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Final report

Draft regulatory technical standards on the assessment methodology under which competent authorities verify an institution's compliance with the internal model approach as per Article 325az(8) of Regulation (EU) No 575/2013 (Capital Requirements Regulation 2 - CRR2)

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1. Executive Summary

The amendments to Regulation (EU) No 575/2013 (the Capital Requirements Regulation 2 – CRR2) implement in EU legislation, inter alia, the revised requirements to compute own funds requirements for market risk of the Basel III package, i.e. the Fundamental Review of the Trading Book (FRTB).

One of the prerequisites for an institution to use an internal model approach (IMA) for calculating the own funds requirements for market risk is the approval from its competent authority. Typically, for being granted such approval, the institution is subject to a thorough and comprehensive examination, where the competent authority assesses the institution's internal model against the relevant regulatory provisions. The approval is granted when the institution is found compliant with the requirements set out in CRR, and more specifically in Part Three, Title IV, Chapter 1b of, as well as the regulatory technical standards developed by the European Banking Authority (EBA), and later adopted by the European Commission (EC).

These draft RTS, that are based on the mandate provided in Article 325az(8)(b) CRR, aim at setting out a framework for competent authorities to assess those requirements. They are divided into three main chapters:

- (i) A chapter on governance;
- (ii) A chapter relating to the internal risk-measurement model covering for the expected shortfall and the stress scenario risk measure;
- (iii) A chapter relating to the internal default risk model.

As regards the chapter on governance, these draft RTS mirror the requirements envisaged in the previous' final draft RTS on assessment methodology¹, i.e. the assessment methodology setting out the requirements linked to the Basel II framework that relies on a VaR-based risk measures. In particular, (the 'new') Article 325bi CRR and (the 'old') Article 368 CRR are de-facto identical – hence, also the assessment methodology provisions relating to those requirements should not diverge. However, the governance requirements need to consider some features that are FRTB-specific, e.g. the fact that the approval is given at trading desk level and should be accompanied by an assessment by the competent authority that the trading desk set-up is done in an adequate manner.

As a result, competent authorities are required to assess all the following governance-related aspects during the process of granting the approval: the organisational structure for the governance and management of the market risk model, the decision-making process of the institution regarding all aspects of market risk internal models, the composition and the role of the senior management and the management body, the set-up of the trading desks for which the institution is seeking the approval,

¹ <https://www.eba.europa.eu/sites/default/documents/files/documents/10180/1669525/f75ab291-838d-42fb-871e-3b2011728dfb/Final%20draft%20RTS%20on%20the%20IMA%20assessment%20methodology%20%26%20significant%20shares%20%28EBA-RTS-2016-07%29.pdf?retry=1>

the internal governance and oversight of the institution in relation to the risk control unit, the position limits and the processes to update those limits.

Considering that risks stemming from climate change and broader environmental issues are changing the risk picture for the financial sector and are expected to become even more prominent going forward, these RTS also explicitly require competent authorities to verify that institutions consider those risks in their stress testing programmes for internal models.

As regards the chapters relating to the internal-risk measurement model and the internal default risk model, these RTS are generally addressed to the competent authorities, rather than the institutions. In particular, as mentioned, the EBA developed a set of regulatory technical standards setting out the details of the framework for institutions. Consequently, there is no need for these RTS to further specify the requirements to which institutions are subject. Instead, these RTS provide competent authorities with a set of assessment methodologies and techniques to verify those requirements – this to ensure that the assessment itself is comprehensive in its scope, and where possible, harmonised.

In particular, these RTS envisage assessment methods that the competent authorities must apply, and some others that competent authorities may decide to apply or not depending on the situation of the institution, e.g. on the basis of proportionality considerations. As a result, these RTS create transparency in relation to what kind of requests institutions can expect from the competent authority during the investigation phase, without restricting the supervisory powers of the competent authority to request different or additional information during an inspection.

While these RTS target competent authorities rather than institutions, it also includes several documentation requirements, which are expected to be in place by institutions. These are included in order to ensure a harmonised basis of the model assessment by the competent authorities can take place. In addition, it provides several clarifications to how the CRR requirements should be understood in the context of the model approval process.

In terms of scope, the chapter relating to the internal risk-measurement model for the expected shortfall and stress scenario risk measure includes assessment methods relating to all the following aspects: the risk factor set-up and their properties, including the mapping to the appropriate liquidity horizon and the modellability assessment, the back-testing and profit and loss attribution results, the treatment of foreign-exchange and commodity risk in the banking book, data quality and the use proxies, the calculation of the partial expected shortfall measures for modellable risk factors and the calculation of the stress scenario risk measure for non-modellable risk factors.

In relation to the internal default risk model, these RTS cover the following aspects: the scope of positions subject to a default risk change, the correlation structure between issuers, the hedging recognition in the model, the estimation of default probabilities and losses given defaults, as well as other requirements referred to as particular requirements in CRR (see Article 325bp CRR).

2. Background and rationale

Article 325az(8)(b) CRR specifies that the EBA has to develop regulatory technical standards setting out the assessment methodology that competent authorities shall use when assessing institutions' internal models for market risk. The assessment constitutes the basis for a decision taken by the competent authority granting (or not) the approval for using the model for the computation of the own funds requirements for market risk.

These draft RTS have been divided into three main chapters. The first chapter deals with governance requirements, the second chapter relates to the internal risk-measurement model covering the expected shortfall and the stress scenario risk measure, and the third chapter relates to the internal default risk model. As a result, all regulatory aspects included in CRR as well as in the relevant delegated regulations will be part of the competent authority assessment.

This background section provides a high-level overview of those chapters and describe the most relevant policy proposals.

2.1 Governance requirements

As mentioned, Article 325bi and Article 368 CRR on qualitative requirements are fundamentally identical. Requirements included in the governance section are therefore based on those proposed in the previous RTS on assessment methodology². This should help institutions that already met the requirements set out therein in their transition to the new framework. Those requirements have been however adjusted to reflect the new FRTB framework. In these final draft RTS, the competent authority is required to check all the following aspects:

- that an institution has a clear organisational structure for the governance and management of the market risk model with well defined, transparent, and appropriate lines of responsibility
- that the decision-making process of the institution regarding all aspects of market risk internal models is clearly established in the institution's internal documentation
- that the composition and the role of the senior management and the management body is adequate
- that the set-up of the trading desks for which the institution is seeking the approval is adequate
- that the internal governance and oversight of the institution in relation to the risk control unit is adequate

² <https://www.eba.europa.eu/sites/default/documents/files/documents/10180/1669525/f75ab291-838d-42fb-871e-3b2011728dfb/Final%20draft%20RTS%20on%20the%20IMA%20assessment%20methodology%20%26%20significant%20shares%20%28EBA-RTS-2016-07%29.pdf?retry=1>

- that the internal policy regarding the introduction of any new product is adequate
- that the independent review of the internal model is adequate
- that the process governing the internal validation as well as the scope of the validation itself are adequate
- that the internal regular reporting is adequate
- that the position limits and the processes to update those limits as well as to deal with potential breaches is adequate
- that the stress testing programme is adequate, and in particular, that the reverse stress testing scenarios and ad-hoc stress testing scenarios are adequate as well
- that the IT systems used to generate risk-figures are adequate
- that the internal risk-measurement model, including any pricing model, have a proven track record of being reasonably accurate in measuring risks

The "old" RTS, which set out the governance requirements under the previous market risk model, i.e. VaR and Stressed VaR models, is used as a basis, albeit reviewed. . There are fundamentally three novelties in comparison with the previous RTS, which are worth highlighting.

First, these draft RTS envisage requirements for the set-up of the trading desks. In particular, Article 104b CRR lays down several requirements for trading desks in the scope of the internal model approach. Accordingly, these RTS set out how competent authorities are to check those requirements. Among others, the competent authority is required to check:

- the distinctive nature of the trading desk to ensure that their set up has not been done with the sole purpose of meeting the back-testing and profit and loss attribution requirements;
- that either there is only one head dealer for trading desk or that, where two head dealers are present, they either have responsibilities and authorities that are clearly separated, or one has ultimate oversight over the other;
- that where one dealer is allocated to more than one trading desk, the tasks performed when operating for one trading desk do not create potential conflicts with those performed when operating for the other trading desk. In particular, competent authorities should verify that the dealer is not subject to any conflict as a result of the double hat;
- that transactions between trading desks are consistent with the business strategies of those trading desks and that they are not performed with the objective of reducing the own funds requirements for market risk, meeting the profit and loss attribution and the back-testing requirements. Competent authorities may perform checks at transaction level.

Second, these draft RTS specify that the competent authority verifies that as part of the back-testing programmes referred to in Article 325bj CRR, the institution also back-tests its expected shortfall directly. These RTS neither prescribe a specific methodology to use, nor other aspects, e.g. the inclusion/exclusion of non-modellable risk factors, the liquidity horizon, whether this should be done for the whole portfolio, or in the context of some only. Institutions are therefore free to define several aspects in relation to such back-testing. However, it is important that the validation function of the institutions actually tests the expected shortfall numbers against the P&Ls, as finally these are numbers used in the computation of the own funds requirements (that will not be based anymore on a VaR measure). Compared to the RTS proposed for consultation, the final RTS make explicit that the direct ES back-testing is not a regulatory test, and its outcome, should not in any way supersede the results of the regulatory back-testing and of the profit and loss attribution requirements. It is indeed a tool for the bank to identify potential weaknesses, and to support supervisors in their investigation. Given the novelty of this requirement, the draft RTS clarify that this aspect should be assessed by the competent authority only from 01/01/2026.

Third, the draft RTS specify that as part of their stress testing programmes under the internal model approach, institutions also consider environmental risk scenarios, and the effect that those scenarios can have on the institutions' portfolio in terms of losses. Given the novelty of this requirement, and the work that EU credit institutions are currently undertaking in relation to the identification of environmental risks, the draft RTS clarify that this aspect is assessed by the competent authority only from 1-January-2025. De-facto, this implies that institutions are expected to have these scenarios in place only from that date.

2.2 Assessment of the internal risk-measurement model used for the calculation of the expected shortfall and the stress scenario risk-measure

The FRTB-IMA framework significantly differs from the current internal model approach, as several new aspects have been introduced. The EBA has developed over the last years several technical standards to implement the FRTB-IMA rules in the EU, namely:

- RTS on liquidity horizon³
- RTS on back-testing and profit and loss attribution requirements⁴
- RTS on risk factor modellability⁵

³ https://www.eba.europa.eu/sites/default/documents/files/document_library/EBA-RTS-2020-001%20Final%20draft%20RTS%20on%20Liquidity%20Horizon%20for%20the%20IMA.pdf

⁴ https://www.eba.europa.eu/sites/default/documents/files/document_library/EBA-RTS-2020-02%20Final%20draft%20RTS%20on%20Backtesting%20and%20PLA%20requirements.pdf

⁵ https://www.eba.europa.eu/sites/default/documents/files/document_library/EBA-RTS-2020-03%20Final%20draft%20RTS%20on%20Risk%20factor%20modellability.pdf

- RTS on the determination of the stress scenario risk measure for non-modellable risk factors⁶
- RTS on the treatment of FX and Commodity risk in the banking book⁷
- RTS on default probabilities and losses given default for the default risk model⁸

The CRR combined with those RTS already create a rather prescriptive framework. Hence, in general, there is no need for these RTS to further define those requirements. These RTS have been therefore designed to support the competent authority in its assessment – hence, most of the provisions included in the chapter are addressed to the competent authority. It should be noted, however, that some documentation requirements for institutions have been included in these RTS to make the assessment of the authority effective.

The assessment methods that have been included as part of these RTS are of two types:

- Mandatory assessment methods that the competent authority must apply: these assessment methods are typically not burdensome, and are to be applied regardless of the situation of the institution.
- Optional assessment methods that the competent authority may apply: these assessment methods are more intrusive, and generate more burden both for the institution and the competent authority in the investigation phase. They are meant to be used whenever the mandatory assessment methods are not sufficient, and are expected to be used, for example, when the documentation of the institution is not comprehensive or show weaknesses in the analysis performed to validate a modelling aspect.

These optional assessment methods are also included to provide guidance to competent authorities on how the compliance of the institution can be further verified. However, the competent authority may also decide to apply a different method in order to consider the specificities of the institution, and the specific aspect that the competent authority wants to assess.

As a result, these RTS create transparency in relation to what kind of requests institutions can expect from the competent authority during the investigation phase, without restricting the supervisory powers of the competent authority to request different or additional information during an inspection.

While, these RTS address often competent authorities rather than institutions, this chapter introduces some more clarify in relation to the requirement included in Article 325bh(1) CRR to capture basis risk so to ensure a consistent reading of that provision. They also include a specific additional monitoring exercise that institutions are to perform in order to identify whether overshootings are due to

⁶ <https://www.eba.europa.eu/regulation-and-policy/market-risk/regulatory-technical-standards-capitalisation-non-modellable-risk-factors-under-ftb>

⁷ <https://www.eba.europa.eu/regulatory-technical-standards-treatment-non-trading-book-positions-subject-foreign-exchange-risk-or>

⁸ <https://www.eba.europa.eu/regulation-and-policy/market-risk/regulatory-technical-standards-rtb-default-probabilities-and-losses-given-default-default-risk-model>

modellable or non-modellable risk factors (see section below dealing with back-testing and profit and loss attribution requirements).

In terms of content, all the following points will have to be assessed by the competent authority:

- (i) Aspects relating to risk factors, including the risk factor set-up, risk factors included in the internal risk-measurement model for each broad risk factor category, modelling of curves and surfaces, compliance with the RTS on liquidity horizons, compliance with the RTS on RFET
- (ii) Aspects relating to the treatment of FX and Commodity in the banking book, and notably, the compliance of the institution with the corresponding RTS
- (iii) Aspects relating to data quality and proxies
- (iv) Aspects relating to back-testing and profit and loss attribution requirements, and notably, the compliance of the institution with the corresponding RTS
- (v) Aspects relating to the calculation of the expected shortfall risk measure, including estimators for the expected shortfall, number of simulations used where the model relies on Monte Carlo simulations, correct implementation of the effective liquidity horizons, distribution of risk factors and correlation between risk factors
- (vi) Aspects relating to the calculation of the stress scenario risk measure, and notably, the compliance of the institution with the corresponding RTS

Here below a brief summary of the provisions included for each topic is provided.

2.2.1 Risk factors

In relation to risk factors, these RTS aim at ensuring compliance of the institution with the requirements set out in Article 325bh, and more specifically to those paragraphs including provisions on the risk coverage of the model.

To that end, these RTS specify that institutions should document whether there are risk factors that are included in the standardised approach but not in the internal risk-measurement model, and the rationale for the choice. In addition, institutions are expected to monitor the impact of the exclusion, in terms of own funds requirements, as well as profit and loss attribution test results as set out in Article 325bh(1) CRR.

During the investigation phase, the competent authority should obtain a clear understanding of how the risk is covered in the internal model. Accordingly, the competent authority is expected to obtain an overview of the risk factors in the portfolio, the exposure of the institution to those risk factors, as well as how pricing factors in the economic P&L (i.e. the end-of-day value) are modelled in the internal-risk measurement model, e.g. whether there is a risk factor that directly replicates the pricing factor, or other methods, such as proxies, are used.

The competent authority is then required to check whether there are material risk factors that are not modelled at all and assess the risk coverage of the model by combining this information with the back-testing and profit and loss attribution results.

These RTS also envisage the possibility for competent authorities to require one-off calculations to assess the effect of a non-modelled pricing factor on the P&Ls used in the internal risk-measurement model. In particular, the competent authority could compare:

- (i) the hypothetical changes value in the portfolio's value computed in accordance with Article 1 of the RTS on back-testing and profit and loss attribution requirements;
- (ii) the hypothetical changes in the portfolio's value computed in accordance with Article 1 of the RTS on back-testing and profit and loss attribution requirements, while keeping the risk factors that are not included in the internal risk-measurement model unchanged
- (iii) the risk-theoretical changes in the portfolio's value computed in accordance with Article 12 of the RTS on back-testing and profit and loss attribution requirements

After having performed this overarching assessment, these RTS require competent authority to perform risk category - by - risk category checks. The objective of these additional checks is to assess:

- (i) That basis risk is captured
- (ii) That the modelling of curves and surfaces is appropriate

These RTS provide competent authorities with concrete assessment methods for performing these checks. For basis risk, competent authorities are required to check whether the basis is modelled by directly modelling two positions, or by introducing a specific basis risk factor. In relation to curves and surfaces, the techniques proposed in these RTS aim at checking that modelling is done in a way that allows capturing the volatility observed in the market at the points of the curves and surfaces. For example, for curves that are modelled via a parameter, these RTS envisage that the competent authority compares the volatility at the points in the curve as resulting from the shocks applied to the parameters, and the volatility of those points as directly observed in the market.

As regards risk factors, the EBA also developed two RTS, one for the mapping of the risk factor to the relevant liquidity horizon, and another for the assessment of the risk factor modellability.

In accordance with these RTS, to verify the correct mapping of risk factors to the appropriate liquidity horizon, the competent authority should, on the basis of an inventory that institutions are required to have in place, check that the mapping follows the rules set out in the RTS on liquidity horizon. In particular, competent authorities should focus on those risk factors for which the mapping is not trivial, e.g. risk factors that may be mapped to more than one subcategory, such as parameters or basis risk factors. Furthermore, where applicable, the competent authority is required to check that the derogation envisaged in the CRR to use a higher liquidity horizon is applied correctly, i.e. consistently across all positions in the trading desk.

To verify that the risk factor modellability assessment is done in a sound manner, the competent authority is required to check, on the basis of an inventory that institutions are required to have in place, that the conditions set out in the RTS on risk factor modellability for considering a price as verifiable and representative are met. The competent authority is also required to assess, on the basis of the internal policies of the institutions, how the conditions set out in the RTS on risk factor modellability are made operational, e.g. how it is practically checked whether the volume of a transaction is negligible. When doing so, the competent authority is also required to take a sample of risk factors, the corresponding transactions (or quotes) considered to be verifiable and representative, and verify how those practical checks were actually performed. It should be noted that these RTS have been drafted to reflect also cases where the verifiability of a transaction/quote is assessed by a third-party vendor.

2.2.2 Proxies and data quality

In relation to proxies, these RTS aim at ensuring that the institution uses a proxy only where data are insufficient and when doing so, that the proxy is sufficiently conservative and keeps track of the actual position held (as required by CRR). To that end, these RTS require the institution to document any proxying approach it uses, as well the risk factors for which the approach is used. These RTS then require competent authorities to perform several assessments for which these RTS provide concrete assessment techniques, including:

- a verification of the correlation between proxy data and data used to mark the risk factor in the end of day value
- a comparison of the resulting volatilities when proxy data are used and when proxy data are not used
- for non-modellable risk factors, an assessment of the rationale provided by the institution to use proxies when at least 12 observations are available (i.e. where they would be in a position to use the asymmetrical sigma method to compute the stress scenario risk measure in accordance with these RTS on the stress scenario risk measure).

As regards data quality, these RTS aim at ensuring that institutions' time series meet minimum data standards. First, they further specify what are the minimum checks that institutions should do on their time series in order to monitor the overall data quality. Second, they provide competent authorities with concrete techniques and relevant indicators to detect those times series that are affected by low data quality and require them to investigate what is the reason behind such low quality, and assess the impact on the calculation of the own funds requirements.

2.2.3 Treatment of foreign exchange and Commodity risk in the banking book

As regards foreign exchange and commodity risk in the banking book, these RTS aim at ensuring institutions' compliance with the corresponding RTS.

These RTS specify that the institution's internal policies must set out which are those foreign exchange and commodity positions in the banking book that are included in the scope of the internal model and those that are not, as well as the rationale for the choice. Furthermore, given that institutions can pick among several options in the context of the RTS on foreign exchange and commodity risk in the banking book, these RTS require institutions to document the choices made along with their rationale.

Competent authorities are then required to check several aspects including the following:

- that the institution's internal risk measurement systems are able to capture all positions that are subject to FX and commodity risk in a timely manner, including where the FX risk arises when translating positions held e.g. in foreign subsidiaries into the parent bank's reporting currency
- that the institution's internal risk measurement systems are able to retrieve the correct position data, accounting value (or fair value) from those systems that compute that value in the first place
- that the institution's processes ensure the identification of items that may be subject to impairment due to FX risk, and of items for which the derogations included in the RTS on FX and Commodity risk in the banking book can (and are) be used
- that the institution actually shocks only risk factors relating to FX and commodity risk as required by the delegated regulation, and that the institution computes the actual and hypothetical changes in the portfolio value in compliance with that regulation.

To do so, these RTS provide competent authorities with concrete assessment techniques implying among others, reconciliations between items captured in the internal risk-measurement model systems and in the accounting systems, as well as ad-hoc P&L calculations on samples of banking book positions.

2.2.4 Back-testing and profit and loss attribution requirements

In relation to the calculation of the hypothetical, actual and risk-theoretical P&L (HPL, APL and RTPL respectively), these RTS aim at ensuring institution's compliance with the RTS on back-testing and profit and loss attribution requirements.

These RTS specify that institutions should have in place a daily report identifying the various elements making up the actual and hypothetical P&Ls. In the report, for example, it should be clear how changes in the Valuation Adjustment (VAs) contributed to the overall changes in the actual and hypothetical P&Ls.

The competent authority is then required to use this report over subsequent days, analyse the figures reported therein, and assess whether the institution is compliant with the requirement of the RTS. For example, the competent authority is required to check that the contribution of a VA that is updated weekly is non-zero only in those days when it is updated.

While this daily-report is expected to be sufficient to understand the institution's compliance with the RTS on back-testing and profit and loss attribution requirements, there may be cases where it presents elements of unclarity. These RTS therefore envisage the possibility for competent authorities to require one-off calculations of the actual and hypothetical P&Ls on a sample of positions to further assess the institution's compliance.

As regards the RTPL, competent authorities are required to check that the RTPL is calculated using the ES/SSRM set-up (e.g. same pricing functions). Furthermore, they are required to check that risk factors that are not shocked in the ES/SSRM do not contribute to the RTPL. These RTS also envisage several checks on potential data alignments that the institution does in accordance with Articles 14 and 15 of the RTS.

These RTS also specify that competent authorities must verify the correct implementation of the profit and loss attribution test. When doing so, the competent authority may also repeat the calculation to obtain the Spearman correlation and Kolmogorov-Smirnov metric. In relation to regulatory back-testing results, these RTS outline what are the aspects that institutions are expected to consider when investigating the cause of an overshooting that occurred in the top-of-the-house back-testing.

Finally, the draft RTS require competent authorities to assess how institutions deal with errors that occur in P&Ls' computations, how institutions treat illiquid positions in the end-of-day valuation process (as they may suffer from stale data) as well as how those illiquid positions are treated in the risk-measurement model.

Additional internal back-testing – monitoring of P&L due to modellable and non-modellable risk factors

Institutions are required, as per Article 325bj CRR, to run additional internal back-testing programmes and not only rely on regulatory back-testing. The back-testing requirements in the FRTB standards, implemented in the EU in Article 325bd CRR, entail that non-modellable risk factors are not shocked in the VaR calculation. As a result, the institution may suffer overshootings due to the fact that the P&Ls reflect changes in non-modellable risk factors while the VaR doesn't.

To support institutions and competent authorities in identifying potential deficiencies in the internal-risk measurement model, the draft RTS specify that, as part of the internal back-testing, institutions are to monitor when the following P&L measures breach the top of the house value at risk number:

$$HPL_{MRF} = HPL + RTPL_{MRF} - RTPL$$

$$APL_{MRF} = APL + RTPL_{MRF} - RTPL$$

Where:

- *HPL* are the hypothetical changes in the portfolio's value;
- *APL* are the actual changes in the portfolio's value;
- *RTPL* are the risk-theoretical changes in the institution's portfolio's value;

- $RTPL_{MRF}$ are the risk-theoretical changes in the institution's portfolio's value considering only changes to modellable risk factors.

It should be noted that the calculation of $RTPL_{MRF}$ should not pose significant burden on banks, as banks are required to shock in their expected shortfall only modellable risk factors. Hence, the set up for doing the P&L calculation is already implemented for that purpose. However, considering that HPL_{MRF} and APL_{MRF} are just proxies, the draft RTS allows banks to not implement specifically this test, but to run alternative back-testing programmes that would still aim at assessing the contribution of modellable and non-modellable risk factors to the back-testing results.

Finally, it should be stressed that these back-testing results do not lead to any automatic 'consequence' – this internal back-testing is solely intended to enhance the internal monitoring.

2.2.5 Calculation of the expected shortfall measure and the stress scenario risk measure

Competent authorities are required to check that the calculation of the expected shortfall and the stress scenario risk measure is sound. These RTS distinguish between:

- Aspects that are relevant in both contexts
- Aspects that primarily relate to the expected shortfall calculation
- Aspects that primarily relate to the stress scenario risk measure

These RTS identify only one aspect to be assessed that relates to both the expected shortfall and the stress scenario risk measure, namely, how the model accounts for non-linearity. The competent authority is required to check that where a sensitivity-based approach is used the model captures at least the material first- and second-order terms of Taylor series approximations to reflect the change in the prices due to changes in relevant risk factors. These RTS also envisage the possibility for the competent authority to require one-off calculations to assess whether that is the case – those one-off calculations aim at comparing the outcome of a full revaluation approach against a sensitivity-based approach.

As regards aspects that relate to the calculation of the expected shortfall measure, these RTS include concrete assessment methods ensuring among others:

- (i) A correct implementation of the effective liquidity horizon as referred to in Article 325bd CRR, as well as of the various scaling that institutions are to perform in accordance with Article 325bc CRR;
- (ii) A sound identification of the reduced set of risk factors as referred to in 325bc(2) CRR;
- (iii) That where the institution uses the derogation to compute the unconstrained expected shortfall measures and the partial expected shortfall measures for the broad risk factor

categories (as per Article 325bb CRR) at a reduced frequency, then there is no underestimation of risk;

- (iv) That the estimator used by the institution to compute the ES is appropriate, and that where the model relies on a Monte Carlo approach, the number of simulations used does not lead to a significant estimation error;
- (v) That the multivariate joint distribution of the risk factors as well as correlation parameters to reflect the joint movement of those risk factors is backed by historical data.

The result of the expected shortfall estimation depends strongly both on (i) the choice of the estimator, and in particular on the quantile function and the assumption beyond the largest observed loss, and (ii) on the distribution of the P&L of the portfolio under the IMA ES model. These aspects are extensively discussed in Annex I to this paper.

On the basis of the discussion presented in Annex I, these RTS specify that institutions are to justify the choice of the ES estimators that are chosen to compute the expected shortfall measures. Institutions are expected in particular to meet the CRR requirements on accuracy and conceptual soundness, and to show that the selection of the ES estimator is overall aligned with that the estimator used for the VaR back-testing purposes. In particular, these RTS ensure that the selection of the estimators is not done in a way that the VaR estimator is built on conservative assumptions (since it is used for back-testing only) while the ES estimator is built on aggressive assumptions, since it is the one used for capital purposes. To that end, these RTS also provide competent authorities with a list of VaR-ES estimators' couples such that the ES estimator is actually the integral over the tail of the VaR as described in Annex I of this paper. While the list is not meant to identify "right" or "wrong" estimators, it could still help supervisors in assessing the rationale of the choice made by the institution, as well as in understanding whether the choice made is expected to be conservative (or not) in the context of a predefined set of distributions.

In relation to the stress scenario risk measure, these RTS include several assessment techniques to ensure that an institution complies with these RTS on the calculation of the stress scenario risk measure for non-modellable risk factors. In particular, the focus of those checks is around those cases where the institution uses the flexibility granted in these RTS (e.g. the possibility to determine the stress period on the basis of modellable risk factors). These RTS envisage one-off calculations that institutions may be required to perform during the investigation phase. For example, where the institution determines the stress period on the basis of modellable risk factors in accordance with these RTS on SSRM, the competent authority may require it to determine the stress period by maximizing the own funds requirements for non-modellable risk factors, and verify that the two periods do not significantly differ.

2.3 Assessment of the internal default risk model

As regards internal default risk model, these RTS envisage methods to assess whether the institution is compliant with the requirements set out in these RTS on default probabilities and losses given default for the default risk model as well as in CRR.

As regards PD and LGD estimates, these RTS require institutions to have an inventory in place outlining how PDs and LGDs have been obtained for the DRC model, e.g. via the IRB approach, or via external sources. On the basis of this inventory, the competent authority must run several checks that are tailored to the approach used by the institution to obtain PDs and LGDs. Among others, they include checks on the definition of default, on techniques used to rescale a PD to the applicable time horizon, and on the data used to estimate the PD and LGD.

Furthermore, these RTS envisage checks aiming at verifying that the estimator used to compute the value-at-risk number for default risk is appropriate, and that the number of simulations used does not lead to a significant sampling error.

Finally, these RTS include methods to assess the correlation structure use to model the correlation between issuers' asset values, the copula assumptions made by the institution, as well as methods to assess that the recognition of hedging and diversification effects is appropriate.

Constant position assumption and maturity mismatches

Article 325bn(1)(d) CRR requires the DRC model to be based on a one-year constant position assumption. Under the current framework (i.e. previous to FRTB), institutions already had the possibility to build IRC models in accordance following the constant position assumption as an alternative to the constant level of risk assumption (which will not be allowed anymore under FRTB).

The exact meaning of the term constant position assumption could be understood in the two following manners:

- (i) Constant position assumption as to mean “buy and hold”. Positions could therefore be modelled with their correct time to maturity.

Positions with maturity < 1 year would not be “renewed”, so that maturity mismatches would be reflected “automatically” in the model. The PD for a given maturity could be achieved via modelling several small time steps or via scaling the PD on the one year horizon for the positions with maturity < 1 year.

For the example of a portfolio of a long bond and the “hedging” CDS position with little remaining time to maturity, the maturity mismatch between both positions would be reflected.

- (ii) Constant position assumption as to mean “freeze” of the positions, i.e. no positions mature until the end of the one-year horizon, even if in reality some positions would. In this setup, the maturity of positions is ignored – this implies that all positions remain during the entire capital horizon of one year.

In this regard, it should be noted that the final draft RTS to not preclude the use of any of the two options above. Competent authority should however ensure that the actual implementation of the DRC model meet the CRR requirements.

Internal risk measurement model reflecting the economic cycle

Article 325bp(2) CRR states that *“The internal default risk model shall reflect the economic cycle, including the dependency between recovery rates and the systematic risk factors referred to in paragraph 1.”*

In relation to this requirement, these RTS only envisage that the competent authority assesses how the modelling of losses given defaults, including stochastic ones, is done for the LGD themselves to reflect changes in the value taken by the systematic risk factors. When doing so, the competent authority may, on a sample of issuers, perform statistical analysis, including hypothesis testing, to test the dependency of losses given defaults on the systematic risk factors.

Accordingly, these RTS imply a rather narrow scope of application of the provision, e.g. competent authorities are not expected to check that also PDs reflect the economic cycle – hence, it is left to institutions to decide whether PDs reflect the economic cycle.

3. Draft regulatory technical standards on the assessment methodology under which competent authorities verify an institution's compliance with the requirements set out in Articles 325bh, 325bi, 325bn, 325bo and 325bp Regulation (EU) No 575/2013 (Capital Requirements Regulation 2 – CRR2)

COMMISSION DELEGATED REGULATION (EU) .../...**of XXX****supplementing Regulation (EU) No 575/2013 of the European Parliament and of the Council with regard to regulatory technical standards on the assessment methodology under which competent authorities verify an institution's compliance with the requirements set out in Articles 325bh, 325bi, 325bn, 325bo and 325bp of that Regulation****(Text with EEA relevance)**

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Regulation (EU) No 575/2013 of the European Parliament and of the Council of 26 June 2013 on prudential requirements for credit institutions and amending Regulation (EU) No 648/2012⁹, and in particular Article 325az(8), first subparagraph, point (b), and third subparagraph, thereof,

Whereas:

- (1) Regulation (EU) No 575/2013 provides for competent authorities to assess institutions' compliance with the requirements to use internal models for market risk. These requirements include general conditions which are to be complied with at all times. Competent authorities' assessment of institutions' compliance with those requirements does not only relate to the initial application of an institution for permission to use internal models, but also applies to applications for material extensions or changes to the internal models for market risk that the institution has been granted permission to use, and to the on-going review of the internal models for market risk that the institution is permitted to use. Therefore, competent authorities should apply the same criteria to each of these aspects of the assessment of compliance with the requirements to use internal models for market risk. Hence, the rules on the assessment methodology should apply to all of the above cases, in order to harmonise the application of those methodologies by competent authorities and mitigate regulatory arbitrage.
- (2) Where competent authorities assess the compliance of an institution with the requirements to use internal models for market risk other than for the initial application for permission, competent authorities should apply only the rules that are relevant to the scope of the new assessment, and should, in each case, build on the conclusions from previous assessments as the starting point.

⁹ OJ L 176, 27.6.2013, p. 1.

- (3) Competent authorities should evaluate the overall quality of the solutions, systems and approaches implemented by an institution, and request constant improvements and adaptations to changed circumstances in order to achieve continuous compliance with such requirements.
- (4) The competent authority's assessment requires the exercise of supervisory judgement. Rules for the assessment methodology to be applied by competent authorities should envisage prescriptive assessment techniques to ensure harmonisation and comparability of supervisory practices across different jurisdictions. However, they should also allow those authorities to exercise their discretion by carrying out additional checks to those specified therein, as necessary. In particular, competent authorities should be granted the necessary flexibility to apply the most appropriate methods for verifying compliance with particular requirements, so to take into account the nature, size and complexity of an institution's structure and business model, the complexity of the internal models and the nature of products they cover, the quality of evidence provided by the institution and the resources available to the competent authorities themselves. Given the broad range of products available in trading activities, products should also be classified into non-exhaustive categories of increasing level of complexity to assist competent authorities in conducting the assessment in a proportionate manner.
- (5) Rules on the assessment methodology should provide that, while some risk tools, IT systems and risk management solutions may be purchased from external providers, all the key tasks, activities or functions related to the internal model are conducted by the risk control unit referred to in Article 325bi(1), point (b), of Regulation (EU) No 575/2013. They should also require that adequate controls are implemented and quality and validation tests are performed by the risk control unit for any outsourced solution, and that full documentation is available in all cases, ensuring sufficient in-house understanding of the model, including outsourced operations. For the same reasons, competent authorities should assess any tools and IT solutions obtained from third party vendors in a manner similar to cases where they have been fully developed via internal processes.
- (6) Governance and operational aspects play a central role in the proper functioning of the internal model. Accordingly, the assessment methodology should ensure a comprehensive assessment of governance and operational aspects, including, among others, an assessment of the trading desk set-up, of the role of the senior management and the management body, of the risk-control unit, and of the independent review of the model itself.
- (7) In setting out the assessment rules relating to governance aspects, it is necessary to consider that there may be institutions requesting the permission for using the alternative internal model approach that were already granted the approval to use an internal model to calculate the own funds requirements for market risk before Regulation (EU) No 575/2013 was amended by Regulation (EU) 2019/876 of the European Parliament and of the Council¹⁰. Accordingly, it is necessary to envisage

¹⁰ Regulation (EU) 2019/876 of the European Parliament and of the Council of 20 May 2019 amending Regulation (EU) No 575/2013 as regards the leverage ratio, the net stable funding ratio, requirements for own funds and eligible liabilities, counterparty credit risk, market risk, exposures to central counterparties, exposures to collective investment undertakings, large exposures, reporting and disclosure requirements, and Regulation (EU) No 648/2012 (OJ L 150, 7.6.2019, p. 1).

similar assessment rules to those developed in the past for those aspects that were not amended by Regulation (EU) 2019/876, and introduce new rules for covering new provisions introduced by that Regulation. Notably, this is the case in relation to the trading desk requirements laid down in Article 104b of Regulation (EU) No 575/2013.

- (8) In order to assess compliance with the requirements for validation and review of internal models, it is appropriate that the internal validation of the model is performed at least annually. While initial validation should cover all methodologies applied throughout the internal model, in consideration of staff and resources constraints it is appropriate that the annual validation focuses at least on the main issues detected either in previous internal validations or previous internal audit reviews, as well as on any changes or new methodologies introduced in the model.
- (9) Considering the evolving nature of trading activities, in particular for institutions using internal models, as well as of financial markets, it is necessary to incorporate qualitative and procedural standards in the assessment methodology with regard to the introduction and formal approval of new instruments and products in the trading area by the institution. Standards for a formal new product approval policy are necessary to ensure that the flexibility to introduce new instruments, which may pose additional risk factors or require methodological changes, is fully compatible with the comprehensive control and validation.
- (10) The quality of data and the accuracy of risk estimation and of calculation of own funds requirements for market risk are highly dependent on the reliability of the IT systems used for this purpose. Equally, the continuity and consistency of the risk management processes and the calculation of own funds requirements for market risk can only be ensured when such IT systems are safe, secure and reliable and the IT infrastructure is sufficiently robust. It is therefore necessary that, in the course of the assessment of the market risk internal models, competent authorities also check the reliability of the institution's IT systems and the robustness of the IT infrastructure used for the models.
- (11) Risks stemming from climate change and broader environmental issues are changing the risk picture for the financial sector and are expected to become even more prominent going forward. Considering the importance of these risk drivers, it is appropriate to specifically require competent authorities to verify that institutions consider them in their stress testing programmes referred to in Article 325bi Regulation (EU) No 575/2013. In this context, institutions have already taken steps to include environmental risks in their stress testing programmes. However, in light of the challenges that such inclusion triggers, it is appropriate that competent authorities assess this aspect from 01 January 2025 only.
- (12) Considering that one of the novelties of the new market risk framework as set out in Part Three, Title IV, Chapter 1b of Regulation (EU) No 575/2013 is the determination of own funds requirements on the basis of expected shortfall measures, it is necessary to ensure that institutions actively monitor the accuracy of those figures. It is therefore appropriate to include a requirement for institutions to directly back-test their expected shortfall measures as part of the internal back-testing programme required in Article 325bj of that Regulation. As there is not yet an established methodology among market participants for back-testing an expected

shortfall measure, no specific methodology should be prescribed, and institutions should be left free to take into account the evolution of new techniques and best practices in that regard, in line with the requirements set out in Article 325bi of that Regulation.

- (13) For an internal-risk measurement model to be considered implemented with integrity in accordance with Article 325bi of Regulation (EU) No 575/2013, all regulatory requirements should be met. Accordingly, it is necessary to ensure that also provisions included in delegated regulations are duly considered in the competent authority's assessment. At the same time, the prescriptive nature of the several delegated Regulations developed to specify elements relating to the alternative internal model approach should be taken into account. Accordingly, as regards all aspects covered by those delegated regulations, it is necessary to specify assessment techniques for competent authorities without further framing requirements laid down therein. Nonetheless, specific documentation requirements that institutions are to meet for those assessment techniques to be effective should be envisaged.
- (14) The back-testing and the profit and loss attribution requirements provide a solid basis for a critical monitoring of the performance of the internal-risk measurement model. It is therefore necessary to envisage assessment rules leveraging on the results of those tests. In relation to back-testing, it should be ensured that overshootings are critically analysed to identify potential weaknesses in the model, and that institutions monitor whether the changes in the portfolios' values are driven by modellable or by non-modellable risk factors. Furthermore, in light of the profit and loss attribution test results, competent authorities should be required to assess the accuracy of the pricing functions employed by the institution, as their accuracy is essential for a sound calculation of the own funds requirements.
- (15) In order to ensure their consistent application, it is necessary to detail the quantitative requirements referred to in Article 325bh of Regulation (EU) No 575/2013. For easing their application by the competent authorities, assessment rules relating to quantitative requirements should be developed by broad risk factor category. In particular, for each of the broad risk factors categories referred to in Table 2 of Article 325bd of Regulation (EU) No 575/2013, it is necessary to lay down how competent authorities are to assess whether basis risk is captured, and whether the treatment of curves and surfaces in the internal risk-measurement model is sound.
- (16) Unreliable, inaccurate, incomplete or outdated data results in errors in the risk estimation and in the calculation of own funds requirements, particularly in market risk models, due to the fast changing and evolving nature of financial markets. In the context of risk management processes of an institution, such erroneous data may also lead to poor management decisions. Consequently, in order to ensure the reliability and high quality of data, the infrastructure related to the collection and storage of data as well as the relevant procedures should be well documented, including a full description of the characteristics, quality checks, automatic filters and specific sources of daily data, in order to ensure their proper use in the internal processes and the processes for the calculation of own funds requirements. Competent authorities, in the assessment of market risk internal models, should therefore give particular

attention to the quality and reliability of the data used for modelling purposes, together with the processes applied to ensure that such quality is maintained.

- (17) To ensure an appropriate calculation of the own funds requirements, competent authorities should assess whether the approach employed by the institution to proxy time series is sound when assessing the overall quality of the data. Assessment rules should therefore be designed for verifying that the requirements set out in Regulation (EU) No 575/2013 governing the usage of proxies are met, and, where relevant, they should differ depending on whether the time series for which a proxy has been used relates to a risk factor that passed the modellability assessment, or to a risk factor that did not.
- (18) In relation to Articles 325bn, 325bo, 325bp of Regulation (EU) No 575/2013, assessment rules ensuring that the internal default risk model leads to accurate results should be set out. Those assessment rules should therefore cover all aspects affecting the outcome of that model, including the scope of the positions captured by the internal default risk model, the estimates of default probabilities and losses given default, the choice of systematic risk factors to simulate the default of issuers, as well of all modelling assumptions made by the institution, such as any copula assumption made for simulating the default of multiple issuers.
- (19) This Regulation is based on the draft regulatory technical standards submitted to the Commission by the European Banking Authority.
- (20) The European Banking Authority has conducted open public consultations on the draft regulatory technical standards on which this Regulation is based, analysed the potential related costs and benefits and requested the advice of the Banking Stakeholder Group established in accordance with Article 37 of Regulation (EU) No 1093/2010 of the European Parliament and of the Council¹¹.

HAS ADOPTED THIS REGULATION:

¹¹ Regulation (EU) No 1093/2010 of the European Parliament and of the Council of 24 November 2010 establishing a European Supervisory Authority (European Banking Authority), amending Decision No 716/2009/EC and repealing Commission Decision 2009/78/EC (OJ L 331, 15.12.2010, p. 12).

CHAPTER 1

GENERAL PROVISIONS

Article 1

Structure of the assessment

1. For the purpose of assessing the institution's compliance with the requirements set out in Articles 325bh, 325bi, 325bn, 325bo, 325bp of Regulation (EU) No 575/2013, the competent authority shall assess all of the following:
 - (a) the governance aspects in accordance with Chapter 2;
 - (b) aspects relating to the internal risk-measurement model used to compute the expected shortfall measure and the stress scenario risk measure in accordance with Chapter 3;
 - (c) aspects relating to the internal default risk model used to compute the additional own funds requirement for default risk in accordance with Chapter 4.

When performing the assessment referred to in the first subparagraph, the competent authority shall apply the principles related to proportionality in accordance with Article 2, the quality of the documentation in accordance with Article 3, and the outsourcing arrangements in accordance with Article 4.

2. Where, as part of the assessment performed in accordance with this Regulation, the competent authority identifies that the internal risk-measurement model presents significant deficiencies in relation to some product classes in a given trading desk, or it cannot verify that the internal risk-measurement model has a proven track record of being reasonably accurate in measuring the risks corresponding to those product classes, the competent authority may either require the institution to remove the positions corresponding to those product classes from that trading desk, or it may refuse to grant the permission to calculate the own funds requirements in accordance with the internal model approach for that trading desk.
3. Where the competent authority identifies that product classes in a given trading desk are booked back-to-back with those of another entity of the group that is outside the scope of the highest level of consolidation within the Union and this hinders the ability of the competent authority to verify that the internal risk-measurement model has a proven track record of being reasonably accurate in measuring risks corresponding to those product classes, the competent authority may require the institution to remove the positions corresponding to those product classes from that trading desk, or it may refuse to grant the permission to calculate the own funds requirements in accordance with the internal model approach for that trading desk.
4. Where the market risk of positions corresponding to some product classes is transferred to another entity of the group that is outside the scope of the highest level of consolidation within the Union, and the effects of such a transfer de-facto resemble those of positions booked back-to-back, the competent authority may apply the provision referred to in paragraph 3.

Article 2

Proportionality – product categories and model complexities

The competent authority shall apply the assessment methodology set out in this Regulation in a manner proportionate to the size and complexity of the trading activities included in the internal model, taking into account the following categories of financial instruments in increasing order of complexity:

- (a) simple instruments without optionality;
- (b) instruments, other than those listed in point (a), without path-dependent features, on a single underlying, including indices, with a continuous payoff in the same currency as the underlying;
- (c) instruments with path-dependent features, instruments on multiple underlyings, instruments with payoffs in currencies that are different to that of the underlying, and any other instruments not included in points (a) and (b).

Article 3

Quality and auditability of documentation

In order to assess the quality of the documentation submitted by an institution in support of its application for permission to use an internal model for the calculation of own funds requirements for market risk, the competent authority shall verify that the documentation is of sufficient quality and that it is sufficiently detailed and accurate to allow for examination by qualified third parties.

It shall verify, in particular, that:

- (a) the documentation is approved at the appropriate management level of the institution with sufficient authority delegated by the management body for the purposes of internal models;
- (b) the institution has established policies which ensure high-quality standards for internal documentation, including internal accountability for ensuring that the documentation maintained is complete, consistent, accurate, updated, approved as appropriate in accordance with point (a) and secure;
- (c) the documentation set out in the policies referred to in point (b) provides for the identification of at least the type of document, author, reviewer, authorising agent and owner, dates of development and approval, version number and history of amendments to the document;
- (d) the institution accurately and diligently documents the policies, procedures and methodologies it applies pursuant to this Regulation;
- (e) the documentation is sufficiently detailed to allow qualified third parties to understand all aspects of the internal risk-measurement model.

Article 4

Outsourcing

1. The competent authority shall verify that the outsourcing by an institution of any tasks, activities or functions related to the design, implementation and validation of internal models does not prevent or hinder in any way the application of the methodology specified in this Regulation for the purpose of assessing the institution's compliance with the requirements of Part Three, Title IV, Chapter 1b of Regulation (EU) No 575/2013.
2. For the purposes of paragraph 1, the competent authority shall verify that:
 - (a) tasks and responsibilities reserved for the risk control unit are not outsourced;
 - (b) the senior management and the management body are actively involved in the supervision of any tasks outsourced by the institution and of any IT risk management tool solutions obtained from third parties;
 - (c) the institution itself has sufficient knowledge relating to the outsourced tasks, activities or functions and of the structure of any data and methodologies obtained from a third party, and is able to verify the quality of the work performed by the third party to which it outsources its tasks, as well as the results of that work;
 - (d) the internal audit and the ongoing monitoring by the institution of any outsourced tasks, activities and functions are not limited or inhibited by such outsourcing;
 - (e) full access to all relevant information is granted to competent authorities.
3. The competent authority shall verify that third parties involved in the development of methodologies for assessing market risk used by the institution are not involved in the initial or ongoing internal validation of the model by the institution.
4. For the purpose of the verification required under paragraphs 1, 2 and 3, the competent authority shall, in particular, review the written agreement between the institution and the third party and, where appropriate, may also:
 - (a) interview or require the submission of written statements from any of the following:
 - (i) staff and senior management;
 - (ii) the management body;
 - (iii) the third party to whom the task, activity or function is outsourced;
 - (b) review other relevant documents of the institution or the third party.

CHAPTER 2

ASSESSMENT OF QUALITATIVE REQUIREMENTS

Article 5

Overview of the assessment of qualitative requirements

When assessing the institution's compliance with the qualitative requirements, as referred to in Article 325bi of Regulation (EU) No 575/2013, including requirements regarding the senior management and the management body, internal organisation, reporting, risk control unit, internal audit, oversight and validation, the competent authority shall:

- (a) verify that the institution has a clear organisational structure for the governance and management of the market risk model with well defined, transparent and appropriate lines of responsibility. When making this assessment, the competent authority shall take into account the nature and size of the institution, as well as the scale and complexity of its activities;
- (b) verify that the decision-making process of the institution regarding all aspects of market risk internal models is clearly established in the institution's internal documentation;
- (c) verify the adequacy of the composition and the role of the senior management and the management body, in accordance with Article 6;
- (d) verify that the set-up of the trading desks for which the institution is in the process of being granted the approval or has already obtained the approval, is adequate, in accordance with Article 7;
- (e) assess the internal governance and oversight of the institution in relation to the risk control unit, in accordance with Article 8;
- (f) assess the adequacy of the internal policy regarding the introduction of new products, in accordance with Article 9;
- (g) assess the independent review of the internal model, in accordance with Article 10;
- (h) assess the adequacy of the internal validation process and of its outcome in accordance with Article 11, and the adequacy of the scope of the validation, as well as of its completeness, in accordance with Article 12;
- (i) assess the adequacy of the internal regular reporting, in accordance with Article 13;
- (j) assess the adequacy of position limits in accordance with Article 14, of the process to update those limits in accordance with Article 15, and of the process followed where those limits are breached in accordance with Article 16;

- (k) assess the adequacy of the stress testing programme in accordance with Article 17, and of reverse stress-testing scenarios and ad-hoc stress-testing scenarios in accordance with Article 18;
- (l) assess the adequacy of the IT systems in accordance with Article 19;
- (m) assess whether the internal risk-measurement model, including any pricing model, have a proven track record of being reasonably accurate in measuring risks, and does not differ significantly from the models that the institution uses for its internal risk management in accordance with Article 20.

Article 6

Assessment of the adequacy of the composition and role of the management body and senior management

1. When assessing the adequacy of the composition and the role of the senior management and the management body in accordance with Article 325bi(1), point (c), of Regulation (EU) No 575/2013, the competent authority shall assess their composition, and shall:
 - (a) verify that, as part of its documentation, the institution describes the composition, the roles and responsibilities of the management body and senior management, and the roles and responsibilities of each member of the management body and senior management;
 - (b) verify that the senior management is constituted of members representing the highest hierarchical levels below the management body with defined responsibility for the proper functioning of the internal model for market risk;
 - (c) assess, in accordance with paragraph 2, the adequacy of the composition of any internal committee structure established by the management body to support its decision-making;
 - (d) assess, in accordance with paragraph 3, the adequacy of the role of the senior management;
 - (e) assess, in accordance with paragraph 4, the adequacy of the role of the management body and of the committees constituting the internal committee structure referred to in point (c).

Where the institution's management body delegates any of its tasks to an internal committee, the competent authority shall, in the context of those delegated tasks, make the assessments provided by this Regulation at the level of the internal committee designated by the management body.
2. For the purpose of assessing the adequacy of the internal committee structure as referred to in paragraph 1, first subparagraph, point (c), the competent authority shall verify that:
 - (a) for each committee of the internal committee structure, the management body has clearly defined its mandate, hierarchy, reporting lines, permanent members, frequency of meetings and levels of responsibility;

- (b) the internal committee structure includes a committee ('new product committee') that assesses, proposes to the senior management for approval and monitors any new product, and that the risk control unit and any other function of the institution affected by the introduction of a new product are represented in such committee;
 - (c) the governance underpinning the internal committee structure allows for the effective and timely control of all internal position limits referred to in Article 104b(2), point (c), and Article 325bi(1), point (b), of Regulation (EU) No 575/2013;
 - (d) the governance underpinning the internal committee structure ensures active involvement of the management body in the risk-control process as required by Article 325bi(1), point (c), of Regulation (EU) No 575/2013;
 - (e) as part of the internal documentation, the institution has documented all aspects referred to in point (a).
3. For the purpose of assessing the soundness of the role of senior management as referred to in paragraph 1, point (d), the competent authority shall verify that:
- (a) the senior management of the institution takes appropriate corrective actions where weaknesses of the internal risk-measurement model or the internal default risk model are identified by the risk control unit, the qualified parties tasked with the validation of the model ('validation function'), the internal audit function or any other control function of the institution;
 - (b) the senior management is informed of, and follows up on, the recommendations made by the internal audit, the risk control unit or the validation function in relation to the internal risk-measurement model or the internal default risk model;
 - (c) the senior management of the institution is able to ensure the overall quality of the institution's governance of the valuation of positions included in the internal risk-measurement model or the internal default risk model.
4. For the purpose of assessing the role of the management body and of the internal committee structure referred to in paragraph 1, point (e), the competent authority shall verify that:
- (a) on the basis of a proposal from the risk control unit, the management body approves all relevant policies and procedures related to the implementation of the internal risk-measurement model or the internal default risk model, including the appropriate organisational structure, ensuring that the model is implemented with integrity;
 - (b) on the basis of a proposal from the risk control unit and after due consideration of the conclusions and recommendations resulting from the validation process, the management body approves the methodologies for assessing market risk applied in internal risk-measurement model or the internal default risk model;
 - (c) on the basis of an assessment from the risk control unit and after due consideration of the conclusions and recommendations resulting from the

validation process, the management body approves any new products as referred to in Article 9;

- (d) on the basis of a proposal from the risk control unit, the management body approves and updates the internal position limits;
- (e) on the basis of a proposal from the risk control unit articulating and assessing the acceptable level of risk, the management body approves the acceptable level of risk, the internal capital allocation and the budget by trading desk;
- (f) the management body adopts the approval procedure for breaches of internal position limits, and approves or requires corrective actions in relation to breaches of the internal limits escalated by the risk control unit in accordance with Article 16(1), point (b);
- (g) on the basis of a proposal from the risk control unit, the management body approves the stress testing programme, discusses the results of the stress tests, assesses potential action and, where necessary, takes corrective actions.

Article 7

Assessment of the adequacy of the set-up of the trading desk

When assessing whether the set-up of trading desks is adequate in accordance with Article 104b of Regulation (EU) No 575/2013, the competent authority shall:

- (a) review the business strategy referred to in Article 104b of that Regulation as documented in the internal policies of the institution, and verify that:
 - (i) internal policies include a clear description of the economic rationale of the business strategy, including its primary activities, trading, and hedging strategies. When making this assessment, the competent authority shall verify that the strategy defines how much of the activities are customer driven, whether the business strategy entails trade origination and structuring, execution of services, or both;
 - (ii) internal policies include a description of the features of the financial instruments and commodities traded by trading desk, as well as a regularly updated and comprehensive list of those instruments and commodities;
 - (iii) the institution highlights in its internal policies which are the instruments that are most frequently traded and that contribute the most to the acceptable level of risk for the trading desk;
 - (iv) internal policies include a description of risk factor's types inherent in the financial instruments and commodities referred to in point (ii);
 - (v) internal policies include a clear description of how the instruments and commodities referred to in point (ii) are hedged, what are the

- expected slippages and mismatches of hedges, and what is the expected holding period for the positions in the trading desk;
- (vi) verify that the business strategies of the trading desks are distinctive, as referred to in Article 104b of Regulation (EU) No 575/2013, by identifying the main characteristics of the trading desks in terms of business strategy, including primary activities, trading and hedging strategies, and verifying that those main characteristics meaningfully differ from one trading desk to another;
- (b) verify that transactions between trading desks of the institution are consistent with the business strategies of those trading desks and that those transactions were not performed with the objective of:
- (i) reducing the own funds requirements for market risk;
 - (ii) meeting the profit and loss attribution requirements;
 - (iii) meeting the back-testing requirements.

Where appropriate, to support its analysis, the competent authority may require the institution to provide a sample of transactions between trading desks, including between trading desks for which the institution computes the own funds requirements with the internal approach and trading desks for which it uses the standardised approach;

- (c) review the organisational structure referred to in Article 104b(2), point (b), of Regulation (EU) No 575/2013 and the annual business plan referred to in Article 104b(2), point (e), of that Regulation, as documented in the internal policies of the institution, and verify that for each trading desk, the institution identified one or two head dealers, and that where two head dealers are present, they either have roles, responsibilities and authorities that are clearly separated, or one has ultimate oversight over the other;
- (d) review the reports referred to in Article 104b(2), points (d) and (f), of Regulation (EU) No 575/2013, and verify that all aspects referred to in those points are duly covered;
- (e) verify that the institution documents and justifies appropriately those cases where a dealer is assigned to more than one trading desk in accordance with Article 104b(3) of Regulation (EU) No 575/2013. When making this assessment, the competent authority shall:
 - (i) review the responsibility of those dealers in the context of the trading desks to which they have been assigned;
 - (ii) verify that the tasks performed by the dealer in one trading desk as per the business strategy of that desk are not in contradiction and do not create any conflict with the tasks that the dealer performs for the other trading desks.
- (f) assess the rationale for the inclusion of the trading desks in the scope of the alternative internal model approach as referred to in Article 325az(2), point (b), of Regulation (EU) No 575/2013. When making this assessment, the

competent authority shall verify that the rationale provided meets all of the following conditions:

- (i) it is documented in the internal policies referred to in Article 325bi(1), point (e), of Regulation (EU) No 575/2013;
- (ii) it ensures consistency in the approach used for calculating the own funds requirements for market risk among trading desks managing similar positions;
- (iii) it is coherent with the business strategy of the trading desks as referred to in Article 104b(2), point (a), of Regulation (EU) No 575/2013;
- (iv) it entails that at least 10% of the own funds requirements for market risk are calculated in accordance with the alternative internal model approach.

Article 8

Assessment of the internal governance and oversight of the institution

1. When assessing the internal governance and oversight of the institution in relation to the risk control unit in accordance with Article 325bi(1), point (b), of Regulation (EU) No 575/2013, the competent authority shall verify all of the following:
 - (a) the risk control unit is completely separate and independent from the personnel and the management functions responsible for the trading business areas;
 - (b) the risk control unit is appropriately represented in the institution's decision-making bodies and, as a minimum, is involved in the decision-making process where any of the following issues are on the agenda:
 - (i) approval of new methodologies for assessing market risk and any changes to the existing methodologies;
 - (ii) approval of the trading desk set-up in accordance with Article 104b of Regulation (EU) No 575/2013;
 - (iii) approval or update of reports and inventories;
 - (iv) the setting of the acceptable level of risk;
 - (v) the setting and regular update of the internal limit structure;
 - (vi) approval of limit breaches;
 - (vii) approval of new products or new business lines;
 - (viii) approval of pricing models used for risk purposes;
 - (ix) approval of the stress testing programmes;
 - (x) approval of IT infrastructure systems related to risk management tools;

- (c) the risk control unit is adequate and proportionate to the size of the firm and the risks of the business and has the appropriate resources to perform its tasks effectively;
 - (d) the risk control unit has adequate resources and sufficiently experienced, qualified and trained personnel to undertake all relevant activities for the effective risk management of the internal model and for monitoring and challenging the actions of other units, in particular of the trading business units;
 - (e) the risk control unit is responsible for the outcome of the calculations carried out using the internal-risk measurement model and the internal default risk model.
2. When conducting the verification referred to in paragraph 1, point (a), the competent authority shall verify all of the following:
- (a) the risk control unit is composed of one or more separate organisational structures in the institution's organisational chart;
 - (b) the heads of the risk control unit or units are senior managers of the institution;
 - (c) the staff and the senior management responsible for the risk control unit are not responsible for any trading business activities;
 - (d) senior managers of the risk control unit and those responsible for business areas have different reporting lines to the management body of the institution;
 - (e) the variable remuneration of the staff and senior management responsible for the risk control unit is not linked to the performance of the tasks related to trading business areas under their supervision in a way that hinders or impedes their independence.
3. When conducting the verification referred to in paragraph 1, point (b), the competent authority shall take into account all of the following:
- (a) the documented view of the risk control unit when any of the issues listed in paragraph 1(b) are discussed by either the management body or the relevant committee of the internal committee structure;
 - (b) the minutes of the institution's management body or relevant committee of the internal committee structure, and the action points reflected therein. When making this assessment, the competent authority shall assess the degree of involvement of the risk control unit when any of the issues listed in paragraph 1(b) are discussed, and shall identify cases where there has been a divergence from the view of the risk control unit and the final decision taken by either the management body or the relevant committee of the internal committee structure;
 - (c) the reports produced by the risk control unit relating to internal position limits, as well as any decisions regarding limit breaches;
 - (d) information provided by the staff and senior management of the institution, where appropriate.

Article 9

Assessment of the adequacy of the new product policy

Where assessing the adequacy of the internal policy in accordance with Article 325bi(1), point (e), of Regulation (EU) No 575/2013, with reference to the introduction of any new product, including new financial instruments, activities, markets, booking locations or business lines, the competent authority shall verify all of the following:

- (a) the risk control unit has documented a new product policy and the management body has approved that policy, which includes an internal definition of ‘new product’;
- (b) the internal committee structure includes a committee (‘new product committee’) that assesses, controls and monitors all issues arising from the introduction of new products, including, where relevant:
 - (i) assessing regulatory compliance;
 - (ii) reviewing any pricing models used for risk purposes;
 - (iii) defining the market parameters to be used for calibration purposes, the way the calibration is done and the frequency of update of the calibration;
 - (iv) introducing any new methodologies for assessing market risk;
 - (v) assessing the impacts on the acceptable level of risk, capital adequacy and profitability;
 - (vi) ensuring the availability of adequate front, back and middle office resources and adequate internal tools and expertise to understand and monitor any associated new risks;
 - (vii) specifying and proposing to the management body the restrictions in terms of maturities, underlying, counterparties and internal limits for that new product;
 - (viii) assessing the adequacy of the accounting schemes and ensuring that the internal reporting appropriately reflects the underlying risks;
- (c) the management body, based on an assessment by the committee referred to in point (b), authorises the trading of new products;
- (d) where the management body delegates the authorisation task to the new-product committee:
 - (i) that the volume allowed for the new product is restrictive enough to prevent any material losses stemming from such new products, including, where appropriate, shorter trial periods for products in the category referred to in point (c), of Article 1;
 - (ii) that the authorisation is delegated separately for each type of new product and always for a limited period of time, with a maximum of six months;

- (iii) that this authorisation, if renewed, is only renewed once by the management body;
- (iv) that, after a one-year period, all relevant aspects referred to in point (b) are addressed, or no additional trading in that new product is allowed;
- (e) that, without the specific approval from the new-product committee, the business areas are not authorized to trade new products before the relevant aspects referred to in point (b) are addressed;
- (f) in the specific cases where traders are allowed to trade new products which do not fulfil all the aspects listed in point (b), the transactions have to be approved on an individual basis by the new-product committee and within the limits referred to in point (d)(i);
- (g) the new-product committee meets frequently enough to evaluate and approve any new product transaction and to monitor all the potential issues listed in point (b) that these transactions may pose;
- (h) transactions are monitored individually until all issues listed in point (b) have been fully addressed and, based on an assessment by the new-product committee, the management body confirms that the transactions are fully incorporated into all relevant IT systems and controlled via the regular risk-management system;
- (i) regardless of their degree of incorporation into the IT systems, all new products are computed both in the internal risk-measurement model and in the daily changes to the portfolio's value used for back-testing and profit and loss attribution test purposes.

Article 10

Independent review of the internal risk-measurement model

1. For the purposes of assessing the independent review of the internal model in accordance with Article 325bi(1), point (h), of Regulation (EU) No 575/2013, the competent authority shall verify all of the following:
 - (a) the reviewer is independent;
 - (b) the resources assigned to the review are appropriate;
 - (c) the process established within the institution to address the recommendations made by the reviewer is adequate;
 - (d) the reviewer conducts the review of the internal risk-measurement models on at least an annual basis, and includes the conclusions of that review in a report submitted to the senior management and the management body;
 - (e) the report referred to in point (d) provides sufficient information to the senior management and the management body of the institution on all elements referred to in Articles 325bi(2) and 325bp(7) of Regulation (EU) No

- 575/2013, and identifies the areas in the annual work plan where it is necessary to carry out a more detailed compliance analysis of those elements;
- (f) the review is adequate, proportionate and effective.
2. When conducting the verification referred to in paragraph 1, the competent authority shall verify all of the following:
- (a) the review is proportionate to the nature, size and degree of complexity of the institution's business and organizational structure, and in particular to the complexity of the models and their implementation;
 - (b) the reviewer has adequate resources and experienced and qualified personnel to undertake all relevant activities;
 - (c) the reviewer is not nor was involved in any aspect of the design and implementation of the internal model subject to review;
 - (d) the reviewer is independent from the personnel and management function responsible for the business and risk control units;
 - (e) the variable remuneration of the staff and management responsible for the review is not linked to the performance of the tasks related to the institution's trading business areas in a way that hinders or impedes their independence.
3. The competent authority shall examine the latest and other relevant reports produced by the reviewer and verify that the remediation of the issues identified in those reports is relevant, material and credible.

Article 11

Assessment of the internal validation process and of its outcome

1. The competent authority shall verify that the internal validation process referred to in Article 325bj of Regulation (EU) No 575/2013 is adequate by verifying all of the following:
- (a) the validation process is conducted by personnel that is not nor was involved in any way in the development of the internal model subject to validation;
 - (b) the validation process is conducted with adequate resources, including experienced and qualified personnel to perform its tasks;
 - (c) the variable remuneration of the staff and senior managers responsible for the validation process is not dependent on the performance of the tasks related to the institution's risk control or business areas in a way that hinders or impedes their independence;
 - (d) all necessary corrective measures resulting from the validation process are reflected in the validation report referred to in paragraph 2, and implemented in a timely manner;
 - (e) there is a decision-making process in place to ensure that the findings and recommendations resulting from the validation process are properly taken into account by the senior management of the institution;

- (f) the reviewer referred to in Article 10 regularly assesses the fulfilment of the conditions referred to in points (e) and (f).
2. When assessing the adequacy of the outcome of the validation process, the competent authority shall:
- (a) verify that the recommendations, findings and conclusions of the validation process are included in a validation report identifying and describing the validation methodology, the tests performed, the reference dataset used and the respective data cleansing processes;
 - (b) verify that the conclusions, findings and recommendations of the validation report are directly communicated to and considered by the management body of the institution before the management body approves a model to be applied for capital purposes and before any subsequent changes in the methodologies are applied;
 - (c) verify that any remedial measure proposed by the validation functions is documented in the validation report and is accompanied by an adequate timeline for fixing the identified deficiencies;
 - (d) verify that, in its internal policies, there is an escalation process for those remedial measures that are overdue, and verify, based on evidence from the past, that this process has been followed;
 - (e) assess the overall quality of the outcome of the validation process by comparing the deficiencies identified in the assessment of the model when applying this Regulation and those identified by the validation unit in the validation process.

Article 12

Assessment of the adequacy of the scope and completeness of the internal validation

1. When assessing the adequacy of the scope of the validation referred to in Article 325bj of Regulation (EU) No 575/2013, the competent authority shall verify that that scope is such that it:
- (a) provides for a critical review of all aspects of the methodologies and pricing functions used for capital purposes, including those applied to new products taking account of strengths and weaknesses compared to any alternative methodologies;
 - (b) comprises verification of the choice of market data, the mapping of risk factors to the relevant liquidity horizon, the mapping of a real price observation to a risk factor or to a bucket for which it is considered representative, and the proxying approaches used;
 - (c) comprises a verification that the distributional and any other relevant stochastic assumptions and parameters of the underlying stochastic processes, including volatility and correlation, are well justified, including with regard to the tails of the distributions relevant for the calculation of the expected

shortfall risk measures referred to in Article 325bb of Regulation (EU) No 575/2013 and the stress scenario risk measure referred to in Article 325bk of that Regulation;

- (d) comprises an assessment of the soundness of any empirical correlations used both within and across the broad risk factor categories to calculate the unconstrained expected shortfall measure as referred to in Article 325bh(2) of Regulation (EU) No 575/2013;
- (e) comprises an assessment of the correlation assumptions made in the calculation of the own funds requirements for default risk, including the choice of the relevant copula, where modelled explicitly, the choice and weights of the systematic risk factors referred to in Article 325bp of Regulation (EU) No 575/2013, and an assessment of the ability of the model to explain default clusters;
- (f) comprises an assessment of the assumptions made to obtain estimates of default probabilities and losses given default for the purpose of computing own funds requirements for default risk;
- (g) comprises an assessment of the assumptions made in relation to the modelling of hedges in the computation of own funds requirement for default risk as referred to in Article 325bo of Regulation (EU) No 575/2013;
- (h) comprises an analysis of the results of the stress testing programme, including that relating to default risk, extracting relevant conclusions, if any, around methodological flaws or weaknesses stemming from particular market scenarios;
- (i) applies and analyses the results obtained for the hypothetical portfolios required by Article 325bj(3), point (c), of Regulation (EU) No 575/2013, to ensure that the internal model can account for structural features, including, where relevant, at least the following:
 - (i) basis risks between different yield curves;
 - (ii) less than perfectly correlated movements between similar but not identical positions;
 - (iii) name-related basis risk and basis stemming from similar but not identical credit or equity positions;
 - (iv) concentration risk;
- (j) verifies the robustness of the implementation in IT systems, and ensures that methodologies are applied consistently by all business and support units and for all relevant geographic areas;
- (k) verifies the appropriateness and materiality of the proxies by assessing the percentage of proxied time series used, the percentage marginal contribution of proxied time series, as well as the impact that proxy usage may have in the recognition of diversification effects.

2. When assessing the completeness of the validation process, the competent authority shall verify that:

- (a) for the internal validation conducted when the model is initially developed, the institution has performed and documented a complete validation process for all methodologies applied in the internal model;
 - (b) for the periodic internal validation to be conducted after the initial validation referred to in point (a), the institution has conducted a complete validation, or has done the validation on areas to be validated following the changes referred to in paragraph 3, on any new methodologies required by the introduction of new products, as well as on areas related to any issues identified in the conclusions of previous validations and internal audit reviews.
3. When assessing the adequacy of the process governing the periodic validation referred to in paragraph 2, point (b), the competent authority shall:
- (a) verify that the internal policies of the institution ensure that the periodic validation is performed at least annually, and each time significant structural changes in the market or changes to the composition of the portfolio occur, which may lead to the internal model no longer being adequate, including the following:
 - (i) a number of overshootings that deviate significantly from what is anticipated by the model calibration;
 - (ii) large market losses relative to the level predicted by risk metrics;
 - (iii) a significant change in the institution's business that may challenge the modelling assumptions;
 - (iv) unusual and significant misalignments between the theoretical and hypothetical changes to the portfolios' values;
 - (b) verify that the periodic validation is based on a work plan, approved by the management body, setting out the scope of the validation, the tasks performed by the validation unit and the priorities of the validation;
 - (c) assess how the work plan referred to in point (b) ensures that a comprehensive and risk-oriented validation process is performed, and that relevant aspects are not omitted from the validation scope.

Article 13

Assessment of the adequacy of reporting

1. Where assessing the adequacy of the reports referred to in Article 104b(2), points (d) and (f), and Article 325bi(1), point (b), of Regulation (EU) No 575/2013, the competent authority shall verify that the institution maintains an inventory of those reports, specifying their content, frequency and addressees.
2. The competent authority shall also verify that that inventory has been approved at the appropriate management level and is updated in consultation with the risk control unit.

Article 14

Assessment of adequacy of trading limits

When assessing the adequacy of trading limits referred to in Article 103(2), point (b)(ii), Article 104b(2), points (c) and (f), and Article 325bi(1), point (b), of Regulation (EU) No 575/2013, the competent authority shall verify that all of the following apply:

- (a) the institution has a clear breakdown of trading limits consistent with the acceptable level of risk set by the institution and the budget of each trading desk;
- (b) the choice of the limits reflects the trading strategy of the trading desk and the nature of the underlying risks;
- (c) the limits include at least the following:
 - (i) a VaR limit for the maximum level of portfolio aggregation at which the internal model is applied, and that this VaR limit is understood as the sum of individual VaR limits when the permission referred to in Article 325 of Regulation (EU) No 575/2013 has not been granted;
 - (ii) a VaR limit for each trading desk for which the institution calculates its own funds requirement for market risk with the internal risk-measurement model;
- (d) whether the institution has a further breakdown in the VaR limits, proportional to its trading strategies;
- (e) all internal limits, including those referred to in point (c), are properly documented and formally approved;
- (f) as part of the limit approval and update process, the risk control unit assesses and documents the consistency and compatibility between the VaR limits approved by the management body and the rest of the internal limits not based on VaR, including sensitivities or loss trigger;
- (g) the institution properly documents and formally approves an inventory of authorized instruments and underlying risk positions that traders can enter.

Article 15

Assessment of the adequacy of the process to update trading limits

1. When assessing the adequacy of the process of updating the institution's trading limits referred to in Article 103(2), points (b)(ii), Article 104b(2), points (c) and (f), and Article 325bi(1), point (b), of Regulation (EU) No 575/2013, the competent authority shall verify all of the following:

- (a) the update process is coordinated and appropriately documented by the risk control unit;

- (b) the proposal for updating the trading limits reflects any changes in the acceptable level of risk set by the institution and in the expected activity or in the budget objectives of the trading desks;
 - (c) the proposal for updating the trading limits takes into account the average level of use of the trading limits applicable at the time of the update and the number and magnitude of limit breaches, over the period where the limit applicable at the time of the update has been used.
2. The competent authority shall verify that the update process of the internal limit structure is conducted at least every year, and more frequently where there are changes in the organisation or new business lines or products are introduced.

Article 16

Assessment of the adequacy of the process relating to limit breaches

1. Where assessing the adequacy of the process for the approval of breaches to the trading limits referred to in Article 104b(2), point (f), of Regulation (EU) No 575/2013, the competent authority shall verify all of the following:
- (a) there is a clear and documented procedure for the approval of limit breaches, which the management body has approved;
 - (b) the management body has defined materiality conditions in which any limit breaches are escalated to the board, irrespectively of the level where the limits were approved;
 - (c) limit breaches are documented by the risk control unit and reported to the responsible committee, sub-committee or individual manager, and that those either take action on the limit breached, or escalate it according to the requirements established in point (b);
 - (d) the documentation referred to in point (c) includes the magnitude and main causes of the limit breach, including any increase in the trading positions, any methodological changes introduced in the internal risk-measurement model or developments in market conditions.
2. The competent authority shall verify that the frequency and magnitude of limit breaches, and the measures taken by the risk control unit and management in response to these breaches, are appropriate. The competent authority shall conduct such verification, in particular, when a trading desk has frequently exceeded limits.

Article 17

Assessment of adequacy of the stress testing programme

1. For the purposes of assessing the adequacy of the programme of stress testing referred to in Article 325bi(1), point (g), and Article 325bp(7), point (b), of Regulation (EU) No 575/2013, the competent authority shall verify that:

- (a) the scenarios applied as part of the stress testing programme are reviewed at least annually;
 - (b) the risk control unit runs the stress test scenarios determined in the stress testing programme at an appropriate frequency and at least every month, and at a higher frequency where the institution has significant trading activities;
 - (c) the scenarios to be applied as part of the stress testing programme include, apart from historically observed or hypothetical scenarios, ad-hoc scenarios reviewed at least yearly as a result of either of the following:
 - (i) identifying scenarios after performing reverse stress tests in accordance with Article 18(1);
 - (ii) identifying specific scenarios designed to address the relevant risk drivers referred to in Article 18(2).
2. The competent authority shall verify that the scenarios referred to in paragraph 1, point (c), are used to assess the reasonableness of the elements constituting the own funds requirements for market risk, including the additional own funds requirement for default risk, when compared with potential losses stemming from severe, but plausible market scenarios.
 3. For the purpose of paragraph 2, the competent authority shall also verify that the losses arising from events, including credit events, hypothetical rating downgrades, market events on specific issuers' types, as well as changes to copulas' types and parameters, where modelled explicitly, are also used to assess the reasonableness of the default risk model assumptions, in particular regarding the capture of credit risk concentrations.

Article 18

Assessment of the adequacy of the reverse and ad-hoc stress testing scenarios

1. Where assessing the adequacy of the reverse stress testing scenarios referred to in Article 325bi(1), point (g), of Regulation (EU) No 575/2013, the competent authority shall verify all of the following:
 - (a) the risk control unit applies the reverse stress test as a tool to identify possible combinations of severe events and risk concentrations within the institution that might not be generally considered, including those that may derive from environmental risks;
 - (b) the analysis performed with the reverse stress test complements the regular stress testing;
 - (c) when identifying the scenario or scenarios resulting from reverse stress testing, the risk control unit assesses all of the following:
 - (i) the business lines where traditional risk management models indicate an exceptionally good trade-off between risk and return;
 - (ii) new products and new markets which have not experienced severe strains;

- (iii) exposures where there are no liquid two-way markets;
 - (iv) foreign exchange exposures either pegged or subject to a cap or floor to other currencies;
 - (v) positions in deep out-of-the-money options, in particular digital options;
 - (vi) events not contemplated in the stress period used to calibrate the expected shortfall risk measures referred to in Article 325bb of Regulation (EU) No 575/2013;
 - (vii) environmental risks in the form of both physical and transition risks.
2. Where assessing the adequacy of ad hoc stress testing scenarios as part of the stress testing programmes referred to in Article 325bi(1), point (g), of Regulation (EU) No 575/2013, competent authorities shall verify that the risk control unit designs the relevant stressed scenarios taking into account the composition, at the last reporting date, of the portfolio of positions included in the scope of the internal model, and in particular, by verifying all of the following:
- (a) the risk control unit uses the results obtained from sensitivity analysis towards single risk factors, considered individually and jointly, to identify scenarios that include the stress of a combined set of plausible risk factors;
 - (b) the risk control unit explicitly considers at least the following elements when establishing the stress scenarios:
 - (i) illiquidity of markets in stressed market conditions, gapping of prices, concentration risk and one-way markets. This may be achieved by considering larger shocks to reflect the impossibility of unwinding positions in a timely manner, especially for cash instruments, either because positions are concentrated or due to a sharp increase in market illiquidity;
 - (ii) an event resulting in a rise in correlation across instruments or risk factors or a sharp foreign exchange shift scenario, stemming from any currencies which are subject to a peg, cap or floor at the time of the review, which are breaking its relationship, where that event occurs at the same time as an event referred to in point (i);
 - (iii) event risks for equities and jump-to-default risk for credit positions by considering four instantaneous defaults with zero recovery of the long debt positions in the current portfolio with the largest exposure and the two largest equity long positions in the current portfolio, or the event risk stemming from a sharp rise in equity prices for the two largest short positions;
 - (iv) non-linearity of products, deep out-of-the-money positions where the portfolio is revalued applying full revaluation of all positions to reflect non-linearity effects accurately and where the shocks applied are large enough to trigger the exercise of some deep out-of-the-money options, in particular digital options;
 - (v) event risks stemming from environmental risk drivers;

- (vi) other risks that may not be captured appropriately in the internal models, including those derived from the use of proxies, such as the potential misalignment between a proxy and the underlying risk. This may be achieved in particular by assessing the potential risk incurred when hedging positions valued using a proxy and by applying the stressed scenario movements to the proxy while keeping illiquid positions constant.

Article 19

Assessment of the robustness of the IT systems

1. When assessing that the internal risk-measurement model is calculated and implemented with integrity in accordance with Article 325bi(1) of Regulation (EU) No 575/2013, the competent authority shall verify that the institution's IT systems related to market risk management and the IT systems supporting the internal model are robust enough to cope with errors during execution. When making this assessment, the competent authority shall:
 - (a) assess the robustness of the IT systems during the last 250 business days;
 - (b) verify that appropriate remediation capabilities are in place in case of system breakdown, that the institution is able to re-calculate any affected risk metrics and that back-testing overshootings produced by technical problems are exceptional.
2. The competent authority shall verify that the institution examines all internal model positions and instruments in the internal risk-measurement model and the end-of-day value systems with a view to reconcile them by confirming, at least on a weekly basis, that the positions and instruments in one system correspond to those in the others. The competent authority shall verify that the institution fully documents and monitors any positions and instruments not fully reconciled.

Article 20

Assessment of reasonable model accuracy

1. When assessing the institution's compliance with Article 325bi(1), point (f), of Regulation (EU) No 575/2013 in relation to the requirement for the internal risk-measurement model, including any pricing model, to have a proven track record of being reasonably accurate in measuring risks, and not differing significantly from the models that the institution uses for its internal risk management, the competent authority shall:
 - (a) verify that the institution has regularly updated inventories, including:
 - (i) the pricing functions or methods used in the internal-risk measurement model and the pricing functions or methods used to calculate the end-of-day value of the portfolio;

- (ii) for each of those pricing functions or methods referred to in point (i), a concise description, the main features and assumptions, key parameters and how they were calibrated, and implementation characteristics;
 - (iii) the scope of financial instruments and commodities included in the internal-risk measurement model covered by each pricing function or method;
 - (iv) the scope of financial instruments and commodities covered by each pricing function or method in the calculation of the end-of-day-value of the portfolio;
 - (v) one or more metrics to measure the materiality of positions priced with the corresponding pricing function or method in the internal risk-measurement model;
 - (vi) one or more metrics to measure the materiality of positions priced with the corresponding pricing function and method in the calculation of the end-of-day-value of the portfolio;
 - (vii) a comprehensive mapping between the pricing functions and methods used in the internal risk-measurement model and the pricing functions and methods used in the calculation of the end-of-day-value of the portfolio;
- (b) verify that the inventories referred to in point (a) are updated at least annually, and the internal policies of the institution provide for a specific update whenever this would imply substantial changes in the information provided in the inventories;
- (c) verify that all the differences between the pricing functions used to compute the end-of-day value and those used in the internal risk-measurement model are validated as part of the internal validation referred to in Article 325bj of Regulation (EU) No 575/2013;
- (d) assess, on the basis of the profit and loss attribution results and the back-testing results, whether there are pricing functions that may present deficiencies. Where appropriate, the competent authority may complement its assessment by requiring the institution to compute, on a set of instruments and commodities for which it wants to test the accuracy of the pricing functions, the risk-theoretical changes as referred to in Chapter 2, Section 2, of Commission Delegated Regulation (EU) 2022/2059 of 14 June 2022¹² and the hypothetical changes as referred to in Chapter 1, Section 2, of that Delegated Regulation, and require the institution to justify deviations in the two measures;

¹² Commission Delegated Regulation (EU) 2022/2059 of 14 June 2022 supplementing Regulation (EU) No 575/2013 of the European Parliament and of the Council with regard to regulatory technical standards specifying the technical details of back-testing and profit and loss attribution requirements under Articles 325bf and 325bg of Regulation (EU) No 575/2013 (OJ L 276, 26.10.2022, p. 47).

- (e) analyse the conclusions in the most recent reports by the institution's internal validation referred to in Article 325bj of Regulation (EU) No 575/2013 regarding the accuracy of the internal risk-measurement model;
 - (f) analyse the conclusions in the most recent reports by the institution's internal review referred to in Article 325bi(1), point (h), of Regulation (EU) No 575/2013 regarding the accuracy of the internal risk-measurement model;
 - (g) verify that the institution has documented the differences between the internal risk-measurement model and the models that the institution uses for its internal risk management for the same scope of positions, and that the institution is able to explain them;
 - (h) analyse the results of the tests performed by the institution as part of its internal validation to verify whether the assumptions made in the model are appropriate and do not underestimate or overestimate the risk as referred to in Article 325bj(3), point (a), of Regulation (EU) No 575/2013, in particular for the trading desks with the highest differences of the own funds requirements computed in accordance with the alternative standardised approached referred to in Part Three, Title IV, Chapter 1a of Regulation (EU) No 575/2013, and the internal risk-measurement model.
2. Where positions corresponding to product classes assigned to a trading desk are booked back-to-back with those of another entity of the group that is outside the scope of the highest level of consolidation within the Union, and the competent authority needs more evidence to verify that model is reasonably accurate, the competent authority may require institutions to provide:
- (a) the actual, hypothetical, risk theoretical changes in the trading desk portfolio's value without any hedges with the entity of the group being considered, over 60 business days;
 - (b) the VaR numbers at trading desk level referred to in Article 325be of Regulation (EU) No 575/2013 without any hedges with the entity of the group being considered, over 60 business days;
 - (c) an assessment of the profit and loss attribution results and back-testing results in light of the changes in the portfolio's values referred to in point (a) and the VaR numbers referred to in point (b),
3. Where the market risk of positions corresponding to some product classes is transferred to another entity of the group that is outside the scope of the highest level of consolidation within the Union, and the effects of such transfer de-facto resemble those of positions booked back-to-back, competent authority may apply the provision referred to in paragraph 2.

Article 21

Assessment of compliance in relation to additional back-testing programmes

1. When assessing that the institution's internal model is implemented with integrity in accordance with Article 325bi(1) of Regulation (EU) No 575/2013 in relation to

requirements on back-testing programmes to be performed by the institution in accordance with Article 325bj(3), point (b), of that Regulation, the competent authority shall verify whether, as part of those programmes, the institution:

- (a) runs the back-testing programme referred to in paragraph 2 or another internal back-testing programme that allows the institution to identify the contribution of modellable and non-modellable risk factors to the back-testing results;
- (b) applies direct expected shortfall back-testing approaches to its portfolios. When making this assessment, the competent authority shall verify how the institution motivates the choice of the applied direct expected shortfall back-testing methodology, and analyse if the methodology is conceptually sound.

The back-testing programmes referred to in the first subparagraph may serve as an element to detect and monitor potential deficiencies in the calculation of the expected shortfall measures and shall not supersede the outcomes of the regulatory back-testing referred to in Article 325bf of Regulation (EU) No 575/2013 and the profit and loss attribution requirements referred to in Article 325bg of that Regulation in the decisions of the competent authority regarding the permission to use the alternative internal model approach to compute the own funds requirement for market risk.

2. For the purposes of paragraph 1, first subparagraph, point (a), the institution may run a back-testing programme that applies the following principles:
 - (a) an overshooting is identified as a one-day change in HPL_{MRF} or in APL_{MRF} that exceeds the value risk-number referred to in Article 325bf(6), point (a), of that Regulation;
 - (b) HPL_{MRF} and APL_{MRF} are calculated as follows:

$$HPL_{MRF} = HPL + RTPL_{MRF} - RTPL$$

$$APL_{MRF} = APL + RTPL_{MRF} - RTPL$$

Where:

- HPL are the hypothetical changes in the portfolio's value;
 - APL are the actual changes in the portfolio's value;
 - $RTPL$ are the risk-theoretical changes in the institution's portfolio's value;
 - $RTPL_{MRF}$ are the risk-theoretical changes in the institution's portfolio's value considering only changes to modellable risk factors;
- (c) the institution identifies potential weaknesses in its risk-measurement model by counting the overshootings, as identified in accordance with point (a), that occurred over the last 250 business days, and by comparing the amount of the identified overshootings against the thresholds referred to in Article 325bf(3), points (a) and (b), of Regulation (EU) No 575/2013.

CHAPTER 3

ASSESSMENT OF THE INTERNAL RISK-MEASUREMENT MODEL USED TO COMPUTE THE EXPECTED SHORTFALL MEASURE AND THE STRESS SCENARIO RISK MEASURE

SECTION 1

OVERVIEW OF THE ASSESSMENT

Article 22

Introduction to the assessment of the internal risk-measurement model used to compute the expected shortfall measure and the stress scenario risk measure

For the purpose of assessing the institution's compliance with the requirements applicable to the internal risk-measurement model used to compute the expected shortfall measure and the stress scenario risk measure, the competent authority shall assess all of the following:

- (a) the compliance of the institution in relation to requirements on risk factors, including the modellability assessment and the mapping to the appropriate liquidity horizon, in accordance with the Section 2;
- (b) the compliance of the institution in relation to the data quality and the proxy approaches used in the calculation of the expected shortfall measure referred to in Article 325bb of Regulation (EU) No 575/2013 and the stress scenario risk measure referred to in Article 325bk of Regulation (EU) No 575/2013 in accordance with Section 3;
- (c) the compliance of the institution in relation to back-testing and profit and loss attribution requirements in accordance with the Section 4;
- (d) the compliance of the institution in relation to the treatment of foreign-exchange and commodity risk in the non-trading book in accordance with Section 5;
- (e) the compliance of the institution in relation to requirements on the expected shortfall measure and the stress scenario risk measure calculations in accordance with Section 6.

SECTION 2

ASSESSMENT OF THE INTERNAL RISK MEASUREMENT MODEL'S RISK FACTORS SET-UP AND PROPERTIES

SUBSECTION 1

ASSESSMENT OF THE INTERNAL RISK MEASUREMENT MODEL'S RISK FACTORS SET-UP

Article 23

Assessment of the internal risk-measurement model's coverage of the risk

1. When assessing the institution's compliance with Article 325bh(1), point (a), of Regulation (EU) No 575/2013 in relation to requirements on the inclusion in the internal risk-measurement model of at least those risk factors that are used in the calculation of the own funds requirements under the alternative standardised approach, the competent authority shall verify that:
 - (a) the institution documents whether there are risk factors used in the standardised approaches that are not included in the internal risk-measurement model, and that all the following aspects are highlighted:
 - (i) whether there are currencies for which general interest rate risk, including inflation risk or cross-currency basis risk, are not modelled;
 - (ii) whether there are issuer's credit spreads that are not modelled;
 - (iii) whether there are equity spot prices and equity repo rates that are not modelled;
 - (iv) whether there are commodity spot prices that are not modelled;
 - (v) whether there are spot exchange rates that are not modelled;
 - (vi) whether there are cases where the implied volatility in instruments with optionality is not modelled;
 - (b) where there are risk factors used in the alternative standardised approach that are not included in the internal risk-measurement model, the institution, in addition to providing information on the impact of the exclusion of those risk factors on the profit and loss attribution results in accordance with Article 325bh(1), point (a), of Regulation (EU) No 575/2013:
 - (i) provides an appropriate rationale for not including those risk factors in the internal risk-measurement model and, in the case that this is due to lack of representative prices for the risk factors, the rationale for not capturing them in the calculation of the stress scenario risk measure referred to in Article 325bk of Regulation (EU) No 575/2013, and documents such a rationale;

- (ii) calculates and monitors the impact on the own funds requirements resulting from excluding those risk factors from the internal risk-measurement model.
2. When assessing the institution's compliance with Article 325bh(1), point (a), of Regulation (EU) No 575/2013 in relation to the requirements on the inclusion in the internal risk-measurement model of a sufficient number of risk factors, the competent authority shall perform the following steps in sequence:
- (a) require the institution to provide an overview of the factors used in the calculation of the end-of-day value of the portfolio, including, where appropriate, a list of aggregates of factors used in the calculation of the end-of-day value, which specifies the following for each aggregate:
 - (i) the number of factors per aggregate;
 - (ii) the broad risk factor category and broad risk factor subcategory, as referred to in Table 2 of Article 325bd of Regulation (EU) No 575/2013, to which the factors in the aggregate can be mapped;
 - (iii) a gross and net sensitivity of the institution portfolio to the factors that are part of the aggregate;
 - (iv) whether the factors are included or not in the internal risk-measurement model, and:
 - (1) where included, whether each factor is directly modelled as a risk factor in the internal-risk measurement model without any proxy being used, or whether other techniques, such as proxies or reduction of granularity, including beta approximations, factor models, reduction in the tenors captured for a curve, parametrisation of curves, surfaces and cubes, are used;
 - (2) where not included, the rationale for that choice.

The aggregation of factors shall be done so that each aggregate share the same attributes in relation to points (ii), (iv)(1), and (iv)(2).
 - (b) by using the overview referred to in point (a):
 - (i) verify that there are no material factors that are not modelled, and that the rationales supporting the exclusions of non-modelled factors are appropriate. When making this assessment, the competent authority shall apply the assessment method referred to in paragraph 3, which may be complemented by the assessment method referred to in paragraph 4;
 - (ii) assess how, for factors that are not modelled directly as risk factors in the risk-measurement model as referred to in point (a)(iv), the institution ensures that all material risks, including material basis risks, are captured.
3. For the purpose of the assessment referred to in paragraph 2, point (b)(i), the competent authority shall identify trading desks or hypothetical portfolios used by the institution for internal validation as referred to in Article 325bj(3), point (c), of Regulation (EU) No

575/2013 whose values depend on factors that are not included in the internal risk-measurement model. Competent authorities shall verify, for those trading desks, whether the results of the back-testing referred to in Article 325bf of Regulation (EU) No 575/2013 or of the own internal model validation tests as referred to in Article 325bj(3), point (b), of Regulation (EU) No 575/2013 indicate weaknesses in the model.

4. For the purpose of the assessment referred to in paragraph 2, point (b)(i), the competent authority may identify trading desks or hypothetical portfolios used by the institution for internal validation as referred to in Article 325bj(3), point (c), of Regulation (EU) No 575/2013 whose values depend on factors that are not included in the internal risk-measurement model, and apply the following steps:
 - (a) require the institution to compute the following:
 - (i) the hypothetical changes in the trading desk portfolio's value or in the hypothetical portfolio's value computed in accordance with Article 3 of Delegated Regulation (EU) 2022/2059;
 - (ii) the hypothetical changes in the trading desk portfolio's value or in the hypothetical portfolio's value computed in accordance with Article 3 of Delegated Regulation (EU) 2022/2059, while keeping unchanged the factors that are not included as risk factors in the internal risk-measurement model;
 - (iii) the risk-theoretical changes in the trading desk portfolio's value or in the hypothetical portfolio's value computed in accordance with Article 12 of Delegated Regulation (EU) 2022/2059;
 - (b) require the institution to explain deviations in the changes in the portfolio's values computed in accordance with points (a)(i), (ii), and (iii).

Article 24

Assessment of general interest rates risk factors

1. When assessing the institution's compliance with the requirements set out in Article 325bh(1), point (c), of Regulation No 575/2013 in relation to the modelling of the interest rate risk, the competent authority shall:
 - (a) require the institution to provide a list of all the currencies towards which the institution's portfolio is sensitive and, for each of those currencies, all the yield curves towards which the institution's portfolio is sensitive. For each of those yield curves, the competent authority shall require that it is specified whether a curve is modelled in its entirety directly, or whether it is modelled as a sum of a base curve and a basis curve;
 - (b) require the institution to provide a sensitivity analysis of its portfolio towards each of the curves referred to in point (a);
 - (c) verify, by using the information referred to in points (a) and (b), that the basis risk between any two given curves is either implicitly captured by the fact that two curves are modelled directly, or by the fact that a basis curve

- representing the difference between those two curves is included in the internal-risk measurement model;
- (d) perform, in relation to curves where risk factors are points in the curve, an additional assessment in accordance with Article 29 and, where buckets are established by the institution in accordance with Article 5(4) of Commission Delegated Regulation (EU) 2022/2060 of 14 June 2022¹³, verify that the institution uses at least six risk factors when both of the following conditions are met:
 - (i) the exposure to the yield curve is material;
 - (ii) the exposure is in a most liquid currency as referred to in Annex I to Commission Delegated Regulation (EU) 2022/2058 of 28 February 2022¹⁴;
 - (e) perform, in relation to curves that have been modelled by means of function parameters as referred to in Article 6 of Delegated Regulation (EU) 2022/2060, an additional assessment of compliance in accordance with Article 29;
 - (f) assess whether vega risk related to interest rate risk is duly captured in accordance with Article 30.
2. By way of derogation from paragraph 1, point (a), the competent authority may require the institution to provide the information referred to in that point for the most relevant currencies and yield curves only, and perform the assessment provided in that paragraph on those data.

Article 25

Assessment of equity risk factors

1. When assessing the institution's compliance with the requirements set out in Article 325bh(1), point (e), of Regulation No 575/2013 in relation to the modelling of equity risk, the competent authority shall:
 - (a) require the institution to provide a list of all equity names and equity indices towards which the institution's portfolio is sensitive, and the risk factors used to model the associated risk;
 - (b) require the institution to provide a sensitivity analysis of its portfolio towards each of the equity names and equity indices referred to in point (a);
 - (c) verify that, where the risk in an equity name is modelled as a sum of a systematic risk factor as referred to in Article 3(3) of Delegated Regulation

¹³ Commission Delegated Regulation (EU) 2022/2060 of 14 June 2022 supplementing Regulation (EU) No 575/2013 of the European Parliament and of the Council with regard to regulatory technical standards specifying the criteria for assessing the modellability of risk factors under the internal model approach (IMA) and specifying the frequency of that assessment under Article 325be(3) of that Regulation (OJ L 276, 26.10.2022, p. 60).

¹⁴ Commission Delegated Regulation (EU) 2022/2058 of 28 February 2022 supplementing Regulation (EU) No 575/2013 of the European Parliament and of the Council with regard to regulatory technical standards on liquidity horizons for the alternative internal model approach, as referred to in Article 325bd(7) (OJ L 276, 26.10.2022, p. 40).

- (EU) 2022/2060 and idiosyncratic risk factor, the volatility generated by shocking those factors reflects the volatility observed for that equity name. Where appropriate, the competent authority may compare the volatility of the shocks applied to the issuer equity name, as resulting from the systematic and idiosyncratic risk factors, with the volatility observed for that equity name;
- (d) verify that the basis risk between two different equity names is captured by either modelling the two equity names directly or by means of a basis risk factor;
 - (e) assess whether the risk in changes in equity curves is duly captured in accordance with Article 29;
 - (f) assess whether vega risk related to equity risk is duly captured in accordance with Article 30.
2. By way of derogation from paragraph 1, point (a), the competent authority may require the institution to provide the information referred to in that point for the most relevant equity names and indices only, and perform the assessment provided in that paragraph on those data.

Article 26

Assessment of credit spread risk factors

1. When assessing the institution's compliance with the requirements set out in Article 325bh(1) of Regulation No 575/2013 in relation to the modelling of credit spread risk, the competent authority shall:
- (a) require the institution to provide a list of all issuers' credit spreads curves and credit indices towards which the institution's portfolio is sensitive, and the risk factors used to model the associated risk;
 - (b) require the institution to provide a sensitivity analysis of its portfolio towards each of the issuers' credit spreads curves and credit indices referred to in point (a);
 - (c) verify that, where the risk in an issuer credit spread is modelled as a sum of a systematic risk factor as referred to in Article 3(3) of Delegated Regulation (EU) 2022/2060 and an idiosyncratic risk factor, the volatility generated by shocking those factors reflects the volatility observed for that issuer credit spread. Where appropriate, the competent authority may compare the volatility of the shocks applied to the issuer credit spread, as resulting from the systematic and idiosyncratic risk factors, with the volatility observed for that issuer credit spread;
 - (d) verify that the basis risk between issuers is captured by either modelling the issuers' credit spreads directly or by means of a basis risk factor, and verify that the basis between different positions referencing to the same issuer is monitored and, when material, included in the model;

- (e) assess whether the risk in changes in credit spread curves is duly captured in accordance with Article 29;
 - (f) assess whether vega risk related to credit spread risk is duly captured in accordance with Article 30.
2. By way of derogation from paragraph 1, point (a), the competent authority may require the institution to provide the information referred to in that point for the most relevant credit spreads curves and credit indices only, and perform the assessment provided in that paragraph on those data.

Article 27

Assessment of foreign-exchange risk factors

1. When assessing the institution's compliance with the requirements set out in Article 325bh(1), point (d), of Regulation No 575/2013 in relation to the modelling of foreign-exchange risk, the competent authority shall:
- (a) require the institution to provide a list of all the currency pairs towards which the institution's portfolio is sensitive and, for each of those currency pairs, to clarify whether it is subject to the spot exchange rate only, or other risk factors, including implied volatilities;
 - (b) require the institution to provide a sensitivity analysis of its portfolio towards each currency pair referred to in point (a);
 - (c) verify, by using the information referred to in points (a) and (b), that basis risk between any couple of currency pairs is either implicitly captured by the fact that the two currency pairs are modelled directly, or by the fact that a basis representing the difference between those two currencies pairs is included in the internal-risk measurement model;
 - (d) verify whether and how the risk linked to unpegging events is captured for non-free floating currency pairs to which the institution is materially exposed;
 - (e) assess whether the risk in changes in foreign-exchange curves is duly captured in accordance with Article 29;
 - (f) assess whether vega risk related to foreign-exchange risk is duly captured in accordance with Article 30.
2. By way of derogation from paragraph 1, point (a), the competent authority may require the institution to provide the information referred to in that point for the most relevant currency pairs only, and perform the assessment provided in that paragraph on those data.

Article 28

Assessment of commodity risk factors

1. When assessing the institution's compliance with the requirements set out in Article 325bh(1), point (f), of Regulation No 575/2013 in relation to the modelling of commodity risk, the competent authority shall:
 - (a) require the institution to provide a list of all the types of commodities towards which the institution's portfolio is sensitive and, for each of those commodities, to clarify whether it is subject to the spot price of the commodity only, or other risk factors, including implied volatilities;
 - (b) require the institution to provide a sensitivity analysis of its portfolio towards each of the commodity types referred to in point (a);
 - (c) verify that the institution's internal policies identify appropriate metrics to assess the materiality of a commodity market as referred to in Article 325bh(1), point (f), of Regulation No 575/2013 and that, for markets identified as material, each different commodity is specifically modelled in the institution's internal risk-measurement model;
 - (d) verify that the basis risk between similar but not identical commodities towards which the institution has material exposure is captured, including the basis risk stemming from a different place of delivery and basis due to maturity mismatches. When making this assessment, the competent authority shall verify that the institution models two different commodities directly or captures the basis by means of a basis risk factor;
 - (e) assess whether the risk in changes in commodity curves is duly captured in accordance with Article 29;
 - (f) assess whether vega risk related to commodity risk is duly captured in accordance with Article 30.
2. By way of derogation from paragraph 1, point (a), the competent authority may require the institution to provide the information referred to in that point for the most relevant commodities only, and perform the assessment provided in that paragraph on those data.

Article 29

Assessment of curves

1. The competent authority shall apply paragraph 2 of this Article where required to assess curves whose points are risk factors as referred to in Article 4 of Delegated Regulation (EU) 2022/2060, and paragraph 4 of this Article where required to assess curves that have been modelled by means of function parameters as referred to in Article 6 of that Delegated Regulation. In both cases, the competent authority shall assess the interpolation and extrapolation techniques used by the institution in accordance with paragraph 6.

2. For curves whose buckets are defined by the institution in accordance with Article 5(4) of Delegated Regulation (EU) 2022/2060, the competent authority shall verify both of the following:
 - (a) the institution's internal policies have established criteria to decide on the numbers of risk factors to be used to model a curve, and that such criteria are based on the liquidity and materiality of the positions with exposure to that curve;
 - (b) the criteria referred to in point (a) are accompanied by an analysis showing that the number of risk factors used allows for the volatility across different tenors to be captured. Where the number of risk factors used to model a curve may not be appropriate, the competent authority may complement its assessment using the assessment method referred to in paragraph 3.
3. For the purpose of the assessment referred to in paragraph 2, point (b), the competent authority may apply the following steps:
 - (a) require the institution to apply scenarios of future shocks to the curve's risk factors as made in the internal risk-measurement model;
 - (b) require the institution to derive the volatility of a point in the curve that is not a risk factor, as such a volatility results from the scenarios of future shocks applied in point (a);
 - (c) require the institution to obtain the observed volatility of the point in the curve referred to in point (b);
 - (d) compare the volatility obtained in point (b) with the observed volatility in point (c).

Such an assessment shall be done on the basis of both the period referred to in Article 325bc(4), point (c), of Regulation (EU) No 575/2013 and the period of financial stress referred to in Article 325bc(2), point (c), of that Regulation

4. For curves that have been modelled by means of function's parameters as referred to in Article 6 of Delegated Regulation (EU) 2022/2060, the competent authority shall verify that the institution's internal policies include analysis showing that shocking functions parameters allows capturing all material risks in the curves and the volatility across different tenors. Where appropriate, the competent authority may complement its assessment using the assessment method referred to in paragraph 5.
5. For the purpose of the assessment referred to in paragraph 5, the competent authority may apply the following steps:
 - (a) require the institution to apply scenarios of future shocks to the function parameters as made in the internal risk-measurement model;
 - (b) require the institution to derive the volatility of a point in the curve, as such a volatility results from the scenarios of future shocks applied in point (a);
 - (c) require the institution to obtain the volatility of the point in the curve referred to in point (b);
 - (d) compare the volatility obtained in point (b) with the observed volatility obtained in point (c).

Such an assessment shall be done on the basis of both the period referred to in Article 325bc(4), point (c), of Regulation (EU) No 575/2013 and the period of financial stress referred to in Article 325bc(2), point (c), of that Regulation

6. The competent authority shall assess whether all the techniques used by the institution to build a curve, including interpolation and extrapolation techniques, are sound. Where part of the curve is derived by extrapolating its two outer points, the competent authority shall verify that the volatility of the returns observed in the market for the extrapolated part of the curve does not significantly differ from that resulting from the extrapolation. To that end, the competent authority may apply the assessment method referred to in paragraphs 3 and 5, by picking a point in the curve obtained via extrapolation when applying point (b), of those paragraphs.

Article 30

Assessment of implied volatility surfaces

1. When assessing the institution's compliance with the requirements set out in Article 325bh(1), point (h), of Regulation No 575/2013 in relation to capturing vega risk for any given broad risk factor category, the competent authority shall:
 - (a) require the institution to provide a list of all the volatility surfaces towards which the institution's portfolio is sensitive. For each of those surfaces, it shall be specified whether it is modelled in its entirety directly, or whether it is modelled as a sum of a base surface and a basis surface;
 - (b) require the institution to provide a sensitivity analysis of its portfolio towards each of the surfaces referred to in point (a);
 - (c) verify, by using the information referred to in points (a) and (b), that any material basis risk between any two given surfaces is either implicitly captured by the fact that two surfaces are modelled directly, or by the fact that a basis surface representing the difference between those two curves is modelled;
 - (d) verify, in relation to volatility surfaces whose points are risk factors in accordance with Article 4 of Delegated Regulation (EU) 2022/2060, that:
 - (i) the institution's internal policies have established criteria to decide on the numbers of risk factors to be used to model a surface, and that such criteria are based on the liquidity and materiality of the positions exposed to that surface;
 - (ii) the criteria referred to in point (i) are accompanied by an analysis showing that the number of risk factors used allows for a comprehensive representation of the risk across the surface. Where appropriate, the competent authority may complement its assessment using the assessment method referred to in paragraph 2;
 - (e) verify, in relation to surfaces that have been modelled by means of function parameters as referred to in Article 6 of Delegated Regulation (EU) 2022/2060, that the institution's internal policies include analysis showing

that shocking functions parameters allows for a comprehensive representation of the risk across the surface. Where appropriate, the competent authority may complement its assessment using the assessment method referred to in paragraph 3;

- (f) assess whether interpolation and extrapolation techniques used by the institution to build a surface are sound. Where part of the surface is derived by extrapolating its two outer points, the competent authority shall verify that the volatility of the returns observed in the market for the extrapolated part of the surface does not significantly differ from that resulting from the extrapolation. To that end, the competent authority may apply the assessment method referred to in paragraphs 2 and 3, by picking a point in the surface obtained via extrapolation when applying point (b), of those paragraphs.
2. For the purpose of the assessment referred to in paragraph 1, point (d)(ii), the competent authority may apply the following steps:
 - (a) require the institution to apply scenarios of future shocks to the surface's risk factors as made in the internal risk-measurement model;
 - (b) require the institution to derive the volatility of a point of the surface that is not a risk factor, as such a volatility results from the scenarios of future shocks applied in point (a);
 - (c) require the institution to obtain the observed volatility of the point in the surface referred to in point (b);
 - (d) compare the volatility obtained in point (b) with the observed volatility obtained in point (c).

Such an assessment shall be done on the basis of both the period referred to in Article 325bc(4), point (c), of Regulation (EU) No 575/2013 and the period of financial stress referred to in Article 325bc(2), point (c), of that Regulation.

3. For the purpose of the assessment referred to in paragraph 1, point (e), the competent authority may apply the following steps:
 - (a) require the institution to apply scenarios of future shocks to the function parameters as made in the internal risk-measurement model;
 - (b) require the institution to derive the volatility of a point of the surface, as such a volatility results from the scenarios of future shocks applied in point (a);
 - (c) require the institution to obtain the observed volatility of the point in the surface referred to in point (b);
 - (d) compare the volatility obtained in point (b) with the observed volatility obtained in point (c).

Such an assessment shall be done on the basis of both the period referred to in Article 325bc(4), point (c), of Regulation (EU) No 575/2013 and the period of financial stress referred to in Article 325bc(2), point (c), of that Regulation

Article 31

Assessment of correlation risk factors

When assessing whether the institution's internal risk-measurement model captures correlation risk in accordance with Article 325bh(1), point (b), of Regulation No 575/2013, the competent authority shall verify that, for multi-underlying options and any other products whose end-of-day value is determined via an implied correlation parameter, a risk factor capturing the risk of changes in the correlation parameter is included in the internal risk-measurement model. The competent authority may identify options and products relying on an implied correlation parameter by using the information reported as part of Article 23, and by identifying those factors that are correlation parameters.

SUBSECTION 2

ASSESSMENT OF THE RISK FACTORS PROPERTIES

Article 32

Assessment of compliance in relation to the requirements on the assessment of the modellability of risk factors

1. When assessing the institution's compliance with Article 325bi(1), point (e), of Regulation (EU) No 575/2013 in relation to requirements on the risk factors' modellability, the competent authority shall verify that the internal policies referred to in that Article meet all the following conditions:
 - (a) they cover aspects referred to in Article 7 of Delegated Regulation (EU) 2022/2060 for all documentation;
 - (b) they entail the production of an up-to-date inventory specifying the following for each risk factor:
 - (i) a description of the risk factor;
 - (ii) whether the risk factor is modellable following the modellability assessment referred to in Article 325be of Regulation (EU) No 575/2013, and whether it has ever changed its modellability status in the previous year;
 - (iii) the 12 month-period used for the modellability assessment;
 - (iv) whether the risk factor is a systematic credit or equity risk factor as referred to in Article 3(3) of Delegated Regulation (EU) 2022/2060;
 - (v) whether the risk factor is a point of a curve, a surface or a cube as referred to in Article 4 of Delegated Regulation (EU) 2022/2060, the bucket used for assessing its modellability in accordance with that Article and the results of the modellability assessment of that bucket;

- (vi) whether the risk factor is a function parameter used to represent a curve, a surface or a cube as referred to in Article 6 of Delegated Regulation (EU) 2022/2060, and:
 - (1) the set of points of the curve, surface or cube that have been used to calibrate the parametric function as referred to in Article 6(1) of Delegated Regulation (EU) 2022/2060;
 - (2) the set of buckets, and their modellability, as resulting from the application of the steps referred to in Article 6(1), points (b) and (c) of Delegated Regulation (EU) 2022/2060;
 - (3) the set of points of the curve, surface or cube that have been used to calibrate the function parameter as referred to in Article 6(2) of Delegated Regulation (EU) 2022/2060;

- (vii) the number of verifiable prices that are representative for the risk factor over the period considered for the modellability assessment.

Where the modellability assessment for a risk factor is performed by assessing the modellability of a set of buckets first, the competent authority shall verify that the number of verifiable and representative prices are specified at the level of each of those buckets;

- (viii) whether there are 90-day periods with less than four verifiable and representative prices.

Where the modellability assessment for a risk factor is performed by assessing the modellability of a set of buckets first, the competent authority shall verify that that information is provided at the level of each of those buckets;

- (c) they set out criteria for identifying risk factors whose assessment period is shifted in accordance with the derogations referred to in Article 1(2) and Article 4(3) of Delegated Regulation (EU) 2022/2060 and criteria establishing when risk factors are considered of the same type as referred to in Article 1(2), point (a), of that Regulation;
- (d) they set out criteria for identifying whether the modellability assessment of a curve, surface or cube is performed by using standard, pre-defined buckets as referred to in Article 5(2) of Delegated Regulation (EU) 2022/2060, or by using the institution's own definition of buckets as referred to in Article 5(3) of that Delegated Regulation;
- (e) they set out the rationale of the choice, where the standard, pre-defined buckets in Article 5(2) of Delegated Regulation (EU) 2022/2060 are subdivided into smaller buckets in accordance with the last subparagraph of Article 5(2) of that Regulation.

2. When assessing that the institution's internal model is implemented with integrity in accordance with Article 325bi(1) of Regulation (EU) No 575/2013 in relation to the modellability assessment of risk factors falling in the scope of Article 1 of Delegated Regulation (EU) 2022/2060, the competent authorities shall:

- (a) verify, in relation to the results of the modellability assessment:

- (i) by using the inventory referred to in paragraph 1, point (b), that risk factors that are assessed to be modellable meet any of the two conditions referred to in Article 1(1) of Delegated Regulation (EU) 2022/2060;
 - (ii) where applicable, by using the inventory referred to in paragraph 1, point (b), that the period used for the modellability assessment complies with the requirements set out in Article 1(2) of Delegated Regulation (EU) 2022/2060. When making this assessment, the competent authority shall verify that the criteria referred to in paragraph 1, point (c) to identify whether risk factors are of the same type are sound and, by using the inventory referred to in paragraph 1, point (b), verify that those criteria are applied correctly;
- (b) in relation to the requirements for considering a price verifiable as referred to in Article 2 of Delegated Regulation (EU) 2022/2060:
- (i) verify that the institution's internal systems and policies, and its contractual agreements with third-party vendors, ensure that the conditions referred to in Article 2(1) of Delegated Regulation (EU) 2022/2060 are met and that there are no prices meeting the conditions referred to in Article 2(2) of that Regulation that are considered verifiable. When making this assessment, the competent authority shall apply the assessment method referred to in paragraph 5;
 - (ii) by reviewing the audit reports, verify that the independent audit to which third-party vendors are subject is robust and covers all aspects referred to Article 2(7) of Delegated Regulation (EU) 2022/2060;
 - (iii) where applicable, review the contractual agreements between the institution and the third-party vendors referred to in Article 2(8) of Delegated Regulation (EU) 2022/2060;
- (c) in relation to the requirements for considering a verifiable price as representative of a risk factor as referred to in Article 3 of Delegated Regulation (EU) 2022/2060, verify that the mapping process and the criteria used to determine the representativeness of a price for a risk factor as referred to in Article 7(1), point (d), of that Regulation are sound.

When making this assessment, the competent authority shall apply the assessment method referred to in paragraph 6.

3. When assessing that the institution's internal model is implemented with integrity in accordance with Article 325bi(1) of Regulation (EU) No 575/2013 in relation to the modellability assessment of risk factors belonging to curves, surfaces or cubes falling in the scope of Article 4 of Delegated Regulation (EU) 2022/2060, the competent authorities shall:
- (a) in relation to the results of the modellability assessment:
 - (i) by using the inventory referred to in paragraph 1, point (b), verify that the bucketing of curves, surfaces and cubes is performed in conformity with the conditions referred to in Article 5(2) or Article 5(4) of Delegated Regulation (EU) 2022/2060, and that the criteria

- referred to in paragraph 1, point (d) to select the bucketing approach are applied correctly;
- (ii) when the institution uses the set of standard, pre-defined buckets referred to in Article 5(2), point (d), of Delegated Regulation (EU) 2022/2060, the competent authority shall verify that any conversion of buckets into a different market-standard convention is appropriate;
 - (iii) by using the inventory referred to in paragraph 1, point (b), verify that the buckets that are assessed to be modellable meet any of the two conditions referred to in Article 4(2) of Delegated Regulation (EU) 2022/2060;
 - (iv) by using the inventory referred to in paragraph 1, point (b), verify that the period used for the modellability assessment is the same for all buckets of a given curve, surface or cube;
- (b) in relation to the requirements for considering a price verifiable as referred to in Article 2 of Delegated Regulation (EU) 2022/2060:
- (i) by reviewing the institution's internal systems and policies, and its contractual agreements with third-party vendors, ensure that the conditions referred to in Article 2(1) of Delegated Regulation (EU) 2022/2060 are met and that there are no prices meeting the conditions referred to in Article 2(2) of that Delegated Regulation that are considered verifiable. When making this assessment, the competent authority shall apply the assessment method referred to in paragraph 5;
 - (ii) by reviewing the audit reports, verify that the independent audit to which third-party vendors are subject is robust and covers all aspects referred to Article 2(6) of Delegated Regulation (EU) 2022/2060;
 - (iii) where applicable, review the contractual agreements between the institution and the third-party vendors referred to in Article 2(7) of Delegated Regulation (EU) 2022/2060;
- (c) in relation to the requirements for allocating a verifiable price to a bucket as referred to in Article 4(4) of Delegated Regulation (EU) 2022/2060, verify that the mapping process and the criteria referred to in Article 7(1), point (d), of that Regulation used to determine that a price is representative for a point in the bucket are sound.

When making this assessment, the competent authority shall apply the assessment method referred to in paragraph 7;

- (d) in relation to the possibility of reallocating a verifiable price of a bucket to an adjacent bucket in accordance with Article 5(5) of Delegated Regulation (EU) 2022/2060, verify that the approach documented in accordance with Article 7(1), point (f), of that Regulation used by the institution in performing such reallocation is appropriate, and how the institution ensures that the conditions under which reallocation is allowed in accordance with Article 5(5) of Delegated Regulation (EU) 2022/2060 are fulfilled.

4. When assessing that the institution's internal model is implemented with integrity in accordance with Article 325bi(1) of Regulation (EU) No 575/2013 in relation to the modellability assessment of risk factors falling in the scope of Article 6 of Delegated Regulation (EU) 2022/2060, the competent authorities shall:
- (a) in relation to the results of the modellability assessment:
 - (i) by using the inventory referred to in paragraph 1, point (b), verify that the buckets of the curve, surface or cube modelled through a parametric function that are assessed to be modellable meet any of the two conditions referred to in Article 4(2) of Delegated Regulation (EU) 2022/2060;
 - (ii) by using the inventory referred to in paragraph 1, point (b), verify that the bucketing approach used is that provided in Article 5(2) of Delegated Regulation (EU) 2022/2060, and that any conversion of buckets into a different market-standard convention in accordance with Article 5(2), point (d), of that Regulation is appropriate;
 - (iii) by using the inventory referred to in paragraph 1, point (b), verify that the function parameter is assessed to be modellable only where all points in the curve, surface or cube that are used to calibrate it belong to buckets that are modellable;
 - (b) in relation to the requirements for considering a price verifiable as referred to in Article 2 of Delegated Regulation (EU) 2022/2060:
 - (i) verify that the institution's internal systems and policies, and its contractual agreements with third-party vendors, ensure that the conditions referred to in Article 2(1) of Delegated Regulation (EU) 2022/2060 are met and that there are no prices meeting the conditions referred to in Article 2(2) of Delegated Regulation (EU) 2022/2060 that are considered verifiable. When making this assessment, the competent authority shall apply the assessment method referred to in paragraph 5;
 - (ii) by reviewing the audit reports, verify that the independent audit to which third-party vendors are subject is robust and covers all aspects referred to Article 2(7) of Delegated Regulation (EU) 2022/2060;
 - (iii) where applicable, review the contractual agreements between the institution and the third-party vendors referred to in Article 2(8) of Delegated Regulation (EU) 2022/2060;
 - (c) in relation to the requirements for allocating a verifiable price to a bucket as referred to in Article 4(4) of Delegated Regulation (EU) 2022/2060, verify that the mapping process and the criteria referred to in Article 7(1), point (d), of that Regulation used to determine that a price is representative for a point in the bucket are sound.

When making this assessment, the competent authority shall apply the assessment method referred to in paragraph 7;

- (d) in relation to the possibility of reallocating a verifiable price of a bucket to an adjacent bucket in accordance with Article 5(4) of Delegated Regulation (EU) 2022/2060, verify that the approach documented in accordance with Article 7(1), point (f), of that Regulation used by the institution in performing such reallocation is appropriate, and how the institution ensures that the conditions under which reallocation is allowed in accordance with Article 5(4) of Delegated Regulation (EU) 2022/2060 are fulfilled.
5. For the purpose of the assessment method referred to in paragraphs 2, point (b)(i), 3, point (b)(i) and 4, point (b)(i), the competent authority shall:
- (a) require the institution to provide a sample of risk factors and buckets, with the corresponding verifiable and representative prices. The sample of risk factors and buckets shall include, among others, risk factors and buckets that narrowly met the conditions for being assessed modellable and those that changed their modellability status over the previous year. Where applicable, that sample shall include risk factors and buckets for which verifiable prices are obtained solely by the institution, solely by third-party vendors, and by both the institution and third-party vendors;
 - (b) require the institution to justify for the prices referred to in point (a), which of the conditions referred to in Article 2(1) of Delegated Regulation (EU) 2022/2060 is met, and apply the following:
 - (i) when the condition met is that referred to in Article 2(1), point (a), of Delegated Regulation (EU) 2022/2060, the competent authority shall verify how the institution assessed that the transaction was entered at arm's length;
 - (ii) when the condition met is that referred to in Article 2(1), point (b), of Delegated Regulation (EU) 2022/2060, the competent authority shall verify how the institution or the third-party vendor assessed that the transaction was entered at arm's length;
 - (iii) when the condition met is that referred to in Article 2(1), point (c), of Delegated Regulation (EU) 2022/2060, the competent authority shall verify how the institution or the third-party vendor identified both bid and offer quotations;
 - (c) for the verifiable prices referred to in point (a), verify all of the following:
 - (i) that the price is not a transaction or quotation between two entities of the same group in accordance with Article 2(2), point (a), of Delegated Regulation (EU) 2022/2060, and that the approach used by the institution or the third-party vendor to conclude that the two entities do not belong to the same group is sound;
 - (ii) how the institution or the third-party vendor concluded that the volume of the transaction or committed quote associated with the verifiable price is non-negligible as referred to in Article 2(2), point (b), of Delegated Regulation (EU) 2022/2060, and whether the metrics employed to evaluate the negligibility are sound;

- (iii) where the verifiable price relates to committed quotes in accordance with Article 2(1), point (c), of Delegated Regulation (EU) 2022/2060, how the institution or the third-party vendor concluded that the bid-offer spread does not deviate substantially from applicable market conditions as referred to in Article 2(2), point (c), of that Regulation, and whether the metrics employed to evaluate such potential deviation are sound;
- (iv) whether among those prices some may be considered to meet the conditions referred to in Article 2(2), point (b) or Article 2(2), point (c), of Delegated Regulation (EU) 2022/2060 because they are characterised by an unusually low volume or by an unusually large bid-offer spread;
- (v) that the institution or the third-party vendor identified a time zone that is used consistently across all data sources to identify the observation date of the verifiable price in accordance with Article 2(4) of Delegated Regulation (EU) 2022/2060.

When applying such an assessment method, the competent authority shall be provided with all necessary information to perform it comprehensively either directly by the institution or through the third-party vendor in accordance with Article 2(5), point (b), of Delegated Regulation (EU) 2022/2060.

6. For the purpose of the assessment method referred to in paragraph 2, point (c), the competent authority shall:
- (a) require the institution to provide a sample of risk factors, and the corresponding verifiable and representative prices used to assess the conditions referred to in Article 1 of Delegated Regulation (EU) 2022/2060. The sample of risk factors shall include, among others, risk factors that narrowly met the conditions for being assessed modellable and those that changed their modellability status over the previous year. Where applicable, that sample shall include risk factors for which verifiable prices are obtained solely by the institution, solely by third-party vendors, and by both the institution and third-party vendors;
 - (b) verify that, where for the risk factor there are multiple verifiable prices on a given observation date, only one is considered when assessing whether the conditions referred to in Article 1 of Delegated Regulation (EU) 2022/2060 are met;
 - (c) for those risk factors in the sample referred to in point (a) that are not systematic credit or equity risk factors capturing market-wide movements as referred to in Article 3(3) of Delegated Regulation (EU) 2022/2060, assess whether the risk factor is a strong driver of the price considered representative, verify whether the method used by the institution to conclude that there is a close relationship between the risk factor and that price is sound, and verify that the methodology employed by the institution to extract the value of the risk factor from that price is sound;
 - (d) for those risk factors in the sample referred to in point (a) that are systematic credit or equity risk factors capturing market-wide movements as referred to

in Article 3(3) of Delegated Regulation (EU) 2022/2060, verify whether the verifiable prices used are representative of attributes of the systematic risk factors.

7. For the purpose of the assessment method referred to in paragraphs 3, point (c), and 4, point (c), the competent authority shall:
 - (a) require the institution to provide a sample of buckets relating to a set of curves, surfaces or cubes, and the corresponding verifiable and representative prices. The sample of buckets shall include, among others, buckets that narrowly met the conditions for being assessed modellable and those that changed their modellability status over the previous year. Where applicable, that sample shall include buckets for which verifiable prices are obtained solely by the institution, solely by third-party vendors, and by both the institution and third-party vendors;
 - (b) for the verifiable prices referred to in point (a), verify, for the buckets for which there are multiple verifiable prices on a given observation date, that only one verifiable price per each date is considered when assessing whether the conditions referred to in Article 1 of Delegated Regulation (EU) 2022/2060 are met;
 - (c) for the verifiable prices referred to in point (a), assess that the methodology employed by the institution to map a verifiable price to a given bucket is appropriate. When making this assessment, the competent authority shall assess whether the points in a bucket are a strong driver of the price considered representative, verify whether the method used by the institution to conclude that there is a close relationship between any point in the bucket and that price is sound, and verify that the methodology employed by the institution to extract the value of that point in the bucket from that price is sound.

Article 33

Assessment of compliance in relation to requirements on the risk factors' liquidity horizon

1. When assessing the institution's compliance with Article 325bi(1), point (e), of Regulation (EU) No 575/2013 in relation to requirements on the risk factors' liquidity horizon, the competent authority shall verify that the internal policies referred to in that Article entail the production of an up-to-date inventory specifying, for each risk factor, the following:
 - (a) a description of the risk factor;
 - (b) whether the risk factor is modellable following the modellability assessment referred to in Article 325be of Regulation (EU) No 575/2013 and, where modellable, whether it is included in the subset of modellable risk factors referred to in Article 325bc(2), point (a), of that Regulation;
 - (c) a simple description of the data inputs used to mark the risk factor;

- (d) the liquidity horizon assigned to the risk factor in accordance with Article 325bd(2) of Regulation (EU) No 575/2013;
 - (e) whether the nature of the risk factor does not correspond to any broad risk factor category in accordance with Article 1(2) of Delegated Regulation (EU) 2022/2058;
 - (f) whether the nature of the risk captured by the risk factor and the data inputs used for that risk factor correspond to risk factors that could fall under more than one broad risk factor category or broad risk factor sub-category in accordance with Article 1(3) of Delegated Regulation (EU) 2022/2058;
 - (g) where used to model a homogenous index, whether the methodology referred to in Article 1 of Delegated Regulation (EU) 2022/2058 or that referred to in Article 2 of that Regulation has been used to map the risk factor to the appropriate category and sub-category of Article 325bd, Table 2, of Regulation (EU) No 575/2013.
2. When assessing that the institution's internal model is implemented with integrity in accordance with Article 325bi(1) of Regulation (EU) No 575/2013 in relation to requirements on the risk factors' liquidity horizon, the competent authority shall:
- (a) verify, by using the elements listed in paragraph 1, that:
 - (i) there is consistency between the nature of the risk factors, the data inputs used for the risk factors, and the category and sub-category identified in Article 325bd, Table 2, of Regulation (EU) No 575/2013;
 - (ii) equity and credit risk factors that reflect a systematic component have been subject to the treatment referred to in Article 1(3) of Delegated Regulation (EU) 2022/2058, when those risk factors are calibrated using data inputs related to different broad risk factor categories or sub-categories;
 - (iii) basis risk factors representing the difference between two risk factors that if modelled directly by the institution, instead of the basis, would be assigned to two different sub-categories, are subject to the treatment referred to in Article 1(3) of Delegated Regulation (EU) 2022/2058;
 - (iv) when a risk factor is not among those specified in Articles 3 and 4 of Delegated Regulation (EU) 2022/2058 and does not unambiguously relate to one of the sub-categories referred to in Article 325bd, Table 2, of Regulation (EU) No 575/2013, the risk factor is mapped to the sub-category 'other' of the appropriate category;
 - (v) equity risk factors recognised as equity with large capitalisation meet one of the conditions referred to in Article 7(1) of Delegated Regulation (EU) 2022/2058.
 - (b) verify that the institution has in place objective criteria for identifying when a credit spread risk factor refers to an investment grade or a high yield position.

- (c) verify that, where the institution applies the derogation referred to in Article 325bd(3) of Regulation (EU) No 575/2013 regarding the use of longer liquidity horizons in calculating the expected shortfall risk measure referred to in Article 325bb of that Regulation and the stress scenario risk measure referred to in Article 325bk of that Regulation, the institution distinguishes between positions belonging to trading desks for which the derogation is used from those for which it is not. The competent authority shall focus on risk factors belonging to the sub-category subject to the derogation and that are present both in trading desks for which the derogation is used and in trading desks for which it is not.
 - (d) verify that, as part of the monthly update referred to in Article 325bd(6) of Regulation (EU) No 575/2013, the institution verifies whether:
 - (i) due to a change in the equity capitalisation or in the constituents of indices referred to in Article 7(1), point (b), of Delegated Regulation (EU) 2022/2058, there has been a change in the appropriate sub-category for an equity risk factor;
 - (ii) due to migration or other credit quality events, there has been a change in the appropriate sub-category for a credit spread risk factor;
 - (e) verify that only one currency is considered domestic for the purpose of mapping a risk factor to the broad category 'Interest rate' and sub-category 'Most liquid currencies and domestic currency' of Article 325bd, Table 2, of Regulation (EU) No 575/2013.
3. For the purpose of the assessment referred to in paragraph 2, point (a), the competent authority may require the institution to identify the risk factors in a sample of financial instruments or commodities, and make its assessment taking into account the nature of the financial instruments bearing the risk factors. When requesting the sample in accordance with this paragraph, the competent authority shall focus on financial instruments or commodities encompassing a sufficiently wide range of risk factor types to ensure a comprehensive assessment.
4. For the purpose of the assessment referred to in paragraph 2, point (d), the competent authority may require the institution to provide risk factors that were subject to a change in the sub-category, and verify that, following the monthly update, the expected shortfall risk measure referred to in Article 325bb of Regulation (EU) No 575/2013 and the stress scenario risk measure referred to in Article 325bk of that Regulation reflected the changes in the liquidity horizon.

SECTION 3

ASSESSMENT OF PROXIES AND DATA QUALITY

Article 34

Assessment of proxies

1. When assessing that the institution's internal model is implemented with integrity in accordance with Article 325bi(1) of Regulation (EU) No 575/2013 in relation to requirements on the use of proxies, the competent authority shall verify that:
 - (a) the institution has established, as part of the internal policies referred to in Article 325bi(1), point (e), of Regulation (EU) No 575/2013, criteria outlining when a risk factor is proxied, how a risk factor would be proxied if subject to a proxy approach, and that the internal policies cover all proxy approaches employed by the institution, including, where used, factor models, beta approximations, and mapping of risk factors to benchmarks, such as names representative of the sector and region or indices;
 - (b) for non-modellable risk factors, there is a clear rationale behind the choice of using a proxy approach despite the number of returns N in the time series for the risk factor resulting from Article 3 of [RTS SSRM] would allow for using the historical method or the asymmetrical sigma method referred to respectively in Articles 4 and 5 of that Regulation;
 - (c) the approach used to proxy the risk factor is appropriate and ensures, in accordance with Article 325bh(1), point (g), of Regulation (EU) No 575/2013, a conservative calibration of the scenarios of future shocks for modellable risk factors and of the extreme scenarios of future shock for non-modellable risk factors. When making this assessment, the competent authority shall apply the assessment method referred to in paragraphs 2, 3 and 4. It shall apply additionally the assessment method referred to in paragraph 5 for non-modellable risk factors for which the institution uses a proxy approach despite the number of returns N in the time series for the risk factor resulting from Article 3 of [RTS SSRM] would allow for using the historical method or the asymmetrical sigma method referred to respectively in Articles 4 and 5 of that Regulation;
 - (d) for risk factors for which proxy data are used only for specific periods in the time series, there are no anomalous jumps between the parts of the time series that are proxied and the parts of the time series that are not proxied.
2. For the purpose of the assessment method referred to in paragraph 1, point (c), the competent authority shall, on a sample of risk factors that are proxied, verify that:
 - (a) the proxy approach used for those risk factors is that described in the internal policies as referred to in paragraph 1, point (a), and the proxy used is economically meaningful;

- (b) the basis risk between that risk factor as proxied and other risk factors is duly captured, including where different risk factors are proxied by mapping them to the same risk factor;
- (c) there are no cases where, as a result of the proxy, the specific risk is not duly captured.

When applying this assessment method, the competent authority shall choose a sample of risk factors reflecting a variety of proxy approaches, including, where used, factor models, beta approximations, and mapping of risk factors to benchmarks, such as names representative of the sector and region or indices.

3. For the purpose of the assessment method referred to in paragraph 1, point (c), the competent authority shall, on a sample of risk factors for which data in the last 12-month period have been proxied:
 - (a) require the institution to provide the time series of the proxied risk factors as used in the internal risk-measurement model and the time series of the corresponding pricing factors as used in the end-of-day valuation process;
 - (b) verify that the volatilities of the two time series referred to in point (a) do not substantially diverge;
 - (c) verify that the two time series are highly correlated.

When applying this assessment method, the competent authority shall choose a sample of risk factors reflecting a variety of proxy approaches, including, where used, factor models, beta approximations, and mapping of risk factors to benchmarks, such as names representative of a given sector and region or indices.

4. For the purpose of the assessment method referred to in paragraph 1, point (c), to test the conservativeness of proxy approaches, the competent authority shall select a sample of approaches and apply all the following steps for each proxy approach:
 - (a) require the institution to provide the time series of a sample of risk factors that are not proxied and that, if proxied, would follow the proxy approach being assessed;
 - (b) require the institution to provide the time series that would be used by applying the proxy approach being assessed to the risk factors' time series referred to in point (a);
 - (c) for both time series, obtain the volatilities of the risk factors in the stress period and in the last 12-month period, and verify that the volatility resulting from the proxy time series referred to in point (b) does not underestimate the volatility resulting from the time series referred to in point (a).

When applying this assessment method, the competent authority shall choose a sample of risk factors reflecting a variety of proxy approaches, including, where used, factor models, beta approximations, and mapping of risk factors to benchmarks, such as names representative of a given sector and region or indices.

5. For the purpose of the assessment method referred to in paragraph 1, point (c), the competent authority shall, on a sample of non-modellable risk factors for which proxy data have been used in the stress period despite the number of returns N in the time series for the risk factor resulting from Article 3 of [RTS SSRM] would allow for using the

historical method or the asymmetrical sigma method referred to respectively in Articles 4 and 5 of that Regulation:

- (a) require the institution to provide the original time series for the risk factors before any proxy approach has been used;
- (b) require the institution to provide the time series used for the proxied risk factors;
- (c) compare the upward and downward calibrated shocks as resulting from the application of Article 4, 5 of [RTS SSRM] to the time series referred to in points (a) and (b), and verify that shocks resulting from the proxied time series are not systematically less conservative than those obtained by using the original time series.

When applying this assessment method, the competent authority shall choose a sample of risk factors reflecting a variety of proxy approaches, including, where used, factor models, beta approximations, and mapping of risk factors to benchmarks, such as names representative of the sector and region or indices.

Article 35

Assessment of the data quality

1. When assessing whether the institution's data standards meet the minimum standards for the internal risk-measurement model to be considered reasonably accurate as referred to in Article 325bi(1), point (f), of Regulation (EU) No 575/2013, the competent authority shall verify that:
 - (a) the institution documents, as part of its internal policies, any methodology used to fill in time series with missing data points, and that such documentation includes sound analysis showing that those methodologies do not affect the risk factors' volatilities and correlations;
 - (b) the institution established objective criteria setting out which methodology to fill in time series is used, where more than one methodology is available, and documented those criteria in its internal policies;
 - (c) the institution establishes, as part of its internal policies, the process to be followed whenever the values in a time series are changed, and that such process includes the documentation of the performed changes;
 - (d) filtering of data, including flooring, capping and exclusions of outliers, is not performed unless the institution is able to demonstrate that the excluded data point relates to erroneous or stale data, and that it documents such an exclusion;
 - (e) the institution performs periodic quality checks on the time series used for the computation of the expected shortfall risk measure, and that those checks and the corresponding results are documented. When making this assessment, the competent authority shall verify whether those checks monitor, for each time series, all the following:

- (i) the number of days for which data points were initially missing and were then filled in using a particular methodology;
 - (ii) the number of days for which data points were initially available and have been replaced using a particular methodology;
 - (iii) the number of days with no daily changes;
 - (iv) the maximum number of consecutive days with no daily change;
 - (f) the institution analyses, as part of the checks referred to in point (e), the effect that missing or replaced data and the methodology used to obtain the time series have on the risk factors' volatilities and correlations;
 - (g) the data quality of the time series used by the institution is appropriate. When making this assessment, the competent authority shall apply the assessment method referred to in paragraph 2.
2. For the purpose of the assessment method referred to in paragraph 1, point (g), the competent authority shall:
- (a) require the institution to provide an overview of their time series used in PES_t^{RS} , PES_t^{RC} , PES_t^{FC} , $PES_t^{RS,i}$, $PES_t^{RC,i}$ and $PES_t^{FC,i}$, as defined in Article 325bb of Regulation (EU) No 575/2013, and in the calculation of the stress scenario risk measures, as defined in Article 3 of [RTS SSRM]. For each time series used, the overview shall include at least:
 - (i) the total number of days in the historical observation period used to calculate the PES_t^{RS} , PES_t^{RC} , PES_t^{FC} , $PES_t^{RS,i}$, $PES_t^{RC,i}$ and $PES_t^{FC,i}$, as defined in Article 325bb of Regulation (EU) No 575/2013, and the stress scenario risk measures, as defined in Article 3 of [RTS SSRM];
 - (ii) the number of days with missing data in the time series before any adjustment is introduced by the institution;
 - (iii) the number of days without any daily change in the time series before any adjustment is introduced by the institution;
 - (iv) the maximum number of consecutive days without any daily change in the time series before any adjustment is introduced by the institution;
 - (v) the number of days for which data were initially available in the time series but were excluded or changed by the institution before being used in the calculation of the PES_t^{RS} , PES_t^{RC} , PES_t^{FC} , $PES_t^{RS,i}$, $PES_t^{RC,i}$ and $PES_t^{FC,i}$, as defined in Article 325bb of Regulation (EU) No 575/2013, and the stress scenario risk measures, as defined in Article 3 of [RTS SSRM];
 - (b) based on the overview referred to in point (a):
 - (i) identify those times series used for risk factors that may be affected by low data quality. Where appropriate, the competent authority may use the following indicators as a basis for such identification:
 - (1) time series with less than 10% of initially available data points;

- (2) time series with 20 consecutive business days without any daily change;
 - (3) time series with more than 20% of days with no changes;
 - (4) time series for which more than 50% of the initially available data have been changed;
- (ii) require the institution to justify the use of those time series and, where applicable, the reason why the corresponding risk factor is included in the reduced set of risk factors as referred to in Article 325bc(2), points (a) and (b), and Article 325bc(3), points (a) and (b), of Regulation (EU) No 575/2013;
- (c) based on the overview referred to in point (a), select a sample of time series that are characterised by a high number of data points initially missing, and apply the following steps:
 - (i) require the institution to provide the time series with the initial data points only, and the time series after they have been filled in;
 - (ii) verify that the time series have been filled in in accordance with the methodologies envisaged in the internal policies as referred to in paragraph 1, points (a) and (b), and that such methodologies are appropriate for the case at matter;
 - (d) based on the overview referred to in point (b), select a sample of time series characterised by a high number of data points that were initially available but have been substituted by other data points, and apply the following steps:
 - (i) require the institution to provide the time series with the initial data points only, and the time series after data points in the time series have been substituted;
 - (ii) verify that the data points have been replaced in accordance with the methodologies envisaged in the internal policies as referred to in paragraph 1, points (a) and (b), and that such methodologies are appropriate for the case at matter.

For risk factors for which proxy data are used, the assessment shall be performed on the proxy time series as used in the calculation of the PES_t^{RS} , PES_t^{RC} , PES_t^{FC} , $PES_t^{RS,i}$, $PES_t^{RC,i}$ and $PES_t^{FC,i}$, as defined in Article 325bb of Regulation (EU) No 575/2013, and of the stress scenario risk measures, as defined in Article 3 of [RTS SSRM].

SECTION 4

ASSESSMENT OF COMPLIANCE WITH REQUIREMENTS RELATING TO THE BACK-TESTING AND PROFIT-LOSS ATTRIBUTION TEST

Article 36

Assessment of compliance in relation to requirements on the technical elements to be included in the actual and hypothetical changes in the portfolio's value for the purposes of the back-testing requirements

1. When assessing the institution's compliance with Article 325bi(1), point (e), of Regulation (EU) No 575/2013 in relation to requirements on the technical elements to be included in the actual and hypothetical changes in the portfolio's value, the competent authority shall verify that the internal policies referred to in that Article:
 - (a) Specify all elements referred to in Article 5 of Delegated Regulation (EU) 2022/2059 and all elements referred to in Article 1(5), point (c), of that Regulation where applicable;
 - (b) Entail the production of a periodic report including daily figures where the different elements contributing to the changes in the portfolio's value are disentangled, including:
 - (i) The changes related to elements that are removed from the end-of-day value to obtain the actual and hypothetical changes in accordance with Articles 1 to 4 of the Delegated Regulation (EU) 2022/2059, including those relating to intraday trading activities;
 - (ii) The changes related to adjustments that are included in the end-of-day of value but not in the calculation of the actual and hypothetical changes in accordance with Articles 1 to 4 Delegated Regulation (EU) 2022/2059;
 - (iii) The changes related to adjustments that are included in the end-of-day of value and in the calculation of the actual and hypothetical changes in accordance with Articles 1 to 4 Delegated Regulation (EU) 2022/2059;
 - (iv) The changes related to adjustments resulting from the independent price verification process referred to in Article 1(1) and 2(1) of Delegated Regulation (EU) 2022/2059;
 - (c) Entail the production of the report referred to in point (b) both at the level of each trading desk subject to trading desk's back-testing requirements in accordance with Articles 1 and 3 of Delegated Regulation (EU) 2022/2059, and at the level of the portfolio subject to back-testing requirements in accordance with Articles 2 and 4 of Delegated Regulation (EU) 2022/2059;

- (d) Specify the rectification processes to follow in the calculation of the actual and hypothetical changes in case of contingencies, exceptions, errors, and pricing failures.
2. When assessing that the institution's internal model is implemented with integrity in accordance with Article 325bi(1) of Regulation (EU) No 575/2013 in relation to requirements on the technical elements to be included in the actual and hypothetical changes in the portfolio's value, the competent authority shall:
 - (a) In relation to the calculation of the actual changes in the trading desk portfolio's value as referred to in Article 1 of Delegated Regulation (EU) 2022/2059:
 - (i) by using the reports referred to in paragraph 1, points (b) and (c) and the outline of the differences referred to in Article 5(a) of Delegated Regulation (EU) 2022/2059, identify the elements that differ between the changes in the end-of-day portfolio values produced by the end-of-day valuation process and the actual changes, and verify that they are limited to fees and commissions as referred to in Article 325bf(4), point (b), of Regulation (EU) No 575/2013, and to those adjustments that must or may be excluded from the actual changes in accordance with Article 1 of Delegated Regulation (EU) 2022/2059;
 - (ii) by using the reports referred to in paragraph 1, points (b) and (c), verify that, in accordance with Article 1(1) of Delegated Regulation (EU) 2022/2059, the adjustments resulting from the independent price verification are included in the actual changes in the trading desk portfolio's value;
 - (iii) verify that the passage of time as referred to in Article 1(2) of Delegated Regulation (EU) 2022/2059 is reflected in the calculation of the actual changes, and that it is reflected in the same way as in the calculation of the end-of-day portfolio values produced by the end-of-day valuation process;
 - (iv) assess how the institution evaluates whether an adjustment is market-risk related as referred to in Article 1(3) of Delegated Regulation (EU) 2022/2059 and, by using the reports referred to in paragraph 1, points (b) and (c), verify that those that are not market-risk related are excluded from the calculation of the actual changes;
 - (v) by comparing the reports referred to in paragraph 1, points (b) and (c) at different dates, verify that, in accordance with Article 1(4) of Delegated Regulation (EU) 2022/2059, the institution reflects changes in adjustments' values only on the dates at which the adjustment is recomputed;
 - (vi) verify that, in accordance with Article 1(4) of Delegated Regulation (EU) 2022/2059, the scope of positions on which the adjustment is calculated includes only positions assigned to the trading desk. When making this assessment, the competent authority shall verify that the institution does not derive the adjustment applicable to the trading

- desk from a broader scope of positions than those assigned to the trading desk;
- (vii) verify that the adjustments excluded from the actual changes in accordance with Article 1(5) of Delegated Regulation (EU) 2022/2059 are non-additive. When making this assessment, the competent authority shall evaluate how the institution risk-manages those adjustments;
 - (viii) verify that the information included in the list referred to in Article 5(c) of Delegated Regulation (EU) 2022/2059 is consistent with the evidence resulting from the reports referred to in paragraph 1, points (b) and (c);
- (b) In relation to the calculation of the actual changes in the portfolio's value as referred to in Article 2 of Delegated Regulation (EU) 2022/2059:
- (i) by using the reports referred to in paragraph 1, points (b) and (c) and the outline of the differences referred to in Article 5(a) of Delegated Regulation (EU) 2022/2059, identify the elements that differ between the changes in the end-of-day portfolio values produced by the end-of-day valuation process and the actual changes, and verify that they are limited to fees and commissions as referred to in Article 325bf(4), point (b), of Regulation (EU) No 575/2013, and to those adjustments that must or may be excluded from the actual changes in accordance with Article 2 of Delegated Regulation (EU) 2022/2059;
 - (ii) by using the reports referred to in paragraph 1, points (b) and (c), verify that, in accordance with Article 2(1) of Delegated Regulation (EU) 2022/2059, the adjustments resulting from the independent price verification are included in the actual changes in the portfolio's value;
 - (iii) verify that the passage of time as referred to in Article 2(2) of Delegated Regulation (EU) 2022/2059 is reflected in the calculation of the actual changes, and that it is reflected in the same way as in the calculation of the end-of-day portfolio values produced by the end-of-day valuation process;
 - (iv) assess how the institution evaluates whether an adjustment is market-risk related as referred to in Article 2(3) of Delegated Regulation (EU) 2022/2059 and, by using the reports referred to in paragraph 1, points (b) and (c), verify that those that are not market-risk related are excluded from the calculation of the actual changes;
 - (v) verify that, in accordance with Article 2(4) of Delegated Regulation (EU) 2022/2059, the scope of positions on which an adjustment is computed is either made of:
 - (1) positions assigned to trading desks for which the institution calculates its own funds requirements for market risk in accordance with Part Three, Title IV, Chapter 1b of Regulation (EU) No 575/2013. When this scope is used, the competent authority shall verify that the institution does not derive the

- adjustment applicable to that scope from a broader scope of positions;
- (2) all positions subject to own funds requirements for market risk. When this scope is used, the competent authority shall verify that the whole adjustment computed on that scope is included in the actual changes in the portfolio's value;
- (vi) by comparing the reports referred to in paragraph 1, points (b) and (c), at different dates, verify that, in accordance with Article 2(5), second subparagraph, of Delegated Regulation (EU) 2022/2059, the institution reflects changes in adjustments' values only on the dates at which the adjustment is recomputed;
- (vii) verify that the information included in the list referred to in Article 5(c) of Delegated Regulation (EU) 2022/2059 is consistent with the evidence resulting from the reports referred to in paragraph 1, point (b) and (c);
- (c) In relation to the calculation of the hypothetical changes in the trading desk portfolio's value as referred to in Article 3 of Delegated Regulation (EU) 2022/2059:
- (i) identify, by using the reports referred to in paragraph 1, point (b) and (c), the elements that differ between the changes in the end-of-day portfolio values produced by the end-of-day valuation process and the hypothetical changes, and verify that they are limited to fees and commissions, to those elements that are not captured due to the assumption that positions are unchanged as referred to in Article 325bf(4), point (a), of Regulation (EU) No 575/2013, and to those adjustments that must or may be excluded from the hypothetical changes in accordance with Article 3 of Delegated Regulation (EU) 2022/2059;
- (ii) verify that, in accordance with Article 3(2) of Delegated Regulation (EU) 2022/2059, the effect of the passage of time is reflected in the hypothetical changes consistently with the treatment the institution applies for such effect in the calculation of the expected shortfall risk measure as referred to in Article 325bb of Regulation (EU) No 575/2013 and in the calculation of the stress scenario risk measure referred to in Article 325bk of that Regulation;
- (iii) assess how the institution evaluates whether an adjustment is market-risk related as referred to in Article 3(3) of Delegated Regulation (EU) 2022/2059 and, by using the reports referred to in paragraph 1, point (b) and (c), verify that those that are not market-risk related are excluded from the calculation of the hypothetical changes;
- (iv) by using the reports referred to in paragraph 1, point (b) and (c), verify that, in accordance with Article 3(3) of Delegated Regulation (EU) 2022/2059, only adjustments that are calculated daily and that are included in the institution's risk measurement model are included as part of the hypothetical changes;

- (v) verify that, in accordance with Article 3(4) of Delegated Regulation (EU) 2022/2059, the scope of positions on which the adjustment is calculated includes only positions assigned to the trading desk. When making this assessment, the competent authority shall verify that the institution does not derive the adjustment applicable to the trading desk from a broader scope of positions than those assigned to the trading desk;
 - (vi) verify that the adjustments that are excluded from the hypothetical changes in accordance with Article 3(5) of Delegated Regulation (EU) 2022/2059 are non-additive. When making this assessment, the competent authority shall evaluate how the institution risk-manages those adjustments;
 - (vii) by using the outline referred to in Article 5, point (c)(viii) of Delegated Regulation (EU) 2022/2059, verify that the methodology used by the institution to calculate changes in the value of an adjustment assuming that positions are unchanged as referred to in Article 325bf(4), point (a), of Regulation (EU) No 575/2013 is appropriate;
 - (viii) verify that the information included in the list referred to in Article 5, point (c), of Delegated Regulation (EU) 2022/2059 is consistent with the evidence resulting from the reports referred to in paragraph 1, point (b) and (c);
- (d) In relation to the calculation of the hypothetical changes in the portfolio's value as referred to in Article 4 of Delegated Regulation (EU) 2022/2059:
- (i) by using the reports referred to in paragraph 1, point (b) and (c), identify the elements that differ between the changes in the end-of-day portfolio values produced by the end-of-day valuation process and the hypothetical changes, and verify that they are limited to fees and commission, to those elements that are not captured due to the assumption that positions are unchanged as referred to in Article 325bf(4), point (a), of Regulation (EU) No 575/2013, and to those adjustments that must or may be excluded from the hypothetical changes in accordance with Article 3 of Delegated Regulation (EU) 2022/2059;
 - (ii) verify that, in accordance with Article 4(2) of Delegated Regulation (EU) 2022/2059, the effect of the passage of time is reflected in the hypothetical changes consistently with the treatment the institution applies for such effect in the calculation of the expected shortfall risk measure as referred to in Article 325bb of Regulation (EU) No 575/2013 and in the calculation of the stress scenario risk measure referred to in Article 325bk of that Regulation;
 - (iii) assess how the institution evaluates whether an adjustment is market-risk related as referred to in Article 4(3) of Delegated Regulation (EU) 2022/2059 and, by using the reports referred to in paragraph 1, point

- (b) and (c), verify that those that are not market-risk related are excluded from the calculation of the hypothetical changes;
- (iv) by using the reports referred to in paragraph 1, point (b) and (c), verify that, in accordance with Article 4(3) of Delegated Regulation (EU) 2022/2059, only adjustments that are calculated daily and that are included in the institution's risk measurement model are included as part of the hypothetical changes;
- (v) verify that, in accordance with Article 4(4) of Delegated Regulation (EU) 2022/2059, the scope of positions on which an adjustment is computed is either made of:
- (1) positions assigned to trading desks for which the institution calculates its own funds requirements for market risk in accordance with Part Three, Title IV, Chapter 1b of Regulation (EU) No 575/2013. When this scope is used, the competent authority shall verify that the institution does not derive the adjustment applicable to that scope from a broader scope of positions;
 - (2) all positions subject to own funds requirements for market risk. When this scope is used, the competent authority shall verify that the whole adjustment computed on that scope is included in the actual changes in the portfolio's value;
- (vi) by using the outline referred to in Article 5, point (c)(viii), of Delegated Regulation (EU) 2022/2059, verify that the methodology used by the institution to calculate changes in the value of an adjustment assuming that positions are unchanged as referred to in Article 325bf(4), point (a), of Regulation (EU) No 575/2013 is appropriate;
- (vii) verify that the information included in the list referred to in Article 5(c) of Delegated Regulation (EU) 2022/2059 is consistent with the evidence resulting from the reports referred to in paragraph 1, point (b) and (c);
- (e) In relation to the processes followed by the institution to compute actual and hypothetical changes:
- (i) verify that the process to map a position to one trading desk only is robust;
 - (ii) verify that the rectification processes referred to in paragraph 1, point (d) are robust, and that they are followed in practice whenever contingencies, exceptions, errors, and pricing failures occur. When verifying this, the competent authority shall review the history of contingencies, exceptions, errors, and pricing failures in the calculations of the changes in the portfolios' values, assess how they have been remediated and, where relevant, the impact of those errors on the back-testing and profit-and-loss attribution test results;

- (iii) verify how illiquid positions are treated in the end-of-day valuation process and in the independent price verification process. Where, due to stale data, those positions lead to no changes in the end-of-day valuation and in the actual and hypothetical changes in the portfolio's value, the competent authority shall assess whether, despite the lack of data, the risk-measurement model is reasonably accurate in measuring risks of those positions as referred to in Article 325bi(1), point (f), of Regulation (EU) No 575/2013.
3. For the purpose of the assessments referred to in paragraph 2, points (a) to (d), the competent authority may apply any of the following assessment methods:
- (a) On a sample of transactions, it may require the institution to calculate and reconcile the changes in the end-of-day value as resulting from the end-of-day valuation process, the actual changes, and the hypothetical changes;
 - (b) On a sample of transactions, it may require the institution to calculate the hypothetical changes and the risk-theoretical changes, and verify that the effect of the passage of time is captured consistently;
 - (c) It may compare the profile of the cumulative hypothetical changes to the portfolio's value over a given period of time and the corresponding cumulative actual changes over the same period to assess the plausibility of the calculations performed by the institution.

Article 37

Assessment of compliance in relation to requirements to analyse overshootings

1. The competent authority shall verify that the institution analyses all overshootings referred to in Article 325bf(5) of Regulation No 575/2013 in detail, in order to determine their causes.
2. When making the assessment referred to in paragraph 1, the competent authority shall verify that the institution carries out at least the following with regard to the analysis of the overshootings:
 - (a) it identifies which portfolios or trading desks primarily caused the overshooting;
 - (b) it analyses the differences in the hypothetical and actual changes in the portfolio's value;
 - (c) it analyses whether and which market movements, risk factors or parameters caused the overshooting;
 - (d) it analyses whether any modelling issues, or missing risk factors, contributed to the overshooting, including an explanation of which part of the changes in the portfolio's value can be explained by the model and which cannot;
 - (e) it analyses whether process failures, including positions not being properly captured or missing updates of data, contributed to or caused the overshooting;

- (f) it includes the results of actions taken as a result of points (a) to (e) when notifying competent authorities of overshootings that emerged from their back-testing programme in accordance with Article 325bf of Regulation (EU) No 575/2013.
3. The competent authority shall verify that, where the analysis referred to in paragraphs 1 and 2 identifies a material weakness or inaccuracy in the model or processes, the institution assesses that weakness or inaccuracy and promptly develops a plan for a timely return to compliance to be assessed as part of the regular validation of the model.
 4. The competent authority shall verify that the institution ensures both of the following:
 - (a) any overshooting, including those relating to the back-testing referred to in Article 325bf(5) of Regulation (EU) No 575/2013, is reported to senior management within three working days of the date it has been identified;
 - (b) the analyses referred to in paragraphs 1 and 2 are reported to the competent authority and to the senior management within one month of the date the overshooting has occurred.

Article 38

Assessment of compliance in relation to the profit and loss attribution requirements

1. When assessing that the institution's internal model is implemented with integrity in accordance with Article 325bi(1) of Regulation (EU) No 575/2013 in relation to requirements on the technical elements to be included in the hypothetical changes in the trading desk portfolio's value for the purpose of the profit and loss attribution requirements referred to in Article 325bg of that Regulation, the competent authority shall verify that, in accordance with Article 13 of Delegated Regulation (EU) 2022/2059, the time series of hypothetical changes in the trading desk portfolio's value as used for the purpose of the back-testing requirements coincides with the time series of hypothetical changes in the trading desk portfolio's value as used for the purpose of the profit and loss attribution requirement.
2. When assessing the institution's compliance with Article 325bi(1), point (e), of Regulation (EU) No 575/2013 in relation to requirements on the technical elements to be included in the theoretical changes in the portfolio's value for the purpose of the profit and loss attribution requirements referred to in Article 325bg of that Regulation, the competent authority shall verify that the internal policies referred to in that Article:
 - (a) ensure that the business days used in the calculation of the theoretical changes in the portfolio's value are the same as those used in the calculation of the expected shortfall risk measure referred to in Article 325bb of Regulation (EU) No 575/2013 and the stress scenario risk measure referred to in Article 325bk of that Regulation;
 - (b) specify whether, in accordance with Article 6(2) of Delegated Regulation (EU) 2022/2059, the institution aligns the snapshot time for which it calculates the theoretical changes in the trading desk portfolio's value with

- the snapshot time for which it calculates the hypothetical changes in the trading desk portfolio's value, or whether such an alignment is not performed;
- (c) specify whether there are risk factors for which the institution, in accordance with Article 14(1) and (2) of Delegated Regulation (EU) 2022/2059, uses input data or values employed in the calculation of the hypothetical changes to calculate the theoretical changes, or whether there are no risk factors for which such treatment is used. Where the treatment is used for some, but not all, risk factors, the competent authority shall verify that the internal policies specify objective criteria to select risk factors for which the treatment is applied;
 - (d) cover all aspects referred to in Article 15(2) and (3) of Delegated Regulation (EU) 2022/2059 in relation to risk factors for which the institution uses input data or values employed in calculating the hypothetical changes to calculate the theoretical changes, in accordance with Article 14(1) and (2) of that Delegated Regulation. When making this assessment, the competent authority shall verify that the institution uses quantitative criteria to assess the effect of the alignment referred to in Article 15(2), point (b), of Delegated Regulation (EU) 2022/2059;
 - (e) Specify the rectification processes to follow in the calculation of the theoretical changes in case of contingencies, exceptions, errors, and pricing failures;
 - (f) cover all aspects referred to in Article 15(1) of Delegated Regulation (EU) 2022/2059.
3. When assessing that the institution's internal model is implemented with integrity in accordance with Article 325bi(1) of Regulation (EU) No 575/2013 in relation to the profit and loss attribution requirements referred to in Article 325bg of that Regulation, the competent authority shall:
- (a) In relation to the calculation of the theoretical changes in the portfolio's value:
 - (i) verify that the business days used in the calculation of the theoretical changes in the portfolio's value are the same as those used in the calculation of the expected shortfall risk measure referred to in Article 325bb of Regulation (EU) No 575/2013 and the stress scenario risk measure referred to in Article 325bk of that Regulation;
 - (ii) verify that the positions used in the calculation of the hypothetical changes are those used for calculating the theoretical changes. When making this assessment, the competent authority shall evaluate whether the institution's IT systems ensure the calculation of those changes on the same positions. To complement its assessment, the competent authority may require the institution to provide the inventory of positions captured in the actual and theoretical changes, and compare them;
 - (iii) verify that, in accordance with Article 12(1) of Delegated Regulation (EU) 2022/2059, when calculating the theoretical changes, positions are assumed to be unchanged. When making this assessment, the

- competent authority shall use one or more of the assessment methods referred to in paragraph 4;
- (iv) verify that, in accordance with Article 12(2) of Delegated Regulation (EU) 2022/2059, there are no differences between the pricing methods, model parametrisations, market data and any other technique used in the internal risk-measurement model, and those used for calculating the theoretical changes. When making this assessment, the competent authority shall verify that the institutions' systems ensure that the pricing functions used for calculating the theoretical changes are those used in the calculation of the expected shortfall risk measure referred to in Article 325bb of Regulation (EU) No 575/2013 and the stress scenario risk measure referred to in Article 325bk of that Regulation;
 - (v) verify that, in accordance with Article 12(3) of Delegated Regulation (EU) 2022/2059, theoretical changes in the portfolio's value reflect only changes in the values of risk factors that are shocked when computing the expected shortfall risk measure referred to in Article 325bb of Regulation (EU) No 575/2013 or the stress scenario risk measure referred to in Article 325bk of that Regulation. When making this assessment, the competent authority shall verify that the institutions' systems ensure that the value of other risk factors is kept constant when calculating the theoretical changes, and may complement its assessment by using the assessment method referred to in paragraph 5;
 - (vi) verify that the rectification processes referred to in paragraph 2, point (e) are robust and are followed in practice whenever contingencies, exceptions, errors, and pricing failures occur. When making this assessment, the competent authority shall review the history of contingencies, exceptions, errors, and pricing failures in the calculations of the changes in the portfolios' values, assess how they have been remediated and, where relevant, the impact of those errors on the back-testing and profit-and-loss attribution test results;
- (b) In relation to the profit and loss attribution results:
- (i) verify that the Spearman correlation coefficient and the Kolmogorov-Smirnov test metric are calculated correctly. When making this assessment, the institution shall apply the assessment method referred to in paragraph 6;
 - (ii) verify that risk factors for which the institution uses input data employed in calculating the hypothetical changes to calculate the theoretical changes in accordance with Article 14(1) of Delegated Regulation (EU) 2022/2059 are only those for which the conditions referred to in that Article are met. When making this assessment, the competent authority shall apply the assessment method referred to in paragraph 7;

- (iii) verify that risk factors, whose values employed in calculating the hypothetical changes are used by the institution to calculate the theoretical changes in accordance with Article 14(2) of Delegated Regulation (EU) 2022/2059, are only those for which the conditions referred to in that Article are met. When making this assessment, the competent authority shall apply the assessment method referred to in paragraph 8.
- 4. For the purpose of the assessment referred to in paragraph 3, point (a)(iii), the competent authority shall use one or more of the following assessment methods:
 - (a) to require the institution to provide the inventory, at a given day and at the subsequent day as referred to in Article 12(1) of Delegated Regulation (EU) 2022/2059, of the positions in the portfolio on which it calculates theoretical changes, and assess whether they coincide;
 - (b) to verify that the risk theoretical changes are typically closer to the hypothetical than to the actual changes and, by using the reports referred to in Article 36, paragraph 1, point (b) and (c), identify those days in the time series where the actual and hypothetical changes differ the most because of a change in the trading desk's portfolio composition, and verify that the theoretical changes in those days are not affected by such a change in the portfolio's composition.
- 5. For the purpose of the assessment referred to in paragraph 3, point (a)(v), the competent authority may:
 - (a) require the institution to obtain a sample of financial instruments in its portfolio, the prices of which depend both on risk factors that are shocked and risk factors that are not shocked when calculating the excepted shortfall risk measure referred to in Article 325bb of Regulation (EU) No 575/2013 or the stress scenario risk measure referred to in Article 325bk of that Regulation;
 - (b) verify that, for a given reference date, the value of risk factors that are not shocked is kept constant when calculating the theoretical changes related to the financial instruments referred to in point (a).
- 6. For the purpose of the assessment referred to in paragraph 3, point (b)(i), the competent authority shall, for the most material or all trading desks:
 - (a) require the institution to provide the time series of hypothetical and theoretical changes in the trading desk's portfolio's value used for calculating the Spearman correlation coefficient and Kolmogorov-Smirnov test metric as referred to in Article 6 of Delegated Regulation (EU) 2022/2059;
 - (b) compute the Spearman correlation coefficient in accordance with Article 7 of Delegated Regulation (EU) 2022/2059 and the Kolmogorov-Smirnov test metric in accordance with Article 8 of that Delegated Regulation;
 - (c) verify that the Spearman correlation coefficient and Kolmogorov-Smirnov test metric resulting from point (b) coincide with those obtained by the institution;

- (d) verify that the classification of the trading desks to the zones referred to in Article 9 of Delegated Regulation (EU) 2022/2059 is correct.
7. For the purpose of the assessment referred to in paragraph 3, point (b)(ii), the competent authority shall:
- (a) identify the most material risk factors for which the institution applied the treatment referred to in Article 14(1) of Delegated Regulation (EU) 2022/2059;
 - (b) verify that the same risk factor is used in the calculation of the hypothetical and theoretical changes;
 - (c) verify that the value of those risk factors differs only because of the different sources or extraction times of their input data.

The intensity at which the competent authority performs this assessment shall be proportionate to the effect that the alignment of risk factors' input data has on the theoretical changes and on the profit and loss attribution test results as referred to in Article 15(2), points (a) and (b) of Delegated Regulation (EU) 2022/2059.

8. For the purpose of the assessment referred to in paragraph 3, point (b)(iii), the competent authority shall:
- (a) identify the most material risk factors for which the institution applied the treatment referred to in Article 14(2) of Delegated Regulation (EU) 2022/2059;
 - (b) for the risk factors referred to in point (a), acquire a comprehensive understanding of the techniques of the valuation systems that are used to derive the value of the risk factor from the input data in accordance with Article 14(2), point (b), of Delegated Regulation (EU) 2022/2059;
 - (c) on the basis of point (b), assess whether the conditions referred to in Article 14(2) Delegated Regulation (EU) 2022/2059 are met, taking into account any rationale provided in accordance with Article 15(3) of that Regulation.

The intensity at which the competent authority performs this assessment shall be proportionate to the effect that the alignment of risk factors' values has on the theoretical changes and on the profit and loss attribution test results as referred to in Articles 15(2), points (a) and (b) of Delegated Regulation (EU) 2022/2059.

SECTION 5

ASSESSMENT OF COMPLIANCE WITH REQUIREMENTS RELATING TO THE TREATMENT OF FOREIGN-EXCHANGE AND COMMODITY RISK IN THE NON-TRADING BOOK

Article 39

Assessment of compliance in relation to requirements on the calculation of the own funds requirements for foreign-exchange and commodity risk in the non-trading book

1. When assessing the institution's compliance with Article 325bi(1), point (e), of Regulation (EU) No 575/2013 in relation to requirements on the calculation of own funds requirements for market risk for positions in the non-trading book, the competent authority shall verify that the internal policies referred to in that Article specify all of the following:
 - (a) The scope of foreign-exchange positions in the non-trading book for which the own funds requirements are computed with the alternative internal model approach and, where applicable, the underlying reason for excluding some positions from that scope;
 - (b) The scope of commodity positions in the non-trading book for which the own funds requirements are computed with the alternative internal model approach, and where applicable, the underlying reason for excluding some positions from that scope;
 - (c) For positions subject to foreign exchange risk but not to commodity risk:
 - (i) Whether the value that is used as a basis to compute the own funds requirements for foreign exchange risk is the last available accounting value in accordance with Article 3(1) of Commission Delegated Regulation (EU) 2023/1577 of 20 April 2023¹⁵, or the last available fair value in accordance with Article 3(2) of that Delegated Regulation, and the frequency at which such value is recalculated;
 - (ii) Whether there are trading desks whose non-linear positions in the exchange rate are subject to the treatment referred to in Article 3(4) and Article 5(1), second subparagraph, of Delegated Regulation (EU) 2023/1577 and, where applicable, the reason for using such derogation for some trading desks, while not for some others;
 - (d) The trading desks for which the hypothetical and the actual changes in the portfolio's value in relation to a non-trading book position which is subject to commodity risk or both to commodity and foreign exchange risk are calculated in accordance with Article 5(2), point (a), of Delegated Regulation

¹⁵ Commission Delegated Regulation (EU) 2023/1577 of 20 April 2023 supplementing Regulation (EU) No 575/2013 of the European Parliament and of the Council with regard to regulatory technical standards on the calculation of the own funds requirements for market risk for non-trading book positions subject to foreign exchange risk or commodity risk and the treatment of those positions for the purposes of the regulatory back-testing requirements and the profit and loss attribution requirement under the alternative internal model approach (OJ L 193, 1.8.2023, p. 1).

- (EU) 2023/1577, and those for which the changes are calculated in accordance with Article 5(2), point (b), of that Delegated Regulation, and the reason for that choice.
2. When assessing that the institution's internal model is implemented with integrity in accordance with Article 325bi(1), of Regulation (EU) No 575/2013 in relation to requirements on the calculation of own funds requirements for market risk for positions in the non-trading book, the competent authority shall:
- (a) Verify that the internal processes referred to in Article 325bi(1), point (e), of Regulation (EU) No 575/2013 ensure all of the following:
 - (i) the traceability of non-trading book positions incorporated in the scope of the alternative internal model approach, as well as the correctness of the accounting or fair values used as a basis to compute the own funds requirements for market risk in accordance with Article 3 and Article 4 of Delegated Regulation (EU) 2023/1577;
 - (ii) that non-trading book positions attracting foreign-exchange risk or commodity risk booked on a given date are included in the calculation of the expected shortfall risk measure referred to in Article 325bb of Regulation (EU) No 575/2013 or the stress scenario risk measure referred to in Article 325bk of that Regulation. Where appropriate, the competent authority may apply the assessment method referred to in paragraph 3;
 - (iii) that any foreign exchange risk positions stemming from a change in the reporting currency at the different levels of consolidation ('translation risk') are included in the scope of positions subject to foreign exchange risk. When making this assessment, the competent authority shall verify how the institution includes in the internal risk-measurement model the net open positions stemming from different entities of the group. Where appropriate, the competent authority may apply the assessment method referred to in paragraph 4;
 - (iv) a correct identification of foreign-exchange positions meeting the conditions for using the treatment referred to in Article 3(4) and Article 5(1), second subparagraph, of Delegated Regulation (EU) 2023/1577, where the institution uses that treatment;
 - (v) a correct and complete identification of items meeting the conditions set out in Article 3(6) of Delegated Regulation (EU) 2023/1577. Where appropriate, the competent authority may apply the assessment method referred to in paragraph 5;
 - (b) in relation to the computation of own funds requirements for positions that are subject to foreign-exchange risk as referred to in Article 3 of Delegated Regulation (EU) 2023/1577, verify that:
 - (i) foreign-exchange positions for which the derogation in Article 3(4) and Article 5(1), second subparagraph, of Delegated Regulation (EU) 2023/1577 is used are distinguished from those for which that derogation is not used;

- (ii) in accordance with Article 3(3) of Delegated Regulation (EU) 2023/1577, only foreign-exchange risk factors of the last available accounting or fair value are updated to determine the value of the position before the application of the scenario of future shock, unless the treatment referred to in Article 3(4) of that Regulation is used;
 - (iii) in accordance with Article 3(4) of Delegated Regulation (EU) 2023/1577, for positions for which the treatment in Article 5(1), second subparagraph of that Regulation is used, all risk factors are updated to determine the value of the position before the application of the scenario of future shock;
 - (iv) When making the assessment according to points (i) to (iii), the competent authority may use the assessment method referred to in paragraph 6 when the institution uses the fair value as a basis for computing its own funds requirements in accordance with Article 3(2) of Delegated Regulation (EU) 2023/1577, or the assessment method referred to in paragraph 7 when the institution uses the accounting value in accordance with Article 3(1) of that Regulation;
- (c) in relation to items meeting the conditions referred to in Article 3(6) of Delegated Regulation (EU) 2023/1577, verify that:
- (i) the criteria established by the institution to identify events triggering an impairment are appropriate, based on historical data and historical events;
 - (ii) the criteria referred to in point (i) are consistent with the internal risk-management of impairment risk;
 - (iii) the level of impairment recognised following the events referred to in (i) is based on objective reasonings;
- (d) in relation to the computation of own funds requirements for positions that are subject to commodity risk or both to commodity and foreign exchange risk as referred to in Article 4 of Delegated Regulation (EU) 2023/1577, verify that scenarios of future shocks are applied only to risk factors belonging to the commodity broad risk factor category, and, where applicable, to the foreign-exchange broad risk factor category. Where appropriate, the competent authority may use the assessment method referred to in paragraph 8;
- (e) verify that the calculation of the hypothetical and actual changes related to non-trading book positions subject to foreign exchange risk or commodity risk is done in accordance with Article 5 of Delegated Regulation (EU) 2023/1577. Where appropriate, the competent authority may use the assessment method referred to in paragraph 9.
3. For the purpose of the assessment referred to in paragraph 2, point (a)(ii), the competent authority may apply one of the two following approaches:
- (a) on a sample of non-trading book positions taken on a given reference date, verify that they are included in the scope of positions captured in the expected

- shortfall risk measure or stress scenario risk measure at that reference date or in the scope of positions of the alternative standardised approach;
- (b) require the institution to perform a reconciliation between the non-trading book positions taken at a given reference date and the non-trading book positions that are in the scope of the internal risk-measurement model and in the scope of the alternative standardised approach at that reference date.
4. For the purpose of the assessment referred to in paragraph 2, point (a)(iii), the competent authority may require the institution to provide types of positions that are included in the model and that stem from assets and liabilities that do not attract market risk when the own funds requirements are computed at the solo level, but attract it when the own funds requirements are computed at the consolidated level because of the translation risk.
 5. For the purpose of the assessment referred to in paragraph 2, point (a)(v), the competent authority may require the institution to reconcile the items that the institution identified as meeting the conditions referred to in Article 3(6) of Delegated Regulation (EU) 2023/1577 for the purpose of computing the own funds requirements with the alternative internal model approach, with the items meeting those conditions in accordance with the applicable accounting framework.
 6. For the purpose of the assessment referred to in paragraph 2, point (b), the competent authority may, on a sample of non-trading book positions and for a reference date for the calculation of the expected shortfall risk measure as referred to in Article 325bb of Regulation (EU) No 575/2013 and the stress scenario risk measure as referred to in Article 325bk of that Regulation, apply the following assessment method:
 - (a) require the institution to provide the list of:
 - (i) risk factors used as inputs to determine the fair value constituting the basis for the computation of the own funds requirements in accordance with Article 3 of Delegated Regulation (EU) 2023/1577;
 - (ii) risk factors out of those included in the list referred in point (i) on which the institution applies scenarios of future shocks calculating the expected shortfall risk measure referred to in Article 325bb of Regulation (EU) No 575/2013 or the stress scenario risk measure referred to in Article 325bk of that Regulation;
 - (b) require the institution to provide the value of the risk factors referred to in point (a) at the following dates:
 - (i) the date at which the last available fair value was determined;
 - (ii) the given reference date for the calculation of the expected shortfall risk measure or the stress scenario risk measure;
 - (c) verify that:
 - (i) for positions for which the treatment in Article 3(4) of Delegated Regulation (EU) 2023/1577 is not used, the value of risk factors not reflecting foreign-exchange risk has not been updated between the two dates referred to in points (b)(i) and (b)(ii);

- (ii) for positions for which the treatment in Article 3(4) of Delegated Regulation (EU) 2023/1577 is used, the value of all risk factors is updated between the two dates referred to in points (b)(i) and (b)(ii);
 - (iii) the risk factors referred to in (a)(ii) relates only to foreign-exchange risk, regardless of whether the treatment in Article 3(4) of Delegated Regulation (EU) 2023/1577 is used.
- 7. For the purpose of the assessment referred to in paragraph 2, point (b), the competent authority may, on a sample of non-trading book positions and for a reference date for the calculation of the expected shortfall risk measure as referred to in Article 325bb of Regulation (EU) No 575/2013 and the stress scenario risk measure as referred to in Article 325bk of that Regulation, apply the following assessment method:
 - (a) assess how the institution disentangles the foreign-exchange risk factors from other inputs used to determine the accounting value of a position;
 - (b) require the institution to provide the list of risk factors out of the foreign-exchange risk factors referred to in point (a) on which the institution applies scenarios of future shocks when calculating the expected shortfall risk measure referred to in Article 325bb of Regulation (EU) No 575/2013 or the stress scenario risk measure referred to in Article 325bk of that Regulation;
 - (c) obtain the value of the foreign-exchange risk factors and of other inputs used to determine the accounting value at the following dates:
 - (i) the date at which the last available accounting value was determined;
 - (ii) the given reference date for the calculation of the expected shortfall risk measure and the stress scenario risk measure;
 - (d) verify that:
 - (i) for positions for which the treatment in Article 3(4) of Delegated Regulation (EU) 2023/1577 is not used, the valuation inputs not reflecting foreign-exchange risk have not been updated between the two dates referred to in points (c)(i) and (c)(ii);
 - (ii) for positions for which the treatment in Article 3(4) Delegated Regulation (EU) 2023/1577 is used, the valuation inputs, including foreign exchange risk factors, have been updated between the two dates referred to in points (c)(i) and (c)(ii);
 - (iii) the risk factors referred to in (b) relates only to foreign-exchange risk, regardless of whether the treatment in Article 3(4) of Delegated Regulation (EU) 2023/1577 is used.
- 8. For the purpose of the assessment referred to in paragraph 2, point (d), the competent authority may, on a sample of non-trading book positions and for a reference date for the calculation of the expected shortfall risk measure as referred to in Article 325bb of Regulation (EU) No 575/2013 and the stress scenario risk measure referred to in Article 325bk of that Regulation, apply the following assessment method:
 - (a) require the institution to provide the list of:

- (i) risk factors used as inputs to determine the fair value constituting the basis for the computation of the own funds' requirements in accordance with Article 4 of Delegated Regulation (EU) 2023/1577;
 - (ii) risk factors out of those included in the list referred to in point (a) on which the institution applies scenario of future shock when calculating the expected shortfall risk measure referred to in Article 325bb of Regulation (EU) No 575/2013 or extreme scenario of future shock when calculating the stress scenario risk measure referred to in Article 325bk of that Regulation;
- (b) verify that in the list referred to in point (a)(ii), there are only risk factors reflecting commodity risk, and foreign-exchange risk where applicable.
9. For the purpose of the assessment referred to in paragraph 2, point (e), the competent authority may, on a sample of non-trading book positions, apply the following method:
- (a) require the institution to provide a description of the valuation inputs used to determine the accounting or the fair value of the position;
 - (b) require the institution to provide the values of such valuation inputs at the end of the day following the computation of the value-at-risk number referred to in Article 325bf of Regulation (EU) No 575/2013 and at the end of the previous day, as used in the computation of the hypothetical and actual changes to the portfolio's value;
 - (c) verify that, depending on the position subject to the assessment, the values are updated or kept unchanged in accordance with the requirements included in Article 5(2) of Delegated Regulation (EU) 2023/1577.

SECTION 6

ASSESSMENT OF THE CALCULATION OF THE EXPECTED SHORTFALL RISK MEASURES AND THE STRESS SCENARIO RISK MEASURE

SUBSECTION 1

ASSESSMENT OF ASPECTS THAT ARE RELEVANT BOTH FOR THE CALCULATION OF THE EXPECTED SHORTFALL RISK MEASURES AND THE STRESS SCENARIO RISK MEASURE

Article 40

Assessment of compliance in relation to the requirement for the internal risk-measurement model to capture non-linearities

1. When assessing the institution's compliance with Article 325bh(1), point (b), of Regulation (EU) No 575/2013 in relation to requirements on the effectiveness and capability of the internal-risk measurement model to capture non-linearities of options

and other products for an institution using a sensitivity-based approach, the competent authority shall verify that:

- (a) the internal risk-measurement model captures at least the material first- and second-order terms of Taylor series approximations to reflect the change in the prices due to changes in relevant risk factors, including the cross-gamma risk represented by material joint-moves in risk factors;
- (b) the sensitivity-based approach leads to appropriate results, including when severe shocks are applied to the risk factors.

Where appropriate, the competent authority may apply the assessment method referred to in paragraph 2.

2. For the purpose of the assessment referred to in paragraph 1, the competent authority may apply the following steps in sequence:
 - (a) identify products for which it wants to test the materiality of the order terms of a Taylor series approximation, and the appropriateness of the sensitivity-based approach under severe shock;
 - (b) identify a business day in the stress period where the returns observed for the risk factors in those products were particularly high, where positive, or particularly low, where negative;
 - (c) require the institution to compute the hypothetical and theoretical changes in the values of those products in accordance with Delegated Regulation (EU) 2022/2059, under the scenario identified by the returns on the business day identified in point (b);
 - (d) based on the results in point (c), assess whether the sensitivity-based approach leads to appropriate results.

SUBSECTION 2

ASSESSMENT OF ASPECTS THAT ARE RELEVANT FOR THE CALCULATION OF THE EXPECTED SHORTFALL RISK MEASURES

Article 41

Assessment of compliance with Article 325bi of Regulation (EU) No 575/2013 in relation to the requirements provided in Article 325bb of that Regulation

When assessing that the institution's internal model is implemented with integrity in accordance with Article 325bi(1) of Regulation (EU) No 575/2013 in relation to the calculation of the unconstrained expected shortfall measures and of the partial expected shortfall measures for all broad risk factor categories at a reduced frequency as referred to in Article 325bb(4) of Regulation (EU) No 575/2013, the competent authority shall:

- (a) analyse the process used by the institution to determine the day of the week when the measures are computed;

- (b) verify that a reduction in the calculation frequency does not lead to an underestimation of risk. When making this assessment, the competent authority shall:
- (i) verify that the analysis performed by the institution to demonstrate that there is no underestimation of risk is adequate;
 - (ii) verify that the evolution of the daily figures for UES_t , PES_t^{RS} , PES_t^{FC} and PES_t^{RC} computed on all portfolio's positions in accordance with Article 325bb(1) of Regulation (EU) No 575/2013, does not systematically show a lower risk profile in the day chosen by the institution. Where there are hints of a systematically lower risk profile, the competent authority may complement its assessment by requiring the institution to calculate daily and for a given period the unconstrained expected shortfall measures UES_t^i and the partial expected shortfall measures $PES_t^{RS,i}$, $PES_t^{FC,i}$ and $PES_t^{RC,i}$ for each broad risk factor categories, and by analysing whether those measures are systematically lower on the day chosen by the institution.

Article 42

Assessment of compliance with Article 325bi of Regulation (EU) No 575/2013 in relation to the requirements included in Article 325bc of that Regulation

1. When assessing that the institution's internal model is implemented with integrity in accordance with Article 325bi(1) of Regulation (EU) No 575/2013 in relation to the calculation of the partial expected shortfall measures referred to in Article 325bc of that Regulation, competent authorities shall:
 - (a) verify that the estimator used by the institution to estimate the expected shortfall risk measures is conceptually sound and reasonably accurate. When making this assessment, the competent authority:
 - (i) shall verify how the institution chose the estimator it uses and the analysis made to support such choice;
 - (ii) shall verify that the expected shortfall estimator corresponds either to the integral of the estimator for the Value-at-Risk numbers referred to in Article 325bf of Regulation (EU) No 575/2013 understood as a function of the tail probability from zero to one minus the relevant confidence level, and dividing by one minus the relevant confidence level, or to a more conservative choice;
 - (iii) may compare the Value-at-Risk and expected-shortfall estimators used by the institution against the estimators included in Table 1;

Table 1: estimators of value-at-risk and expected shortfall in increasing order of conservativeness for rolling sums of ten independent and identically distributed normal random variables

Value-at-risk estimators	Expected shortfall estimators
$Q_{\text{emp}}(\alpha) = X_{(M_1+1)}$	$ES_{\text{emp}} = \frac{-1}{\alpha \cdot N} \left(\sum_{i=1}^{M_{\text{emp}}} X_{(i)} + R_{\text{emp}} \cdot X_{(M_{\text{emp}}+1)} \right);$ $ES_{\text{SAE}} = \frac{-1}{M_1} \sum_{i=1}^{M_{\text{emp}}} X_{(i)}$
$Q_{\text{lin}}(\alpha) = \begin{cases} (1 - R_{\text{lin}})X_{(M_{\text{lin}})} + R_{\text{lin}}X_{(M_{\text{lin}}+1)}, & \text{for } M_{\text{lin}} \geq 1 \\ X_{(1)}, & \text{for } M_{\text{lin}} = 0 \end{cases}$	$ES_{\text{lin}} = \frac{-1}{\alpha \cdot (N + 1)} \left(\frac{3}{2} X_{(1)} + \sum_{i=2}^{M_{\text{lin}}-1} X_{(i)} + \frac{1 + 2R_{\text{lin}} - R_{\text{lin}}^2}{2} X_{(M_{\text{lin}})} + \frac{R_{\text{lin}}^2}{2} X_{(M_{\text{lin}}+1)} \right)$
$Q_{\text{lin_extra}}(\alpha) = \begin{cases} (1 - R_{\text{lin}}) \cdot X_{(M_{\text{lin}})} + R_{\text{lin}} \cdot X_{(M_{\text{lin}}+1)}, & \text{for } M_{\text{lin}} \geq 1 \\ \frac{X_{(1)}}{(\alpha \cdot (N + 1))^3}, & \text{for } M_{\text{lin}} = 0 \end{cases}$	$ES_{\text{lin_extra}} = \frac{-1}{\alpha \cdot (N + 1)} \left(2 \cdot X_{(1)} + \sum_{i=2}^{M_{\text{lin}}-1} X_{(i)} + \frac{1 + 2R_{\text{lin}} - R_{\text{lin}}^2}{2} X_{(M_{\text{lin}})} + \frac{R_{\text{lin}}^2}{2} X_{(M_{\text{lin}}+1)} \right)$
<p>Where:</p> <p>$X_{(i)}$ denotes the i-th lowest value in the sample $\{X_i\}$ used for the estimation, i.e. $X_{(1)}$ is the most severe loss in a profit-and-loss sample and typically a large negative number;</p> <p>N denotes the number of values in the sample $\{X_i\}$ used for the estimation;</p> <p>α denotes the tail probability, i.e. one minus the confidence level;</p> <p>[...] denotes the integer part of an argument;</p> <p>$M_{\text{emp}} = \lfloor \alpha \cdot N \rfloor$ and for the expected shortfall assuming $M_1 < N$, i.e. computing for a left tail of a sample;</p> <p>$R_{\text{emp}} = \alpha \cdot N - \lfloor \alpha \cdot N \rfloor$;</p> <p>$M_{\text{lin}} = \lfloor \alpha \cdot (N + 1) \rfloor$ and for the expected shortfall assuming that $M_{\text{lin}} \geq 2$, i.e. more than one loss is in the α-tail of a profit-and-loss sample;</p> <p>$R_{\text{lin}} = \alpha \cdot (N + 1) - \lfloor \alpha \cdot (N + 1) \rfloor$.</p>	

- (b) where the calculation of the expected shortfall risk measures is based on Monte Carlo simulations, verify that the number of simulations ensures convergence towards stable results. When making this assessment, the competent authority shall review the tests performed by the institution to set the number of simulations, and the statistical tests ensuring that the randomness properties of the sequences used to generate the simulation are appropriate. Where it deems those tests insufficient, the competent authority may use the assessment method referred to in paragraph 2;
- (c) verify that, when calculating partial expected shortfall measures $PES_t(T)$ and $PES_t(T, j)$ referred to in Article 325bc(1) of Regulation (EU) No 575/2013, the institution identifies effective liquidity horizons of the risk factors of a given position, taking into account the maturity of the position in accordance with Article 325bd(4) of that Regulation. When making this assessment, the competent authority shall use the assessment method referred to in paragraph 3;
- (d) verify that, as part of the internal policies referred to in Article 325bi(1), point (e), of Regulation (EU) No 575/2013, the institution has established objective and appropriate criteria for choosing the risk factors forming the subset of modellable risk factors referred to in Article 325bc(2), point (a), of that Regulation. When making this assessment, the competent authority shall obtain an overview of the risk factors chosen by the institution and verify all of the following:
 - (i) whether the criteria ensure a sufficient level of coverage in the modellable risk factors' types chosen compared to the full set of modellable risk factors to which the institution is exposed;
 - (ii) whether the criteria are as such that the threshold referred to in 325bc(2), point (a), of Regulation (EU) No 575/2013 is expected to be exceeded over time. When doing so, the competent authority shall assess by which margin the institution exceeded the threshold in the previous quarters;
 - (iii) whether the institution tests alternative subsets of modellable risk factors to ensure that its choice does not underestimate the own funds requirements. Where it deems those tests insufficient, the competent authority may require the institution to test alternative subsets and assess whether alternative choices lead to material differences in terms of own funds requirements;
 - (iv) whether the institution, in its choice, favours the selection of risk factors for which data in the stress period exist over risk factors for which proxies are used. When this is not the case, the competent authority shall assess the reason why the institution did not implement such a criterion, and whether a different choice would improve the quality of the unconstrained and partial expected shortfall measure;
- (e) verify that risk factors that are not part of the subset of modellable risk factors chosen by the institution in accordance with Article 325bc(2), point (a), of

Regulation (EU) No 575/2013 are kept constant when computing PES_t^{RC} , $PES_t^{RC,i}$ and PES_t^{RS} , $PES_t^{RS,i}$;

- (f) verify that the techniques used to calculate PES_t^{FC} , PES_t^{RC} , $PES_t^{FC,i}$, $PES_t^{RC,i}$ and those used to calculate PES_t^{RS} , $PES_t^{RS,i}$ are the same, except for those deviations necessary to ensure the fulfilment of requirements set out in Article 325bc(2) to (4) of Regulation (EU) No 575/2013. When making this assessment, the competent authority shall obtain an overview of the differences in the techniques employed by the institution when calculating the partial expected shortfall measures calibrated on the recent 12-month period and on the stress period, and verify that those differences do not go beyond what is needed to achieve compliance with the requirements set out in that Regulation;
 - (g) verify that, when calculating the PES_t^{FC} , PES_t^{RC} , $PES_t^{FC,i}$, $PES_t^{RC,i}$, equally weighted data in the observation period are used;
 - (h) in relation to the identification of the stress period, verify that the 12-month rolling windows tested to determine the stress period starts at least from 1 January 2007 as referred to in Article 325bc(2), point (c), of Regulation (EU) No 575/2013 and that the internal policies of the institution specify the frequency of update of the stress period for the calculation of the partial expected shortfall measures, and the other applicable criteria triggering its update. When making this assessment, the competent authority shall verify, also on the basis of past updates, that the stress period is updated at least with a quarterly frequency and that any possible criteria specified in the internal policies have been followed in practice.
2. For the purpose of the assessment method referred to in paragraph 1, point (b), the competent authority shall:
 - (a) require the institution to provide the Monte Carlo statistical error at 95% confidence level, and verify that the method employed to measure such statistical error is sound;
 - (b) require the institution to calculate the expected shortfall risk measures with several different seeds, all other assumptions being equal;
 - (c) assess whether the differences in the expected shortfall risk measures with a different seed resulting from point (b) are compatible with the statistical error referred to in point (a). Where the results are deemed incompatible, the competent authority shall assess the root cause of such incompatibility, and shall assess the number of simulations needed to ensure that the statistical error is below 5%.
 3. For the purpose of the assessment method referred to in paragraph 1, point (c), the competent authority shall:
 - (a) verify that, where the position has a maturity of less than 10 days, the effective liquidity horizon of all risk factors is set to 10 days, and that such position does not impact the calculation of $PES(T, j)$ for $j \geq 2$;

- (b) verify that, where the position has a maturity of Mat days, with $10 \text{ days} \leq Mat \leq 120 \text{ days}$:
 - (i) all risk factors of that position with a liquidity horizon $SubCatLH \geq Mat$ have been assigned to an effective liquidity horizon that is the shortest liquidity horizon among those provided in Table 1 of Article 325bc of Regulation (EU) No 575/2013 that is greater than or equal to Mat ;
 - (ii) the position does not impact the calculation of $PES(T, j)$ for all j corresponding to a liquidity horizon that is greater than the shortest liquidity horizon among those provided in Table 1 of Article 325bc of Regulation (EU) No 575/2013 that is greater than or equal to Mat ;
- (c) verify that, where the position has a maturity of Mat days, with $Mat > 120 \text{ days}$, all risk factors of that position have been assigned to an effective liquidity horizon corresponding to the liquidity horizon $SubCatLH$ assigned to the risk factors;
- (d) verify that, when computing $PES(T, j)$, the institution keeps constant those risk factors with an effective liquidity horizon that is lower than the liquidity horizon corresponding to the index j .

Article 43

Assessment of distributional and statistical assumption

1. When assessing that the institution's internal model is implemented with integrity in accordance with Article 325bi(1) of Regulation (EU) No 575/2013 in relation to the requirement for the expected shortfall risk measures referred to in Article 325bb of Regulation (EU) No 575/2013 to reflect historically observed data in accordance with Article 325bc(2), point (c), and (4), point (c), of that Regulation, the competent authority shall verify that:
 - (a) the distributional and any other relevant statistical assumptions used in the model, including volatility and correlations, are well justified, including with regard to the tail of the distributions relevant for the expected shortfall calculation. When making this assessment, the competent authority shall apply the assessment method referred to in paragraph 2, and may complement it using the assessment method referred to in paragraph 3.
 - (b) that the empirical correlations used when applying scenario of future shocks to reflect the joint movement of risk factors in the calculation of the expected shortfall risk measures referred to in Article 325bb of Regulation No 575/2013 are based on historically observed data in accordance with Article 325bc(2), point (c), and (4), point (c), of that Regulation. Where appropriate, the competent authority may require the institution to provide a sample of time series, calculate the empirical correlations among those time series, and verify that they do not materially differ from those used by the institution in its internal risk-measurement model.

2. For the purpose of the assessment method referred to in paragraph 1, the competent authority shall compare, on the basis of a sample of time series:
 - (a) the volatility and other distributional properties of the scenario of future shocks applied to a given risk factor in the calculation of the partial expected shortfall measures;
 - (b) the volatility and other distributional properties of the returns observed for the given risk factor.

Such an assessment shall be done on the basis of both the period referred to in Article 325bc(4), point (c), of Regulation (EU) No 575/2013 and the period of financial stress referred to in Article 325bc(2), point (c), of that Regulation.

3. For the purpose of the assessment method referred to in paragraph 1, the competent authority may, on a sample of risk factors, perform additional tests, including normality tests, to assess whether the distributions assumed by the institution are adequate, and may require the institution to provide the impact that using alternative distributions would have on the expected shortfall risk measures.

SUBSECTION 3

ASSESSMENT OF ASPECTS THAT ARE RELEVANT FOR THE CALCULATION OF THE STRESS SCENARIO RISK MEASURE

Article 44

Assessment of compliance with Article 325bi of Regulation (EU) No 575/2013 in relation to requirements on the stress scenario risk measure

1. When assessing the institution's compliance with Article 325bi(1), point (e), of Regulation (EU) No 575/2013 in relation to requirements on the determination of the extreme scenario of future shock, the competent authority shall verify that the internal policies referred to in that Article meet all of the following requirements:
 - (a) they comply with Article 17 of [RTS on SSRM];
 - (b) they entail the production of an up-to-date inventory specifying the following for each non-modellable risk factor:
 - (i) a description of the risk factor;
 - (ii) the liquidity horizon assigned to the risk factor in accordance with Article 325bd of Regulation (EU) No 575/2013;
 - (iii) whether the institution calculates the extreme scenario of future shock by the direct method or the stepwise method referred to in Article 1 and Article 2 of the [RTS on SSRM], or it determines a regulatory extreme scenario of future shock in accordance with Article 10 of [RTS on SSRM];

- (iv) where the stepwise method is used, whether the historical, asymmetrical sigma or fallback method is used to calibrate the downward and upward shocks;
 - (v) for risk factors for which the institution determines a regulatory extreme scenario of future shock in accordance with Article 10 of [RTS on SSRM], a justification of that choice;
 - (vi) whether the risk factor is part of a bucket and which;
- (c) they specify the criteria referred to in Article 1(3), point (a), of [RTS on SSRM] establishing when either the direct method or the stepwise method referred to in Article 1 and Article 2 of that Regulation is used with reference to any non-modellable risk factor or non-modellable standardised bucket;
 - (d) they specify the criteria to identify business and non-business days, in a way that is consistent across the calculation of the stress scenario risk measure under Article 325bk of Regulation (EU) No 575/2013 and the calculation of the expected shortfall risk measure referred to in Article 325bb of that Regulation;
 - (e) they specify the criteria to identify risk factors for which the institution determines the stress scenario risk measure by applying a regulatory extreme scenario of future shock in accordance with Article 10 of [RTS on SSRM];
 - (f) they entail that the institution keeps track of all pricing failures as referred to in Article 9(3) of [RTS on SSRM], the cause of the pricing failures, and the remedial actions taken in accordance with that Article;
 - (g) they specify the frequency of updates, according to Article 8(4) of the [RTS on SSRM], of the stress period used for the determination of the extreme scenario of future shock, and the other possible criteria triggering an update of such stress period.
2. When assessing that the institution's internal model is implemented with integrity in accordance with Article 325bi(1) of Regulation (EU) No 575/2013 in relation to requirements on the calculation of the stress scenario risk measure referred to in Article 325bk of that Regulation, the competent authority shall:
- (a) where the institution uses the direct method referred to in Article 1(2) of [RTS on SSRM] in relation to non-modellable risk factors:
 - (i) verify that the institution's processes follow the criteria referred to in Article 1(3), point (a), of [RTS on SSRM] as formalised in the internal policies referred to in Article 325bi(1), point (e), of Regulation (EU) No 575/2013;
 - (ii) verify that, in accordance with Article 1(3), point (b), of [RTS on SSRM], the institution documents and justifies changes in the approach used for the calculation of the stress scenario risk measure. When assessing compliance with that Article, the competent authority shall verify that the justification provided fits with the criteria referred to in point (i) and is not driven by the fact that one method leads to a lower stress scenario risk measure than the other. Where appropriate,

- the competent authority may apply the assessment method referred to in paragraph 3;
- (iii) verify whether there is any material difference between the stress scenario risk measure resulting from the direct method and the stepwise method for the twenty business days referred to in Article 1(3), point (c), of [RTS on SSRM]. Where there are material differences, the competent authority shall investigate reasons behind them;
- (b) where the institution uses the direct method referred to in Article 2(2) of [RTS on SSRM] in relation to non-modellable standardised buckets:
- (i) verify that the institution's processes referred to in that Article follow the criteria referred to in Article 2(3), point (a), of [RTS on SSRM] as formalised in the internal policies referred to in Article 325bi(1), point (e), of Regulation (EU) No 575/2013;
 - (ii) verify that, in accordance with Article 2(3), point (b), of [RTS on SSRM], the institution documents and justifies changes in the approach used for the calculation of the stress scenario risk measure. When assessing compliance with that Article, the competent authority shall verify that the justification provided fits with the criteria referred to in point (i) and is not driven by the fact that one method leads to a lower stress scenario risk measure than the other. Where appropriate, the competent authority may apply the assessment method referred to in paragraph 3;
 - (iii) verify whether there is any material difference between the stress scenario risk measure resulting from the direct method and the stepwise method for the twenty business days referred to in Article 2(3), point (c), of [RTS on SSRM]. Where there are material differences, the competent authority shall investigate reasons behind them;
- (c) in relation to the determination of the time series of 10 business days returns referred to in Article 3 of [RTS on SSRM]:
- (i) verify that, in accordance with Article 3(1), point (a), of [RTS on SSRM], the institution does not include more than one observation per business day in the time series used to generate a stress scenario risk measure and that the time series includes actual market data only. Where appropriate, the competent authority may apply the assessment method referred to in paragraph 4;
 - (ii) verify that the criteria referred to in paragraph 1, point (d) to identify business and non-business days are employed in the calculation of the 10 business days returns referred to in Article 3 of [RTS on SSRM] and in the extension of the stress period by up to 20 business days as referred to in Article 3(1), point (b), of that Regulation, and verify that the steps to obtain the 10 business days returns, including the determination of $D_{t,T}$ as referred to in Article 3(1), point (c), of that Regulation, are performed correctly;

- (iii) verify that, in accordance with Article 3(2) of [RTS on SSRM], the time series of non-modellable risk factors previously assessed to be modellable in accordance with Article 325be of Regulation (EU) No 575/2013 include the observations that were used for calibrating the scenarios of future shocks referred to in Article 325bc of that Regulation. Where appropriate, the competent authority may apply the assessment method referred to in paragraph 5;
- (d) in relation to the implementation of the fallback method referred to in Article 6 of [RTS on SSRM]:
 - (i) verify that institutions can justify the scarce data availability for the non-modellable risk factors or non-modellable standardised buckets for which the fallback method is used;
 - (ii) verify that there is an appropriate identification of risk factors for which the approach referred to in paragraphs 2 and 3 of that Article shall be used. Where appropriate, the competent authority may apply the assessment method referred to in paragraph 6;
 - (iii) verify that, when applying the method referred to in paragraph 4 of that Article, the approach used by the institution to select a risk factor meeting the conditions referred to in paragraph 5 of that Article leads to the determination of upward and downward shocks that are suitable for risk factor for which the fallback approach is applied. Where appropriate, the competent authority may apply the assessment methods referred to in paragraphs 7, 8 and 9;
- (e) require the institution to identify non-modellable risk factors or non-modellable standardised buckets for which the value of the non-linearity coefficient referred to in Article 13 and Article 14 of [RTS on SSRM] is equal either to κ_{min} or κ_{max} , as defined according to those Articles, and verify whether the extreme scenario of future shock is appropriate or whether, in accordance with Article 325bk(3), point (b), of Regulation (EU) No 575/2013, the institution should be required to apply a regulatory extreme scenario of future shock in accordance with Article 10 of [RTS on SSRM]. Where appropriate, the competent authority may apply the assessment methods referred to in paragraph 10;
- (f) in relation to the determination of the stress period in accordance with Article 8 of [RTS on SSRM]:
 - (i) where the institution determines the stress period by maximising the value referred to in Article 8(1) of [RTS on SSRM] and using sensitivity-based pricing methods in accordance with Article 9(4) of [RTS on SSRM], verify the robustness of the analysis performed by the institution to demonstrate that the price changes that are not captured by the sensitivity-based pricing methods would not modify the stress period. Where appropriate and where losses corresponding to changes in material non-modellable risk factors or non-modellable standardised buckets are highly non-linear, the competent authority may apply the assessment methods referred to in paragraph 11;

- (ii) where the institution determines the stress period for the non-modellable risk factors in a broad risk factor category by identifying the 12-month observation period maximising the partial expected shortfall measure $PES^{RS,i}$ in accordance with Article 8(2) of [RTS on SSRM], verify the robustness of the analysis performed by the institution to demonstrate that the stress period identified is a period of financial stress for its non-modellable risk factors. Where appropriate, the competent authority may apply the assessment method referred to in paragraph 12;
 - (iii) verify that the 12-month rolling windows tested to determine the stress period starts at least from 1 January 2007 as referred to in Article 8(3) of [RTS on SSRM], and verify that past updates of the stress period followed the frequency and criteria referred to in paragraph 1, point (g);
- (g) in relation to the computation of losses with sensitivity-based pricing methods under the conditions of Article 9(3) of [RTS on SSRM]:
- (i) assess the robustness of the processes and methods for detecting pricing failures, identifying the financial instruments and commodities for which a pricing failure occurred, identifying the causes of the pricing failures, and determining their material sensitivities. Where appropriate, the competent authority may apply the assessment methods referred to in paragraph 13;
 - (ii) verify that, following the application of the extreme scenario of future shock to a non-modellable risk factor, the use of sensitivity-based pricing methods is applied only to financial instruments and commodity bearing that risk factor and subject to the pricing failures in accordance with Article 9(3) of [RTS on SSRM]. When making this assessment, the competent authority shall verify that the losses related to other financial instruments and commodities bearing that risk factor but not subject to a pricing failure are computed with the pricing methods used in the risk measurement model in accordance with Article 9(2) of [RTS on SSRM];
- (h) in relation to the determination of the regulatory extreme scenario of future shock referred to in Article 10 of [RTS on SSRM]:
- (i) verify the appropriateness of the method employed by the institution to determine whether the maximum loss that may occur due to a change in a non-modellable risk factor or to a change in a non-modellable standardised bucket is finite or not;
 - (ii) where the maximum loss corresponding to a non-modellable risk factor or a non-modellable bucket is finite, verify that the institution identifies such maximum loss accurately;
 - (iii) where the maximum loss that may occur due to a change in a non-modellable risk factor or to a change in a non-modellable standardised bucket is not finite, verify that the distributional and statistical assumptions used in the expert-based approach referred to in Article

10(2), point (a) are based on objective data and robust tests, and that the extreme scenario of future shock is sufficiently conservative. Where appropriate, the competent authority may apply the assessment methods referred to in paragraph 14;

- (iv) verify that the information included in the inventory referred to in paragraph 1, point (b) are consistent with the criteria referred to in paragraph 1, point (e), and that the criteria specified therein to identify those risk factors for which the stress scenario risk measure is obtained by determining a regulatory extreme scenario of future shock are sound. Where appropriate, the competent authority may use the assessment method referred to in paragraph 15;
 - (i) verify the robustness of the methodology and the statistical tests employed by the institution to identify risk factors reflecting idiosyncratic risk only in accordance with Article 12(3) and 12(4). Where appropriate, the competent authority may apply the assessment methods referred to in paragraph 16.
3. For the purpose of the assessment referred to in paragraph 2, point (a)(ii) and paragraph 2, point (b)(ii), the competent authority may compare the stress scenario risk measure of the risk factors or standardised buckets for which a change in the approach has occurred and assess whether the changes systematically correspond to a lower stress scenario risk measure.
 4. For the purpose of the assessment referred to in paragraph 2, point (c)(i), the competent authority may, on a sample of time series of observations referred to in Article 3(1), point (a), of [RTS on SSRM], verify that where observations in the time series are constants over subsequent business days, the actual market data for the risk factor are unchanged. When collecting the sample, the competent authority shall consider time series characterised by a large amount of data without changes over subsequent business days.
 5. For the purpose of the assessment referred to in paragraph 2, point (c)(iii), the competent authority may, on a sample of risk factors, compare the risk factors' observations used by the institution to compute the expected shortfall for the risk factor when it was modellable against those used in the computation of the stress scenario risk measure.
 6. For the purpose of the assessment referred to in paragraph 2, point (d)(ii), the competent authority may, on a sample of risk factors for which the institution uses the approaches referred to in Article 6, paragraphs 2 or 3, of [RTS on SSRM], verify that those risk factors meet the conditions for being subject to that methodology.
 7. For the purpose of the assessment referred to in paragraph 2, point (d)(iii), the competent authority may, on a sample of risk factors for which the approach referred to in Article 6, paragraph 4, of [RTS on SSRM] is used, verify that the corresponding selected risk factors meet the conditions referred to in paragraph 5 of that Article. When verifying that the two risk factors are of the same nature in accordance with Article 6(5), point (b), of [RTS on SSRM] and that they do not differ for features leading to an underestimation of the volatility in accordance with Article 6(5), point (c), of that Regulation, the competent authority shall verify that the risk factors share the main characteristics, and that the selected risk factor attracts name-related specific risk if the non-modellable risk factor attracts it.

8. For the purpose of the assessment referred to in paragraph 2, point (d)(iii), the competent authority may, on a sample of risk factors for which the methodology referred to in Article 6, paragraph 4, of [RTS on SSRM] is used:
 - (a) require the institution to test alternative suitable risk factors meeting the conditions referred to in Article 6, paragraph 5, of [RTS on SSRM] instead of those selected by the institution;
 - (b) compare the extreme scenario of future shock obtained using the risk factors selected by the institution and that obtained using the alternative risk factors referred to in point (a);
 - (c) assess whether the risk factors selected by the institution lead to a systematic underestimation of the extreme scenario of future shock;

9. For the purpose of the assessment referred to in paragraph 2, point (d)(iii), the competent authority may, on a sample of risk factors for which the methodology referred to in Article 6, paragraph 4, of [RTS on SSRM] is used and for which observations over a 1-year period are more than twelve:
 - (a) require the institution to estimate the volatility of those risk factors over that 1-year period;
 - (b) require the institution to estimate the volatility over that 1-year period of the risk factors selected in accordance with Article 6, paragraph 5, of [RTS on SSRM] for the risk factors referred to in point (a);
 - (c) assess whether the volatility of the risk factors selected by the institution resulting from point (b) is systematically lower than the volatility of the risk factors in the institution risk-measurement model resulting from point (a).

10. For the purpose of the assessment referred to in paragraph 2, point (e), the competent authority may, on a sample of risk factors and standardised buckets:
 - (a) assess whether the non-linearity coefficient is equal to κ_{min} or κ_{max} because extremely high or extremely low values characterise the numerator or denominator of the following term $\frac{loss_{-1} - 2 \times loss_0 + loss_{+1}}{2 \times loss_0}$ as used in the computation of κ in accordance with Article 13 and Article 14 of [RTS on SSRM];
 - (b) require the institution to plot the loss resulting from risk factor changes in the neighbourhood of the extreme scenario of future shock and assess whether the profile of the loss function is particularly concave or convex in that neighbourhood.

The set of non-modellable risk factors shall be chosen considering their materiality.

11. For the purpose of the assessment referred to in paragraph 2, point (f)(i), the competent authority may:
 - (a) require the institution to determine the stress period by maximising the value referred to in Article 8(1) of [RTS on SSRM] on a set of non-modellable risk factors or any non-modellable standardised bucket belonging to the same broad risk factor category, using the pricing methods used in the risk-measurement model in accordance with Article 9(2) of [RTS on SSRM];

- (b) require the institution to determine the stress period by maximising the value referred to in Article 8(1) of [RTS on SSRM] on the set referred to in point (i), using sensitivity-based pricing methods in accordance with Article 9(4) of [RTS on SSRM];
- (c) assess whether the stress periods resulting from points (i) and (ii) materially differ.

The set of non-modellable risk factors or non-modellable buckets referred to in point (a) shall be chosen considering their materiality and the non-linear profile of the loss to changes in their values. To identify non-modellable risk factors or non-modellable standardised buckets with a non-linear loss profile, the competent authority may use the value of the non-linearity coefficient κ calculated in accordance with Article 13 or Article 14 of [RTS on SSRM] as a basis.

12. For the purpose of the assessment referred to in paragraph 2, point (f)(ii), the competent authority may:

- (a) require the institution to determine the stress period by maximising the value referred to in Article 8(1) of [RTS on SSRM] on a set of non-modellable risk factors or any non-modellable standardised bucket belonging to the same broad risk factor category, using the pricing methods used in the risk-measurement model in accordance with Article 9(2) of [RTS on SSRM];
- (b) assess whether the stress period resulting from (a) significantly differ with that identified by the institution when applying the methodology referred to in Article 8(2) of [RTS on SSRM].

13. For the purpose of the assessment referred to in paragraph 2, point (g), the competent authority may, on a sample of pricing failures that the institution may have faced, verify that the processes and methods referred to in that paragraph were followed and assess on that basis their robustness.

14. For the purpose of the assessment referred to in paragraph 2, point (h)(iii), the competent authority may, on a sample of non-modellable risk factors or non-modellable standardised buckets:

- (a) require the institution to generate a time series of returns from a fat-tailed statistical distribution prescribed by the competent authority and calculate the extreme scenario of future shock with the stepwise method referred to in Article 1 and Article 2 of [RTS on SSRM] combined with the historical method referred to in Article 4 of that Regulation;
- (b) verify the conservativeness of the institution's expert-based approach by comparing the regulatory extreme scenario of future shock resulting from that approach with that resulting from point (a).

By way of derogation from point (a), the competent authority may require the institution to use the time series of another risk factor instead of generating the time series from a conservative distribution. When doing so, the competent authority shall choose a risk factor similar to the one for which the regulatory extreme scenario of future shock is calculated.

15. For the purpose of the assessment referred to in paragraph 2, point (h)(iv), the competent authority may, on a sample of non-modellable risk factors or non-modellable standardised buckets and at a given reference date, verify that:
- (a) the risk factors or standardised buckets for which the stress scenario risk measure is determined by applying a regulatory extreme scenario of future shock in accordance with Article 10 fulfil the criteria identified by the institution to use that method;
 - (b) the risk factors or standardised buckets for which the stress scenario risk measure is not determined by applying a regulatory extreme scenario of future shock in accordance with Article 10 do not fulfil the criteria identified by the institution to use that method.
16. For the purpose of the assessment referred to in paragraph 2, point (i), the competent authority may, on a sample of non-modellable risk factors:
- (a) verify that, in accordance with Articles 12(3), point (a), and 12(4), point (a), of [RTS on SSRM], the nature of the risk factor is such that it reflects idiosyncratic risk only by reviewing the description of the risk factor provided in the list referred to in Article 33(1), and the data inputs used to mark it;
 - (b) perform hypothesis testing to assess the significance of correlation coefficients between risk factors in the sample and compare the results of the hypothesis testing with those obtained by the institution when performing the statistical tests referred to in Articles 12(3), point (d), and 12(4), point (d), of [RTS on SSRM].

CHAPTER 4

ASSESSMENT OF THE INTERNAL DEFAULT RISK MODEL USED TO COMPUTE THE ADDITIONAL OWN FUNDS REQUIREMENT FOR DEFAULT RISK

SECTION 1

OVERVIEW OF THE ASSESSMENT

Article 45

Assessment of the internal default risk model used to compute the additional own funds requirement for default risk

For the purpose of assessing the institution's compliance with the requirements applicable to the internal default risk model, the competent authority shall assess all of the following:

- (a) the compliance of the institution with the general requirements for the internal default risk model in accordance with Section 2;
- (b) the compliance of the institution with the requirements for estimates for default probabilities and losses given defaults in accordance with Section 3;

- (c) the compliance of the institution with the requirements for default correlation between issuers, recognition of hedges and other particular requirements in accordance with Section 4.

SECTION 2

ASSESSMENT OF GENERAL REQUIREMENTS

Article 46

Assessment of the scope of positions subject to default risk

1. When assessing that the institution's internal model is implemented with integrity in relation to the scope of positions subject to the own funds requirement for default risk referred to in Article 325bl of Regulation (EU) No 575/2013, the competent authority shall:
 - (a) verify that the institution's internal systems ensure that all positions containing at least one risk factor mapped to the broad risk factor categories 'equity' or 'credit spread', as referred to in Article 325bd(1) of Regulation (EU) No 575/2013, are included in the scope of the additional own funds requirement for default risk. When making this assessment, the competent authority shall verify the consistency between the mapping and the inventories referred to in Articles 33(1), 48(1) and Article 49(1), and may apply the assessment method referred to in paragraph 2;
 - (b) obtain an overview of the default risk in the institution's portfolio, by requiring the institution to provide an inventory of positions aggregated by one or more dimensions and the corresponding aggregated jump-to-default exposures. Depending on the portfolio, the competent authority may require the institution to aggregate the positions by different dimensions, including by positions having the same rating, by positions falling within the same exposure class, or by positions sharing the same systematic risk factors referred to in Article 325bp(1) of Regulation (EU) No 575/2013.
2. For the purpose of the assessment method referred to in paragraph 1, point (a), the competent authority may:
 - (a) require the institution to provide the list of positions assigned to trading desks for which the institution was granted the permission referred to in Article 325az of Regulation (EU) No 575/2013 or is in the process of being granted such permission;
 - (b) require the institution to identify those positions containing a risk factor mapped to the broad risk factor category 'equity' or the broad risk factor category 'credit spread', as referred to in Article 325bd(1) of Regulation (EU) No 575/2013, and the corresponding traded debt or equity instrument in accordance with Article 325bi of Regulation (EU) No 575/2013;

- (c) verify the accuracy of the list referred to in point (a) and of the identification referred to in point (b);
- (d) verify, on a sample of instruments identified in point (b), that they are in the scope of instruments included in the calculation of the own funds requirement for default risk.

Article 47

Assessment of accuracy and frequency of the calculation of the own fund requirement for default risk

1. When assessing that the institution's own funds requirements for default risk equal a value-at-risk number at a 99.9% confidence interval level as referred to in Article 325bn(1), points (a) and (b), of Regulation (EU) No 575/2013, the competent authority shall:
 - (a) verify that the estimator used by the institution to estimate the value-at-risk is accurate. When making this assessment, the competent authority shall verify how the institution chose the estimator and the analysis made to back such choice;
 - (b) where the value-at-risk calculation is based on Monte Carlo simulations, verify that the number of simulations ensures convergence towards stable results, and the randomness properties of the sequences used to generate the simulations. When making this assessment, the competent authority shall review the tests performed by the institution to set the number of simulations, and may use the assessment method referred to in paragraph 2 where the competent authority deems those tests insufficient;
 - (c) verify that, before calculating the changes in the portfolio's value following issuers' defaults, the value of the positions in the institution's portfolios refers to the value-at-risk's reference date;
 - (d) verify that, with the exception of the positions subject to the derogation referred to in Article 325bn(3) of Regulation (EU) No 575/2013, a one-year time horizon is used in the computation of the value-at-risk. When making this assessment, the competent authority shall verify that the rationale of the institution for applying that derogation is sound, in particular where the institution uses a time horizon of sixty days for some equity positions, and a one-year time horizon for some other equity positions;
 - (e) where the default risk is computed less frequently than daily, the competent authority shall analyse the process used by the institution to determine the frequency of the calculation of the own funds requirements for default risk, and verify that the calculation at a reduced frequency does not lead to underestimation of risk. When making this assessment, the competent authority shall:

- (i) where the default risk is computed weekly, analyse the process used by the institution to determine the day of the week when the own funds requirements for default risk are computed;
- (ii) require the institution to calculate, where not yet available, daily jump-to-default exposures over a given period, and assess whether those exposures hint at a systematically lower risk profile on those days in which the own funds requirements are computed. Where there are hints of a systematically lower risk profile, the competent authority may complement its assessment by requiring the institution to calculate, on a daily basis and for a given period, its own funds requirements for default risk, and by analysing whether those measures are systematically lower on the days chosen by the institution.

For the purpose of this assessment, the competent authority may also use additional figures that may be computed daily by the institution for internal risk-management purposes, such as daily sensitivities to the most material issuers;

- (f) verify that for equity instruments prices are set to zero when simulating their defaults. The competent authority shall verify that this is systematically ensured by the internal systems, and may verify that this is the case on a sample of equity positions.
2. For the purpose of the assessment method referred to in paragraph 1, point (b), the competent authority may:
- (a) require the institution to provide the Monte Carlo statistical error at 95% confidence level, and verify that the method employed to measure such statistical error is sound;
 - (b) require the institution to calculate the value-at-risk measure with several different seeds, all other assumptions being equal, and verify that the method used to generate simulation does not create bias in the results;
 - (c) assess whether the differences in the value-at-risk measures with a different seed, as resulting from point (b), are compatible with the statistical error referred to in point (a). Where this is not the case, the competent authority shall assess the root cause of such incompatibility, and assess the number of simulations needed to ensure that the statistical error is below 5%.

SECTION 3

ASSESSMENT OF DEFAULT PROBABILITIES AND LOSSES GIVEN DEFAULT ESTIMATES

Article 48

Assessment of default probabilities

1. When assessing the institution's compliance with Article 325bi(1), point (e), of Regulation (EU) No 575/2013 in relation to the requirements on the estimation of default probabilities, the competent authority shall verify that the internal documentation covers all aspects laid down in Article 5 of Commission Delegated Regulation (EU) 2023/1578 of 20 April 2023¹⁶, and that the institution's internal policies entail the production of an up-to-date inventory specifying:
 - (a) the methods that the institution used to estimate default probabilities, including the materiality, in terms of number of issuers, size of positions and contribution to the default risk own funds requirements, of each different method;
 - (b) for each issuer, it specifies the default probability value, the rating, where available, and whether:
 - (i) the default probability is available under the IRB approach for a non-trading book exposure of the issuer, and it is used for the trading book exposure in accordance with Article 325bp(5), point (d), of Regulation (EU) No 575/2013;
 - (ii) the default probability is not available under the IRB approach for a non-trading book exposure of the issuer, and the institution employs the IRB approach to obtain the issuer's default probability in accordance with Article 325bp(5), point (d), of Regulation (EU) No 575/2013, on the basis that the institution has the IRB approval for the exposure class to which the exposure of the issuer belongs;
 - (iii) the default probability is not available under the IRB approach for a non-trading book exposure of the issuer, and the institution uses an internal methodology fulfilling the requirements of the IRB approach as referred to in Article 1(1) of Delegated Regulation (EU) 2023/1578 to obtain it;
 - (iv) the default probability is not available under the IRB approach for a non-trading book exposure of the issuer, and the institution uses an internal methodology fulfilling the requirements set out in Article 1,

¹⁶ Commission Delegated Regulation (EU) 2023/1578 of 20 April 2023 supplementing Regulation (EU) No 575/2013 of the European Parliament and of the Council with regard to regulatory technical standards specifying the requirements for the internal methodology or external sources used under the internal default risk model for estimating default probabilities and losses given default (OJ L 193, 1.8.2023, p. 7).

- paragraphs 3 or 4, of Delegated Regulation (EU) 2023/1578 to obtain it;
- (v) the default probability is not available under the IRB approach for a non-trading book exposure of the issuer, and the institution uses external sources as referred to in Article 2 of Delegated Regulation (EU) 2023/1578 to obtain it;
- (c) for all issuers, the exposure class referred to in Article 147(2) of Regulation (EU) No 575/2013 to which their exposure belongs;
 - (d) for issuers for which an estimate of default probability is obtained by using external sources as referred to in Article 2 of Delegated Regulation (EU) 2023/1578, whether the estimate is obtained in combination with current market prices as referred to in Article 325bp(5), point (c), of Regulation (EU) No 575/2013 and Article 2(2), point (b), of Delegated Regulation (EU) 2023/1578.
2. When assessing that the institution's internal model is implemented with integrity in accordance with Article 325bi(1) of Regulation (EU) No 575/2013 in relation to requirements on the estimation of default probabilities, the competent authority shall:
- (a) verify that, in accordance with Article 325bp(4) of Regulation (EU) No 575/2013, default probability estimates, as well as the data inputs used to derive them, are updated at a frequency that ensures that the own funds requirements for default risk are risk-sensitive, and that any new relevant information is reflected timely. Where appropriate, the competent authority may identify issuers for which the estimated default probability has not changed for an extensive period, assess whether they are up-to-date and verify that the institution can explain the reasons behind the unchanged values;
 - (b) by using the inventory referred to in paragraph 1, verify that all estimates are floored in accordance with Article 325bp(5), point (a), of Regulation (EU) No 575/2013. When performing this assessment, the competent authority shall analyse the materiality and the characteristics of the positions subject to the floor, including their rating and exposure class;
 - (c) verify that any method used for scaling a default probability to the applicable time horizon referred to in Article 325bp(5), point (b), or Article 325bn(3) of Regulation (EU) No 575/2013 is conceptually sound and that the method used is supported by robust analysis. When performing this assessment, the competent authority shall:
 - (i) identify the effective time horizon that is used before applying any scaling to obtain the applicable time horizon;
 - (ii) assess the rationale for using, as a starting point of the scaling, a different time horizon than the one that is ultimately applicable in accordance with Article 325bp(5), point (b), or Article 325bn(3) of Regulation (EU) No 575/2013;
 - (d) verify that, where the institution estimates the default probability using the method referred to in paragraph 1, points (b)(iv) and (b)(v), the definition of default used by the institution for issuers in the scope of the internal default

risk model is documented in the institution's internal policies and that material differences to the definition of default used in the IRB framework are identified;

- (e) assess whether and how extreme declines in market prices referred to in Article 325bp(5), point (c), of Regulation (EU) No 575/2013 are considered when determining the estimates of default probabilities and whether and how those declines relate to the credit worthiness of an issuer;
- (f) for default probabilities that are obtained in accordance with paragraph 1, points (b)(i) to (b)(iii), verify that they take into account the margin of conservatism referred to in Article 179(1), point (f), and Article 180(1), point (e), of Regulation (EU) No 575/2013;
- (g) for default probabilities that are obtained in accordance with paragraph 1, point (b)(i):
 - (i) verify that any additional levels of conservatism applied to the default probabilities under the IRB approach are applied when the default-risk requirement is computed;
 - (ii) on a sample of issuers, verify that the default probability used in the IRB approach does not differ from the one used in the calculation of the default risk requirement;
- (h) for default probabilities that are obtained in accordance with paragraph 1, point (b)(ii):
 - (i) verify that the process to estimate the default probability under the IRB approach is followed;
 - (ii) on a sample of issuers, verify that the default probability used is identical to the one that would be produced by the IT systems used under the IRB approach;
 - (iii) assess input variables used in the rating process in the IRB approach and, on a sample of issuers, verify that the data inputs exist and are sufficiently reliable to determine an appropriate default probability;
- (i) for default probabilities that are obtained in accordance with paragraph 1, point (b)(iii), review the reports produced by the internal validation or the internal audit regarding the compliance of the internal methodology used to obtain the default probabilities with the requirements set out in Part Three, Title II, Chapter 3, of Regulation (EU) No 575/2013;
- (j) for default probabilities that are obtained in accordance with paragraph 1, point (b)(iv):
 - (i) verify that the internal documentation supporting the compliance of the institution with the conditions referred to in Article 1(2) of Delegated Regulation (EU) 2023/1578 is complete;
 - (ii) on a sample of issuers, assess the rationale for estimating the default probability by using neither the internal methodology referred to in Article 1(1) of Delegated Regulation (EU) 2023/1578, nor the external sources referred to in Article 2 of that Delegated Regulation;

- (iii) on a sample of issuers for which the rationale referred to in point (ii) relates to the lack of input data as referred to in Article 1(2), point (b)(i) of Delegated Regulation (EU) 2023/1578, verify that the institution substantiate the fact that the input data are missing;
- (iv) verify that, as part of its internal policies, the institution defines the holding period referred to in Article 1(2), point (b)(ii), of Delegated Regulation (EU) 2023/1578, below which the institution deems acceptable not to use the internal methodology meeting the requirements set out for the IRB approach, and assess whether such holding period fits with the institution's portfolio, in terms of size, complexity and trading strategy;
- (v) review the value of 'm' calculated in accordance with Article 1(5) of Delegated Regulation (EU) 2023/1578 and, where applicable, require the institution to explain the source of any significant changes in its value over the previous quarters;
- (vi) review the process followed by the institution to investigate whether any additional external sources are available in accordance with Article 1(2), point (c)(ii)(1), of Delegated Regulation (EU) 2023/1578;
- (vii) for a quarter where the value of 'm' is higher than 10%, verify that the analysis performed in accordance with Article 1(2), point (c)(ii)(2), Delegated Regulation (EU) 2023/1578 is robust;
- (viii) assess that the determination of the default probability as outlined in Article 1, paragraphs 3 and 4 of Delegated Regulation (EU) 2023/1578, is performed correctly, by using the inventory referred to in paragraph 1, and verify that the institution updates the highest default probability assigned to investment grade issuers and the equally weighted average of default probabilities. as referred to Article 1(3), points (a) and (b), of that Delegated Regulation, respectively, with the same frequency at which the default risk requirement is computed;
- (k) for default probabilities that are obtained in accordance with paragraph 1, point (b)(v):
 - (i) on a sample of issuers, verify that the data used to estimate the default probability is representative for the issuer. When performing this assessment, the competent authority shall verify whether the data used are reflective of the sector or region of the issuer;
 - (ii) verify that the hierarchy of sources referred to in Article 2(3) of Delegated Regulation (EU) 2023/1578 is well defined in the institution's internal documentation and verify, on a sample of issuers, that it is implemented correctly;
 - (iii) verify that the methodology employed by the institution to obtain the expected range of estimation errors referred to in Article 2(4), point (a)(i), of Delegated Regulation (EU) 2023/1578 is sound. When

- making this assessment, the competent authority may require the institution to provide a sensitivity analysis following the principles of the sensitivity analysis referred to in Article 1(2), second subparagraph, of that Delegated Regulation, for the purpose of assessing the potential impact of changes in the PD estimate;
- (iv) assess how the institution made operational the conditions referred to in Article 2(4), points (a) of Delegated Regulation (EU) 2023/1578, and verify whether there are cases of default probabilities set at 0 before the floor referred to in Article 325bp(5), point (a), of Regulation (EU) No 575/2013 is applied;
 - (v) where applicable, verify that the method used to transform default probabilities that are obtained in combination with current market prices into a real-world probability is sound, and that the analysis referred to in Article 2(4), point (b), of Delegated Regulation (EU) 2023/1578 is robust.
3. When performing the assessment referred to in paragraph 2, the competent authority may, where appropriate, require the institution to estimate default probabilities with another method among those laid out in Delegated Regulation (EU) 2023/1578, and explain the differences in the results obtained.

Article 49

Assessment of losses given defaults

1. When assessing the institution's compliance with Article 325bi(1), point (e), of Regulation (EU) No 575/2013 in relation to the requirements on the estimation of the losses given default, the competent authority shall verify that the internal documentation covers all aspects laid down in Article 5 of Delegated Regulation (EU) 2023/1578, and that the institution's internal policies entail the production of an up-to-date inventory specifying:
 - (a) the methods that the institution used to estimate the losses given default, including the materiality, in terms of size of positions and contribution to the default risk own fund requirement, of each different method;
 - (b) for each position, it specifies the loss given default value, whether the position is a subordinated debt, a senior unsecured debt, a covered bond, or any other type of position, and whether:
 - (i) the loss given default is available under the IRB approach for a non-trading book exposure, and it is used for the trading book exposure in accordance with Article 325bp(6), point (c), of Regulation (EU) No 575/2013;
 - (ii) the loss given default is not available under the IRB approach for a non-trading book exposure, and the institution employs the IRB approach to obtain the position's loss given default in accordance with Article 325bp(6), point (c), of Regulation (EU) No 575/2013;

- (iii) the loss given default is not available under the IRB approach for a non-trading book exposure, and the institution uses an internal methodology fulfilling the requirements of the IRB approach as referred to in Article 3(1) of Delegated Regulation (EU) 2023/1578 to obtain it;
 - (iv) the loss given default is not available under the IRB approach for a non-trading book exposure, and the institution uses an internal methodology fulfilling the requirements set out in Article 3, paragraphs 3 or 4, of Delegated Regulation (EU) 2023/1578 to obtain it;
 - (v) the loss given default is not available under the IRB approach for a non-trading book exposure, and the institution uses external sources as referred to in Article 4 of Delegated Regulation (EU) 2023/1578 to obtain it;
 - (c) for all positions, the exposure class referred to in Article 147 of Regulation (EU) No 575/2013 to which they belong.
2. When assessing that the institution's internal model is implemented with integrity in accordance with Article 325bi(1) of Regulation (EU) No 575/2013 in relation to requirements on the estimation of loss given default, the competent authority shall:
- (a) verify that the granularity of the losses given default provides a meaningful differentiation of risk and, among others, that it allows to appropriately reflect the seniority of the position as referred 325bp(6), point (b), of Regulation (EU) No 575/2013, and also its collateralisation;
 - (b) verify that, in accordance with Article 325bp(4) of Regulation (EU) No 575/2013, loss given default estimates as well as the data inputs used to derive them are updated at a frequency that ensures that the own funds requirements for default risk are risk-sensitive, and that any new relevant information is reflected timely. Where appropriate, the competent authority may identify positions for which the estimated losses given default has not changed for an extensive period, assess whether they are up-to-date and verify that the institution can explain the reasons behind the unchanged values;
 - (c) for losses given default that are obtained in accordance with paragraph 1, point (b)(i), verify that any additional layer applied to the losses given default under the IRB approach to obtain more conservative estimates is applied when the own funds requirements for default risk are computed. When performing this assessment, the competent authority shall, on a sample of positions, verify that the loss given default estimate used in the IRB approach does not differ from the one used in the calculation of the default risk requirement;
 - (d) for loss given default that are obtained in accordance with paragraph 1, point (b)(ii):
 - (i) verify that the process to estimate the loss given default under the IRB approach in accordance with the institution IRB's internal policies is followed;

- (ii) on a sample of positions, verify that the loss given default used is identical to the estimate that would be produced by the IT systems used under the IRB approach;
 - (iii) assess the variables used in the IRB approach, and on a sample of positions, verify that the data inputs exist and are sufficiently reliable to determine an appropriate loss given default;
- (e) for losses given default that are obtained in accordance with paragraph 1, point (b)(iii), review the reports produced by the internal validation and the internal audit regarding the compliance of the internal methodology used to obtain the losses given default with the requirements set out in Part Three, Title II, Chapter 3, of Regulation (EU) No 575/2013;
- (f) for losses given default that are obtained in accordance with paragraph 1, point (b)(iv):
 - (i) verify that the internal documentation supporting the compliance of the institution with the conditions referred to in Article 3(2) of Delegated Regulation (EU) 2023/1578 is complete;
 - (ii) on a sample of positions, assess the rationale for estimating the loss given default by using neither the internal methodology referred to in Article 3(1) of Delegated Regulation (EU) 2023/1578, nor the external sources referred to in Article 4 of that Delegated Regulation;
 - (iii) on a sample of positions for which the rationale referred to in point (ii) relates to the lack of input data as referred to in Article 3(2), point (b)(i), of Delegated Regulation (EU) 2023/1578, verify that the institution substantiates the fact that the input data are missing;
 - (iv) verify that, as part of its internal policies, the institution defines the holding period referred to in Article 3(2), point (b)(ii), of Delegated Regulation (EU) 2023/1578, below which the institution deems acceptable not to use the internal methodology meeting the requirements set out for the IRB approach, and assess whether such holding period fits with the institution's portfolio, in terms of size, complexity and trading strategy;
 - (v) review the value of 'm' calculated in accordance with Article 3(5) of Delegated Regulation (EU) 2023/1578 and, where applicable, require the institution to explain the source of any significant changes in its value over the previous quarters;
 - (vi) review the process followed by the institution to investigate whether any additional external sources are available in accordance with Article 3(2), point (c)(ii), of Delegated Regulation (EU) 2023/1578;
 - (vii) by using the inventory referred to in paragraph 1, assess whether the determination of the loss given default as outlined in Article 3, paragraphs 3 and 4, of Delegated Regulation (EU) 2023/1578 is performed correctly;

- (g) for losses given default that are obtained in accordance with paragraph 1, point (b)(v):
 - (i) on a sample of positions, verify that the data used to estimate the loss given default are representative for the position. When performing this assessment, the competent authority shall verify whether the data used are reflective of the seniority of the position as referred to in Article 325bp(6), point (b), of Regulation (EU) No 575/2013, and the region or sector;
 - (ii) verify that the hierarchy of sources referred to in Article 4(2) of Delegated Regulation (EU) 2023/1578 is well defined in the institution's internal documentation and verify, on a sample of positions, that it is implemented correctly;
 - (iii) verify whether the estimates of losses given default distinguish between positions that are defaulted and positions that are not. The competent authority may verify whether this is the case by assessing the estimate assigned by the institution to positions of the same issuer that are defaulted and that are not defaulted included in the scope of the additional own funds requirements for default risk.
3. When performing the assessment referred to in paragraph 2, the competent authority may, where appropriate, require the institution to estimate losses given default with another method among those laid out in Delegated Regulation (EU) 2023/1578, and explain the differences in the results obtained.

SECTION 4

ASSESSMENT OF CORRELATION, HEDGING AND PARTICULAR REQUIREMENTS

Article 50

Assessment of the correlation structure

1. When assessing the methodology used by the institution to determine the correlation between different issuers in accordance with Article 325bn(1), point (c), of Regulation (EU) No 575/2013, the competent authority shall:
 - (a) verify that only listed equity and credit spreads are used as data inputs for determining the correlation between different issuers. Where appropriate, the competent authority may require the institution to provide data used to model the correlation between a sample of issuers selected by the competent authority, and verify that those data only relate to listed equities and credit spreads;
 - (b) where the institution uses copulas to model default correlations, assess the internal validation of the copula assumptions performed by the institution and verify that there is compatibility between the historical data used for the calibration of the correlations and the issuers included in the institution's

- portfolio. When performing this assessment, the competent authority shall apply the assessment method referred to in paragraph 2;
- (c) identify whether the correlation among issuers is based on absolute or relative returns, and assess whether the rationale behind the choice of the return type is sound, and consistent with the choices made by the institutions in relation to other aspects of the internal risk-measurement model;
 - (d) assess whether the method used by the institution to obtain a correlation on the applicable time-horizon from returns calculated on a shorter time horizon is sound. When performing this assessment, the competent authority shall verify that, where the institution applies the derogation referred to in Article 325bn(3) of Regulation (EU) No 575/2013, a correlation of sixty business days is used only between equity positions for which the derogation is used, and that the correlation is otherwise measured over a one-year time horizon;
 - (e) assess how the institution determines the calibration period referred to in Article 325bn(1), point (c), of Regulation (EU) No 575/2013. When performing this assessment, the competent authority shall verify that the approach used by the institution to select the period, including its length, is sound, that it is documented in the institution's internal policies, and that it is reviewed to account for any changes in the stress period referred to in Article 325bc(2) of Regulation (EU) No 575/2013.
2. For the purpose of the assessment referred to in paragraph 1, point (b), the competent authority shall, on a sample of issuers for which the institution has positions subject to the own funds requirements for default risk, verify that the pairwise issuer correlations derived from the correlation modelling are compatible to those derived from observable market data.

Article 51

Assessment of the hedging recognition

1. When assessing whether the recognition of hedges in the institution's internal default risk model is performed in compliance with the requirements set out in Article 325bo of Regulation (EU) No 575/2013, the competent authority shall:
 - (a) verify that the institution's internal policies describe how the netting is performed, and specify those basis risks that are implicitly captured in the model by modelling two different positions, and those that are instead explicitly captured by introducing a basis risk factor;
 - (b) review the internal policies of the institution, and verify the criteria envisaged therein to recognise netting, and to recognise hedging or diversification effects. When performing this assessment, the competent authority shall verify that those criteria ensure that the netting and hedging are efficient also where a credit or any other event occurs;

- (c) assess whether the monitoring of potential significant basis risk that may arise in the interval between the maturity of an instrument and the one-year time horizon is robust;
- (d) require the institution to provide a sample of positions in the default risk model, and the list of risk factors corresponding to those positions. For those positions the competent authority shall:
 - (i) verify that the institution's mapping of positions to risk factors ensures that exposures to different obligors are not netted, and that such netting only takes place for positions that relate to the same financial instruments of the same obligor;
 - (ii) verify that either exposures to different obligors are mapped to different risk factors, or there is a basis risk factor to capture the differences in those exposures. When making this assessment, the competent authority shall also verify that the basis risk between obligors that are constituents of credit indices and other obligors is captured;
 - (iii) for positions in different financial instruments of the same obligor, the competent authority shall verify that the analysis performed by the institution to assess whether significant basis risk in the hedging strategies may arise due to different type of products, seniority in the capital structure, internal or external ratings, maturity, or vintage, are robust;

When requesting the sample for the purpose of this assessment, the competent authority shall ensure that there is variety in the positions provided, and that, where applicable, both positions that are netted and positions that are not netted are included.

Article 52

Assessment of particular requirements

2. When assessing the internal default risk model's compliance with the particular requirements set out in Article 325bp of Regulation (EU) No 575/2013, the competent authority shall:
 - (a) in relation to the modelling of the default of individual as well as multiple issuers in accordance with Article 325bp(1) of Regulation (EU) No 575/2013:
 - (i) identify the approach used by the institution to model the default, and verify that the two types of systematic risk factors selected by the institution capture the most relevant systematic effects. When performing this assessment, the competent authority shall assess the rationale provided in the institution's internal policies for the choice of the systematic risk factors, and their economic interpretation;
 - (ii) verify that the granularity of the two types of systematic risk factors is sufficient to capture the characteristics of the issuers in the portfolio subject to the own funds requirement for default risk;

- (iii) verify that for each issuer, the institution uses a separate idiosyncratic risk factor in addition to the two types of systematic risk factors referred to in Article 325bp(1) of Regulation (EU) No 575/2013. Where appropriate, the competent authority may, on a sample of similar issuers, verify that the idiosyncratic risk factors differ;
- (iv) verify that the mapping of issuers to the appropriate systematic risk factors is sound. Where appropriate, the competent authority may, on a sample of issuers, verify that the mapping is correct;
- (v) verify that the institution analyses the explanatory power of the factor model. Where appropriate, and where the analyses performed by the institution do not seem sufficient for the portfolio subject to default risk as it stands, the competent authority may, on a sample of issuers, require the institution to assess the power of the systematic risk factors chosen by the institution in explaining the drivers of the default of each issuer's asset.

When requesting the sample for the purpose of this assessment, the competent authority shall consider the materiality of the issuers, as well as ensure that the sample encompasses issuers that have been mapped to different systematic risk factors;

- (b) in relation to the requirement to reflect the economic cycle in the internal default risk model in accordance with Article 325pb(2) of Regulation (EU) No 575/2013, the competent authority shall assess how the modelling of losses given defaults, including stochastic ones, is performed for such losses given defaults to reflect changes in the properties taken by the systematic risk factors. Where appropriate, the competent authority may, on a sample of issuers, perform statistical analyses, including hypothesis testing, to test the dependency of losses given defaults on the systematic risk factors;
- (c) in relation to the requirement to capture non-linearities in accordance with Article 325pb(3) of Regulation (EU) No 575/2013, the competent authority shall assess:
 - (i) how institutions revalue a non-linear financial instrument following the default of an issuer, including how institutions revalue a financial instrument with multiple underlying following the default of an individual issuer or of multiple issuers corresponding to the underlyings;
 - (ii) whether any simplifications introduced by the institution to calculate the price of a financial instrument leads to material inaccuracies or a systematic underestimation of the risk;
 - (iii) the extent to which the revaluation of a financial instrument takes into account model risk;
- (d) in relation to the requirement to have an internal default risk model that is consistent with internal risk-management in accordance with Article 325bp(9) of Regulation (EU) No 575/2013, the competent authority shall verify that the institution has documented the differences between the internal

default risk model and the models that the institution uses for its internal risk management for the same scope of positions, and that the institution is able to explain them.

CHAPTER 5

FINAL PROVISIONS

Article 53

Entry into force and application

This Regulation shall enter into force on the twentieth day following that of its publication in the *Official Journal of the European Union*.

This Regulation shall apply from the date of its entry into force, with the exception of Article 18(1), point (a), as regards the environmental risk, Article 18(1), point (c)(vii), and Article 18(2), point (b)(v), which shall apply from 01 January 2025, and with the exception of Article 21(1), point (b), which shall apply from 1 January 2026.

This Regulation shall be binding in its entirety and directly applicable in all Member States.

Done at Brussels,

For the Commission
The President
Ursula von der Leyen

4. Accompanying documents

4.1 Draft cost-benefit analysis / impact assessment

Article 325az(8)(b) of the CRR2 requires the EBA to develop draft RTS to specify the assessment methodology under which competent authorities verify an institution's compliance with the requirements set out in Articles 325bh, 325bi, 325bn, 325bo and 325bp of the CRR2 in order to use the alternative internal model approach.

As per Article 10(1) of Regulation (EU) No 1093/2010 (EBA Regulation), any regulatory technical standards developed by the EBA shall be accompanied by an Impact Assessment (IA), which analyses 'the potential related costs and benefits'.

This section presents the cost-benefit analysis of the provisions included in the draft RTS described in this Consultation Paper (CP). The analysis provides an overview of identified problems, the proposed options to address those problems and the costs and benefits of those options. The analysis is high-level and qualitative in nature.

A. Problem identification

In January 2019, the Basel Committee on Banking Supervision (BCBS) finalised the standards on Minimum capital requirement for market risk (FRTB). The new framework introduces a new internal model approach that relies upon the use of an expected shortfall metric for modellable risk factors and a separate capital requirement for risk factors that are deemed non-modellable. Furthermore, institutions are required to compute an additional own fund requirements for the default risk that positions in their portfolio may be subject to.

CRR2 implements FRTB in EU legislation and introduces the new internal model approach, referred to as the alternative internal model approach, only for reporting purposes. An institution can use this approach only if it has received a permission by its competent authority. To grant such permission, the competent authority should assess if the institution complies with the requirements set out in Articles 325bh, 325bi, 325bn, 325bo and 325bp of the CRR2 on the use of the alternative internal model approach.

However, CRR2 does not specify how component authorities should assess compliance with the above requirements. The lack of a common assessment methodology can result in inconsistent decisions related to the approval of internal models for market risk across the EU. This may lead to an uneven playing field across member states, an increased risk of regulatory arbitrage and unharmonised supervisory practises.

B. Policy objectives



The specific objective of the draft RTS are to establish a harmonised methodology for competent authorities when assessing an institution's compliance with the requirements set out in CRR2 for the alternative internal model approach. In addition, these RTS are expected to provide guidance and useful information to competent authorities on how such assessment should be performed in practice.

While the draft RTS is addressed to competent authorities, institutions are expected to benefit from such harmonisation, as they would be faced with a similar assessment for their internal models when applying for permission to different competent authorities across the EU.

Generally, the draft RTS aim to create a level playing field, ensure consistency in supervisory practises and enhance comparability of own funds requirements across EU. Overall, the draft RTS are expected to promote the effective and efficient functioning of the EU banking sector.

C. Baseline scenario

Under the current regulatory framework, the EBA has published in November 2016 Final draft RTS on the specification of the assessment methodology for competent authorities regarding compliance of an institution with the requirements to use internal models for market risk. However, this assessment methodology is based on the previous internal model approach (based on Value-at-Risk) specified in Chapter 5 of Title IV of Part Three of the CRR, which is fundamentally different from the alternative internal model approach (based on Expected Shortfall). Thus, while some parts of these RTS are still relevant for the assessment of the requirements of the alternative internal model approach, others are not anymore.

It should be noted that the above Final draft RTS has not been endorsed yet by the European Commission, although it is expected that competent authorities follow to a large extent these RTS for assessing an institution's compliance with the requirements to use an internal model.

D. Options considered, Cost-Benefit Analysis and Preferred Options

Assessment of Governance requirements (Article 325bi)

Article 325bi introduces several qualitative requirements to ensure that internal risk measurement models are conceptually sound and implemented with integrity. These qualitative requirements are independent of the type of internal model used and are applicable regardless of the particular risk categories/portfolio for which the institution has applied for internal model approval.

Given that these requirements are very similar to the current qualitative requirements for the permission of the internal model approach (i.e. those included in Article 368 CRR), the EBA has considered the following policy options:

Option 1a: Re-use the assessment criteria specified in the previous EBA draft RTS on assessment methodology for the governance requirements

Option 1b: Implement new assessment criteria for the governance requirements

Under Option 1a, competent authorities can use the existing criteria for assessing compliance with the governance requirements. These are still relevant since the previous qualitative requirements related to governance under Article 368 of the CRR are identical to the ones introduced in Article 325bj of the CRR2. Nevertheless, some limited adjustments were necessary to reflect the significant changes in the market risk framework. This option would ensure certain level of continuity in the assessment of governance requirements when moving to the new framework for both competent authorities and institutions. It would also reduce the burden for competent authorities because they are already familiar with these assessment criteria. In addition, institutions with internal models are, to a large extent, already compliant with these governance requirements under the current framework, reducing the cost of compliance.

On the other hand, Option 1b allows to change the previous criteria for assessing the governance requirements. While this option would allow to introduce new criteria or remove unnecessary criteria in the assessment, this has not been assessed as necessary, given that the qualitative requirements related to governance have not changed fundamentally.

Option 1a is retained.

Assessment of internal risk measurement model (ES/SSRM) requirements

These RTS provides guidance on what competent authorities should consider when assessing compliance of the internal risk measurement models with the CRR2 requirements. The EBA has considered the following policy options with regards to this guidance:

Option 2a: Competent authorities shall assess compliance based only on a set of mandatory checks

Option 2b: Competent authorities shall compliance based only on a set of optional checks

Option 2c: Competent authorities shall assess compliance based on a minimum set of mandatory checks supplemented by additional optional checks

Option 2a provides for a fully harmonized approach, where all competent authorities would follow the same checks to assess compliance of the internal risk measurement models with the CRR2 requirements for all institutions. However, depending on the situation of the bank, some checks could be non-proportionate for the objective to be achieved, i.e. verify the compliance of the institution with a specific provision. As a result, having the same checks for all institutions, regardless of their actual situation, would put an excessive burden on both the institutions and competent authorities.

Option 2b allows competent authorities to decide which checks are suitable on a case-by-case basis. While these may reduce the burden in some cases, where the checks are unduly cumbersome, it risks creating different supervisory practices across jurisdictions.

On the other hand, Option 2c ensures a minimum set of harmonization across jurisdictions while at the same time provides some flexibility to the competent authorities to apply additional checks on

a case-by-case basis, where those are deemed necessary to ensure compliance with the CRR2 requirements.

Option 2c is retained.

Expected shortfall back-testing

Article 325bj(3)(b) of the CRR2 requires institutions to have their own internal validation tests in addition to the regulatory back-testing and P&L attribution requirements. When assessing the institution's compliance with Article 325bi(1)(f) that any internal risk-measurement model should have a proven track record of being reasonably accurate in measuring risks, the EBA has considered the following policy options:

Option 3a: Include a check for competent authorities to verify that the institution applies direct expected shortfall back-testing approaches to their portfolios.

Option 3b: Do not include the above check

Option 3a requires institutions to include direct expected shortfall back-testing approaches in their own internal validation tests. This check ensures that the expected shortfall measure (and not just the value at risk) is tested by the institution, so that events that are further in the tail (compared to a pure quantile measure) are taken into account. Furthermore, this back-testing allows to verify that the internal risk-measurement model for the expected shortfall has a proven track record of being reasonably accurate in measuring risks. The EBA has considered the back-testing of the expected shortfall measure without prescribing the method to be used as reasonable and prudent internal validation test, given that the measure ultimately determines capital requirements.

Option 3b does not further specify the type of internal validation tests competent authorities are expecting an institution to have in place under Article 325bj(3)(b). Thus, it allows institutions to develop their own internal validation tests freely without any requirements. However, this would mean that institutions may decide to not back-test their expected shortfall measures, and that accordingly, the key-measure used to calculate the capital figures is not back-tested.

One respondent to the CP highlighted that the expected shortfall back-testing requirement under Option 3a would put an additional burden on institutions. Another noted that this additional burden is small compared to the typical costs to validate an internal risk model and the benefits of having such requirement (e.g. better validation techniques by institutions) should outweigh the related costs.

The EBA considered that there are merits to have such requirement in place given that the ES measure is the one ultimately affecting the capital requirements for market risk under the internal model approach. The fact that the details of the ES back-testing is left to the institutions to choose should reduce the concerns on the additional burden that such requirement might pose. However, acknowledging that institutions are currently in the process of preparing their model application for initial IMA approval, the EBA decided to postpone the application date for this requirement to

reduce the immediate burden on banks and avoid interfering with the application process at a short notice.

Option 3a is retained complemented by a postponement of the application date for this requirement.

Climate risk stress testing scenarios

The EBA has considered the following policy options regarding the stress testing scenarios that institutions should have in place to receive an internal model approval:

Option 4a: Explicitly request to consider climate risk scenarios

Option 4b: Do not explicitly request to consider climate risk scenarios

Under Option 4a, institutions should consider climate risk scenarios in their stress testing programmes to receive a model approval. While this specification may increase the burden for institutions, the EBA is of the view that an explicit specification to use climate risks in the stress test scenarios is important, given the increased relevance of these risks going forward.

Under Option 4b, there is no explicit specification to include climate risk scenarios in the stress testing programs. While this may reduce the burden to institutions, if environmental risks are material for a bank, the competent authority would still expect them to be incorporate in the stress testing programs to assess those as adequate.

Option 4a is retained. Given the novelty of this requirement, the EBA propose to allow institutions until end-2024 for incorporating such scenarios in their stress testing programs. This should alleviate the burden to institutions and provide them with enough time to gather any relevant data and build expertise on climate risk management.

Estimation errors in the risk parameters of the internal default risk model

Under the DRC, institutions are required to derive default probabilities (PD) and losses given default (LGD) estimates based on the IRB approach, where permitted. These estimates include a margin of conservatism (MoC) that is related to the expected range of estimation errors (Article 179(1)(f) of the CRR).

If there is no such permission, institutions should use an internal methodology or external sources. When using external sources, institution should make sure that the PD and LGD estimates are considered accurate for all obligor grades having analysed their expected range of estimation errors.

As part of the assessment of the internal default risk model, the EBA has considered the following policy options with regards to the methodology used by institutions to obtain the expected range of estimation errors for PD and LGD estimates when using external sources:

Option 5a: Competent authorities should assess how this methodology compares to the one used to obtain the margin of conservatism under the IRB approach referred to in Article 179 of the CRR

Option 5b: Competent authorities should verify that estimation errors for external sources is equivalent to the margin of conservatism that would have been added to the risk parameters under the IRB approach.

Option 5c: Do not set any specific requirements related this methodology.

Under Option 5a, competent authorities would need to compare the methodology used to estimate the expected range of estimation errors for the PD and LGD estimates derived from external sources with the one used to obtain the margin of conservatism under Article 179. This would allow competent authorities to understand the differences, if any, between the margin of conservatism that would have been added if an IRB approach was used to derive the PD and LGD instead of the external sources.

Under Option 5b the estimation errors for external sources would need to be equivalent to the margin of conservatism under the IRB approach. This would ensure that the same level of conservatism is embedded in the risk parameters irrespectively of which the method (external sources or IRB approach) used to derive them. While this may be more burdensome than Option 5a, it would lead to the same level of conservatism for PDs and LGDs regardless of the approach used .

Option 5c does not set any specific requirement related to this methodology. While this is the least burdensome approach, it may create inconsistencies between the level of conservatism added in the risk parameters when using external sources vis-à-vis when using the IRB approach.

One respondent to the CP was in favor for option 5c given the challenges to compare the methodology used to calculate the margin of conservatism for internal purposes with the one used for external sources (option 5a). In addition, ithe noted that there are cases where external sources may only provide a PD/LGD estimate without a range of the estimation errors, making Option 5b difficult to implement. However, to ensure some level of conservatism the respondent suggested that institutions could carry out a sensitivity analysis following the principles of the sensitivity analysis prescribed in the RTS on PDs and /LGDs, for the purpose of assessing the potential impact of changes in the PD estimate.

In light of the feedback received, the EBA considers appropriate to amend the draft RTS to incorporate Option 5c complemented with the sensitivity analysis suggested for PDs. This analysis will inform about the magnitude of the change in the requirements upon small changes in the PDs.

The above options are put forward for consultation. Option 5c is retained complemented by a sensitivity analysis.

Reflecting the economic cycle in the internal default risk model

Article 325bp(2) CRR requires that the internal default risk model shall reflect the economic cycle, including the dependency between recovery rates and the systematic risk factors. The EBA has considered the following policy options when assessing the internal default risk model:

Option 6a: Competent authorities should assess that all risk parameters are dependent on the systematic risk factors

Option 6b: Competent authorities should assess that only LGD is dependent on the systematic risk factors

Option 6a ensures that both the PD and LGD reflect the economic cycle and depend on the systematic risk factors. This ensures that the default risk model is fully reactive to the systematic risk factors. However, this may be burdensome for institutions. On the other hand, Option 6b requires to assess such dependency only for LGD. This is expected to reduce the burden for institutions, particularly when using LGD from the IRB approach, which is expected to reflect the economic cycle (as they are downturn LGD).

Option 6b is retained.

4.2 Feedback on the public consultation

The EBA undertook a public consultation on these RTS contained in this paper. The consultation period lasted for 3 months and ended on 26 June 2023. Two responses were received, both of them being non-confidential and as such published on the EBA website.

This section presents a summary of the key points and other comments arising from the consultation, the analysis and discussion triggered by these comments and the actions taken to address them if deemed necessary. Changes to the draft RTS have been incorporated as a result of the responses received during the public consultation.

4.2.1 Summary of key issues and the EBA's response

In the feedback table that follows, the EBA has summarised the comments received and explains which responses have and have not led to changes, and the reasons for this.

Summary of responses to the consultation and the EBA's analysis

Comments	Summary of responses received	EBA analysis	Amendments to the proposals
General comments			
Role of the management body	<p>One respondent notes that these RTS should include an explicit provision allowing the delegation of tasks to be performed by the management body, to a committee designated by the latter, and accordingly suggests reviewing article 17 to 23 of the draft RTS so to not refer the management body only but more broadly to the management body or a committee designated by it.</p>	<p>The EBA acknowledges that some tasks of the management body may be delegated to one or more committees.</p> <p>Such possibility is however already reflected in the draft proposed for consultation where in Article 6 it is explicitly stated that: “Where the institution’s management body delegates any of its tasks to an internal committee, the competent authority shall, in the context of those delegated tasks, make the assessments provided by this Regulation at the level of that internal committee.”, implicitly recognising that such delegation of tasks can be done, and requiring the competent authority to perform the assessment at the level of the committee (as opposed to an assessment at the level of the management body) when assessing the requirements included in these RTS (i.e. also those included in Article 17 to 23).</p> <p>Accordingly, the EBA did not make any amendment to reflect this comment, as the draft proposed for consultation already reflects the stance made by the respondent. However, an additional specification has been added clarifying that, while delegation of tasks to an internal committee is possible, this should still</p>	Specification made in Article 6(2)(d)

Comments	Summary of responses received	EBA analysis	Amendments to the proposals
		<p>be performed in a way that it ensures that active involvement of the management body as required by Article 325bi(1)(c)</p>	
<p>Assessing other correlation patterns than those used in the model</p>	<p>One respondent notes that the requirement set out in Article 12(1)(d) of the draft RTS as proposed for consultation, requiring institution to test alternative correlations would not bring any benefit, and therefore suggests deletion of the paragraph.</p>	<p>The requirement to test alternative correlations refers to the partial expected shortfall calculation, i.e. institutions would be required to test different correlations between risk factors than those used in the model (similarly to the SbM set up, where banks are required to test different correlation scenarios to aggregate sensitivities). Hence, the requirement did not aim at changing the rho parameter provided in Article 325bc CRR.</p> <p>Considering that a correlation parameter is already prescribed across risk classes, and acknowledging that it may not be trivial to implement this requirement under the new FRTB set-up, the EBA decided to amend these RTS, and delete Article 12(1)(d)</p>	<p>Deletion of Article 12(1)(d)</p>
<p>Trading limits at trader level</p>	<p>One respondent claims that the requirements included in Article 14(1)(c) of the draft RTS proposed for consultation relating to the VaR limits at a level below the trading desk one go beyond what the requirements set out in Article 104b on the trading desk set-up.</p>	<p>The EBA acknowledges that the wording included in Article 14(1)(c) of the draft RTS proposed for consultation would put constraints that go beyond those laid down in Article 104b CRR. Accordingly, decided to amend these RTS, and remove the reference to individual traders' trading limits.</p>	<p>Amendments to Article 14</p>

Comments	Summary of responses received	EBA analysis	Amendments to the proposals
	<p>Furthermore, the respondent notes that trading limits at individual trader level would not be meaningful, as generally more than one trader is involved in a given activity.</p>		
<p>Elements to consider in stress testing programmes</p>	<p>One respondent advocates for the deletion in Article 18 of some elements specifying which kind of risks institutions are expected to account for in their reverse stress testing scenarios (e.g. risk of currency de-pegging), claiming that they go beyond existing European regulation on stress test.</p>	<p>The EBA notes that elements included in Article 18 were already part of the final draft RTS on assessment methodology relating to the existing internal models.</p> <p>Furthermore, it is the real purpose of these RTS to check whether institutions implement requirements included in CRR in a fair manner. In this specific case, the requirements included in Article 18 do not go beyond what institutions would be expected to do when operationalising requirement laid down in Article 325bi CRR. Hence, no amendments are made to Article 18.</p>	<p>No amendments</p>
<p>Responses to questions in Consultation Paper EBA/CP/2023/04</p>			
<p>Question 1: Do you agree with the provisions included in this chapter? Did you face challenges in complying with the governance chapter of the old RTS? If so, in which respect? Please elaborate.</p>	<p>One respondent suggested regarding Article 20(a) on pricing function inventories on that they should only relate to internal risk measurement model pricing functions that are different from the pricing functions used in the end-of-day valuation and where the P&L Attribution Test shows high materiality impacts in order to reduce the burden of such inventory.</p> <p>The respondent suggested also to remove paragraphs (a)(v) to (a)(vii) of Article 20 as the statements were perceived as unclear.</p>	<p>Article 325bi(1), point (f), of Regulation (EU) No 575/2013 requires for the internal risk-measurement model, including any pricing model, to have a proven track record of being reasonably accurate in measuring risks, and not differing significantly from the models that the institution uses for its internal risk management. Referring to explicitly “any” pricing model does not provide flexibility to restrict a pricing function inventory based on criteria of materiality and results of the P&L Attribution Test.</p> <p>Points (a)(v) to (a)(vii) of Article 20 refer to indicators of materiality and a mapping of pricing function</p>	<p>No amendments</p>

Comments	Summary of responses received	EBA analysis	Amendments to the proposals
<p>Question 2: What are your views in relation to the assessment methods relating to the requirements on the set-up of trading desks (see Article 7)? How do you plan to substantiate your choice of using internal models, in particular in the context of the requirement included in 325az(2), according to which the choice of not including a desk in the internal model shall not be motivated on the basis that the standardised approach requirements are lower compared to the internal model ones? Please elaborate.</p>	<p>One respondent notes that cases of multiple desks managing similar positions are rare, and supports the view that where two desks manage similar positions there should be a strong rationale and could potentially justify a different approach in calculating OFR. The respondent deems that supervisory discretion should apply in these circumstances.</p> <p>The respondent also raises some other points. First, it believes that that using similar hedging instruments does not in itself mean that desks have similar positions or business objectives, and that this principle should be clarified in these RTS.</p> <p>Second, the respondent recalls that FX and commodity in the banking book do not form actual desks and should be considered separately. According to the respondent, although their positions may be similar to those of desks in the IMA perimeter, institutions should be given the choice to capitalise those exposures under the standardised approach.</p>	<p>between the internal risk measurement model and end-of-day valuation process.</p> <p>It should be also noted that institutions under direct ECB supervision are already expected to have pricing function inventories including indicators of materiality and a mapping (see ECB Guide to internal models, Market Risk chapter, paragraph 132).</p> <p>The EBA notes that trading desks are to have a distinctive business strategy. It also notes that, trading similar instruments may not be sufficient condition for concluding that two desks do not have a distinctive business strategy. Accordingly, supervisors are provided with significant discretion in this regard.</p> <p>As regards FX and commodity risk in the banking book, it is noted that the requirements in Article 7 of these RTS do not apply in this context if the institution allocates those positions to those desks that the FRTB text refers to as “notional trading desks” (possibility which will be available to institutions in accordance with Article 104b(5) of the CRR3 Commission proposal, as well as of the Council position).</p> <p>Finally, as regards internal risk transfer for interest rate risk, it is noted that in CRR there are no provisions impeding the institution to include the desk made of IR-IRT in the scope of the standardised approach (to be capitalised on a stand-alone basis as per Article 106), even where other interest risk trading desks are included in the scope of the alternative internal model approach.</p>	No amendments

Comments	Summary of responses received	EBA analysis	Amendments to the proposals
	<p>Finally, the respondent notes that interest rates internal risk transfer (IR-IRT) portfolios can be made by positions that are similar to desks capitalised with an internal model approach. However, despite that similarity, institutions should be free to keep those desks under the standardised approach.</p> <p>More generally, for sets of portfolios or desks which bear no material risk, the respondent believes that an exception to the proposed rules should be granted.</p>	<p>Accordingly, there is no need to reflect changes in these RTS in this regard.</p>	
<p>Question 3: What are your views in relation to the requirement for credit institutions to specifically consider environmental risk as part of their stress-testing programme under the internal model approach? Do you agree that the assessment of that aspect should only apply from 2025? If not, by when EU credit institutions could be ready to be subject to this assessment? Please elaborate.</p>	<p>The respondent replies that environmental risks should be carefully considered by banks as they could, for instance, deteriorate credit quality. With specific regard to the traded market risk, the respondent argued that there was no evidence that environmental risks (either transition or climate risks) could impact markets significantly in the short liquidity horizons that are commonly applied in banks' stress testing programme.</p> <p>The respondent also argued that there was no consensus on the way these risks should be captured in market stress tests, and that the industry suggests removing any reference to environmental risk at this stage.</p>	<p>Risks stemming from climate change and broader environmental issues are changing the risk picture for the banking sector and are expected to become even more prominent going forward.</p> <p>The EBA is of the opinion that environmental risks are to be considered a concern, and to be identified and assessed, also for traded market risk, e.g., in terms of elements of event driven risks and various market risk concentrations. It is therefore appropriate to require competent authorities to verify that institutions consider these risks, as part of their stress testing programmes referred to in Article 325bi, point g, of Regulation (EU) No 575/2013.</p> <p>The EBA is aware of the steps taken by institutions, as well as the challenges, involved towards the incorporation of environmental risks in stress testing programmes for the trading book. The EBA therefore deems that it is appropriate that competent</p>	<p>No amendments</p>

Comments	Summary of responses received	EBA analysis	Amendments to the proposals
<p>Question 4: What is the status of credit institutions in relation to capturing environmental risks in their stress test for market risk under the internal model approach? Please elaborate.</p>	<p>The respondent stated that institutions were actively studying the integration of environmental risks into the market risk scope. The respondent also explained that currently no consensus had been reached, as the work on assessing environmental risks within the trading book continues.</p>	<p>authorities assess these aspects no earlier than 1 January 2025.</p>	<p>No amendments</p>
<p>Question 5: What is the status of credit institutions in relation to investigating whether environmental risk affects risk factor volatilities and/or the default risk? Are there credit institutions considering environmental (physical) risks as a form of event risk in their internal risk-measurement model? Please elaborate.</p>	<p>The respondent highlighted that some institutions studied the impact of environmental crises/natural disasters on markets within a short-term traded market risk context. The respondent however clarified that the outcome was highly dependent on individual banks' trading books and their respective composition, and exposure to vulnerable sectors, regions, etc.</p>	<p>In line with Question 3 and 4 above, the EBA acknowledges that institutions are already making efforts to include environmental risk considerations as part of their stress test programme, and accordingly, consider the requirement included in these RTS for consultation appropriate.</p>	<p>No amendments</p>
<p>Question 6: What are your views on the provisions included in Article 21(a)? In particular, do you think that monitoring APL_MRF, and HPL_MRF is relevant for identifying potential deficiencies in the model? Please elaborate.</p>	<p>The respondent voiced concerns over the suitability of the proposed metrics and their usefulness for identifying deficiencies in the model. The respondent pointed out that they did not share the assumption underlying the monitoring approach, namely that the ratio of APL/HPL to APL_MRF/HPL_MRF behaves similarly to the ratio RTPL to RTPL_MRF.</p>	<p>The EBA acknowledges the technical drawbacks in the definition of HPL_MRF and APL_NMRF identified by the respondent.</p> <p>Therefore the following changes have been made:</p> <p>The definition of HPL_MRF and APL_NMRF has been changed, and the definition proposed by the respondent has been retained, i.e. HPL_MRF = HPL -</p>	<p>Amendments to Article 21</p>

Comments	Summary of responses received	EBA analysis	Amendments to the proposals
<p>Question 7: Do you think that the scaling proposed in APL_MRF and HPL_MRF in Article 21(a) could lead to frequent numerical issues (e.g. due to a denominator, i.e. RTPL, that is close to zero)? Please elaborate.</p> <p>Question 8: What could be alternative definitions of APL_MRF and HPL_MRF in Article 21(a) that could provide an estimate of the contribution of modellable risk factors? Please elaborate.</p>	<p>The respondent suggested that the scope of Article 21(a) should only cover those desks that pass the desk-level back-tests and PLAT and should only be based on modellable risk factors.</p> <p>The respondent also pointed out that there could be situations where the RTPL is close to zero as the MRF and NMRF parts cancel each other out, thus rendering the methodology proposed in the Consultation Paper meaningless.</p> <p>The respondent proposes to replace the current methodology suggested in the Consultation Paper by one of two approaches:</p> <p>(i) Determine a VaR that includes both modellable and non-modellable risk factors; or</p> <p>(ii) Additively decompose the HPL (and APL analogously) by setting $HPL_MRF = HPL - (RTPL - RTPL_MRF)$, and then do the back-testing on HPL_MRF.</p>	<p>$(RTPL - RTPL_MRF), APL_MRF = APL - (RTPL - RTPL_MRF)$</p> <p>In accordance with the final draft RTS, the institution is free to implement this internal back-testing as described in these RTS, or do it differently. The objective should in any case be, the identification of the contribution of MRF and NMRFs to the back-testing results.</p>	
<p>Question 9: What are your views in relation to the assessment method to verify that the internal validation process includes a direct back-testing of the expected shortfall, as per Article 21(b)? Do you expect this requirement to put significant burden on</p>	<p>One respondent noted that direct ES back-testing would lead to additional operational burden and considered there was little benefit. The respondent pointed out that back-testing on a ten business days horizon would commensurately require ten days P&Ls. The respondent reminded that ES and VaR are jointly elicitable, and claimed that methodologies to directly back-test ES available in scientific literature were not robust and required significant</p>	<p>Acknowledging there is some incremental operational burden, the EBA considers that the use of ES as risk metric merits direct ES back-testing in internal validation.</p> <p>Leaving the details of ES back-testing to institutions allows choosing an approach most suited to the</p>	<p>Amendments to Article 21 and Article 53</p>

Comments	Summary of responses received	EBA analysis	Amendments to the proposals
<p>institutions? Which of the methods available in the literature do you expect credit institutions to use to back-test their expected shortfall? Please elaborate.</p>	<p>assumptions on P&L distributions. According to the respondent, approaches chosen by institutions could be challenged and required extensive research to identify a suitable approach.</p> <p>Another respondent noted that direct ES backtesting was a fundamental advance in risk methodologies in regulation and in line with the requirements of additional internal back-testing as required in Article 325bj(3) CRR. The respondent highlighted there were conclusive results on ES back-testing in academic literature and that suitable ES back-testing methodologies existed. While recognising the additional operational burden, the respondent noted that they were small compared to the typical efforts necessary to construct and validate an internal risk model. The respondent considered that ES back-testing would provide institutions with more advanced model validation techniques, know-how, and would allow collecting data and experience necessary for studying these methodologies on real data. The small additional burden was thus a good investment according to the respondent.</p>	<p>individual circumstances, thereby reducing the additional burden.</p> <p>In order to avoid any misconception of the purpose, these RTS text now clarifies that this additional back-testing is not superseding the results of the regulatory back-testing and PLAT for desk eligibility for the IMA.</p> <p>Moreover, the direct ES back-testing in internal validation is only considered necessary from 01/01/2026 to not create additional burden at short notice, potentially interfering with already prepared model application dossiers for initial IMA approval.</p>	
<p>Question 10: What are your views in relation to the requirement included in this Article (i.e. Article 23) on sufficient risk coverage? Do you agree that institutions should monitor the impact of the exclusion of some risk factors</p>	<p>One respondent proposes to include a materiality constraint to limit the perimeter of inventories and lists.</p> <p>In particular, the respondent expresses that Articles of these RTS on IMA assessment methodology relating to Art. 325bh of the CRR require more information than defined in the CRR. Specifically,</p>	<p>The EBA acknowledges that there is an additional burden arising from requirements to provide exhaustive lists.</p> <p>However, as the purpose of the assessments connected to Art. 325bh of the CRR is to verify requirements on risk measurement, on-site assessments should go beyond the actual scope of</p>	<p>Addition of Articles 24(2), 25(2), 26(2), 27(2), 28(2)</p>

Comments	Summary of responses received	EBA analysis	Amendments to the proposals
from the internal model? Please elaborate.	<p>the provision of exhaustive inventories and lists of objects that the institution's portfolio is sensitive to is a significant operational burden.</p> <p>To limit this additional burden, for all relevant articles of these RTS on IMA assessment methodology, it is proposed that competent authorities, instead of analysing exhaustive lists, shall only consider capitalised risk factors for IMA trading desks already successfully passing P&L attribution requirements.</p> <p>In addition to the abovementioned constraint, the respondent proposes to adjust article 23 by conditioning on PLAT materiality and not monitoring non-material risk factors from a PLAT perspective.</p>	<p>capitalised risk factors – in particular, the institution should be able to identify at a minimum those risks that institutions capitalise in the standardised approach, but not in the internal model approach. This is indeed a pre-condition to verify the requirement in Article 325bh(1)(a). It should also be noted that the overview referred to in Article 23(2) is at aggregated level.</p> <p>The EBA acknowledges that the risk-class level assessments referred to in Article 24-28 instead refer to all risk factors. Accordingly, in Articles 24-28, the possibility for the competent authorities to require only most material risk factors, rather than all risk factors has been added.</p>	
<p>Question 11: Do you agree with the provisions included in Article 24 and the relevant assessment techniques to verify that interest rate risk is properly captured? Do you think there are additional aspects that should be covered and/or assessed? Please elaborate.</p>	<p>One respondent highlights that Article 24 suggests providing a full inventory of sensitivities at market parameter level for general interest rates with all related risk factors which represents a strong operational burden.</p> <p>That respondent concludes that the materiality constraint as referred to in Question 10 should be introduced to this article.</p>	<p>See EBA analysis as given for Question 10.</p>	<p>Addition of Articles 24(2), 25(2), 26(2), 27(2), 28(2)</p>
<p>Question 12: Do you agree with the provisions included in Article 25 and the relevant assessment techniques to verify that equity risk is properly</p>	<p>One respondent highlights that Article 25 suggests providing a full inventory of sensitivities at market parameter level for equity positions with all related risk factors represents a strong operational burden.</p>	<p>See EBA analysis as given for Question 10.</p>	<p>Addition of Articles 24(2), 25(2), 26(2), 27(2), 28(2)</p>

Comments	Summary of responses received	EBA analysis	Amendments to the proposals
<p>captured? Do you think there are additional aspects that should be covered and/or assessed? Please elaborate.</p>	<p>The respondent concludes that the materiality constraint as referred to in Question 10 should be introduced to this article.</p>		
<p>Question 13: Do you agree with the provisions included in Article 26 and the relevant assessment techniques to verify that credit spread risk is properly captured? Do you think there are additional aspects that should be covered and/or assessed? Please elaborate.</p>	<p>One respondent highlights that no specific sub-articles were developed in Article 325bh(1) for credit spread risk factors. Thus, article 26 should be linked to the general sub-article Article 325bh(1)(a) and should be strongly related to any impact on P&L attribution requirements. Instead, the same inventory logic is retained and is decorrelated from the logic developed in CRR2.</p>	<p>See EBA analysis as given for Question 10.</p>	<p>Addition of Articles 24(2), 25(2), 26(2), 27(2), 28(2)</p>
<p>Question 14: Do you agree with the provisions included in Article 27 and the relevant assessment techniques to verify that foreign-exchange risk is properly captured? Do you think there are additional aspects that should be covered and/or assessed? Please elaborate.</p>	<p>One respondent highlights that Article 27 suggests providing a full inventory of sensitivities at market parameter level for foreign exchange positions. They state that this requirement is decorrelated from P&L attribution requirements.</p> <p>Further, the respondent states that the specific risk of unpegging events is added without connection to Article 325bh(1)(d): As unpegging events are usually not market driven, they should not be included in the market risk framework.</p>	<p>See EBA analysis as given for Question 10.</p>	<p>No amendments</p>
<p>Question 15: Do you agree with the provisions included in Article 28 and the relevant assessment techniques to verify that commodity risk is properly</p>	<p>One respondent proposes to include the materiality constraint as referred to in Question 10 to this article.</p>	<p>See EBA analysis as given for Question 10.</p>	<p>Addition of Articles 24(2), 25(2), 26(2), 27(2), 28(2)</p>

Comments	Summary of responses received	EBA analysis	Amendments to the proposals
<p>captured? Do you think there are additional aspects that should be covered and/or assessed? Please elaborate.</p>			
<p>Question 16: What are your views on assessment techniques laid down in Article 29 and 30? Do you see alternative or additional techniques that could be introduced to assess whether the modelling of curves and surfaces is accurate? Please elaborate.</p>	<p>One respondent proposes to include the materiality constraint as referred to in Question 10 to this article.</p>	<p>See EBA analysis as given for Question 10.</p>	<p>Addition of Articles 24(2), 25(2), 26(2), 27(2), 28(2)</p>
<p>Question 17: Do you agree with the provisions included in Article 31 relating to the inclusion of implied correlation risk factors? Please elaborate.</p>	<p>One respondent proposes to include the materiality constraint as referred to in Question 10 to this article. Further, the respondent points out that if the implied correlation parameters do not impact the P&L attribution requirements, then the materiality constrain should prevent from forcing the institution to model this risk factor.</p>	<p>See EBA analysis as given for Question 10.</p>	<p>Addition of Articles 24(2), 25(2), 26(2), 27(2), 28(2)</p>
<p>Question 18: Do you agree with the assessment techniques included in Article 32? Please elaborate.</p>	<p>The EBA received no feedback to this question.</p>	<p>The EBA received no feedback to this question.</p>	<p>No amendments</p>
<p>Question 19: How do you expect institutions/third parties to determine that the volume of</p>	<p>The EBA received no feedback to this question.</p>	<p>The EBA received no feedback to this question.</p>	<p>No amendments</p>

Comments	Summary of responses received	EBA analysis	Amendments to the proposals
<p>a transaction or a quote is non-negligible, and that the bid-offer spread does not substantially deviate from current market conditions? How do you expect institutions to determine that there is a close relationship between the verifiable price and the risk factor to which this price is mapped? Please elaborate.</p>			
<p>Question 20: Do you agree with the provisions included in Article 33 aiming at assessing a sound implementation of the requirements relating to the risk factor mapping to the appropriate liquidity horizons? Please elaborate.</p>	<p>The EBA received no feedback to this question.</p>	<p>The EBA received no feedback to this question.</p>	<p>No amendments</p>
<p>Question 21: Do you think that institutions would face challenges in providing the details referred to in paragraph 1 at risk-factor level? In particular, as regards data inputs to mark the risk factor (see paragraph 1(c)), do you think institutions would face challenges in providing a high-level/simple description of data</p>	<p>The EBA received no feedback to this question.</p>	<p>The EBA received no feedback to this question.</p>	<p>No amendments</p>

Comments	Summary of responses received	EBA analysis	Amendments to the proposals
<p>inputs in order to verify that the RF is mapped to the appropriate (sub-)category as per Article 1 of RTS on LH? Please elaborate</p>			
<p>Question 22: Do you think that institutions will make use of the derogation referred to in Article 325bd(3) of Regulation (EU) No 575/2013 regarding the use of longer liquidity horizons? Please elaborate.</p>	<p>The EBA received no feedback to this question.</p>	<p>The EBA received no feedback to this question.</p>	<p>No amendments</p>
<p>Question 23: Do you agree with the assessment techniques proposed in Article 34? What could be alternative techniques for assessing whether a proxy is conservative and keeps track of the actual position held? Please elaborate.</p>	<p>The EBA received no feedback to this question.</p>	<p>The EBA received no feedback to this question.</p>	<p>No amendments</p>
<p>Question 24: What could be reasons why the institution decides to use a proxy approach to determine the stress scenario risk measure for a non-modellable risk factor despite N being above 12? Please elaborate.</p>	<p>The EBA received no feedback to this question.</p>	<p>The EBA received no feedback to this question.</p>	<p>No amendments</p>

Comments	Summary of responses received	EBA analysis	Amendments to the proposals
<p>Question 25: What are your views on the provisions and techniques included in Article 35? Do you consider the indicators included therein adequate? What could be alternative or additional indicators? Please elaborate.</p>	The EBA received no feedback to this question.	The EBA received no feedback to this question.	No amendments
<p>Question 26: Do you agree with the provisions and the assessment techniques included in Article 36 dealing with back-testing? Please elaborate</p>	The EBA received no feedback to this question.	The EBA received no feedback to this question.	No amendments
<p>Question 27: What is your view in the relation to the analysis that institutions are to perform for their top of-the-house overshootings in accordance with Article 37?</p>	The EBA received no feedback to this question.	The EBA received no feedback to this question.	No amendments
<p>Question 28: Do you agree with the provisions and the assessment techniques included in Article 38 dealing with the profit and loss attribution requirements? Please elaborate</p>	The EBA received no feedback to this question.	The EBA received no feedback to this question.	No amendments

Comments	Summary of responses received	EBA analysis	Amendments to the proposals
<p>Question 29: Do you agree with the assessment methods included in Article 39 for verifying a sound implementation of the requirements on the calculation of own funds requirements for FX and commodity risk? If not, what would be alternative proposals?</p>	The EBA received no feedback to this question.	The EBA received no feedback to this question.	No amendments
<p>Question 30: In accordance with the assessment methods referred to in paragraph 3 and paragraph 5 (of Article 39), institutions are expected to perform reconciliation exercises. Do you think that institutions may face difficulties in performing those reconciliations? If so, which? What would be alternative methods to assess the corresponding requirements?</p>	The EBA received no feedback to this question.	The EBA received no feedback to this question.	No amendments
<p>Question 31: Do you consider the term “valuation inputs” appropriate to define inputs that form an accounting value? If not, what would be an alternative terminology on which the assessment method</p>	The EBA received no feedback to this question.	The EBA received no feedback to this question.	No amendments

Comments	Summary of responses received	EBA analysis	Amendments to the proposals	
referred to in paragraph 7 (of Article 39) should be built?	Question 32: Do you agree with the assessment techniques relating to non-linearities? Please elaborate.	One respondent highlights that the ability for the model to capture non-linearities is already measured in the P&L attribution test. It suggests removing any reference to “second-order terms of Taylor series approximations” in Article 40, as in most of the cases, using first order sensitivities is sufficiently precise to pass P&L attribution test. The use of second-order sensitivities could be significantly burdensome as it would require the calculation of those sensitivities even if they are not material.	The draft RTS text require the competent authority to verify that “the internal risk-measurement model captures at least the material first- and second-order terms of Taylor series approximations”. These RTS therefore do not require institutions to capture non-material second order sensitivities. The capture of material first- and second-order terms as stipulated in the draft RTS in fact is in line with Article 325bh(1)(b) which provides that “the internal risk-measurement model shall capture nonlinearities for options and other products as well as correlation risk and basis risk”.	No amendments
Question 33: What are your views in relation to the assessment techniques included in Articles 41 and 42 dealing with aspects relating to Article 325bb and 325bc CRR? Please elaborate.	The EBA received no feedback to this question.	The EBA received no feedback to this question.	No amendments	
Question 34: Do you have comments on the analysis included in the background section and in Annex I relating to ES and VaR estimators? Please elaborate.	The EBA received no feedback to this question.	The EBA received no feedback to this question. However, in line with the discussion on estimators presented in the background section of the consultation paper, the EBA amended these RTS to introduce concrete assessment techniques for competent authorities to assess the estimators used by the institution.	Amendments to Article 42	

Comments	Summary of responses received	EBA analysis	Amendments to the proposals
Question 35: Do you agree that these RTS should require competent authorities to verify that the estimators used are concordant? Please elaborate	The EBA received no feedback to this question.	See EBA analysis as given for Question 34.	Amendments to Article 42
Question 36: How competent authorities should verify that the estimators used are reasonably accurate in measuring risks? Do you agree in adding a list of estimators ranked by conservativeness as that provided in Annex I? Please elaborate. Please elaborate.	The EBA received no feedback to this question.	See EBA analysis as given for Question 34.	Amendments to Article 42
Question 37: Do you have comments on the examples of concordant ES and VaR estimators proposed that can be used by institutions in their calculations? Please elaborate.	The EBA received no feedback to this question.	See EBA analysis as given for Question 34.	No amendments
Question 38: Do you agree with the provisions included in this Article (Article 43)? Are banks fully relying on an historical approach able to fulfil the requirement in Article 12(1)(d) of these RTS, i.e. how in practice they could test alternative correlation patterns than those	The EBA received no feedback to this question. However, one respondent raised some concerns in relation to Article 12(1)(d). They have been included in the general comments section of this table (see beginning of this table), under the title “Assessing other correlation patterns than those used in the model”.	See EBA analysis in “Assessing other correlation patterns than those used in the model” at the beginning of this table.	No amendments

Comments	Summary of responses received	EBA analysis	Amendments to the proposals
historically observed (please note that this provision was already included in the 'old' draft RTS on internal model for market risk)?			
Question 39: Do you agree with the assessment methods included in this Article (i.e. Article 44)?	The EBA received no feedback to this question.	The EBA received no feedback to this question.	No amendments
Question 40: Paragraph 5 of this Article (i.e. Article 44) implies that an institution is able to retrieve data used for calibrating a shock in the ES for a risk factor that was modellable. This provision has been built on the requirement in Article 3(2) [RTS on SSRM]. Hence, banks are expected to keep those data in their systems. Do you agree with the requirement, or do you think that institutions may face difficulties in making this operational? Please elaborate.	The EBA received no feedback to this question.	The EBA received no feedback to this question.	No amendments
Question 41: Paragraph 7 of this Article (i.e. Article 44) requires institutions to select a risk factor that attracts specific risk	The EBA received no feedback to this question.	The EBA received no feedback to this question.	No amendments

Comments	Summary of responses received	EBA analysis	Amendments to the proposals
<p>whenever the original risk factor does so. This is done on the basis that, risk factors attracting specific risk are typically subject to a higher volatility than risk factors that do not (e.g. a diversified index). Do you agree with the requirement? Do you think that there are other cases where it is desirable to make the requirement referred to in Article 6(5)(c) RTS on SSRM more explicit? Please elaborate.</p>			
<p>Question 42: When institutions face pricing failures, or when they are to identify the stress period, institutions are allowed to use sensitivity-based P&Ls. Do you consider that the assessment methods proposed to assess the accuracy of sensitivity-based calculations are appropriate? Or do you think that additional/alternative checks should be envisaged? Please elaborate.</p>	The EBA received no feedback to this question.	The EBA received no feedback to this question.	No amendments
<p>Question 43: What are your views in relation to the</p>	The EBA received no feedback to this question.	The EBA received no feedback to this question.	No amendments

Comments	Summary of responses received	EBA analysis	Amendments to the proposals
<p>requirements included in this chapter (i.e. chapter 4) dealing with the internal default risk model?</p>			No amendments
<p>Question 44: Institutions are required to use two systematic risk factors to model issuers' defaults, as per Article 325bp(1) CRR. Do you agree that this requirement implies that single issuers cannot be modelled directly (by calibrating the correlation structure without the use of a factor model)? Do you agree that this requirement allows factor models based on principal components analysis to be used? Please elaborate.</p>	The EBA received no feedback to this question.	The EBA received no feedback to this question.	No amendments
<p>Question 45: How do you think EU credit institutions will model PDs relating to equities? Are there specific requirements you think should be included in these RTS in relation to equity issuers' PDs? Please elaborate.</p>	The EBA received no feedback to this question.	The EBA received no feedback to this question.	No amendments
<p>Question 46: As per Article 46(3) and 47(3), competent authority may require the institution to obtain PDs or</p>	The EBA received no feedback to this question.	The EBA received no feedback to this question.	No amendments

Comments	Summary of responses received	EBA analysis	Amendments to the proposals
<p>LGDs with different methods, where this is appropriate (and possible). The institution would then be required to explain the differences in the methods. Do you think that in relation to LGDs there could be material differences in the results that are due to different assumptions relating to the recovery period, e.g. when the LGD is stemming from the IRB approach, and when the LGD is instead derived from external sources? Please elaborate.</p>			
<p>Question 47: How institutions are going to implement the constant position assumption? Are there cases where the model set-up does not allow to easily capture the risk deriving from maturity mismatches, and if so, how institutions in those cases monitor such a risk? Please elaborate.</p>	<p>The respondent claimed that integrating all maturity mismatches within the core DRC engine would lead to economic inconsistencies and biased representation of the risk of default. It notably highlighted potential weaknesses of the “buy and hold” option. In particular, it noted that maturity mismatches between listed equity derivatives and spot equities would likely lead to the highest DRC impacts whereas liquidity issues in stressed conditions are much likely to occur for exotic equity positions than for listed equity derivatives. Moreover, the respondent further claimed that this option would be inconsistent with the capitalisation under the standardised approach and the expected shortfall as for the latter liquidity horizons for equity risk factors are short. Then, the respondent also</p>	<p>The respondent commented on the difficulties for credit institutions to implement the constant position assumption while also accurately capturing maturity mismatches. Among the two approaches identified by the EBA, the respondent expressed its concerns on the first approach (“buy and hold” positions). The respondent remained silent on the second approach (“frozen” position) and made an alternative proposal which would consist in implementing the constant position assumption as a constant level of risk assumption while maturity mismatches would be monitored separately.</p> <p>The EBA notes that, in the framework previous to the FRTB, institutions were allowed to implement a constant level of risk assumption by rebalancing the portfolio after a given liquidity horizon so to keep the</p>	<p>No amendments</p>

Comments	Summary of responses received	EBA analysis	Amendments to the proposals
	<p>expressed its concerns that the “buy and hold” option would create more volatility in the IMA outputs due to the cyclicity of hedges rolling.</p> <p>The respondent expressed its preference for the implementation of the constant position assumption as a constant level of risk assumption where maturity mismatches would be separately monitored while considering the liquidity of positions.</p>	<p>same level of risk across a 1-year period. This approach however cannot be implemented under the new FRTB rules (see changes in the CRR between text in Article 325bn(1)(d) where only the constant position assumption is mentioned and Article 374 where both the constant level of risk assumption and the constant position assumption are mentioned).</p> <p>In relation to this aspect, the EBA decided not to amend these RTS, noting that both the “buy and hold” positions option and the “frozen” positions option, as described in the background section of these draft RTS, are in principle allowed. It will then be up to the competent authority to verify that the regulatory provisions are met by the actual implementation of the DRC model.</p>	
<p>Question 48. Do you agree that the requirement in Article 325bp(2) CRR should be read as applicable to LGD only? How it could be argued that a IRB-LGD is already reflecting the economic cycle, and it already dependent on the systematic risk factors? Please elaborate.</p>	<p>The respondent indicated that credit institutions intend to ensure that their internal default risk charge will properly reflect the economic cycle by stochastically modelling the individual issuers’ ability to pay and the LGD, which will both include systematic risk factors. It further states that the additional capture of the economic cycle in the PD selection/modelling should be left at the discretion of the institutions.</p>	<p>The EBA acknowledges that credit institutions expect to comply with the requirement of Article 325bp(2) CRR by stochastically modelling both the issuers’ creditworthiness and the LGD. The EBA also notes that institutions plan to comply with the requirement of the RTS on PD/LGD, in combination of these RTS, by assuming an LGD distribution for which the unconditional average is the IRB-LGD.</p>	No amendments
<p>Question 49. How institutions, in their on-going implementation of model, plan</p>	<p>See summary of the response received for question 48.</p>	<p>See summary of the EBA analysis for question 48.</p>	No amendments

Comments	Summary of responses received	EBA analysis	Amendments to the proposals
<p>to meet the requirement in Article 325bp(2) CRR? Please elaborate.</p>			
<p>Question 50. What is your favourite option among options A, B, C as presented in Article 48(2)(k)(iii)? What are the challenges that an institution would face in implementing option A? and option B? Please elaborate.</p>	<p>One respondent expresses its preference for option C. Nevertheless, the respondent also suggests a potential provision (for PDs) requiring institutions to perform a sensitivity analysis similar to that required under the ‘fallback’ PD methodology under the RTS on PD/LGD: i.e. using a PD one rating grade higher and one rating grade lower and calculating the sensitivity of the requirements to those movements).</p> <p>The respondent notes the challenges that an institution would face in measuring a margin of conservatism (MoC), arguing that the methodology used to establish the MoC for internally derived PD could be very different from the PD’s MoC coming from the institution’s external sources, that may simply provide a PD estimate with no expected range of estimation errors.</p> <p>In the LGD’s case, an example of similar sensitivity analysis is proposed, deriving a crude estimation error from the externally sourced ladder of LGD by obligor grade (by assuming that the LGD error at each ladder rung could be within the LGD average with the rung above and the rung below).</p> <p>The outcome of these proposed potential analysis will not have direct prudential or supervisory consequences.</p>	<p>In light of the feedback received, the EBA considers appropriate to amend the draft RTS to incorporate option C complemented with the sensitivity analysis suggested for PDs. This analysis will inform about the magnitude of the change in the requirements upon small changes in the PDs.</p>	<p>Amended to retain option C while adding sensitivity analysis</p>

Comments

Summary of responses received

EBA analysis

**Amendments to
the proposals**

4.3 Annex I: Accuracy and soundness of ES estimators

This section gives some background on the estimation of the VaR and ES metrics relevant for the IMA approach. Statistically, it is about properties of sample estimators. In a practical ES model implementation, the true underlying distribution of losses is not known, but only a sample is, for example, in a historical simulation or Monte Carlo approach. From this finite sample, the risk metrics need to be estimated.

There is a great variety of estimators for both the quantile¹⁷ and the ES¹⁸, however they are mostly not specifically analyzed in a regulatory risk model setting. To ease the discussion, we discuss only estimators in the class of weighted sums of order statistics (L-estimators), which are commonly used, although other approaches exist.

In the case of a historical simulation approach, the metrics are estimated from risk model generated P&L scenarios obtained from historical risk factor scenario data of one year. In case daily overlapping ten business day returns are used, this means a sample size of around 255, depending on the exact number of business days in the relevant 12 months period. In Monte Carlo approaches, the sample size is orders of magnitude higher.

The properties that we are mainly discussing in the following are:

- **accuracy**, respectively estimation bias¹⁹, and
- consistency between the VaR and ES estimators, termed “**concordance**”²⁰

There are other useful properties of sample estimators, such as **consistency of an estimator**, i.e. the true value is attained for an infinitely large sample, which is typically fulfilled. This is the reason why the choice of estimators for the Monte Carlo approach has only a small impact, while it can be substantial in the historical simulation approach, as we will see.

Another useful property is **efficiency**, i.e. the variability of sample estimates across different samples. To this end, we will show some results for the Gaussian case in Table 1. For the VaR, there are small noticeable differences of the estimators in efficiency, depending on the VaR estimator being based on a single (e.g. empirical quantile) or many order statistics (interpolating or Harrell-Davis estimator), with the Harrell-Davis estimator being the most efficient as measured by the coefficient of variation for the setup investigated. Different estimators of ES presented in the following have very similar efficiency, because they all are effectively tail averages of the largest losses with somewhat different weights assigned to them.

¹⁷ E.g.: Rob J. Hyndman and Yanan Fan. Sample quantiles in statistical packages. *The American Statistician*, 50(4):361–365, 1996.

¹⁸ E.g.: Saralees Nadarajah, Bo Zhang, and Stephen Chan. Estimation methods for expected shortfall. *Quantitative Finance*, 14(2):271–291, 2014.

¹⁹ The bias being the expectation of the difference of the sample estimate and the true value for finite sample size. For a consistent estimator, the bias vanishes for sample size $N \rightarrow \infty$.

²⁰ In order to avoid the words “consistency” and “consistent” which refer to another statistical property (and are overly used)

For ensuring a “proven track record of being reasonably accurate in measuring risks” as required by Art 325bi(f) CRR for any internal model, the estimator should exhibit a low bias, meaning a small difference between the estimated and true (but unknown) value of the metric in question.

A mechanism for ensuring a minimum level of accuracy of the IMA ES capital model is regulatory back-testing, which is performed for the one day VaR numbers (i.e. quantiles) at two confidence levels (97.5% and 99%) based on the rationale that the accuracy of the quantiles in the tail of the profit and loss (P&L) distribution X ensures the accuracy of the ES on the one day horizon and by extension on the relevant horizons, i.e. ten day base horizon and base horizon scaled with the liquidity horizons²¹. This rationale is related to the following integral equation connecting ES and VaR for a tail probability α ,

$$ES(X, \alpha) = \frac{1}{\alpha} \int_0^\alpha \text{VaR}(X, u) du = \frac{-1}{\alpha} \int_0^\alpha Q(X, u) du$$

Equation 1

where $\text{VaR}(X, u) = -Q(X, u)$ denote the VaR and the quantile at a tail probability u . **Error! Reference source not found.** essentially states that specifying the quantile function (and thus the CDF, as the quantile is the generalized inverse of the quantile function) implies an expected shortfall for this same CDF. The equation is equivalent to the more commonly used expression $ES(X, \alpha) = \frac{-1}{\alpha} \int_{-\infty}^{-\text{VaR}(X, \alpha)} x f(x) dx$ if there is a continuous probability density $f(x)$.

If an ES and VaR estimator fulfil the integral equation above for all (relevant) α , we call them a “concordant²² couple” of estimators. If the VaR estimator is conservatively biased (leading to fewer overshootings in the regulatory back-testing), while the ES estimator is aggressively biased and lower than the concordant one, the intended inference from VaR tests to ES breaks down, because of the integral relation (Equation 1).

In the following we illustrate some VaR and ES estimators. The properties of quantile and ES estimators have to our knowledge mostly been analysed separately in pertaining literature, except for the empirical quantile $Q_1(X, \alpha) = X_{(\lfloor \alpha N \rfloor + 1)}$ with $X_{(i)}$ denoting the order statistics of the P&Ls in ascending order of a sample of size N , i.e. $X_{(1)}$ is the most several loss and typically a large negative number. For distinguishing different estimators, we follow the terminology for the quantile function in the R programming language, so that the type 1 quantile is Q_1 .

The concordant ES estimator for the empirical quantile is^{23,24}:

²¹ See the main body of the document for considerations on the aspect that the VaRs are computed for all risk factors, but the ES for modellable risk factors only.

²² Reserving the term “consistent” estimator for the property that an estimator converges to the true value for sample size $N \rightarrow \infty$ as mentioned above.

²³ R. Tyrrell Rockafellar and Stanislav Uryasev. Conditional value-at-risk for general loss distributions. *Journal of Banking & Finance*, 26(7):1443–1471, 2002.

²⁴ Carlo Acerbi. Coherent representations of subjective risk aversion. In Giorgio Szegö (ed.), *Risk Measures for the 21st Century*, chapter 10.2.4. Wiley, 2004. (ISBN 978-0-470-86154-7).

$$ES_1(X, \alpha) = \frac{-1}{\alpha N} \left(\sum_{i=1}^{\lfloor \alpha N \rfloor} X_{(i)} + (\alpha N - \lfloor \alpha N \rfloor) X_{(\lfloor \alpha N \rfloor + 1)} \right)$$

Equation 2

as can be seen from **Error! Reference source not found.**

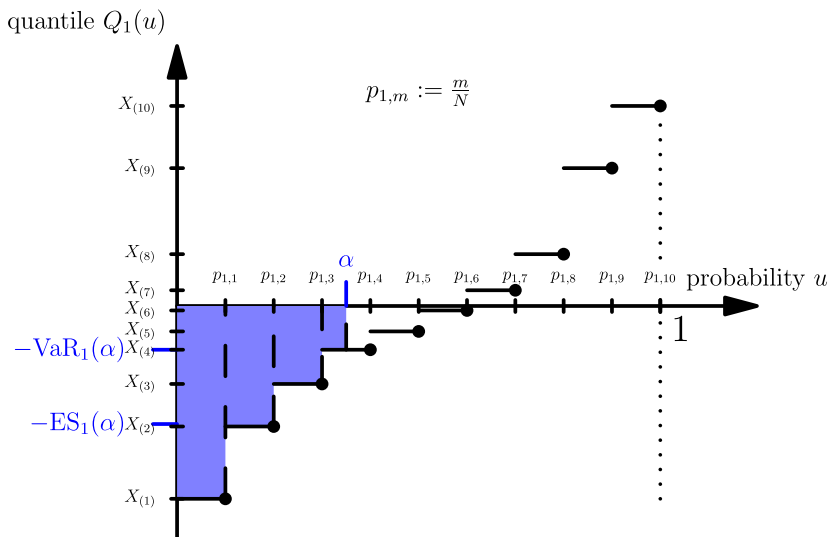


Figure 1 Empirical quantile function Q_1 , VaR and ES for tail probability α for a sample of size ten. Graphically, the ES is the average depth of the blue shaded area. The fractional rectangle of width $\alpha - p_{1,3}$ leads to the last “broken” summand in the formula for ES_1 .

As the tail losses are floored at the maximum observed loss in Q_1 , this ES estimator is typically underestimating the true ES (negative bias), if the true distribution of tail losses extends farther than the observed losses. It has the advantage that it is relatively simple and is continuous in αN , an important feature if the number of observations varies, such as for the stress scenario risk measure (SSRM²⁵). $ES_1(X, \alpha)$ (Equation 2) was proposed in the Final Draft RTS on the calculation of the SSRM (RTS SSRM) for ES estimations in the “historical” and “direct” methods together with an “uncertainty compensation factor” to reduce the negative estimation bias, which can be material.

The median bias of $ES_1(X, \alpha)$ for several sample sizes and typical risk factor distributions was investigated extensively²⁶ in the context of the RTS SSRM, showing that it depends on many parameters, like sample size and risk factor distribution. The RTS SSRM foresees one common uncertainty compensation factor, that still maintains a negative bias introduced by the ES estimators for the “historical” and “direct” methods and highly non-Gaussian risk factors in the “asigma” method.

²⁵ Final Draft RTS on the calculation of the stress scenario risk measure under Article 325bk(3) of Regulation (EU) No 575/2013 (Capital Requirements Regulation 2 – CRR2)

²⁶ Martin. Aichele, Marco Giovanni Crotti, Benedikt Rehle, *A universal stress scenario approach to capitalise NRMF*, EBA Staff paper DZ-AH-21-004-EN-N, 2021, Figure 4 (top panel). The results for the mean bias are very similar.

Another popular estimator for the ES is the simple average of exceedances²⁷,

$$ES_{SAE}(X, \alpha) = \frac{-1}{\lfloor \alpha N \rfloor} \sum_{i=1}^{\lfloor \alpha N \rfloor} X_{(i)}$$

Equation 3

which can be interpreted as a conservative simplification of ES_1 .

Another VaR estimator²⁸ (type 6) is interpolating between the sample values at probabilities assigned to the observations bracketing α : Denoting the integer $M_6 = \lfloor \alpha(N + 1) \rfloor$ and the fractional remainder $R_6 = \alpha(N + 1) - \lfloor \alpha(N + 1) \rfloor$, we define:

$$Q_6(X, \alpha) = (1 - R_6)X_{(M_6)} + R_6X_{(M_6+1)}$$

Equation 4

Outside the probabilities assigned to the observed losses, i.e. $p < \frac{1}{N+1}$ and $p > \frac{N}{N+1}$ it is not clear how the quantile estimator should be extended to take into account tail events in the estimation of the expected shortfall. The simplest choice is to assume $Q_6(X, \alpha)$ stays constant outside the observed range, i.e. no losses can be higher than the ones observed. The ES estimator ES_6 obtained by integration of Q_6 as illustrated in **Error! Reference source not found.**, is as follows for $M_6 \geq 2$:

$$ES_6(X, \alpha) = \frac{-1}{\alpha(N + 1)} \left(\frac{3}{2}X_{(1)} + \sum_{i=2}^{M_6-1} X_{(i)} + \frac{1 + 2R_6 - R_6^2}{2}X_{(M_6)} + \frac{R_6^2}{2}X_{(M_6+1)} \right)$$

Equation 5

The concordant couple $VaR_6 = -Q_6$ and ES_6 exhibit less negative bias compared to the concordant estimators based on the empirical CDF (type 1) in relevant settings (see Table 1 for the Gaussian setup).

When assuming that the historical scenarios of a year are a sample for future scenarios of shocks to which the model is to be calibrated (and conceptually there could be many others, that have just not been observed), an extrapolation outside the observed range of losses is needed. It is a well-known stylized fact of financial time series^{29,30} including loss distributions, that they are heavy-tailed (they have heavier tails than the exponential distribution), have non-zero skewness and excess kurtosis, and therefore losses can extend far out in the tails.

²⁷ Song Xi Chen. Nonparametric Estimation of Expected Shortfall. *The Journal of Financial Econometrics*, (1):87–107, Winter 2008.

²⁸ This interpolating estimator is mentioned in the [ECB guide to internal models](#), Market risk chapter paragraph 115, as an appropriate method for VaR estimation.

²⁹ E.g. Alexander J. McNeil, Rüdiger Frey and Paul Embrechts, *Quantitative Risk Management (2nd ed.)*, chapter 3.1, Princeton University Press, 2015 (ISBN 978-0-691-16627-8), hereafter “QRM2ndEd”.

³⁰ Cf. e.g. for IMA risk factors: Figure 4 (p. 79) in [Final Draft RTS on the calculation of the stress scenario risk measure under Article 325bk\(3\) of Regulation \(EU\) No 575/2013 \(Capital Requirements Regulation 2 – CRR2\)](#). Note that the usual sample moment estimators are strongly negatively biased for small samples.

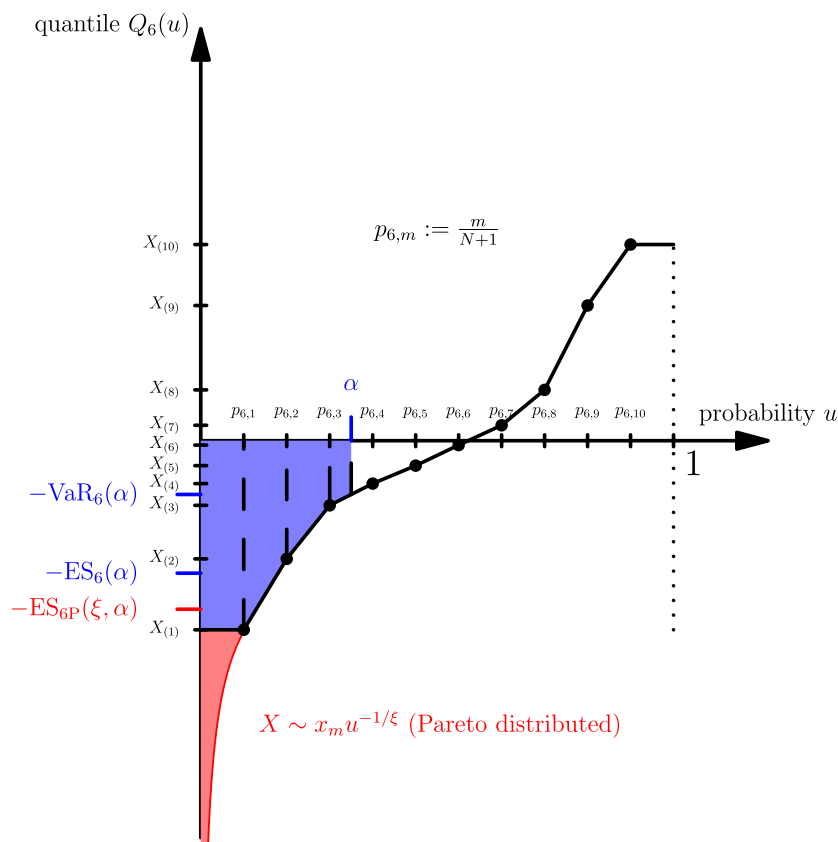


Figure 2 Interpolating quantile function Q_6 and the Pareto tail extrapolated variant Q_{6P} together with the concordant couples of VaR and ES for tail probability α and the same sample of size ten as in Error! Reference source not found.. The fractional trapezoid of width $\alpha - p_{6,3}$ leads to the last two weights in the sum for ES_6 and ES_{6P} depending on R_6 .

The Pickands-Balkema-de Haan theorem of extreme value theory ensures that for essentially all commonly used continuous distributions the properly normalized exceedances sufficiently far in the tail converge to the Generalized Pareto Distribution³¹ (GPD) with shape parameter ξ , so that the GPD is the “canonical distribution for modeling excess losses over high thresholds”³².

Heavy tailed distributions are in the so-called Fréchet maximum domain of attraction and thus, the excess distribution follows the GDP with shape parameter $\xi > 0$, i.e. a Pareto distribution³³.

The [ECB guide to internal models](#) proposes to extend $Q_6(X, \alpha)$ outside the observed range with a logarithmic function³⁴, which can be rationalized as the special case of the Generalized Pareto Distribution with shape parameter $\xi = 0$ (i.e. exponential distribution) for the CDF of which the inverse, the quantile function, is the logarithm. Based on the stylized facts presented before, this means a very mild tail assumption and a shape parameter $\xi > 0$ corresponding to a Pareto

³¹ QRM2ndEd, Def. (5.8)

³² QRM2ndEd, Theorem 5.20

³³ V. Chavez-Demoulin, P. Embrechts, S. Sardy, Extreme-quantile tracking for financial time series, *Journal of Econometrics* 181(1): 44-52, 2014. Section 2.1. and QRM2ndEd, chapter 5.2.

³⁴ [ECB guide to internal models](#), Market risk chapter paragraph 92.

distribution with power-tails could be more appropriate, with the value of ξ depending on the underlying distribution characteristics, that means the portfolio risk characteristics to be modelled.

Based on the above reasoning we use the Pareto CDF for the left tail extrapolation of losses in the Q_6 quantile function: $F_P(x \leq x_m < 0) = \left(\frac{x_m}{x}\right)^{1/\xi}$. The quantile function is the inverse: $Q_P(u) = x_m u^{-\xi}$. To make the quantile function continuous at the values for the highest loss, we fix $Q_P\left(u = p_{6,1} = \frac{1}{N+1}\right) = X_{(1)} = x_m(N+1)^\xi \Leftrightarrow x_m = \frac{X_{(1)}}{(N+1)^\xi}$ and thus:

$$Q_P(u < p_{6,1}) = X_{(1)} \left(\frac{1}{N+1}\right)^\xi u^{-\xi}$$

Equation 6

The contribution to the ES in the range $0 \leq u \leq p_{6,1}$ (the red shape in **Error! Reference source not found.**) is the integral

$$\int_0^{p_{6,1}} Q_P(u) du = X_{(1)} \left(\frac{1}{N+1}\right)^\xi \int_0^{\frac{1}{N+1}} u^{-\xi} du = X_{(1)} \left(\frac{1}{N+1}\right)^\xi \frac{1}{1-\xi} \left(\frac{1}{N+1}\right)^{1-\xi} = \frac{1}{N+1} \frac{1}{1-\xi} X_{(1)}$$

Equation 7

and inserting this result to the ES estimator formula Equation 4, where the contribution of the rectangle in the first summand needs to be subtracted in ES_6 to finally get:

$$ES_{6P}(X, \alpha, \xi) = \frac{-1}{\alpha(N+1)} \left(\left(\frac{1}{2} + \frac{1}{1-\xi}\right) X_{(1)} + \sum_{i=2}^{M_6-1} X_{(i)} + \frac{1+2R_6-R_6^2}{2} X_{(M_6)} + \frac{R_6^2}{2} X_{(M_6+1)} \right)$$

Equation 8

This Pareto extrapolated ES estimator $ES_{6P}(X, \alpha, \xi)$ has only a modification of the weight of the largest loss $X_{(1)}$, with the weight depending on the shape parameter compared to the ES estimator with flat continuation $ES_6(X, \alpha)$. Using the ECB guide quantile function tail extrapolation leads to a weight of approximately 1.7 for $X_{(1)}$, slightly depending on $N \approx 255$.

The k-th moment of the Pareto distribution is finite if $\frac{1}{\xi} > k$ and the following special cases are interesting

- $\xi \rightarrow 0$: no tail, converges to $ES_6(X, \alpha)$, first summand $\frac{3}{2}X_{(1)}$
- $\xi \rightarrow 1/6$: first four moments finite, first summand $1.7X_{(1)}$ approximates the exponential case numerically (while the exponential and Pareto are very different distributions)
- $\xi \rightarrow 1/4$: kurtosis diverges, first summand $\frac{11}{6}X_{(1)} = 1.83X_{(1)}$
- $\xi \rightarrow 1/3$: skewness diverges, first summand $2X_{(1)}$.

This choice is termed ES_{6e} , with “e” for standard tail extrapolation, see below.

- $\xi \rightarrow 1/2$: variance diverges, first summand $\frac{5}{2}X_{(1)}$

From analyzing daily hypothetical P&L data of SSM banks in the time period 2014 to 2022 as a proxy for realistic risk model P&L predictions, one can infer by studying plots of the ratio of the partial maxima over the partial sums of $|X_i|^k$ over observations i , that the variance ($k = 2$) is finite even in stressed periods, while kurtosis and skewness could diverge in some instances. Analyses of the data, including tail shape estimations with the Hill estimator³⁵ indicate that typical values of the shape parameter are often in the range of $\frac{1}{2} \lesssim \xi \lesssim \frac{1}{4}$. It is well-known that the estimation of tail parameters for extreme value analysis for real world data is often challenging and estimates have considerable uncertainty.

That said, the value $\xi = 1/3$ appears as a reasonable standard choice for the tail extrapolation with a Pareto distribution in stress periods starting from 2007 as required under the FRTB and hence including the GFC. We denote the ES estimator using the Pareto tail extrapolation with $\xi = 1/3$ as ES_{6e} , the “e” for standard tail extrapolation.

As an aside, the discussion of the choice of the tail extrapolation echoes a dilemma³⁶ when using the expected shortfall as risk measure: The ES takes into account tail losses, but the finite sample estimation becomes challenging when the tail is not sampled densely. The value-at-risk on the other hand ignores the tail altogether, but does not have this estimation issue.

The estimators $ES_{6...}(X, \alpha)$ are in comparison somewhat more complicated and can be simplified to the conservative side by noting that because the remainder $R_6 < 1$ we have $2R_6 - R_6^2 < 1$, and integrating the quantile function only up to $[\alpha(N+1)] = M_6$, to get the conservative and simplified variants

$$ES_{6c}(X, \alpha) = \frac{-1}{[\alpha(N+1)]} \left(\frac{3}{2} X_{(1)} + \sum_{i=2}^{[\alpha(N+1)]} X_{(i)} \right)$$

Equation 9

$$ES_{6ec}(X, \alpha) = \frac{-1}{[\alpha(N+1)]} \left(2X_{(1)} + \sum_{i=2}^{[\alpha(N+1)]} X_{(i)} \right)$$

Equation 10

The same for the general case ES_{6P} . Conservatively only refers to the comparison to the estimator with fractional order statistics weights, not to guaranteeing a positive bias.

The bias of the estimators is not only driven by the assumptions for the tail, but also strongly by the expectation values of the order statistics $E[X_{(i)}]$ in relation to the true values, and additionally the function shape approximation, like using a step or piecewise-linear function for approximating the quantile function.

³⁵ Bruce M. Hill. A simple general approach to inference about the tail of a distribution. *The Annals of Statistics* 3:5, 1163-1174, 1975.

³⁶ Cf. also the discussion on ES vs. VaR, e.g. in: Jon Danielsson and Chen Zhou. Why risk is so hard to measure. *De Nederlandsche Bank Working Paper No. 494*, 2016. <https://www.dnb.nl/media/padbixha/working-paper-494.pdf>

When the true distribution function F is known, the mean of the m -th order statistic $Z_{(m)}$ for N i.i.d. samples is known and can be expressed as an integral over the density³⁷ using the Beta function $B(\cdot)$ instead of binomial coefficients:

$$E[Z_{(m)}] = \frac{N!}{(m-1)!(N-m)!} \int_{-\infty}^{\infty} xF(x)^{m-1}(1-F(x))^{N-m} dF(x) = \frac{1}{B(m, N+1-m)} \int_0^1 F^{-1}(y)y^{m-1}(1-y)^{N-m} dy$$

Equation 11

For i.i.d. samples and given the weights of an L-estimator, the ES estimator bias can be obtained by applying the weights to the means of the order statistics of Equation 11 and subtracting $ES(Z, \alpha)$. For the unimodal continuous distributions investigated, the absolute values of the $E[Z_{(m)}]$ converge from above to the true values. Because a piecewise linear approximation of the concave quantile function in the tail region is conservative, this means that $ES_{6P}(X, \alpha, \xi)$ has a (substantial) positive bias for i.i.d. samples if the shape parameter ξ is chosen accurately.

For highly serially correlated samples however, such as from overlapping returns, the absolute value of the means $E[X_{(m)}]$ can get significantly smaller than the true value, which in turn leads to a more negative bias of the ES estimator, everything else being equal. In other words, an ES estimator that is conservative for i.i.d. samples can exhibit a significant negative bias for overlapping returns.

After discussing properties of VaR and ES estimators, we turn to results of sample estimates for some stylized proxy choices for risk model P&Ls in a historical simulation approach. For the examples in the following, we focus on a historical simulation approach setting with 255 business days (the typical number of business days in a year ranging from 250 to 260) and ten-business-days overlapping returns at a confidence level of 97.5%, i.e. $\alpha = 2.5\%$. Using ten-days *non*-overlapping returns would result in 25 observations, and consequently very high estimation error³⁸, while avoiding the complication of overlapping returns with serial autocorrelation. Approaches between those two choices are of course possible as well.

For describing the risk model distribution of P&Ls on the ten days horizon, we make the stylized assumption that the daily returns are i.i.d. and use standardized distributions for the one-day increments. Ten daily i.i.d. returns are summed to obtain $N = 255$ rolling ten-day returns. Those block of 255 returns are then sampled 500,000 times for the analyses.

As a reference point, we present in Table 1 the results for the Gaussian case and $\alpha = 2.5\%$, for which the true VaR=6.198 and ES=7.3928 are known analytically, as the normal distribution is closed under convolution. We note that the Pareto extrapolated ES estimator with a shape parameter $\xi = \frac{1}{6}$ adapted to the Gaussian case by matching the weight of the largest loss with an exponential tail shows almost no bias, but this not generally true as discussed above.

³⁷ Eric W. Weisstein. "Order Statistic." From *MathWorld—A Wolfram Web Resource*. <https://mathworld.wolfram.com/OrderStatistic.html>, Accessed: 2023-01-04.

³⁸ Cf. the discussion in Danielsson and Zhou

$\alpha = 2.5\%$	Mean estimate	bias to true value	coeff. of variation
VaR_1	6.0166	-2.93%	19.11%
VaR_HD	6.1028	-1.54%	18.69%
VaR_6	6.1365	-0.99%	19.11%
VaR_6e	6.1365	-0.99%	19.11%
VaR_6P(xi=1/6)	6.1365	-0.99%	19.11%
ES_1	6.8952	-6.73%	18.80%
ES_HD	6.947	-6.03%	18.64%
ES_SAE	6.9501	-5.99%	18.84%
ES_6	7.1496	-3.29%	18.78%
ES_6c	7.6122	2.97%	18.80%
ES_6e	7.7703	5.11%	18.76%
ES_6ec	8.2742	11.92%	18.77%
ES_6P(xi=1/6)	7.3979	0.07%	18.77%

Table 1: Simulated results for the mean estimates, bias and coefficient of variation for the different estimators discussed and for N=255 10-days overlapping Gaussian returns at confidence level 97.5%.

One should not overuse those results of the Gaussian case, because as we mentioned, financial time series are typically heavy-tailed, i.e. skewed and having excess kurtosis³⁹ that might even diverge. We also note that the results are strongly driven by the degree of return overlap, because of the effect on the means of order statistics. For i.i.d. samples, the bias is substantially shifted in the positive direction.

Besides the Gaussian, we analyzed the Student-t, and Normal Inverse Gaussian (NIG) for the one-day daily returns.

The Normal Inverse Gaussian has the convenient property that it is closed under convolution, so that the sum of NIG is also NIG with known parameters. The first four moments are finite and analytically known⁴⁰ as a sub-class of the generalized hyperbolic distribution (GHyp) family. All moments for finite parameters are finite, and thus cannot reflect diverging skewness and kurtosis that occur in realistic P&L data. We note that the analysis could be complemented by similar simulations using the Variance-Gamma (VG) distribution family⁴¹, another sub-class of the GHyp family which is closed under convolution. The NIG and VG are the only sub-classes of the GHyp family that are closed under convolution⁴².

Another choice is the SGT distribution family used for the analyses for the Final Draft RTS SSRM, which allows modelling of infinite moments, however is not closed under convolution in general,

³⁹ Cf. e.g. for IMA risk factors: Figure 4 (p. 79) in [Final Draft RTS on the calculation of the stress scenario risk measure under Article 325bk\(3\) of Regulation \(EU\) No 575/2013 \(Capital Requirements Regulation 2 – CRR2\)](#)

⁴⁰ David J. Scott et al. Moments of the generalized hyperbolic distribution. *Comput Stat* 26:459–476, 2011. Section 6.1.

⁴¹ Scott Nestler, Andrew Hall, The Variance Gamma Distribution, *Significance*, 16:5, 10-11, 2019. <https://doi.org/10.1111/j.1740-9713.2019.01314.x>

⁴² Krzysztof Podgórski and Jonas Wallin, Convolution-invariant subclasses of generalized hyperbolic distributions, *Communications in Statistics - Theory and Methods*, 45:1, 98-103, 2016. DOI: 10.1080/03610926.2013.821489

so that only numerical results are available. Some selected simulations using the SGT were performed which showed qualitatively similar results for the different estimators, while the infinite moments occurring for SGT distributions made the tail extrapolation more relevant. Those simulations also confirmed for cases of crossing to an infinite k-th moment that the tails could very well be described with Pareto distributions with $\xi = 1/k$.

The NIG has four parameters, $NIG(\mu_{NIG}, \delta_{NIG}, \alpha_{NIG}, \beta_{NIG})$ and after standardizing to zero mean and unit variance, only two parameters α_{NIG} (tail heaviness parameter) and β_{NIG} (skewness parameter) remain. Because the skewness is $\propto \frac{\beta_{NIG}}{\alpha_{NIG}}$, we characterize the standardized one-day NIG distributions by α_{NIG} and $\frac{\beta_{NIG}}{\alpha_{NIG}}$. The parameters α_{NIG} and β_{NIG} stay constant under convolution, so that the 10-days distribution is known exactly analytically.

The following cases were investigated:

Distributions	Parameters	Skewness (10d)	Ex. Kurtosis (10d)
Gaussian		0	0
Student t	dof = 5 (on 1d)	0	0.5566
NIG(low positive skew & ex. kurt)	$\alpha_{NIG} = 0.4; \frac{\beta_{NIG}}{\alpha_{NIG}} = 0.35$	0.9460	3.6282
NIG(low negative skew & ex. kurt)	$\alpha_{NIG} = 0.4; \frac{\beta_{NIG}}{\alpha_{NIG}} = -0.35$	-0.9460	3.6282
NIG(medium positive skew & ex. kurt)	$\alpha_{NIG} = 0.55; \frac{\beta_{NIG}}{\alpha_{NIG}} = 0.55$	1.3601	4.5051
NIG(medium negative skew & ex. kurt)	$\alpha_{NIG} = 0.55; \frac{\beta_{NIG}}{\alpha_{NIG}} = -0.55$	-1.3601	4.5051
NIG(large positive skew & ex. kurt)	$\alpha_{NIG} = 0.4; \frac{\beta_{NIG}}{\alpha_{NIG}} = 0.55$	1.8702	8.5174
NIG(large negative skew & ex. kurt)	$\alpha_{NIG} = 0.4; \frac{\beta_{NIG}}{\alpha_{NIG}} = -0.55$	-1.8702	8.5174

While the examples are synthetic, the values for the NIG parameters are compatible to values fitted to the hypothetical P&L dataset from 2014 to 2022, while taking into account that the stress period of the GFC was more severe than the data period.

The following plots in Figure 3 show for $\alpha = 2.5\%$ the ES estimation biases for $N = 255$ samples of overlapping returns vs. the analytical (Gauss), large sample (Student t) or numerical values (NIG⁴³) of the different estimators and the different distributions. While in the Gaussian case the underestimation remains limited to about 7% for all estimators, the presence of negative skewness, i.e. when large losses are more likely than large gains, drives the bias into substantial negative territory. The effect is exacerbated with increasing excess kurtosis. In the most non-Gaussian scenarios, all of the estimators investigated show a tangible underestimation.

This analysis supports the relevance of the provisions in these RTS regarding the justification of the VaR and ES estimators used in the ES model.

Based on the above considerations, the following VaR and ES estimators could be used in the assessment of VaR and ES estimators employed in a risk model⁴⁴.

VaR estimator	Concordant ES estimator	Conservative simplification	Comment
VaR_1	ES_1	ES_SAE	Empirical CDF (subscript “emp” in the RTS text)
VaR_HD	ES_HD		Harrell-Davis estimator providing higher efficiency
VaR_6	ES_6	ES_6c	Improved accuracy of VaR estimates, lower bound of the 6P family (corresponding to $\xi = 0$) (subscript “lin” in the RTS text)
VaR_6e	ES_6e	ES_6ec	Improved accuracy of VaR estimates, standard choice $\xi = 1/3$ for the Pareto tail extrapolation covering diverging skewness (subscript “lin_extra” in the RTS text)
VaR_6P	ES_6P	ES_6Pc	Improved accuracy of VaR estimates, choice of ξ based on portfolio P&L characteristics and analysis

⁴³ Using the quantile and ES functions of the R package ghyp, version 1.6.3.

⁴⁴ The RTS text uses the mnemonics “emp” for the subscript “_1” denoting the empirical CDF based estimators, “lin” for the subscript “_6” denoting the linear interpolation of the quantile function, and “lin_extra” for the subscript “_6e” denoting the linear interpolation of the quantile function with a Pareto tail extrapolation with $\xi = 1/3$.



Figure 3: Expected shortfall estimation bias of 255 overlapping 10 days returns vs. the true ES (obtained as formulaic or large sample value) for different daily return increment distribution assumptions.