Minimum capital requirements for market risk

Basel Committee on Banking Supervision

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Introduction

The BCBS published in January 2016 final standards proposing a revised market risk framework, after conducting the Fundamental Review of the Trading Book

Introduction

Significant weaknesses in the Basel capital framework for trading activities resulted in materially undercapitalised trading book exposures prior to the 2007–08 period of the financial crisis. To deal with the most pressing weaknesses, the BCBS introduced a set of revisions to the market risk framework in July 2009. Nonetheless, at the time the BCBS recognised that a number of structural flaws in the market risk framework remained unaddressed.

In response, it undertook the **Fundamental Review of the Trading Book** (FRTB) to improve the overall design and coherence of the capital standard for market risk.

- Consistent with the policy rationales underpinning three consultative papers on the FRTB, the BCBS published in January 2016 **revised standards for minimum capital requirements for market risk**.
- This revised market risk framework consists of the following **key enhancements**:
  - Revised boundary. the boundary between the banking book (BB) and trading book (TB) has been revised to reduce incentives for a bank to arbitrage its regulatory capital requirements between the two regulatory books.
  - Revised Standardised Approach (SA). It has been revised to make it sufficiently risk-sensitive to serve as a credible fallback for as well as a floor to the Internal Models Approach, while still providing an appropriate standard for banks that do not require a sophisticated treatment for market risk.
  - Revised Internal Models Approach (IMA). The enhancements to the IMA have three main aims: (i) more coherent and comprehensive risk capture that takes better account of “tail risks” and market illiquidity risk; (ii) a more granular model approval process whereby internal models are approved for use at the trading desk level; and (iii) constraints on the capital-reducing effects of hedging and portfolio diversification. All banks, even those for which approval has been granted to use the IMA, must calculate the SA capital charge for each trading desk as if it were a standalone regulatory portfolio. This calculation must be performed at least monthly.

This document analyses these revised standards.

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Executive summary

These revised standards, which are expected to be implemented by January 2019, apply to internationally active banks on a worldwide consolidated basis. They have been elaborated consistently with the policy rationales underpinning the BCBS consultative papers on the FRTB

Executive summary

Scope of application

- **Internationally active banks**, on a worldwide consolidated basis.

Regulatory context

- **Basel II** framework[1]. BCBS, June 2006
- **Basel 2.5** framework[2]. BCBS, July 2009
- **Fundamental Review of the Trading Book** (FTRB): three consultative papers (latest 2014)

Next steps

- National supervisors are expected to finalise the implementation of the revised market risk standards by **January 2019**.
- Banks would be required to report under the new standards by the **end of 2019**.

Main content

Revised boundary between the TB and the BB

- **Additional guidance on the TB content**: the definition of TB is supplemented with a list of instruments presumed to be in the TB. A bank must receive explicit supervisory approval for any deviations from this list.
- **Strict limit to arbitrage the boundary** and requirements for **trading desks**, limits to the **internal risk transfers** (IRT) on equity and interest rate as well as to the treatment of the counterparty credit risk **(CCR)** charge.

Revised Standardised Model (SA)

- **Sensitivities-based method** which captures capital charges for delta, vega and curvature risks within a set of risk classes.
- **Default Risk Charge** for prescribed risk classes: default risk non-securitisation, default risk securitisation and default risk securitisation correlation trading portfolio (CTP).
- **Residual risk add-on** which captures any other risks by applying risk weights to notional amounts of instruments with non-linear payoffs.

Revised Internal Model Approach (IMA)

- **Eligibility of trading desks**.
- **Capital charge**: Expected Shortfall or ES (replaces the VaR and stressed VaR with an ES metric which measures the riskiness of a position by considering the size and likehood of losses , ensuring capture of tail risks), Default Risk Charge or DRC (replaces the Incremental Risk Charge) and stressed capital add-on or SES.
- **More granular approval process**, for each trading desk that pretends to use the IMA.

(1) International Convergence of Capital Measurement and Capital Standards.
(2) Revisions to the market risk framework as part of the "Basel 2.5" package of reforms.

Executive summary
General considerations

Capital requirements for market risk apply on a consolidated basis, and banks are expected to meet them on a continuous basis. In determining the market risk for capital purposes, a bank may choose between the SA and the IMA

General considerations

Scope

- The Basel framework applies only to **internationally active banks** on a **worldwide consolidated basis**[1].
- Banks are expected to manage their market risk in such a way that the **capital requirements** are being met on a **continuous basis**, including at the close of each business day. Banks will also be expected to maintain strict risk management systems to ensure that intraday exposures are not excessive.
- If a bank fails to meet the capital requirements at any time, the national authority shall ensure that the bank takes **immediate measures** to rectify the situation.
- The **risks subject** to market risk capital charges include but are not limited to:
  - Default risk, interest rate risk, credit spread risk, equity risk, foreign exchange risk and commodities risk for **trading book instruments**.
  - Foreign exchange risk and commodities risk for **banking book instruments**.

Methods of measuring market risk

- In determining its market risk for regulatory capital requirements, a bank may choose between two broad methodologies: the **SA** and the **IMA**, subject to the approval of the national authorities.

Deductions from capital

- **Holdings of the bank's own** eligible regulatory capital instruments are **deducted** from capital.
- **Holdings of other banks'**, securities firms', and other financial entities' eligible regulatory capital instruments, as well as intangible assets, will receive the **same treatment** as that set down by the national supervisor for such assets held in the **BB**, which in many cases is deduction from capital[2].
- The BCBS will determine, as part of a broader review, whether any adjustments to the existing threshold requirement are warranted for certain bank activities or instruments (e.g. TLAC holdings).

(1) Although supervisory authorities may continue to monitor the market risks of individual entities on a non-consolidated basis to ensure that imbalances within a group do not escape supervision.
(2) Where a bank demonstrates that it is an active market-maker, then a national supervisor may establish a dealer exception.

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Revised boundary between the TB and the BB

Definition of the TB and the BB

The definition of the TB is supplemented with a list of instruments presumed to be in the TB. More importantly, a bank must receive explicit supervisory approval for any deviations from this list

Definition of the TB and the BB (1/2)

	Instruments in the Trading Book	Instruments in the Banking Book

Definition	• Instruments a bank hold for **short-term resale**, profiting from **short-term price movements**, locking in **arbitrage** profits, or **hedging** risks that arise from instruments meeting these criteria.
	• The following instruments must be included in the TB:
	  • Instruments in the correlation trading portfolio.
	  • Instruments managed on a **trading desk**.
	  • Instruments giving rise to a **net short credit** or **equity position** in the BB.
	  • Instruments resulting from **underwriting commitments**
		• **Unlisted equities**
		• Instrument designated for **securitisation warehousing**
		• **Real estate** holdings
		• **Retail and SME** credit
		• **Equity investments** in a fund, including hedge funds
		• **Derivative instruments** that have the above instrument types as underlying assets
		• Instruments held for the purpose of **hedging** a particular risk of position in the types of instrument above.

Presumption	• There is a presumption that the following are TB instruments:
	  • Instruments held as **accounting trading assets or liabilities**.
	  • Instruments resulting from **market-making** activities.
	  • Some **equity investments** in a fund.
	  • **Listed equities**.
	  • Trading-related **repo-style** transaction.
	  • **Options** including bifurcated embedded derivatives from instruments issued out of BB.	

Supervisory powers

- If a bank believes that it needs to **deviate from the presumption list** it must submit a request to its supervisor and receive **explicit approval**. In cases where this approval is not given, the instrument must be designated as TB instrument.
- For instruments on the **presumptive list**, the supervisor may require the bank to **provide evidence** that an instrument in the TB is held for at least one of the purposes listed above and may require the bank to **assign** the instrument to the BB.

(1) Similarly, the supervisor may require the bank to provide evidence that an instrument in the BB is not held for any of the purposes listed above (TB purposes) and assign the instrument to the TB, except for the instruments listed above as in the BB.

Revised boundary between the TB and the BB

Definition of the TB and the BB

The BCBS also establishes other requirements regarding the boundary between the books, with regard to documentation of instrument designation and risk management policies for TB instruments. In addition, some restrictions on moving instruments between books are included

Definition of the TB and the BB (2/2)

Documentation of instrument designation

- A bank must have clearly **defined policies, procedures and documented practices** for determining which instruments to include in or to exclude from the TB for purposes of calculating their regulatory capital.
- A **bank's internal control functions** must conduct an ongoing evaluation of instruments both in and out of the TB to **assess whether its instruments are being properly designated** initially as trading or non-trading instruments in the context of the bank's trading activities.
- **Compliance** with the policies and procedures must be **fully documented** and subject to periodic (at least yearly) internal audit and the results must be available for supervisory review.

Policies for TB instruments[1]

- **TB instruments** must be subject to **clearly defined policies and procedures**, approved by senior management, that are aimed at ensuring active risk management.
- The application of the policies and procedures must be thoroughly **documented**[1].

Restrictions on moving instruments

- Switching instruments between books for **arbitrage is strictly prohibited** and, only in extraordinary circumstances, supervisors will allow to switch instruments.
- If the **capital charge is reduced** as a result of a **switch**, the difference as measured at time of the switch will be imposed on the banks as a disclosed **additional Pillar 1 capital surcharge**.
- Any re-designation between books must be **approved by senior management**; **documented**; determined by internal review to be in **compliance** with the bank's policies; subject to prior **approval by the supervisor**; and publicly **disclosed**.
- A bank must adopt relevant **policies** that must be **updated at least yearly**, including the re-designation restriction requirements above-mentioned, how a bank identifies an extraordinary event, etc.

(1) Guidelines on the activities that are covered by these policies and procedures are set out in the Annex 1.

Revised boundary between the TB and the BB

Trading desks

The institutions should assign to each individual trader or trading account a unique trading desk which must have a clear reporting line to senior management, a well-define business strategy as well as a clear risk management structure

Trading desks

Definition

- A trading desk is a **group of traders** or trading accounts of traders that implement a well-defined **business strategy** operating within a clear **risk management structure**.
- Banks define trading desk subject to the regulatory approval of the supervisor for capital purposes. However, they **do not need the supervisory approval** for defining operational sub-desks for internal purposes.

Requirements of trading desks

- Each **individual trader** or trading account must be assigned to **only one trading desk**.
- Desks must have:
  - A clear **reporting line to senior management** and must have a **clear compensation policy** linked to its pre-established objectives.
  - A well-defined and documented **business strategy**, including an annual budget and regular management information reports.
  - A **clear risk management structure**, including trading limits based on the business strategy of the desk.
- The bank must prepare, evaluate and have available for supervisors for all trading desks:
  - **Inventory ageing** reports.
  - **Daily limit** reports including exposures, limit breaches and follow-up action.
  - Reports on **intraday limits** and respective utilisation and breaches for banks with active intraday trading.
  - Reports on the assessment of **market liquidity**.
- Any foreign exchange or commodity positions held in the banking book must be included in the market risk charges.

Revised boundary between the TB and the BB
Internal risk transfers

An internal risk transfer (IRT) is an internal written record of a transfer or risk between the regulatory books[1]. For IRTs from the TB to the TB no regulatory capital recognition will be applied, whereas for IRTs from the BB to the TB the risk type have to be considered

Internal risk transfers (IRTs)

From the TB to the BB

- There will be **no regulatory capital recognition** for IRTs from the TB to the BB. Therefore, this transfer would not be taken into account to determine regulatory capital requirements.

From the BB to the TB

Credit risk

The BB exposure is not deemed to be hedged for capital purposes unless:

- The TB enters into an **external hedge** with an **eligible third-party** protection provider that exactly matches the IRT.
- The external hedge meets some **requirements from the Basel II framework** vis-à-vis the BB exposure.

Equity risk

The BB exposure is not deemed to be hedged for capital purposes unless:

- The TB enters into an **external hedge** from an **eligible third-party** protection provider that exactly matches the IRT.
- The external hedge is recognised as a hedge of a BB equity exposure.

Interest rate (IR) risk

The TB leg of the IRT is treated as a TB instrument under the market risk framework if and only if the IRT is:

- Documented with respect to the BB IR risk being hedged and the sources of such risks.
- Conducted with a **dedicated IRT trading desk** approved by the **supervisor**.
- Subject to **TB capital requirements** under the market risk framework on a stand-alone basis for the dedicated IRT desk.

(1) IRTs also exist between different trading desks within the TB, which will generally receive regulatory capital recognition. IRTs between the IRT desk and other trading desks will only receive capital recognition if some constraints are fulfilled (those applying to IR risk).

Revised boundary between the TB and the BB
CCR in the TB

The counterparty credit risk (CCR) charge must be calculated separately from the capital charge for market risk for OTC derivatives, repo-style and other transactions booked in the TB

CCR in the TB

CCR charge calculation

- Banks will be required to calculate the CCR charge for **OTC derivatives**, **repo-style** and **other transactions** booked in the TB, **separate** from the capital charge for general market risk.
- The **risk weights** to be used in this calculation must be **consistent** with those used for calculating the capital requirements in the BB (i.e. banks using the SA for credit risk in the BB will use the SA risk weights in the TB and banks using the IRB approach in the BB will use the IRB risk weights in the TB).

OTC derivatives

- The **rules** to calculate the CCR charge for collateralised OTC derivative transactions are the **same** as the rules prescribed for such transactions booked in the BB.

Repo-style transactions

- The **rules** to calculate de CCR charge for repo-style transactions are the **same** as the rules prescribed in the Basel II framework for such transactions booked in the BB.
- For this type of transactions in the TB, all instruments that are included in the trading book may be used as **eligible collateral**.
  - Those instruments that fall outside the BB definition of eligible collateral shall be subject to a haircut at the level applicable to non-main index equities listed on recognised exchanges.
  - For instruments that count as eligible collateral in the TB, but not in the BB, the haircuts must be calculated for each individual security. Banks that use a VaR approach to measure exposure for repo-style transactions may apply this approach in the TB.

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Revised standardised approach (SA)

Overview of the SA

The SA capital requirement is the sum of the risk charges under the sensitivities-based method, the default risk charge and the residual risk add-on. The SA must be calculated by all banks and reported to their supervisor on a monthly basis

Overview of the SA

- The SA must be calculated by **all banks** and reported to their supervisor on a **monthly basis**. A bank must determine its regulatory capital requirements for market risk according to the SA for market risk at the demand of their supervisor.

SA capital requirement

Sensitivities-based method

- It captures **three risk sensitivities** (delta, vega and curvature risks) within a prescribed set of risk classes (e.g. GIRR, CSR, FX risk, etc.).
- **3 risk charge figures** must be calculated for each risk class, using different correlation values. The capital charge at a portfolio level is the largest.
  - The **aggregate capital charge** is the simple sum of each risk-class level capital charge.

Default risk charge (DRC)

- It captures the **jump-to-default risk** in three independent capital charge computations for default risk of non-securitisations, securitisations non-correlation trading portfolio (CTP) and securitisations CTP.
- It allows **limited hedging** recognition within each bucket category, and no diversification benefit is recognised.

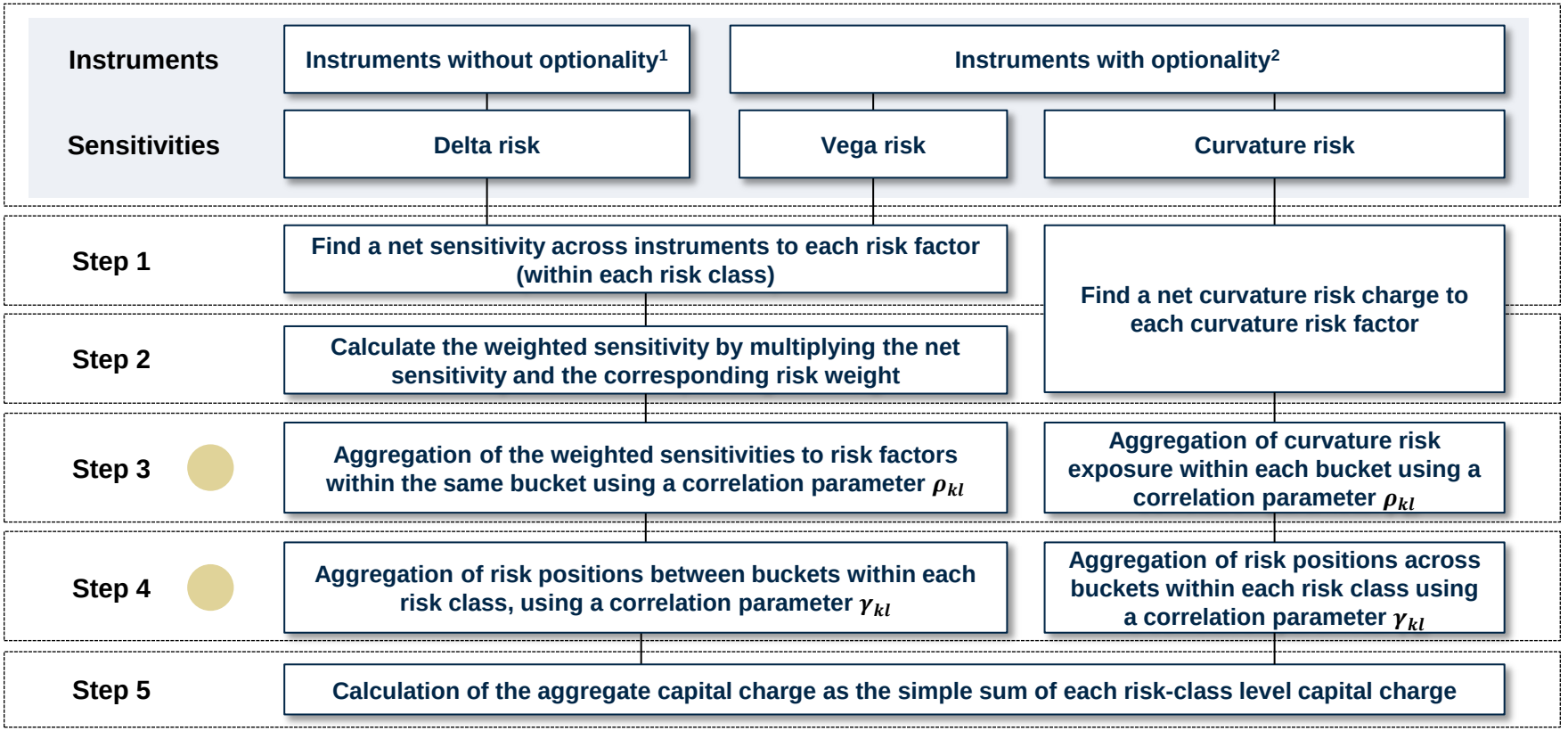
Residual Risk Add-on

- It captures **other risks** beyond the main risk factors already captured in the sensitivities-based method or the standardised DRC.
- It provides a simple and conservative capital treatment for **sophisticated trading book instruments**.

Revised standardised approach (SA)
Sensitivities-based method

A bank should follow five steps in determining the capital charge under the sensitivities-based method

Summary of the method's application



- In these stages, three risk charge figures are to be calculated for each risk class corresponding to **three different scenarios** (using high correlations, medium correlations and low correlations). See Annex 2.
- For each scenario, the bank must determine a risk charge at the portfolio level as the simple sum of the risk charges at risk class level for that scenario. The ultimate portfolio level risk capital charge is the **largest** of the **three capital charges**.

(1) Instruments whose cash flows can be written as a linear function of underlying notional.
(2) Calls, puts, swaptions, barrier options and exotic options.

Revised standardised approach (SA)

Sensitivities-based method

Delta and vega risks are calculated by applying prescribed risk weights to net sensitivities across each risk factor, calculating risk positions for each bucket and aggregating them. Nonetheless, delta and vega risks are calculated separately, with no diversification benefit

Delta and vega risks

General considerations

- Delta and vega risks consist of a set of **prescribed risk factors and sensitivities**. The net sensitivities for each risk factor within a risk class are multiplied by **prescribed risk weights**[1].
- Delta and vega risks are computed using the same aggregation formulae on all relevant risk factors, but **calculated separately**, with **no diversification benefit** recognised.

Step-by-step calculation

1. Find a **net sensitivity** $_{sk}$ across instruments to each **risk factor** $_{K}$. *Example. All sensitivities to the vertex 1 year of the swap curve Euribor 3 months should offset, irrespective of the instrument from which they derive.*
2. The **weighted sensitivity** WS_k is the product of the net sensitivity $_{sk}$ and the corresponding risk weight $\mathbf{RW_k}$.

$$WS_k = RW_k \cdot Sk$$

3. The **risk position** for delta (respectively vega) **bucket b (K_b)** must be determined by **aggregating the weighted sensitivities** to risk factors within the same bucket using the correlation ρ_{kl}.

$$K_b = \sqrt{\sum_k WS_k^2 + \sum_k \sum_{k \neq l} \rho_{kl} WS_k WS_l}$$

The quantity within the square root function is **floored at zero**.

4. The delta (respectively vega) **risk charge** is determined from the **aggregation of risk positions** between buckets within each risk class, using the prescribed γ_{bc} correlations.

$$Delta\ (respectively\ vega) = \sqrt{\sum_b K_b^2 + \sum_b \sum_{c \neq b} \gamma_{bc} WS_b S_c}$$

$S_B = \sum_K WS_k$ for bucket b

$S_C = \sum_K WS_k$ for bucket c

(1) The sensitivities, risk factors, buckets, risk weights and correlations are detailed in Annex 2.

Revised standardised approach (SA)

Sensitivities-based method

In the curvature risk charge, two scenarios (upward and downward shocks) are computed per risk factor, with the delta effect being removed. Then, the worst loss is aggregated within each bucket and within each risk class to determine the capital charge

Curvature risks

General considerations

- The curvature risk charge consist of a **set of scenarios on given risk factors** which are prescribed[1]. Two scenarios (an **upward shock** and a **downward shock**) are computed per risk factor[2].
- The two scenarios are shocked by **risk weights** and the **worst loss is aggregated** by prescribed correlations.

Step-by-step calculation

1. Find a **net curvature risk charge CVR_K** across instruments to each **curvature risk factor K**. *Example. All vertices of all the curves within a given currency (e.g. Euribor 3 months) must be shifted upward and downward. The worst loss[2] (expressed as a positive quantity) is the curvature risk position for risk factor* $_K$:

$$CVR_k = -min\left[\begin{matrix}\sum_i \left\{V_i\left(x_k^{(RW^{(curvature)+})}\right) - V_i(x_k) - RW_k^{(curvature)} \cdot s_{ik}\right\} \\ \sum_i \left\{V_i\left(x_k^{(RW^{(curvature)-})}\right) - V_i(x_k) + RW_k^{(curvature)} \cdot s_{ik}\right\}\end{matrix}\right]$$

- Price of instrument i depending on the current level of risk factor K
- Delta sensitivity (FX and equity) or sensitivities (GIRR, CSR and commodity)
- Price of instrument **i** after x_k is shifted upward and downward
- i is an instrument subject to curvature risks
- x_k is the current level of risk factor K
- Risk weight for curvature risk factor K for instrument i

2. The curvature risk exposure must be **aggregated within each bucket** as set out in the following formula:

$$K_b = \sqrt{max\left(0, \sum_k max(CVR_k, 0)^2 + \sum_k \sum_{k \neq l} \rho_{kl} CVR_k CVR_l \psi(CVR_k, CVR_l)\right)}$$

- The negative curvature risk exposures are ignored (unless they hedge a positive one). If there is a negative net curvature risk exposure from an option, the risk charge is 0
- Function that takes the value 0 if CVR_k and CVR_l both have negative signs. In all other cases, it takes the value of 1
- Prescribed correlation

3. Curvature risk positions must then be **aggregated** across buckets **within each risk class**:

$$Curvature\ risk = \sqrt{\sum_b K_b^2 + \sum_b \sum_{c \neq b} \gamma_{bc} S_b S_c \psi(S_b S_c)}$$

- Function that takes the value 0 if S_b and S_c [3] both have negative signs. In all other cases, it takes the value of 1
- Prescribed correlation

(1) The sensitivities, risk factors, buckets, risk weights and correlations are detailed in Annex 2.
(2) The delta effect is removed as it is already captured by the delta risk charge.
(3) In case these values produce a negative number under the root, there is an alternative calculation.

Revised standardised approach (SA)
Default Risk Charge

The approach for the standardised default risk capital charge comprises a multi-step procedure intended to capture the jump-to-default risk

Overview

General considerations

- The default risk charge for **non-securitisations and securitisations** is independent from the other capital charges in the SA for market risk, in particular from the credit spread risk (CSR) capital charge.
- The capital for the **correlation trading portfolio** (CTP) includes the default risk for securitisation exposures and for non-securitisation hedges. There must be **no diversification benefit** between the DRC for non-securitisations, DRC for securitisations (non-CTP) and DRC for the securitisation CTP.
- At national discretion claims on sovereigns, public sector entities and multilateral development banks may be subject to a **zero default risk weight**[1].
- For traded non-securitisation credit and equity derivatives, JTD amounts by individual constituent issuer legal entity should be determined by applying a **look-through approach**.

Instruments

- **Non-securitisations**
- **Securitisations non-Correlation Trading Portfolio**
- **Securitisations Correlation Trading Portfolio**

Step-by-step calculation

1. **Gross jump-to-default risk (JTD)**
   Compute the JTD risk of each instrument separately as a function of notional amount and market value of the instrument and prescribed LGD.
2. **Net JTD**
   Offsetting rules enable the derivation of net jump-to-default risk positions.
3. **Default Risk Charge (DRC)**
   Net jump-to-default risk positions are allocated to buckets and weighted by prescribed risk weights.

(1) National authorities may apply a non-zero risk weight to securities issued by certain foreign governments, including to securities denominated in a currency other than that of the issuing government.

Revised standardised approach (SA)
Default Risk Charge

The gross JTD risk for non-securitisations is calculated through a function of the LGD, the notional amount and the cumulative P&L realised on the position

DRC for non-securitisations (1/2)

1 Gross JTD

- It shall be calculated **exposure by exposure** using the formula below.

Direction of positions. The determination of the long/short positions must be determined with respect to the underlying credit exposure. Specifically, a long exposure results from a instrument for which the default of the underlying obligor results in a loss.

Maturity. The JTD for all exposures of maturity<1 year (and their hedges) are scaled by a fraction of a year[2]. No scaling is applied to the JTD exposures≥1 year (e.g. JTD for a position with a 6-month maturity would be weighted by 0.5). The maturity weighting

$$JTD\ (long) = max\ (LGD \times notional + P\&L, 0)$$
$$JTD\ (short) = min\ (LGD \times notional + P\&L, 0)$$

Notional amount. Bond-equivalent notional (or face value of the position). If it gives rise to a long (short) exposure then the value is recorded as positive (negative).

LGD. The following LGD values shall apply[1]:
- Equity and non-senior debt instruments: 100%
- Senior debt instruments: 75%
- Covered bonds: 25%

P&L. It is the cumulative mark-to-market loss (or gain) already realised, expressed as follows:

$$P\&L = market\ value - notional$$

Current value of the position.

In these equations, when the P&L counts as a loss (gain) then the value is recorded as negative (positive).

(1) When the price of the instrument is not linked to the recovery rate of the defaulter there should be no multiplication of the notional by the LGD.
(2) Stocks are assigned to a maturity of either 1 year or 3 months, at banks' discretion. For derivatives, the maturity of the derivative contract is considered (not the maturity of the underlying instrument).

Revised standardised approach (SA)
Default Risk Charge

The net JTD is calculated by offsetting long and short exposures to the same obligor, where the short exposure has the same or lower seniority relative to the long exposure. Then, the total capital charge is calculated by following a multi-step procedure

DRC for non-securitisations (2/2)

2 Net JTD

- The gross JTD amounts of long and short exposures to the **same obligor** may **be offset** where the short exposure has the **same or lower seniority** relative to the long exposure (e.g. a short exposure in an equity may offset a long exposure in a bond).
- Exposures of **different maturities** that meet this offsetting criterion may be offset as follows:
  - Exposures with **maturities>1 year** may be **fully offset**.
  - An exposure to an obligor comprising a mix of long and short exposures with a **maturity<1 year** must be weighted by the ratio of the exposure's maturity relative to the capital horizon (1 year).

3 Default risk charge

1. **Default risk weights** are assigned to net JTD by **credit quality categories**[1], irrespective of the type of counterparty.
2. The **weighted net JTD** are allocated into **three buckets** (i.e. corporates, sovereigns, and local governments/ municipalities).
3. A **hedge benefit ratio** ("weighted to short ratio" or $\boldsymbol{WtS}$) is computed to recognise hedging relationship between long and short positions.

$$\boldsymbol{WtS} = \frac{\sum \boldsymbol{net\ JTD_{long}}}{\sum \boldsymbol{netJTD_{long}} + \sum |\boldsymbol{netJTD_{short}}|}$$

Simple sum of the net (not risk-weighted) long JTD amounts

Simple sum of the net (not risk-weighted) short JTD amounts

4. The **overall capital charge for each bucket** is to be calculated as the combination of the sum of the risk-weighted long net JTD, the $\boldsymbol{WtS}$ and the sum of the risk-weighted short net JTD.

$$\boldsymbol{DRC_b} = \boldsymbol{max}\left[\left(\sum_{i \in long} \boldsymbol{RW_i} \cdot \boldsymbol{netJTD_i}\right) - \boldsymbol{WtS} \cdot \left(\sum_{i \in short} \boldsymbol{RW_i} \cdot |\boldsymbol{netJTD_i}|\right); \boldsymbol{0}\right]$$

$\boldsymbol{RW_i}$: Risk weight of instrument i belonging to bucket b

5. The **total capital charge** for default risk non-securitisations must be calculated as a simple **sum of the bucket-level capital charges**, as no hedging is recognised between different buckets.

(1) Credit quality categories and default risk weights are specified in Annex 3.

Revised standardised approach (SA)
Default Risk Charge

As for the non-securitisation DRC, the total capital charge for default risk securitisations must be calculated as a simple sum of the bucket-level capital charges

DRC for securitisations (non-correlation trading portfolio)

1 Gross JTD

- The **same approach** must be followed as for **non-securitisations**, except that the **LGD ratio is not applied** to the exposure. Thus, the JTD for securitisations is simply the **market value** of the securitisation exposure.
- For the purposes of **offsetting and hedging**, positions in underlying names or a non-tranched index position may be decomposed proportionately the equivalent replicating tranches that span the entire tranche structure. When underlying names are used in this way, they must be removed from the non-securitisation default risk treatment.

2 Net JTD

- Offsetting is limited to a specific securitisation exposure: **tranches** with the **same underlying asset pool** (i.e. no offsetting is permitted between securitisation exposures with different underlying securitised portfolio, or from different tranches with the same securitised portfolio).
- Exposures that are otherwise **identical except for maturity** may be **offset**, subject to the same restriction as for positions of less than one year for non-securitisation. Securitisation exposures that can be **perfectly replicated** through decomposition may also be offset.

3 Default risk charge

- The **DRC** is determined in the **same approach** as for non-securitisations default risk, except that securitisation exposures are sorted by tranche instead of credit quality.
- Default risk weights are based on the **risk weights** in the corresponding treatment of the BB[1].
- The **buckets** are defined as follows:
  - Corporates constitute a unique bucket, taking into account all the regions.
  - The other buckets are defined along two dimensions: asset classes (e.g. credit cards, CDOs, SMEs, student loans, etc.) and regions (e.g. Asia, Europe, etc.).
- The **capital charge for each bucket** is determined in a similar approach to that for non-securitisations. The hedge benefit discount WtS is applied to net short securitisation exposures.
- The **total capital charge** for default risk securitisations must be calculated as a simple **sum of the bucket-level capital charges**, as no hedging is recognised between different buckets.

(1) *Revisions to the securitisation framework,* BCBS. December 2014.

Revised standardised approach (SA)

Default Risk Charge

The gross JTD risk is computed using the same approach as for the default risk securitisation (non-CTP). As for the net JTD, exposures that are otherwise identical except for maturity may be offset with the same specifications as for non-securitisation exposures of less than one year

DRC for securitisations (CTP) (1/2)

1 Gross JTD

- The **same approach** must be followed as for default risk securitisation (non-CTP). The definition of JTD for non-securitisations in the CTP (i.e. single-name and index hedges) positions is their **market value**.
- **Nth-to-default products** should be treated as tranched products with attachment and detachment points.

2 Net JTD

- Exposures that are otherwise **identical except for maturity** may be **offset** but with the same specifications as for non-securitisation exposures of less than one year.
  - For **index products**, for the exact same index family, series and tranche, securitisation exposures should be **offset across maturities**. Long/short exposures that are perfect replications through decomposition may be offset in certain cases.
  - For long/short exposures positions in **index tranches**, and **indices** (non-tranched), if the exposures are to the exact same series of the index, then offsetting is allowed by replication and decomposition.
  - Long securitisation exposures in the **various tranches** that, when combined perfectly, replicate a position in the index series can be offset against a short securitisation exposure in the index series if all the positions are to the exact same index and series.
  - **No offsetting**: different tranches of the same index or series; different series of the same index; and different index families may not be offset.

Revised standardised approach (SA)
Default Risk Charge

The DRC for securitisations (CTP) differs from the approach for non-securitisations as there is no floor at 0 so the DRC can be negative

DRC for securitisations (correlation trading portfolio) (2/2)

3 Default risk charge

- Default risk weights are based on the **risk weights** in the corresponding treatment of the BB.
- **Each index** is regarded as **a bucket** of its own (e.g. CDX North America IG, iTraxx Europe IG, etc.). Bespoke securitisation exposures should be allocated to the index bucket of the index they are a bespoke tranche of.
- The **capital charge** for default risk is determined in a similar approach to that for non-securitisations. The hedge benefit ratio $\boldsymbol{WtS}$ is applied to net short positions in that bucket using the combined long and short positions across all indices in the CTP, but there is no floor at 0 at bucket level, so the DRC can be negative.

$$\boldsymbol{DRC_b = \left(\sum_{i \in long} RW_i \cdot netJTD_i\right) - WtS_{ctp} \cdot \left(\sum_{i \in short} RW_i \cdot |netJTD_i|\right)}$$

The hedge benefit ratio is calculated using the combined long and short positions across the entire CTP and not just the positions in the particular bucket.

- Then the bucket-level capital amounts are aggregated as follows:

$$\boldsymbol{DRC_{CTP} = max\left[\sum_b (max[DRC_b, 0] + 0.5 \times min[DRC_b, 0]), 0\right]}$$

Revised standardised approach (SA)
Residual risk add-on

The residual risk add-on is to be calculated for all instruments bearing residual risk separately and in addition to other components of the capital requirement under the SA for market risk

Residual risk add-on

Calculation

- It is calculated as the simple sum of **gross notional amounts** of the instruments bearing residual risks, **multiplied by a risk weight**[1].

Instruments with an **exotic underlying**	**RW = 1.0%**
Instruments bearing **other residual risk.**	**RW = 0.1%**

Exotic underlying

- TB instruments with an **underlying exposure** that is not within the scope of delta, vega or curvature risk treatment in any risk class under the Sensitivities-based Method or DRC in the SA.

Other residual risk

- Instruments that meet the following criteria:
  - Instruments subject to **vega or curvature risk** capital charges in the trading book and with **pay-offs that cannot be written or replicated** as a finite linear combination of vanilla options with a single underlying equity price, commodity price, etc.
  - Instruments which fall under the definition of the **CTP**, except for those instruments which are recognised as eligible hedges of risks within the CTP.
- A non-exhaustive list of risks types and instruments that may fall within the criteria include:
  - **Gap risk**: risk of a significant change in vega parameters in options due to small movements in the underlying (e.g. barrier options, Asian options an digital options).
  - **Correlation risk**: risk of a change in the correlation parameter to determine the value of an instrument with multiple underlyings (e.g. basket options, best-of-options, spread options, basis options, Bermudan options, etc.).
  - **Behavioural risk**: risk of a change in exercise outcomes motivated by social factors.

Instruments not subject to the add-on

- Instruments used in transactions where a transaction **exactly matches** with a third-party transaction.
- Any instrument that is listed and/or eligible for **central clearing**.
- When an instrument is subject to certain risk specified in the market risk framework (e.g. smile risk, correlation risk, etc.) this by itself will not cause the instrument to be subject to the risk add-on.

(1) Where the bank cannot satisfy the supervisor that the residual risk add-on provides a sufficiently prudent capital charge, the supervisor will address any potentially under-capitalised risks by imposing a conservative additional capital charge under Pillar 2.

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Revised internal models approach (IMA)
Overview of the IMA

The total IMA capital requirement would be an aggregation of the Expected Shortfall (ES), the default risk charge (DRC) and the stressed capital add-on (SES) for non-modellable risks

Overview of the IMA[1]

Determining the eligibility of trading desks

Step 1

Overall assessment of the bank's firm-wide internal risk capital model.

Step 2 (i)

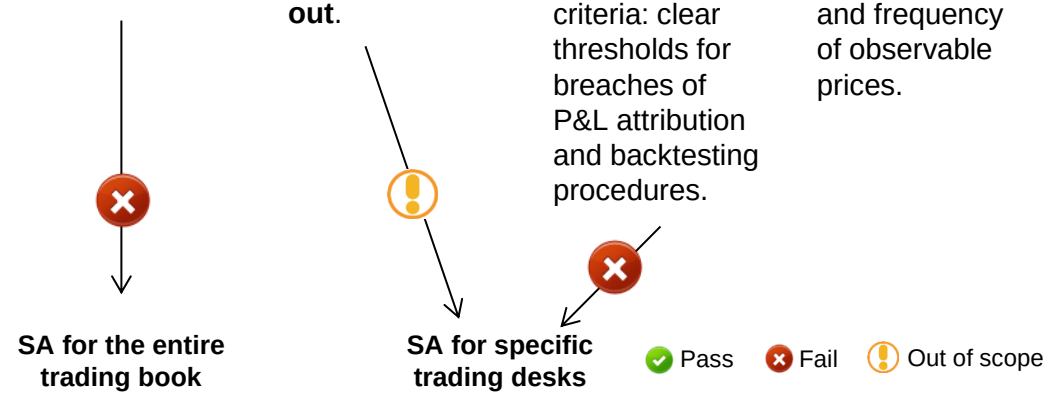
Banks nominate which **trading desks** are **in-scope** for model approval and which **fall out**.

Step 2 (ii)

Assessment of **trading desk-level model performance** against quantitative criteria: clear thresholds for breaches of P&L attribution and backtesting procedures.

Step 3

Individual risk factor analysis. Risk factors must be based on real and verifiable prices and frequency of observable prices.



Securitisation exposures in the trading book are fully out of the scope of internal models and capitalised in the revised SA.

Capital charge

Modellable risk factors

1. **Global Expected Shortfall (ES)** Equal weighted average of diversified ES and non-diversified partial ES capital charges for specified risk classes.

+

2. **Default Risk Charge (DRC)** Captures default risk of credit and equity trading book exposures with no diversification effects allowed with other market risk (including credit spread risk).

+

Non-modellable risk factors

3. **Stressed capital add-on (SES)** Aggregate regulatory capital measure for non-modellable risk factors in model-eligible desks.

(1) The use of an internal model will be conditional upon the explicit approval of the bank's supervisory authority, and thus it implies the fulfillment of a set of general criteria. See Annex 4.

Revised internal models approach (IMA)
Eligibility of trading desks

The process for determining the eligibility of trading activities for the internal models-based approach is based on a three-stage approach

Eligibility of trading desks

1 Overall assessment

- The **overall assessment** of the bank's **organisational infrastructure** (including the definition and structure of trading desks) and its **firm-wide internal risk capital model** based on both qualitative and quantitative factors (the latter are based on backtesting).

2(i) Trading desks

- Banks must nominate which **trading desks** are **in-scope** for model approval and which trading desks are **out-of-scope**. Banks must not nominate desks whose SA capital charges are less than the modelled requirements.
- Desks that are **out-of-scope** will be capitalised according to the **SA on a portfolio basis**. Desks that opt out of the IMA at this stage must remain ineligible for a period of at least 1 year.

2(ii) Backtesting & P&L attribution requirements

- Each trading desk deemed to be in-scope must satisfy **backtesting and P&L attribution requirements**:
  - Backtesting: based on comparing each desk's 1-day static VaR measure (calibrated to the most recent 12 months' data, equally weighted) at both the 97.5th and the 99th percentile. If any given desk experiences more than 12 exceptions at the 99th percentile or 30 at the 97.5th in the most recent 12-month period, all of its positions must be capitalised under the SA[1].
  - P&L attribution: based on the mean unexplained daily P&L over the standard deviation of hypothetical daily P&L, and the ratio of variances of unexplained daily P&L and hypothetical daily P&L. If the first ratio is outside of the range of -10% +10% or if the second ratio were in excess of 20% there is a breach, and if the desk experiences 4 or more breaches within the prior 12 months it must be capitalised under SA.
- To remain eligible for capitalisation under IMA, a **minimum of 10% of the bank's aggregated market risk charges** must be based on positions held in desks that qualify for inclusion in the bank's internal model.

3 Risk factors

- For a **risk factor** to be classified as **modellable**, there must be continuously available **real prices** for a sufficient set of representative transactions. A price will be considered real if certain conditions are met (e.g. it is obtained from a committed quote). A risk factor must have at least 24 observable real prices per year.
- Once a risk factor is deemed modellable[2], the most **appropriate data** should be used to calibrate the model.

(1) Positions will be capitalised under SA until the desk no longer exceeds the thresholds over the prior 12 months.
(2) With supervisory approval, some risk factor that would be considered modellable under the above criteria may be temporally excluded from a bank's model.

Revised internal models approach (IMA)
Capital charge

For desks that are permitted to be on the IMA, all modellable risk factors must be included in the bank's internal firm-wide expected shortfall model, whereas non-modellable risk factors are to be capitalised using a stress scenario

Global ES and Stressed capital add-on

Global ES

- For those desks that are permitted to be on the IMA, all **risk factors** that are deemed to be **modellable** must be included in the bank's **internal firm-wide ES model**.
- The bank must calculate its capital charge at the bank-wide level using this model, with no supervisory constraints on cross risk class correlations (**IMCC(C)**). The bank must also calculate a series of **partial ES charges** for the range of broad regulatory risk classes (IR risk, equity risk, etc.). These partial, non-diversifiable (constrained) ES values (IMCC(Ci)) will then be **summed** to provide an **aggregated risk class ES charge**.
- The aggregate capital charge is based on the weighted average of the constrained and unconstrained ES:

$$IMCC = \rho(IMCC(C)) + (1-\rho)\left(\sum_{i=1}^{R} IMCC(C_i)\right)$$

Relative weight assigned to the firm's internal model. $\rho = 0{,}5$

$ES_{R,S} \times \frac{ES_{F,C}}{ES_{R,C}}$

$ES_{R,S,i} \times \frac{ES_{F,C,i}}{ES_{R,C,i}}$

Stressed capital add-on (SES)

- Each **non-modellable risk factor** is to be capitalised using a **stress scenario**[1]. For each risk factor, the **liquidity horizon** of the scenario must be the greater of the largest time interval between two consecutive price observations over the prior year and the liquidity horizon assigned to the risk factor (as specified afterwards). For risk factors arising from idiosyncratic credit spread risk, banks may apply the same scenario.
- **No correlation or diversification effect** between other non-modellable risk factors is permitted. In the event that a bank cannot provide a stress scenario which is acceptable for the supervisor, the bank will have to use the **maximum possible loss** as the stress scenario.
- The aggregate regulatory capital measure for L (idiosyncratic credit spread risk factors) and K (risk factors in model-eligible desks that are non-modellable) is:

$$SES = \sqrt{\sum_{i=1}^{L} ISES_{NM,i}^2 + \sum_{j=1}^{K} SES_{NM,j}}$$

Stress scenario capital charge for idiosyncratic credit spread non-modellable risk from the L risk factors aggregated with 0 correlation

Stress scenario capital charge for non-modellable risk

(1) It should be calibrated to be at least as prudent as the ES calibration used for modelled risks (i.e. a loss calibrated to a 97.5% confidence threshold over a period of extreme stress).

Revised internal models approach (IMA)
Capital charge

Banks must have a separate internal model to measure the default risk of TB positions. The general criteria and qualitative standards specified afterwards also apply to the default risk model, but the criteria detailed below should also be fulfilled when measuring default risk

Default Risk Charge (1/2)

Definition and calculation of the DRC

- All positions subject to the market risk framework that have **default risk** (e.g. sovereign exposures, equity positions and defaulted debt positions), must be included in the model[1].
- Banks must measure default risk using a **VaR model** with two types of systematic risk factors. Correlations must be based on data based on credit spreads or on listed equity prices, covering a period of 10 years that includes a period of stress and based on a one-year liquidity horizon. The VaR calculation must be done **weekly** and be based on a **one-year time horizon** at a one-tail, **99.9 percentile confidence level**.
- The DRC model **capital requirement** is the greater of: (i) the average of the DRC measures over the previous 12 weeks; (ii) the most recent DRC model measure.
- A bank must assume **constant positions** over the one-year horizon (or 60 days for equity sub-portfolios).
- Default risk must be measured for **each obligor**. The model may reflect **netting** of long and short exposures to the same obligor.
- The **basis risk** between **long and short exposures** of different obligors must be modelled explicitly.

Potential impact on the DRC model

- The DRC model must recognise the impact of **correlations** between defaults among obligors:
  - A bank must validate that its modelling approach for these correlations is appropriate for its portfolio, including the choice and weights of its systematic risk factors.
  - Correlations must be measured over a liquidity horizon of 1 year and calibrated over a period of 10 years.
  - Banks need to reflect all significant basis risks in recognising these correlations.
- The model must capture any **material mismatch** between a position and its hedge; and reflect the effect of **issuer and market concentrations**, as well as concentrations that can arise within and across product classes during stressed conditions.
- The bank must calculate, for each and every position subjected to the model, an **incremental loss amount** relative to the current valuation that the bank would incur if the obligor of the position defaults. These loss estimates must reflect the **economic cycle**.

(1) With the exception of those positions subject to standardised charges.

Revised internal models approach (IMA)
Capital charge

Banks must measure default risk using a VaR model, based on a one-year time horizon with a 99.9 percentile confidence level. Validation of a DRC model must rely on indirect methods, and banks should develop internal modelling benchmarks to assess the overall accuracy

Default Risk Charge (2/2)

Validation and approval of DRC

- The model must reflect the non-linear impact of **options and other positions** with material **nonlinear behaviour** with respect to default. In the case of equity derivatives positions with multiple underlyings, simplified modelling approaches may be applied, subject to supervisory approval.
- **Validation of a DRC model** necessarily must rely on **indirect methods** including but not limited to stress tests, sensitivity analyses and scenario analyses. The validation of a DRC model represents an ongoing process in which supervisors and firms jointly determine the exact set of validation procedures to be employed.
- Firms should strive to **develop** relevant **internal modelling benchmarks** to assess the overall accuracy of their DRC models.
- Due to the unique relationship between **credit spread and default risk**, banks must seek **approval for each desk** with exposure to these risks, both for credit spread risk and default risk. Desks which do not receive approval will be deemed ineligible for internal modelling standards and be subject to the SA.

PD estimates[1]

- The **probability of default (PD) estimates** must adhere to the following standards:
  - Where an institution has approved PD estimates as part of the IRB approach, this data must be used. Otherwise, PDs must be computed using a methodology consistent with the IRB methodology.
  - Risk neutral PDs should not be used as estimates of observed (historical) PDs.
  - PDs must be estimated based on historical data of default frequency over a one year period.
  - PDs are subject to a floor of 0.03%.
  - PDs provided by external sources may also be used.

LGD estimates[1]

- The **loss Given Default (LGD) estimates** must adhere to the following standards:
  - If an institution has approved LGD estimates as part of the IRB approach, this data must be used. Otherwise, LGDs must be computed using a methodology consistent with the IRB methodology.
  - LGDs must be determined from a market perspective, based on a position's current market value less the position's expected market value subsequent to default. The LGD should reflect the type and seniority of the position and cannot be less than zero.
  - LGDs provided by external sources may also be used by institutions.

(1) Banks must establish a hierarchy ranking their preferred sources for PDs and LGDs.

Revised internal models approach (IMA)
Capital charge

The total capital charge for an institution using the IMA would be an aggregation of the ES, the DRC and the SES. Moreover, the capital charge for unapproved desks, which is to be calculated using the SA, should be also aggregated to the total capital charge

Capital charge

Capital charge

- For regulatory capital purposes, the charge associated with **approved desks (C_A)** is equal the maximum of the most recent observation and a weighted average of the previous 60 days scaled by a multiplier (m_c).

$$C_A = max\{IMCC_{t-1} + SES_{t-1}; m_c \cdot IMCC_{avg} + SES_{avg}\}$$

SES is the aggregate regulatory capital measure for risk factors in model-eligible desks that are non-modellable

Aggregate capital charge for modellable risk factors

It will be 1.5 or set by individual supervisory authorities on the basis of their assessment of the quality of the bank's risk management system, subject to an absolute minimum of 1.5.

- The additional regulatory capital charge for modellable risk positions subject to default risk is the **Default Risk Charge**. Moreover, the capital charge for **unapproved desks** should also be aggregated. Thus, the aggregate capital charge for market risk (ACC) is equal to the aggregate capital requirement for eligible trading desks plus the standardised capital charge for risks from unapproved trading desks:

$$ACC = C_A + DRC + C_U$$

The regulatory capital charge associated with risks from model-ineligible desks (C_u) is to be calculated by aggregating all such risks and applying the **standardised charge**.

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Next steps
Timeline

The revised framework comes into effect on 1 January 2019, and national supervisors are expected to require banks to report under the new standards by the end of 2019

Timeline

Jan.16

- **Approval by the BCBS** of the revised market risk framework, introducing changes in the SA and the IMA, as well as in the boundary between TB and BB.

Jan.19

- Deadline for the **revised market risk framework to be implemented** as final rules under domestic legislation.

Dec.19

- Deadline for **regulatory reporting** by banks under the revised SA or IMA, with use of the latter subject to the approval of the national authorities.

- The BCBS will continue to **monitor the impact** of the capital requirements for market risk on banks as they move towards implementation, to ensure consistency in the overall calibration of the Pillar 1 capital framework. In this regard, the BCBS notes that has underway several areas of ongoing work that may have an impact on the market risk capital requirements (e.g. proposal on the application of the market risk framework to CVA).
- The BCBS will continue to conduct further quantitative assessment on the **P&L attribution test** required for the revised IMA.

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Annex 1
Supervisory Review Process

Some provisions are included regarding the Pillar 2 Supervisory Review Process. In particular, the revised market risk framework contains some requirements on policies for TB eligibility, policies for IRTs, valuation, and stress testing under the IMA

Supervisory Review Process

Policies for TB eligibility

- Instruments held in the TB must be subject to **clearly defined policies and procedures**, approved by **senior management**, that are aimed at ensuring active risk management.
- The application of the policies and procedures must be thoroughly **documented**.
- A list is provided including the aspects that these policies and procedures should address at a minimum (e.g. trading strategies, the activities the bank considers to be trading or hedging of covered instruments, etc.).

Policies for IRTs from BB to TB

- The bank must **document all IRT with its TB**, with respect to the BB risk being hedged and the amount of such risk, **document** the details of any external **third party matching hedge** and submit a list to its supervisor of the **procedures and strategies** to manage the risks that the IRT desks undertake[1]. The bank must ensure regular and consistent reporting of its internal risk transfer activities.
- The bank must have a **consistent methodology** for identifying and quantifying the BB risk to be hedged through IRTs, properly integrated in the bank's risk management framework.
- A bank must have a set of consistent **risk management methods** and **internal controls** in order to ensure and control the effectiveness of risk mitigation for its IRTs.

Valuation

- In certain circumstances (e.g. less well diversified portfolios, portfolios containing less liquid instruments, etc.), supervisors will consider whether a bank has sufficient capital. To the extent there is a shortfall the supervisor will react appropriately, which will usually require the bank to reduce its risks and/or hold **additional capital**.

Stress testing under the IMA

- A bank must ensure that it has sufficient capital to meet the minimum capital requirements and to cover the results of its stress testing requirements. Supervisors will consider whether a bank has **sufficient capital** for these purposes, taking into account the nature and scale of the trading activities and any other relevant factors.
- To the extent that there is a shortfall, or if supervisors are not satisfied with the premise upon which the bank's assessment of internal market risk capital adequacy is based, supervisors will take **measures**.

(1) This list must be approved by the bank's senior management.

Annex 2: Sensitivity-based method

Sensitivities, risk factors, buckets, risk weights and correlations

The BCBS provides guidance on how banks must calculate sensitivities for each risk class. Sensitivities are expressed in the reporting currency of the bank

Sensitivities (1/2)

Delta GIRR

Risk-free yield curve at vertex *t*

$$s_{k,rt} = \frac{V_i(r_t + 0.0001, cs_t) - V_i(r_t, cs_t)}{0.0001}$$

Credit spread curve at vertex *t*

Market value of the instrument *i* as a function of the risk-free interest rate curve and credit spread curve

Delta CSR non-securitisation

$$s_{k,cst} = \frac{V_i(r_t + 0.0001, cs_t) - V_i(r_t, cs_t)}{0.0001}$$

Delta CSR securitisation and nth-to-default

$$s_{k,cst} = \frac{V_i(r_t + 0.0001, cs_t) - V_i(r_t, cs_t)}{0.0001}$$

Delta Equity spot

k is a given equity

$$s_k = \frac{V_i(1.01\ EQ_k) - V_i(EQ_k)}{0.01}$$

Market value of equity *k*

Market value of instrument *i* as a function of the price of equity *k*

Delta Equity repos

k is a given equity

$$s_k = \frac{V_i(RTS_t + 0.0001\ ) - V_i(RTS_k)}{0.0001}$$

Repo term structure of equity *k*

Market value of the instrument *i* as a function of the repo term structure of equity *k*

Delta Commodity

k is a given commodity

$$s_k = \frac{V_i(1.01\ CTY_k) - V_i(CTY_k)}{0.01}$$

Market value of commodity *k*

Market value of the instrument *i* as a function of the spot price of commodity *k*

Delta FX

k is a given currency

$$s_k = \frac{V_i(1.01\ FX_k) - V_i(FX_k)}{0.01}$$

Exchange rate between currency *k* and the reporting currency

Market value of the instrument *i* as a function of the exchange rate *k*

Annex 2: Sensitivity-based method

Sensitivities, risk factors, buckets, risk weights and correlations

Regarding vega risk, the option-level sensitivity must be calculated as the product of the vega and implied volatility of the option. Then, the portfolio-level vega risk sensitivity is equal to the simple sum of option-level risk sensitivities

Sensitivities (2/2)

Vega sensitivities

- The **option-level vega risk sensitivity** to a given risk factor is the **product of the vega and implied volatility of the option**. To determine this product, the bank must use the instrument's vega and implied volatility contained within the pricing models used by the independent risk control unit of a bank.
- **The portfolio-level vega risk sensitivity** to a given vega risk factor is equal to the **simple sum of option-level vega risk sensitivities** to that risk factor, across all options in the portfolio.
- The following sets out how vega risk sensitivities are to be derived in specific cases:
  - (With regard to options that do not have a maturity, assign those options to the longest prescribed maturity vertex, and assign these options also to the residual risks add-on.
  - With regard to options that do not have a strike or barrier and options that have multiple strikes or barriers, apply the mapping to strikes and maturity used internally to price the option, and assign those instruments also to the residual risks add-on.
  - With regard to CTP securitisation tranches which do not have an implied volatility, do not compute vega risk for such an instrument. Such instruments may not, however, be exempt from delta and curvature risk charges.

Requirements on sensitivity computations

- When computing a first-order sensitivity for instruments subject to optionality, banks should assume that the **implied volatility remains constant**, consistent with a "sticky delta" approach.
- When computing a **vega GIRR or CSR sensitivity**, banks may use either the **lognormal or normal assumptions**. When computing a **vega Equity, Commodity or FX sensitivity**, banks must use the **lognormal assumption**.
  - If, for internal risk management, a bank computes sensitivities using definitions differing from the definitions provided in the present standards, this bank may use linear transformations to deduce from the sensitivities it computes the one to be used for the vega risk measure.
  - All sensitivities must be computed ignoring the impact of CVA.

Annex 2: Sensitivity-based method
Correlation scenarios

The sensitivities-based method uses different scenarios to address correlation between risk charges

Correlation scenarios

Correlation scenarios and risk aggregation

- **Three risk charge figures** are to be calculated for each risk class corresponding to **three different scenarios** on the specified values for the correlation **parameter** ρ_{kl} (correlation between risk factors) and γ_{kl} (correlation across buckets within a risk class), which are detailed afterwards.

Scenarios for each risk class

1. **High correlations**
   Where ρ_{kl} and γ_{kl} are uniformly multiplied by **1.25**, with ρ_{kl} and γ_{kl} subject to a cap at 100%.
2. **Medium correlations**
   Where ρ_{kl} and γ_{kl} remain **unchanged**
3. **Low correlations**
   Where ρ_{kl} and γ_{kl} are uniformly multiplied by **0.75**.

Risk charge at portfolio level

- For each scenario, the bank must determine a **scenario-related risk charge** at the **portfolio level** as the simple sum of the risk charges at risk class level for that scenario.
- The ultimate portfolio level risk capital charge is the **largest of the three** scenario-related portfolio level risk **capital charges**.

Annex 2: Sensitivity-based method

Sensitivities, risk factors, buckets, risk weights and correlations

GIRR delta risk factors are defined based on a risk-free yield curve for each currency and on vertices, upon which risk weights are applied

Delta risk - GIRR

1 Risk factors

- The GIRR delta risks factors are defined along two dimensions: a **risk-free yield curve** for each currency in which interest rate-sensitive instruments are denominated and the following **vertices**: 0.25, 0.5, 1, 2, 3, 5, 10, 15, 20, and 30 years, to which delta risk factors are assigned.
- They also include a flat curve of **market-implied inflation rates for each currency**, and one of two possible cross currency basis risk factors for each currency with term structure not recognised as a risk factor.

2 Buckets and risk weights

- Each bucket represents an **individual currency exposure** to GIRR.

Vertex	0.25 year	0.5 year	1 year	2 year	3 year	5 year	10 year	15 year	20 year	30 year
Risk weighs (% point)	2.4%	2.4%	2.25%	1.88%	1.73%	1.5%	1.5%	1.5%	1.5%	1.5%

- A risk weight of 2.2.5% is set for the inflation risk factor and the cross currency basis risk factors, respectively.
- For selected currencies by the BCBS, the above risk weights may at the discretion of the bank be divided by the square root of 2.

3 Correlations

- The delta risk correlation $\boldsymbol{\rho_{kl}}$ is set at 99.90% between sensitivities $\boldsymbol{WS_k}$ and $\boldsymbol{WS_l}$ within the same bucket, same assigned vertex, but different curves.
- However, the delta risk correlation $\boldsymbol{\rho_{kl}}$ between sensitivities $\boldsymbol{WS_k}$ and $\boldsymbol{WS_l}$ within the same bucket with different vertex and same curve is set at:

$$\boldsymbol{max}\left[e^{\left(-\boldsymbol{\theta}\cdot\frac{|\boldsymbol{T_k}-\boldsymbol{T_l}|}{\boldsymbol{min}\{\boldsymbol{T_k};\boldsymbol{T_l}\}}\right)};\mathbf{40\%}\right]$$

T_k (respectively T_l) is the vertex that relates to WS_k (respectively WS_l).
θ set as 3%.

- The parameter $\boldsymbol{\gamma_{bc}} = \mathbf{50\%}$ must be used for aggregating between different currencies.

Annex 2: Sensitivity-based method

Sensitivities, risk factors, buckets, risk weights and correlations

For CSR non-securitisation, risk factors are based on the relevant issuer credit spread curves and vertices. Risk exposures should be first assigned to one of the prescribed buckets

Delta risk – CSR non-securitisation (1/2)

1 Risk factors

- These factors are defined along two dimensions: the relevant **issuer credit spread curves** (bond and Credit Default Swaps[1]) and the following **vertices**: 0.5, 1, 3, 5, and 10 years to which delta risk factors are assigned.

2 Buckets and risk weights[1]

Bucket number	Credit quality	Sector	Risk weights (% points)
1	Investment grade (IG)	Sovereigns including central banks, multilateral development banks	0.5%
2		Local government, government-backed non-financials, education, public administration	1.0%
3		Financials including government-backed financials	5.0%
4		Basic materials, energy, industrials, agriculture, manufacturing, mining and quarrying	3.0%
5		Consumer goods and services, transportation and storage, administrative and support service activities	3.0%
6		Technology, telecommunications	2.0%
7		Health care, utilities, professional and technical activities	1.5%
8		Covered bonds	4.0%
9	High yield (HY) and non-rated (NR)	Sovereigns including central banks, multilateral development banks	3.0%
10		Local government, government-backed non-financials, education, public administration	4.0%
11		Financials including government-backed financials	12.0%
12		Basic materials, energy, industrials, agriculture, manufacturing, mining and quarrying	7.0%
13		Consumer goods and services, transportation and storage, administrative and support service activities	8.5%
14		Technology and telecommunications	5.5%
15		Health care, utilities, professional and technical activities	5.0%
16	Other sector		12.0%

(1) Risk weights are the same for all vertices within each bucket

Annex 2: Sensitivity-based method

Sensitivities, risk factors, buckets, risk weights and correlations

The correlations for delta CSR non-securitisation are established by considering the names, vertices and curves of the sensitivities

Delta risk – CSR non-securitisation (2/2)

3 Correlations

- Between two sensitivities WS_k and WS_l within the same bucket, the correlation parameter ρ_{kl} is set as follows:

Equal to 1 where the two names of sensitivities k and l are identical, and 35% otherwise[1].

$$\rho_{kl} = \rho_{kl}^{(name)} \cdot \rho_{kl}^{(tenor)} \cdot \rho_{kl}^{(basis)}$$

Equal to 1 where the two vertices of sensitivities k and l are identical, and 65% otherwise[1].

Equal to 1 if the two sensitivities are related to the same curves, and 99.90% otherwise[1].

- The correlation parameter γ_{bc} is set as follows:

Equal to 1 where the two buckets b and c have the same rating category, and 50% otherwise.

$$\gamma_{bc} = \gamma_{bc}^{(rating)} \cdot \gamma_{bc}^{(sector)}$$

Equal to 1 where the two buckets have the same sector, and otherwise the following table applies.

Bucket	1/9	2/10	3/11	4/12	5/13	6/14	7/15	8
1/9		75%	10%	20%	25%	20%	15%	10%
2/10			5%	15%	20%	15%	10%	10%
3/11				5%	15%	20%	5%	20%
4/12					20%	25%	5%	5%
5/13						25%	5%	15%
6/14							5%	20%
7/15								5%
8								

(1) These correlations do not apply to the "other sector" bucket. For this bucket, the capital requirement for the delta and vega risk aggregation formula would be equal to the simple sum of the absolute values of the net weighted sensitivities allocated to this bucket.

Annex 2: Sensitivity-based method

Sensitivities, risk factors, buckets, risk weights and correlations

CSR securitisation (CTP) includes risk factors defined along two dimensions: the relevant issuer credit spread curves and certain vertices. Risk exposures should first be assigned to a bucket

Delta risk – CSR securitisation (CTP)

1 Risk factors

- Delta CSR securitisation (CTP) risk factors are defined along two dimensions: the relevant issuer **credit spread curves** (bond and CDS) and the following **vertices**: 0.5, 1, 3, 5, and 10 years to which delta risk factors are assigned.

2 Buckets and risk weights

- The **same bucket structure** and **correlation structure** apply as those for the CSR non-securitisation framework, but **other risk weights** are assigned to each bucket.

Bucket number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Risk weights	4.0%	4.0%	8.0%	5.0%	4.0%	3.0%	2.0%	6.0%	13.0%	13.0%	16.0%	10.0%	12.0%	12.0%	12.0%	13.0%

3 Correlations

- The delta risk correlation ρ_{kl} is derived the same way as for delta CSR non-securitisation except that $\rho_{kl}^{(basis)}$ is now equal to 1 if the two sensitivities are related to the same curves, and **99.00% otherwise**.
- Otherwise, the correlation parameters for ρ_{kl} and γ_{bc} are **identical** to CSR non-securitisation.

Annex 2: Sensitivity-based method

Sensitivities, risk factors, buckets, risk weights and correlations

CSR securitisations (non-CTP) include risk factors based on tranche credit spread curves and vertices. Risk exposures should first be assigned to a bucket

Delta risk – CSR securitisation non-CTP (1/2)

1 Risk factors

- Risk factors are defined along two dimensions: **tranche credit spread curves** and the following **vertices**: 0.5, 1, 3, 5, 10 years to which delta risk factors are assigned.

2 Buckets and risk weights

Bucket number	Credit quality	Sector	Risk weights (% points)
1	Senior Investment grade (IG)	RMBS – Prime	0.9%
2		RMBS – Mid-Prime	1.5%
3		RMBS – Sub-prime	2.0%
4		CMBS	2.0%
5		ABS – Student loans	0.8%
6		ABS – Credit cards	1.2%
7		ABS – Auto	1.2%
8		CLO non-correlation trading portfolio	1.4%
9	Non-senior Investment grade (IG)	RMBS – Prime	1.125%
10		RMBS – Mid-Prime	1.875%
11		RMBS – Sub-prime	2,5%
12		CMBS	2.5%
13		ABS – Student loans	1.0%
14		ABS – Credit cards	1.5%
15		ABS – Auto	1.5%
16		CLO non-correlation trading portfolio	1.75

Bucket number	Credit quality	Sector	Risk weights (% points)
17	High yield (HY) & non-rated (NR)	RMBS – Prime	1.575%
18		RMBS – Mid-Prime	2.625%
19		RMBS – Sub-prime	3.5%
20		CMBS	3.5%
21		ABS – Student loans	1.4%
22		ABS – Credit cards	2.1%
23		ABS – Auto	2.1%
24		CLO non-correlation trading portfolio	2.45%
25	Other sector		3.5%

Annex 2: Sensitivity-based method

Sensitivities, risk factors, buckets, risk weights and correlations

The correlations for delta CSR securitisation (non-CTP) are established by considering the tranches, vertices and curves of the sensitivities

Delta risk – CSR securitisation non-CTP (2/2)

3 Correlations

- Between two sensitivities $\boldsymbol{WS_k}$ and $\boldsymbol{WS_l}$ within the same bucket, the correlation parameter $\boldsymbol{\rho_{kl}}$ is set as follows:

Equal to 1 where the two names of sensitivities k and l are within the same bucket and related to the same securitisation tranche (more than 80% overlap in notional terms), and 40% otherwise[1].

$$\boldsymbol{\rho_{kl} = \rho_{kl}^{(tranche)} \cdot \rho_{kl}^{(tenor)} \cdot \rho_{kl}^{(basis)}}$$

Equal to 1 where the two vertices of sensitivities k and l are identical, and 80% otherwise[1].

Equal to 1 if the two sensitivities are related to the same curves, and 99.90% otherwise[1].

- The correlation parameter $\boldsymbol{\gamma_{bc}}$ applies to the aggregation of sensitivities between different buckets. It is **0%**.

(1) These correlations do not apply to the "other sector" bucket. For this bucket, the capital requirement for the delta and vega risk aggregation formula would be equal to the simple sum of the absolute values of the net weighted sensitivities allocated to this bucket.

Annex 2: Sensitivity-based method

Sensitivities, risk factors, buckets, risk weights and correlations

The equity delta risk factors are all equity spot prices and all the requirement repo rates. The buckets and risk weights are defined based on market cap, economy and sector

Delta risk – Equity (1/2)

1 Risk factors

- The equity delta risk factors are all the **equity spot prices** and all the **equity repurchase agreement rates** (equity repo rates).

2 Buckets and risk weights

Bucket	Market cap[1]	Economy	Sector
1	Large[2]	Emerging market economy	Consumer goods and services, transportation and storage, administrative and support services activities, healthcare, utilities
2			Telecommunications, industrials
3			Basic materials, energy, agriculture, manufacturing, mining and quarrying
4			Financial including government-backed financials, real estate activities, technology
5		Advanced economy	Consumer goods and services, transportation and storage, administrative and support service activities, healthcare, utilities
6			Telecommunications, industrials
7			Basic materials, energy, agriculture, manufacturing, mining and quarrying
8			Financial including government-backed financials, real estate activities, technology
9	Small	Emerging market economy	All sectors described under bucket 1,2,3 and 4
10		Advanced economy	All sector described under bucket 5,6,7 and 8
11	Other sector		

Bucket number	1	2	3	4	5	6	7	8	9	10	11
Risk weight for equity spot price	55%	60%	45%	55%	30%	35%	40%	50%	70%	50%	70%
Risk weight for equity repo rate	0.55%	0.60%	0.45%	0.55%	0.30%	0.35%	0.40%	0.50%	0.70%	0.50%	0.70%

(1) Market cap is defined as the sum of the market capitalisations of the same legal entity or group of legal entities across all stock markets globally.
(2) Large market cap is a market capitalisation equal or greater than USD 2 billion.

Annex 2: Sensitivity-based method

Sensitivities, risk factors, buckets, risk weights and correlations

The correlation parameter ρ_{kl} for equity delta equity risk is set at 99.90% for sensitivities within the same bucket, whereas for sensitivities not within the same bucket different correlation parameters are given. The correlation parameter γ_{bc} is set at 15% in most cases

Delta risk – Equity (2/2)

3 Correlations[1]

- The delta risk correlation parameter ρ_{kl} is set at **99.90%** between two sensitivities WS_k and WS_l within the same bucket where one is a sensitivity to an Equity spot price and other a sensitivity to an Equity repo rate, where both are related to the same Equity issuer name.
- Otherwise, between two sensitivities within the same bucket the correlation parameter ρ_{kl} is set at:
  - **15%** → buckets 1, 2, 3 or 4.
  - **25%** → buckets 5, 6, 7 or 8.
  - **7.5%** → bucket 9.
  - **12.5%** → bucket 10.
- Between two sensitivities within the same bucket where one is a sensitivity to an Equity spot price and the other a sensitivity to an Equity repo rate and both sensitivities relate to a different Equity issuer name, the correlation parameter ρ_{kl} is set at the **correlations specified above multiplied by 99.90%**.
- The correlation parameter γ_{bc} applies to the aggregation of sensitivities between different buckets. γ_{bc} is set at **15%** if bucket b and bucket c fall within bucket numbers 1 to 10.

(1) These correlations do not apply to the "other sector" bucket. For this bucket, the capital requirement for the delta and vega risk aggregation formula would be equal to the simple sum of the absolute values of the net weighted sensitivities allocated to this bucket.

Annex 2: Sensitivity-based method

Sensitivities, risk factors, buckets, risk weights and correlations

Delta risk factors for commodities are all the commodity spot prices depending on the contract grade, the legal terms with respect to the delivery location, the time to maturity and some vertices

Delta risk – Commodity (1/2)

1 Risk factors

- These factors are all the commodity spot prices depending on **contract grade** of the commodity, **legal terms** with respect to the delivery location of the commodity and **time to maturity** of the traded instrument at the following **vertices**: 0, 0.25, 0.5, 1, 2, 3, 5, 10, 15, 20, and 30 years.

2 Buckets and risk weights

Bucket	Commodity bucket	Examples of commodities to each commodity bucket (non-exhaustive)	Risk weight
1	Energy-solid combustibles	Coal, charcoal, wood pellets, nuclear fuel (such as uranium)	30%
2	Energy-liquid combustibles	Crude oil (such as Light-sweet, heavy, WTI and Brent); biofuels (such as bioethanol and biodiesel); petrochemicals (such as propane, ethane, gasoline, methanol and butane); refined fuels (such as, kerosene, gasoil, fuel oil, heating oil and diesel)	35%
3	Energy-electricity and carbon trading	Electricity (such as spot, day-ahead); carbon emissions trading (such as certified emissions reductions, and renewable energy certificates)	60%
4	Freight	Dry-bulk route (such as capesize, panamex, handysize and supramax); liquid-bulk/gas shipping route (such as suezmax, aframax and very large crude carriers)	80%
5	Metal-non precious	Base metal (such as aluminium, copper, lead, nickel, tin and zinc); steel raw materials (such as steel billet, steel wire, steel coil, steel scrap and steel rebar, iron ore, tungsten, vanadium, titanium and tantalum); minor metals	40%
6	Gaseous combustibles	Natural gas; liquefied natural gas	45%
7	Precious metals	Gold; silver; platinum; palladium	20%
8	Grains & oilseed	Corn; wheat; soybean (such as soybean seed); oats; palm oil; canola; barley; rapeseed; red bean, sorghum; coconut oil; olive oil; peanut oil; sunflower oil; rice	35%
9	Livestock & dairy	Cattle (such as live and feeder); hog; poultry; lamb; fish; shrimp; dairy (such as milk)	25%
10	Softs and other agriculturals	Cocoa; coffee; tea; citrus and orange juice; potatoes; sugar; cotton; wool; lumber and pulp; rubber	35%
11	Other commodity	Industrial minerals (such as potash), rare earths; terephthalic acid; flat glass	50%

Annex 2: Sensitivity-based method

Sensitivities, risk factors, buckets, risk weights and correlations

The correlations for commodities are to be calculated considering the intra-bucket correlations provided in the table, the vertices, the contract grade an the delivery location of the commodity

Delta risk – Commodity (2/2)

3 Correlations

- Any two commodities are considered distinct commodities if there exists in the market **two contracts** differentiated only by the underlying commodity to be delivered against each contract. Formally, between two sensitivities $\boldsymbol{WS_k}$ and $\boldsymbol{WS_l}$ within the same bucket, the correlation parameter $\boldsymbol{\rho_{kl}}$ is set:

Equal to 1 where the two names of sensitivities k and l are identical, and otherwise equal to the intra-bucket correlations in the table below.

$$\rho_{kl} = \rho_{kl}^{(cty)} \cdot \rho_{kl}^{(tenor)} \cdot \rho_{kl}^{(basis)}$$

Equal to 1 where the two vertices of sensitivities k and l are identical, and 99.00% otherwise.

Equal to 1 if the two sensitivities are identical in both (i) contract grade of the commodity, and (ii) delivery location of a commodity, and 99.90% otherwise.

Bucket	Commodity bucket	Correlation (ρ_{kl})
1	Energy-solid combustibles	55%
2	Energy-liquid combustibles	95%
3	Energy-electricity and carbon trading	40%
4	Freight	80%
5	Metal-non precious	60%
6	Gaseous combustibles	65%
7	Precious metals	55%
8	Grains & oilseed	45%
9	Livestock & dairy	15%
10	Softs and other agriculturals	40%
11	Other commodity	15%

- The correlation parameter $\boldsymbol{\gamma_{bc}}$ applying to sensitivity of risk exposure pairs between different buckets is set at:
  - **20%** if bucket b and bucket c fall within bucket numbers 1 to 10.
  - **0%** if either bucket b and bucket c is bucket number 11.

Annex 2: Sensitivity-based method

Sensitivities, risk factors, buckets, risk weights and correlations

For foreign exchange delta risk a uniform risk weight of 30% is applied to all FX sensitivities, except for certain currency pairs for which that risk weight may be divided by the square roof of 2. The correlation parameter γ_{bc} is set at 60%

Delta risk – Foreign exchange risk

1 Risk factors

- All the **exchange rates** between the currency in which an instrument is denominated and the reporting currency.

2 Buckets and risk weights

- A unique relative risk weight equal to **30%** applies to all the FX sensitivities or risk exposures.
- For the currency pairs specified by the BCBS[1], the above risk weight may at the discretion of the bank be divided by the **square root of 2**.

3 Correlations

- A uniform correlation parameter γ_{bc} equal to **60%** applies to FX sensitivity or risk exposure pairs.

(1) USD/EUR, USD/JPY, USD/GBP, USD/AUD, USD/CAD, USD/CHF, USD/MXN, USD/CNY, USD/NZD, USD/RUB, USD/HKD, USD/SGD, USD/TRY, USD/KRW, USD/SEK, USD/ZAR, USD/INR, USD/NOK, USD/BRL, EUR/JPY, EUR/GBP, EUR/CHF and JPY/AUD.

Annex 2: Sensitivity-based method

Sensitivities, risk factors, buckets, risk weights and correlations

The vega risk covers the risk factors for GIRR, CRS non-securitisation, CSR securitisation (non-CTP), CSR securitisation (CTP), equity, commodity and FX

Vega risk (1/2)

1 Risk factors

GIRR	Within each currency, the risk factors are the implied volatilities of options that reference GIRR-sensitive underlyings, further defined along two dimensions: (i) **maturity of the option**; and (ii) **residual maturity of the underlying** of the option at the expiry date of the option.
CSR non-securitisation	The risk factors are the implied volatilities of options that reference the relevant credit issuer names as underlyings (bond and CDS), further defined along the **maturity of the option**[1].
CSR securitisation (non-CTP)	The risk factors are the implied volatilities of options that reference non-CTP credit spreads as underlyings (bonds and CDS), further defined along the **maturity of the option**[1].
CSR securitisation (CTP)	The risk factors are the implied volatilities of options that reference CTP credit spreads as underlyings (bond and CDS), further defined along the **maturity of the option**[1].
Equity	The risk factors are the implied volatilities of option that reference the equity spot prices as underlyings, further defined along the **maturity of the option**[1]. There is **no vega risk capital charge for equity repo rates**.
Commodity	The risk factors are the implied volatilities of options that reference commodity spot prices as underlyings, further defined along the **maturity of the option**[1]. No differentiation between commodity spot prices by maturity of the underlying, grade or delivery location is required.
FX	The factors are the implied volatilities of options that reference exchange rates between currency pairs, further defined along the **maturity of the option**[1].

(1) The vertices to which the implied volatility of the option must be mapped are: 0.5, 1, 3, 5, and 10 years.

Annex 2: Sensitivity-based method

Sensitivities, risk factors, buckets, risk weights and correlations

The buckets applied to vega risks are the same as those used for delta risk. However, the risk weights should be calculated using a function that incorporates the risk of market illiquidity

Vega risk (2/2)

2 Buckets and risk weights

- The delta buckets are **replicated** in the vega context, unless specified otherwise. The bucket remains the first level of aggregation between vega risk positions within a risk class.
- The risk of market illiquidity is incorporated into the determination of vega risk factors, through the assignment of **different liquidity horizons** for each risk class. The risk weight for a given vega risk factor $\boldsymbol{k}(\boldsymbol{RW_k})$ is determined by the following function:

Set at 55%.

$$RW_k = min\left[RW_\sigma \cdot \frac{\sqrt{LH_{risk\ class}}}{\sqrt{10}}; 100\%\right]$$

Regulatory liquidity horizon to be prescribed in the determination of each vega risk factor $\boldsymbol{k}$ is specified in the following table.

Risk class	$LH_{risk\ class}$
GIRR	60
CSR non-securitisation	120
CSR securitisation (CTP)	120
CSR securitisation (non-CTP)	120
Equity (large cap)	20
Equity (small cap)	60
Commodity	120
FX	40

3 Correlations

- Between vega risk sensitivities within the same bucket of the GIRR risk class, the parameter $\boldsymbol{\rho_{kl}}$ is calculated:

$$\rho_{kl} = min\left[\rho_{kl}^{(option\ maturity)} \cdot \rho_{kl}^{(underlying\ maturity)}; 1\right]$$

- Between vega risk sensitivities within the same bucket of other risk classes, the parameter $\boldsymbol{\rho_{kl}}$ is calculated as:

$$\rho_{kl} = min\left[\rho_{kl}^{(DELTA)} \cdot \rho_{kl}^{(option\ maturity)}; 1\right]$$

- With regard to vega risk sensitivities between buckets within a risk class (GIRR and non-GIRR), the **same correlation** parameter for $\boldsymbol{\gamma_{bc}}$ **as specified for delta correlations** are to be used in the vega risk context.

Annex 2: Sensitivity-based method

Sensitivities, risk factors, buckets, risk weights and correlations

The curvature risk covers the risk factors for general interest rate risk, CSR non-securitisation, CSR securitisation (non-CTP), CSR securitisation (CTP), equity, commodity and FX

Curvature risk (1/2)

1 Risk factors

GIRR	The risk factors are defined along only one dimension: the **constructed risk-free yield curve per currency**. All vertices (as defined for delta GIRR) are to be shifted in parallel[1].
CSR non-securitisation	The risk factors are defined along one dimension: the **relevant issuer credit spread curves** (bond and CDS). All the vertices (as defined for CSR) are to be shifted in parallel.
CSR securitisation (non-CTP)	The risk factors are defined along one dimension: the **relevant tranche credit spreads curves** (bonds and CDS). All the vertices are to be shifted in parallel.
CSR securitisation (CTP)	The risk factors are defined along one dimension: the **relevant underlying credit spread curves** (bond and CDS). All the vertices are to be shifted in parallel.
Equity	The risk factors are all the **equity spot prices**. There is no curvature risk charge for equity repo rates.
Commodity	The risk factors are defined along only one dimension: the **constructed curve** per commodity spot prices. All vertices (as defined for delta commodity) are to be shifted in parallel.
FX	The risk factors are all the exchange rates between the currency in which an instrument is denominated and the reporting currency[2].

(1) There is no curvature risk charge for inflation and cross currency basis risks.
(2) No distinction is required between onshore and offshore variant of a currency for all FX delta, vega and curvature risk factors.

Annex 2: Sensitivity-based method

Sensitivities, risk factors, buckets, risk weights and correlations

The buckets applied to curvature risks are the same as those used for delta risk whereas the correlation parameters should be squared

Curvature risk (2/2)

2 Buckets and risk weights

- The **delta buckets are replicated** in the curvature context, unless specified otherwise. The bucket remains the first level of aggregation between curvature risk positions within a risk class.
- Regarding risk weights:
  - For **FX and Equity curvature risk factors**, the curvature risk weights are relative shifts (shocks) equal to the delta risk weights.
  - For **GIRR, CSR and commodity curvature risk factors**, the curvature risk weight is the parallel shift for all the vertices for each curve based on the highest prescribed delta risk weight for each risk class.

3 Correlations

- Between curvature exposures, each delta correlation parameters ρ_{kl} and γ_{bc} should be **squared**.

Annex 3: Sensitivity-based method
Default Risk Charge

Default risk weights are assigned to net JTD by credit quality categories

DRC for non-securitisations

Default risk weights

- Default risk weights are assigned to net JTD by **credit quality categories** (i.e. rating bands) irrespective of the type of counterparty, as in the following table:

Credit quality category	Default risk weight
AAA	0.5%
AA	2%
A	3%
BBB	6%
BB	15%
B	30%
CCC	50%
Unrated	15%
Defaulted	100%

Annex 4

Supervisory criteria for the approval of IMA

The use of an internal model will be conditional upon the explicit approval of the bank's supervisory authority, considering a set of general criteria. In addition, banks using internal models will be subject to other requirements, such as qualitative standards

Supervisory criteria for the approval of internal models (1/4)

General criteria

- The supervisory authority will only give its approval if at a minimum[1]:
  - The bank's risk management is **sound and integral**.
  - The number of **staff skilled** in the use of sophisticated models is sufficient (in trading, risk control, etc.).
  - The bank's models have a proven track record of **reasonable accuracy** in measuring risk.
  - The bank regularly conducts **stress tests**.
  - The positions included in this model are held in approved **trading desks**.
- In addition to these general criteria, banks using IMA will be subject to the following **requirements**:

Qualitative standards

- The bank must have a **risk control unit** (independent from trading units) responsible for the design and implementation of the risk management system, and reporting directly to **senior management**. It must conduct regular backtesting and P&L attribution programmes and produce daily reports on the output of the model.
- A **distinct unit** must conduct the initial and ongoing **validation** of all internal models (at least annually).
- The **board and senior management** must be actively involved in the **risk control process** (e.g. review of the daily reports prepared by the independent risk control unit).
- **Internal models for market risk** are likely to differ from those used in the day-to-day internal management, but the starting point for the design of both the regulatory and the internal risk models should be the same.
- A programme of **stress testing** is required. The result of stress testing must be reviewed at least monthly by senior management, used in the ICAAP, and reflected in the policies set by management and the board.
- Banks need to have a routine in place for ensuring compliance with a documented set of **internal policies, controls**, etc. concerning the operation of the risk measurement system, which must be well **documented**.
- Any **significant changes** to an approved model must be **approved** prior to being implemented.
- Risk measures must be calculated on the full set of **positions** which are in the **scope of the model**.
- An **independent review** of the risk measurement system must be carried out regularly by either the bank's own internal auditing process or an external auditor.

(1) Supervisory authorities will be able to insist on a period of initial monitoring and live testing of a bank's internal model before it is used for supervisory capital purposes.

Annex 4

Supervisory criteria for the approval of IMA

Banks will also be required to fulfil quantitative standards regarding frequency, confidence levels, liquidity horizons, calibration, correlations, option's risks and capital requirement. Moreover, banks must have processes to validate their internal models adequately

Supervisory criteria for the approval of internal models (2/4)

Quantitative standards

- The **ES** must be computed on a **daily basis** for the bank-wide internal model and for each trading desk to be included within the scope of the internal model, using a **97.5th** percentile one-tailed confidence level.
- The ES for a liquidity horizon must be calculated from an ES at a base **liquidity horizon of 10 days** with **scaling** applied to this base horizon result[1].
- The ES measure must be calibrated to a **period of stress** using a reduced set of risk factors. Banks are to specify a reduced set of risks factors that is relevant for their portfolio (i.e. it must be able to explain a minimum of 75% of the variation of the full ES model). Thus, the ES for the portfolio is calculated as follows[2]:

ES based on a stressed observation period (most severe 12-month period of stress available over the observation horizon) using a reduced set of risk factors.

$$ES = ESR_{,S} \cdot \frac{ES_{F,C}}{ES_{R,C}}$$

ES measure based on the current (most recent) 12-month observation period with a full set of risk factors / ES measure based on the current period with a reduced set of risk factors. This ratio is **floored at 1**.

- Banks will have **discretion** to recognise **empirical correlations** within a broad regulatory risk factor classes (e.g. interest rate, equity risk, etc.), but they will be constrained by the supervisory aggregation scheme and must be calculated in a manner consistent with the applicable liquidity horizons, and clearly documented.
- Bank's models must accurately capture the **unique risks associated with options** (i.e. the non-linear price characteristics of options positions and the volatilities of the rates and prices underlying option positions).

Validation requirements

- Banks must have **processes** in place to ensure that their internal models have been adequately **validated**. Validation must be conducted when the model is initially developed and when significant changes are made. Models must be **periodically revalidated**, particularly when there have been significant structural changes.
- In addition to P&L attribution and backtesting, validation should also include **tests** to demonstrate that **assumptions** are appropriate; the use of **hypothetical changes in portfolio value** that would occur were end-of-day positions to remain unchanged[3]; and the use of **hypothetical portfolios** .

(1) As detailed in Annex 5.
(2) No particular type of expected shortfall model is prescribed, and supervisors may permit banks to use models based on historical simulation, Monte Carlo simulation, or other analytical methods.
(3) Including additional tests (e.g. testing carried out for longer periods than required for the regular backtesting programme, etc.).

Annex 4
Supervisory criteria for the approval of IMA

The bank's internal market risk measurement system should cover a set of market risk factors related to pricing, interest rates, exchange rates, equity prices and commodity prices

Supervisory criteria for the approval of internal models (3/4)

Specification of market risk factors

- The **risk factors** contained in a market risk measurement system must be sufficient to capture the **risks inherent in the bank's portfolio** of on- and off-balance sheet trading positions[1].
- Although banks will have some **discretion** in specifying the risk factors, the following **requirements** apply.

Pricing

- Factors relevant for pricing should be included as risk factors in the bank's internal models. Where a risk factor is incorporated in a pricing model but not in the risk capital model, the bank must justify it.

Interest rates

- There must be a set of risk factors corresponding to **interest rates in each currency** in which the bank has **interest rate-sensitive** on- or off-balance sheet positions. The risk measurement system must model the yield curve using one of a number of generally accepted approaches,

Exchange rates

- For exchange rates, the risk measurement system must incorporate risk factors corresponding to the **individual foreign currencies** in which the bank's positions are denominated.

Equity prices

- There must be risk factors corresponding to each of the **equity markets** in which the bank holds **significant positions**:
  - At a minimum, there must be a risk factor that is designed to capture market-wide movements in equity prices (e.g. market index). Additionally, a more detailed approach would be to have risk factors corresponding to various sectors of the overall equity market. A more extensive approach would be to have risk factors reflecting volatility of equity issues.
  - The sophistication of the modelling technique for a given market should correspond to the bank's exposure to the overall market as well as its concentration in individual equity issues.

Commodity prices

- For commodity prices, there must be risk factors corresponding to each of the **commodity markets** in which the bank holds **significant positions**. For banks with relatively limited positions in commodity-based instruments, a straightforward specification of risk factors would be acceptable. For more active trading, the model must also take account of variation in the "convenience yield".

Annex 4
Supervisory criteria for the approval of IMA

The stress testing is required to identify possible impact at both the trading desk and banking-wide level. External auditors or supervisory authorities should validate the models' accuracy

Supervisory criteria for the approval of internal models (4/4)

Stress testing

- Banks using the IMA must have a rigorous and **comprehensive stress testing program** at both the trading desk and bank-wide. Stress scenarios need to cover a range of factors that can create extraordinary losses or gains in trading portfolios, or kame the control of risk very difficult (e.g. low- probability events).
- Banks' stress tests should be both of a **quantitative and qualitative nature**.
- Banks should combine the use of **supervisory stress scenarios** with **stress tests developed by banks** themselves to reflect their specific risk characteristics. Specifically, supervisory authorities may ask banks to provide **information** on stress testing in **three broad areas**:

1 Supervisory scenarios requiring no simulations by the bank

Banks should have information on the **largest losses** experienced during the **reporting period** and should make this available for supervisory review.

2 Supervisory scenarios requiring a simulation by the bank

Banks should subject their portfolios to a series of **simulated stress scenarios** and provide the results to supervisory authorities. These scenarios could include using past periods of significant disturbance, or evaluating the sensitivity of the bank's market risk exposure to changes in the assumptions.

3 Scenarios developed by the bank[1]

Banks should provide supervisory authorities with a description of the **methodology** used and the **results**. The results should be **reviewed periodically** by senior management and should be **reflected in the policies** set by management and the board. If a particular vulnerability is revealed, the national authorities would expect the bank to take prompt steps.

External validation

- External auditors and/or supervisory authorities should validate the models by:
  - Verifying the adequacy of internal validation **processes**.
  - Ensuring that the **formulae** used in the calculation process are validated.
  - Checking that the **structure** of internal models is adequate against bank's activities and geographies.
  - Checking the result of the banks' **backtesting** and its **P&L attribution process**.
  - Ensuring that data flows and processes are **transparent and accessible**.

(1) Those scenarios should be the most adverse based on the characteristics of the portfolio.

Annex 5
Liquidity horizons

The expected shortfall for a liquidity horizon must be calculated from an expected shortfall at a base liquidity horizon of 10 days, with scaling applied to this base horizon

Liquidity horizons (1/2)

Liquidity horizons

- The expected shortfall for a liquidity horizon must be calculated from an expected shortfall at a **base liquidity horizon of 10 days** with scaling applied to this base horizon result as follows:

$$ES = \sqrt{(ES_T(P))^2 + \sum_{J \geq 2} \left(ES_T(P,J) \sqrt{\frac{LH_j - LH_{j-1}}{T}} \right)^2}$$

Regulatory liquidity-adjusted ES

ES at horizon T of a portfolio with positions $P = (p_i)$ with respect to shocks to all risk factors that the positions P are exposed to

ES at horizon T of a portfolio with positions $P = (p_i)$ with respect to shocks to each positions p_i in the subset of risk factors $Q(p_i, j)$ [1] with all other risk factors held constant

Length of the base horizon, i.e. 10 days

- LH_j is the liquidity horizon j, with lengths in the following table:

j	LH_j
1	10
2	20
3	40
4	60
5	120

- The ES at horizon $T, ES_T(P)$ must be calculated for changes in the risk factors, and $ES_T(P, j)$ must be calculated for changes in the relevant subset $Q(p_i, j)$ of risk factors, over the time interval T without scaling from a shorter horizon.
- The time series of change in risk factors over the base time interval T may be determined by overlapping observations.

(1) Subset of risk factors whose liquidity horizons for the desk where p_i is booked are at least as long as LH_j according to the table above.

Annex 5
Liquidity horizons

The liquidity horizon *n* must be determined for each broad category of risk factor as provided by the BCBS, although the values provided can be increased subject to supervisory approval

Liquidity horizons (2/2)

Liquidity horizons

- As set out above, a scaled ES must be calculated based on the liquidity horizon *n* defined below. *n* is calculated using the following conditions:
  - Banks must **map each risk factor** on to one of the **risk factor categories** shown below using consistent and clearly documented procedures.
  - The mapping must be (i) set out in writing; (ii) validated by the bank's risk management; (iii) made available to supervisors; and (iv) subject to internal audit.
  - *n* is determined for each broad category of risk factor as set out in the following table[1].

Risk factor category	*n*
Interest rate; specified currencies – EUR, USD, GBP, AUD, JPY, SEK, CAD and domestic currency of a bank	10
Interest rate: - unspecified currencies	20
Interest rate: volatility	60
Interest rate: other types	60
Credit spread: sovereign (IG)	20
Credit spread: sovereign (HY)	40
Credit spread: corporate (IG)	40
Credit spread: corporate (HY)	60
Credit spread: volatility	120
Credit spread: other types	120

Risk factor category	*n*
Equity price (large cap)	10
Equity price (small cap)	20
Equity price (large cap): volatility	20
Equity price (small cap): volatility	60
Equity: other types	60
FX rate: specified currency pairs	10
FX rate: currency pairs	20
FX: volatility	40
FX: other types	40

Risk factor category	*n*
Energy and carbon emissions trading price	10
Precious metals and non-ferrous metal price	20
Other commodities price	20
Energy and carbon emissions trading price: volatility	60
Precious metals and non-ferrous metals price: volatility	60
Other commodities price: volatility	10
Commodity: other types	20

(1) However, on a desk-by-desk basis *n* can be increased relative to the values in the table below. Where *n* is increased, the increased horizon must be 20, 40, 60 or 120 days and the rationale must be documented and be subject to supervisory approval. Furthermore, liquidity horizons should be capped at the maturity of the related instrument: