



# Compounded €STR average rates and index

## Calculation and publication rules

### 1 Background

The ECB calculates and publishes daily compounded averages of the euro short-term rate (€STR) for a specific set of tenors, as well as a compounded €STR index.

The compounded average rates and index are intended to encourage wider use of the €STR for financial contracts and instruments, as [recommended](#) by the Financial Stability Board. Such products may require the use of compounding and therefore benefit from the availability of a trusted source for these calculations.

The ECB is tasked with the calculation and publication of the compounded €STR average rates and index by the ECB in accordance with [Guideline \(EU\) 2019/1265](#).

The daily compounded €STR average rates and index are based entirely on historical €STR rates, which are publically available.

### 2 Calculation rules

#### 2.1 Compounded €STR average rates

The formula for calculating compounded €STR average rates uses the historical daily values of the €STR<sup>1</sup> and yields an average rate for the respective tenor over which the €STR values were recorded (e.g. the past week or month).

##### Formula 1

$$\text{Compound interest} = \left[ \prod_{i=1}^{d_b} \left( 1 + \frac{r_i \times n_i}{N} \right) - 1 \right] \times \frac{N}{d_c}$$

where

$i$  = an index representing each TARGET2 business day in the interest period;

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<sup>1</sup> Including, if necessary, values determined under the contingency procedure described in Section 6 of [The euro short-term rate methodology and policies](#).

$d_b$  = the number of TARGET2 business days in the interest period;

$d_c$  = the number of calendar days in the interest period;

$r_i$  = the €STR rate published on business day  $i$  (based on €STR-eligible trades executed on the previous business day,  $i - 1$ );

$n_i$  = the number of calendar days for which rate  $r_i$  applies (generally one day except on each Monday within the interest period, when it will be three to account for accrual over the weekend; this number will also be adjusted to reflect TARGET2 holidays);

$N$  = the number of days in the year, i.e. 360 in European money market calculations.

#### Example of compounding over a one-week horizon

Daily €STR publication date	€STR on the previous business day	Compounding factor
Friday	$u$	$1 + u * 1/360$
Saturday	n/a	n/a
Sunday	n/a	n/a
Monday	$v$	$1 + v * 3/360$
Tuesday	$w$	$1 + w * 1/360$
Wednesday	$x$	$1 + x * 1/360$
Thursday	$y$	$1 + y * 1/360$

Since compounded €STR average rates are backward-looking, the start date of a tenor is established using the reference date for the rate and the European modified previous business day convention. When the start date of a tenor falls on a non-business day it is adjusted to the previous business day provided that the latter falls within the same month as the unadjusted date; otherwise it is adjusted to the following business day.<sup>2</sup> In line with that principle, for example:

- the one-week rate published for Thursday, 23 April 2020, starts on Thursday, 16 April (the standard case with no adjustment of the start date);
- the one-month rate published for Monday, 25 May 2020, starts on Friday, 24 April (the start date is adjusted to the previous business day);
- the one-month rate published for Friday, 1 February 2019, starts on Wednesday, 2 January 2019 (which is the following business day, since the previous business day falls in the previous month).

<sup>2</sup> The modified previous business day convention applies to all tenors of one month or multiples thereof. For one-week tenors, the standard previous business day convention applies instead: a start date that would otherwise fall on a non-business day is always adjusted to the previous business day, even if that day is in the previous calendar month.

## 2.2 The compounded €STR index

The compounded €STR index represents the evolving daily value of a notional instrument that accrues compounded interest on an initial sum of €100 starting on 1 October 2019, which was the first trade date of the €STR.<sup>3</sup> The compounded €STR index is published for every TARGET2 business day and had a starting value of 100.00000000 on 1 October 2019.

The index is calculated by the ECB using Formula 2 below.

### Formula 2

$$\text{Compounded €STR index on date } i = \begin{cases} 100, & \text{if } i = 0 \\ 100 \times \prod_{t=1}^i \left(1 + \frac{r_t \times n_t}{N}\right), & \text{if } i > 0 \end{cases}$$

The index allows users to calculate interest rates for customised maturities or over any period of their choice simply and transparently using formula 3 below.

### Formula 3

Compounded €STR average rate between  $x$  and  $y$  =

$$\left( \frac{\text{Compounded €STR index } y}{\text{Compounded €STR index } x} - 1 \right) \times \frac{N}{d_c}$$

where:

$r_t$  = the €STR published on business day  $t$ ;

$n_t$  = the number of calendar days for which  $r_t$  applies; this is  $n_t = 1$  on Tuesdays to Fridays and  $n_t = 3$  on Mondays, assuming no TARGET2 holidays;<sup>4</sup>

$x, y$  = the start and end dates for calculating the compounded average for a customised maturity or period;

$N$  = the number of days in the year, i.e. 360 in European money market calculations;

$d_c$  = the number of calendar days in the interest period;

$t = 0$  refers to 1 October 2019 (the first €STR reference date).

<sup>3</sup> Specifically, this is the value of a notional overnight deposit of €100 placed on 1 October 2019 remunerated at the applicable daily €STR rate and rolled over every day with daily liquidation of interest on business days, so interest due for non-business days accrues on a simple, rather than compounded, basis.

<sup>4</sup> As in Section 2.1, the rate on the last business day available is applied to the non-business days in the period. Absent any holiday,  $n_t = 3$  on Mondays accounts for the weekend. When the period includes TARGET2 holidays,  $n_t$  is adjusted accordingly. For instance,  $n_t = 2$  on a Thursday if the Wednesday was a TARGET 2 holiday;  $n_t = 3$  on a Thursday if both the Tuesday and the Wednesday were TARGET 2 holidays;  $n_t = 4$  on a Monday if the previous Friday was a TARGET 2 holiday; and so on.

Compounded €STR average rate between  $x$  and  $y$  = the compounded €STR average rate from start date  $x$  to end date  $y$ .

Example of the calculation of a compounded €STR average rate using the index

Start date	Index value	End date	Index value	Number of calendar days	Compounded average rate
11 February 2020	99.80028570	28 February 2020	99.77488944	17	-0.53888%

Note: The compounded rate is calculated as follows:  $(99.77488944/99.80028570 - 1) \times 360 / 17 = -0.53888\%$ .

### 3 Publication

Compounded €STR average rates and the compounded €STR index are published every Target 2 business day at 9:15 CET.

They are published on the ECB's website and via the Market Information Dissemination (MID) platform and the ECB's [Statistical Data Warehouse](#).

The tenors for which compounded €STR average rates are published are one week, one month, three months, six months and twelve months.

The publication of the daily compounded €STR average rates includes the start and end dates of the various tenors.<sup>5</sup>

Example – compounded €STR average rates published on Thursday, 7 October 2020

Term	Start date	End date	Compounded rate (%)
Overnight	6 October 2020	7 October 2020	-0.55600
One week	30 September 2020	7 October 2020	-0.55769
One month	7 September 2020	7 October 2020	-0.55411
Three months	7 July 2020	7 October 2020	-0.55201
Six months	7 April 2020	7 October 2020	-0.54643
Twelve months	7 October 2019	7 October 2020	-0.54167

Compounded €STR average rates are published as percentages to five decimal places; the daily compounded index is published to eight decimal places. Standard rounding is used in both cases.<sup>6</sup>

The published daily compounded €STR average rates and compounded index are based on publically available and final data. Corrections are therefore not envisaged.

Should daily compounded €STR average rates and/or the compounded index be temporarily unavailable, users may decide to calculate the respective rates

<sup>5</sup> For any given publication date, the end date for all tenors is the same and coincides by convention with the reference date (which is also the publication date). Accordingly, the daily dissemination via the MID platform contains the end date within a single <REF\_DATE> tag applicable to all tenors.

<sup>6</sup> Rates are rounded to the nearest one hundred-thousandth of a percentage point, with ties rounded away from zero, so that -1.000005% becomes -1.00001% and 1.000005% becomes 1.00001%.

themselves using the historical €STR data and applying the calculation rules set out in Section 2.

#### 4 Review of the calculation and publication rules

Any change in the calculation and publication rules, including a decision to cease publication of compounded €STR average rates and/or the compounded €STR index, will be subject to public consultation as far as possible and practicable. Any change in the calculation rules approved by the ECB will not result in revision of the historical data series of compounded €STR average rates and the compounded index.

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