Compounded ZARONIA period averages and index

Calculation methodology and publication

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South African Reserve Bank

Contents

1. Background

1.1 The South African Reserve Bank (SARB) will calculate and publish the compounded South African Overnight Index Average (ZARONIA) period averages and index daily to encourage the use of ZARONIA in financial products.

1.2 The ZARONIA compounded index will represent the returns from rolling an investment that earns interest daily at the ZARONIA rate. The index will allow users to easily determine the interest rate that is applicable over their period of choice and thereby provide the flexibility to customise maturities. Publishing the index will achieve the primary objectives of simplifying the calculation of compounded interest rates and providing a standardised basis through an official source.

1.3 Calculating the ZARONIA compounded index will require the use of daily compounding, which should more accurately reflect the time value of money than simple averaging. The calculation methodology for the ZARONIA compounded index is consistent with the methodology used to determine the Secured Overnight Financing Rate (SOFR), Sterling Overnight Indexed Average (SONIA) and Euro Short-Term Rate (ESTR) compounded indices.

1.4 Compounded ZARONIA period averages will address the need of market participants that require a simpler reference point for compounded interest rates for commonly used tenors. The SARB will publish averages for 1-week, 1-month, 3-month, 6-month, 9-month and 12-month tenors.[1] Section 2.1 specifies the calculation methodology for ZARONIA period averages, which is consistent with the International Swaps and Derivatives Association's (ISDA) methodology used in overnight index swaps.[2] And hence, publishing period averages should assist market participants to contemplate effective

[1] Essentially, the ZARONIA period average and compounding will yield the same result when the reference period is the same. Any differences will be due to rounding.
[2] Given that the European Central Bank (ECB) and the United States Federal Reserve (Fed) use the same ISDA methodology for ESTR and SOFR averages respectively, ZARONIA period averages will be consistent with international practice.

hedges for ZARONIA-linked liabilities and contribute to better market functioning.

1.5 Market participants are strongly encouraged to adopt ZARONIA compounded in arrears where possible, instead of waiting for a viable forward-looking term rate to be introduced. The Market Practitioners Group (MPG) has produced market conventions that provide a golden standard to guide the use of compounded ZARONIA rates. Suitable forward-looking term rates will most likely be implied from ZARONIA-based derivatives instruments. And hence, the development of robust term rates will depend on how long it will take the derivatives market to build sufficient liquidity.

2. Calculation methodology

2.1 Compounded ZARONIA period average

2.1.1 The formula for calculating compounded ZARONIA rates based on historical daily ZARONIA rates is detailed below:

$$Compounded\ ZARONIA\ period\ average = \left[\prod_{i=1}^{d_b}\left(1+\frac{r_i \times n_i}{N}\right)-1\right]\times\frac{N}{d_c}$$

where

d_b = the number of business days in the interest period

d_c = the number of calendar days in the interest period

r_i = the ZARONIA rate applicable on business day i
(ZARONIA is published on the next business day immediately following i.)

n_i = the number of calendar days for which r_i applies
(Generally, $n_i = 1$ on most days, except for Fridays, where $n_i = 3$ to account for the weekend; the number will also be adjusted to account for public holidays.)

N = the number of days in the year, which is 365 days (even in leap years) for domestic money markets

i = the series of whole numbers from one to d_b, each representing a business day in chronological order

2.1.2 Consistent with the ISDA methodology, interest will compound only on South African business days. Simple interest will apply to any non-business days at a rate equal to the ZARONIA value for the last available business day. For example, in a typical weekend, the averages and the index would use the ZARONIA value published for Friday – the value would be multiplied by three to account for Friday, Saturday and Sunday. The compounding rates and index would be determined using that adjusted term.

2.1.3 Furthermore, in accordance with the South African money market convention, interest will be calculated using the actual number of calendar days, assuming a 365-day year (ACT/356). Figure 1 below demonstrates the mechanics of the methodology applied to ZARONIA rates published over a 1-week period.

Figure 1: Example of compounding over a 1-week period

1/A	B	C	D	E	F	H
2	**Date**		**ZARONIA (%, annualised)**	**Number of days applied**	**Effective Rate (%, not annualised)**	**Compounded Interest**
3						
4	2023-01-16	Monday	6.838	1	0.018734247	0.00018734
5	2023-01-17	Tuesday	6.840	1	0.018739726	0.00037477
6	2023-01-18	Wednesday	6.839	1	0.018736986	0.00056221
7	2023-01-19	Thursday	6.862	1	0.018800000	0.00075032
8	2023-01-20	Friday	6.842	3	0.056235616	0.00131310
9	2023-01-21	Saturday				
10	2023-01-22	Sunday				
11	2023-01-23	Monday	Value Date			0.00131310
12						
13					=(E4*D4)/365	=(1+F4/100)-1
14					=(E5*D5)/365	=(1+F4/100)*(1+F5/100)-1
15					=(E6*D6)/365	=(1+F4/100)*(1+F5/100)*(1+F6/100)-1
					=(E7*D7)/365	=(1+F4/100)*(1+F5/100)*(1+F6/100)*(1+F7/100)-1
					=(E8*D8)/365	=(1+F4/100)*(1+F5/100)*(1+F6/100)*(1+F7/100)*(1+F8/100)-1
16						
17	2023-01-23	Monday	Effective Annualised Rate			6.84687193
18						
19						=H11*(365/7)*100
20						
21						
22				Principal	1,000,000.00	
23				Interest	1,313.10	=F22*(H17/100)*7/365
24				Payment	1,001,313.10	

2.1.4 The start dates of the reference period will be determined in a way that closely matches the period used for the 'modified following' calendar conventions.[3] Given that ZARONIA compounded averages will be backward-looking, when the start date of a tenor falls on a non-business day, it will be adjusted to the previous business day, provided that the latter falls within the same month as the unadjusted date, otherwise it will be adjusted to the following business day.

2.1.5 As illustrated in Figure 1, each respective ZARONIA period average will span the relevant number of historical calendar days, with the final value being the ZARONIA rate published the specified day. For example, the ZARONIA rate published on Monday, 23 January 2023 (for value date Friday, 20 January 2023) was the final value used to calculate the 1-week period average which would have been published on Monday, 23 January, its value date.

2.2 ZARONIA compounded index

2.2.1 The ZARONIA compounded index measures the cumulative effect of compounding ZARONIA rates on a notional unit of investment, with an initial value set to 100.000000000000 on 1 November 2022, the date of the first official publication of ZARONIA. The compounded ZARONIA index will be published on every business day, starting with the value of 100.000000000000 as published on 1 November 2022. The index value on any other date will represent the effect of compounding ZARONIA rates from 1 November 2022 until that date.

2.2.2 The formula for calculating ZARONIA compounded index based on historical daily ZARONIA rates is detailed below:

[3] The 'modified following' convention prescribes that if the end date of an interest period falls on a weekend or public holiday, the end date is rolled forward to the next business day. Furthermore, if the next business day falls in the next calendar month, the payment day is rolled back to the preceding business day.

$$Compounded\ ZARONIA\ Index_t = \begin{cases} 100.000000000000, & if\ i = 0 \\ 100 \times \prod_{t=0}^{i} \left(1 + \frac{r_i \times n_i}{N}\right), & if\ i > 0 \end{cases}$$

where

t = 0, refers to 1 November 2022

r_i = the ZARONIA rate applicable on business day i
(ZARONIA is published on the next business day immediately following i.)

n_i = the number of calendar days for which r_i applies
(Generally, $n_i = 1$ on most days, except for Fridays, where $n_i = 3$ to account for the weekend; the number will also be adjusted to account for public holidays.)

N = the number of days in the year, which is 365 days for domestic money markets

2.2.3 The ZARONIA compounded index will allow users to determine the compounded interest over any period of their choice by using the following formula:

$$Compounded\ ZARONIA\ average\ between\ x\ and\ y = \left(\frac{ZARONIA\ Index_y}{ZARONIA\ Index\_x} - 1\right) \times \frac{N}{d_c}$$

where

x = the start date of the calculation period

y = the end date of the calculation period

d_c = the number of calendar days in the interest period

N = the number of days in the year, which is 365 days for domestic money markets

2.2.4 Using the example in Figure 1 and assuming that the initial value of the investment was 100.000000000000 on 16 January 2023, the index values that would have been published on Monday, 23 January 2023 and Friday, 20 January 2023 would have been 100.13130987623 and 100.075032061442 respectively. Applying the formula in section 2.2.3, the compounded interest

rate for the period equals to 6.8420% $\left(\left(\frac{100.131309872623}{100.075032061442}-1\right)\times\frac{365}{3}\right)$, which correctly reconciled to the ZARONIA rate published for value date 20 January 2023 (cell D8). Similarly, the compounded interest rate for the whole week equals to 6.84687% $\left(\left(\frac{100.131309872623}{100.000000000000}-1\right)\times\frac{365}{7}\right)$, which is the compounded ZARONIA period average rate that would have been published on 23 January 2023 (cell H17).

3. Publication

3.1 The compounded ZARONIA period averages and index will be published on the SARB website every South African business day at 10:00.

3.1.1 With each standard tenor, the SARB will publish the start date, end date and the applicable period average rate. Standard tenors include 1-week, 1-month, 3-month, 6-month, 9-month and 12-month maturities.

3.2 Compounded ZARONIA period average rates will be rounded off to five decimal places.[4] The ZARONIA compounded index will be rounded off to 12 decimal places.[5]

3.3 Should the SARB be unable to publish at the prescribed time, it shall inform the public to that effect with a notice on its website and the newswires and provide an estimated publication time.

3.4 If an error is discovered after the publication of the compounded averages and index at 10:00, and if such an error pertains to the calculation process or the determination of ZARONIA, the rates and the index levels may be republished at any time before 12:00, South African time. The republication will be accompanied by a note indicating the reason for the republication.

[4] This is consistent with the convention used in the derivatives market. Also, the Fed and ECB round off to five decimal places.
[5] While the preference would be to publish the index values with more decimal places for the sake of precision, the Bank of England (2020) found that some infrastructure providers' systems were unable to handle data with more than eight decimal places. Nonetheless, the underlying computation rule allowed for 28 decimal places.