SOFR Futures Settlement Calculation

Following the Alternative Reference Rates Committee's ("ARRC") announcement on June 22, 2017 that the Secured Overnight Financing Rate ("SOFR") is its preferred alternative reference rate, CME Group announced it would launch one-month ("1M") and three-month ("3M") SOFR futures that enable participants to create and hedge SOFR exposures. Both the 1M and 3M SOFR Futures will be listed for first trade date of Monday, May 7, 2018 pending certification of terms and conditions with the Commodity Futures Trading Commission and completion of all regulatory review periods. This note will expound on the settlement calculation methodologies, naming conventions, and holiday calendars for both types of SOFR Futures.

3M SOFR Futures Final Settlement

The final settlement price for an expiring 3M SOFR futures contract is 100 minus the SOFR benchmark rate, compounded over the contract's Reference Quarter. The Reference Quarter for 3M SOFR futures is the interval from the 3rd Wednesday (inclusive) of the month three months prior to the delivery month, to the 3rd Wednesday (exclusive) of the delivery month.

The definitions to the right make this more precise:

Exhibit 1 on the following page provides a breakdown of the calculation methodology for the June 2017 3M SOFR futures calculation period.

Final Settlement Price = 100 - R

R	$[\ \Pi_i \{1+(d_i/360)*(r_i/100)\} - 1\ ] \times (360/D) \times 100$
N	Number of US government securities market business days in the Reference Quarter
i	Running variable indexing US government securities market business days during Reference Quarter
Π_i	Capital pi (Π) indicates the terms to be compounded. It is the product of values indexed by the running variable, $i= 1,2,\ldots,n$.
r_i[1]	SOFR value for i^{th} US government securities market business day
d_i	Number of calendar days to which r_i applies
D	$\Sigma_i d_i$ (i.e., number of calendar days in Reference Quarter)

The examples to the right highlight three hypothetical instances in which a non-business day results in a period of accrued simple interest, but no compounding:

As the SOFR value for any given business day is provided on the next good business day (i.e the SOFR value for Monday is published Tuesday morning) the Exchange will compute an expiring contract's final settlement price on the morning after the contract's last trading day, when the SOFR value for the last day of the contract's Reference Quarter first becomes available. The final settlement price is computed so that the value of R is rounded to the nearest 1/10,000th of a percentage point (i.e., the nearest 1/100th of one basis point, or 0.0001 percent per annum). In the case of a tie (a rate that ends with 0.00005 in percent per annum terms) the value of R will be rounded up..

Mid-week holiday	Monday	Tuesday	Wednesday	Thursday	Friday
July	3	4	5	6	7
SOFR benchmark rate (r_i*)	1.10	no rate Independence Day	1.05	1.03	1.01
Days in period (d_i)	2		1	1	3
$\{1+(d_i/360)*(r_i/100)\}$	1.00006111		1.00002917	1.00002861	1.00008417

Weekend	Thursday	Friday	Saturday	Sunday	Monday
July	13	14	15	16	17
SOFR benchmark rate (r_i*)	1.02	1.02	no rate Weekend	no rate Weekend	1.04
Days in period (d_i)	1	3			1
$\{1+(d_i/360)*(r_i/100)\}$	1.00002833	1.000085			1.00002889

Long Weekend	Friday	Saturday	Sunday	Monday	Tuesday
September	1	2	3	4	5
SOFR benchmark rate (r_i*)	1.09	no rate Weekend	no rate Weekend	no rate Labor Day	1.05
Days in period (d_i)	4				1
$\{1+(d_i/360)*(r_i/100)\}$	1.00012111				1.00002917

** SOFR benchmark rate (r_i) is published by the New York Fed on day i + 1*

1 *The SOFR benchmark rate (r_i) is published by the New York Fed on the next good business day i+1 (i.e. one business day after the transaction date)*

Exhibit 1—Final Settlement 3M SOFR June 2017

Transaction Day	Publication Day	SOFR (percent)	Day Count	DIAF[2]
6/21/17	6/22/17	1.02	1	1.00002833
6/22/17	6/23/17	1.02	1	1.00002833
6/23/17	6/26/17	1.06	3	1.00008833
6/26/17	6/27/17	1.05	1	1.00002917
6/27/17	6/28/17	1.03	1	1.00002861
6/28/17	6/29/17	1.04	1	1.00002889
6/29/17	6/30/17	1.07	1	1.00002972
6/30/17	**7/3/17**	**1.20**	**3**	**1.00010000**
7/3/17	**7/5/17**	**1.10**	**2**	**1.00006111**
7/5/17	**7/6/17**	**1.05**	**1**	**1.00002917**
7/6/17	**7/7/17**	**1.03**	**1**	**1.00002861**
7/7/17	**7/10/17**	**1.01**	**3**	**1.00008417**
7/10/17	7/11/17	1.01	1	1.00002806
7/11/17	7/12/17	1.01	1	1.00002806
7/12/17	**7/13/17**	**1.01**	**1**	**1.00002806**
7/13/17	**7/14/17**	**1.02**	**1**	**1.00002833**
7/14/17	**7/17/17**	**1.02**	**3**	**1.00008500**
7/17/17	**7/18/17**	**1.04**	**1**	**1.00002889**
7/18/17	7/19/17	1.02	1	1.00002833
7/19/17	7/20/17	1.01	1	1.00002806
7/20/17	7/21/17	1.02	1	1.00002833
7/21/17	7/24/17	1.01	3	1.00008500
7/24/17	7/25/17	1.05	1	1.00002917
7/25/17	7/26/17	1.04	1	1.00002889
7/26/17	7/27/17	1.04	1	1.00002889
7/27/17	7/28/17	1.04	1	1.00002889
7/28/17	7/31/17	1.03	3	1.00008583
7/31/17	8/1/17	1.08	1	1.00003000
8/1/17	8/2/17	1.03	1	1.00002861
8/2/17	8/3/17	1.01	1	1.00002806
8/3/17	8/4/17	1.01	1	1.00002806
8/4/17	8/7/17	1.01	3	1.00008417
8/7/17	8/8/17	1.01	1	1.00002806
8/8/17	8/9/17	1.01	1	1.00002806
8/9/17	8/10/17	1.01	1	1.00002806
8/10/17	8/11/17	1.03	1	1.00002861
8/11/17	8/14/17	1.05	3	1.00008750
8/14/17	8/15/17	1.08	1	1.00003000
8/15/17	8/16/17	1.11	1	1.00003083
8/16/17	8/17/17	1.09	1	1.00003028
8/17/17	8/18/17	1.09	1	1.00003028
8/18/17	8/21/17	1.06	3	1.00008833
8/21/17	8/22/17	1.04	1	1.00002889
8/22/17	8/23/17	1.02	1	1.00002833
8/23/17	8/24/17	1.02	1	1.00002833
8/24/17	8/25/17	1.08	1	1.00003000
8/25/17	8/28/17	1.05	3	1.00008750
8/28/17	8/29/17	1.05	1	1.00002917
8/29/17	8/30/17	1.03	1	1.00002861
8/30/17	8/31/17	1.03	1	1.00002861
8/31/17	**9/1/17**	**1.14**	**1**	**1.00003167**
9/1/17	**9/5/17**	**1.09**	**4**	**1.00012111**
9/5/17	**9/6/17**	**1.05**	**1**	**1.00002917**
9/6/17	9/7/17	1.03	1	1.00002861
9/7/17	9/8/17	1.04	1	1.00002889
9/8/17	9/11/17	1.04	3	1.00008667
9/11/17	9/12/17	1.04	1	1.00002889
9/12/17	9/13/17	1.05	1	1.00002917
9/13/17	9/14/17	1.05	1	1.00002917
9/14/17	9/15/17	1.09	1	1.00003028
9/15/17	9/18/17	1.10	3	1.00009167
9/18/17	9/19/17	1.04	1	1.00002889
9/19/17	9/20/17	1.01	1	1.00002806

Π_i Term	1.002655388
Annualized (subtract 1, multiply by 360/91)	1.05048%
Rounded to Nearest 1/100 BP:	1.05050%
Contract Settlement:	98.9495

What are They Called?

As the 3M SOFR futures final settlement will reference the realized compounded daily values of the SOFR benchmark over a forward looking three-month period between two IMM dates, **the month symbol in the code will reference the beginning of the calculation period, not the month for final settlement. The final settlement month will be three months after the month referenced in the contract code.**

CME Group and Bloomberg 3M SOFR Codes for 2018:

Month	CME Group	Bloomberg
March	SR3H8	SFRH8
June	SR3M8	SFRM8
September	SR3U8	SFRU8
December	SR3Z8	SFRZ8

*2 Daily Interest Accumulation Factor = {1+(Day Count/360) * SOFR in %} or {1+(di/360)*(ri/100)} from the calculation formula*

1M SOFR Futures Final Settlement

Final Settlement for the 1M SOFR future will be the average daily values of the SOFR benchmark over the given delivery month. The settlement process will be extremely similar to the process for the currently listed 30-Day Federal Funds Futures contracts.[3] The below presents a sample calculation of the final settlement for the July 2017 1M SOFR Futures contract.

Exhibit 2—Final Settlement 1M SOFR July 2017

Day	SOFR (in %)
Saturday, July 01, 2017	**1.20%**
Sunday, July 02, 2017	**1.20%**
Monday, July 03, 2017	1.10%
Tuesday, July 04, 2017	**1.10%**
Wednesday, July 05, 2017	1.05%
Thursday, July 06, 2017	1.03%
Friday, July 07, 2017	1.01%
Saturday, July 08, 2017	**1.01%**
Sunday, July 09, 2017	**1.01%**
Monday, July 10, 2017	1.01%
Tuesday, July 11, 2017	1.01%
Wednesday, July 12, 2017	1.01%
Thursday, July 13, 2017	1.02%
Friday, July 14, 2017	1.02%
Saturday, July 15, 2017	**1.02%**
Sunday, July 16, 2017	**1.02%**
Monday, July 17, 2017	1.04%
Tuesday, July 18, 2017	1.02%
Wednesday, July 19, 2017	1.01%
Thursday, July 20, 2017	1.02%
Friday, July 21, 2017	1.01%
Saturday, July 22, 2017	**1.01%**
Sunday, July 23, 2017	**1.01%**
Monday, July 24, 2017	1.05%
Tuesday, July 25, 2017	1.04%
Wednesday, July 26, 2017	1.04%
Thursday, July 27, 2017	1.04%
Friday, July 28, 2017	1.03%
Saturday, July 29, 2017	**1.03%**
Sunday, July 30, 2017	**1.03%**
Monday, July 31, 2017	1.08%
Average Daily Rate:	1.04129%
Rounded to Nearest 1/10 BP:	1.04100%
Contract Settlement:	98.959

An overnight rate is assigned to every day in the contract month (as mentioned above, SOFR values are published on the next good business day after transaction date). As per the rulebook chapter for SOFR futures, weekends and holidays (highlighted in blue in Exhibit 2) are assigned the prevailing rate from the last preceding day for which a rate was published.

For example, the rate applied on Saturday July 15 and Sunday July 16 is the rate published for Friday July 14. Note that Independence Day—July 4—is a holiday for the source data of SOFR and thus there is no SOFR value for that day.

To calculate the final settlement of a 1M SOFR Future:

1. Calculate the simple arithmetic average of the daily SOFR rates of the calendar month (i.e. the sum of all rates in the month period divided by the number of calendar days in the month period). For our July 2017 example, this is 1.04129%
2. Round the arithmetic average to the nearest 1/10th of a basis point. For July 2017 this is 1.041%
3. The final contract settlement value is equal to 100-the rounded arithmetic average. For July 2017 this is 100-1.041, or 98.959.

What are They Called?

As 1M SOFR futures final settlement will reference the realized average daily values of the SOFR benchmark over a given delivery month, **the month symbol in the code will reference the delivery month for that contract.**

Exhibit 3—CME Group and Bloomberg 1M SOFR Codes for 2018:

Month	CME Group	Bloomberg
January	SR1F8	SERF8
February	SR1G8	SERG8
March	SR1H8	SERH8
April	SR1J8	SERJ8
May	SR1K8	SERK8
June	SR1M8	SERM8
July	SR1N8	SERN8
August	SR1Q8	SERQ8
September	SR1U8	SERU8
October	SR1V8	SERV8
November	SR1X8	SERX8
December	SR1Z8	SERZ8

Holiday Calendars

The SOFR benchmark will be published on every business day that is not a weekend or holiday according to the exhaustive list of the SIFMA US holiday calendar, and Federal Reserve holiday calendar. Note that SIFMA considers Good Friday a holiday whereas the Federal Reserve does not; **a SOFR value will not be published on Good Friday**. The SIFMA and Federal Reserve holiday calendars can be found via the following:

- SIFMA: **https://www.sifma.org/resources/general/holiday-schedule/**
- Federal Reserve: **https://www.federalreserve.gov/aboutthefed/k8.htm**

3 The only notable difference are the holiday calendars utilized for the respective rates.

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