Market & credit risk modelling comparative study ('MCRCS'), year-end 2020 edition

Instructions to participating undertakings for filling out the data request

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I. Purpose

The aim of this document is to provide instructions to the insurance undertakings participating to the Europe-wide comparative study on the internal modelling of market & credit risk on financial instruments. Particularly, this note contains further explanations to complement the instructions in the response templates for the data request which the undertakings should fill out.

An annex provides an overview on which templates have to be filled in for which 'model types'.

II. Context

Market & credit risk modelling

In general, market risk contributes significantly to the overall solvency capital requirement (SCR) of insurance undertakings.

The primary objective of the MCRCS is to compare market and credit risk model outputs for a set of realistic asset portfolios.

Secondly, the MCRCS aims to highlight the causes for the presumed variability of results by analysing additional information such as individual risk charges, (e.g. individual asset classes such as Fixed Income, Equity, etc.).

Furthermore, the data request and modelling approach analysis would provide valuable supporting tools to authorities for the Supervisory Review Process (SRP) on internal models, inter alia to monitor the development of models and their calibration over time as well as to assess model changes. It is thus expected to foster consistent supervisory assessments on Market and Credit risk.

The previous editions of this study targeted the combined market and credit risk, with the ambition to resolve some shortcomings and to improve the tools to reflect the typical model choices encountered in practice[1]. The MCRCS is an annual exercise, for which year-end 2017 was the first data collection. The MCRCS year-end 2020 is largely based on the previous edition. This should reduce the burden of filling out the response template for participating undertakings. For changes from the MCRCS year-end 2019 to the current study please refer to section IV.1.

References

Comparative studies are supported by article 122 (4) of the Solvency II Directive and by the EIOPA opinion '*EIOPA-BoS-15/083*' of 14 April 2015. The Board of Supervisors has adopted the annual MCRCS as set out in '*Decision of the Board of Supervisors on the annual market and credit risk modelling comparative study*' (EIOPA-BoS 18/062).

III. Participation to this data request

Expectation on participation

The *Decision of the Board of Supervisors on the annual market and credit risk modelling comparative study* referred above states that all undertakings with a significant exposure to assets denominated in Euro and an approved internal model covering market and credit risk shall take part in the study.

Preliminary assumption

The data request assumes that for the combined market and credit risk, at least for the 99.5% confidence level a VaR estimator could be provided, but typically a set of percentiles and ideally scenario by scenario data are also expected.

Depending on the model type, the 'market risk module' (or, if relevant, a combined 'market & credit risk module') is expected to be based on a Monte Carlo simulation, while for credit risk other approaches have also been observed (cf. section IV). Following this, there are no assumptions on the aggregation model to combine the market and credit risk modules.

Benefits for the participating undertakings

The advantages for undertakings include:

- A more level playing field via an enhanced harmonisation of the supervision;

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[1] Commonly, credit risk is split into three sub-risks, namely credit default risk, 'rating migration risk' and 'pure credit spread risk' (where the second might be defined as the risk of 'spread movements related to rating migrations', and the third as the risk of 'spread movements for a constant credit rating'). While credit spread risk is often treated as one aspect of market risk, in practice, different approaches can be observed to split out these sub-risks over the credit and market risk modules of a model.

- An increased general acceptance of internal models for market and credit risk;
- Opportunities for stimulants towards model improvements.

Contact points

In the case of subsidiaries belonging to a group with group supervisor in the European Community, the group supervisor is the contact point for the whole group. Furthermore, it is expected that the group provides one response to its group supervisor.

In the case of subsidiaries belonging to a group which head is outside the European Community but use the same modelling approach, only one response needs to be provided to EIOPA. The supervisor of this entity preparing the response is the contact point for the whole group. In case of more than one entity and more than one supervisors, these will agree on the contact point.

As an aside, please note that your (group) supervisor might want to augment the data request with its own additional questions or requests.

For practical purposes, you are advised to designate (at least) two contact persons, who will liaise with your (group) supervisor for the purpose of this data request.

Confidentiality

General outcomes of this study, such as summary statistics, could be disclosed to external parties only insofar as they are made anonymous; i.e., any external disclosure will not allow identifying individual participants.

Publication

EIOPA expects to publish the conclusions of the study within one year following the end of the data collection, in an aggregated form, in order to avoid the identification of individual participants. EIOPA will address the participating undertakings any potential publication beforehand.

IV. Data request

IV.1. Main changes from MCRCS YE 2019 to MCRCS YE 2020

- Inclusion of additional inflation-linked instruments: three new ones for currency EUR (maturities 1, 5 and 20) and one each of maturity 1 for GBP and USD (see '*MCRCS_2020_instruments_and_BMP.xlsx*').

- Enhancement of the questions on modelling of interest rate risk for assets especially beyond the last liquid point of the risk-free-rates (RFR) in the qualitative questionnaire ("part-04") (cf. question 8).

- Adding questions to the qualitative questionnaire ("part-04") on the consideration of inflation in the internal models (cf. question 12).

- Enhancement of the questions on sustainable finance in the qualitative questionnaire ("part-04") (cf. question 15).

IV.2. Overview

This subsection briefly outlines the data requested, and the next subsections provide more details for individual parts and test assets of the data request.

The data as at year-end 2020 (i.e. 31 December 2020) are requested from the participants.

For the purposes of comparing market and credit risk modelling in quantitative terms, two main approaches have to be differentiated (a more detailed typology of model types will be elaborated in section IV.5). This affects the structure of the data as follows:

Integrated approaches:

Solely one 'fully integrated' simulation (without separate 'market' and 'credit' risk modules). There is solely one scenario set, which covers the market & credit risks (including the default and migration risks).

Modular approaches:

The market and certain facets of credit risk are calculated in separate modules, whose outcomes are brought together to a combined market & credit risk.

These approaches vary in allocation of the facets of credit risk, aggregation methodology and granularity of output available at the various levels of calculation.

This data request consists of four parts:

Remark: please note that the data requested consists of "values" (i.e. 'prices') of single instruments and benchmark portfolios and not of profits or losses (this holds also e.g. for VaR estimates)

01. Combined market & credit risk for benchmark portfolios and own asset portfolio – all model types:

Model results under the combined market & credit risk for <u>values</u> of *benchmark portfolios* composed of synthetic financial instruments, as granular as possible, comprising especially starting value at t=0, the expected value and the VaR 99.5% according to the modelled VaR estimator (mVaR), supplemented by selected prescribed percentiles and scenario-by-scenario data. Additionally these data should also be provided for the own asset portfolio. Among the benchmark portfolios there are also simplified liability benchmark portfolios and combinations with certain asset portfolios (cf. IV.3 for details).

⇨ Part-01 allows analysing key questions of the combined market & credit risk modelling.

02. Data for further analysis – depending on model type:

(a) Integrated approaches: Combined market & credit risk for single instruments:

Same data as for part-01 but now for the single instruments which build up the benchmark portfolios, supplemented e.g. by synthetic risk free zero coupon bonds to explore the risk free rates used.

(b) Integrated and modular approaches: Market risk for benchmark portfolios, single instruments and own asset portfolio:

Data request analogous to part-01 and part-02a but now for the market risk.

For modular approaches data from the market risk module as defined in the model.

For integrated approaches data from the combined risk but excluding migration and default risk[2].

(c) Modular approaches: Credit risk module for benchmark portfolios and own asset portfolio:

Data request analogous to part-01 but now for the credit risk module as defined in the model.

⇨ Part-02 allows further analysing market risk & credit risk charges of typical portfolios, supported by data reflecting the modelled marginal market risk distributions and correlation effects.

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[2] If this data cannot be retrieved from your model, please contact your local supervisor,

03. Information on your undertaking's actual asset allocation.

⇨ Part-03 helps assess the level of comparability in terms of the materiality of specific risk (sub-)types (and helps perform some plausibility checks).

04. Qualitative questionnaire.

⇨ Part-04 helps understand the modelling approach.

⇨ Please note that the questions are identical as for the previous study. The undertakings which participated in the previous study could re-use the answers from the previous study and highlight where changes are made.

Importantly, undertakings should use the model calibrated for year-end-2020. Likewise, the financial positions specified in this data request should be mapped into your model in the same way as they would have been if these positions belonged to your Solvency II balance sheet at 31 December 2020.

Finally, to support the analysis of results, you are furthermore asked for qualitative information which will be used for ranking the synthetic instruments in the two dimensions, 'exposure materiality' and 'modelling quality'. For details on that 'relevance score' please refer to the following sections.

IV.3. Specification of financial instruments and benchmark portfolios

The financial instruments are to a large extent based on the concept of synthetic assets, i.e. they are not actually traded in the market but strive to replicate the most important characteristics of real instruments. All fixed-income instruments are zero-coupon bonds with a notional value of one. Due to their synthetic nature one cannot observe a market price at the reference date. For the credit risky instruments, however, a simplified valuation formula is foreseen in order to provide consistent calibration targets for all participating undertakings. These calibration targets should be interpreted as the observed market price at the reference date if the respective instrument was actually traded in the market.

More concretely, the calibration target is calculated instrument by instrument according to the following formula:

$$\text{calibration\_target} = \frac{Notional}{(1 + swap + cs)^{maturity}} = \frac{Notional}{(1 + rfr + cra + cs)^{maturity}}$$

'rfr' is the relevant risk-free rate excl. volatility adjustment (VA) as officially published by EIOPA. In combination with the credit risk adjustment 'cra' the risk-free rate serves as proxy for a market rate (in this case 'swap'). As all instrument maturities are within the liquid part of the rfr-curve, this is considered as a plausible assumption.

'cs' are instrument-specific credit spreads versus the currency specific swap rates (reference date: 2020-12-31). The only exception are AAA-spreads which are specified as a fixed percentage of AA-spreads.

For those instruments where no explicit calibration target is specified the participating undertaking either has to calculate (e.g. derivative positions) or observe (e.g. FX rates) the market value at the reference date.

Each benchmark portfolio is based on a combination of financial instruments and is related to the representative asset portfolios for insurers of the Euro zone as well as seven national portfolios. In contrast to the official process for deriving the VA, however, some positions are deliberately not taken into account in order to end up with more realistic risk profiles of the asset side. E.g. unit-linked assets and participation values are excluded, therefore the final asset allocation for each portfolio deviates from the representative portfolios published for the VA. Two additional asset portfolios are composed purely of sovereign bonds for one, and corporate bonds for the other. Each BMP is defined by a combination of position and price information. The initial market value of each benchmark portfolio is derived by multiplying the position units of the portfolio's constituents with its respective calibration targets and by convention the market values then add up to 1000 for asset only portfolios. In order to

derive the market value based fraction of an instrument one can simply calculate the product 'position unit' times 'calibration target' divided by 1000.

Supplementing these asset benchmark portfolios, the year-end 2020 MCRCS includes two simplified liability benchmark portfolios aiming to capture also the risk of decreasing interest rates. These portfolios consist of risk-free zero coupon bonds with negative weights, using the EEA liability cash flow data obtained from the corresponding QRTs. One portfolio has a longer duration than the asset benchmark portfolios, one has a shorter duration. At the current stage these portfolios intentionally neither capture potential asset-liability interactions, loss-absorbing capacities of technical provisions nor any other optionalities.

These (simplified) liability benchmark portfolios have on the one hand to be evaluated in isolation (i.e. market values add up to -1000) as well as in combination with specific asset benchmark portfolios (in the latter case the total market value of the liability instruments in the combined benchmark portfolio will not add up to -1000 in order to ensure a positive surplus of assets over liabilities). Furthermore, for undertakings using a VA it is expected that results be presented with and without applying their VA mechanism, which could be constant or dynamic (for further details see IV.5).

IV.4. Specification of the requested information and values

Each 'response template' spreadsheet is organised in different blocks of information and contains several data types that are expected as output from your internal model. While most of them are requested for each template, some of them are only applicable for specific ones.

- *Initial value:* initial value of each benchmark portfolio and each single instrument in your risk model (expected to correspond or at least similar to the initial values prescribed).

- *Notional:* the notional amount for fixed income instruments or position units for equity, real estate etc. They are provided in the 'instrument specification template' and are specified in the issuer's home currency (please cf. section IV.5, subsection 'coverage of currencies' for the treatment of FX in this study).

- *Deterministic Interest Rates (IR) sensitivities:* To support the analysis of the simulation results we further request a set of deterministic IR sensitivities for the fixed income synthetic assets and BMPs. You are expected to recalculate the value of the respective positions by applying a simple parallel shift of the risk-free rate by +/-100 bps. By comparing these sensitivities between undertakings we intend to get more insights into the overall result variations. I.e. to what extent the differences in simulation results might be driven by different valuation functions within the internal model and/or by the applied stresses in the real-world model.

- *Expected value*: The expected value (at t=1) is supposed to correspond to the mean of the distribution. Please elaborate on any deviation from that assumption in your answer to question 5 of part 04.

- "*Modelled Value-at-Risk (mVaR)*": Aim of this information is to obtain a 'VaR for the value/price of each single instrument and benchmark portfolio' (not a profit or loss). Broadly speaking, you are expected to apply your modelled 'SCR definition' to assets only (i.e. especially the liabilities and deferred tax effects are absent from this 'VaR for the asset side'). Hence, the mVaR might differ from the 99.5% sample quantile on the simulated asset values, owing to the statistical estimator for the 99.5 percentile (e.g. including any interpolation or smoothing scheme), Any additional hypotheses you had to make when providing these figures can be explained in your answer to question 6 of part 04. (Please note that you are also asked to provide the mVaR for the simplified liability portfolios and combined portfolios (cf. IV.3), but still not including 'your' liabilities or e.g. tax effects). Please cf. Annex VI.3 for a numerical example how this information should be provided.

- *Selected prescribed percentiles*: they should be directly taken from the simulated values or by other means derived from the model, depending on the approaches. You are at least expected to provide the 50th percentile and the 0.5th percentile. Please ensure the correct ordering of the percentiles, e.g. the 99.5th percentile describes the value below which are 99.5% of the values of

the distribution while below the 0.5th percentile are only 0.5% of the values of the distribution, i.e. for the assets low percentiles correspond to the low values in the distribution and vice-versa).

- *Scenario-by-scenario data*: directly taken from the simulated <u>values</u> or by other means derived from the model, depending on the approaches.

  Your aggregated market & credit risk model is supposed to encompass a number of risk factors, running between 'time zero' and 'time one'[3]. In case that the model jointly simulates not only market and credit risk but e.g. also underwriting risk, you should not provide the simulated underwriting risk factors. Indeed, the data request solely concerns the market and credit risk factors.

  Finally, effectively the values (of financial positions) under each of the scenarios employed during a 'normal run' of your real-world market risk simulation are requested. Only in the case that your model simulates more than 50,000 Monte Carlo scenarios, it is – for practical reasons – not necessary that the entire scenario set is transmitted, but you should assure that the number of scenarios is sufficient to provide high quality results.

  Please contact your (group) supervisor in case your model uses more than 50,000 scenarios.

- *Relevance Scores:* To support the analysis of results we are furthermore requesting qualitative indicators which can be used for ranking the synthetic instruments in the two dimensions 'exposure materiality' and 'modelling quality'. The intended use of this information is to indicate where any observed outliers could be due to arbitrary setting, for example "because there was no exposure and no intention to invest in assets of this type". For more details regarding the relevance score concept please cf. Annex VI.2.

- *Information on derivatives:* Only relevant for part-02a and part-02b. Additional information for supporting the interpretation of derivative instruments' valuation results. This comprises information about the applied pricing models and pricing relevant parameters like strike levels and implied volatilities. In the scenario-by-scenario data part of this separate tab in the response template we request simulated risk factor levels of the instrument specific 'implied volatility' **risk factor** expressed as decimal number. **Important:** The ordering of simulation scenarios in the scenario-by-scenario data for the additional information must correspond exactly to the ordering of scenarios in the response-template where the valuation results are collected for these instruments.

IV.5. More detailed specification of the four parts of the data request

For good reasons modelling freedom is guaranteed by the directive, which has to properly be covered by any comparative study. For the purpose of the MCRCS it seems reasonable to expect that the following cases cover the possible model structures (with respect to the credit risk and the combined market & credit risks):

Modelling approaches and model types

Integrated approaches:

(A) *"Integrated approaches": Solely one 'fully integrated' simulation (without separate 'market' and 'credit' risk modules).* There is solely one scenario set, which covers the market & credit risks (including the default and migration risks);

Modular approaches:

(B) *One integrated simulation, drawing on separate 'market' & 'credit' risk modules which each employ a simulation approach.* That is, the market and credit risks are simulated in separate (clearly

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[3] Note that these scenarios could actually be implemented as 'instantaneous shocks'.

distinct) modules, whose outcomes are brought together into an overarching Monte Carlo simulation (i.e., using a set of 'joint' market & credit risk scenarios);

(C) *Next to the market risk module (using a simulation approach), the credit risk module only generates a distribution (i.e., no simulated scenarios); and a 'combined value distribution' for the 'market & credit risk' is generated.* That is, the credit risk module does not employ a simulation approach, but distributions are generated (for the credit risk and at the 'aggregated' level);

(D) *Next to the market risk module (using a simulation approach), the credit risk module generates a distribution (and this module might even simulate scenarios), but no 'combined value distribution' is generated.* That is, the credit risk module generates a distribution, but there's only a Value-at-Risk at 'aggregated market & credit risk' level (for instance, because the top-level aggregation is done with a 'Var-Covar' approach);

(E) Something else.

The data request is structured on a first hierarchy level by the risks and on the second level by the model types given in the parentheses above as these reflect the availability of data. Undertakings are encouraged to provide as granular data as possible and beyond the model type where meaningful.

Part 01 – Combined market & credit risk modelling for benchmark portfolios and own asset portfolio

This part of the data request aims at obtaining model results as regards the values (i.e. 'prices') of *benchmark portfolios* of certain synthetic financial positions, under the combined market and credit risk. Additionally this part requests the same type of data on the undertakings own asset portfolio.

More concretely you are requested to provide for each benchmark portfolio as available the:

- *Initial value*
- *Expected value*
- *mVaR*
- *Selected prescribed sensitivities*
- *Selected prescribed percentiles*
- *Scenario-by-scenario data*

In practical terms, your answer will take the form of a matrix of values, in which the rows are defined by the above mentioned types of data and the columns correspond to the benchmark portfolios and one additional column for the own asset portfolio.

Part 01 focuses on the benchmark portfolios and the own asset portfolio, while part 02 will go in further details of the single assets making up the benchmark portfolios, including synthetic zero-coupon bonds to explore the risk free interest rate curve in your model.

Please refer to the '*MCRCS_2020_instruments_and_BMP.xlsx*' file for the definition of the benchmark portfolios and the financial instruments composing them.

There is the ambition to have selected a universe of synthetic instruments whose attributes are kept stable over the course of time and once implemented in the systems should be rich enough to reflect a typical European insurer's asset portfolio.

The MCRCS also collects data for simplified uniform synthetic liability portfolios composed of zero coupon bond short positions. These are combined with five different selected asset benchmark portfolios, resulting in ten Asset-Liability portfolios with a positive net asset value. The first asset portfolio was set up with the ambition to mimic a representative asset allocation for the whole insurance market operating in the EUR zone; the second and the third asset portfolios, representative of two national portfolios, are characterized by different asset allocations. The last two asset portfolios are composed purely of sovereign bonds for one, and corporate bonds for the other. Undertakings using a

constant VA or a scenario dependent VA ('dynamic VA') are requested to provide additional data (cf. subsection IV.6).

The BMPs only include non-EUR currencies to a limited extent. Regarding the coverage of currencies please refer to the following on part-02.

Part 02 – Data collection for further analysis

To further explore the market and credit risk modelling, especially regarding generic risk factors, implied spreads and interdependencies, further data is needed.

> In practical terms, as for part-01 your answer will take the form of a matrix containing values of financial positions, where – broadly speaking – the rows correspond to the same types of data as in part-01 and the columns correspond to synthetic assets mimicking real financial instruments which are considered to be relevant to reflect a typical European insurers asset portfolio, supplemented by synthetic risk free zero-coupon bonds[4].

> Additionally you are requested to provide additional information on derivatives, namely 'strike_level', 'initial_implied_volatility' and the 'pricing_model_used'.

> Remarks:
>
> - Consider the synthetic 'zero-coupon bonds free from credit risk', which intends to capture the simulated Solvency II interest rate curves. The starting point for this simulation is expected to be the *risk-free rate curve per end-2020 as officially published by EIOPA, but excluding the Volatility Adjustment* (i.e., without the currency-specific VA, and without the country-specific VA), unless the undertaking uses a different approach for official Solvency II calculations (but also in this case any VA should be excluded as well as a transitional on risk free rates);
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> - Your supervisor could request to include certain indices (e.g. specific real-estate indices) into your answer. Practically, this would mean that your supervisor specifies additional columns (and the codes in the column headers) corresponding to these extra indices.

Coverage of currencies

The study has the ambition to also include currencies other than the EUR, namely British Pound ('GBP') and US Dollar ('USD'). Consequently, there are also Risk Free Rates for GBP and USD which are not part of the benchmark portfolios in part 01. Part 03 of the study collects information of the undertakings' portfolio composition including the currency split.

Furthermore, you should also provide the foreign exchange ('FX') rates, for each simulated scenario, between the EUR and each non-EUR currency covered by the response template. E.g. in the case of British Pound you are expected to enter the exchange rate EUR/GBP, i.e. how much British Pound is received in exchange for one Euro.

Your (group) supervisor will contact you about other material currencies that should be covered and if an extension of the template would thus be useful.

Importantly, certain assets will be denominated in a 'foreign currency', which differs from your 'reporting currency'; and the code of the asset in the response template might indicate yet another currency (see the prefix of each code). In all cases, your answer for an asset should correspond to the currency indicated in its code within the response template – *not* to the asset's currency denomination in the real capital markets, *nor* to your reporting currency. For instance,

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[4] This will contribute to the granular analysis of the models (for instance, by considering the simulated risk factors like interest rates and credit spreads), as well as to certain verifications.
Remark that synthetic assets are used here to capture the modelled dynamics of specific risk factors. Asking for synthetic assets is preferred relative to the risk factors themselves (since it avoids possible ambiguities in risk factors definitions – considering e.g. continuously vs. annually compounding interest rates).

with the aim to look at equity risk without being 'disturbed by currency risk', the values provided for an equity position with code 'EQ-EUR-PUBL-US-SPTR500N' for the purpose of the study should be thought of being denominated in EUR (for both initial value and simulated values) – even if it concerns a US equity index, and/or your official Solvency II reporting currency is not EUR (but, e.g., GBP). I.e. the asset would be considered to be fully hedged relative to the 'asset specific reporting currency', which would be EUR in the concrete case. Depending on your model's set-up, this might mean that you should perform a FX translation of each simulated value (not only for setting the initial value in your model) when filling out the response template. As mentioned above, your answer should then also contain a column with the FX rate in each scenario.

In more technical terms along the terminology of the asset and BMP definition file '*MCRCS_2020_instruments_and_BMP.xlsx*':

- Fixed Income (FI): Column 'ccy' specifies the reporting currency for the purpose of the study and column 'rfr_ccy' specifies the currency in which the instrument is issued. Where these two are different, FX has to be included.

  Examples:

  (a) "GOV-FI-UK-NA-NA-05" for the purpose of the study has to be reported in EUR and is issued in GBP, thus submissions have to include FX.

  That means that in the reporting templates in row "initial value" we should not see the value of the calibration target but this should be converted with the undertaking's relevant FX-exchange rate per YE 2020. And, consistently all values (including notional value) to be submitted should be converted, e.g. the scenario data should be submitted in EUR including the FX-exchange rate in the respective scenario, accordingly the expected value (EV), quantiles.

  (b) "FI-GBP-RFR-NA-NA-NA-NA-01 to -60" for the purpose of the study have to be reported in GBP and are issued in GBP, thus submissions don't include FX. I.e. the initial values in the reporting template should be in the region of the calibration target and the scenario data should also not be converted.

  (c) "FI-USD-RFR-NA-NA-NA-NA-01 to -60" for the purpose of the study have to be reported in USD and are issued in USD, thus submissions don't include FX. I.e. the initial values in the reporting template should be in the region of the calibration target and the scenario data should also not be converted.

  (d) "FI-GBP-RFR-INFL-NA-NA-SEN_UNS-01" for the purpose of the study the valuation of this asset should be in analogy to the RFR instruments, i.e. reporting and issuing currency are assumed to be GBP, thus submissions do not include FX (cf. b). "FI-USD-RFR-INFL-NA-NA-SEN_UNS-01" is handled similarly for USD.

- Equity (EQ): Same meaning for column 'ccy' as for FI but no entries in column 'rfr_ccy' as we only want to look at the equity risk without FX. E.g. the description "Other-EQ-EUR-PUBL-UK-TUKXG-NA-NA-NA" reads: "FTSE 100 Total Return Index (GBP to be converted in EUR, per simulated scenario). Initial market value as at reference date of study." Conversion to EUR would only be necessary if the model would simulate GBP.

- Real Estate (RE): As for EQ no FX to be considered. E.g. for "Other-RE-EUR-COM-UK-NA-NA-NA-NA" the description says "Commercial real-estate: large office building located in the center of London, UK. Completely leased on a long term basis, high rental income. No leveraging. Initial market value at reference date of study = 1 million EUR." Thus no FX to be considered. You could think of the FX risk being completely hedged.

As the granularity of data available is depending on the modelling approach the data request for this part is differentiated by the main model types, introduced above:

Integrated approaches ("model type A"):

Part 02 (a) – Integrated approaches: Combined market & credit risk for single instruments:

Exploring certain aspects of the modelling approach will be based on the model results for the single assets building up the benchmark portfolios supplemented by a selected choice of additional instruments. The requested information focuses on *the combined market and credit risk results* for each instrument:

- o *Relevance score*
- o *Initial value*
- o *Notional value*
- o *Expected value*
- o *mVaR: values should be provided on a stand-alone basis for the respective instrument column, i.e. no risk contributions or similar.*
- o *Selected prescribed sensitivities*
- o *Selected prescribed percentiles*
- o *Scenario-by-scenario data*

It should be noted that the instrument data needs to be consistent with the BMP data on a scenario-by-scenario basis, i.e. in each row the same 'risk factors' are deflected ('scenario identity'). In detail this implies that the appropriately weighted sum of asset values equals the respective BMP value in each scenario.

Modular approaches ("model types B, C, and D") and integrated approaches ("model type A"):

Part 02 (b) – Integrated and modular approaches: Market risk module (or combined market and credit risk excluding migration and default) for benchmark portfolios, single instruments and own asset portfolio

This part requests the same type of data as part-01 and part-02a but for the *market risk: For modular the approaches the market risk module as it is defined in your undertaking's model and for integrated models the combined market and credit risk excluding migration and default.* I.e. you are requested to provide for each single instrument as in part-02a and additionally for each benchmark portfolio and for your own asset portfolio as in part-01 but now for the market risk module or its respective counterpart (and as for each part along the availability of data):

- o *Relevance score*
- o *Initial value*
- o *Notional value*
- o *Expected value*
- o *mVaR: values should be provided on a stand-alone basis for the respective instrument column, i.e. no risk contributions or similar*
- o *Selected prescribed sensitivities*
- o *Selected prescribed percentiles*
- o *Scenario-by-scenario data*

It should be noted that the instrument data needs to be consistent with the BMP data on a scenario-by-scenario basis, i.e. in each row the same 'risk factors' are deflected ('scenario identity'). In detail this implies that the appropriately weighted sum of asset values equals the respective BMP value in each scenario.

It needs to be ensured that the results in part-01, part-02a and part-02b are consistent on a scenario-by-scenario basis. (i.e. there is 'path identity' across the different parts and no noise by e.g. different ordering of simulations or different seeds is being introduced). In practice, part-

02a needs to contain a risky bond price including pure spread and interest rate risks, but also migration and default risks and part-02b contains the same risky bond price only subject to pure spread and interest rate risks. If for a given simulation no migration and default was observed for a risky bond, the bond price should be exactly the same between part-02a and part-02b (since they are based on the same pure spread and interest rate risk simulation).

Part 02 (c) – Modular approaches: Credit risk for benchmark portfolios and own asset portfolio:

Especially for portfolio credit risk models, no valuable insight could be expected from running this module on single assets only, this part as part-01 asks to provide model results for the benchmark portfolios (specified in part 01) and the undertaking's own asset portfolio.

The data types requested are the same as for part-01, part-02a and part-02b, but as for part-01 no relevance score information is requested.

Part 03 – The undertaking's actual asset allocation

This part requests information on your insurance undertaking's actual asset exposure (in the form of the relative allocation of assets into broad classes). Please refer to the response template for this part.

Remark that it concerns the actual assets in the (consolidated) Solvency II balance sheet corresponding to all the entities encompassed by your internal model[5].

This information will be used to support the analysis of parts 01 and 02 (e.g. to approach potential weaknesses and their severity in the light of an undertaking's own asset exposure).

Part 04 – Qualitative questionnaire

Please refer to the response template for this part.

Please note that the questions are mainly identical to the previous study. But new questions were included on the modelling of inflation (question 12). Additionally the questions on modelling of interest rate risk for assets (question 8) and the questions on 'sustainability' (now question 15) were adjusted. In case your undertaking took part in the previous study, please feel free to copy & paste and indicate only changes since then.

IV.6. Additional data request for a constant VA ('CVA') or a scenario-dependent VA ('DVA')

The MCRCS compares the approaches along results for five prescribed asset portfolios and two prescribed virtual and simplified liability portfolios. More concretely, your CVA or DVA approach should be applied to an undertaking in five constellations, i.e. it holds assets as in five of the benchmark portfolios, namely EUR_BMP_01 (EUR BMP), EUR_BMP_03 (DE BMP), EUR_BMP_07 (IT BMP), EUR_BMP_09 (100% SOV BMP) and EUR_BMP_10 (100% CORP BMP), and the liability side is defined by a cash flow profile from short risk-free zero bond positions (i.e. no asset-liability interactions and no consideration of loss absorbing capacity of liabilities), namely EUR_BMPL_01 and BMPL_02. The combined portfolios could be considered each as an own funds position.

To explore the CVA and DVA impact, the following benchmark portfolios are part of the study:

- EUR_BMP_01
- EUR_BMP_03

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[5] "Solvency II balance sheet" should – for practical purposes – be read as "asset data used for the year-end 2020 Solvency II internal model calculations". Particularly, in the case of an insurance group, it concerns the entities covered by the approved group internal model, as used for the group solvency calculations. This interpretation should be applied analogously for a model in an advanced stage of development.

- EUR_BMP_07
- EUR_BMP_09
- EUR_BMP_10
- EUR_BMPL_01
- EUR_BMPL_02
- EUR_BMP_AL_01_01: the asset benchmark portfolio EUR_BMP_01 is combined to the liability portfolio EUR_BMPL_01; i.e. EUR_BMP_AL_01_01 consists of all assets contained in both portfolios
- EUR_BMP_AL_02_01: the asset benchmark portfolio EUR_BMP_03 is combined to the liability portfolio EUR_BMPL_01; i.e. EUR_BMP_AL_02_01 consists of all assets contained in both portfolios
- EUR_BMP_AL_03_01 the asset benchmark portfolio EUR_BMP_07 is combined to the liability portfolio EUR_BMPL_01; i.e. EUR_BMP_AL_03_01 consists of all assets contained in both portfolios
- EUR_BMP_AL_04_01: the asset benchmark portfolio EUR_BMP_09 is combined to the liability portfolio EUR_BMPL_01; i.e. EUR_BMP_AL_04_01 consists of all assets contained in both portfolios
- EUR_BMP_AL_05_01: the asset benchmark portfolio EUR_BMP_10 is combined to the liability portfolio EUR_BMPL_01; i.e. EUR_BMP_AL_05_01 consists of all assets contained in both portfolios
- EUR_BMP_AL_01_02: the asset benchmark portfolio EUR_BMP_01 is combined to the liability portfolio EUR_BMPL_02; i.e. EUR_BMP_AL_01_02 consists of all assets contained in both portfolios
- EUR_BMP_AL_02_02: the asset benchmark portfolio EUR_BMP_03 is combined to the liability portfolio EUR_BMPL_02; i.e. EUR_BMP_AL_02_02 consists of all assets contained in both portfolios
- EUR_BMP_AL_03_02: the asset benchmark portfolio EUR_BMP_07 is combined to the liability portfolio EUR_BMPL_02; i.e. EUR_BMP_AL_03_02 consists of all assets contained in both portfolios
- EUR_BMP_AL_04_02: the asset benchmark portfolio EUR_BMP_09 is combined to the liability portfolio EUR_BMPL_02; i.e. EUR_BMP_AL_04_02 consists of all assets contained in both portfolios
- EUR_BMP_AL_05_02: the asset benchmark portfolio EUR_BMP_10 is combined to the liability portfolio EUR_BMPL_02; i.e. EUR_BMP_AL_05_02 consists of all assets contained in both portfolios

Values of these portfolios have to be provided along the model types, e.g. scenario-by-scenario data for the combined market & credit risk for model types A and B without applying any VA.

For EUR_BMPL_01, EUR_BMPL_02, EUR_BMP_AL_01_01, EUR_BMP_AL_02_01, EUR_BMP_AL_03_01, EUR_BMP_AL_04_01, EUR_BMP_AL_05_01, EUR_BMP_AL_01_02, EUR_BMP_AL_02_02, EUR_BMP_AL_03_02, EUR_BMP_AL_04_02 and EUR_BMP_AL_05_02, additional values have to be provided, in which for each scenario EUR_BMPL_01 and EUR_BMPL_02 (alone and within EUR_BMP_AL's) would be evaluated using your DVA approach.

If your undertaking (at group level or on a single entity level) uses a CVA or a DVA, you are requested to additionally provide values for EUR_BMPL_01, EUR_BMPL_02 and EUR_BMP_AL_xx_yy's, when applying the CVA or DVA.

Importantly, the values for all combined portfolios (EUR_BMP_AL_xx_yy) should not only be generated by adding the values for asset portfolios (EUR_BMP_01, EUR_BMP_03, EUR_BMP_07, EUR_BMP_09 and EUR_BMP_10) and EUR_BMPL_01 and EUR_BMPL_02 but be taken from simulating the combined portfolio.

Please contact your supervisor to agree on the details depending on your CVA or DVA approach.

IV.7. Consideration of Ageing effects

In order to have a meaningful comparison between undertakings at risk factor level, undertakings modelling an ageing effect should remove the undiscounted ageing effect and discounted ageing effect as well as the credit ageing effect and apply instantaneous shocks in the MCRCS templates for fixed income instruments (risk free bonds, risky bonds and benchmark portfolios). In addition, no rebalancing actions over the risk horizon should be taken into account. But, any other assumptions as e.g. trends and dividends could be kept. These would become visible e.g. in the expected value if (materially) different from the initial value. When considering these effects as before a consistency between the individual asset values and the BMP values is desired.

V. Deadline and practical aspects of filling out the data request

Deadline

Final deadline for all submissions: **31 May 2021**. In case you are a first-time participant or have severe restrictions, please liaise with your supervisor to get additional support or discuss deadline flexibility[6].

However, you are invited to provide your (group) supervisor with the answers to the data request as soon as possible.

Instrument and benchmark portfolio specification

The detailed specification of the financial instruments and benchmark portfolios are included in the spreadsheet

– 'MCRCS_2020_instruments_and_BMP.xlsx'.

Parts 01 till 03

The data requested in parts 01 till 03 should be inserted in the dedicated sheets of the following 'response template' <u>spreadsheets</u>:

– 'firm-*001*_part-01_response_template_year-end_2020_mcrcs.xlsx',

– 'firm-*001*_part-02(a)_response_template_year-end_2020_mcrcs.xlsx',

– 'firm-*001*_part-02(b)_response_template_year-end_2020_mcrcs.xlsx',

– 'firm-*001*_part-02(c)_response_template_year-end_2020_mcrcs.xlsx',

– 'firm-*001*_part-03_response_template_year-end_2020_mcrcs.xlsx'.

Part 04

For part 04 (the qualitative questionnaire), the response template takes the form of a <u>'word document'</u> entitled:

– 'firm-*001*_part-04_response_template_year-end_2020_mcrcs.docx'.

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[6] Please note that regarding any relevant change in the deadline, the decision will have to be discussed with the EIOPA MCRCS Project Group to ensure that the overall project schedule is not materially impaired.

The questionnaire includes 16 questions. In case your undertaking took part in the previous study, please feel free to copy & paste and indicate only changes since then.

Remarks concerning the files to be submitted

- The number '*001*' in the file name should be changed in accordance to the instructions of your (group) supervisor, who has provided you with this data request;

- When your model corresponds to 'case A' (cf. introduction to section IV.5), you do not have to provide a file for 'part-02 (c)'.

Data quality

Please note that you are expected to verify the correctness of your response to this data request before handing in your answers.

Number format

To allow for a sufficient analysis, please deliver all results with at least ten decimal places.

VI. Appendix

VI.1. Appendix 1: Templates to be filled along cases of model structures

This section provides a mapping of templates expected along the modelling approaches of credit and market risk (cf. section IV.5, cases (A) to (E)).

In all constellations data should be provided based on the reporting date 31 December 2020 and for groups based on the consolidated balance sheet.

All submissions should provide

- "part-01_response_template_year-end_2020_mcrcs.xlsx": Benchmark portfolios and own asset portfolio under the combined market & credit risk.

- "part-03_response_template_year-end_2020_mcrcs.xlsx": The actual asset allocation.

- "part-04_response_template_year-end_2020_mcrcs.docx": Qualitative questionnaire.

Integrated approaches (model type A) should additionally to parts 01, 03, 04 provide:

- "part-02(a)_response_template_year-end_2020_mcrcs.xlsx": Prescribed single instruments under the combined market & credit risk and relevance scores for the instruments.

- "part-02(b)_response_template_year-end_2020_mcrcs.xlsx": Benchmark portfolios, prescribed single instruments and own asset portfolio under the equivalent to the market risk, i.e. the combined market and credit risk input excluding migration and default, and relevance scores for the single instruments for market risk. Please ensure scenario-identical simulation output w.r.t. part-02a and part-01.

Modular approaches (non-type-A-models) should additionally to parts 01, 03 and 04 provide

- "part-02(b)_response_template_year-end_2020_mcrcs.xlsx": Benchmark portfolios, prescribed single instruments and own asset portfolio under the market risk module and relevance scores for the single instruments for market risk.

- "part-02(c)_response_template_year-end_2020_mcrcs.xlsx": Benchmark portfolios and own asset portfolio under the credit risk module. Part-02c should be provided in the level of granularity available by the model types:

  o *Type B:* Initial value, mVaR, selected prescribed sensitivities, selected prescribed percentiles, scenario-by-scenario data.

- o *Type C:* Initial value, mVaR, selected prescribed sensitivities, selected prescribed percentiles.
- o *Type D:* Initial value, mVaR, selected prescribed sensitivities, expected value and 0.5 percentile.
- o *Type E:* To be discussed with your supervisor.

The following table gives an overview about the expected templates and values for part-01 and -02:

Data available by model type	BMPs			Single Instruments			Own Asset PF		
	Scenarios	Percentiles	VaR, et al*)	Scenarios	Percentiles	VaR et al*)	Scenarios	Percentiles	VaR et al*)
Market & Credit	A, B	A, B, C	A, B, C, D	A	A	A	A, B	A, B, C	A, B, C, D
Market	A, B, C, D	A, B, C, D	A, B, C, D	A, B, C, D	A, B, C, D	A, B, C, D	A, B, C, D	A, B, C, D	A, B, C, D
Credit only	B	B, C	B, C, D				B	B, C	B, C, D

Part-01: Combined Market & Credit Risk – Benchmark portfolios and own asset portfolio, all approaches
Part-02a: Combined Market & Credit Risk – Single instruments, integrated approaches only
Part-02b: Market Risk – Benchmark portfolios, own asset portfolio, single instruments, modular and integrated approaches
Part-02c: Credit Risk – Benchmark portfolio and own asset portfolio, modular approaches only

*) "VaR et al" is used as abbreviation for "initial value, mVaR, expected value, 0.5 percentile.

VI.2. Appendix 2: Relevance score concept

To support the analysis of results we are furthermore requesting qualitative indicators which can be used for ranking the synthetic instruments in the two dimensions 'exposure materiality' and 'modelling quality'.

The intended use of this information is to indicate where any observed outliers is due to arbitrary setting, for example "because there was no exposure and no intention to invest in assets of this type".

The following criteria should be used to assess the relevance score for instruments:

- Exposure Relevance (E): the importance of the respective instruments (or instruments which are quite similar to them, e.g. coupon bearing bonds instead of ZCB) should be assessed in terms of their materiality (e.g. for a synthetic corporate ZCB relative to the overall fixed income portfolio; for risk-free ZCB relative to size of technical provisions in the respective currency). The higher the score, the higher the materiality of this instrument type for your undertaking. When assessing the materiality please take into account not only the group perspective but also the point of view from a solo-undertaking. Please consider your assets, your liabilities as well as their net position. Please include a model independent assessment in your considerations: I.e. choose the classification in consistency with any limit system in your risk and 'asset-liability-management' and take into account the exposure in your balance and not only the exposure modelled.
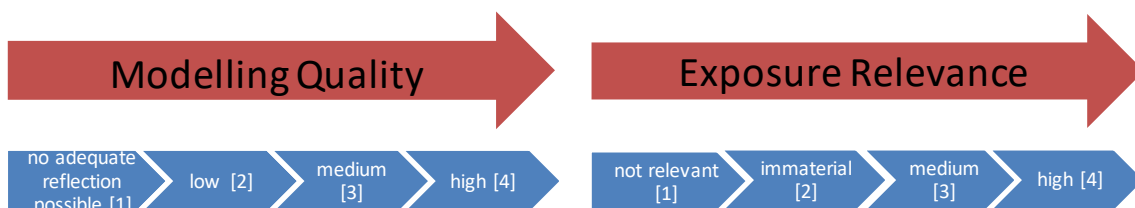
  Examples

  - If an undertaking is strongly invested in fixed income instruments (EUR) and the liabilities (EUR) are interest rate sensitive, however both positions are well matched, i.e. small duration mismatch or small interest rate risk position overall. Then the EUR-RFR-ZCBs should nonetheless be assigned with a high exposure relevance.

  - An undertaking's liability cash flows are concentrated in the first 10 years (GBP), the asset side shows a duration of less than 20 (GBP). In this case it could be reasonable to set the exposure relevance of the GBP-RFR-ZCB to "2" ('immaterial') or even "1" ('not

relevant') for the long maturities, while putting a higher value, "3" ('medium') or "4" ('high'), on shorter maturities.

- If the current exposure to equity is low according to your limit system but in your strategic asset allocation you intend to materially increase the exposure, please rather choose an exposure score according to your target allocation.

- Suppose the reporting currency is EUR and a material share of fixed interest bonds or liabilities is denoted in either GBP or USD. Then the corresponding FX instruments (FX-GBP-NA-NA-NA-NA-NA-NA and FX-USD-NA-NA-NA-NA-NA-NA) assigned a medium or high exposure relevance, even if the portfolios would be matched.

- When assessing the relevance of Swaptions not only the actual exposure to these particular financial instruments should be considered but also the Technical Provisions which are exposed to implied interest rate volatility.

- Modelling Quality (M): an assessment on how good the respective instrument characteristics are reflected in your internal model. In case you are not able to model a specific instrument (e.g. because a certain currency is not in scope of your internal model) the score 1 should be selected. A score of 4 should be selected for those instruments which can be modelled in an accurate way. The range in-between is foreseen for 'proxy' or 'work-around' solutions where a higher score indicates a higher quality.

The following graph summarises the different combinations of scores which can be selected in the drop-down list of the templates:

Modelling Quality				Exposure Relevance			
no adequate reflection possible [1]	low [2]	medium [3]	high [4]	not relevant [1]	immaterial [2]	medium [3]	high [4]

	Modelling Quality (M)			
Exposure Relevance (E)	E1M1	E1M2	E1M3	E1M4
	E2M1	E2M2	E2M3	E2M4
	E3M1	E3M2	E3M3	E3M4
	E4M1	E4M2	E4M3	E4M4

The score is expected for all instruments but not for the benchmark portfolios and as appropriate covers the combined market & credit risk for integrated approaches and – in case of modular approaches – the market risk with reference to the credit risk module as appropriate. Please use the response template for part-02a resp. part-02b.

In addition to the score you can enter text into the field 'Comment on relevance score' in order to explain your choice. This information is optional.

VI.3. Appendix 3: Q&A to specific parts of the data request

Q1: What is the difference between 'mVaR' and the 50 Bps.-quantile of the probability distribution forecast and how should the values be reported?

Answer: Often these values are identical but depending on the concrete definition of your risk measure there might be deviations between the estimated 0.50%-percentile of the probability distribution forecast and the mVaR (e.g. by taking into account the mean of the distribution). In any case the mVaR should be provided as value and not as P&L.

As the study is calculating the "risk charge" relative to the initial value, for models which take into account the mean, a transformation has to be applied: The change in the value is the difference of mean and 0.005 Q which has to be applied the initial value.

The following examples illustrate this:

- Example 1: mVaR equals 0.50%-percentile

	EUR_BMP_01	GOV-FI-AT-NA-NA-05
initial value	1000,00	0,90
mean value	1000,00	0,90
0.005Q	850	0,78
mVaR	850	0,78

- Example 2: mVaR is defined w.r.t. mean. In this case you would have

	EUR_BMP_01	GOV-FI-AT-NA-NA-05
initial value	1000,00	0.90
mean value	995	0,87
0.005Q	850	0,78
mVaR	855	0,81

The change in value is 0.005Q – mean = 850 – 995 = -145. The mVaR expected is initial value + change in value = 1.000 + (850 -995) = 855.

Background: in subsequent processing steps the absolute difference 'mVaR' minus 'initial value' is being interpreted as (P&L.-)VaR – according to the risk measure definition chosen by your undertaking,

Q2: Some of the fixed income instruments are not issued in EUR but a different currency (e.g. GBP or USD). How should currency risk be treated in that context?

Answer: For these instruments it is relevant, which 'reporting' currency is specified in column 'ccy' of the asset definition file.

E.g. "GOV-FI-UK-NA-NA-05" for the purpose of the study has to be reported in EUR and is issued in GBP, thus submissions have to include FX.

That means that in the reporting templates in row "initial value" we should not see the value of the calibration target but this should be converted with the undertaking's relevant FX-exchange rate per YE 2020. And, consistently all values (including notional value) to be submitted should be converted, e.g. the scenario data should be submitted in EUR including the FX-exchange rate in the respective scenario, accordingly the expected value (EV), quantiles.

For "FI-GBP-RFR-NA-NA-NA-NA-01 to -60", for the purpose of the study have to be reported in GBP and are issued in GBP, thus submissions don't include FX. I.e. the initial values in the reporting template should be in the region of the calibration target and the scenario data should also not be converted.

The inflation linked bonds "FI-GBP-RFR-INFL-NA-NA-SEN_UNS-01" or the equivalent in USD should be reported analogously to the RFR instruments, i.e. excluding FX.

Q3: Some of the equity and real estate exposures are located in Non-EUR countries (e.g. S&P500, office-building in London). Should currency risk also be incorporated in the reported results?

Answer: For RE and EQ for the MCRCS 2020 no FX has to be considered. E.g. for "Other-RE-EUR-COM-UK-NA-NA-NA-NA" the description says "Commercial real-estate: large office building located in the center of London, UK. Completely leased on a long term basis, high rental income. No leveraging. Initial market value at reference date of study = 1 million EUR." Thus no FX to be considered. You could think of the FX risk being completely hedged.

VI.4. Appendix 4: Main changes to the study compared to the previous MCRCS editions

MCRCS YE 2018 vs. MCRCS YE 2017

- Changed composition of Asset BMP: asset allocation for EUR_BMP_01 to EUR_BMP_08 are still based on EIOPA VA reference portfolios, but unit-linked assets and participations have been excluded (in general leading to an increase of fixed income and a decrease of equity instruments in the portfolios).

- Included three additional Asset-Liability BMP (EUR_BMP_AL_03 to EUR_BMP_AL_05).

- For derivatives additional request of information on risk factor level 'implied volatility'

MCRCS YE 2019 vs. MCRCS YE 2018

- Inclusion of an additional liability portfolio, BMPL_02 (cf. section IV.6).

- Additional data request for integrated models ('Type-A') to provide values without default and migration. (cf. section IV.5).

- The Technical Information now contains additional columns for considering the volatility adjustment. This relates to all RFR-instruments, the BMPL and AL-BMP.

- Additional questions in the qualitative questionnaire on sustainable finance (questions 14&15) and privileging bonds issued within a group (question 10).

- An enhanced consistency is asked between simulation outputs of instrument data and BMP data on a scenario-by-scenario basis (cf. section IV.5).