Precision of rounding for calculating interest flows in issues of floating-rate debt securities

Document of the National Working Group for benchmark reform

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This document aims to discuss material aspects of the rules of calculating interest flows based on WIRON or WIRON Compound Index in issues of floating-rate debt securities.

Introduction

1. The rules of calculating the value of RFR-based interest flows are complicated and ambiguous (compared to the current simple interest calculation convention) and, if not specified, may cause discrepancies in the calculated interest values.
2. Considering the practice developed in other markets which have introduced the benchmark reform earlier, thee methods of determining the amount of interest flows in an RFR-based financial instrument may be indicated for the adopted rule of calculating the compound rate (e.g. Lookback with Observation Period Shift):
    a. Method 1 – based on the use of returns from the published RFR Compound Indices;
    b. Method 2 – based on the use of RFR indices (using the Cumulative Compounded Rate);
    c. Method 3 – based on the use of RFR indices (without using the Cumulative Compounded Rate; sequential calculation of interest in each O/N period based on the given RFR index);
3. One should bear in mind the following limitations:
    a. In the Polish market, values of the RFR index (WIRON) and the RFR Compound Index (WIRON Compound Index) are available and published.
    b. WIRON is calculated and presented as a value rounded to the third decimal place (where rounding applies to an interest rate expressed in %).
    c. WIRON Compound Index is expressed in index points and rounded to the eighth decimal place.
    d. Considering accounting rules, the value of interest due and the value of interest flows should be expressed in PLN and rounded to the second decimal place.
    e. There are systemic limitations related with floating-point precision of a system or tool which calculates interest for a financial instrument which interest may affect the calculation results.

Important aspects of the convention of calculating WIRON-based interest flows in issues of floating-rate debt securities

1. In theory, the above-mentioned Methods 1–3 are thematically equivalent, but in practice, considering the above-described limitations, there will almost always be differences in the amount of interest calculated.
2. If a contract for a financial instrument allows the use of the RFR Compound Index and an RFR index, then to calculate interest, it is necessary to indicate the recommended convention, to introduce appropriate rounding precision and to define precise rules for determining interest flows.
3. The absence of rounding at the level of calculation of the value of interest due does not means than the above-mentioned Methods 1–3 give identical results with the above-mentioned limitations.
4. Introducing appropriate rounding precision at the level of interest calculation is necessary and allows to reduce differences that may occur between Methods 1–3 in practice.
5. Interest flows calculated for an O/N period, for a defined Backward-looking rate use convention (e.g. Lookback with Observation Period Shift), may take negative values (despite positive interest rates).
6. To calculate the correct amount of interest, it is necessary to have the possibility to manage rounded values resulting from the published data for WIRON or WIRON Compound Index at the level of systems and/or tools used to calculate interest flows.
7. One could also consider using the published compound rates for pre-defined periods but, in practice, it is necessary to bear in mind the key assumptions made for the calculation (as they may not necessarily correspond to the assumptions for the transaction for which the amount of interest based on WIRON or WIRON Compound Index is calculated):
    a. The Reference Period End Date is the date of the WIRON Compound Rate.
    b. The Reference Period Start Date is a Business Day resulting from the backward shift of the Reference Period End Date by a set pre-defined backward period in months (i.e. 1M, 3M or 6M) in accordance with the Modified Preceding Business Day Convention.
8. The key action is to define the final amount of interest in the given Interest Period. The amounts of interest corresponding to O/N periods can be calculated using the above methods but one must remember that, in practice, without introducing appropriate rounding precision, this might generate significant discrepancies in the amount of interest (the sum of interest values from one-day periods *versus* the final amount of interest using the Cumulative Compounded Rate).
9. For floating-rate debt instruments, the recommended method of calculating coupon payments is the approach based on the use of returns from the published RFR compound indices (using the Cumulative Compounded Rate, Method 1).
10. With a clear indication of the approach based on the use of returns from the published RFR compound indices, there is no need to introduce any other additional assumption about rounding.
11. In practice, Method 2 or 3 may be used, by approximating interest values resulting from Method 1. In such case, it is recommended to use the '7 d.p.' rounding precision (that is precision to the fifth decimal place where rounding applies to the value of a rate expressed in % or, equivalently, precision

to the seventh decimal place if rounding applies to a numerical value) at the level of calculation of the Annualised Cumulative Compounded RFR (ACR) parameter. Such level of rounding precision guarantees the best concurrence in the calculation of interest between the three methods being considered.

12. As a rule, bonds are denominated in: PLN 1 000 or a multiple thereof. Please note that when differences arise at the level of 1 *grosz* (PLN 0.01) per bond, the discrepancy in the amount of interest increases significantly, if we talk about a portfolio made of many bonds purchased – variability on interest due to rounding up and down to PLN 0.01 may lead to material changes in the final amount of interest (e.g. when considering an issue for PLN 100 million, including 100 000 bonds worth PLN 1 000 each – for such series, the discrepancy of PLN 0.01 corresponds to the amount of PLN 1 000 on the total amount of interest).

    In practice, for bonds the Interest Period Start/End Date may fall on a Non-business Day. If this is the case, when applying the Backward-looking rate use convention (Lookback with Observation Period Shift) – it is necessary to specify the method of defining the day from which the published value of WIRON or WIRON Compound Index for the first O/N Interest Period is to be used.

13. For instruments which allow the use of WIRON and WIRON Compound Index to calculate interest flows, it is necessary to specify the method of calculating the final amount of interest in the given Interest Period (e.g. Method 1) and agree on appropriate rounding precision that will minimise discrepancies between the method of interest calculation using WIRON and WIRON Compound Index.

Commentary on the examples presented in the attached spreadsheet:

- **#1:** An example presenting the recommended approach to issues of floating-rate debt securities (using WIRON Compound Index, Method 1), adopted when applying the Backward-looking rate use convention (Lookback with Observation Period Shift). For each O/N Interest Period, the index value from the day preceding the last 5 business days is used. The approach is based on the use of returns from the published RFR compound indices (using the Cumulative Compounded Rate).
- **#1 (1):** The calculation of interest payments according to the recommended Lookback with Observation Period Shift convention may be done using two mathematically equivalent methods: by compounding the WIRON index (calculating the compounded interest) over a defined Reference Period (Method 2, Method 3), or by calculating the quotient of the WIRON Compound Index from the end and from the beginning of the Reference Period (Method 1). In practice, when considering the above-mentioned limitations, there will almost always be differences in the amount of interest calculated. The absence of rounding does not means than the Methods give identical results with the above-mentioned limitations. To minimise differences in interest calculation, the example involves **rounding at the level of calculation of Annualised Cumulative Compounded RFR (ACR)**. It should be noted that, on one hand, adopting lower rounding precision increases the differences between Methods 2 and 3 but, on the other hand, increasing the precision of rounding of the ACR increases the discrepancies between Methods 1 and 2.

  The '7 d.p.' rounding precision (which means precision to the fifth decimal place, where rounding applies to the value of a rate expressed in % or, equivalently, precision to the seventh decimal place if rounding applies to a numerical value) guarantees the best concurrence between the three methods being considered.
- **#1 (2):** An example involving a significant increase in transaction denomination. If rounding precision is maintained, an increase in denomination does not increase the discrepancies between Methods 1–3 being considered.
- **#1 (3):** An example of a situation where interest flows calculated for the given O/N period, according to the recommended Lookback with Observation Period Shift convention, may take negative values (despite positive interest rates). Managing such cases may be very challenging in the systems used currently.
- **#1 (4a):** An example of a situation where the Interest Period Start Date and the Interest Period End Date falls on a Non-business Day. To achieve concurrence of the methods, the observation period shift for the first O/N Interest Period must be properly adjusted. Managing such cases may be very challenging in the systems used currently.

  The problem occurs for both bonds and loans (based on the current values of the RFR index and the RFR Compound Index) when applying the Lookback with Observation Period Shift convention. Then the problem can be solved by:
  - shifting the Interest Period Start/End Dates to Business Days, including applying the Modified Following Business Day Convention (considering the practice developed in other market, this is the preferred solution) – **an example of bonds and the method used is provided in sheet #1 (4b);**
  - shifting the RFR index reading date according to the following mechanism:

- If the Interest Period Start Date for which interest is calculated (O/N period start date) is a Business Day, then: Observation Date = O/N period start date – 5BD;
- If the Interest Period Start Date for which interest is calculated (O/N period start date) is not a Business Day, then: Observation Date = O/N period start date – 6BD;
- Regardless of whether the Interest Period End Date for which interest is calculated (O/N period end date) is a Business Day or a Non-business Day = O/N period end date – 5BD.

An example of bonds using the above mechanism is provided in sheet #1 (4c);

- **#1 (5):** An example of a situation where the absence of rounding at the level of ACR and ACR* causes a significant difference at the level of each flow over O/N periods and in the final value of interest due, between Method 1 and Method 2. The absence of rounding does not means than the Methods give identical results with the above-mentioned limitations.
- **#1 (6a):** A variable denomination in the Interest Period requires adaptation of the formulas.
- **#1 (6b):** A variable denomination in the Interest Period requires adaptation of the formulas (an alternative approach, which involves the calculation of interest calculated using the ACR and appropriate adjustment of the amount of payment after the change of denomination).
- **#1 (7a):** The sheet shows an analysis of remainder distribution between Method 1 and Method 2 and between Method 2 and Method 3 on a set of market data from 9 January 2019 to 2 February 2023 with the recommended rounding precision (7 d.p. at the level of ACR and ACR*).

  The analysis was performed on the basis of differences between Method 1 and Method 2 and between Method 2 and Method 3 through a change of the Interest Period Start Date, using dates from the period from 9 January 2019 to 2 February 2023 (corresponding to the range of dates for the WIRON history taken).

  The '7 d.p.' rounding precision (which means precision to the fifth decimal place, where rounding applies to the value of a rate expressed in % or, equivalently, precision to the seventh decimal place if rounding applies to a numerical value) in a step consisting in calculating ACR and ACR* guarantees the best concurrence between the three methods being considered. Lower precision (e.g. 6 d.p.) 'also' creates differences and involves a loss of a certain general accuracy, while if precision is further increased (e.g. up to 8 d.p.), no material benefit can be seen.
- **#1 (7b):** The sheet shows an analysis of remainder distribution between Method 2 and Method 3 on a set of market data from 9 January 2019 to 19 December 2022 in a stress scenario: WIRON+10%, with the recommended rounding precision (7 d.p. at the level of ACR and ACR*).
- **#1 (8):** An example of a situation where a six-month Interest Period is defined. If rounding precision is maintained, an extension of the Interest Period does not increase the discrepancies between Methods 1–3 being considered.
- **#2:** An example presenting the Backward-looking rate use convention (Lookback with Observation Period Lag).