EIOPA-RFR-19/001
7 October 2019

Risk-free interest rate term structures Coding version 07/10/2019

General description

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I Introduction

EIOPA has been monthly calculating and publishing the risk-free interest rates (RFR) technical information using specific software coding which has been developed by EIOPA on the basis of the technical specifications adopted by its Board of Supervisors.

EIOPA made full use of the Solvency II Preparatory Phase while developing the RFR and a robust quality-check process was and is being conducted both internally and externally. In 2014, EIOPA launched a public consultation on the RFR technical documentation. In the summer of 2015, the Authority called its stakeholders and, in particular, the MATLAB community to spot possible errors and help further improve the source code. Furthermore, the coding benefitted from EIOPA's dialogue with key insurance stakeholders and a validation process conducted together with experts from national competent authorities.

In December 2015, the external auditor PWC positively assessed the accuracy and replicability of EIOPA's RFR model. Full text of the PWC Report was published on EIOPA's website

Since December 2015, EIOPA has been publishing every year the updated coding versions used to produce the Solvency II relevant risk free interest rate (RFR) term structures. The following coding versions can be found on EIOPA's website (zip files):

- **RFR_Coding_files_2015_12_22**
- **RFR_Coding_files_2016_02_05**
- **RFR_Coding_files_2016_03_07**
- **RFR_Coding_files_2016_06_07**
- **RFR_Coding_files_2016_09_30**
- **RFR_Coding_files_2017_07_19**
- **RFR_Coding_files_2018_11_08**
- **RFR_Coding_files_2019_10_07**

II Content

The attached documentation to this description paper is as follows:

1. Zip file "**EIOPA_RFR_coding_2019_10_07**" which includes MATLAB Risk-Free Interest Rate term Structures Coding which EIOPA uses to calculate and publish the monthly RFR information. The coding is split up into two parts:
   - one for the RFR source code itself titled **RFR_code**, and
   - another one for the underlying data files titled **RFR_data** (it does not include any market input data).

This source code also includes explanations and comments that could be helpful to understand how the calculations are carried out.

2. File "**User's Manual-RFR process_v7**" which contains descriptions of steps EIOPA is carrying out to calculate and publish the RFR information.

The published source code is fully reflecting the methodology set out in the Risk Free Interest

Rate technical documentation published on EIOPA's website as of the date of publication[1].

III Legal background

The RFR coding information together with supporting documents relates to the risk-free interest rate technical documentation published on EIOPA's website, being the technical framework that EIOPA will apply for the calculation of the technical information as set out in Article 77e of Directive 2009/138/EC.

1. Article 77e Technical information produced by the European Insurance and Occupational Pensions Authority

   1. EIOPA shall lay down and publish for each relevant currency the following technical information at least on a quarterly basis:

   (a) a relevant risk-free interest rate term structure to calculate the best estimate referred to in Article 77(2), without any matching adjustment or volatility adjustment;

   (b) for each relevant duration, credit quality and asset class a fundamental spread for the calculation of the matching adjustment referred to in Article 77c(1)(b);

   (c) for each relevant national insurance market a volatility adjustment to the relevant risk-free interest rate term structure referred to in Article 77d(1).

   2. In order to ensure uniform conditions for the calculation of technical provisions and basic own funds, the Commission may adopt implementing acts which set out, for each relevant currency, the technical information referred to in paragraph 1.

   Those implementing acts shall make use of that information. Those implementing acts shall be adopted in accordance with the advisory procedure referred to in Article 301(2).

   On duly justified imperative grounds of urgency relating to the availability of the relevant risk-free interest rate term structure, the Commission shall adopt immediately applicable implementing acts in accordance with the procedure referred to in Article 301(3).

   3. Where the technical information referred to in paragraph 1 is adopted by the Commission in accordance with paragraph 2, insurance and reinsurance undertakings shall use that technical information in calculating the best estimate in accordance with Article 77, the matching adjustment in accordance with Article 77c, and the volatility adjustment in accordance with Article 77d.

   With respect to currencies and national markets where the adjustment referred to in paragraph 1(c) is not set out in the implementing acts referred to in paragraph 2, no volatility adjustment shall be applied to the relevant risk- free interest rate term structure to calculate the best estimate.

2. Furthermore the Delegated Regulation supplementing that Directive contains the following recitals

   (23) In order to ensure transparency in the determination of the relevant risk free interest rate, in accordance with recital 29 of Directive 2014/51/EU, the methodology, assumptions and identification of the data used by the European

[1] https://eiopa.europa.eu/regulation-supervision/insurance/solvency-ii-technical-information/risk-free-interest-rate-term-structures

Insurance and Occupational Pensions Authority (EIOPA) to calculate the adjustment to swap rates for credit risk, the volatility adjustment and the fundamental spread for the matching adjustment, should be published by EIOPA as part of the technical information to be published by virtue of Article 77e(1) of Directive 2009/138/EC.

(29) In order to allow for the consistent calculation of technical provisions by insurance and reinsurance undertakings under Directive 2009/138/EC, it is necessary for a central body to derive, publish, and update certain technical information relating to the relevant risk-free interest rate term structure on a regular basis, taking account of observations in the financial market. The manner in which the relevant risk-free interest rate term structure is derived should be transparent. Given the technical and insurance-related nature of those tasks, they should be carried out by EIOPA.

IV Description of RFR Coding structure and elements to be considered before running the process

As stated above, the RFR Coding is split into two parts, the data (RFR_data) and the coding itself (RFR_code).

Each part is structured in modules. Each module includes functions and files. Inside the coding there is an explanation about every function.

For some of the modules the following important elements need to be considered before running the code:

- **Main path**

  The coding shows up a first window including two options:

  - The path is taken from the current working directory or
  - It is necessary a change of the directory.

  This window will be shown up in each step of the process

- **Other paths to set out in config**

  - iBoxx files to import. By default it is 'C:\Corps\' ;
  - History runs: By default it's 'C:\'

RFR_data

- **00_Uploads**

  It contains the templates to request data from Bloomberg regarding to:

  - Swaps
  - Government Bonds
  - Credit Risk Adjustment (CRA)
  - Danish Government Bond (NYKROYTM/NYKRRYTM)

In order to use the supplied request files, the login name of the "FIRMNAME" variable has to be changed in all four files.

- **01_Config**

  RFR_excel_config

  Most of the information used in the process is included in this excel file. Any amendment to this file could impact on the results of process or interrupting it.

  configuration.json

  The connection details are stored inside here. Usernames, passwords, SSH fingerprints etc. have to be entered here for Refinitiv, Bloomberg and IHS Markit.

- **02_Downloads**

  Mat structures/files

  Due to contractual restrictions and conditions, the following mat files included in this folder do not include any data either:

  - RFR_basic_curves

    This mat structure includes mat files for Swaps, Governments and OIS interest rates for each currency/country with 61 columns (one for the date and the remaining ones for the different maturities used).
    Before starting the process, data from Jan 1st 2016 till the last available end-month date should be downloaded and copied here.

  - RFR_basic_curves_Bid_Ask

    This mat structure includes mat files for swaps ask and bid interest rates for each currency/country with 61 columns (one for the date and the remaining ones for the different maturities used).).
    For the time being, this mat structure is not used for the regular monthly process. It is only used to carry out DLT assessments from time to time not linked to the RFR process itself.

  - RFR_CRA

    This mat structure includes only one mat file with double dimension for Interbank Offered Rates (Ibor) and OIS swap interest rates for each currency/country.

    Before starting the process, data from Jan 1st 1999 till the last available end-month date should be downloaded and copied here.

  - Str_Corporates

    This mat structure includes two mat sub-structures:

    - DKK_Nykredit containing two mat files for Nykredits Realkreditindeks one

for data and another one for duration (this duration is fixed)

Before starting the process, data for this index from Dec 31st 2014 till the last available end-month date should be downloaded and copied here.

- Str_Corporates_iBoxx_Bid containing mat files for yields and durations related to four types of corporate indices:

  a) Euro investment grade indices

  b) Euro HY: for EURO high yield indices

  c) GBP: for GBP indices and

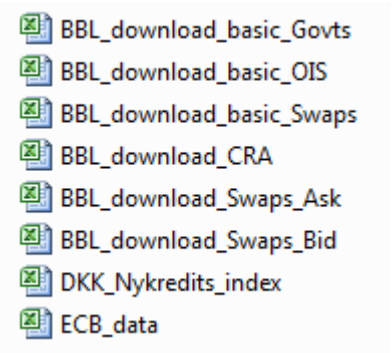
  d) USD: for USD indices.

  For each index you can find files for Non-finance and Finance data broken down by 6 different credit quality steps (CQS, i.e. ratings) and 6 tranches: 1-3 y, 3-5 y, 5-7 y, 7-10 y, 10-15 y and +15 y.

  Before starting the process, data for these indices from Jan 1st 1999 till the last available end-month date should be downloaded and copied here.

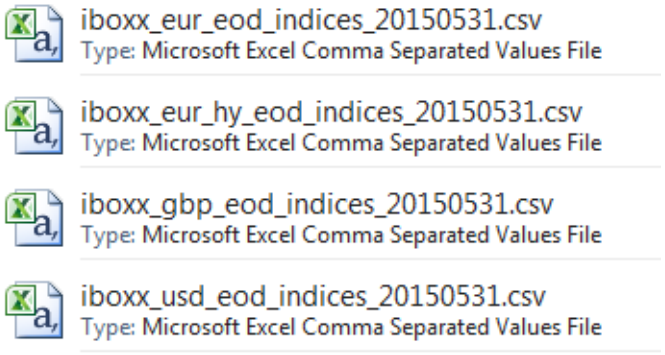
Templates

It contains the following excel files produced in the process. For the same above reasons, these files do not include any data either:



iboxx_files zip files

It contains the following csv files produced in the process. . For the same above reasons, these files do not include any data either:



- **03_Import**

  iBoxx_FTP_inventory.xls

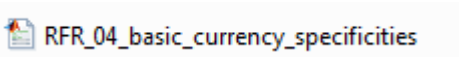
  It contains the worksheet iBoxx_Settings used to download the iBoxx data files from the Markit FTP server.

  RFR_Downloads_controls.xls

  Excel file created to verify outliers and any crucial findings by analysing the content of this file.

- **04_Basic**

  It contains the ML function:

  This function was mainly used to include the monthly ISK currency government bond rates applying a previous method. For the time being, it is not used.

- **05_LTAS**

  Str_History_basic_RFR Mat structures/files

  This mat structure includes mat files for the RFR basic spot interest rates curves for each currency/country with 61 columns (one for the date and the remaining ones for the different maturities used).).

  V1C_alpha_fit

  Mat structure not used containing zero values

- **06_VA**

  Excel files

  The following .xls files should be kept for running the process:

  - RFR_VA_currency_Corps_test_file

- RFR_VA_currency_Govts_test_file
- RFR_VA_national_Govts_test_file
- RFR_VA_national_Corps_test_file

Mat structure/files

The following mat structures should be kept for running the process:

- Str_LTAS_YE2015, Str_VA_market_data

  This mat structure includes mat files for Government, Corporate and Basic with calculated LTAS data.

- Str_PD_CoD

  This mat structure includes mat files for transition matrices for 31/12/2013 and 1/1/2019, broken down by financial and non-financial data.

  Each transition matrix contains data for 8 CQS.

  As these transition matrices are empty of data, before starting the process, data from S&P should be downloaded and copied in the mat structure for 31/12/2013 and 1/1/2019.

- Str_VA_market_data

  This mat structure includes mat files with information on representative portfolios for 31/12/2013 and 31/3/2019.

- **07_DVA**

  For the time being, this module is not used for the process, but the files should be kept for running the process.

- **08_Results**

It also contains a folder with the word document template to produce the RFR information to be provided to the Commission on a quarterly basis.

In addition, the following .xls files should be kept for running the process:

- RFR_validation_file
- RFR_internal_PD_CoD_Govts
- Any RFR_for_publication_xxx

- **09_Publication**

The following .xls files should be kept for running the process (using the last month only is sufficient):

- **EIOPA_RFR_xxxxxxxx_PD_Cod**
- **EIOPA_RFR_xxxxxxxx_Qb_SW**

- **EIOPA_RFR_xxxxxxxx_Term_Structures**
- **EIOPA_RFR_xxxxxxxx_VA_portfolios**

- **10_Documents**

  This folder is used to save the following reports generated in the RFR process:

  - **GVT_SWP_Comparison**
  - **ResultOverview_xxxxxxxx_xx**
  - **Technical_Notesxxxxxxxx_xx**

  Further detail can be found in User's Manual-RFR process_v7

- **98_Runs_Logs**

  When the process is run an excel file RFR_log_register will be issued reflecting the history of the steps have been carried out.

RFR_Coding

The structure of modules is very similar to RFR_data but it only contains the coding to run the process as it is explained in the **User's Manual-RFR process_v7**.

However, the code relies on the following toolboxes or external libraries:

- Mathworks Financial Toolbox (installed together with MATLAB)
- Bloomberg RequestBuilder (bbdlapi.jar has to be in the directory "96_extLib")
- WinSCP .NET assembly (WinSCP.exe and WinSCPnet.dll have to be in the "96_extLib" directory)

  - The WinSCP .NET Assembly is licensed under the Mozilla Public License 2.0 (MPL v2.0). it is a free library: it can be used, redistributed and/or modified under the terms of the Mozilla Public License Version 2.0.
  - The WinSCP program itself is licensed under the GNU Public License 2.0 (GPL 2). WinSCP is free software: it can be used, redistributed and/or modified under the terms of the GNU General Public License (GPL) as published by the Free Software Foundation, either version 3 of the License, or (at your option) any later version.

- **Historical runs**

  When the process is ending, you will be required to save a backup of the executed calculations, including data, in a specific folder to keep track of historical data and results. By default it's C: