swaps, which are not analyzed in this section) markets. The ARRC is working with market participants to encourage the development of sufficient liquidity in futures and swaps markets referencing the new rate, with the goal of enabling trading in these markets to eventually replace a significant portion of current trading in interest rate derivatives referencing LIBOR. Additionally, a strong futures and swaps market is necessary to build a SOFR term structure, which will then feed further growth in derivatives markets.

In this section, we analyze the growth of the SOFR futures markets using CME product data. We also look to compare SOFR's trajectory to other comparable CME futures contracts, to extrapolate the growth trajectory of this market. We note that all futures contracts are not created equal, and different contracts follow varying growth trajectories. In general, exchanges develop new products to meet existing client demands, servicing these needs to work within the regulatory environment and current market structure characteristics.

New product development takes time as there is a chicken-and-egg dilemma for clients – even if clients demand a product, they cannot always enter the market with the hope that volumes, open interest (OI)[2] and liquidity will develop in a timely manner. Clients are highly sensitive to liquidity, and some clients may have liquidity thresholds that need to be met before they can even enter a market. Exchanges frequently offer liquidity incentives for new products, and then as more participants enter the market, OI begets OI. Even with these programs, clients often have restrictions on what percent of the liquidity pool they are allowed to hold and would have to temper the pace at which they grow their positions in a nascent market.

In other words, liquidity pools do not form instantly overnight.

[2] Total # futures contracts long or short in a delivery month or market that has been entered into and not yet offset or fulfilled by delivery, each has a buyer and seller but only one side of the contract is counted in the OI calculation.

SOFR Among CME's Top Product Launches

The first exchange to begin facilitating trading of SOFR futures was the CME Group in May 2018 (CME also clears OTC SOFR-based swaps[3]); over 4.6 million SOFR futures contracts have traded since the launch. Cumulative volume in the CME SOFR futures market since launch now exceeds $133M DV01 (dollar value of a basis point; 4.6M contracts, $8.9T notional), 16x the SOFR swaps market (CME + LCH)).[4]

CME provides trading of one-month SOFR (SR1) and three-month SOFR (SR3) futures[5], and the launch of SOFR futures contracts was among CME's top five product launches. ADV for the last three months of year one of trading was 31,531 contracts, while peak OI in year one of trading was 151,454 contracts. This is behind CME's most successful launch, the Ultra 10-Year note (ADV 101,223; OI 326,035), and more in line with the launches of the Nasdaq-100 and Dow E-mini contracts:

CME's Leading Product Launches

	ADV	OI
Ultra 10-Year Note	101,223	326,035
Ultra T-Bond	53,548	396,692
E-mini Nasdaq-100	32,405	35,059
SOFR Futures	31,531	151,454
E-mini Dow	29,840	32,516

Source: CME Group.

Note: ADV = last 3 months of year 1; OI = year 1 peak; both = # contracts. Please see appendix for futures contracts methodology

Though the launch figures for SOFR represent 0.3x ADV and 0.5x OI of the 2016 launch of the Ultra 10-year note, it should not be construed that this launch was not as successful. SOFR is the fourth best launch of a CME product in the exchanges 170+ year history. Further, there are differences in the intent behind the two products. The Ultra 10-year contract product suite was specifically developed to meet market demand for a futures contract that is more closely aligned with the 10-year maturity point on the Treasury yield curve.

SOFR addresses another, and quite unique, need. The SOFR futures (and swaps) markets are being developed to support SOFR as the alternative for LIBOR. The potential cessation of LIBOR represents a substantial shift in market structure, as something of this magnitude has not been seen before in the financial services industry. Therefore, the growth of SOFR futures may not follow traditional product growth trajectories.

[3] CME made OTC cleared SOFR swaps available 10/1/18 using SOFR discounting. At the writing of this report, CME was the only clearing house to offer clearing for IRS, swaptions and IR futures within a single netting pool. Multiple clients, including banks and buyside firms, have cleared $4.5 billion in notional of OTC SOFR swaps at CME since the service was launched.

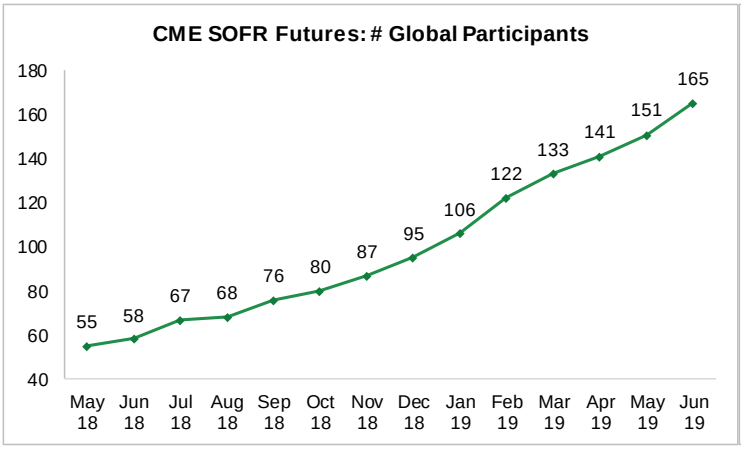
[4] SOFR Swaps DV01 volume across all exchanges is calculated based on the cumulative notional and volume-weighted average tenor by instrument (OIS, EFFR v. SOFR Basis, LIBOR v. SOFR Basis) reported to the DTCC SDR

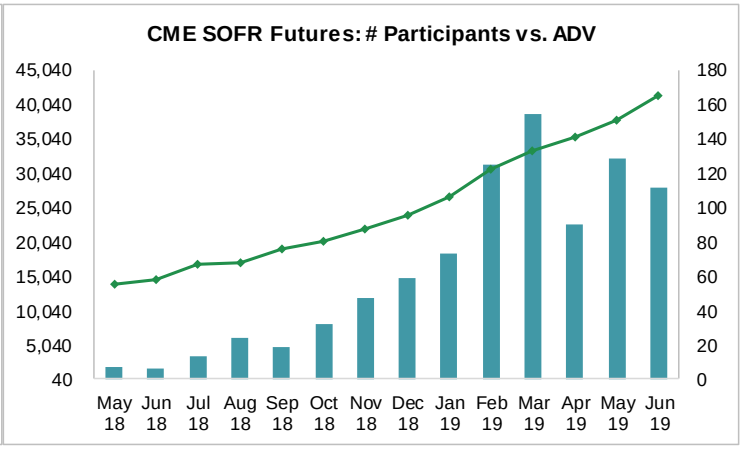
[5] CME would like to point out that SR1 and SR3 are parts of the single SOFR Futures product, capturing helpful levels of granularity for curve construction, and not two separate products

Market Participant Uptake Continues to Grow

A key to volume growth is growth in market participants, and growth in SOFR futures participants continues. Participation in the total SOFR futures liquidity pool has risen and broadened, with over 165 firms participating on CME (as of 2Q19). The mix of market participants is well balanced, representing global investment banks, asset managers, hedge funds, proprietary trading firms and other market participants.

- SOFR participants grew to 165 from 55 since the May 2018 launch, +200%
- Ultra 10-year has 580+ participants, 3.5x SOFR (but markets are not identical, and the Ultra launch was ~3 years ago)
- SOFR participant M/M average growth rate 8.9% since May 2018
- SOFR participant M/M average growth rate 9.7% in 2019
- SOFR participant Y/Y average growth rate 179.5%





Source: CME Group
Note: ADV = # contracts

Comparing CME SOFR to Eurodollar and Fed Funds Futures

While we referenced stats for the new(ish) Ultra 10-year above, SOFR is more comparable with CME's Eurodollar and Fed Funds futures product suites. All three of these contracts are based on predictions of future short term rates, not actual longer term Treasury rates as with Ultra product suite. We therefore look to stats on Eurodollar and Fed Funds to analyze the potential for SOFR growth (again, contracts are not identical and may not experience exact growth patterns).

Looking at results one year into product launch, the first anniversary, SOFR ADV is 11.3x Eurodollar and 50.8x Fed Funds (OI 7.4x and 40.3x respectively):

First Anniversary Results

	ADV	OI
SOFR Futures	13,978	151,454
Eurodollar Futures	1,240	20,336
Fed Fund Futures	275	3,761

Source: CME Group
Note: ADV = year 1; OI = year 1 peak; both = # contracts. Please see appendix for futures contracts methodology

Concentrated liquidity pools (CME estimates it has 90% of OI on a DV01 basis as of 2Q19) have an inflection point where it becomes a category of its own. For example, Eurodollar futures volumes growth was flat for many years after its launch, but eventually became a highly liquid product. Yes, there are significant differences in market structure – electronification of trading, greater number of and more diverse set of market participants – and macro-economic environment today versus the Eurodollar launch in 1981.

Looking at Eurodollar and Fed Funds products today, Eurodollar futures ADV 3.2 million contracts, OI 12.8 million contracts (as of 2Q19). While Fed Funds futures are smaller than Eurodollar futures (0.1x ADV, 0.2x OI), this product suite also contains of highly liquid contracts.

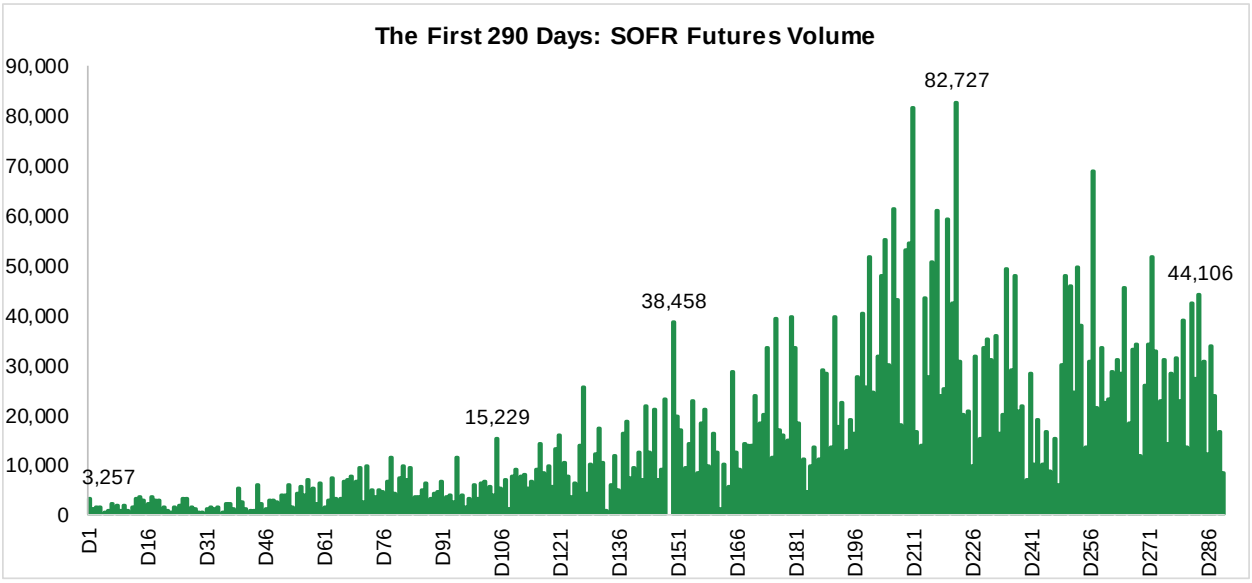
Eurodollars and Fed Funds Today

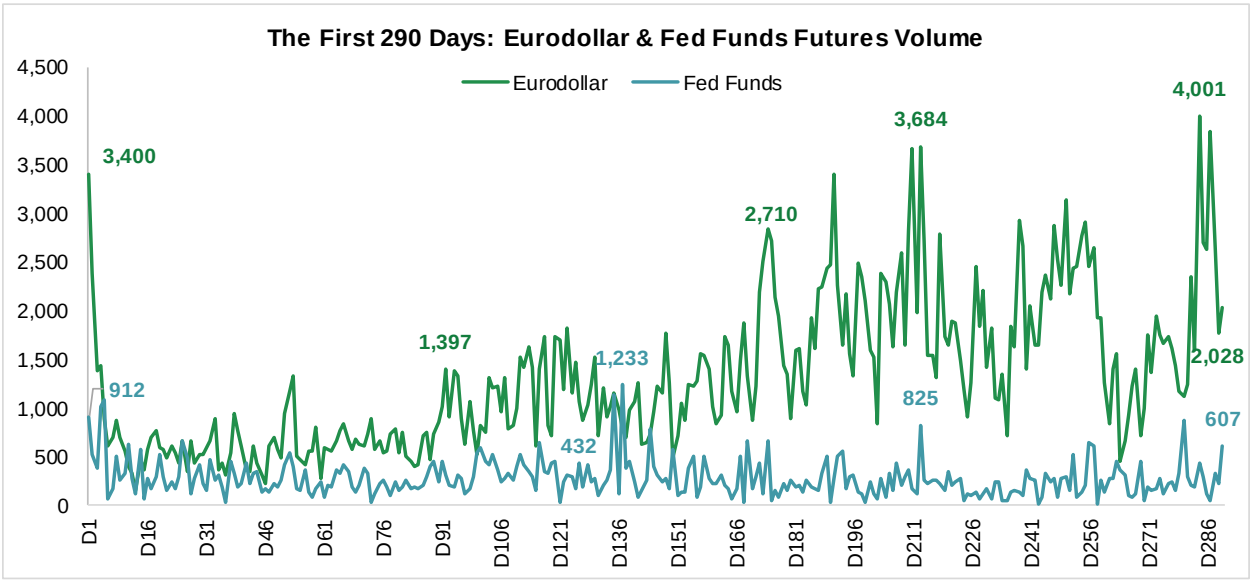
	# Years	ADV	OI
Eurodollar Futures	38	3,211,000	12,757,000
Eurodollar Options	34	2,230,000	65,053,000
Fed Fund Futures	31	433,000	2,244,000

Source: CME Group
Note: As of 2Q19. # years since launch; ADV = rounded to nearest 1,000; OI = as of end of quarter; both = # contracts. Please see appendix for futures contracts methodology

YTD 2019 (Jan-Jun) SOFR futures ADV is 28K contracts per day ($53B notional, or $816,000 DV01 per day). OI peaked at 168,964 contracts ($533B notional). While SOFR is still a very young product, its growth trajectory has been accelerated versus peer products. SOFR volume growth was 152% in its first 290 days, whereas both Eurodollar and Fed Funds futures leveled out from day one to day 290 after seeing a significant pop on day 1.

VOLUMES						
Contract	**Launch**	**D1**	**D290**	**% Change**	**Peak**	**Avg**
SOFR	2018	3,257	8,209	152.0%	82,727	16,053
Eurodollar	1981	3,400	2,028	-40.4%	4,001	1,311
Fed Funds	1988	912	607	-33.4%	1,233	274





Source: CME Group. Note: # contracts. Please see appendix for futures contracts methodology

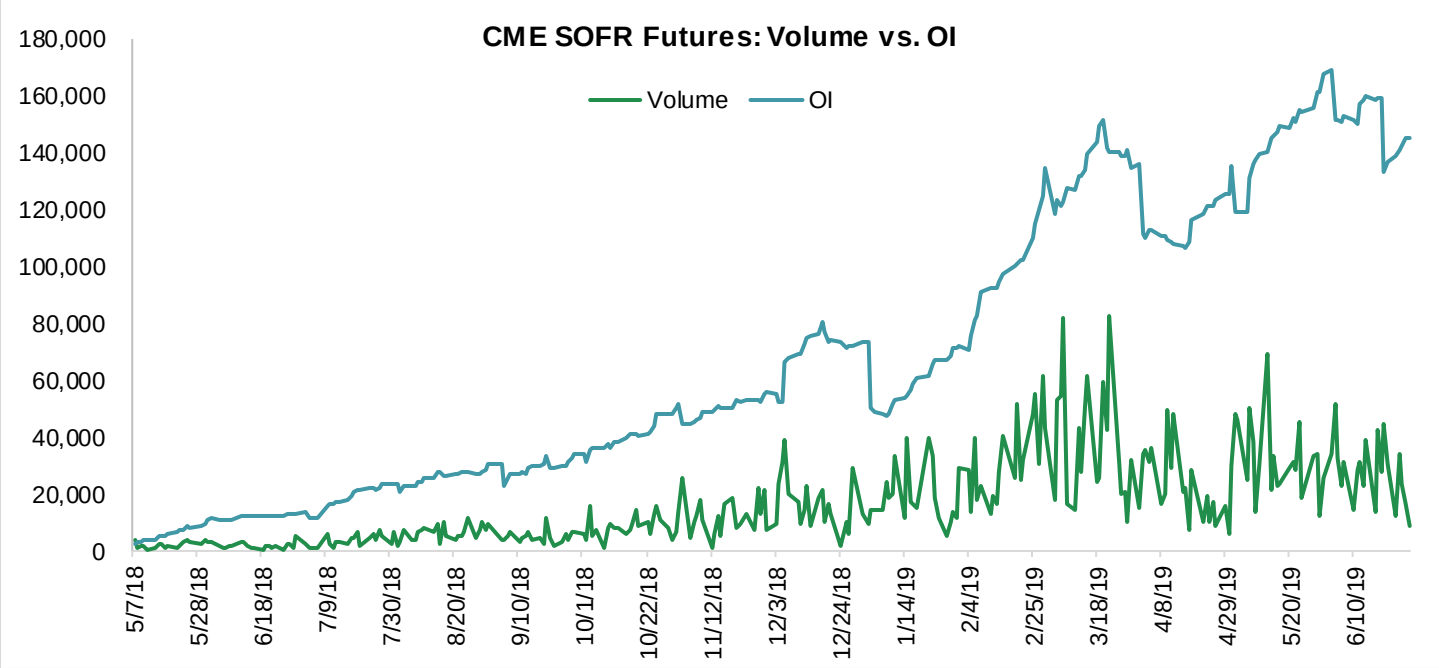
With its strong start and critical place in market structure, SOFR futures look poised to grow into highly liquid contracts. SOFR's day one volume was in line with Eurodollar futures, while its OI was 2x greater. While we are not predicting it will grow to the size of the Eurodollar contract, SOFR growth is also outpacing Fed Funds futures. SOFR volumes are growing faster than comparable peer contracts.
(Please see Eurodollar and Fed Funds futures charts on the following pages)

VOLUMES

Contract	Launch	Day 1	Current	% Change	Peak	Avg
SOFR	2018	3,257	8,209	152.0%	82,727	16,053
Eurodollar	1981	3,400	2,119,108	62,227%	11,562,175	1,072,933
Fed Funds	1988	912	314,459	34,380%	1,293,459	47,692

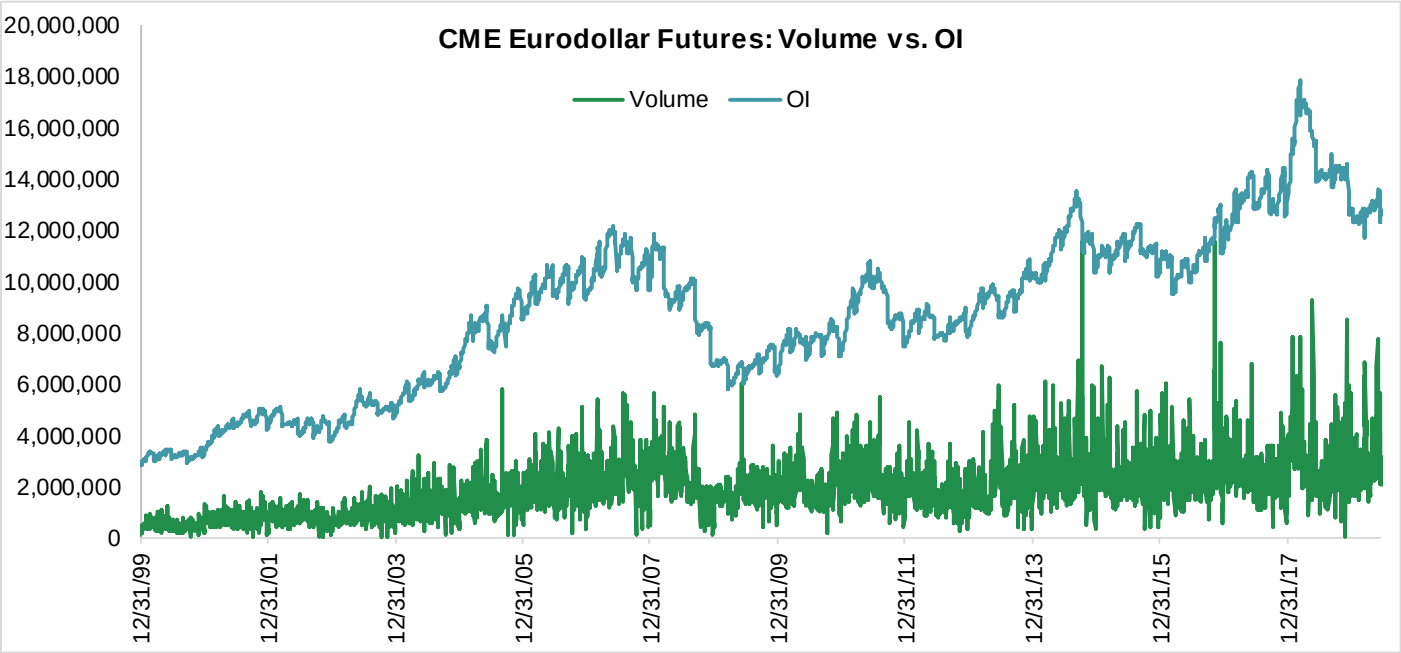
OI

Contract	Launch	Day 1	Current	% Change	Peak	Avg
SOFR	2018	2,033	145,179	7,041%	168,964	68,109
Eurodollar	1981	1,000	12,757,383	1,275,638%	17,876,100	5,129,671
Fed Funds	1988	517	2,243,956	433,934%	2,547,743	403,892

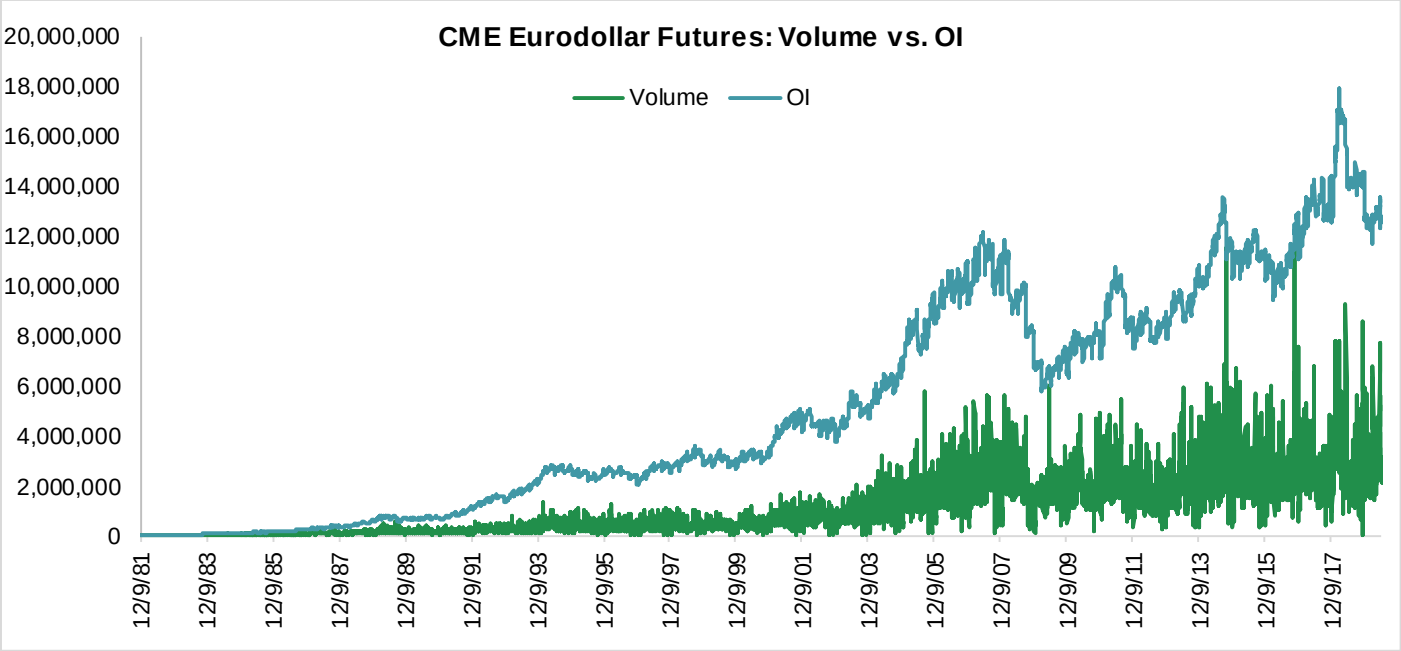


Source: CME Group. Note: # contracts. Please see appendix for futures contracts methodology

Timeline 2000+

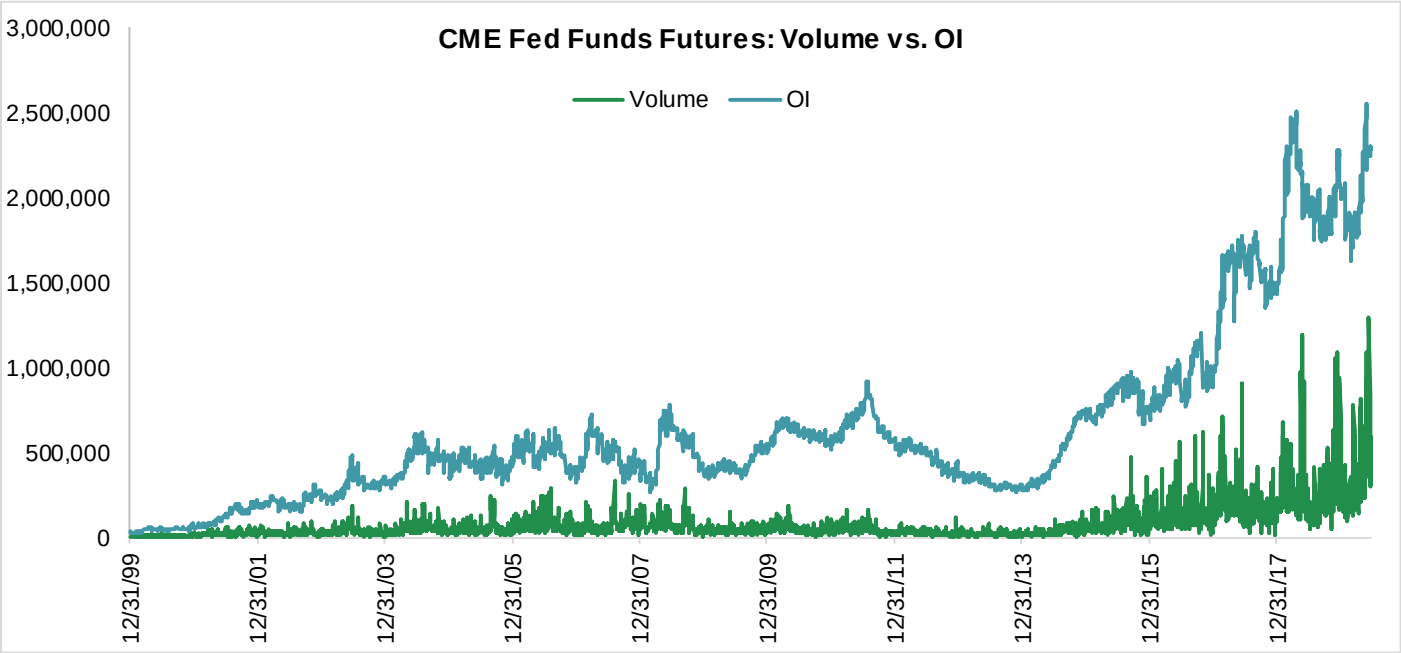


Full Time Series

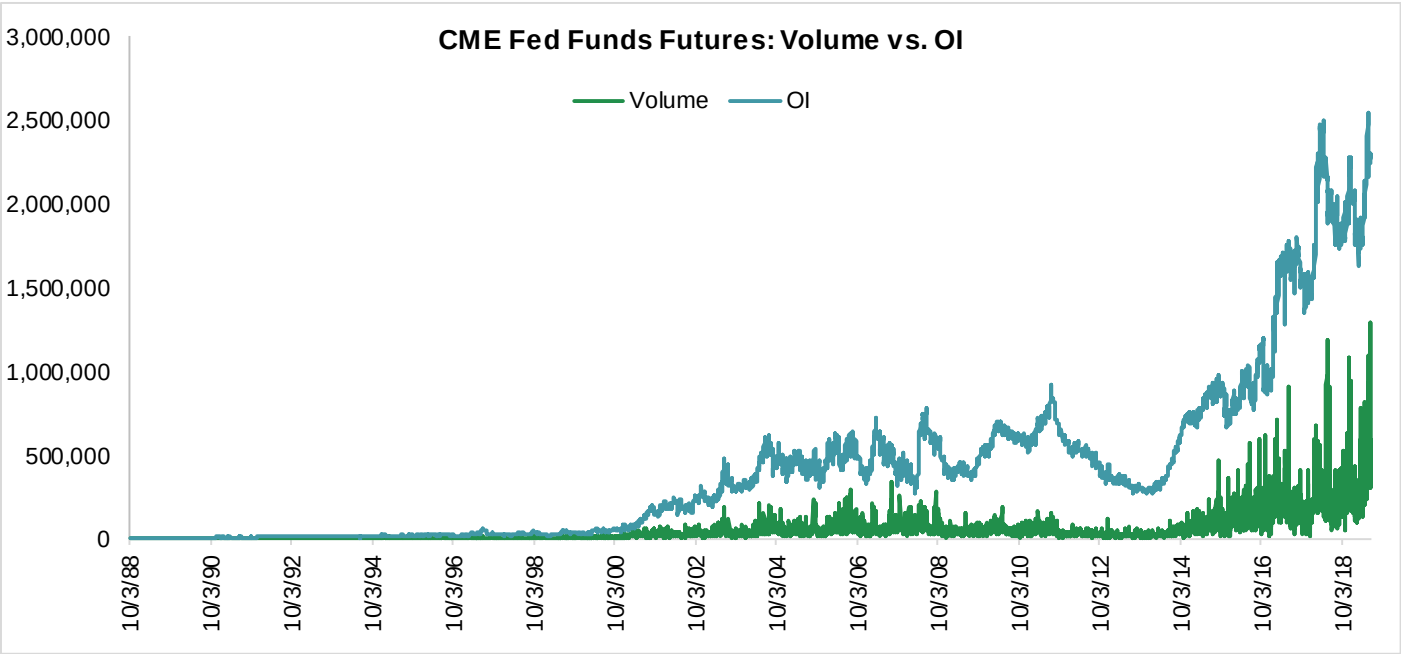


Source: CME Group. Note: # contracts. Please see appendix for futures contracts methodology

Timeline 2000+



Full Time Series



Source: CME Group. Note: # contracts. Please see appendix for futures contracts methodology

Potential Growth Catalysts for SOFR Futures

Given SOFR's critical place in market structure, we expect volume growth to continue at a good clip. But what could be catalysts for faster uptake? We identify three general categories for increasing the pace of growth, including:

- **Demand** – Clients are expressing interest in utilizing SOFR for hedging, and exchanges have created products accordingly (ex: products to trade spreads with Eurodollar and Fed Funds futures). Block trading at CME in SOFR futures indicates these products are earning acceptance as risk management tools in significant sizes. SR1 and SR3 display similar levels of OI, indicating the two products perform complementary roles despite being based upon the same underlying SOFR benchmark

- **Comfort** – New participants continue to connect to exchanges trading SOFR and are increasing comfort levels with how SOFR products trade as time passes

- **Milestones** – Market milestones in the transition to SOFR from LIBOR (ex: finalization of fallback language, could create a closer link between SOFR and LIBOR) are expected to accelerate SOFR futures volumes growth

To make this more tangible, one can observe the paths taken by both the ARRC and CME. The ARRC streams include:

- **Identify** SOFR as the U.S. alternative reference rate (completed)

- **Assist** in creating liquidity by providing guidance on derivatives and cash products (ongoing)

- **Improve** fallback language to enable the shift to SOFR products (ongoing; the ARRC is working on cash products, ISDA and CCPs are working on derivatives)

Growth in participants feeds into OI growth. Additionally, the current futures market is already providing decent price discovery across the SOFR curve, with actual quotes out to three years while CME settles futures out to five years (OTC out to 30 years using indicative and actual curves).

With these building blocks in place, CME has identified several market driven paths for growth of SOFR derivatives markets, including:

- Trading of SOFR **futures** (completed)
- Clearing of OIS and basis **swaps** (completed)
- Trading of **options** on SOFR futures (CME estimates potentially 2020 or 2021)
- One-time **switch** from Fed Funds Price Alignment & Discounting to SOFR (CME estimates potentially 2020)[6]
- Upgrade the fallback **language**[7] for
    - Cleared SOFR swaps (ISDA estimates finalization by end of 2019)
    - Eurodollar futures (CME estimates at a similar time as OTC derivatives)

[6] CME is consulting clients on adoption of SOFR for PA/discounting of all cleared OTC Swaps and working with the industry to build consensus on the best path forward for achieving single-day discounting conversion for existing swaps. CME is supportive of a coordinated single-day discounting/PA change as it will result in an immediate pickup in SOFR liquidity throughout the curve, which is the most common concern raised by clients when discussing SOFR adoption

[7] CME supports efforts by the official sector, ARRC, ISDA and industry-wide working groups to improve and strengthen LIBOR fallbacks and intends to align with ISDA to include revised fallback language in its rules along with amendments or new definitions being adopted across the OTC derivative marketplace, reserving the right to make necessary adjustments based on consultations with its clients. CME's guiding principles for LIBOR fallbacks are to minimize value transfer, maximize operational efficiency and maximize alignment with ISDA's approach for OTC derivatives

IBOR Global Benchmark Transition Checklist

Assessment: Have You Assessed Your Exposure to IBORs?

- Develop an inventory of products, financial instruments and contracts linked to the IBORs
- Quantify the exposure to IBORs across core business lines and products
- Calculate financial exposure anticipated to roll off prior to the end of 2019, 2020 and 2021
- Evaluate operational exposure to IBORs by assessing impacts to processes, data and technology
- Implement reporting to monitor exposure to the IBORs throughout the transition period

Comprehension: How Would a Permanent Cessation of IBORs Impact You and Your Clients?

- Review existing contracts and assess current fallback provisions by product and contract type
- Determine required re-papering and client outreach
- Collaborate w/ market participants, industry working groups to define fallback provisions/contract disclosures
- Organize efforts to implement required contract amendments; amend legacy trades in advance of transition

Mobilization: Have You Mobilized a Formal IBOR Transition Program?

- Appoint a senior executive to own and manage a multi-year IBOR transition program
- Establish a robust governance structure to oversee the successful transition to alternative RFRs
- Allocate budget and confirm staffing needs to execute implementation activities
- Establish workstreams with clear objectives, tangible milestones/work products & defined success criteria
- Initiate internal stakeholder outreach and education

Roadmap: Have You Defined a Transition Road Map?

- Review OSSG & RFR working group reports, IBOR Global Benchmark Transition Roadmap, other reports
- Apply to participate in relevant RFR working groups
- Contribute to the demand for, design of and trading in new products that reference alternative RFRs
- Determine required infrastructure/process changes to support the transition, prioritizing enhancements
- Develop an implementation route map inclusive of key projects, milestones and ownership

Communication: What is Your External Communication Strategy?

- Define a communication strategy to educate clients on benchmark reform efforts
- Identify external dependencies (technology vendors) involved in transition planning
- Develop an advocacy plan to share the organization's viewpoints and perspectives

Please see full details in the SIFMA, AFME, ICMA, ISDA "IBOR Global Benchmark Transition Report", 2018

Global Efforts to Transition to New Reference Rates

As discussed above, a number of concerns have been raised regarding the reliability of major financial market benchmarks, particularly interest rate and foreign exchange benchmarks. Major interest rate reference rates – LIBOR, EURIBOR, TIBOR, or generically the IBORs – are widely used in the global financial system as benchmarks for a large volume and broad range of financial products and contracts.

As such, the G20 asked the Financial Stability Board (FSB) to undertake a fundamental review of major interest rate benchmarks and plans for reform across the globe. The main objective is to ensure plans are consistent and coordinated and interest rate benchmarks are robust and appropriately used by market participants.

FSB's Official Sector Steering Group (OSSG) Objectives

In July 2013, the FSB established the Official Sector Steering Group (OSSG), which comprises senior officials from central banks and regulatory authorities. It published its initial set of recommendations in July 2014, including:

- Strengthen IBORs by anchoring them to a greater number of transactions (where possible)
- Improve the processes and controls around submissions
- Identify alternative near-risk free rates (RFRs)
- Encourage derivative market participants to transition new contracts to an appropriate RFR (where suitable)

The OSSG regularly engages stakeholders to enhance the robustness of contracts for derivatives and cash instruments (loans, mortgages, FRNs, etc.) to accommodate the discontinuation of widely-used interest rate benchmarks.

Additionally, national working groups have been established in Australia, Canada, the EU, Japan, South Africa, Switzerland, the U.K. and the U.S. to make recommendations to enable a smooth transition to RFRs.

Members of the FSB OSSG Benchmark Group			
Co-Chairs	Andrew Bailey Chief Executive Officer UK Financial Conduct Authority	Jerome Powell Chair US Federal Reserve Board of Governors	
Australia	Chris Kent Assistant Governor, Financial Markets Reserve Bank of Australia	South Africa	Leon Myburgh Head, Financial Markets Department South African Reserve Bank
Brazil	Claudio Henrique da Silveira Barbedo Deputy Advisor, Open Market Operations Department Central Bank of Brazil	Switzerland	Marcel Zimmermann Head, Money Market and Foreign Exchange Swiss National Bank
Canada	Paul Chilcott Advisor to the Governor Bank of Canada	UK	Andrew Hauser Executive Director, Markets Bank of England
Hong Kong	Clement Lau Executive Director, Monetary Management Department Hong Kong Monetary Authority	US	Chris Giancarlo Chairman Commodity Futures Trading Commission
Japan	Hiroki Ootake Director, Head of Market Infrastructure Group, Market Infrastructure Division, Financial Markets Department Bank of Japan Kenji Oki Director for International Banking Regulations Financial Services Agency	ECB	Cornelia Holthausen Deputy Director General Directorate General Market Operations
		European Commission	Tilman Lueder Head of Unit, Securities Markets
		EBA	Adam Farkas Executive Director
Mexico	Rodrigo Cano Director of Operations Support Bank of Mexico	ESMA	Fabrizio Planta Head, Markets Division
Saudi Arabia	Moath A. Alyousef Head of Monetary Policy Section Saudi Arabian Monetary Authority	IOSCO	Jean-Paul Servais Vice Chairman of the Board (Belgium Financial Services & Markets Authority)
Singapore	Cindy Mok Executive Director, Monetary & Domestic Markets Management Monetary Authority of Singapore	FSB Secretariat	Laurence White Member of Secretariat

Source: FSB (as of June 2019)

FSB Progress Reports on Benchmark Interest Rate Reform

The FSB publishes progress reports on implementation of its recommendations to reform major interest rate benchmarks (latest report November 2018). The reports track progress made on developing overnight RFRs and markets based on these rates, as well as reforms to interbank offered rates (IBORs), assessing three key areas:

- **Alternative Reference Rates** – In markets facing the disappearance of IBORs, particularly those reliant on LIBOR, market participants need an orderly transition to new reference rates which are sufficiently robust for extensive use. A "great deal of progress" has been made to identify RFRs and other alternative reference rates in currency areas currently reliant on LIBOR benchmarks, as well as to plan for and begin to execute transition to those RFRs.

- **IBORs** – Work continues among major IBORs (EURIBOR, TIBOR, etc.) to strengthen existing methodologies by making them transaction based, as well as to strengthen regulatory frameworks and supervision. In other jurisdictions, actions are also underway to implement further regulatory reforms.

- **Enhancing Contract Robustness** – Significant work continues among market participants to strengthen contract robustness to stem the risk from discontinuation of major interest-rate benchmarks. Contract reliance on benchmarks that will cease to exist is a concern for derivatives and cash products (syndicated loans, bonds, mortgages, etc.).

Comparing Global RFR Candidates

We highlight key work being performed by select non-U.S. national working groups established to make recommendations to enable a smooth transition to RFRs.

- **Australia** – For the Australian dollar, the key interest rate benchmarks are the bank bill swap rates (BBSW) and the cash rate (AONIA or AUD Overnight Index Average). Reforms have been undertaken to enhance the robustness of these benchmarks, i.e. reforming old rates (https://www.rba.gov.au/mkt-operations/resources/interest-rate-benchmark-reform.html)

- **Canada** – Canada established the Canadian Alternative Reference Rate Working Group (CARR), sponsored by the Canadian Fixed-Income Forum, to identify and develop a Canadian dollar term risk-free rate benchmark that is robust, reliable and resilient to market stress, as well as consistent with the IOSCO Principles for Financial Benchmarks and compliant with any applicable global regulations. CARR also seeks to identify possible enhancements to the existing Canadian overnight risk-free rate, the Canadian Overnight Repo Rate Average (CORRA), i.e. reforming old rate. (https://www.bankofcanada.ca/markets/canadian-alternative-reference-rate-working-group/)

- **EU** – The working group on Euro risk-free rates was established to identify and recommend risk-free rates that could serve as a basis for an alternative to current benchmarks used in a variety of financial instruments and contracts in the Euro Area, such as EONIA and EURIBOR, i.e. develop new rates. This is a private sector working group; the ECB provides the secretariat and attends as an observer only. In September 2018, the working group recommended that the Euro short-term rate (€STR) be used as the risk-free rate for the Euro Area and is now focused on supporting the market with the transition to the new rate.

  In March 2019, the working group recommended that market participants gradually replace EONIA with the €STR as a reference rate for all products and contracts and make all necessary adjustments for using the €STR as their standard benchmark, including appropriate changes to systems to enable a T+1 publication (€STR will be available by 09:00 CET based on individual transactions conducted on the previous trading day, versus EONIA which currently publishes by 19:00 CET based on same-day transactions). The working group also recommended that the European Money Market Institute (EMMI), EONIA's administrator, modify the current EONIA methodology to become €STR plus a spread from the first publication date of €STR in October 2019 until end-2021, to give market participants sufficient time to transition to the €STR. (https://www.ecb.europa.eu/paym/initiatives/interest_rate_benchmarks/WG_euro_risk-free_rates/html/index.en.html)

- **Japan** – In Japan, the LIBOR alternative identified by Bank of Japan is the Tokyo Overnight Average Rate (TONAR), which has served as the reference rate for the Japanese Yen (JPY) overnight index swap (OIS) market. JPY LIBOR co-existed with the Tokyo Interbank Offered Rate (TIBOR). TONAR is based on unsecured, overnight transactions and is a new reference rate. (https://www.boj.or.jp/en/paym/market/sg/index.htm/)

- **South Africa** – In August 2018, the South African Reserve Bank (SARB) published a consultation paper on reforming select interest rate benchmarks in South Africa and developing a suite of new benchmarks to be used as reference interest rates, i.e. reform old rates and create new ones. The SARB established a joint public and private sector body, the Market Practitioners Group (MPG), to work with other groups such as the Financial Markets Liaison Group (FMLG). The FMLG is chaired by the Deputy Governor of Markets and International at the SARB and is comprised of the SARB, the Financial Sector Conduct Authority (FSCA) and various financial institutions active in domestic money markets.

  The primary purpose of the MPG will be to facilitate decisions on the choice of interest rate benchmarks to be used as reference interest rates for financial and derivative contracts, as well as to provide input on how to implement the new interest rate benchmark proposals. The MPG will remain in existence until the new benchmarks have been implemented and embedded, after which the Reference Rate Working Group of the FMLG will assume responsibility for further work on reference interest rates. (https://www.resbank.co.za/Markets/MPG/Pages/default.aspx)

- **Switzerland** – The Swiss National Bank (SNB), in cooperation with SIX Swiss Exchange, developed CHF reference rates for the financial markets in 2009. These reference rates are based on CHF repo interbank market data provided by SIX Repo Ltd. The Swiss reference rates comprise the Swiss Average Rates (SAR) and the Swiss Current Rates (SCR), covering a term spectrum ranging from overnight to 12 months. SIX Swiss Exchange is the Swiss reference rates administrator and is thus responsible for their daily calculation and publication. Internationally, overnight interest rates play a significant role in determining yield curves, and the Swiss franc yield curve is to be based on the Swiss Average Rate Overnight (SARON) in future, i.e. a new rate. Since June 2019, the SNB has been implementing its monetary policy by setting the SNB policy rate. The SNB seeks to keep the secured short-term Swiss franc money market rates close to its policy rate and is focusing on SARON in this regard. (https://www.snb.ch/en/ifor/finmkt/fnmkt_benchm/id/finmkt_reformrates)

- **U.K.** – The working group on Sterling Risk-Free Reference Rates was established in 2015 to implement the Financial Stability Board's recommendation to develop alternative risk-free rates (RFRs) for use instead of Libor-style reference rates. In April 2017, the working group recommended the SONIA benchmark as their preferred RFR, i.e. a new rate, and has been focused on how to transition to using SONIA across sterling markets. (https://www.bankofengland.co.uk/markets/transition-to-sterling-risk-free-rates-from-libor)

Mapping Interest Rate Benchmarks to Alternative Reference Rates

Currency	Interest Rate Benchmark	Alternative Rate Candidate(s)	Type	Notes
AUD	BBSW	RBA Cash Rate	Unsecured	Multiple-rate approach
BRL	DI rate	Selic	Secured	Multiple-rate approach
CAD	CDOR	Enhanced CORRA	Secured	Multiple-rate approach; term RFR developed in 2019
CHF	LIBOR	SARON	Secured	Compounded SARON recommended, forward-looking term rate seems not feasible
EUR	LIBOR	ESTER, Euribor	Unsecured	EUR LIBOR not in scope of working group given limited market usage vs. Euribor, alternatives = ESTER, reformed Euribor
EUR	Euribor	ESTER	Unsecured	Term RFR under consideration; Euribor is being reformed
EUR	EONIA	ESTER	Unsecured	EONIA prohibited for new contracts starting 1/1/20
GBP	LIBOR	SONIA	Unsecured	Public consultation on term SONIA released
HKD	HIBOR	TBD (ex: HONIA)		Multiple-rate approach not precluded
JPY	LIBOR	TONA or TIBOR	Unsecured	Term RFR planned to be discussed
JPY	TIBOR	TONA	Unsecured	Multiple-rate approach
JPY	Euroyen, TIBOR	TONA	Unsecured	Multiple-rate approach
SGD	SIBOR	N/A	N/A	Rate not used in SGD derivatives
SGD	SOR	TBD	TBD	SOR is a transaction-based rate; reviewing USD funding rate for SOR computation, considering USD LIBOR to SOFR transition
USD	LIBOR	SOFR	Secured	ARRC's Paced Transition Plan
ZAR	Jibar	Existing = reformed Jibar, new = ZARibor, SASFR	Reformed Jibar, ZARibor = unsecured; SASFR = secured	Multiple-rate approach recommended; Treasury bill curve & GC repo market potential platforms for term RFRs

Source: FSB Reforming Major Interest Rate Benchmarks Progress Report, November 2018

Appendix: Contract Size Methodology

CME Group's Short-Term Interest Rate (STIR) contracts have the following contract sizes as defined in the product rulebooks. Contract-grade Index for each product is defined as Index = 100 – rate:

- Fed Fund Futures: $4,167 x contract grade IMM index ($41.67 per basis point)
- Eurodollar Futures: $2,500 x contract grade IMM index ($25 per basis point)
- 1-Month SOFR Futures: $4,167 x contract grade IMM index ($41.67 per basis point)
- 3-Month SOFR Futures: $2,500 x contract grade IMM index ($25 per basis point)

STIR contract Notional amounts for illustrative purposes are shown below, computed based on the value of an equivalent money market instrument with the same dollar-value-of-basis-point (DV01):

- Eurodollar Futures: $1,000,000
- Fed Fund Futures: $5,000,000
- 3-Month SOFR Futures: $1,000,000
- 1-Month SOFR Futures: $5,000,000

Source: CME Group

Appendix: Terms to Know

RFR	Risk Free Rate (global)
LIBOR	London Inter-bank Offered Rate (global)
IBOR	Interbank Offered Rate (global)
BBSW	Bank Bill Swap Rate (Australia)
RBA Cash	RBA Cash Rate (Australia)
DI	Overnight Interbank Offered Rate (Brazil)
Selic	Average Interest Rate on Overnight Repos (Brazil)
CDOR	Canadian Dollar Offered Rate (Canada)
CORRA	Canadian Overnight Repo Rate (Canada)
EONIA	Euro Overnight Index Average (EU)
ESTER	Euro Short-Term Rate (EU)
EURIBOR	Euro Interbank Offered Rate (EU)
HIBOR	Hong Kong Interbank Offered Rate (Hong Kong)
HONIA	Hong Kong Dollar Overnight Index Average (Hong Kong)
Euroyen	Bonds Issued in Eurobond Market but Denominated in JPY (Japan)
TIBOR	Tokyo Interbank Offered Rate (Japan)
TONA	Tokyo Overnight Average Rate (Japan)
SIBOR	Singapore Interbank Offered Rate (Singapore)
SOR	Singapore Dollar Swap Offer Rate (Singapore)
Jibar	Johannesburg Interbank Average Rate (South Africa)
SASFR	South African Secured Financing Rate (South Africa)
ZARibor	South African Rand Interbank Overnight Rate (South Africa)
SARON	Swiss Average Rate Overnight (Switzerland)
SONIA	Sterling Overnight Index Average (UK)
SOFR	Secured Overnight Financing Rate (US)

FX	Foreign Exchange
AUD	Australian Dollar
BRL	Brazilian Real
CAD	Canadian Dollar
CHF	Swiss Franc
EUR	Euro
GBP	British Pound
HKD	Hong Kong Dollar
JPY	Japanese Yen
SGD	Singapore Dollar
USD	US Dollar
ZAR	South African Rand

CME	CME Group
DTCC	The Depository Trust & Clearing Corporation
FICC	Fixed Income Clearing Corporation
IBA	ICE Benchmark Administration
ICE	Intercontinental Exchange
LCH	f.k.a. London Clearing House; London Stock Exchange subsidiary
ISDA	International Swaps and Derivatives Association

FSB	Financial Stability Board (global)
OSSG	Official Sector Steering Group (global)
NWG	National Working Group (global)
ARRC	Alternative Reference Rates Committee (US)
CFPB	Consumer Financial Protection Bureau (US)
Fed	Federal Reserve System (US)
FRB	Federal Reserve Bank (US)
FSOC	Financial Stability Oversight Council (US)
NY Fed	Federal Reserve Bank of New York (US)
PTP	ARRC's Paced Transition Plan (US)
BoE	Bank of England (UK)
FCA	Financial Conduct Authority (UK)
RBA	Reserve Bank of Australia

ABS	Asset-Backed Security
ADV	Average Daily Trading Volume
BGCR	Broad General Collateral Rate
CCP	Central Counterparty Clearing House
CDO	Collateralized Debt Obligation
CLO	Collateralized Loan Obligation
DV01	Dollar Value of Basis Point
DVP	Delivery-versus-Payment
EFFR	Effective Fed Funds Rate
ETD	Exchange Traded Derivative
Eurodollar	USD Denominated Deposits (futures contract)
Fed Funds	Federal Funds Rate (futures contract)
FRA	Forward Rate Agreement
FRN	Floating Rate Note
GCF	General Collateral Financing
IR	Interest Rate
IRS	Interest Rate Swap
MBS	Mortgage-Backed Security
OI	Open Interest
OIS	Overnight Index Swap
OTC	Over-the-Counter
PAI	Price Alignment Interest
Repo	Repurchase Agreement
STIR	Short-Term Interest Rate
TGCR	Tri-Party General Collateral Rate
VWAP	Volume Weighted Average Price

M/M	Month-over-Month
Y/Y	Year-over-Year
EST	Eastern Standard Time
GMT	Greenwich Mean Time

Author

SIFMA Insights

Katie Kolchin, CFA

kkolchin@sifma.org