TD Securities

Transitioning from LIBOR to SOFR

Overview of Different Approaches to Referencing SOFR

November 18, 2020

LIBOR vs. SOFR

Summary of Key Characteristics & Differences

	SOFR (Secured Overnight Financing Rate)	LIBOR (London Inter-bank Offered Rate)
Administrator	Federal Reserve Bank of New York (FBNY)	ICE Benchmark Administration (IBA)
Established	April 2018	1986
Definition	**Secured risk-free rate,** based on repo transactions collateralized by Treasuries	**Unsecured, wholesale inter-bank lending rate,** based on a survey of 16 panel banks
Underlying Data Supporting Derivation	**Fully transaction-based** (~$1tn of daily transaction volumes)	**Part transaction-based; Part judgement-based** (<$1bn of daily transaction volumes)
Calculations	"Backward-looking" (rate known at end of overnight period it reflects)	"Forward-looking" (rate known at beginning of period it reflects)
Term Structure	Not yet available; targeted in 2021	Readily available in various terms (Overnight, 1wk, 1m, 2m, 3m, 6m, 12m)

Source: TD Securities, Alternative Reference Rates Committee, Federal Reserve Bank of New York, ICE Benchmark Administration

How Overnight Rates Are Used in Financial Products

- There are financial products that reference overnight rates as benchmarks (e.g. Fed Funds FRNs)
- When referencing such benchmarks, it's important to remember that financial products either ***explicitly*** or ***implicitly*** reference some kind of ***average*** of the overnight rates, **not a single overnight reading**
  - An average more accurately reflects movements in interest rates over a period of time
  - Smooths out idiosyncratic, day-to-day fluctuations in market rates

Forward-looking Term Rate

Based on

Cash (e.g. IBOR)	Derivatives

Availability & Usage

At the beginning *"in advance"*

Backward-looking Term Rate

Based on

Average of daily overnight rates

Availability & Usage

At the end *"in arrears"*	At the beginning *"in advance"*

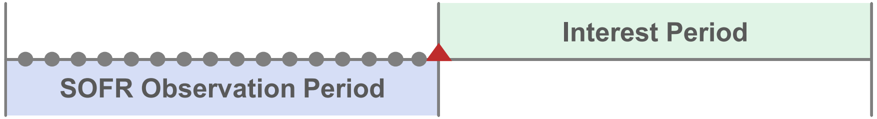
Source: Alternative Reference Rates Committee (A User's Guide to SOFR , April 2019), Financial Stability Board (Overnight Risk-Free Rates: A User's Guide , June 2019), TD Securities

How SOFR Can Be Referenced in Cash Products

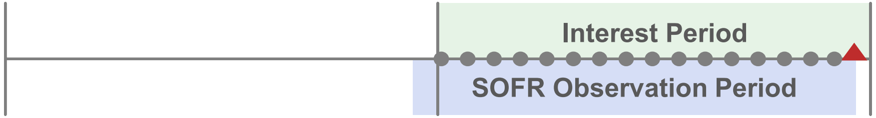
Different Types of SOFR-Based Rates

Type		Description
Exists Today	**Simple Average SOFR, In Arrears**	▪ <u>**Arithmetic**</u> average of daily SOFR <u>**during**</u> the relevant interest period. ▪ For example, for the 1-month period beginning Sept 1st, daily SOFR would be averaged from Sept 1st- Oct 1st
Exists Today	**Compounded SOFR, in Arrears**	▪ <u>**Compounded**</u> average of daily SOFR <u>**during**</u> the relevant interest period. ▪ For example, for the 1-month period beginning on Sept 1st, daily SOFR would be compounded from Sept 1st - Oct 1st
Exists Today	**Compounded SOFR, in Advance**	▪ <u>**Compounded**</u> average of daily SOFR from a period <u>**before**</u> the relevant interest period begins ▪ For example, for a 1-month period beginning on Sept 1st, daily SOFR would be compounded for the month of August
Does Not Exist	**Forward-Looking Term SOFR**	▪ Analogous to LIBOR, quoted for various tenors; implied from SOFR futures/derivatives trading ▪ A rate that reflects market *expectations* of SOFR over a tenor/relevant interest period

"In Advance" Framework



"In Arrears" Framework



Source: Alternative Reference Rates Committee (A User's Guide to SOFR , April 2019), Financial Stability Board (Overnight Risk-Free Rates: A User's Guide , June 2019), TD Securities

▲ = Indicates interest determination date for the relevant interest period

Notice of Payment in an "In Arrears" Framework

- To allow for advance notice of payment within an "in arrears" framework, calculation conventions would need to be modified to allow for interest to be calculated several days before it is due
- Common mechanisms to achieve cashflow certainty before interest payment is due include:

<table>
<tr><th>Mechanism</th><th>Description</th><th>Considerations</th></tr>
<tr><td>Lockout</td><td>Number of days immediately preceding an interest payment date for which a prior SOFR rate is recycled</td><td>▪ May require additional system functionality to lock the rate and then calculate a simple or compounded average</td></tr>
<tr><td>Lookback</td><td>For each day of the interest period, use SOFR from "x" business days ago</td><td rowspan="2">▪ Avoids risk of locking SOFR rate during periods of unusual volatility
▪ Long lookback (e.g. greater than 5 days) can be problematic for short interest periods (e.g. 1m) when it represents a considerable proportion of the interest period</td></tr>
<tr><td>Observation Shift</td><td>For each day of the interest, period use SOFR from "x" business days ago, taking account the # of overnight periods such rate would have applied in the Treasury repo market</td></tr>
<tr><td>Payment Delay</td><td>Number of business days between the last day of interest accrual and actual payment of interest</td><td>▪ Follows standard SOFR derivatives convention</td></tr>
</table>

Source: Alternative Reference Rates Committee (A User's Guide to SOFR , April 2019), Financial Stability Board (Overnight Risk-Free Rates: A User's Guide , June 2019), TD Securities

Comparison of SOFR-Based Rates

Key Considerations

	Type	Pros	Cons
Exists Today	**Simple Average SOFR, In Arrears**	▪ Relatively easy to operationalize ▪ Close to compounded averages	▪ Interest payments not known until end of interest period ▪ Requires short notice before payment is due
Exists Today	**Compounded SOFR, in Arrears**	▪ Reflects actual path of interest rates during interest period ▪ Standard convention in SOFR swaps (i.e. can be optimally hedged)	▪ Interest payments not known until end of interest period ▪ Requires short notice before payment is due ▪ Could be difficult to operationalize, particularly for cash products that are pre-payable intra-period and principal amount may fluctuate
Exists Today	**Compounded SOFR, in Advance**	▪ Looks & feels like LIBOR ▪ Rate known at start of period ▪ Easy to operationalize (30-, 90- and 180-Day SOFR Averages now available) ▪ GSEs have adopted 30-day Average SOFR for SOFR-based loans	▪ Could be perceived as stale. Such concerns are more limited when SOFR is relatively stable and/or interest period resets are relatively frequent (i.e. short interest periods) ▪ Rate cannot be *perfectly* hedged
Does Not Exist	**Forward-Looking Term SOFR**	▪ Known in advance ▪ Looks & feels like SOFR ▪ Easy to operationalize	▪ May not be available by year-end 2021 ▪ Not the standard convention in SOFR derivatives; may introduce basis risk with hedges

Source: Alternative Reference Rates Committee (A User's Guide to SOFR , April 2019), Financial Stability Board (Overnight Risk-Free Rates: A User's Guide , June 2019), TD Securities

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