Office of the Superintendent of Financial Institutions Canada
Bureau du surintendant des institutions financières Canada

Guideline

Subject: Capital Adequacy Requirements (CAR)

Chapter 9 – Market Risk Effective Date: November 2025 / January 2026

For institutions with a fiscal year ending October 31 or December 31, respectively.

The Capital Adequacy Requirements (CAR) for banks, bank holding companies, and trust and loan companies, collectively referred to as 'institutions', are set out in nine chapters, each of which has been issued as a separate document. This document, Chapter 9 – Market Risk, should be read in conjunction with the other CAR chapters. The complete list of CAR chapters is as follows:

Chapter 1	Overview of Risk-based Capital Requirements
Chapter 2	Definition of Capital
Chapter 3	Operational Risk
Chapter 4	Credit Risk – Standardized Approach
Chapter 5	Credit Risk – Internal Ratings Based Approach
Chapter 6	Securitization
Chapter 7	Settlement and Counterparty Risk
Chapter 8	Credit Valuation Adjustment (CVA) Risk
Chapter 9	Market Risk

Please refer to OSFI's *Corporate Governance Guideline* for OSFI's expectations of institution Boards of Directors in regards to the management of capital and liquidity.

Table of Contents

Chapter 9 – Market Risk

Eligibility Requirements

1. This chapter is drawn from the Basel Committee on Banking Supervision (BCBS) Basel framework published on the Bank for International Settlements (BIS) website[1]. For reference, the Basel paragraph numbers that are associated with the text appearing in this chapter are indicated in square brackets at the end of each paragraph.[2]

2. These requirements apply only to internationally active institutions.

3. OSFI retains the right to apply the framework to other institutions, on a case by case basis. All institutions designated by OSFI as domestic systemically important banks (D-SIBs) shall meet the requirements of this chapter.

9.1. Market Risk Terminology, Definition and Application

9.1.1 MARKET RISK TERMINOLOGY

This section provides a high-level description of terminologies used in the market risk frameworks.

9.1.1.1 General Terminology

4. *Market risk*: the risk of losses in on- and off-balance sheet risk positions arising from movements in market prices. [Basel Framework, MAR10.1]

5. *Notional value*: the notional value of a derivative instrument is equal to the number of units underlying the instrument multiplied by the current market value of each unit of the underlying. [Basel Framework, MAR10.2]

6. *Trading desk*: a group of traders or trading accounts in a business line within an institution that follows defined trading strategies with the goal of generating revenues or maintaining market presence from assuming and managing risk. [Basel Framework, MAR10.3]

7. *Pricing model*: a model that is used to determine the value of an instrument (mark-to-market or mark-to-model) as a function of pricing parameters or to determine the change in the value of an instrument as a function of risk factors. A pricing model may be the combination of several calculations; e.g. a first valuation technique to compute a price, followed by valuation adjustments for risks that are not incorporated in the first step. [Basel Framework, MAR10.4]

8. *Rating Agencies*: OSFI conducted a process to determine which of the major international rating agencies would be recognized as an eligible external credit assessment institution under this chapter. As a result of this process, OSFI will permit institutions to recognize credit ratings

[1] The Basel Framework
[2] Following the format: [Basel Framework, XXX yy.zz].

from the following rating agencies for market risk capital adequacy purposes: DBRS; Moody's Investor Service; Standard and Poor's (S&P); Fitch Rating Services and; Kroll Bond Rating Agency, Inc.

9.1.1.2 Terminology for Financial Instruments

9. *Financial instrument*: any contract that gives rise to both a financial asset of one entity and a financial liability or equity instrument of another entity. Financial instruments include primary financial instruments (or cash instruments) and derivative financial instruments. [Basel Framework, MAR10.5]

10. *Instrument*: the term used to describe financial instruments, instruments on foreign exchange (FX) and commodities. [Basel Framework, MAR10.6]

11. *Embedded derivative*: a component of a financial instrument that includes a non-derivative host contract. For example, the conversion option in a convertible bond is an embedded derivative. [Basel Framework, MAR10.7]

12. *Look-through approach*: an approach in which an institution determines the relevant capital requirements for a position that has underlyings (such as an index instrument, multi-underlying option, or an equity investment in a fund) as if the underlying positions were held directly by the institution. [Basel Framework, MAR10.8]

9.1.1.3 Terminology for Market Risk Capital Requirement Calculations

13. *Risk factor*: a principal determinant of the change in value of an instrument (e.g. an exchange rate or interest rate). [Basel Framework, MAR10.9]

14. *Risk position*: the portion of the current value of an instrument that may be subject to losses due to movements in a risk factor. For example, a bond denominated in a currency different to an institution's reporting currency has risk positions in general interest rate risk, credit spread risk (non-securitization) and FX risk, where the risk positions are the potential losses to the current value of the instrument that could occur due to a change in the relevant underlying risk factors (interest rates, credit spreads, or exchange rates). [Basel Framework, MAR10.10]

15. *Risk bucket*: a defined group of risk factors with similar characteristics. [Basel Framework, MAR10.11]

16. *Risk class*: a defined list of risks that are used as the basis for calculating market risk capital requirements: general interest rate risk, credit spread risk (non-securitization), credit spread risk (securitization: non-correlation trading portfolio), credit spread risk (securitization: correlation trading portfolio), FX risk, equity risk and commodity risk. [Basel Framework, MAR10.12]

9.1.1.4 Terminology for Risk Metrics

17. *Sensitivity*: an institution's estimate of the change in value of an instrument due to a small change in one of its underlying risk factors. Delta and vega risks are sensitivities. [Basel Framework, MAR10.13]

18. *Delta risk*: the linear estimate of the change in value of a financial instrument due to a movement in the value of a risk factor. The risk factor could be the price of an equity or commodity, or a change in an interest rate, credit spread or FX rate. [Basel Framework, MAR10.14]

19. *Vega risk*: the potential loss resulting from the change in value of a derivative due to a change in the implied volatility of its underlying. [Basel Framework, MAR10.15]

20. *Curvature risk*: the additional potential loss beyond delta risk due to a change in a risk factor for financial instruments with optionality. In the standardized approach in the market risk framework, it is based on two stress scenarios involving an upward shock and a downward shock to each regulatory risk factor. [Basel Framework, MAR10.16]

21. *Value at risk (VaR)*: a measure of the worst expected loss on a portfolio of instruments resulting from market movements over a given time horizon and a pre-defined confidence level. [Basel Framework, MAR10.17]

22. *Expected shortfall (ES)*: a measure of the average of all potential losses exceeding the VaR at a given confidence level. [Basel Framework, MAR10.18]

23. *Jump-to-default (JTD)*: the risk of a sudden default. JTD exposure refers to the loss that could be incurred from a JTD event. [Basel Framework, MAR10.19]

24. *Liquidity horizon*: the time assumed to be required to exit or hedge a risk position without materially affecting market prices in stressed market conditions. [Basel Framework, MAR10.20]

9.1.1.5 Terminology for Hedging and Diversification

25. *Basis risk*: the risk that prices of financial instruments in a hedging strategy are imperfectly correlated, reducing the effectiveness of the hedging strategy. [Basel Framework, MAR10.21]

26. *Diversification*: the reduction in risk at a portfolio level due to holding risk positions in different instruments that are not perfectly correlated with one another. [Basel Framework, MAR10.22]

27. *Hedge*: the process of counterbalancing risks from exposures to long and short risk positions in correlated instruments. [Basel Framework, MAR10.23]

28. *Offset*: the process of netting exposures to long and short risk positions in the same risk factor. [Basel Framework, MAR10.24]

29. *Standalone*: being capitalised on a stand-alone basis means that risk positions are booked in a discrete, non-diversifiable trading book portfolio so that the risk associated with those risk positions cannot diversify, hedge or offset risk arising from other risk positions, nor be diversified, hedged or offset by them. [Basel Framework, MAR10.25]

9.1.1.6 Terminology for Risk Factor Eligibility and Modellability

30. *Real prices*: a term used for assessing whether risk factors pass the risk factor eligibility test. A price will be considered real if it is (i) a price from an actual transaction conducted by the institution, (ii) a price from an actual transaction between other arm's length parties (e.g. at an exchange), or (iii) a price taken from a firm quote (i.e. a price at which the institution could transact with an arm's length party). [Basel Framework, MAR10.26]

31. *Modellable risk factor*: risk factors that are deemed modellable, based on the number of representative real price observations and additional qualitative principles related to the data used for the calibration of the ES model. Risk factors that do not meet the requirements for the risk factor eligibility test are deemed as non-modellable risk factors (NMRF). [Basel Framework, MAR10.27]

9.1.1.7 Terminology for Internal Model Validation

32. *Backtesting*: the process of comparing daily actual and hypothetical profits and losses with model-generated VaR measures to assess the conservatism of risk measurement systems. [Basel Framework, MAR10.28]

33. *Profit and loss (P&L) attribution (PLA)*: a method for assessing the robustness of institutions' risk management models by comparing the risk-theoretical P&L predicted by trading desk risk management models with the hypothetical P&L. [Basel Framework, MAR10.29]

34. *Trading desk risk management model*: the trading desk risk management model (pertaining to in-scope desks) includes all risk factors that are included in the institution's ES model with OSFI parameters and any risk factors deemed not modellable, which are therefore not included in the ES model for calculating the respective regulatory capital requirement, but are included in NMRFs. [Basel Framework, MAR10.30]

35. *Actual P&L (APL)*: the actual P&L derived from the daily P&L process. It includes intraday trading as well as time effects and new and modified deals, but excludes fees and commissions as well as valuation adjustments for which separate regulatory capital approaches have been otherwise specified as part of the rules or which are deducted from Common Equity Tier 1 (CET1). Any other valuation adjustments that are market risk-related must be included in the APL. As is the case for the hypothetical P&L, the APL should include FX and commodity risks from positions held in the banking book. [Basel Framework, MAR10.31]

36. *Hypothetical P&L (HPL)*: the daily P&L produced by revaluing the positions held at the end of the previous day using the market data at the end of the current day. Commissions, fees, intraday trading and new/modified deals, valuation adjustments for which separate regulatory capital approaches have been otherwise specified as part of the rules and valuation adjustments

which are deducted from CET1 are excluded from the HPL. Valuation adjustments updated daily should usually be included in the HPL. Time effects should be treated in a consistent manner in the HPL and risk-theoretical P&L. [Basel Framework, MAR10.32]

37. *Risk-theoretical P&L (RTPL)*: the daily desk-level P&L that is predicted by the valuation engines in the trading desk risk management model using all risk factors used in the trading desk risk management model (i.e. including the NMRFs). [Basel Framework, MAR10.33]

9.1.1.8 Terminology for Credit Valuation Adjustment Risk

38. *Credit valuation adjustment (CVA)*: an adjustment to the valuation of a derivative transaction to account for the credit risk of contracting parties. [Basel Framework, MAR10.34]

39. *CVA risk*: the risk of changes to CVA arising from changes in credit spreads of the contracting parties, compounded by changes to the value or variability in the value of the underlying of the derivative transaction. [Basel Framework, MAR10.35]

9.1.2 DEFINITIONS AND APPLICATION OF MARKET RISK

This section defines the methods available for calculating and the scope of application of market risk capital requirements.

9.1.2.1 Definition and Scope of Application

40. Market risk is defined as the risk of losses arising from movements in market prices. The risks subject to market risk capital requirements include but are not limited to:

(1) default risk, interest rate risk, credit spread risk, equity risk, foreign exchange (FX) risk and commodities risk for trading book instruments; and

(2) FX risk and commodities risk for banking book instruments.

[Basel Framework, MAR11.1]

41. Derivative, repurchase/reverse repurchase, securities lending and other transactions booked in the trading book are subject to both the market risk and the counterparty credit risk capital requirements. This is because they face the risk of loss due to market fluctuations in the value of the underlying instrument and due to the failure of the counterparty to the contract. The counterparty risk weights used to calculate the credit risk capital requirements for these transactions are those used for calculating the capital requirements in the banking book.

42. All transactions, including forward sales and purchases, shall be included in the calculation of capital requirements as of the date on which they were entered into. Although regular reporting will in principle take place only at intervals (quarterly in most countries), institutions 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. OSFI has at its disposal a number of effective measures to ensure that institutions do not window-dress by showing significantly lower market risk positions on reporting dates. Institutions will also be expected to maintain strict risk management systems to ensure that intraday exposures are not

excessive. If an institution fails to meet the capital requirements at any time, OSFI shall ensure that the institution takes immediate measures to rectify the situation. [Basel Framework, MAR11.2]

43. A matched currency risk position will protect an institution against loss from movements in exchange rates, but will not necessarily protect its capital adequacy ratio. If an institution has its capital denominated in its domestic currency and has a portfolio of foreign currency assets and liabilities that is completely matched, its capital/asset ratio will fall if the domestic currency depreciates. By running a short risk position in the domestic currency, the institution can protect its capital adequacy ratio, although the risk position would lead to a loss if the domestic currency were to appreciate. OSFI will allow institutions to protect their capital adequacy ratio in this way and exclude certain currency risk positions from the calculation of net open currency risk positions, subject to meeting each of the following conditions:

(1) The risk position is taken or maintained for the purpose of hedging partially or totally against the potential that changes in exchange rates could have an adverse effect on its capital ratio.

(2) The risk position is of a structural (i.e. non-dealing) nature such as positions stemming from:

  (a) investments in affiliated but not consolidated entities denominated in foreign currencies; or

  (b) investments in consolidated subsidiaries or branches denominated in foreign currencies.

(3) The exclusion is limited to the amount of the risk position that neutralizes the sensitivity of the capital ratio to movements in exchange rates.

(4) The exclusion from the calculation is made for at least six months.

(5) The establishment of a structural FX position and any changes in its position must follow the institution's risk management policy for structural FX positions. This policy must be pre-approved by OSFI.

(6) Any exclusion of the risk position needs to be applied consistently, with the exclusionary treatment of the hedge remaining in place for the life of the assets or other items.

(7) The institution must document and have available for OSFI review the positions and amounts to be excluded from market risk capital requirements.

[Basel Framework, MAR11.3]

44. No FX risk capital requirement will apply to positions related to items that are deducted from an institution's capital when calculating its capital base. [Basel Framework, MAR11.4]

45. Holdings of capital instruments that are deducted from an institution's capital or risk weighted at 1250% are not allowed to be included in the market risk framework[3]. This includes:

(1) holdings of the institution's own eligible regulatory capital instruments and, if applicable, own Other TLAC Instruments[4]; and

(2) holdings of other institutions', securities firms' and other financial entities' eligible regulatory capital instruments and in G-SIBs' or D-SIBs' Other TLAC Instruments, as well as intangible assets, where OSFI requires that such assets are deducted from capital.

(3) Where an institution demonstrates that it is an active market-maker, OSFI may establish a dealer exception for holdings of other institutions', securities firms', and other financial entities' capital instruments in the trading book. In order to qualify for the dealer exception, the institution must have adequate systems and controls surrounding the trading of financial institutions' eligible regulatory capital instruments and Other TLAC Instruments.

[Basel Framework, MAR11.5]

46. This dealer exception applies only to positions in another institution's regulatory capital instruments and/or Other TLAC Instruments that do not exceed the 10% threshold or the 5% threshold on non-significant investments described in Chapter 2 – Definition of Capital, section 2.3. For the capital treatment of significant investments in capital and Other TLAC Instruments of banks, financial and insurance entities refer to Chapter 2 – Definition of Capital, section 2.3.

47. In the same way as for credit risk and operational risk, the capital requirements for market risk apply on a worldwide consolidated basis.

(1) OSFI may permit banking and financial entities in a group which is running a global consolidated trading book and whose capital is being assessed on a global basis to include just the net short and net long risk positions no matter where they are booked.[5]

(2) OSFI may grant this treatment only when the standardized approach in section 9.5 permits a full offset of the risk position (i.e. risk positions of the opposite sign do not attract a capital requirement).

(3) Nonetheless, there will be circumstances in which OSFI demands that the individual risk positions be taken into the measurement system without any offsetting or netting against risk positions in the remainder of the group. This may be needed, for example, where there are obstacles to the quick repatriation of profits from a foreign subsidiary or where there are legal and procedural difficulties in carrying out the timely management of risks on a consolidated basis.

[3] For investments in capital and/or Other TLAC Instruments of banking, financial, or insurance entities, institutions should also refer to section 2.3 of Chapter 2 of this guideline and apply the applicable regulatory adjustment.

[4] 'Other TLAC Instruments' are defined under CAR Chapter 2, paragraph 53.

[5] The positions of less than wholly owned subsidiaries would be subject to the generally accepted accounting principles in the country where the parent company is supervised.

(4) Moreover, OSFI will retain the right to continue to monitor the market risks of individual entities on a non-consolidated basis to ensure that significant imbalances within a group do not escape supervision. OSFI will be especially vigilant in ensuring that institutions do not conceal risk positions on reporting dates in such a way as to escape measurement.

[Basel Framework, MAR11.6]

9.1.2.2 Methods of Measuring Market Risk

48. In determining its market risk for regulatory capital requirements, an institution may choose between two broad methodologies: the standardized approach and internal models approach (IMA) for market risk, described in section 9.5 and section 9.6, respectively, subject to the approval of OSFI. [Basel Framework, MAR11.7]

49. All institutions must calculate the capital requirements using the standardized approach. Institutions that are approved by OSFI to use the IMA for market risk capital requirements must also calculate and report the capital requirement values calculated as set out below.

(1) An institution that uses the IMA for any of its trading desks must also calculate the capital requirement under the standardized approach for all instruments across all trading desks, regardless of whether those trading desks are eligible for the IMA.

(2) In addition, an institution that uses the IMA for any of its trading desks must calculate the standardized approach capital requirement for each trading desk that is eligible for the IMA as if that trading desk were a standalone regulatory portfolio (i.e. with no offsetting across trading desks). This will:

   (a) serve as an indication of the fallback capital requirement for those desks that fail the eligibility criteria for inclusion in the institution's internal model as outlined in section 9.6;

   (b) generate information on the capital outcomes of the internal models relative to a consistent benchmark and facilitate comparison in implementation between institutions and/or across jurisdictions;

   (c) monitor over time the relative calibration of standardized and modelled approaches, facilitating adjustments as needed; and

   (d) provide macroprudential insight in an ex ante consistent format.

[Basel Framework, MAR11.8]

50. All institutions must calculate the market risk capital requirement using the standardized approach for the following:

(1) securitization exposures; and

(2) equity investments in funds that cannot be looked through but are assigned to the trading book in accordance to the conditions set out in paragraph 65(5)(b).

[Basel Framework, MAR11.9]

51. With respect to securitization exposures, asset backed securities that do not involve "at least two different stratified risk positions or tranches reflecting different degrees of credit risk" but might involve other sorts of tranching associated with pre-payment, as an example, are not considered products under this framework. As a consequence, such products can be treated as non-securitized positions for the purposes of credit spread risk capital requirements based on either the standardized framework or internal models. If in the standardized framework, these positions could also be subject to the residual risk add on if they are exposed to prepayment risk.

9.1.2.3 Definitions of Trading Desk

This section defines a trading desk, which is the level at which model approval is granted.

52. For the purposes of market risk capital calculations, a trading desk is a group of traders or trading accounts that implements a well-defined business strategy operating within a clear risk management structure. [Basel Framework, MAR12.1]

53. Trading desks are defined by the institution but subject to the regulatory approval of OSFI for capital purposes.

(1) An institution should be allowed to propose the trading desk structure per their organizational structure, consistent with the requirements set out in paragraph 55.

(2) An institution must prepare a policy document for each trading desk it defines, documenting how the institution satisfies the key elements in paragraph 55.

(3) OSFI will treat the definition of the trading desk as part of the initial model approval for the trading desk, as well as ongoing approval.

  (a) OSFI may determine, based on the size of the institution's overall trading operations, whether the proposed trading desk definitions are sufficiently granular.

  (b) OSFI will check that the institution's proposed definition of trading desk meets the criteria listed in key elements set out in paragraph 55.

[Basel Framework, MAR12.2]

54. Within this OSFI-approved trading desk structure, institutions may further define operational subdesks without the need for OSFI approval. These subdesks would be for internal operational purposes only and would not be used in the market risk capital framework. [Basel Framework, MAR12.3]

55. The key attributes of a trading desk are as follows:

(1) A trading desk for the purposes of the regulatory capital charge is an unambiguously defined group of traders or trading accounts.

  (a) A trading account is an indisputable and unambiguous unit of observation in accounting for trading activity.

(b) The trading desk must have one head trader and can have up to two head traders provided their roles, responsibilities and authorities are either clearly separated or one has ultimate oversight over the other.

(i) The head trader must have direct oversight of the group of traders or trading accounts.

(ii) Each trader or each trading account in the trading desk must have a clearly defined specialty (or specialties).

(c) Each trading account must only be assigned to a single trading desk. The desk must have a clearly defined risk scope consistent with its pre-established objectives. The scope should include specification of the desk's overall risk class and permitted risk factors.

(d) There is a presumption that traders (as well as head traders) are allocated to one trading desk. An institution can deviate from this presumption and may assign an individual trader to work across several trading desks provided it can be justified to OSFI on the basis of sound management, business and/or resource allocation reasons. Such assignments must not be made for the only purpose of avoiding other trading desk requirements (e.g. to optimize the likelihood of success in the backtesting and profit and loss attribution tests).

(e) The trading desk must have a clear reporting line to institution senior management, and should have a clear and formal compensation policy clearly linked to the pre-established objectives of the trading desk.

(2) A trading desk must have a well-defined and documented business strategy, including an annual budget and regular management information reports (including revenue, costs and risk-weighted assets).

(a) There must be a clear description of the economics of the business strategy for the trading desk, its primary activities and trading/hedging strategies.

(i) Economics: what is the economics behind the strategy (e.g. trading on the shape of the yield curve)? How much of the activities are customer driven? Does it entail trade origination and structuring, or execution services, or both?

(ii) Primary activities: what is the list of permissible instruments and, out of this list, which are the instruments most frequently traded?

(iii)Trading/hedging strategies: how would these instruments be hedged, what are the expected slippages and mismatches of hedges, and what is the expected holding period for positions?

(b) The management team at the trading desk (starting from the head trader) must have a clear annual plan for the budgeting and staffing of the trading desk.

(c) A trading desk's documented business strategy must include regular Management Information reports, covering revenue, costs and risk-weighted assets for the trading desk.

(3) A trading desk must have a clear risk management structure.

(a) Risk management responsibilities: the institution must identify key groups and personnel responsible for overseeing the risk-taking activities at the trading desk.

(b) A trading desk must clearly define trading limits based on the business strategy of the trading desk and these limits must be reviewed at least annually by senior management at the institution. In setting limits, the trading desk must have:

(i) well-defined trading limits or directional exposures at the trading desk level that are based on the appropriate market risk metric (e.g. sensitivity of credit spread risk and/or jump-to-default for a credit trading desk), or just overall notional limits; and

(ii) well-defined trader mandates.

(c) A trading desk under the internal model approach must produce, at least weekly, appropriate risk management reports. This would include, at a minimum:

(i) profit and loss reports, which would be periodically reviewed, validated and modified (if necessary) by Product Control; and

(ii) internal and regulatory risk measure reports, including trading desk VaR / ES, trading desk VaR/ES sensitivities to risk factors, backtesting and p-value.

[Basel Framework, MAR12.4]

56. The institution must prepare, evaluate, and have available for OSFI the following for all trading desks:

(1) inventory ageing reports;

(2) daily limit reports including exposures, limit breaches, and follow-up action;

(3) reports on intraday limits and respective utilization and breaches for institutions with active intraday trading; and

(4) reports on the assessment of market liquidity.

[Basel Framework, MAR12.5]

57. Any foreign exchange or commodity positions held in the banking book must be included in the market risk capital requirement as set out in paragraph 40. For regulatory capital calculation purposes, these positions will be treated as if they were held on notional trading desks within the trading book.

In the context of banking book FX and commodities positions, a “notional trading desk” does not necessarily have traders or trading accounts assigned to it, nor does it need to meet the qualitative trading desk requirements set out in this section. Institutions that wish to use the IMA to measure the FX or commodity risk of such notional trading desks must take at least one of the following actions:

(i) Transfer all or part of banking book FX and commodity risks to another trading desk via intra-trading book internal risk transfers (IRTs) (where trading desk requirements would continue to apply as appropriate for that desk);

(ii) Apply for IMA approval for the notional trading desk. In this case, the notional desk only needs to meet the quantitative trading desk requirements.

Subject to certain conditions, certain traders can have ownership and responsibilities in both trading book and banking book portfolios.

[Basel Framework, MAR12.6]

9.2. Boundary between the Banking Book and the Trading Book

This section sets out the instruments to be included in the trading book (which are subject to market risk capital requirements) and those to be included in the banking book (which are subject to credit risk capital requirements).

9.2.1 Scope of the Trading Book

58. A trading book consists of all instruments that meet the specifications for trading book instruments set out in paragraphs 59 through 70. All other instruments must be included in the banking book. [Basel Framework, RBC25.1]

59. Instruments comprise financial instruments, foreign exchange (FX), and commodities. A financial instrument is any contract that gives rise to both a financial asset of one entity and a financial liability or equity instrument of another entity. Financial instruments include primary financial instruments (or cash instruments) and derivative financial instruments. A financial asset is any asset that is cash, the right to receive cash or another financial asset or a commodity, or an equity instrument. A financial liability is the contractual obligation to deliver cash or another financial asset or a commodity. Commodities also include non-tangible (i.e. non-physical) goods such as electric power.

The CSR capital requirement applies to money market instruments to the extent such instruments are covered instruments (i.e. they meet the definition of instruments to be included in the trading book as specified in paragraphs 59 through 70. [Basel Framework, RBC25.2]

60. Institutions may only include a financial instrument, instruments on FX or commodity in the trading book when there is no legal impediment against selling or fully hedging it. [Basel Framework, RBC25.3]

61. Institutions must fair value daily any trading book instrument and recognize any valuation change in the profit and loss (P&L) account.

Instruments designated under the fair value option may be allocated to the trading book, but only if they comply with all the relevant requirements for trading book instruments set out in section 9.2. [Basel Framework, RBC25.4]

9.2.2 Standards for Assigning Instruments to the Regulatory Books

62. Any instrument an institution holds for one or more of the following purposes must, when it is first recognised on its books, be designated as a trading book instrument, unless specifically otherwise provided for in paragraph 60 or paragraph 64:

(1) short-term resale;

(2) profiting from short-term price movements;

(3) locking in arbitrage profits; or

(4) hedging risks that arise from instruments meeting (1), (2) or (3) above.

Evidence of periodic sale activity is insufficient on its own to consider such position as being held for short-term resale and, as such, is insufficient to meet sub-bullet (1).

[Basel Framework, RBC25.5]

63. Any of the following instruments is seen as being held for at least one of the purposes listed in paragraph 62 and must therefore be included in the trading book, unless specifically otherwise provided for in paragraph 60 or paragraph 65:

(1) instruments in the correlation trading portfolio;

(2) instruments that would give rise to a net short credit or equity position in the banking book;[6] or

(3) instruments resulting from underwriting commitments, where underwriting commitments refer only to securities underwriting, and relate only to securities that are expected to be actually purchased by the institution on the settlement date[7].

Institutions should have processes in place to manage and monitor their banking book positions to ensure that any instrument that individually has the potential to create a net short credit or equity position in the banking book is not actually creating a non-negligible net short position at any point in time. Such processes should include clear limit structures and an appropriate monitoring frequency. Institutions should be proactive in identifying potential non-negligible net short positions and limiting their occurrence.

As a general principle, instruments that give rise to a net short credit or equity position in the banking book must be assigned to the trading book unless a trading book treatment is explicitly excluded for the specific type of position. For example, if a credit default swap (CDS) that hedges loans in the banking book gives rise to a net short credit position, the net short position resulting from such instruments (i.e. the amount which cannot be offset against any long positions) must be treated as a trading book position and be subject to market risk capital requirements. [Basel Framework, RBC25.6]

[6] An institution will have a net short risk position for equity risk or credit risk in the banking book if the present value of the banking book increases when an equity price decreases or when a credit spread on an issuer or group of issuers of debt increases

[7] Within the context of positions that remain unsold after the underwriting period.

64. Any instrument which is not held for any of the purposes listed in paragraph 62 at inception, nor seen as being held for these purposes according to paragraph 63, must be assigned to the banking book. [Basel Framework, RBC25.7]

65. The following instruments must be assigned to the banking book:

(1) unlisted equities;

(2) instruments designated for securitization warehousing;

(3) real estate holdings, where in the context of assigning instrument to the trading book, real estate holdings relate only to direct holdings of real estate as well as derivatives on direct holdings;

(4) retail and small or medium-sized enterprise (SME) credit, including commitments;

(5) equity investments in a fund, unless the institution meets at least one of the following conditions:

  (a) the institution is able to look through the fund to its individual components at least on a quarterly basis, and there is sufficient and frequent information, verified by an independent third party, provided to the institution regarding the fund's composition; or

  (b) the institution obtains daily price quotes for the fund and it has access to the information contained in the fund's mandate or in the national regulations governing such investment funds;

(6) hedge funds;

(7) derivative instruments and funds that have the above instrument types as underlying assets; and

(8) instruments held for the purpose of hedging a particular risk of a position in the types of instrument above.

[Basel Framework, RBC25.8]

66. There is a general presumption that any of the following instruments are being held for at least one of the purposes listed in paragraph 62 and therefore are trading book instruments, unless specifically otherwise provided for in paragraph 60 or paragraph 65:

(1) instruments held as accounting trading assets or liabilities;[8]

(2) instruments resulting from market-making activities;

(3) equity investments in a fund excluding those assigned to the banking book in accordance with paragraph 65(5);

[8] Under IFRS (IAS 39) and US GAAP, these instruments would be designated as held for trading. Under IFRS 9, these instruments would be held within a trading business model. These instruments would be fair valued through the P&L account.

(4) listed equities;[9]

(5) trading-related repo-style transactions, which comprise those entered into for the purposes of market-making, locking in arbitrage profits or creating short credit or equity positions. Repo-style transactions that are (i) entered for liquidity management or (ii) valued at accrual for accounting purpose are not part of the presumptive list of paragraph 66. Institutions must have documentation for the definition of liquidity management and internal control processes to monitor these transactions, which should be made available to OSFI upon request; or

(6) options including embedded derivatives[10] from instruments that the institution issued out of its own banking book and that relate to credit or equity risk.

Liabilities issued out of the institution's own banking book that contain embedded derivatives and thereby meet the criteria of paragraph 66(6) should be bifurcated. This means that institutions should split the liability into two components: (i) the embedded derivative, which is assigned to the trading book; and (ii) the residual liability, which is retained in the banking book. No internal risk transfers are necessary for this bifurcation. Likewise, where such a liability is unwound, or where an embedded option is exercised, both the trading and banking book components are conceptually unwound simultaneously and instantly retired; no transfers between trading and banking book are necessary.

An option that manages FX risk in the banking book is covered by the presumptive list of trading book instruments included in paragraph 66(6). Only with explicit OSFI approval may an institution include in its banking book an option that manages banking book FX risk.

A floor to an equity-linked bond is an embedded option with an equity as part of the underlying, and therefore the embedded option should be bifurcated and included in the trading book.

[Basel Framework, RBC25.9]

67. Institutions are allowed to deviate from the presumptive list specified in paragraph 66 according to the process set out below.[11]

(1) If an institution believes that it needs to deviate from the presumptive list established in paragraph 66 for an instrument, it must submit a request to OSFI and receive explicit

9 Subject to OSFI's review, certain listed equities may be excluded from the market risk framework. Examples of equities that may be excluded include, but are not limited to, equity positions arising from deferred compensation plans, convertible debt securities, loan products with interest paid in the form of "equity kickers", equities taken as a debt previously contracted, institution-owned life insurance products, and legislated programmes. The set of listed equities that the institution wishes to exclude from the market risk framework should be made available to, and discussed with OSFI and should be managed by a desk that is separate from desks for proprietary or short-term buy/sell instruments.

10 An embedded derivative is a component of a hybrid contract that includes a non-derivative host such as liabilities issued out of the institution's own banking book that contain embedded derivatives. The embedded derivative associated with the issued instrument (i.e. host) should be bifurcated and separately recognised on the institution's balance sheet for accounting purposes.

11 The presumptions for the designation of an instrument to the trading book or banking book set out in this text will be used where a designation of an instrument to the trading book or banking book is not otherwise specified in this text.

approval. In its request, the institution must provide evidence that the instrument is not held for any of the purposes in paragraph 62.

(2) In cases where this approval is not given by OSFI, the instrument must be designated as a trading book instrument. Institutions must document any deviations from the presumptive list in detail on an on-going basis.

Repo-style transactions not held for any of the purposes in paragraph 62 can be exempted from the list of presumptive trading book instruments in paragraph 66(5) and can be designated in the banking book for regulatory capital purposes.

[Basel Framework, RBC25.10]

9.2.3 Supervisory Powers

68. Notwithstanding the process established in paragraph 67 for instruments on the presumptive list, OSFI may require the institution to provide evidence that an instrument in the trading book is held for at least one of the purposes of paragraph 62. If OSFI is of the view that an institution has not provided enough evidence or if OSFI believes the instrument customarily would belong in the banking book, it may require the institution to assign the instrument to the banking book, except if it is an instrument listed under paragraph 63. [Basel Framework, RBC25.11]

69. OSFI may require the institution to provide evidence that an instrument in the banking book is not held for any of the purposes of paragraph 62. If OSFI is of the view that an institution has not provided enough evidence, or if OSFI believes such instruments would customarily belong in the trading book, it may require the institution to assign the instrument to the trading book, except if it is an instrument listed under paragraph 65. [Basel Framework, RBC25.12]

9.2.4 Documentation of Instrument Designation

70. An institution must have clearly defined policies, procedures and documented practices for determining which instruments to include in or to exclude from the trading book for the purposes of calculating their regulatory capital, ensuring compliance with the criteria set forth in this section, and taking into account the institution's risk management capabilities and practices. An institution's internal control functions must conduct an ongoing evaluation of instruments both in and out of the trading book to assess whether its instruments are being properly designated initially as trading or non-trading instruments in the context of the institution'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 OSFI's review. [Basel Framework, RBC25.13]

9.2.5 Restrictions on Moving Instruments between the Regulatory Books

71. Apart from moves required by paragraphs 62 to 67, there is a strict limit on the ability of institutions to move instruments between the trading book and the banking book by their own discretion after initial designation, which is subject to the process in paragraphs 72 and 73. Switching instruments for regulatory arbitrage is strictly prohibited. In practice, switching should be rare and will be allowed by OSFI only in extraordinary circumstances. Examples are a major

publicly announced event, such as an institution restructuring that results in the permanent closure of trading desks, requiring termination of the business activity applicable to the instrument or portfolio or a change in accounting standards[12] that allows an item to be fair-valued through P&L. Market events, changes in the liquidity of a financial instrument, or a change of trading intent alone are not valid reasons for reassigning an instrument to a different book. When switching positions, institutions must ensure that the standards described in paragraphs 62 to 67 are always strictly observed. [Basel Framework, RBC25.14]

72. Without exception, a capital benefit as a result of switching will not be allowed in any case or circumstance. This means that the institution must determine its total capital requirement (across the banking book and trading book) before and immediately after the switch. If this capital requirement is reduced as a result of this switch, the difference as measured at the time of the switch will be imposed on the institution as a disclosed Pillar 1 capital surcharge. This surcharge will be allowed to run off as the positions mature or expire, in a manner agreed with OSFI. To maintain operational simplicity, it is not envisaged that this additional capital requirement would be recalculated on an ongoing basis, although the positions would continue to also be subject to the ongoing capital requirements of the book into which they have been switched. The disallowance of capital benefits as a result of switching positions from one book to another applies without exception and in any case or circumstance. It is therefore independent of whether the switch has been made at the discretion of the institution or is beyond its control, e.g. in the case of the delisting of an equity. [Basel Framework, RBC25.15]

73. Any reassignment between books must be approved by senior management and OSFI as follows. Any reallocation of securities between the trading book and banking book, including outright sales at arm’s length, should be considered a reassignment of securities and is governed by requirements of this paragraph.

(1) Any reassignment must be approved by senior management; thoroughly documented; determined by internal review to be in compliance with the institution’s policies; subject to prior approval by OSFI based on supporting documentation provided by the institution; and publicly disclosed.

(2) Unless required by changes in the characteristics of a position, any such reassignment is irrevocable.

(3) If an instrument is reclassified to be an accounting trading asset or liability there is a presumption that this instrument is in the trading book, as described in paragraph 66. Accordingly, in this case an automatic switch without approval of OSFI is acceptable.

The treatment specified for internal risk transfers applies only to risk transfers done via internal derivatives trades. The reallocation of securities between trading and banking book should be considered a re-assignment of securities and is governed by this paragraph.

Moving instruments between the trading book and the banking book should be rare. The movement of an instrument from the trading book to the banking book requires OSFI approval. Where an instrument is reclassified as an accounting trading asset or liability and per sub-bullet

[12] A change in accounting standards refers to the accounting standards themselves changing, rather than the accounting classification of an instrument changing.

(3) above, and is switched to a trading book instrument for capital requirement purposes without OSFI approval, the disallowance of capital requirement benefits specified in paragraph 72 will apply.

[Basel Framework, RBC25.16]

74. An institution must adopt relevant policies that must be updated at least yearly. Updates should be based on an analysis of all extraordinary events identified during the previous year. Updated policies with changes highlighted must be sent to OSFI. Policies must include the following:

(1) The reassignment restriction requirements in paragraphs 71 through 73, especially the restriction that re-designation between the trading book and banking book may only be allowed in extraordinary circumstances, and a description of the circumstances or criteria where such a switch may be considered.

(2) The process for obtaining senior management and OSFI approval for such a transfer.

(3) How an institution identifies an extraordinary event.

(4) A requirement that re-assignments into or out of the trading book be publicly disclosed at the earliest reporting date.

Institutions are permitted to exclude the following from the restrictions on moving instruments between regulatory books noted in paragraphs 71 to 73:

- CAD-denominated Level 1 and Level 2A High Quality Liquid Assets (HQLA); and
- non CAD-currency denominated Level 1 and Level 2A HQLA issued by Canadian entities[13], as defined in Chapter 2 of OSFI's *Liquidity Adequacy Requirements Guideline*.

[Basel Framework, RBC25.17]

9.2.6 Treatment of Internal Risk Transfers

75. An internal risk transfer is an internal written record of a transfer of risk within the banking book, between the banking and the trading book or within the trading book (between different desks). [Basel Framework, RBC25.18]

76. There will be no regulatory capital recognition for internal risk transfers from the trading book to the banking book. Thus, if an institution engages in an internal risk transfer from the trading book to the banking book (e.g. for economic reasons) this internal risk transfer would not be taken into account when the regulatory capital requirements are determined. [Basel Framework, RBC25.19]

[13] Canadian entities include the Government of Canada, the government of a province or territory within Canada, and an agent of any of those governments whose debts are, by virtue of the agent's governing legislation, guaranteed by the applicable government. Canadian entities also include any body corporate, trust, partnership, fund, and unincorporated association or organization formed under the laws of Canada, including under the laws of a province or territory within Canada.

77. For internal risk transfers from the banking book to the trading book, paragraphs 78 to 84 apply. [Basel Framework, RBC25.20]

Internal risk transfer of credit and equity risk from banking book to trading book

78. When an institution hedges a banking book credit risk exposure or equity risk exposure using a hedging instrument purchased through its trading book (i.e. using an internal risk transfer),

(1) The credit exposure in the banking book is deemed to be hedged for capital requirement purposes if and only if:

   (a) the trading book enters into an external hedge with an eligible third-party protection provider that exactly matches the internal risk transfer; and

   (b) the external hedge meets the requirements of paragraphs 265 to 270 of Chapter 4 vis-à-vis the banking book exposure.[14]

(2) The equity exposure in the banking book is deemed to be hedged for capital requirement purposes if and only if:

   (a) the trading book enters into an external hedge from an eligible third-party protection provider that exactly matches the internal risk transfer; and

   (b) the external hedge is recognized as a hedge of a banking book equity exposure.

External hedges for the purposes of paragraph 78(1) and 78(2) can be made up of multiple transactions with multiple counterparties as long as the aggregate external hedge exactly matches the internal risk transfer, and the internal risk transfer exactly matches the aggregate external hedge.

The term 'exactly matches' implies that the external hedge is considered to be effective if changes in fair value of the external hedge and the internal hedge are within a range of 90% to 110%. This assessment of effectiveness is to be done at inception and on a monthly basis thereafter, and the external hedge must be identified within five business days of the internal hedge. Institutions are expected to capture any residual risks add-on between the internal and external hedge with respect to instruments with exotic underlying and instruments bearing other residual risks, consistent with section 9.5.4.

[Basel Framework, RBC25.21]

79. Where the requirements in the paragraph above are fulfilled, the banking book exposure is deemed to be hedged by the banking book leg of the internal risk transfer for capital purposes in the banking book. Moreover both the trading book leg of the internal risk transfer and the external hedge must be included in the market risk capital requirements. [Basel Framework, RBC25.22]

[14] With respect to paragraphs 262 to 267 under Chapter 4, the cap of 60% on a credit derivative without a restructuring obligation only applies with regard to recognition of credit risk mitigation of the banking book instrument for regulatory capital purposes and not with regard to the amount of the internal risk transfer.

80. Where the requirements in paragraph 78 are not fulfilled, the banking book exposure is not deemed to be hedged by the banking book leg of the internal risk transfer for capital purposes in the banking book. Moreover, the third-party external hedge must be fully included in the market risk capital requirements and the trading book leg of the internal risk transfer must be fully excluded from the market risk capital requirements. [Basel Framework, RBC25.23]

81. A banking book short credit position or a banking book short equity position created by an internal risk transfer[15] and not capitalised under banking book rules must be capitalised under the market risk rules together with the trading book exposure. [Basel Framework, RBC25.24]

Internal risk transfer of general interest rate risk from banking book to trading book

82. When an institution hedges a banking book interest rate risk exposure using an internal risk transfer with its trading book on or after the beginning of the institution's fiscal Q1-2024, the trading book leg of the internal risk transfer is treated as a trading book instrument under the market risk framework if and only if:

(1) the internal risk transfer is documented with respect to the banking book interest rate risk being hedged and the sources of such risk;

(2) the internal risk transfer is conducted with a dedicated internal risk transfer trading desk which has been specifically approved by OSFI for this purpose; and

(3) the internal risk transfer must be subject to trading book capital requirements under the market risk framework on a stand-alone basis for the dedicated internal risk transfer desk, separate from any other GIRR or other market risks generated by activities in the trading book.

Similar to the notional trading desk treatment set out in paragraph 57 for foreign exchange or commodities positions held in the banking book, general interest rate (GIRR) internal risk transfers (IRT) may be allocated to a trading desk that may not have traders or trading account assigned to it. For a GIRR IRT trading desk, only the quantitative requirements (i.e. PLA test and backtesting) set out in section 9.6.3 apply[16], while the qualitative criteria for trading desks as set out in paragraph 55 do not apply. A GIRR IRT desk must not have any trading book positions allocated to it, except GIRR IRTs between the trading book and the banking book as well as any external hedges that meet the conditions specified in paragraph 84.

[Basel Framework, RBC25.25]

83. Where the requirements in paragraph 82 above are fulfilled, the banking book leg of the internal risk transfer must be included in the banking book's measure of interest rate risk exposures for regulatory capital purposes. When the requirements in paragraph 82 are not fulfilled, the third-party external hedge must be fully included in the market risk capital

[15] Banking book instruments that are over-hedged by their respective documented internal risk transfer create a short (risk) position in the banking book

[16] The PLA test and backtesting requirements are specific to the IMA and do not apply to GIRR IRT desks or other notional desks of institutions that have their entire portfolios and desks under the standardized approach.

requirements and the trading book leg of the internal risk transfer must be fully excluded from the market risk capital requirements. [Basel Framework, RBC25.26]

84. The OSFI-approved internal risk transfer desk may include instruments purchased from the market (i.e. external parties to the institution). Such transactions may be executed directly between the internal risk transfer desk and the market. Alternatively, the internal risk transfer desk may obtain the external hedge from the market via a separate non-internal risk transfer trading desk acting as an agent, if and only if the GIRR internal risk transfer entered into with the non-internal risk transfer trading desk exactly matches the external hedge from the market. In this latter case the respective legs of the GIRR internal risk transfer are included in the internal risk transfer desk and the non-internal risk transfer desk.

External hedges for the purposes of this paragraph can be made up of multiple transactions with multiple counterparties as long as the aggregate external hedge exactly matches the internal risk transfer, and the internal risk transfer exactly matches the aggregate external hedge.

The term ‘exactly matches’ implies that the external hedge is considered to be effective if changes in fair value of the external hedge and the internal hedge are within a range of 90% to 110%. This assessment of effectiveness is to be done at inception and on a monthly basis thereafter, and the external hedge must be identified within five business days of the internal hedge. Institutions are expected to capture any residual risks add-on between the internal and external hedge with respect to instruments with exotic underlying and instruments bearing other residual risks, consistent with section 9.5.4.

[Basel Framework, RBC25.27]

Internal risk transfers within the scope of application of the market risk capital requirement

85. Internal risk transfers between trading desks within the scope of application of the market risk capital requirements (including FX risk and commodities risk in the banking book) will generally receive regulatory capital recognition. Internal risk transfers between the internal risk transfer desk and other trading desks will only receive regulatory capital recognition if the constraints in paragraphs 82 to 84 are fulfilled.

There are no constraints on IRTs between trading desks that have internal model approval and trading desks that do not. In order to ensure a sufficiently conservative aggregation of risks, the aggregation of the capital requirements calculated using the standardized approach and the internal models approach does not recognize portfolio effects between trading desks that use either the standardized approach or the internal models approach.

[Basel Framework, RBC25.28]

86. The trading book leg of internal risk transfers must fulfil the same requirements under paragraph 82 as instruments in the trading book transacted with external counterparties. [Basel Framework, RBC25.29]

Eligible hedges for the CVA capital requirement

87. Eligible external hedges that are included in the credit valuation adjustment (CVA) capital requirement, and FX and commodity risk arising from CVA hedges that are eligible under the CVA standard, must be removed from the institution's market risk capital requirement calculation. [Basel Framework, RBC25.30]

88. Institutions may enter into internal risk transfers between the CVA portfolio and the trading book. Such an internal risk transfer consists of a CVA portfolio side and a non-CVA portfolio side. Where the CVA portfolio side of an internal risk transfer is recognised in the CVA risk capital requirement, the CVA portfolio side should be excluded from the market risk capital requirement, while the non-CVA portfolio side should be included in the market risk capital requirement. [Basel Framework, RBC25.31]

89. In any case, such internal CVA risk transfers can only receive regulatory capital recognition if the internal risk transfer is documented with respect to the CVA risk being hedged and the sources of such risk. [Basel Framework, RBC25.32]

90. Internal CVA risk transfers that are subject to curvature, default risk or residual risk add-on as set out in section 9.5 may be recognised in the CVA portfolio capital requirement and market risk capital requirement only if the trading book additionally enters into an external hedge with an eligible third-party protection provider that exactly matches the internal risk transfer. [Basel Framework, RBC25.33]

91. Independent from the treatment in the CVA risk capital requirement and the market risk capital requirement, internal risk transfers between the CVA portfolio and the trading book can be used to hedge the counterparty credit risk exposure of a derivative instrument in the trading or banking book as long as the requirements of paragraph 78 are met. [Basel Framework, RBC25.34]

92. The revised CVA framework (see Chapter 8) now captures both the risk and hedges of CVA (including both the credit risk and exposure components). As such, any other transactions related to the management of CVA risk will not be covered in the market risk framework. In addition, institutions are not permitted to include sensitivities to other valuation adjustment (commonly referred to as xVA) in the market risk framework. However, any market risk hedges of xVA risk must be included in the market risk framework with the following exceptions:

- Any market risk hedges of collateral valuation adjustments (ColVA sometimes referred to as overnight indexed swap or OIS discounting) that meet the conditions for eligibility listed in the paragraph below; and,

- Any market risk hedges of the exposure component of funding VA (FVA)[17].

[17] FVA can be split into a funding (or cost of funds) component and an exposure component. Hedges of the cost of funds component must be included in the market risk framework.

Hedges of ColVA and hedges of the exposure component of FVA can be excluded from the market risk framework if all of the following conditions are met:

- Institutions have a well-defined and nominated trading desk that satisfies the organizational structure described in paragraph 55. That structure must include an independent risk control unit responsible for the design, documentation, and implementation of the measurement of FVA and ColVA risk. This unit should report directly to senior management of the institution.

- The excluded hedges are evidenced to be risk reducing at their inception according to the documented measure of FVA and/or ColVA risk through the use of: (i) risk factor identification processes, (ii) regular assessment of risk capture between unhedged- and hedged-P&L, (iii) P&L attribution assessment and stress testing programs as described in paragraph 273 and; (iv) an independent model validation process as per paragraph 274.

- The excluded hedges are initiated, tracked and managed as a hedge of either ColVA or the exposure component of FVA in accordance with internal protocols for compliance that are consistent with paragraph 279 and internal audit/validation functions in paragraph 282.

Institutions must measure and monitor the effectiveness of the excluded hedges in normal conditions and in times of stress. Institutions should assess any material residual or basis risk as part of their stress testing programs (e.g., ICAAP, etc.) and account for this in Pillar 2 capital in excess of minimum requirements commensurate with their risk profile.

OSFI will consider other regulatory frameworks as being adequate substitutes for meeting these requirements in order to mitigate duplication for institutions seeking these exemptions.

9.3. Counterparty Credit Risk in the Trading Book

93. Institutions must calculate the counterparty credit risk charge for over-the-counter (OTC) derivatives, repo-style and other transactions booked in the trading book, separate from the capital requirement for market risk[18]. The risk weights to be used in this calculation must be consistent with those used for calculating the capital requirements in the banking book. Thus, institutions using the standardized approach in the banking book will use the standardized approach risk weights in the trading book and institutions using the internal ratings-based (IRB) approach in the banking book will use the IRB risk weights in the trading book in a manner consistent with the IRB roll-out situation in the banking book as described in section 5.2.3 of Chapter 5. For counterparties included in portfolios where the IRB approach is being used, the IRB risk weights will have to be applied.

In the trading book, for repo-style transactions, all instruments, which are included in the trading book, may be used as eligible collateral. Those instruments which fall outside the banking book

[18] The treatment for unsettled foreign exchange and securities trades is set forth in Chapter 7.

definition of eligible collateral shall be subject to a haircut at the level applicable to non-main index equities listed on recognized exchanges (as noted in paragraph 239 of Chapter 4). Where institutions are using a value-at-risk approach to measuring exposure for securities financing transactions, they also may apply this approach in the trading book in accordance with paragraph 125 to 128 of Chapter 5 and Chapter 7. The calculation of the counterparty credit risk charge for collateralized OTC derivative transactions is the same as the rules prescribed for such transactions booked in the banking book (see Chapter 7).

The calculation of the counterparty charge for repo-style transactions will be conducted using the rules in Chapter 7 spelt out for such transactions booked in the banking book. The firm-size adjustment for small or medium-sized entities as set out in paragraph 69 of Chapter 5 shall also be applicable in the trading book. [Basel Framework, CRE55]

9.4. Prudent Valuation Guidance

9.4.1 Introduction

94. This section provides institutions with guidance on prudent valuation for positions that are accounted for at fair value, whether they are in the trading book or in the banking book. This guidance is especially important for positions without actual market prices or observable inputs to valuation, as well as less liquid positions which raise OSFI concerns about prudent valuation. The valuation guidance set forth below is not intended to require institutions to change valuation procedures for financial reporting purposes. OSFI will assess an institution's valuation procedures for consistency with this guidance. One fact in OSFI's assessment of whether an institution must take a valuation adjustment for regulatory purposes under paragraphs 104 to 107 should be the degree of consistency between the institution's valuation procedures and these guidelines. [Basel Framework, CAP50.1]

95. A framework for prudent valuation practices should at a minimum include the following. [Basel Framework, CAP50.2]

9.4.2 Systems and Controls

96. Institutions must establish and maintain adequate systems and controls sufficient to give management and OSFI the confidence that their valuation estimates are prudent and reliable. These systems must be integrated with other risk management systems within the organization (such as credit analysis). Such systems must include:

(1) Documented policies and procedures for the process of valuation. This includes clearly defined responsibilities of the various areas involved in the determination of the valuation, sources of market information and review of their appropriateness, guidelines for the use of unobservable inputs reflecting the institution's assumptions of what market participants would use in pricing the position, frequency of independent valuation, timing of closing prices, procedures for adjusting valuations, end of the month and ad-hoc verification procedures; and

(2) Clear and independent (i.e. independent of front office) reporting lines for the department accountable for the valuation process. The reporting line should ultimately be to a main member of senior management.

[Basel Framework, CAP50.3]

9.4.3 Valuation Methodologies

Marking to market

97. Marking-to-market is at least the daily valuation of positions at readily available close out prices that are sourced independently. Examples of readily available close out prices include exchange prices, screen prices, or quotes from several independent reputable brokers. [Basel Framework, CAP50.4]

98. Institutions must mark-to-market as much as possible. The more prudent side of bid/offer should be used unless the institution is a significant market maker in a particular position type and it can close out at mid-market. Institutions should maximise the use of relevant observable inputs and minimise the use of unobservable inputs when estimating fair value using a valuation technique. However, observable inputs or transactions may not be relevant, such as in a forced liquidation or distressed sale, or transactions may not be observable, such as when markets are inactive. In such cases, the observable data should be considered, but may not be determinative. [Basel Framework, CAP50.5]

Marking to model

99. Only where marking-to-market is not possible should institutions mark-to-model, but this must be demonstrated to be prudent. Marking-to-model is defined as any valuation which has to be benchmarked, extrapolated or otherwise calculated from a market input. When marking to model, an extra degree of conservatism is appropriate. OSFI will consider the following in assessing whether a mark-to-model valuation is prudent:

(1) Senior management should be aware of the elements of the trading book or other fair-valued positions which are subject to mark to model and should understand the materiality of the uncertainty this creates in the reporting of the risk/performance of the business.

(2) Market inputs should be sourced, to the extent possible, in line with market prices (as discussed above). The appropriateness of the market inputs for the particular position being valued should be reviewed regularly.

(3) Where available, generally accepted valuation methodologies for particular products should be used as far as possible.

(4) Where the model is developed by the institution itself, it should be based on appropriate assumptions, which have been assessed and challenged by suitably qualified parties independent of the development process. The model should be developed or approved independently of the front office. It should be independently tested. This includes validating the mathematics, the assumptions and the software implementation.

(5) There should be formal change control procedures in place and a secure copy of the model should be held and periodically used to check valuations.

(6) Risk management should be aware of the weaknesses of the models used and how best to reflect those in the valuation output.

(7) The model should be subject to periodic review to determine the accuracy of its performance (e.g. assessing continued appropriateness of the assumptions, analysis of profit and loss versus risk factors, comparison of actual close out values to model outputs).

(8) Valuation adjustments should be made as appropriate, for example, to cover the uncertainty of the model valuation (see also valuation adjustments in paragraphs 102 to 107).

[Basel Framework, CAP50.6]

Independent price verification

100. Independent price verification is distinct from daily mark-to-market. It is the process by which market prices or model inputs are regularly verified for accuracy. While daily marking-to-market may be performed by dealers, verification of market prices or model inputs should be performed by a unit independent of the dealing room, at least monthly (or, depending on the nature of the market/trading activity, more frequently). It need not be performed as frequently as daily mark-to-market, since the objective, i.e. independent, marking of positions, should reveal any error or bias in pricing, which should result in the elimination of inaccurate daily marks. [Basel Framework, CAP50.7]

101. Independent price verification entails a higher standard of accuracy in that the market prices or model inputs are used to determine profit and loss figures, whereas daily marks are used primarily for management reporting in between reporting dates. For independent price verification, where pricing sources are more subjective, e.g. only one available broker quote, prudent measures such as valuation adjustments may be appropriate. [Basel Framework, CAP50.8]

9.4.4 Valuation Adjustments

102. As part of their procedures for marking to market, institutions must establish and maintain procedures for considering valuation adjustments. OSFI expects institutions using third-party valuations to consider whether valuation adjustments are necessary. Such considerations are also necessary when marking to model. [Basel Framework, CAP50.9]

103. OSFI expects the following valuation adjustments/reserves to be formally considered at a minimum: unearned credit spreads, close-out costs, operational risks, early termination, investing and funding costs, and future administrative costs and, where appropriate, model risk. OSFI also expects that the valuation adjustment will be considered for positions individually (i.e. adjustments should be reflected in the valuation of the individual transactions) rather than on a portfolio level (i.e. adjustments are made in the form of a reserve for a portfolio of exposures and are not reflected in the valuation of the individual transactions). [Basel Framework, CAP50.10]

9.4.5 Adjustment to the Current Valuation of Less Liquid Positions for Regulatory Capital Purposes

104. Institutions must establish and maintain procedures for judging the necessity of and calculating an adjustment to the current valuation of less liquid positions for regulatory capital purposes. This adjustment may be in addition to any changes to the value of the position required for financial reporting purposes and should be designed to reflect the illiquidity of the position. OSFI expects institutions to consider the need for an adjustment to a position's valuation to reflect current illiquidity whether the position is marked to market using market prices or observable inputs, third-party valuations or marked to model. [Basel Framework, CAP50.11]

105. Bearing in mind that the assumptions made about liquidity in the market risk capital requirement may not be consistent with the institution's ability to sell or hedge out less liquid positions, where appropriate, institutions must take an adjustment to the current valuation of these positions, and review their continued appropriateness on an on-going basis. Reduced liquidity may have arisen from market events. Additionally, close-out prices for concentrated positions and/or stale positions should be considered in establishing the adjustment. Institutions must consider all relevant factors when determining the appropriateness of the adjustment for less liquid positions. These factors may include, but are not limited to, the amount of time it would take to hedge out the position/risks within the position, the average volatility of bid/offer spreads, the availability of independent market quotes (number and identity of market makers), the average and volatility of trading volumes (including trading volumes during periods of market stress), market concentrations, the aging of positions, the extent to which valuation relies on marking-to-model, and the impact of other model risks not included in the paragraph above. [Basel Framework, CAP50.12]

106. For complex products including, but not limited to, securitization exposures and n-th-to-default credit derivatives, institutions must explicitly assess the need for valuation adjustments to reflect two forms of model risk: the model risk associated with using a possibly incorrect valuation methodology; and the risk associated with using unobservable (and possibly incorrect) calibration parameters in the valuation model. [Basel Framework, CAP50.13]

107. The adjustment to the current valuation of less liquid positions made under paragraph 105 must impact Common Equity Tier 1 regulatory capital and may exceed those valuation adjustments made under financial reporting standards and paragraphs 102 and 103. [Basel Framework, CAP50.14]

9.5. Standardized Approach

9.5.1 GENERAL PROVISIONS AND STRUCTURE

This section sets out the general provisions and the structure of the standardized approach for calculating risk-weighted assets for market risk.

9.5.1.1 General Provisions

108. The risk-weighted assets for market risk under the standardized approach are determined by multiplying the capital requirements calculated as set out in this section by 12.5. [Basel Framework, MAR20.1]

109. Capital requirements under the standardized approach must be calculated and reported to OSFI on a monthly basis. Subject to OSFI approval, capital requirements under the standardized approach for market risks arising from non-banking subsidiaries of an institution may be calculated and reported to OSFI on a quarterly basis.

[Basel Framework, MAR20.2]

110. An institution must also determine its regulatory capital requirements for market risk according to the standardized approach for market risk at the demand of OSFI. [Basel Framework, MAR20.3]

9.5.1.2 Structure of the Standardized Approach

111. The standardized approach capital requirement is the simple sum of three components: the capital requirement under the sensitivities-based method, the default risk capital (DRC) requirement and the residual risk add-on (RRAO).

(1) The capital requirement under the sensitivities-based method must be calculated by aggregating three risk measures – delta, vega and curvature, as set out in section 9.5.2:

   (a) *Delta*: a risk measure based on sensitivities of an instrument to regulatory delta risk factors.

   (b) *Vega*: a risk measure based on sensitivities to regulatory vega risk factors.

   (c) *Curvature*: a risk measure which captures the incremental risk not captured by the delta risk measure for price changes in an option. Curvature risk is based on two stress scenarios involving an upward shock and a downward shock to each regulatory risk factor.

   (d) The above three risk measures specify risk weights to be applied to the regulatory risk factor sensitivities. To calculate the overall capital requirement, the risk-weighted sensitivities are aggregated using specified correlation parameters to recognize diversification benefits between risk factors. In order to address the risk that correlations may increase or decrease in periods of financial stress, an institution must calculate three sensitivities-based method capital requirement values, based on three different scenarios on the specified values for the correlation parameters as set out in paragraphs 118 and 119.

(2) The DRC requirement captures the jump-to-default risk for instruments subject to credit risk as set out in paragraph 215. It is calibrated based on the credit risk treatment in the banking book in order to reduce the potential discrepancy in capital requirements for similar risk exposures across the institution. Some hedging recognition is allowed for

similar types of exposures (corporates, sovereigns, and local governments/municipalities).

(3) Given recognition that not all market risks can be captured in the standardized approach so as to avoid an unduly complex regime, an RRAO ensures sufficient coverage of market risks for instruments specified in paragraph 260. The calculation method for the RRAO is set out in paragraph 266.

[Basel Framework, MAR20.4]

9.5.1.3 Definition of Correlation Trading Portfolio

112. For the purpose of calculating the credit spread risk capital requirement under the sensitivities based method and the DRC requirement, the correlation trading portfolio is defined as the set of instruments that meet the requirements of (1) or (2) below.

(1) The instrument is a securitization position that meets the following requirements:

  (a) The instrument is not a re-securitization position, nor a derivative of securitization exposures that does not provide a pro rata share in the proceeds of a securitization tranche, where the definition of securitization position is identical to that used in the credit risk framework.

  (b) All reference entities are single-name products, including single-name credit derivatives, for which a liquid two-way market exists,[19] including traded indices on these reference entities.

  (c) The instrument does not reference an underlying that is treated as a retail exposure, a residential mortgage exposure, or a commercial mortgage exposure under the standardized approach to credit risk.

  (d) The instrument does not reference a claim on a special purpose entity.

(2) The instrument is a non-securitization hedge to a position described above.

[Basel Framework, MAR20.5]

9.5.2 SENSITIVITIES-BASED METHOD

This section sets out the calculation of the sensitivities-based method under the standardized approach for market risk.

9.5.2.1 Main Concepts of the Sensitivities-Based Method

113. The sensitivities of financial instruments to a prescribed list of risk factors are used to calculate the delta, vega and curvature risk capital requirements. These sensitivities are risk-weighted and then aggregated, first within risk buckets (risk factors with common

[19] A two-way market is deemed to exist where there are independent bona fide offers to buy and sell so that a price reasonably related to the last sales price or current bona fide competitive bid-ask quotes can be determined within one day and the transaction settled at such price within a relatively short time frame in conformity with trade custom.

characteristics) and then across buckets within the same risk class as set out in paragraphs 120 to 127.[20] The following terminology is used in the sensitivities-based method:

(1) Risk class: seven risk classes are defined in paragraphs 151 to 201. The eighth risk class (Crypto-asset risk) is defined in the *Capital and Liquidity Treatment of Crypto-asset Exposures* Guideline.

  (a) General interest rate risk (GIRR)

  (b) Credit spread risk (CSR): non-securitizations

  (c) CSR: securitizations (non-correlation trading portfolio, or non-CTP)

  (d) CSR: securitizations (correlation trading portfolio, or CTP)

  (e) Equity risk

  (f) Commodity risk

  (g) Foreign exchange (FX) risk

  (h) Crypto-asset risk

(2) Risk factor: variables (e.g. an equity price or a tenor of an interest rate curve) that affect the value of an instrument as defined in paragraphs 121 to 127.[21]

(3) Bucket: a set of risk factors that are grouped together by common characteristics (e.g. all tenors of interest rate curves for the same currency), as defined in paragraphs 151 to 201.[22]

(4) Risk position: the portion of the risk of an instrument that relates to a risk factor. Methodologies to calculate risk positions for delta, vega and curvature risks are set out in paragraph 115 to 117 and paragraphs 127 to 138.[23]

  (a) For delta and vega risks, the risk position is a sensitivity to a risk factor.

  (b) For curvature risk, the risk position is based on losses from two stress scenarios.

(5) Risk capital requirement: the amount of capital that an institution should hold as a consequence of the risks it takes; it is computed as an aggregation of risk positions first at the bucket level, and then across buckets within a risk class defined for the sensitivities-based method as set out in paragraphs 115 to 119.[24]

[Basel Framework, MAR21.1]

[20] For the “Crypto-asset risk” risk class introduced in paragraph 113 sub-bullet (1)(h), please refer to the *Capital and Liquidity Treatment of Crypto-asset Exposures* Guideline.

[21] For the “Crypto-asset risk” risk class introduced in paragraph 113 sub-bullet (1)(h), please refer to the *Capital and Liquidity Treatment of Crypto-asset Exposures* Guideline.

[22] For the “Crypto-asset risk” risk class introduced in paragraph 113 sub-bullet (1)(h), please refer to the *Capital and Liquidity Treatment of Crypto-asset Exposures* Guideline.

[23] For the “Crypto-asset risk” risk class introduced in paragraph 113 sub-bullet (1)(h), please refer to the *Capital and Liquidity Treatment of Crypto-asset Exposures* Guideline.

[24] For the “Crypto-asset risk” risk class introduced in paragraph 113 sub-bullet (1)(h), please refer to the *Capital and Liquidity Treatment of Crypto-asset Exposures* Guideline.

9.5.2.2 Instruments Subject to Each Component of the Sensitivities-Based Method

114. In applying the sensitivities-based method, all instruments held in trading desks as set out in paragraph 52 to 57 and subject to the sensitivities-based method (i.e. excluding instruments where the value at any point in time is purely driven by an exotic underlying as set out in paragraph 261), are subject to delta risk capital requirements. Additionally, the instruments specified in (1) to (4) are subject to vega and curvature risk capital requirements:

(1) Any instrument with optionality[25].

(2) Any instrument with an embedded prepayment option[26] – this is considered an instrument with optionality according to above (1). The embedded option is subject to vega and curvature risk with respect to interest rate risk and CSR (non-securitization and securitization) risk classes. When the prepayment option is a behavioural option the instrument may also be subject to the residual risk add-on (RRAO) as per section 9.5.4. The pricing model of the institution must reflect such behavioural patterns where relevant. For securitization tranches, instruments in the securitized portfolio may have embedded prepayment options as well. In this case the securitization tranche may be subject to the RRAO.

(3) Instruments whose cash flows cannot be written as a linear function of underlying notional. For example, the cash flows generated by a plain-vanilla option cannot be written as a linear function (as they are the maximum of the spot and the strike). Therefore, all options are subject to vega risk and curvature risk. Instruments whose cash flows can be written as a linear function of underlying notional are instruments without optionality (e.g. cash flows generated by a coupon bearing bond can be written as a linear function) and are not subject to vega risk nor curvature risk capital requirements.

(4) Curvature risks may be calculated for all instruments subject to delta risk, not limited to those subject to vega risk as specified in (1) to (3) above. For example, where an institution manages the non-linear risk of instruments with optionality and other instruments holistically, the institution may choose to include instruments without optionality in the calculation of curvature risk. This treatment is allowed subject to all of the following restrictions:

   (a) Use of this approach shall be applied consistently through time.[27]

   (b) Curvature risk must be calculated for all instruments subject to the sensitivities-based method.

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25 For example, each instrument that is an option or that includes an option (e.g. an embedded option such as convertibility or rate dependent prepayment and that is subject to the capital requirements for market risk). A non-exhaustive list of example instruments with optionality includes: calls, puts, caps, floors, swaptions, barrier options and exotic options.

26 An instrument with a prepayment option is a debt instrument which grants the debtor the right to repay part of or the entire principal amount before the contractual maturity without having to compensate for any foregone interest. The debtor can exercise this option with a financial gain to obtain funding over the remaining maturity of the instrument at a lower rate in other ways in the market.

27 When an institution chooses to include instruments without optionality in the calculation of curvature risk, there should be a consistent approach applied at each desk level over time. Should changes be necessary as a result of major methodology or infrastructure enhancements, OSFI should be notified.

[Basel Framework, MAR21.2]

9.5.2.3 Process to Calculate the Capital Requirement under the Sensitivities-Based Method

115. As set out in paragraph 113, the capital requirement under the sensitivities-based method is calculated by aggregating delta, vega and curvature capital requirements. The relevant paragraphs that describe this process are as follows:

(1) The risk factors for delta, vega and curvature risks for each risk class are defined in paragraphs 120 to 126.

(2) The methods to risk weight sensitivities to risk factors and aggregate them to calculate delta and vega risk positions for each risk class are set out in paragraph 116 and paragraphs 127 to 207, which include the definition of delta and vega sensitivities, definition of buckets, risk weights to apply to risk factors, and correlation parameters.

(3) The methods to calculate curvature risk are set out in paragraph 117 and paragraphs 208 to 213, which include the definition of buckets, risk weights and correlation parameters.

(4) The risk class level capital requirement calculated above must be aggregated to obtain the capital requirement at the entire portfolio level as set out in paragraphs 118 and 119.

[Basel Framework, MAR21.3]

Calculation of the delta and vega risk capital requirement for each risk class

116. For each risk class, an institution must determine its instruments' sensitivity to a set of prescribed risk factors, risk weight those sensitivities, and aggregate the resulting risk-weighted sensitivities separately for delta and vega risk using the following step-by-step approach:

(1) For each risk factor as defined in paragraphs 120 to 126, a sensitivity is determined as set out in paragraphs 127 to 150.

(2) Sensitivities to the same risk factor must be netted to give a net sensitivity s_k across all instruments in the portfolio to each risk factor *k*. In calculating the net sensitivity, all sensitivities to the same given risk factor (e.g. all sensitivities to the one-year tenor point of the three-month Euribor swap curve) from instruments of opposite direction should offset, irrespective of the instrument from which they derive. For instance, if an institution's portfolio is made of two interest rate swaps on three-month Euribor with the same fixed rate and same notional but of opposite direction, the GIRR on that portfolio would be zero.

(3) The weighted sensitivity WS_k is the product of the net sensitivity s_k and the corresponding risk weight RW_k as defined in paragraphs 151 to 207.

$$WS_k = RW_k s_k$$

(4) Within bucket aggregation: 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 prescribed correlation ρ_{kl} set out in the following formula, where the quantity within the square root function is floored at zero:

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

(5) Across bucket aggregation: The delta (respectively vega) risk capital requirement is calculated by aggregating the risk positions across the delta (respectively vega) buckets within each risk class, using the corresponding prescribed correlations γ_{bc} as set out in the following formula, where:

(a) $S_b = \sum_k WS_k$ for all risk factors in bucket *b,* and $S_c = \sum_k WS_k$ in bucket *c.*

(b) If these values for S_b and S_c described in above sub paragraph 116(a) produce a negative number for the overall sum of $\sum_b K_b^2 + \sum_b \sum_{c \neq b} \gamma_{bc} S_b S_c$, the institution is to calculate the delta (respectively vega) risk capital requirement using an alternative specification whereby:

(i) $S_b = \max\left[\min\left(\sum_k WS_k, K_b\right), -K_b\right]$ for all risk factors in bucket *b;* and

(ii) $S_c = \max\left[\min\left(\sum_k WS_k, K_c\right), -K_c\right]$ for all risk factors in bucket *c.*

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

[Basel Framework, MAR21.4]

Calculation of the curvature risk capital requirement for each risk class

117. For each risk class, to calculate curvature risk capital requirements an institution must apply an upward shock and a downward shock to each prescribed risk factor and calculate the incremental loss for instruments sensitive to that risk factor above that already captured by the delta risk capital requirement using the following step-by-step approach:

(1) For each instrument sensitive to curvature risk factor *k,* an upward shock and a downward shock must be applied to *k*. The size of shock (i.e. risk weight) is set out in paragraphs 210 and 211.

(a) For example for GIRR, all tenors of all the risk free interest rate curves within a given currency (e.g. three-month Euribor, six-month Euribor, one year Euribor, etc. for the euro) must be shifted upward applying the risk weight as set out in paragraph 211. The resulting potential loss for each instrument, after the deduction of the delta risk positions, is the outcome of the upward scenario. The same approach must be followed on a downward scenario.

(b) If the price of an instrument depends on several risk factors, the curvature risk must be determined separately for each risk factor.

(2) The net curvature risk capital requirement, determined by the values CVR_k^+ and CVR_k^- for an institution's portfolio for risk factor *k* described in the above paragraph is calculated

by the formula below. It calculates the aggregate incremental loss beyond the delta capital requirement for the prescribed shocks, where

(a) i is an instrument subject to curvature risks associated with risk factor k;

(b) x_k is the current level of risk factor k;

(c) $V_i(x_k)$ is the price of instrument i at the current level of risk factor k;

(d) $V_i\left(x_k^{(RW^{(curvature)}+)}\right)$ and $V_i\left(x_k^{(RW^{(curvature)}-)}\right)$ denote the price of instrument i after x_k is shifted (i.e. "shocked") upward and downward respectively;

(e) $RW_k^{(curvature)}$ is the risk weight for curvature risk factor k for instrument *i;* and

(f) s_{ik} is the delta sensitivity of instrument *i* with respect to the delta risk factor that corresponds to curvature risk factor *k,* where:

(i) for the FX and equity risk classes, s_{ik} is the delta sensitivity of instrument i; and

(ii) for the GIRR, CSR and commodity risk classes, s_{ik} is the sum of delta sensitivities to all tenors of the relevant curve of instrument *i* with respect to curvature risk factor *k*.

$$CVR_k^+ = -\sum_i \left\{V_i(x_k^{RW(Curvature)^+}) - V(x_k) - RW_k^{Curvature} \times s_{ik}\right\}$$

$$CVR_k^- = -\sum_i \left\{V_i\left(x_k^{RW(Curvature)^-}\right) - V(x_k) + RW_k^{Curvature} \times s_{ik}\right\}$$

(3) Within bucket aggregation: the curvature risk exposure must be aggregated within each bucket using the corresponding prescribed correlation ρ_{kl} as set out in the following formula, where:

(a) The bucket level capital requirement (K_b) is determined as the greater of the capital requirement under the upward scenario (K_b^+) and the capital requirement under the downward scenario (K_b^-). Notably, the selection of upward and downward scenarios is not necessarily the same across the high, medium and low correlations scenarios specified in the paragraph below.

(i) Where $K_b = K_b^+$, this shall be termed "selecting the upward scenario".

(ii) Where $K_b = K_b^-$, this shall be termed "selecting the downward scenario".

(iii)In the specific case where $K_b^+ = K_b^-$, if $\sum_k CVR_k^+ > \sum_k CVR_k^-$, it is deemed that the upward scenario is selected; otherwise the downward scenario is selected.

(b) $\psi(CVR_k, CVR_l)$ takes the value 0 if CVR_k and CVR_l both have negative signs and the value 1 otherwise.

$$K_b = \max(K_b^+, K_b^-),$$

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

(4) Across bucket aggregation: curvature risk positions must then be aggregated across buckets within each risk class, using the corresponding prescribed correlations γ_{bc}, where:

(a) $S_b = \sum_k CVR_k^+$ for all risk factors in bucket b, when the upward scenario has been selected for bucket b in above (3)(a). $S_b = \sum_k CVR_k^-$ otherwise; and

(b) $\psi(S_b, S_c)$ takes the value 0 if S_b and S_c both have negative signs and 1 otherwise.

$$Curvature\ risk = \sqrt{\max\left(0, \sum_b K_b^2 + \sum_{c \neq b}\sum_b \gamma_{bc} S_b S_c \psi(S_b, S_c)\right)}$$

The delta used for the calculation of the curvature risk capital requirement should be the same as that used for calculating the delta risk capital requirement. The assumptions that are used for the calculation of the delta (i.e. sticky delta for normal or log-normal volatilities) should also be used for calculating the shifted or shocked price of the instrument.

[Basel Framework, MAR21.5]

Calculation of aggregate sensitivities-based method capital requirement

118. In order to address the risk that correlations increase or decrease in periods of financial stress, the aggregation of bucket level capital requirements and risk class level capital requirements per each risk class for delta, vega, and curvature risks as specified in paragraphs 116 to 117 must be repeated, corresponding to three different scenarios on the specified values for the correlation parameter ρ_{kl} (correlation between risk factors within a bucket) and γ_{bc} (correlation across buckets within a risk class).

(1) Under the "medium correlations" scenario, the correlation parameters ρ_{kl} and γ_{bc} as specified in paragraphs 151 to 213 apply.

(2) Under the "high correlations" scenario, the correlation parameters ρ_{kl} and γ_{bc} that are specified in paragraphs 151 to 213 are uniformly multiplied by 1.25, with ρ_{kl} and γ_{bc} subject to a cap at 100%.

(3) Under the "low correlations" scenario, the correlation parameters ρ_{kl} and γ_{bc} that are specified in paragraphs 151 to 213 are replaced by $\rho_{kl}^{low} = \max(2 \times \rho_{kl} - 100\%; 75\% \times \rho_{kl})$ and $\gamma_{bc}^{low} = \max(2 \times \gamma_{bc} - 100\%; 75\% \times \gamma_{bc})$.

[Basel Framework, MAR21.6]

119. The total capital requirement under the sensitivities-based method is aggregated as follows:

(1) For each of three correlation scenarios, the institution must simply sum up the separately calculated delta, vega and curvature capital requirements for all risk classes to determine the overall capital requirement for that scenario.

(2) The sensitivities-based method capital requirement is the largest capital requirement from the three scenarios.

(a) For the calculation of capital requirements for all instruments in all trading desks using the standardized approach as set out in paragraph 49(1), paragraph 109 and paragraph 401, the capital requirement is calculated for all instruments in all trading desks.

(b) For the calculation of capital requirements for each trading desk using the standardized approach as if that desk were a standalone regulatory portfolio as set out in paragraph 49(2), the capital requirements under each correlation scenario are calculated and compared at each trading desk level, and the maximum for each trading desk is taken as the capital requirement.

[Basel Framework, MAR21.7]

9.5.2.4 Sensitivities-Based Method: Risk Factor and Sensitivity Definitions

Risk factor definitions for delta, vega and curvature risks

120. GIRR factors

(1) Delta GIRR: the GIRR delta risk factors are defined along two dimensions: (i) a risk-free yield curve for each currency in which interest rate-sensitive instruments are denominated and (ii) the following tenors: 0.25 years, 0.5 years, 1 year, 2 years, 3 years, 5 years, 10 years, 15 years, 20 years and 30 years, to which delta risk factors are assigned.[28]

(a) The risk-free yield curve per currency should be constructed using money market instruments held in the trading book that have the lowest credit risk, such as overnight index swaps (OIS). Alternatively, the risk-free yield curve should be based on one or more market-implied swap curves used by the institution to mark positions to market. For example, interbank offered rate (BOR) swap curves.

(b) When data on market-implied swap curves described in above (1)(a) are insufficient, the risk-free yield curve may be derived from the most appropriate sovereign bond curve for a given currency. In such cases the sensitivities related to sovereign bonds are not exempt from the CSR capital requirement: when an institution cannot perform the decomposition y=r+cs, any sensitivity to y is allocated both to the GIRR and to CSR classes as appropriate with the risk factor

[28] The assignment of risk factors to the specified tenors should be performed by linear interpolation or a method that is most consistent with the pricing functions used by the independent risk control function of an institution to report market risks or P&L to senior management.

and sensitivity definitions in the standardized approach. Applying swap curves to bond-derived sensitivities for GIRR will not change the requirement for basis risk to be captured between bond and credit default swap (CDS) curves in the CSR class.

(c) For the purpose of constructing the risk-free yield curve per currency, an OIS curve (such as Eonia or a new benchmark rate) and a BOR swap curve (such as three-month Euribor or other benchmark rates) must be considered two different curves. Two BOR curves at different maturities (e.g. three-month Euribor and six-month Euribor) must be considered two different curves. An onshore and an offshore currency curve (e.g. onshore Indian rupee and offshore Indian rupee) must be considered two different curves.

(2) The GIRR delta risk factors also include a flat curve of market-implied inflation rates for each currency with term structure not recognized as a risk factor.

(a) The sensitivity to the inflation rate from the exposure to implied coupons in an inflation instrument gives rise to a specific capital requirement. All inflation risks for a currency must be aggregated to one number via simple sum.

(b) This risk factor is only relevant for an instrument when a cash flow is functionally dependent on a measure of inflation (e.g. the notional amount or an interest payment depending on a consumer price index). GIRR risk factors other than for inflation risk will apply to such an instrument notwithstanding.

(c) Inflation rate risk is considered in addition to the sensitivity to interest rates from the same instrument, which must be allocated, according to the GIRR framework, in the term structure of the relevant risk-free yield curve in the same currency.

(d) Inflation is included in the GIRR vega risk capital requirement. As no maturity dimension is specified for the delta capital requirement for inflation (i.e. the possible underlying of the option), the vega risk for inflation should be considered only along the single dimension of the maturity of the option.

(3) The GIRR delta risk factors also include one of two possible cross-currency basis risk factors[29] for each currency (i.e. each GIRR bucket) with the term structure not recognized as a risk factor (i.e. both cross-currency basis curves are flat).

(a) The two cross-currency basis risk factors are basis of each currency over USD or basis of each currency over EUR. For instance, an AUD-denominated institution trading a JPY/USD cross-currency basis swap would have a sensitivity to the JPY/USD basis but not to the JPY/EUR basis.

(b) Cross-currency bases that do not relate to either basis over USD or basis over EUR must be computed either on “basis over USD” or “basis over EUR” but not both. GIRR risk factors other than for cross-currency basis risk will apply to such an instrument notwithstanding.

[29] Cross-currency basis are basis added to a yield curve in order to evaluate a swap for which the two legs are paid in two different currencies. They are in particular used by market participants to price cross-currency interest rate swaps paying a fixed or a floating leg in one currency, receiving a fixed or a floating leg in a second currency, and including an exchange of the notional in the two currencies at the start date and at the end date of the swap.

(c) Cross-currency basis risk is considered in addition to the sensitivity to interest rates from the same instrument, which must be allocated, according to the GIRR framework, in the term structure of the relevant risk-free yield curve in the same currency.

(d) When calculating the cross-currency basis spread (CCBS) capital requirement, institutions may use a term structure-based CCBS curve and aggregate sensitivities to individual tenors by simple sum.

(e) Cross-currency bases are included in the GIRR vega risk capital requirement. As no maturity dimension is specified for the delta capital requirement for cross-currency bases (i.e. the possible underlying of the option), the vega risk for cross-currency bases should be considered only along the single dimension of the maturity of the option.

(4) Vega GIRR*:* within each currency, the GIRR vega risk factors are the implied volatilities of options that reference GIRR-sensitive underlyings; as defined along two dimensions:[30]

(a) The maturity of the option: the implied volatility of the option as mapped to one or several of the following maturity tenors: 0.5 years, 1 year, 3 years, 5 years and 10 years.

(b) The residual maturity of the underlying of the option at the expiry date of the option: the implied volatility of the option as mapped to two (or one) of the following residual maturity tenors: 0.5 years, 1 year, 3 years, 5 years and 10 years.

(5) Curvature GIRR*:*

(a) The GIRR curvature risk factors are defined along only one dimension: the constructed risk-free yield curve per currency with no term structure decomposition. For example, the euro, Eonia, three-month Euribor and six-month Euribor curves must be shifted at the same time in order to compute the euro-relevant risk-free yield curve curvature risk capital requirement. For the calculation of sensitivities, all tenors (as defined for delta GIRR) are to be shifted in parallel.

(b) There is no curvature risk capital requirement for inflation and cross-currency basis risks.

(6) The treatment described in above (1)(b) for delta GIRR also applies to vega GIRR and curvature GIRR risk factors.

(7) Institutions are not permitted to perform capital computations based on internally used tenors. Risk factors and sensitivities must be assigned to the prescribed tenors. As stated

30 For example, an option with a forward starting cap, lasting 12 months, consists of four consecutive caplets on USD three-month Libor. There are four (independent) options, with option expiry dates in 12, 15, 18 and 21 months. These options are all on underlying USD three-month Libor; the underlying always matures three months after the option expiry date (its residual maturity being three months). Therefore, the implied volatilities for a regular forward starting cap, which would start in one year and last for 12 months should be defined along the following two dimensions: (i) the maturity of the option's individual components (caplets) – 12, 15, 18 and 21 months; and (ii) the residual maturity of the underlying of the option – three months.

in footnote 28 to paragraph 120 and footnote 33 to paragraph 137, the assignment of risk factors and sensitivities to the specified tenors should be performed by linear interpolation or a method that is most consistent with the pricing functions used by the independent risk control function of the institution to report market risks or profits and losses to senior management.

(8) For the specified instruments (e.g. callable bonds, options on sovereign bond futures and bond options), delta, vega and curvature capital requirements must be computed for GIRR.

(9) Repo rate risk factors for fixed income funding instruments are subject to the GIRR capital requirement. A relevant repo curve should be considered by currency.

(10) Risk weights may not be floored for interest rate and credit instruments when applying the risk weights for GIRR.

[Basel Framework, MAR21.8]

121. CSR non-securitization risk factors

(1) Delta CSR non-securitization: the CSR non-securitization delta risk factors are defined along two dimensions:

(a) the relevant issuer credit spread curves (bond and CDS); and

(b) the following tenors: 0.5 years, 1 year, 3 years, 5 years and 10 years.

(2) Vega CSR non-securitization: the vega risk factors are the implied volatilities of options that reference the relevant credit issuer names as underlyings (bond and CDS); further defined along one dimension - the maturity of the option. This is defined as the implied volatility of the option as mapped to one or several of the following maturity tenors: 0.5 years, 1 year, 3 years, 5 years and 10 years.

(3) Curvature CSR non-securitization*:* the CSR non-securitization curvature risk factors are defined along one dimension: the relevant issuer credit spread curves (bond and CDS). For instance, the bond-inferred spread curve of an issuer and the CDS-inferred spread curve of that same issuer should be considered a single spread curve. For the calculation of sensitivities, all tenors (as defined for CSR) are to be shifted in parallel.

(4) Institutions are not permitted to perform capital computations based on internally used tenors. Risk factors and sensitivities must be assigned to the prescribed tenors. As stated in footnote 28 to paragraph 120 and footnote 33 to paragraph 137, the assignment of risk factors and sensitivities to the specified tenors should be performed by linear interpolation or a method that is most consistent with the pricing functions used by the independent risk control function of the institution to report market risks or profits and losses to senior management.

(5) For the specified instruments, delta, vega and curvature capital requirements must be computed for CSR.

(6) Bond and CDS credit spreads are considered distinct risk factors under paragraph 131(1), and $\rho_{kl}^{(basis)}$ referenced in paragraphs 166 and 167 is meant to capture only the bond-CDS basis.

(7) Risk weights are not allowed to be floored for interest rate and credit instruments when applying the risk weights for CSR, even with a possibility of the interest rates being negative.

[Basel Framework, MAR21.9]

122. CSR securitization: non-CTP risk factors

(1) For securitization instruments that do not meet the definition of CTP as set out in paragraph 112 (i.e., non-CTP), the sensitivities of delta risk factors (i.e. CS01) must be calculated with respect to the spread of the tranche rather than the spread of the underlying of the instruments.

(2) Delta CSR securitization (non-CTP): the CSR securitization delta risk factors are defined along two dimensions:

(a) Tranche credit spread curves; and

(b) The following tenors: 0.5 years, 1 year, 3 years, 5 years and 10 years to which delta risk factors are assigned.

(3) Vega CSR securitization (non-CTP): Vega risk factors are the implied volatilities of options that reference non-CTP credit spreads as underlyings (bond and CDS); further defined along one dimension - the maturity of the option. This is defined as the implied volatility of the option as mapped to one or several of the following maturity tenors: 0.5 years, 1 year, 3 years, 5 years and 10 years.

(4) Curvature CSR securitization (non-CTP): the CSR securitization curvature risk factors are defined along one dimension, the relevant tranche credit spread curves (bond and CDS). For instance, the bond-inferred spread curve of a given Spanish residential mortgage-backed security (RMBS) tranche and the CDS-inferred spread curve of that given Spanish RMBS tranche would be considered a single spread curve. For the calculation of sensitivities, all the tenors are to be shifted in parallel.

[Basel Framework, MAR21.10]

123. CSR securitization: CTP risk factors

(1) For securitization instruments that meet the definition of a CTP as set out in paragraph 112, the sensitivities of delta risk factors (i.e. CS01) must be computed with respect to the names underlying the securitization or nth-to-default instrument.

(2) Delta CSR securitization (CTP): the CSR correlation trading delta risk factors are defined along two dimensions:

(a) the relevant underlying credit spread curves (bond and CDS); and

(b) the following tenors: 0.5 years, 1 year, 3 years, 5 years and 10 years, to which delta risk factors are assigned.

(3) Vega CSR securitization (CTP): the vega risk factors are the implied volatilities of options that reference CTP credit spreads as underlyings (bond and CDS), as defined along one dimension, the maturity of the option. This is defined as the implied volatility

of the option as mapped to one or several of the following maturity tenors: 0.5 years, 1 year, 3 years, 5 years and 10 years.

(4) Curvature CSR securitization (CTP): the CSR correlation trading curvature risk factors are defined along one dimension, the relevant underlying credit spread curves (bond and CDS). For instance, the bond-inferred spread curve of a given name within an iTraxx series and the CDS-inferred spread curve of that given underlying would be considered a single spread curve. For the calculation of sensitivities, all the tenors are to be shifted in parallel.

[Basel Framework, MAR21.11]

124. Equity risk factors

(1) Delta equity: the equity delta risk factors are:

(a) all the equity spot prices; and

(b) all the equity repurchase agreement rates (equity repo rates).

(2) Vega equity:

(a) The equity vega risk factors are the implied volatilities of options that reference the equity spot prices as underlyings as defined along one dimension, the maturity of the option. This is defined as the implied volatility of the option as mapped to one or several of the following maturity tenors: 0.5 years, 1 year, 3 years, 5 years and 10 years.

(b) There is no vega risk capital requirement for equity repo rates.

(3) Curvature equity:

(a) The equity curvature risk factors are all the equity spot prices.

(b) There is no curvature risk capital requirement for equity repo rates.

[Basel Framework, MAR21.12]

125. Commodity risk factors

(1) Delta commodity: the commodity delta risk factors are all the commodity spot prices. However for some commodities such as electricity (which is defined to fall within bucket 3 (energy – electricity and carbon trading) in paragraph 194 the relevant risk factor can either be the spot or the forward price, as transactions relating to commodities such as electricity are more frequent on the forward price than transactions on the spot price. Commodity delta risk factors are defined along two dimensions:

(a) legal terms with respect to the delivery location[31] of the commodity; and

[31] For example, a contract that can be delivered in five ports can be considered having the same delivery location as another contract if and only if it can be delivered in the same five ports. However, it cannot be considered having the same delivery location as another contract that can be delivered in only four (or less) of those five ports.

(b) time to maturity of the traded instrument at the following tenors: 0 years, 0.25 years, 0.5 years, 1 year, 2 years, 3 years, 5 years, 10 years, 15 years, 20 years and 30 years.

The current prices for futures and forward contracts should be used to compute the commodity delta risk factors. Commodity delta should be allocated to the relevant tenor based on the tenor of the futures and forward contract and given that spot commodity price positions should be slotted into the first tenor (0 years).

(2) Vega commodity: the commodity vega risk factors are the implied volatilities of options that reference commodity spot prices as underlyings. No differentiation between commodity spot prices by the maturity of the underlying or delivery location is required. The commodity vega risk factors are further defined along one dimension, the maturity of the option. This is defined as the implied volatility of the option as mapped to one or several of the following maturity tenors: 0.5 years, 1 year, 3 years, 5 years and 10 years.

(3) Curvature commodity: the commodity curvature risk factors are defined along only one dimension, the constructed curve (i.e. no term structure decomposition) per commodity spot prices. For the calculation of sensitivities, all tenors (as defined for delta commodity) are to be shifted in parallel.

(4) For precious metals capital calculations, institutions have the option to decompose future and forward contracts into spot and lease rate exposures subject to pricing availability. Lease rates can be included as a GIRR risk factor according to paragraph 120.

[Basel Framework, MAR21.13]

126. FX risk factors

(1) Delta FX: the FX delta risk factors are defined below.

(a) The FX delta risk factors are all the exchange rates between the currency in which an instrument is denominated and the reporting currency. For transactions that reference an exchange rate between a pair of non-reporting currencies, the FX delta risk factors are all the exchange rates between:

(i) the reporting currency; and

(ii) both the currency in which an instrument is denominated and any other currencies referenced by the instrument.[32]

(b) Subject to OSFI's approval, FX risk may alternatively be calculated relative to a base currency instead of the reporting currency. In such case the institution must account for not only:

(i) the FX risk against the base currency; but also

[32] For example, for an FX forward referencing USD/JPY, the relevant risk factors for a CAD-reporting institution to consider are the exchange rates USD/CAD and JPY/CAD. If that CAD-reporting institution calculates FX risk relative to a USD base currency, it would consider separate deltas for the exchange rate JPY/USD risk and CAD/USD FX translation risk and then translate the resulting capital requirement to CAD at the USD/CAD spot exchange rate.

(ii) the FX risk between the reporting currency and the base currency (i.e. translation risk).

(c) The resulting FX risk calculated relative to the base currency as set out in (b) is converted to the capital requirements in the reporting currency using the spot reporting/base exchange rate reflecting the FX risk between the base currency and the reporting currency.

(d) The FX base currency approach may be allowed under the following conditions:

(i) To use this alternative, an institution may only consider a single currency as its base currency; and

(ii) The institution shall demonstrate to OSFI that calculating FX risk relative to their proposed base currency provides an appropriate risk representation for their portfolio (for example, by demonstrating that it does not inappropriately reduce capital requirements relative to those that would be calculated without the base currency approach) and that the translation risk between the base currency and the reporting currency is taken into account.

(2) Vega FX: the FX vega risk factors are the implied volatilities of options that reference exchange rates between currency pairs; as defined along one dimension, the maturity of the option. This is defined as the implied volatility of the option as mapped to one or several of the following maturity tenors: 0.5 years, 1 year, 3 years, 5 years and 10 years.

(3) Curvature FX: the FX curvature risk factors are defined below.

(a) The FX curvature risk factors are all the exchange rates between the currency in which an instrument is denominated and the reporting currency. For transactions that reference an exchange rate between a pair of non-reporting currencies, the FX risk factors are all the exchange rates between:

(i) the reporting currency; and

(ii) both the currency in which an instrument is denominated and any other currencies referenced by the instrument.

(b) Where OSFI's approval for the base currency approach has been granted for delta risks, FX curvature risks shall also be calculated relative to a base currency instead of the reporting currency, and then converted to the capital requirements in the reporting currency using the spot reporting/base exchange rate.

(4) No distinction is required between onshore and offshore variants of a currency for all FX delta, vega and curvature risk factors. In addition, no distinction is required between deliverable and non-deliverable variants of a currency.

[Basel Framework, MAR21.14]

Sensitivities-based method: definition of sensitivities

127. Sensitivities for each risk class must be expressed in the reporting currency of the institution. [Basel Framework, MAR21.15]

128. For each risk factor defined in paragraphs 120 to 126, sensitivities are calculated as the change in the market value of the instrument as a result of applying a specified shift to each risk factor, assuming all the other relevant risk factors are held at the current level as defined in paragraph 129 to 150. In the context of delta sensitivity calculations, as per paragraph 129, an institution may make use of alternative formulations of sensitivities based on pricing models that the institution's independent risk control unit uses to report market risks or actual profits and losses to senior management. In doing so, the institution should demonstrate to OSFI that the alternative formulations of sensitivities yield results very close to the prescribed formulations. [Basel Framework, MAR21.16]

Requirements on instrument price or pricing models for sensitivity calculation

129. In calculating the risk capital requirement under the sensitivities-based method in section 9.5.2, the institution must determine each delta and vega sensitivity and curvature scenario based on instrument prices or pricing models that an independent risk control unit within an institution uses to report market risks or actual profits and losses to senior management. Institutions should use zero rate or market rate sensitivities consistent with the pricing models referenced in that paragraph. [Basel Framework, MAR21.17]

130. A key assumption of the standardized approach for market risk is that an institution's pricing models used in actual profit and loss reporting provide an appropriate basis for the determination of regulatory capital requirements for all market risks. To ensure such adequacy, institutions must at a minimum establish a framework for prudent valuation practices that include the requirements described in section 9.4. [Basel Framework, MAR21.18]

Sensitivity definitions for delta risk

131. Delta GIRR: the sensitivity is defined as the PV01. PV01 is measured by changing the interest rate r at tenor t (r_t) of the risk-free yield curve in a given currency by 1 basis point (i.e. 0.0001 in absolute terms) and dividing the resulting change in the market value of the instrument (V_i) by 0.0001 (i.e. 0.01%) as follows, where:

(1) r_t is the risk-free yield curve at tenor t;

(2) cs_t is the credit spread curve at tenor t; and

(3) V_i is the market value of the instrument i as a function of the risk-free interest rate curve and credit spread curve:

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

In cases where the institution does not have counterparty-specific money market curves, proxying PV01 is permitted.

[Basel Framework, MAR21.19]

132. Delta CSR non-securitization, securitization (non-CTP) and securitization (CTP): the sensitivity is defined as CS01. The CS01 (sensitivity) of an instrument i is measured by changing

a credit spread cs at tenor t (cs_t) by 1 basis point (i.e. 0.0001 in absolute terms) and dividing the resulting change in the market value of the instrument (V_i) by 0.0001 (i.e. 0.01%) as follows:

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

In cases where the institution does not have counterparty-specific money market curves, proxying CS01 is permitted.

[Basel Framework, MAR21.20]

133. Delta equity spot: the sensitivity is measured by changing the equity spot price by 1 percentage point (i.e. 0.01 in relative terms) and dividing the resulting change in the market value of the instrument (V_i) by 0.01 (i.e. 1%) as follows, where:

(1) k is a given equity;

(2) EQ_k is the market value of equity k; and

(3) V_i is the market value of instrument i as a function of the price of equity k.

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

[Basel Framework, MAR21.21]

134. Delta equity repo rates: the sensitivity is measured by applying a parallel shift to the equity repo rate term structure by 1 basis point (i.e. 0.0001 in absolute terms) and dividing the resulting change in the market value of the instrument V_i by 0.0001 (i.e. 0.01%) as follows, where:

(1) k is a given equity;

(2) RTS_k is the repo term structure of equity k; and

(3) V_i is the market value of instrument i as a function of the repo term structure of equity k.

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

[Basel Framework, MAR21.22]

135. Delta commodity: the sensitivity is measured by changing the commodity spot price by 1 percentage point (i.e. 0.01 in relative terms) and dividing the resulting change in the market value of the instrument V_i by 0.01 (i.e. 1%) as follows, where:

(1) k is a given commodity;

(2) CTY_k is the market value of commodity k; and

(3) V_i is the market value of instrument i as a function of the spot price of commodity k:

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

[Basel Framework, MAR21.23]

136. Delta FX: the sensitivity is measured by changing the exchange rate by 1 percentage point (i.e. 0.01 in relative terms) and dividing the resulting change in the market value of the instrument V_i by 0.01 (i.e. 1%), where:

(1) k is a given currency;

(2) FX_k is the exchange rate between a given currency and an institution's reporting currency or base currency, where the FX spot rate is the current market price of one unit of another currency expressed in the units of the institution's reporting currency or base currency; and

(3) V_i is the market value of instrument i as a function of the exchange rate k:

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

[Basel Framework, MAR21.24]

Sensitivity definitions for vega risk

137. The option-level vega risk sensitivity to a given risk factor[33] is measured by multiplying vega by the implied volatility of the option as follows, where:

(1) vega, $\frac{\partial V_i}{\partial \sigma_i}$, is defined as the change in the market value of the option V_i as a result of a small amount of change to the implied volatility σ_i; and

(2) the instrument's vega and implied volatility used in the calculation of vega sensitivities must be sourced from pricing models used by the independent risk control unit of the institution.

$$s_k = vega \times implied\ volatility$$

[Basel Framework, MAR21.25]

138. The following sets out how to derive vega risk sensitivities in specific cases:

(1) Options that do not have a maturity, are assigned to the longest prescribed maturity tenor, and these options are also assigned to the RRAO.

(2) Options that do not have a strike or barrier and options that have multiple strikes or barriers, are mapped to strikes and maturity used internally to price the option, and these options are also assigned to the RRAO.

[33] As specified in the vega risk factor definitions in paragraphs 120 to 126, the implied volatility of the option must be mapped to one or more maturity tenors.

(3) CTP securitization tranches that do not have an implied volatility, are not subject to vega risk capital requirement. Such instruments may not, however, be exempt from delta and curvature risk capital requirements.

(4) In the case where options do not have a specified maturity (e.g. cancellable swaps), the institution must assign those options to the longest prescribed maturity tenor for vega risk sensitivities and also assign such options to the RRAO.

(5) In the case of the institution viewing the optionality of the cancellable swap as a swaption, the institution must assign the swaption to the longest prescribed maturity tenor for vega risk sensitivities (as it does not have a specified maturity) and derive the residual maturity of the underlying of the option accordingly.

[Basel Framework, MAR21.26]

Requirements on sensitivity computations

139. When computing a first-order sensitivity for instruments subject to optionality, institutions should assume that the implied volatility either:

(1) remains constant, consistent with a "sticky strike" approach; or

(2) follows a "sticky delta" approach, such that implied volatility does not vary with respect to a given level of delta.

[Basel Framework, MAR21.27]

140. For the calculation of vega sensitivities, the distribution assumptions (i.e. log-normal assumptions or normal assumptions) for pricing models are applied as follows:

(1) For the computation of a vega GIRR sensitivity, institutions may use either the log-normal or normal assumptions. Institutions may also choose a mix of log-normal and normal assumptions for different currencies.

(2) For the computation of a vega CSR sensitivity, institutions may use either the log-normal or normal assumptions.

(3) For the computation of a vega equity, commodity or FX sensitivity, institutions must use the log-normal assumption.[34]

[Basel Framework, MAR21.28]

[34] Since vega ($\frac{\partial V}{\partial \sigma_i}$) of an instrument is multiplied by its implied volatility (σ_i), the vega risk sensitivity for that instrument will be the same under the log-normal assumption and the normal assumption. As a consequence, institutions may use a log-normal or normal assumption for GIRR and CSR (in recognition of the trade-offs between constrained specification and computational burden for a standardized approach). For the other risk classes, institutions must only use a log-normal assumption (in recognition that this is aligned with common practices across jurisdictions).

141. If, for internal risk management, an institution computes vega sensitivities using different definitions than the definitions set out in this standard, the institution may transform the sensitivities computed for internal risk management purposes to deduce the sensitivities to be used for the calculation of the vega risk measure. [Basel Framework, MAR21.29]

142. All vega sensitivities must be computed ignoring the impact of credit valuation adjustments (CVA). [Basel Framework, MAR21.30]

Treatment of index instruments and multi-underlying options

143. In the delta and curvature risk context: for index instruments and multi-underlying options, a look-through approach should be used. However, an institution may opt not to apply the look-through approach for instruments referencing any listed and widely recognised and accepted equity or credit index, where:

(1) it is possible to look-through the index (i.e. the constituents and their respective weightings are known);

(2) the index contains at least 20 constituents;

(3) no single constituent contained within the index represents more than 25% of the total index;

(4) the largest 10% of constituents represents less than 60% of the total index; and

(5) for equity indices, the total market capitalization of all the constituents of the index is no less than CAD $50 billion.

The no look-through approach for equity and credit indices cannot be applied to funds that do not track a listed and widely recognized index even if their holdings meet the criteria set out above.

[Basel Framework, MAR21.31]

144. For a given instrument, irrespective of whether a look-through approach is adopted or not, the sensitivity inputs used for the delta and curvature risk calculation must be consistent. [Basel Framework, MAR21.32]

145. Where an institution opts not to apply the look-through approach in accordance with paragraph 143, a single sensitivity shall be calculated to each widely recognised and accepted index that an instrument references. The sensitivity to the index should be assigned to the relevant delta risk bucket defined in paragraphs 165 and 184 as follows:

(1) Where more than 75% of constituents in that index (taking into account the weightings of that index) would be mapped to a specific sector bucket (i.e. bucket 1 to bucket 11 for equity risk, or bucket 1 to bucket 16 for CSR), the sensitivity to the index shall be mapped to that single specific sector bucket and treated like any other single-name sensitivity in that bucket.

(2) In all other cases, the sensitivity may be mapped to an "index" bucket (i.e. bucket 12 or bucket 13 for equity risk; or bucket 17 or bucket 18 for CSR). The same principle as above (1) applies when allocating sensitivities to a specific index bucket.

i. For equity risk, an equity index should be mapped to the large market cap and advanced economy indices bucket (i.e. bucket 12) if at least 75% of the constituents in that index (taking into account the weightings of that index) are both large cap and advanced economy equities. Otherwise, it should be mapped to the other equity indices bucket (i.e. bucket 13).

ii. For CSR, a credit index should be mapped to the investment grade indices bucket (i.e. bucket 17) if at least 75% of the constituents in that index (taking into account the weightings of that index) are investment grade. Otherwise, it should be mapped to the high yield indices bucket (i.e. bucket 18).

[Basel Framework, MAR21.33]

146. A look-through approach should be used for indices that do not meet the criteria set out in paragraph 143(2) to (5), and for any multi-underlying instruments that reference a bespoke set of equities or credit positions.

(1) Where a look-through approach is adopted, for index instruments and multi-underlying options other than the CTP, the sensitivities to constituent risk factors from those instruments or options are allowed to net with sensitivities to single-name instruments without restriction.

(2) Index CTP instruments cannot be broken down into its constituents (i.e. the index CTP should be considered a risk factor as a whole) and the above-mentioned netting at the issuer level does not apply either.[35]

(3) Where a look-through approach is adopted, it shall be applied consistently through time,[36] at least at the desk level, and shall be used for all identical instruments that reference the same index.

Where a look-through approach for such indices is not possible, institutions may treat these indices in the same manner as prescribed for equity investments in funds in paragraph 148(2), 148(3) and 221 for default risk charge purposes. This treatment is permitted where institutions have the ability to obtain daily price quotes and have knowledge of the mandate of the indices.

[Basel Framework, MAR21.34]

[35] The delta CSR sensitivity of an index CTP instrument should be assigned to a single specific delta sector bucket consistent with the characteristics of, at least, 75% of the index constituents (taking into account the weightings of that index), in accordance with paragraph 145(1). If this is not possible, then the index should be assigned to bucket 16, “Other sector”. The sensitivity to that index CTP instrument should be considered and treated like any other single-name sensitivity assigned to that same sector bucket.

[36] In other words, an institution can initially not apply a look-through approach, and later decide to apply it. However once applied (for a certain type of instrument referencing a particular index), the institution will require OSFI approval to revert to a “no look-through” approach.

Treatment of equity investments in funds

147. For equity investments in funds that can be looked through as set out in paragraph 65(5)(a), institutions must apply a look-through approach and treat the underlying positions of the fund as if the positions were held directly by the institution (taking into account the institution's share of the equity of the fund, and any leverage in the fund structure), except for the funds that meet the following conditions:

(1) For funds that hold an index instrument that meets the criteria set out under paragraph 143, institutions must still apply a look-through and treat the underlying positions of the fund as if the positions were held directly by the institution, but the institution may then choose to apply the "no look-through" approach for the index holdings of the fund as set out in paragraph 145.

(2) For funds that track an index benchmark, an institution may opt not to apply the look-through approach and opt to measure the risk assuming the fund is a position in the tracked index only where:

  (a) the fund has an absolute value of a tracking difference (ignoring fees and commissions) of less than 1%; and

  (b) the tracking difference is checked at least annually and is defined as the annualized return difference between the fund and its tracked benchmark over the last 12 months of available data (or a shorter period in the absence of a full 12 months of data).

Subject to the criteria in this paragraph, equity investment funds that invest purely in either equity or debt instruments to replicate a listed and widely-recognized index may be treated as if they were investments in those equities or credit indices and institutions may apply the no look-through approach available for credit and equity indices on those funds if those investments in funds meet the requirements set out in paragraphs 143 to 146.

[Basel Framework, MAR21.35]

148. For equity investments in funds that cannot be looked through (i.e. do not meet the criterion set out in paragraph 65(5)(a), but that the institution has access to daily price quotes and knowledge of the mandate of the fund (i.e. meet both the criteria set out in paragraph 65(5)(b), institutions may calculate capital requirements for the fund in one of three ways:

(1) If the fund tracks an index benchmark and meets the requirement set out in paragraph 147(2)(a) and (b), the institution may assume that the fund is a position in the tracked index, and may assign the sensitivity to the fund to relevant sector specific buckets or index buckets as set out in paragraph 145.

(2) Subject to OSFI's approval, the institution may consider the fund as a hypothetical portfolio in which the fund invests to the maximum extent allowed under the fund's mandate in those assets attracting the highest capital requirements under the sensitivities-based method, and then progressively in those other assets implying lower capital requirements. If more than one risk weight can be applied to a given exposure under the sensitivities-based method, the maximum risk weight applicable must be used.

(a) This hypothetical portfolio must be subject to market risk capital requirements on a stand-alone basis for all positions in that fund, separate from any other positions subject to market risk capital requirements.

(b) The counterparty credit and CVA risks of the derivatives of this hypothetical portfolio must be calculated using the simplified methodology set out in paragraph 153(c) of Chapter 4 of OSFI's CAR Guideline pertaining to the banking book equity investment in funds treatment.

(3) An institution may treat their equity investment in the fund as an unrated equity exposure to be allocated to the "other sector" bucket (bucket 11). In applying this treatment, institutions must also consider whether, given the mandate of the fund, the default risk capital (DRC) requirement risk weight prescribed to the fund is sufficiently prudent (as set out in paragraph 221), and whether the RRAO should apply (as set out in paragraph 264).

[Basel Framework, MAR21.36]

149. Equity investments in a given fund that do not meet the requirements of paragraph 65(5) must be assigned to the banking book. Notwithstanding paragraph 63(2), net short positions in funds that do not meet the requirements of paragraph 65(5) should be placed in the banking book and are subject to a 100% capital requirement. [Basel Framework, MAR21.37]

Treatment of vega risk for multi-underlying instruments

150. In the vega risk context:

(1) Multi-underlying options (including index options) are usually priced based on the implied volatility of the option, rather than the implied volatility of its underlying constituents and a look-through approach may not need to be applied, regardless of the approach applied to the delta and curvature risk calculation as set out in paragraphs 143 to 147.[37]

(2) For indices, the vega risk with respect to the implied volatility of the multi-underlying options will be calculated using a sector specific bucket or an index bucket defined in paragraphs 165 and 184 as follows:

(a) Where more than 75% of constituents in that index (taking into account the weightings of that index) would be mapped to a single specific sector bucket (i.e. bucket 1 to bucket 11 for equity risk; or bucket 1 to bucket 16 for CSR), the sensitivity to the index shall be mapped to that single specific sector bucket and treated like any other single-name sensitivity in that bucket.

(b) In all other cases, the sensitivity may be mapped to an "index" bucket (i.e. bucket 12 or bucket 13 for equity risk or bucket 17 or bucket 18 for CSR).

[Basel Framework, MAR21.38]

[37] As specified in the vega risk factor definitions in paragraphs 120 to 126, the implied volatility of an option must be mapped to one or more maturity tenors.

9.5.2.5 Sensitivities-Based Method: Definition of Delta Risk Buckets, Risk Weights and Correlations

151. Paragraphs 153 to 201 set out buckets, risk weights and correlation parameters for each risk class to calculate delta risk capital requirement as set out in paragraph 116. [Basel Framework, MAR21.39]

152. The prescribed risk weights and correlations in paragraphs 153 to 201 have been calibrated to the liquidity adjusted time horizon related to each risk class. [Basel Framework, MAR21.40]

Delta GIRR buckets, risk weights and correlations

153. Each currency is a separate delta GIRR bucket, so all risk factors in risk-free yield curves for the same currency in which interest rate-sensitive instruments are denominated are grouped into the same bucket. [Basel Framework, MAR21.41]

154. For calculating weighted sensitivities, the risk weights for each tenor in risk-free yield curves are set in Table 1 as follows:

Table 1 – Delta GIRR buckets and risk weights

Tenor	Risk weight (percentage points)
0.25 year	1.7%
0.5 year	1.7%
1 year	1.6%
2 year	1.3%
3 year	1.2%
5 year	1.1%
10 year	1.1%
15 year	1.1%
20 year	1.1%
30 year	1.1%

[Basel Framework, MAR21.42]

155. The risk weight for the inflation risk factor and the cross-currency basis risk factors, respectively, is set at 1.6%. [Basel Framework, MAR21.43]

156. For EUR, USD, GBP, AUD, JPY, SEK, CAD as well as the domestic reporting currency of an institution, the above risk weights may, at the discretion of the institution, be divided by the square root of 2. [Basel Framework, MAR21.44]

157. For aggregating GIRR risk positions within a bucket, the correlation parameter ρ_{kl} between weighted sensitivities WS_k and WS_l within the same bucket (i.e. same currency), same assigned tenor, but different curves is set at 99.90%. In aggregating delta risk positions for cross-currency basis risk for onshore and offshore curves, which must be considered two different curves as set out in paragraph 120, an institution may choose to aggregate all cross-currency basis risk for a currency (i.e. "Curr/USD" or "Curr/EUR") for both onshore and offshore curves by a simple sum of weighted sensitivities. [Basel Framework, MAR21.45]

158. The delta risk correlation ρ_{kl} between weighted sensitivities WS_k and WS_l within the same bucket with different tenor and same curve is set in the following Table 2:[38]

Delta GIRR correlations (ρ_{kl}) within the same bucket, with different tenor and same curve — **Table 2**

	Tenor									
Tenor	0.25 year	0.5 year	1 year	2 year	3 year	5 year	10 year	15 year	20 year	30 year
0.25 year	100.0%	97.0%	91.4%	81.1%	71.9%	56.6%	40.0%	40.0%	40.0%	40.0%
0.5 year	97.0%	100.0%	97.0%	91.4%	86.1%	76.3%	56.6%	41.9%	40.0%	40.0%
1 year	91.4%	97.0%	100.0%	97.0%	94.2%	88.7%	76.3%	65.7%	56.6%	41.9%
2 year	81.1%	91.4%	97.0%	100.0%	98.5%	95.6%	88.7%	82.3%	76.3%	65.7%
3 year	71.9%	86.1%	94.2%	98.5%	100.0%	98.0%	93.2%	88.7%	84.4%	76.3%
5 year	56.6%	76.3%	88.7%	95.6%	98.0%	100.0%	97.0%	94.2%	91.4%	86.1%
10 year	40.0%	56.6%	76.3%	88.7%	93.2%	97.0%	100.0%	98.5%	97.0%	94.2%
15 year	40.0%	41.9%	65.7%	82.3%	88.7%	94.2%	98.5%	100.0%	99.0%	97.0%
20 year	40.0%	40.0%	56.6%	76.3%	84.4%	91.4%	97.0%	99.0%	100.0%	98.5%
30 year	40.0%	40.0%	41.9%	65.7%	76.3%	86.1%	94.2%	97.0%	98.5%	100.0%

[Basel Framework, MAR21.46]

159. Between two weighted sensitivities WS_k and WS_l within the same bucket with different tenor and different curves, the correlation ρ_{kl} is equal to the correlation parameter specified in paragraph 158 multiplied by 99.90%.[39]

[38] The delta GIRR correlation parameters (ρ_{kl}) set out in Table 2 is determined by $max\left[e^{\left(-\theta\cdot\frac{|T_k-T_l|}{min\{T_k;T_l\}}\right)};40\%\right]$, where T_k (respectively T_l) is the tenor that relates to WS_k (respectively WS_l); and θ is set at 3%. For example, the correlation between a sensitivity to the one-year tenor of the Eonia swap curve and the a sensitivity to the five-year tenor of the Eonia swap curve in the same currency is $max\left[e^{\left(-3\%\cdot\frac{|1-5|}{min\{1;5\}}\right)};40\%\right]=88.69\%$.

[39] For example, the correlation between a sensitivity to the one-year tenor of the Eonia swap curve and a sensitivity to the five-year tenor of the three-month Euribor swap curve in the same currency is $(88.69\%)\cdot(0.999)=88.60\%$.

The 99.90% correlation also applies to different inflation curves in the same currency for GIRR. [Basel Framework, MAR21.47]

160. The delta risk correlation ρ_{kl} between a weighted sensitivity WS_k to the inflation curve and a weighted sensitivity WS_l to a given tenor of the relevant yield curve is 40%. [Basel Framework, MAR21.48]

161. The delta risk correlation ρ_{kl} between a weighted sensitivity WS_k to a cross-currency basis curve and a weighted sensitivity WS_l to each of the following curves is 0%:

(1) a given tenor of the relevant yield curve;

(2) the inflation curve; or

(3) another cross-currency basis curve (if relevant).

[Basel Framework, MAR21.49]

162. For aggregating GIRR risk positions across different buckets (i.e. different currencies), the parameter γ_{bc} is set at 50%. [Basel Framework, MAR21.50]

Delta CSR non-securitizations buckets, risk weights and correlations

163. For delta CSR non-securitizations, buckets are set along two dimensions – credit quality and sector – as set out in Table 3. The CSR non-securitization sensitivities or risk exposures should first be assigned to a bucket defined before calculating weighted sensitivities by applying a risk weight.

Buckets for delta CSR non-securitizations		Table 3
Bucket number	Credit quality	Sector
1	Investment grade (IG)	Sovereigns including central banks, multilateral development institutions
2	IG	Local government, government-backed non-financials, education, public administration
3	IG	Financials including government-backed financials
4	IG	Basic materials, energy, industrials, agriculture, manufacturing, mining and quarrying
5	IG	Consumer goods and services, transportation and storage, administrative and support service activities
6	IG	Technology, telecommunications
7	IG	Health care, utilities, professional and technical activities
8	IG	Covered bonds[40]
9	High yield (HY) & non-rated (NR)	Sovereigns including central banks, multilateral development institutions
10	HY&NR	Local government, government-backed non-financials, education, public administration
11	HY&NR	Financials including government-backed financials
12	HY&NR	Basic materials, energy, industrials, agriculture, manufacturing, mining and quarrying
13	HY&NR	Consumer goods and services, transportation and storage, administrative and support service activities
14	HY&NR	Technology, telecommunications
15	HY&NR	Health care, utilities, professional and technical activities
16	N/A	Other sector[41]
17	IG	Qualified Indices
18	HY	Qualified Indices

When external ratings are assigned by credit rating agencies, risk weights should be consistent with the treatment of external ratings under paragraphs 178 and 179 of Chapter 4, if there are two ratings which map into different risk weights, the higher risk weight should be applied. If there are three or more ratings with different risk weights, the ratings corresponding to the two lowest risk weights should be referred to and the higher of those two risk weights will be applied.

Consistent with section 4.1 of Chapter 4, instruments issued by the following entities shall receive the same treatment as instruments issued by the Government of Canada: all provincial

[40] Covered bonds must meet the definition provided in paragraphs 26, 27 and 28 in OSFI's Guideline B-2 - Large Exposure Limits for Domestic Systemically Important Banks:

[41] Credit quality is not a differentiating consideration for this bucket.

and territorial governments and agents of the federal, provincial or territorial government whose debts are, by virtue of their enabling legislation, obligations of the parent government.

Where there are no external ratings under paragraph 16 of the revised CVA risk framework (Chapter 8), where there are no external ratings or where external ratings are not recognised within a jurisdiction, institutions may, subject to OSFI's approval:

(1) for the purpose of assigning delta CSR non-securitization risk weights, map the internal rating to an external rating, and assign a risk weight corresponding to either "investment grade" or "high yield" in paragraph 163;

(2) for the purpose of assigning default risk weights under the DRC requirement, map the internal rating to an external rating, and assign a risk weight corresponding to one of the seven external ratings in the table included paragraph 237; or

(3) apply the risk weights specified in paragraph 163 and 237 for unrated/non-rated categories.

Non-tranched MBS issued by government sponsored-entities (GSEs), such as Fannie and Freddie, are assigned to bucket 2 (local government, government-backed non-financials, education, public administration) for CSR with a risk weight of 1.0%.

In accordance with paragraph 225, the LGD for non-tranched MBS issued by GSEs is 75% (i.e. the LGD assigned to senior debt instruments) unless the GSE security satisfies the requirements of footnote 40 for treatment of the security as a covered bond.

[Basel Framework, MAR21.51]

164. To assign a risk exposure to a sector, institutions must rely on a classification that is commonly used in the market for grouping issuers by industry sector.

(1) The institution must assign each issuer to one and only one of the sector buckets in the table under paragraph 163.

(2) Risk positions from any issuer that an institution cannot assign to a sector in this fashion must be assigned to the other sector (i.e. bucket 16).

[Basel Framework, MAR21.52]

165. For calculating weighted sensitivities, the risk weights for buckets 1 to 18 are set out in Table 4. Risk weights are the same for all tenors (i.e. 0.5 years, 1 year, 3 years, 5 years, 10 years) within each bucket:

Risk weights for buckets for delta CSR non-securitizations	Table 4
Bucket number	Risk weight
1	0.5%
2	1.0%
3	5.0%
4	3.0%
5	3.0%
6	2.0%
7	1.5%
8	2.5%[42]
9	2.0%
10	4.0%
11	12.0%
12	7.0%
13	8.5%
14	5.5%
15	5.0%
16	12.0%
17	1.5%
18	5.0%

[Basel Framework, MAR21.53]

166. For buckets 1 to 15, for aggregating delta CSR non-securitizations risk positions within a bucket, the correlation parameter ρ_{kl} between two weighted sensitivities WS_k and WS_l within the same bucket, is set as follows, where:

(1) $\rho_{kl}^{(name)}$ is equal to 1 where the two names of sensitivities *k* and *l* are identical, and 35% otherwise;

(2) $\rho_{kl}^{(tenor)}$ is equal to 1 if the two tenors of the sensitivities *k* and *l* are identical, and to 65% otherwise; and

(3) $\rho_{kl}^{(basis)}$ is equal to 1 if the two sensitivities are related to same curves, and 99.90% otherwise.

$$\rho_{kl} = \rho_{kl}^{(name)} \cdot \rho_{kl}^{(tenor)} \cdot \rho_{kl}^{(basis)}$$ [43]

[42] For covered bonds that are rated AA- or higher, the applicable risk weight may at the discretion of the institution be 1.5%.

[43] For example, a sensitivity to the five-year Apple bond curve and a sensitivity to the 10-year Google CDS curve would be 35% · 65% · 99.90% = 22.73%.

Bond and CDS credit spreads are considered distinct risk factors under paragraph 121(1), and $\rho_{kl}^{(basis)}$ referenced in this paragraph and below is meant to capture only the bond-CDS basis.

[Basel Framework, MAR21.54]

167. For buckets 17 and 18, for aggregating delta CSR non-securitizations risk positions within a bucket, the correlation parameter ρ_{kl} between two weighted sensitivities WS_k and WS_l within the same bucket is set as follows, where:

(1) $\rho_{kl}^{(name)}$ is equal to 1 where the two names of sensitivities *k* and *l* are identical, and 80% otherwise;

(2) $\rho_{kl}^{(tenor)}$ is equal to 1 if the two tenors of the sensitivities *k* and *l* are identical, and to 65% otherwise; and

(3) $\rho_{kl}^{(basis)}$ is equal to 1 if the two sensitivities are related to same curves, and 99.90% otherwise.

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

[Basel Framework, MAR21.55]

168. The correlations above do not apply to the other sector bucket (i.e. bucket 16).

(1) The aggregation of delta CSR non-securitization risk positions within the other sector bucket (i.e. bucket 16) would be equal to the simple sum of the absolute values of the net weighted sensitivities allocated to this bucket. The same method applies to the aggregation of vega risk positions.

$$K_{b(other\ bucket)} = \sum_k |WS_k|$$

(2) The aggregation of curvature CSR non-securitization risk positions within the other sector bucket (i.e. bucket 16) would be calculated by the formula below.

$$K_{b(other\ bucket)} = \max\left(\sum_k max(CVR_k^+, 0), \sum_k max(CVR_k^-, 0)\right)$$

[Basel Framework, MAR21.56]

169. For aggregating delta CSR non-securitization risk positions across buckets 1 to 18, the correlation parameter γ_{bc} is set as follows, where:

(1) $\gamma_{bc}^{(rating)}$ is equal to 50% where the two buckets *b* and *c* are both in buckets 1 to 15 and have a different rating category (either IG or HY/NR). $\gamma_{bc}^{(rating)}$ is equal to 1 otherwise; and

(2) $\gamma_{bc}^{(sector)}$ is equal to 1 if the two buckets belong to the same sector, and to the specified numbers in Table 5 otherwise.

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

Values of $\gamma_{bc}^{(sector)}$ where the buckets do not belong to the same sector Table 5

	Bucket									
Bucket	1 / 9	2 / 10	3 / 11	4 / 12	5 / 13	6 / 14	7 / 15	8	16	17	18
1 / 9		75%	10%	20%	25%	20%	15%	10%	0%	45%	45%
2 / 10			5%	15%	20%	15%	10%	10%	0%	45%	45%
3 / 11				5%	15%	20%	5%	20%	0%	45%	45%
4 / 12					20%	25%	5%	5%	0%	45%	45%
5 / 13						25%	5%	15%	0%	45%	45%
6 / 14							5%	20%	0%	45%	45%
7 / 15								5%	0%	45%	45%
8									0%	45%	45%
16										0%	0%
17											75%
18											

[Basel Framework, MAR21.57]

Delta CSR securitization (CTP) buckets, risk weights and correlations

170. Sensitivities to CSR arising from the CTP and its hedges are treated as a separate risk class as set out in paragraph 113. The buckets, risk weights and correlations for the CSR securitizations (CTP) apply as follows:

(1) The same bucket structure and correlation structure apply to the CSR securitizations (CTP) as those for the CSR non-securitization framework as set out in paragraphs 163 to 169 with an exception of index buckets (i.e. buckets 17 and 18).

(2) The risk weights and correlation parameters of the delta CSR non-securitizations are modified to reflect longer liquidity horizons and larger basis risk as specified in paragraph 171 to 173.

[Basel Framework, MAR21.58]

171. For calculating weighted sensitivities, the risk weights for buckets 1 to 16 are set out in Table 6. Risk weights are the same for all tenors (i.e. 0.5 years, 1 year, 3 years, 5 years, 10 years) within each bucket:

Risk weights for sensitivities to CSR arising from the CTP	Table 6
Bucket number	Risk weight
1	4.0%
2	4.0%
3	8.0%
4	5.0%
5	4.0%
6	3.0%
7	2.0%
8	6.0%
9	13.0%
10	13.0%
11	16.0%
12	10.0%
13	12.0%
14	12.0%
15	12.0%
16	13.0%

[Basel Framework, MAR21.59]

172. For aggregating delta CSR securitizations (CTP) risk positions within a bucket, the delta risk correlation ρ_{kl} is derived the same way as in paragraph 166 and 167 and, except that the correlation parameter applying when the sensitivities are not related to same curves, $\rho_{kl}^{(basis)}$, is modified.

(1) $\rho_{kl}^{(basis)}$ is now equal to 1 if the two sensitivities are related to same curves, and 99.00% otherwise.

(2) The identical correlation parameters for $\rho_{kl}^{(name)}$ and $\rho_{kl}^{(tenor)}$ to CSR non-securitization as set out in paragraph 166 and 167 apply.

[Basel Framework, MAR21.60]

173. For aggregating delta CSR securitizations (CTP) risk positions across buckets, the correlation parameters for γ_{bc} are identical to CSR non-securitization as set out in paragraph 169. [Basel Framework, MAR21.61]

Delta CSR securitization (non-CTP) buckets, risk weights and correlations

174. For delta CSR securitizations not in the CTP, buckets are set along two dimensions – credit quality and sector – as set out in Table 7. The delta CSR securitization (non-CTP) sensitivities or risk exposures must first be assigned to a bucket before calculating weighted sensitivities by applying a risk weight.

Buckets for delta CSR securitizations (non-CTP) Table 7

Bucket number	Credit quality	Sector
1	Senior investment grade (IG)	RMBS – Prime
2	Senior investment grade (IG)	RMBS – Mid-prime
3	Senior investment grade (IG)	RMBS – Sub-prime
4	Senior investment grade (IG)	CMBS
5	Senior investment grade (IG)	Asset-backed securities (ABS) – Student loans
6	Senior investment grade (IG)	ABS – Credit cards
7	Senior investment grade (IG)	ABS – Auto
8	Senior investment grade (IG)	Collateralised loan obligation (CLO) non-CTP
9	Non-senior IG	RMBS – Prime
10	Non-senior IG	RMBS – Mid-prime
11	Non-senior IG	RMBS – Sub-prime
12	Non-senior IG	Commercial mortgage-backed securities (CMBS)
13	Non-senior IG	ABS – Student loans
14	Non-senior IG	ABS – Credit cards
15	Non-senior IG	ABS – Auto
16	Non-senior IG	CLO non-CTP
17	High yield & non-rated	RMBS – Prime
18	High yield & non-rated	RMBS – Mid-prime
19	High yield & non-rated	RMBS – Sub-prime
20	High yield & non-rated	CMBS
21	High yield & non-rated	ABS – Student loans
22	High yield & non-rated	ABS – Credit cards
23	High yield & non-rated	ABS – Auto
24	High yield & non-rated	CLO non-CTP
25	N/A	Other sector[44]

[Basel Framework, MAR21.62]

44 Credit quality is not a differentiating consideration for this bucket.

175. To assign a risk exposure to a sector, institutions must rely on a classification that is commonly used in the market for grouping tranches by type.

(1) The institution must assign each tranche to one of the sector buckets in above Table 7.

(2) Risk positions from any tranche that an institution cannot assign to a sector in this fashion must be assigned to the other sector (i.e. bucket 25).

[Basel Framework, MAR21.63]

176. For calculating weighted sensitivities, the risk weights for buckets 1 to 8 (senior IG) are set out in Table 8:

Risk weights for buckets 1 to 8 for delta CSR securitizations (non-CTP) Table 8

Bucket number	Risk weight (in percentage points)
1	0.9%
2	1.5%
3	2.0%
4	2.0%
5	0.8%
6	1.2%
7	1.2%
8	1.4%

[Basel Framework, MAR21.64]

177. The risk weights for buckets 9 to 16 (non-senior investment grade) are then equal to the corresponding risk weights for buckets 1 to 8 scaled up by a multiplication by 1.25. For instance, the risk weight for bucket 9 is equal to $1.25 \times 0.9\% = 1.125\%$. [Basel Framework, MAR21.65]

178. The risk weights for buckets 17 to 24 (high yield and non-rated) are then equal to the corresponding risk weights for buckets 1 to 8 scaled up by a multiplication by 1.75. For instance, the risk weight for bucket 17 is equal to $1.75 \times 0.9\% = 1.575\%$. [Basel Framework, MAR21.66]

179. The risk weight for bucket 25 is set at 3.5%. [Basel Framework, MAR21.67]

180. For aggregating delta CSR securitizations (non-CTP) risk positions within a bucket, the correlation parameter ρ_{kl} between two sensitivities WS_k and WS_l within the same bucket, is set as follows, where:

(1) $\rho_{kl}^{(tranche)}$ is equal to 1 where the two names of sensitivities *k* and *l* are within the same bucket and related to the same securitization tranche (more than 80% overlap in notional terms), and 40% otherwise;

(2) $\rho_{kl}^{(tenor)}$ is equal to 1 if the two tenors of the sensitivities *k* and *l* are identical, and to 80% otherwise; and

(3) $\rho_{kl}^{(basis)}$ is equal to 1 if the two sensitivities are related to same curves, and 99.90% otherwise.

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

There is no granularity for issuers in the delta CSR securitization part as set out in paragraph 122. Where two tranches have exactly the same issuer, same tenor and same basis, but different tranches (i.e. different credit quality), the correlation must be 40%.

[Basel Framework, MAR21.68]

181. The correlations above do not apply to the other sector bucket (i.e. bucket 25).

(1) The aggregation of delta CSR securitizations (non-CTP) risk positions within the other sector bucket would be equal to the simple sum of the absolute values of the net weighted sensitivities allocated to this bucket. The same method applies to the aggregation of vega risk positions.

$$K_{b(other\ bucket)} = \sum_k |WS_k|$$

(2) The aggregation of curvature CSR risk positions within the other sector bucket (i.e. bucket 16) would be calculated by the formula below.

$$K_{b(other\ bucket)} = \max\left(\sum_k max(CVR_k^+, 0), \sum_k max(CVR_k^-, 0)\right)$$

[Basel Framework, MAR21.69]

182. For aggregating delta CSR securitizations (non-CTP) risk positions across buckets 1 to 24, the correlation parameter γ_{bc} is set as 0%. [Basel Framework, MAR21.70]

183. For aggregating delta CSR securitizations (non-CTP) risk positions between the other sector bucket (i.e. bucket 25) and buckets 1 to 24, (i) the capital requirements for bucket 25 and (ii) the aggregated capital requirements for buckets 1 to 24 will be simply summed up to the overall risk class level capital requirements. There should be no diversification or hedging effects recognised in aggregating the capital requirements for the other sector bucket (i.e. bucket 25) with those for buckets 1 to 24. [Basel Framework, MAR21.71]

Equity risk buckets, risk weights and correlations

184. For delta equity risk, buckets are set along three dimensions – market capitalization, economy and sector – as set out in Table 9. The equity risk sensitivities or exposures must first be assigned to a bucket before calculating weighted sensitivities by applying a risk weight.

Buckets for delta sensitivities to equity risk			**Table 9**
Bucket number	Market cap	Economy	Sector
1	Large	Emerging market economy	Consumer goods and services, transportation and storage, administrative and support service activities, healthcare, utilities
2	Large	Emerging market economy	Telecommunications, industrials
3	Large	Emerging market economy	Basic materials, energy, agriculture, manufacturing, mining and quarrying
4	Large	Emerging market economy	Financials including government-backed financials, real estate activities, technology
5	Large	Advanced economy	Consumer goods and services, transportation and storage, administrative and support service activities, healthcare, utilities
6	Large	Advanced economy	Telecommunications, industrials
7	Large	Advanced economy	Basic materials, energy, agriculture, manufacturing, mining and quarrying
8	Large	Advanced economy	Financials including government-backed financials, real estate activities, technology
9	Small	Emerging market economy	All sectors described under bucket numbers 1, 2, 3 and 4
10	Small	Advanced economy	All sectors described under bucket numbers 5, 6, 7 and 8
11	N/A	N/A	Other sector[45]
12	Large	Advanced economy	Equity indices (non-sector specific)
13	N/A	N/A	Other equity indices (non-sector specific)

[Basel Framework, MAR21.72]

185. Market capitalization (market cap) is defined as the sum of the market capitalizations based on the market value of the total outstanding shares issued by the same listed legal entity or a group of legal entities across all stock markets globally, where the total outstanding shares issued by the group of legal entities refer to cases where the listed entity is a parent company of a group of legal entities. Under no circumstances should the sum of the market capitalizations of

45 Market capitalization or economy (i.e. advanced or emerging market) is not a differentiating consideration for this bucket.

multiple related listed entities be used to determine whether a listed entity is "large market cap" or "small market cap". [Basel Framework, MAR21.73]

186. Large market cap is defined as a market capitalization equal to or greater than CAD 2.5 billion and small market cap is defined as a market capitalization of less than CAD 2.5 billion. [Basel Framework, MAR21.74]

187. The advanced economies are Canada, the United States, Mexico, the euro area, the non-euro area western European countries (the United Kingdom, Norway, Sweden, Denmark and Switzerland), Japan, Oceania (Australia and New Zealand), Singapore and Hong Kong SAR.

An equity issuer must be allocated to a particular bucket according to the most material country or region in which the issuer operates. As stated in paragraph 188: "For multinational multi-sector equity issuers, the allocation to a particular bucket must be done according to the most material region and sector in which the issuer operates."

[Basel Framework, MAR21.75]

188. To assign a risk exposure to a sector, institutions must rely on a classification that is commonly used in the market for grouping issuers by industry sector.

(1) The institution must assign each issuer to one of the sector buckets in the table under paragraph 184 and it must assign all issuers from the same industry to the same sector.

(2) Risk positions from any issuer that an institution cannot assign to a sector in this fashion must be assigned to the other sector (i.e. bucket 11).

(3) For multinational multi-sector equity issuers, the allocation to a particular bucket must be done according to the most material region and sector in which the issuer operates.

[Basel Framework, MAR21.76]

189. For calculating weighted sensitivities, the risk weights for the sensitivities to each of equity spot price and equity repo rates for buckets 1 to 13 are set out in Table 10:

Risk weights for buckets 1 to 13 for sensitivities to equity risk Table 10

Bucket number	Risk weight for equity spot price	Risk weight for equity repo rate
1	55%	0.55%
2	60%	0.60%
3	45%	0.45%
4	55%	0.55%
5	30%	0.30%
6	35%	0.35%
7	40%	0.40%
8	50%	0.50%
9	70%	0.70%
10	50%	0.50%
11	70%	0.70%
12	15%	0.15%
13	25%	0.25%

[Basel Framework, MAR21.77]

190. For aggregating delta equity risk positions within a bucket, the correlation parameter ρ_{kl} between two sensitivities WS_k and WS_l within the same bucket is set at as follows

(1) The correlation parameter $\rho_{kl}$is set at 99.90%, where:

(a) one is a sensitivity to an equity spot price and the other a sensitivity to an equity repo rates; and

(b) both are related to the same equity issuer name.

(2) The correlation parameter ρ_{kl} is set out in (a) to (e) below, where both sensitivities are to equity spot price, and where:

(a) 15% between two sensitivities within the same bucket that fall under large market cap, emerging market economy (bucket number 1, 2, 3 or 4).

(b) 25% between two sensitivities within the same bucket that fall under large market cap, advanced economy (bucket number 5, 6, 7 or 8).

(c) 7.5% between two sensitivities within the same bucket that fall under small market cap, emerging market economy (bucket number 9).

(d) 12.5% between two sensitivities within the same bucket that fall under small market cap, advanced economy (bucket number 10).

(e) 80% between two sensitivities within the same bucket that fall under either index bucket (bucket number 12 or 13)

(3) The same correlation parameter ρ_{kl} as set out in above (2)(a) to (e) apply, where both sensitivities are to equity repo rates.

(4) The correlation parameter ρ_{kl} is set as each parameter specified in above (2)(a) to (e) multiplied by 99.90%, where:

(a) One is a sensitivity to an equity spot price and the other a sensitivity to an equity repo rate; and

(b) Each sensitivity is related to a different equity issuer name.

[Basel Framework, MAR21.78]

191. The correlations set out above do not apply to the other sector bucket (i.e. bucket 11).

(1) The aggregation of equity risk positions within the other sector bucket capital requirement would be equal to the simple sum of the absolute values of the net weighted sensitivities allocated to this bucket. The same method applies to the aggregation of vega risk positions.

$$K_{b(other\ bucket)} = \sum_k |WS_k|$$

(2) The aggregation of curvature equity risk positions within the other sector bucket (i.e. bucket 11) would be calculated by the formula:

$$K_{b(other\ bucket)} = \max\left(\sum_k max(CVR_k^+, 0), \sum_k max(CVR_k^-, 0)\right)$$

[Basel Framework, MAR21.79]

192. For aggregating delta equity risk positions across buckets 1 to 13, the correlation parameter γ_{bc} is set at:

(1) 15% if bucket *b* and bucket *c* fall within bucket numbers 1 to 10;

(2) 0% if either of bucket *b* and bucket *c* is bucket 11;

(3) 75% if bucket *b* and bucket *c* are bucket numbers 12 and 13 (i.e. one is bucket 12, one is bucket 13); and

(4) 45% otherwise.

[Basel Framework, MAR21.80]

Commodity risk buckets, risk weights and correlations

193. For delta commodity risk, 11 buckets that group commodities by common characteristics are set out in Table 11. [Basel Framework, MAR21.81]

194. For calculating weighted sensitivities, the risk weights for each bucket are set out in Table 11:

Delta commodity buckets and risk weights Table 11

Bucket number	Commodity bucket	Examples of commodities allocated to each commodity bucket (non-exhaustive)	Risk weight
1	Energy - solid combustibles	Coal, charcoal, wood pellets, uranium	30%
2	Energy - liquid combustibles	Light-sweet crude oil; heavy crude oil; West Texas Intermediate (WTI) crude; Brent crude; etc. (i.e. various types of crude oil) Bioethanol; biodiesel; etc. (i.e. various biofuels) Propane; ethane; gasoline; methanol; butane; etc. (i.e. various petrochemicals) Jet fuel; kerosene; gasoil; fuel oil; naphtha; heating oil; diesel etc. (i.e. various refined fuels)	35%
3	Energy - electricity and carbon trading	Spot electricity; day-ahead electricity; peak electricity; off-peak electricity (i.e. various electricity types) Certified emissions reductions; in-delivery month EU allowance; Regional Greenhouse Gas Initiative CO2 allowance; renewable energy certificates; etc. (i.e. various carbon trading emissions)	60%
4	Freight	Capesize; Panamax; Handysize; Supramax (i.e. various types of dry-bulk route) Suezmax; Aframax; very large crude carriers (i.e. various liquid-bulk/gas shipping route)	80%
5	Metals – non-precious	Aluminium; copper; lead; nickel; tin; zinc (i.e. various base metals) Steel billet; steel wire; steel coil; steel scrap; steel rebar; iron ore; tungsten; vanadium; titanium; tantalum (i.e. steel raw materials) Cobalt; manganese; molybdenum (i.e. various minor metals)	40%
6	Gaseous combustibles	Natural gas; liquefied natural gas	45%
7	Precious metals (including gold)	Gold; silver; platinum; palladium	20%
8	Grains and oilseed	Corn; wheat; soybean seed; soybean oil; soybean meal; oats; palm oil; canola; barley; rapeseed seed; rapeseed oil; rapeseed meal; red bean; sorghum; coconut oil; olive oil; peanut oil; sunflower oil; rice	35%
9	Livestock and dairy	Live cattle; feeder cattle; hog; poultry; lamb; fish; shrimp; milk; whey; eggs; butter; cheese	25%
10	Softs and other agriculturals	Cocoa; arabica coffee; robusta coffee; tea; citrus juice; orange juice; potatoes; sugar; cotton; wool; lumber; pulp; rubber	35%
11	Other commodity	Potash; fertilizer; phosphate rocks (i.e. various industrial materials) Rare earths; terephthalic acid; flat glass	50%

[Basel Framework, MAR21.82]

195. For the purpose of aggregating commodity risk positions within a bucket using a correlation parameter, the correlation parameter ρ_{kl} between two sensitivities WS_k and WS_l within the same bucket, is set as follows, where:

(1) $\rho_{kl}^{(cty)}$ is equal to 1 where the two commodities of sensitivities k and l are identical, and to the intra-bucket correlations in Table 12 otherwise, where, any two commodities are considered distinct commodities if in the market two contracts are considered distinct when the only difference between each other is the underlying commodity to be delivered. For example, WTI and Brent in bucket 2 (i.e. energy – liquid combustibles) would typically be treated as distinct commodities;

Instruments with a spread as their underlying are considered sensitive to different risk factors. In the example cited, the swap will be sensitive to both WTI and Brent, each of which require a capital charge at the risk factor level (i.e. delta of WTI and delta of Brent).

(2) $\rho_{kl}^{(tenor)}$ is equal to 1 if the two tenors of the sensitivities k and l are identical, and to 99.00% otherwise; and

(3) $\rho_{kl}^{(basis)}$ is equal to 1 if the two sensitivities are identical in the delivery location of a commodity, and 99.90% otherwise.

$$\rho_{kl} = \rho_{kl}^{(cty)} \cdot \rho_{kl}^{(tenor)} \cdot \rho_{kl}^{(basis)}$$ [46]

Values of $\rho_{kl}^{(cty)}$ for intra-bucket correlations Table 12

Bucket number	Commodity bucket	Correlation ($\rho_{kl}^{(cty)}$)
1	Energy – Solid combustibles	55%
2	Energy – Liquid combustibles	95%
3	Energy – Electricity and carbon trading	40%
4	Freight	80%
5	Metals – non-precious	60%
6	Gaseous combustibles	65%
7	Precious metals (including gold)	55%
8	Grains and oilseed	45%
9	Livestock and dairy	15%
10	Softs and other agriculturals	40%
11	Other commodity	15%

[Basel Framework, MAR21.83]

[46] For example, the correlation between the sensitivity to Brent, one-year tenor, for delivery in Le Havre and the sensitivity to WTI, five-year tenor, for delivery in Oklahoma is 95% · 99.00% · 99.90% = 93.96%.

196. For determining whether the commodity correlation parameter ($\rho_{kl}^{(cty)}$) as set out in Table 12 in paragraph 195 should apply, this paragraph provides non-exhaustive examples of further definitions of distinct commodities as follows:

(1) For bucket 3 (energy – electricity and carbon trading):

(a) Each time interval (i) at which the electricity can be delivered and (ii) that is specified in a contract that is made on a financial market is considered a distinct electricity commodity (e.g. peak and off-peak).

(b) Electricity produced in a specific region (e.g. Electricity NE, Electricity SE or Electricity North) is considered a distinct electricity commodity.

(2) For bucket 4 (freight):

(a) Each combination of freight type and route is considered a distinct commodity.

(b) Each week at which a good has to be delivered is considered a distinct commodity.

Instruments with a spread as their underlying are considered sensitive to different risk factors. For example, if there is a swap on the spread between WTI and the Brent, the swap will be sensitive to both WTI and Brent, each of which require a capital charge at the risk factor level (i.e. delta of WTI and delta of Brent). The correlation to aggregate capital charges is specified in paragraph 195.

[Basel Framework, MAR21.84]

197. For aggregating delta commodity risk positions across buckets, the correlation parameter γ_{bc} is set as follows:

(1) 20% if bucket b and bucket c fall within bucket numbers 1 to 10; and

(2) 0% if either bucket b or bucket c is bucket number 11.

[Basel Framework, MAR21.85]

Foreign exchange risk buckets, risk weights and correlations

198. An FX risk bucket is set for each exchange rate between the currency in which an instrument is denominated and the reporting currency. [Basel Framework, MAR21.86]

199. A unique relative risk weight equal to 15% applies to all the FX sensitivities. [Basel Framework, MAR21.87]

200. For the specified currency pairs 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, and for currency pairs forming first-order crosses across these specified currency pairs, the above risk weight may at the discretion of the institution be divided by the square root of 2. [Basel Framework, MAR21.88]

201. For aggregating delta FX risk positions across buckets, the correlation parameter γ_{bc} is uniformly set to 60%. [Basel Framework, MAR21.89]

9.5.2.6 Sensitivities-Based Method: Definition of Vega Risk Buckets, Risk Weights and Correlations

202. Paragraphs 203 to 207 set out buckets, risk weights and correlation parameters to calculate vega risk capital requirement as set out in paragraph 116. [Basel Framework, MAR21.90]

203. The same bucket definitions for each risk class are used for vega risk as for delta risk. [Basel Framework, MAR21.91]

204. For calculating weighted sensitivities for vega risk, the risk of market illiquidity is incorporated into the determination of vega risk, by assigning different liquidity horizons for each risk class as set out in Table 13. The risk weight for each risk class[47] is also set out in Table 13.

Regulatory liquidity horizon, $LH_{risk\ class}$ and risk weights per risk class **Table 13**

Risk class	$LH_{risk\ class}$	Risk weights
GIRR	60	100%
CSR non-securitizations	120	100%
CSR securitizations (CTP)	120	100%
CSR securitizations (non-CTP)	120	100%
Equity (large cap and indices)	20	77.78%
Equity (small cap and other sector)	60	100%
Commodity	120	100%
FX	40	100%

The 20-day liquidity horizon applies to vega risk factors that would be allocated to large market cap buckets (i.e. buckets 1 to 8) or to index buckets (i.e. buckets 12 and 13) as set out in paragraph 184. The 60-day liquidity horizon applies to vega risk factors that would be allocated to small market cap buckets (i.e. buckets 9 and 10) or to the other sector bucket (i.e. bucket 11) as set out in paragraph 184.

[Basel Framework, MAR21.92]

205. For aggregating vega GIRR risk positions within a bucket, the correlation parameter ρ_{kl} is set as follows, where:

[47] The risk weight for a given vega risk factor k (RW_k) is determined by $RW_k = \min\left[RW_\sigma \cdot \frac{\sqrt{LH_{risk\ class}}}{\sqrt{10}}; 100\%\right]$, where RW_σ is set at 55%; and $LH_{risk\ class}$ is specified per risk class in Table 13.

(1) $\rho_{kl}^{(option\ maturity)}$ is equal to $e^{-\alpha \cdot \frac{|T_k - T_l|}{min\{T_k;T_l\}}}$, where:

(a) α is set at 1%;

(b) T_k (respectively T_l) is the maturity of the option from which the vega sensitivity VR_k (VR_l) is derived, expressed as a number of years; and

(2) $\rho_{kl}^{(underlying\ maturity)}$ is equal to $e^{-\alpha \cdot \frac{|T_k^U - T_l^U|}{min\{T_k^U;T_l^U\}}}$, where:

(a) α is set at 1%; and

(b) T_k^U (respectively T_l^U) is the maturity of the underlying of the option from which the sensitivity VR_k (VR_l) is derived, expressed as a number of years after the maturity of the option.

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

[Basel Framework, MAR21.93]

206. For aggregating vega risk positions within a bucket of the other risk classes (i.e. non-GIRR), the correlation parameter ρ_{kl} is set as follows, where:

(1) $\rho_{kl}^{(DELTA)}$ is equal to the correlation that applies between the delta risk factors that correspond to vega risk factors *k* and *l*. For instance, if *k* is the vega risk factor from equity option X and *l* is the vega risk factor from equity option Y then $\rho_{kl}^{(DELTA)}$ is the delta correlation applicable between X and Y; and

(2) $\rho_{kl}^{(option\ maturity)}$ is defined as in the above paragraph

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

For determining the delta risk factors that correspond to vega risk factors k and l, for CSR and commodity risks in paragraphs 121 to 123 and paragraph 125, if the vega risk factors are defined for a smaller number of dimensions than are defined for delta risk factors, only the dimensions that are defined both as a vega risk factor dimension and as a delta risk factor dimension for the relevant risk class need to be considered as a correlation based on delta risk factors ($\rho_{kl}^{(DELTA)}$) in the calculation of vega risk for purposes of the requirements in this paragraph. This means that the following dimensions are considered:

- for CSR non-securitisation risk: option maturity ($\rho_{kl}^{(option\ maturity)}$) and underlying name ($\rho_{kl}^{(name)}$);
- for CSR securitisations (CTP) risk: option maturity ($\rho_{kl}^{(option\ maturity)}$) and underlying name ($\rho_{kl}^{(name)}$);
- for CSR securitisation (non-CTP): option maturity ($\rho_{kl}^{(option\ maturity)}$) and securitisation tranche ($\rho_{kl}^{(tranche)}$); and

- for commodity risk: option maturity ($\rho_{kl}^{(option\ maturity)}$) and commodity ($\rho_{kl}^{(cty)}$).

[Basel Framework, MAR21.94]

207. For aggregating vega risk positions across different buckets within a risk class (GIRR and non-GIRR), the same correlation parameters for γ_{bc}, as specified for delta correlations for each risk class in paragraphs 151 to 201 are to be used for the aggregation of vega risk (e.g. γ_{bc} = 50% is to be used for the aggregation of vega risk sensitivities across different GIRR buckets). [Basel Framework, MAR21.95]

9.5.2.7 Sensitivities-Based Method: Definition of Curvature Risk Buckets, Risk Weights and Correlations

208. Paragraphs 209 to 213 set out buckets, risk weights and correlation parameters to calculate curvature risk capital requirement as set out in paragraph 117. [Basel Framework, MAR21.96]

209. The delta buckets are replicated for the calculation of curvature risk capital requirement, unless specified otherwise in the preceding paragraphs within paragraphs 120 to 201. [Basel Framework, MAR21.97]

210. For calculating the net curvature risk capital requirement CVR_k for risk factor k for FX and equity risk classes, the curvature risk weight, which is the size of a shock to the given risk factor, is a relative shift equal to the respective delta risk weight. For FX curvature, for options that do not reference an institution's reporting currency (or base currency as set out in paragraph 126(b) as an underlying, net curvature risk charges (CVR_k^+ and CVR_k^-) may be divided by a scalar of 1.5. Alternatively, and subject to OSFI's approval, an institution may apply the scalar of 1.5 consistently to all FX instruments provided curvature sensitivities are calculated for all currencies, including sensitivities determined by shocking the reporting currency (or base currency where used) relative to all other currencies. [Basel Framework, MAR21.98]

211. For calculating the net curvature risk capital requirement CVR_k for curvature risk factor k for GIRR, CSR and commodity risk classes, the curvature risk weight is the parallel shift of all the tenors for each curve based on the highest prescribed delta risk weight for each bucket.[48] For example, in the case of GIRR for a given currency (i.e. bucket), the risk weight assigned to 0.25-year tenor (i.e. the most punitive tenor risk weight) is applied to all the tenors simultaneously for each risk-free yield curve (consistent with a "translation", or "parallel shift" risk calculation). [Basel Framework, MAR21.99].

212. For aggregating curvature risk positions within a bucket, the curvature risk correlations ρ_{kl} are determined by squaring the corresponding delta correlation parameters ρ_{kl}. In a case

[48] The sizes of upward and downward shocks applied to assess the net curvature risk capital requirement for a specific commodity´s curvature risk factor should be based on the risk weight connected to the curvature bucket where that commodity is classified, in accordance with paragraphs 209 and 194. The same relative shocks should be applied to all curvature risk factors classified under the same bucket, defined along the dimension of the constructed curve (i.e., no term structure decomposition) per each commodity spot price, as described in paragraph 125(3). For example, the constructed curve for gold (with a risk weight of 20%) would be shifted up by multiplying each tenor price by 1.2 and down by multiplying each tenor price by 0.8.

where a curvature risk factor is defined differently than the corresponding delta risk factor for a given risk class (i.e. for CSR non-securitisations, CSR securitisations (CTP), CSR securitisations (non-CTP) and commodities as defined in paragraph 121 to paragraph 123 and paragraph 125), institutions do not need to consider this delta risk factor dimension. For example, for CSR non-securitisations and CSR securitisations (CTP), consistent with paragraph 121 which defines a bucket along one dimension (i.e. the relevant credit spread curve), the correlation parameter ρ_{kl} as defined in paragraph 166 and paragraph 167 is not applicable to the curvature risk capital requirement calculation. Thus, the correlation parameter is determined by whether the two names of weighted sensitivities are the same. In the formula in paragraph 166 and paragraph 167, the correlation parameters $\rho_{kl}^{(basis)}$ and $\rho_{kl}^{(tenor)}$ need not apply and only correlation parameter $\rho_{kl}^{(name)}$ applies between two weighted sensitivities within the same bucket. This correlation parameter should be squared. In applying the high and low correlations scenario set out in paragraph 118, the curvature risk capital requirements are calculated by applying curvature correlation parameters ρ_{kl} determined in this paragraph.

[Basel Framework, MAR21.100]

213. For aggregating curvature risk positions across buckets, the curvature risk correlations γ_{bc} are determined by squaring the corresponding delta correlation parameters γ_{bc}. For instance, when aggregating CVR_{EUR} and CVR_{USD} for the GIRR, the correlation should be $50\%^2 = 25\%$. In applying the high and low correlations scenario set out in paragraph 118, the curvature risk capital requirements are calculated by applying the curvature correlation parameters γ_{bc}, (i.e. the square of the corresponding delta correlation parameter). [Basel Framework, MAR21.101]

9.5.3 DEFAULT RISK CAPITAL REQUIREMENT

9.5.3.1 Main Concepts of Default Risk Capital Requirements

214. The default risk capital (DRC) requirement is intended to capture jump-to-default (JTD) risk that may not be captured by credit spread shocks under the sensitivities-based method. DRC requirements provide some limited hedging recognition. In this section offsetting refers to the netting of exposures to the same obligor (where a short exposure may be subtracted in full from a long exposure) and hedging refers to the application of a partial hedge benefit from the short exposures (where the risk of long and short exposures in distinct obligors do not fully offset due to basis or correlation risks). [Basel Framework, MAR22.1]

9.5.3.2 Instruments Subject To the Default Risk Capital Requirement

215. The DRC requirement must be calculated for instruments subject to default risk:

(1) Non-securitization portfolios (including equities)

(2) Securitization portfolio (non-correlation trading portfolio, or non-CTP)

(3) Securitization (correlation trading portfolio, or CTP).

[Basel Framework, MAR22.2]

9.5.3.3 Overview of DRC Requirement Calculation

216. The following step-by-step approach must be followed for each risk class subject to default risk. The specific definition of gross JTD risk, net JTD risk, bucket, risk weight and the method for aggregation of DRC requirement across buckets are separately set out per each risk class in subsections in paragraphs 222 to 239.

(1) The gross JTD risk of each exposure is computed separately.

(2) With respect to the same obligator, the JTD amounts of long and short exposures are offset (where permissible) to produce net long and/or net short exposure amounts per distinct obligor.

(3) Net JTD risk positions are then allocated to buckets.

(4) Within a bucket, a hedge benefit ratio is calculated using net long and short JTD risk positions. This acts as a discount factor that reduces the amount of net short positions to be netted against net long positions within a bucket. A prescribed risk weight is applied to the net positions which are then aggregated.

(5) Bucket level DRC requirements are aggregated as a simple sum across buckets to give the overall DRC requirement.

[Basel Framework, MAR22.3]

217. No diversification benefit is recognised between the DRC requirements for:

(1) non-securitizations;

(2) securitizations (non-CTP); and

(3) securitizations (CTP).

[Basel Framework, MAR22.4]

218. For traded non-securitization credit and equity derivatives, JTD risk positions by individual constituent issuer legal entity should be determined by applying a look-through approach.

When decomposing multiple underlying positions of a single security or product (e.g. index options), the JTD equivalent is defined as the difference between the value of the security or product assuming that each single name referenced by the security or product, separately from the others, defaults (with zero recovery) and the value of the security or product assuming that none of the names referenced by the security or product default.

[Basel Framework, MAR22.5]

219. For the CTP, the capital requirement calculation includes the default risk for non-securitization hedges. These hedges must be removed from the calculation of default risk non-securitization. [Basel Framework, MAR22.6]

220. Exposures to the Canadian sovereign, central bank and Canadian public sector entities (PSEs) subject to a 0% risk weight in CAR Chapter 4 should be assigned a default risk weight of 0%. Exposures to the United States sovereign, central bank and US PSEs assigned a 0% risk weight by US regulators should be assigned a default risk weight of 0%. Exposures to Multilateral Development Banks (MDBs) subject to a 0% risk weight in CAR Chapter 4 should be assigned a default risk weight of 0%. Exposures to other investment grade[49] sovereigns which are assigned a 0% default risk weight by their national regulatory authority should be assigned a default risk weight of 0.5%, provided the institution has a local presence (subsidiary or branch) in the country of the sovereign exposure and has funded the exposure in the local currency.

[Basel Framework, MAR22.7]

221. For claims on an equity investment in a fund that is subject to the treatment specified in paragraph 148(3) (i.e. treated as an unrated "other sector" equity), the equity investment in the fund shall be treated as an unrated equity instrument. Where the mandate of that fund allows the fund to invest in primarily high-yield or distressed names, institutions shall apply the maximum risk weight per Table 15 in paragraph 237 that is achievable under the fund's mandate (by calculating the effective average risk weight of the fund when assuming that the fund invests first in defaulted instruments to the maximum possible extent allowed under its mandate, and then in CCC-rated names to the maximum possible extent, and then B-rated, and then BB-rated). Neither offsetting nor diversification between these generated exposures and other exposures is allowed.

For equity investments in funds for which the sensitivities-based method capital requirements are calculated according to paragraph 148(3) (i.e. the "other sector" equity treatment), the mandate of the fund may not be used to determine to jump-to-default (JTD) of the fund for default risk. In such cases, the LGD should be 100%, consistent with the requirement in this paragraph to treat the equity investment as a position in an unrated equity instrument.

[Basel Framework, MAR22.8]

9.5.3.4 Default Risk Capital Requirement for Non-Securitizations

Gross jump-to-default risk positions (gross JTD)

222. The gross JTD risk position is computed exposure by exposure. For instance, if an institution has a long position on a bond issued by Apple, and another short position on a bond issued by Apple, it must compute two separate JTD exposures. [Basel Framework, MAR22.9]

223. For the purpose of DRC requirements, the determination of the long/short direction of positions must be on the basis of long or short with respect to whether the credit exposure results in a loss or gain in the case of a default.

(1) Specifically, a long exposure is defined as a credit exposure that results in a loss in the case of a default.

[49] Investment grade refers to a rating of Baa3 or better by Moody's; a rating of BBB- or better by S&P; and the equivalent investment grade credit rating from any additional rating agency selected by the institution.

(2) For derivative contracts, the long/short direction is also determined by whether the contract will result in a loss in the case of a default (i.e. long or short position is not determined by whether the option or credit default swap (CDS), is bought or sold). Thus, for the purpose of DRC requirements, a sold put option on a bond is a long credit exposure, since a default results in a loss to the seller of the option.

[Basel Framework, MAR22.10]

224. The gross JTD is a function of the loss given default (LGD), notional amount (or face value) and the cumulative profit and loss (P&L) already realised on the position, where:

(1) *notional* is the bond-equivalent notional amount (or face value) of the position; and

(2) P&L is the cumulative mark-to-market loss (or gain) already taken on the exposure. P&L is equal to the market value minus the notional amount, where the market value is the current market value of the position.

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

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

[Basel Framework, MAR22.11]

225. For calculating the gross JTD, LGD is set as follows:

(1) Equity instruments and non-senior debt instruments are assigned an LGD of 100%.

(2) Senior debt instruments are assigned an LGD of 75%.

(3) Covered bonds, as defined within paragraph 163, are assigned an LGD of 25%.

(4) When the price of the instrument is not linked to the recovery rate of the defaulter (e.g. a foreign exchange-credit hybrid option where the cash flows are swap of cash flows, long EUR coupons and short USD coupons with a knockout feature that ends cash flows on an event of default of a particular obligor), there should be no multiplication of the notional by the LGD.

Non-tranched MBS issued by government sponsored-entities (GSEs), such as Fannie and Freddie, are assigned to bucket 2 (local government, government-backed non-financials, education, public administration) for credit spread risk with a risk weight of 1.0%.

The LGD for non-tranched MBS issued by GSEs is 75% (i.e. the LGD assigned to senior debt instruments) unless the GSE security satisfies the requirements of footnote 40 to paragraph 163 for treatment of the security as a covered bond.

[Basel Framework, MAR22.12]

226. In calculating the JTD as set out in paragraph 224, the notional amount of an instrument that gives rise to a long (short) exposure is recorded as a positive (negative) value, while the P&L loss (gain) is recorded as a negative (positive) value. If the contractual or legal terms of the derivative allow for the unwinding of the instrument with no exposure to default risk, then the JTD is equal to zero. [Basel Framework, MAR22.13]

227. The notional amount is used to determine the loss of principal at default, and the mark-to-market loss is used to determine the net loss so as to not double-count the mark-to-market loss already recorded in the market value of the position.

(1) For all instruments, the notional amount is the notional amount of the instrument relative to which the loss of principal is determined. Examples are as follows:

(a) For a bond, the notional amount is the face value.

(b) For credit derivatives, the notional amount of a CDS contract or a put option on a bond is the notional amount of the derivative contract.

(c) In the case of a call option on a bond, the notional amount to be used in the JTD calculation is zero (since, in the event of default, the call option will not be exercised). In this case, a JTD would extinguish the call option's value and this loss would be captured through the mark-to-market P&L term in the JTD calculation.

(2) Table 14 illustrates examples of the notional amounts and market values for a long credit position with a mark-to-market loss to be used in the JTD calculation, where:

(a) the bond-equivalent market value is an intermediate step in determining the P&L for derivative instruments;

(b) the mark-to-market value of CDS or an option takes an absolute value; and

(c) the strike amount of the bond option is expressed in terms of the bond price (not the yield).

Examples of components for a long credit position in the JTD calculation **Table 14**

Instrument	Notional	Bond-equivalent market value	P&L
Bond	Face value of bond	Market value of bond	Market value – face value
CDS	Notional of CDS	Notional of CDS + mark-to-market (MtM) value of CDS	- MtM value of CDS
Sold put option on a bond	Notional of option	Strike amount – | MtM value of option |	(Strike – | MtM value of option |) – Notional
Bought call option on a bond	0	MtM value of option	MtM value of option

P&L = bond-equivalent market value – notional.
With this representation of the P&L for a sold put option, a lower strike results in a lower JTD loss.

The JTD equivalent for a single security or product with multiple underlying positions (e.g. index options) is defined as the difference between the value of the security or product assuming that each single name referenced by the security or product, separately from the others, defaults (with zero recovery) and the value of the security or product assuming that none of the names referenced by the security or product default.

When computing the DRC requirement for a convertible bond, institutions should consider the P&L of the equity optionality embedded within the convertible bond, as a convertible bond can be decomposed into a vanilla bond and a long equity option. This avoids situations where the JTD risk of the instrument is potentially underestimated.

[Basel Framework, MAR22.14]

228. To account for defaults within the one-year capital horizon, the JTD for all exposures of maturity less than one year and their hedges are scaled by a fraction of a year. No scaling is applied to the JTD for exposures of one year or greater.[50] For example, the JTD for a position with a six month maturity would be weighted by one-half, while the JTD for a position with a one year maturity would have no scaling applied to the JTD.

As required by the paragraph below, cash equity positions are assigned a maturity of either more than one year or three months. There is no discretion permitted to assign cash equity positions to any maturity between three months and one year. In determining the offsetting criterion, paragraph 230 specifies that the maturity of the derivatives contract be considered, not the maturity of the underlying instrument. Paragraph 231 further states that the maturity weighting applied to the JTD for any product with a maturity of less than three months is floored at three months.

To illustrate how the standardized approach DRC requirement should be calculated with a simple hypothetical portfolio, consider equity index futures with one month to maturity and a negative market value of EUR 10 million (–EUR 10 million, maturity 1M), hedged with the underlying equity positions with a positive market value of EUR 10 million (+EUR 10 million). Both positions in the example should be considered having a three-month maturity. Based on paragraph 228, which requires maturity scaling, defined as a fraction of the year, of positions and their hedge, the JTD for the above trading portfolio would be calculated as follows: 1/4 x 10 – 1/4 x 10 = 0.

[Basel Framework, MAR22.15]

229. Cash equity positions (i.e. stocks) are assigned to a maturity of either more than one year or three months, at institutions' discretion. [Basel Framework, MAR22.16]

230. For derivative exposures, the maturity of the derivative contract is considered in determining the offsetting criterion, not the maturity of the underlying instrument. [Basel Framework, MAR22.17]

231. The maturity weighting applied to the JTD for any sort of product with a maturity of less than three months (such as short term lending) is floored at a weighting factor of one-fourth or, equivalently, three months (that means that the positions having shorter-than-three months remaining maturity would be regarded as having a remaining maturity of three months for the purpose of the DRC requirement).

[50] Note that this paragraph refers to the scaling of gross JTD (i.e. not net JTD).

In the case where a total return swap (TRS) with a maturity of one month is hedged by the underlying equity, the net JTD for such a position would be zero. If the contractual/legal terms of the derivative allow for the unwinding of both legs of the position at the time of expiry of the first to mature with no exposure to default risk of the underlying credit beyond that point, then the JTD for the maturity-mismatched position is equal to zero.

[Basel Framework, MAR22.18]

Net jump-to-default risk positions (net JTD)

232. Exposures to the same obligator may be offset as follows:

(1) The gross JTD risk positions 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. For example, a short exposure in an equity may offset a long exposure in a bond, but a short exposure in a bond cannot offset a long exposure in the equity.

(2) For the purposes of determining whether a guaranteed bond is an exposure to the underlying obligor or an exposure to the guarantor, the credit risk mitigation requirements set out in paragraphs 260 and 262 of Chapter 4 apply.

(3) Exposures of different maturities that meet this offsetting criterion may be offset as follows.

(a) Exposures with maturities longer than the capital horizon (one year) may be fully offset.

(b) An exposure to an obligor comprising a mix of long and short exposures with a maturity less than the capital horizon (equal to one year) must be weighted by the ratio of the exposure's maturity relative to the capital horizon. For example, with the one-year capital horizon, a three-month short exposure would be weighted so that its benefit against long exposures of longer-than-one-year maturity would be reduced to one quarter of the exposure size.[51]

[Basel Framework, MAR22.19]

233. In the case of long and short offsetting exposures where both have a maturity under one year, the scaling can be applied to both the long and short exposures.

In the case of either i) an investment grade bond[52] or a large cap equity[53] that is hedging a TRS or ii) a bond forward that is hedging a Level 1 High Quality Liquid Asset as defined in Chapter 2 of OSFI's *Liquidity Adequacy Requirements Guideline*, the mismatch applied between long and short position mismatches is capped at 40 days. The institution must be able to demonstrate to

[51] Basel Committee on Banking Supervision, Revisions to the securitization framework, December 2014, 2016 and 2018.; .

[52] Investment grade refers to a rating of Baa3 or better by Moody's; a rating of BBB- or better by S&P; and the equivalent investment grade credit rating from any additional rating agency selected by the institution.

[53] Large cap refers to the shares of a company with a market capitalization higher than CAD $6.25 billion.

OSFI the governance capacity to unwind such cash positions within this timeframe. Such recognition is only admissible if the institution:

i) chooses to make use of the rebalancing/liquidation of the hedge consistently over the relevant set of trading book risk positions,

ii) demonstrates that the inclusion of rebalancing/liquidation results in better risk measurement,

iii) demonstrates that the markets for the security serving as a hedge are liquid enough to allow for this kind of rebalancing/liquidation, even during periods of stress, and

iv) establishes a limit system based on instrument exposure relative to average daily traded volume of the cash position.

[Basel Framework, MAR22.20]

234. Finally, the offsetting may result in net long JTD risk positions and net short JTD risk positions. The net long and net short JTD risk positions are aggregated separately as described below. [Basel Framework, MAR22.21]

Calculation of default risk capital requirement for non-securitization

235. For the default risk of non-securitizations, three buckets are defined as:

(1) corporates;
(2) sovereigns; and
(3) local governments and municipalities.

[Basel Framework, MAR22.22]

236. In order to recognise hedging relationship between net long and net short positions within a bucket, a hedge benefit ratio is computed as follows.

(1) A simple sum of the net long JTD risk positions (not risk-weighted) must be calculated, where the summation is across the credit quality categories (i.e. rating bands). The aggregated amount is used in the numerator and denominator of the expression of the hedge benefit ratio (HBR) below.

(2) A simple sum of the net (not risk-weighted) short JTD risk positions must be calculated, where the summation is across the credit quality categories (i.e. rating bands). The aggregated amount is used in the denominator of the expression of the *HBR* below.

(3) The HBR is the ratio of net long JTD risk positions to the sum of net long JTD and absolute value of net short JTD risk positions:

$$HBR = \frac{\sum \text{net JTD}_{\text{long}}}{\sum \text{net JTD}_{\text{long}} + \sum \left|\text{net JTD}_{\text{short}}\right|}$$

[Basel Framework, MAR22.23]

237. For calculating the weighted net JTD, default risk weights are set depending on the credit quality categories (i.e. rating bands) for all three buckets (i.e. irrespective of the type of counterparty), as set out in Table 15

Default risk weights for non-securitizations by credit quality category

Table 15

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%

Consistent with section 4.1 of Chapter 4, instruments issued by the following entities shall receive the same treatment as instruments issued by the Government of Canada for the purposes of the DRC: all provincial and territorial governments and agents of the federal, provincial or territorial government whose debts are, by virtue of their enabling legislation, obligations of the parent government.

[Basel Framework, MAR22.24]

238. The capital requirement for each bucket is to be calculated as the combination of the sum of the risk-weighted long net JTD, the HBR, and the sum of the risk-weighted short net JTD, where the summation for each long net JTD and short net JTD is across the credit quality categories (i.e. rating bands). In the following formula, DRC stands for DRC requirement; and *i* refers to an instrument belonging to bucket *b*.

$$DRC_b = \max\left[\left(\sum_{i \in Long} RW_i \cdot \text{net } JTD_i\right) - HBR \cdot \left(\sum_{i \in Short} RW_i \cdot |\text{net } JTD_i|\right); 0\right]$$

[Basel Framework, MAR22.25]

239. No hedging is recognised between different buckets – the total DRC requirement for non-securitizations must be calculated as a simple sum of the bucket level capital requirements. [Basel Framework, MAR22.26]

9.5.3.5 Default Risk Capital Requirement for Securitizations (Non-CTP)

Gross jump-to-default risk positions (gross JTD)

240. For the computation of gross JTD on securitizations, the same approach must be followed as for default risk (non-securitizations), except that an LGD ratio is not applied to the exposure. Because the LGD is already included in the default risk weights for securitizations to be applied to the securitization exposure (see below), to avoid double counting of LGD the JTD for securitizations is simply the market value of the securitization exposure (i.e. the JTD for tranche positions is their market value). [Basel Framework, MAR22.27]

241. For the purposes of offsetting and hedging recognition for securitizations (non-CTP), positions in underlying names or a non-tranched index position may be decomposed proportionately into the equivalent replicating tranches that span the entire tranche structure. When underlying names are treated in this way, they must be removed from the non-securitization default risk treatment. [Basel Framework, MAR22.28]

Net jump-to-default risk positions (net JTD)

242. For default risk of securitizations (non-CTP), offsetting is limited to a specific securitization exposure (i.e. tranches with the same underlying asset pool). This means that:

(1) no offsetting is permitted between securitization exposures with different underlying securitized portfolio (i.e. underlying asset pools), even if the attachment and detachment points are the same; and

(2) no offsetting is permitted between securitization exposures arising from different tranches with the same securitized portfolio.

[Basel Framework, MAR22.29]

243. Securitization exposures that are otherwise identical except for maturity may be offset. The same offsetting rules for non-securitizations including scaling down positions of less than one year as set out in paragraphs 228 through 231 apply to JTD risk positions for securitizations (non-CTP). Offsetting within a specific securitization exposure is allowed as follows.

(1) Securitization exposures that can be perfectly replicated through decomposition may be offset. Specifically, if a collection of long securitization exposures can be replicated by a collection of short securitization exposures, then the securitization exposures may be offset.

(2) Furthermore, when a long securitization exposure can be replicated by a collection of short securitization exposures with different securitized portfolios, then the securitization exposure with the "mixed" securitization portfolio may be offset by the combination of replicating securitization exposures.

(3) After the decomposition, the offsetting rules would apply as in any other case. As in the case of default risk (non-securitizations), long and short securitization exposures should be determined from the perspective of long or short the underlying credit, e.g. the

institution making losses on a long securitization exposure in the event of a default in the securitized portfolio.

[Basel Framework, MAR22.30]

Calculation of default risk capital requirement for securitizations (non-CTP)

244. For default risk of securitizations (non-CTP), the buckets are defined as follows:

(1) Corporates (excluding small and medium enterprises) – this bucket takes into account all regions.

(2) Other buckets – these are defined along two dimensions:

(a) Asset classes: the 11 asset classes are defined as asset-backed commercial paper; auto Loans/Leases; residential mortgage-backed securities (MBS); credit cards; commercial MBS; collateralized loan obligations; collateralized debt obligation (CDO)-squared; small and medium enterprises; student loans, other retail; and other wholesale.

(b) Regions: the four regions are defined as Asia, Europe, North America and all other.

[Basel Framework, MAR22.31]

245. To assign a securitization exposure to a bucket, institutions must rely on a classification that is commonly used in the market for grouping securitization exposures by type and region of underlying.

(1) The institution must assign each securitization exposure to one and only one of the buckets above and it must assign all securitizations with the same type and region of underlying to the same bucket.

(2) Any securitization exposure that an institution cannot assign to a type or region of underlying in this fashion must be assigned to the "other bucket".

[Basel Framework, MAR22.32]

246. The capital requirement for default risk of securitizations (non-CTP) is determined using a similar approach to that for non-securitizations. The DRC requirement within a bucket is calculated as follows:

(1) The hedge benefit discount *HBR*, as defined in paragraph 236, is applied to net short securitization exposures in that bucket.

(2) The capital requirement is calculated as in paragraph 238.

[Basel Framework, MAR22.33]

247. For calculating the weighted net JTD, the risk weights of securitization exposures are defined by the tranche instead of the credit quality. The risk weight for securitizations (non-CTP) is applied as follows:

(1) The default risk weights for securitization exposures are based on the corresponding risk weights for banking book instruments, which is defined in Chapter 6. Transactions that are assessed as simple, transparent and comparable-compliant for capital purposes are subject to alternative capital treatment requirements outlined in the Chapter 6 with the following modification: the maturity component in the banking book securitization framework is set to zero (i.e. a one-year maturity is assumed) to avoid double-counting of risks in the maturity adjustment (of the banking book approach) since migration risk in the trading book will be captured in the credit spread capital requirement.

(2) Following the corresponding treatment in the banking book, the hierarchy of approaches in determining the risk weights should be applied at the underlying pool level.

(3) The capital requirement under the standardized approach for an individual cash securitization position can be capped at the fair value of the transaction.

[Basel Framework, MAR22.34]

248. No hedging is recognised between different buckets. Therefore, the total DRC requirement for securitizations (non-CTP) must be calculated as a simple sum of the bucket-level capital requirements. [Basel Framework, MAR22.35]

9.5.3.6 Default Risk Capital Requirement for Securitizations (CTP)

Gross jump-to-default risk positions (gross JTD)

249. For the computation of gross JTD on securitizations (CTP), the same approach must be followed as for default risk-securitizations (non-CTP) as described in paragraph 240. [Basel Framework, MAR22.36]

250. The gross JTD for non-securitizations (CTP) (i.e. single-name and index hedges) positions is defined as their market value. [Basel Framework, MAR22.37]

251. Nth-to-default products should be treated as tranched products with attachment and detachment points defined below, where "Total names" is the total number of names in the underlying basket or pool:

(1) Attachment point = (N – 1) / Total names

(2) Detachment point = N / Total names

[Basel Framework, MAR22.38]

Net jump-to-default risk positions (net JTD)

252. Exposures that are otherwise identical except for maturity may be offset. The same concept of long and short positions from a perspective of loss or gain in the event of a default as set out in paragraph 223 and offsetting rules for non-securitizations including scaling down positions of less than one year as set out in paragraphs 228 to 231 apply to JTD risk positions for securitizations (non-CTP).

(1) For index products, for the exact same index family (e.g. CDX.NA.IG), series (e.g. series 18) and tranche (e.g. 0–3%), securitization exposures should be offset (netted) across maturities (subject to the offsetting allowance as described above).

(2) Long and short exposures that are perfect replications through decomposition may be offset as follows. When the offsetting involves decomposing single name equivalent exposures, decomposition using a valuation model would be allowed in certain cases as follows. Such decomposition is the sensitivity of the security's value to the default of the underlying single name obligor. Decomposition with a valuation model is defined as follows: a single name equivalent constituent of a securitization (e.g. tranched position) is the difference between the unconditional value of the securitization and the conditional value of the securitization assuming that the single name defaults, with zero recovery, where the value is determined by a valuation model. In such cases, the decomposition into single-name equivalent exposures must account for the effect of marginal defaults of the single names in the securitization, where in particular the sum of the decomposed single name amounts must be consistent with the undecomposed value of the securitization. Further, such decomposition is restricted to vanilla securitizations (e.g. vanilla CDOs, index tranches or bespokes); while the decomposition of exotic securitizations (e.g. CDO squared) is prohibited.

(3) Moreover, for long and short 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. For instance, a long securitization exposure in a 10–15% tranche vs combined short securitization exposures in 10–12% and 12–15% tranches on the same index/series can be offset against each other. Similarly, long securitization exposures in the various tranches that, when combined perfectly, replicate a position in the index series (non-tranched) can be offset against a short securitization exposure in the index series if all the positions are to the exact same index and series (e.g. CDX.NA.IG series 18). Long and short positions in indices and single-name constituents in the index may also be offset by decomposition. For instance, single-name long securitization exposures that perfectly replicate an index may be offset against a short securitization exposure in the index. When a perfect replication is not possible, then offsetting is not allowed except as indicated in the next sentence. Where the long and short securitization exposures are otherwise equivalent except for a residual component, the net amount must show the residual exposure. For instance, a long securitization exposure in an index of 125 names, and short securitization exposures of the appropriate replicating amounts in 124 of the names, would result in a net long securitization exposure in the missing 125th name of the index.

(4) Different tranches of the same index or series may not be offset (netted), different series of the same index may not be offset, and different index families may not be offset.

[Basel Framework, MAR22.39]

Calculation of default risk capital requirement for securitizations (CTP)

253. For default risk of securitizations (CTP), each index is defined as a bucket of its own. A non-exhaustive list of indices include: CDX North America IG, iTraxx Europe IG, CDX HY, iTraxx XO, LCDX (loan index), iTraxx LevX (loan index), Asia Corp, Latin America Corp,

Other Regions Corp, Major Sovereign (G7 and Western Europe) and Other Sovereign. [Basel Framework, MAR22.40]

254. Bespoke securitization exposures should be allocated to the index bucket of the index they are a bespoke tranche of. For instance, the bespoke tranche 5% - 8% of a given index should be allocated to the bucket of that index. [Basel Framework, MAR22.41]

255. The default risk weights for securitizations applied to tranches are based on the corresponding risk weights for the banking book instruments, which is defined in Chapter 6 with the following modification: the maturity component in the banking book securitization framework is set to zero, i.e. a one-year maturity is assumed to avoid double-counting of risks in the maturity adjustment (of the banking book approach) since migration risk in the trading book will be captured in the credit spread capital requirement. [Basel Framework, MAR22.42]

256. For the non-tranched products, the same risk weights for non-securitizations as set out in paragraph 237 apply. For the tranched products, institutions must derive the risk weight using the banking book treatment as set out in the paragraph above. [Basel Framework, MAR22.43]

257. Within a bucket (i.e. for each index) at an index level, the capital requirement for default risk of securitizations (CTP) is determined in a similar approach to that for non-securitizations.

(1) The hedge benefit ratio (*HBR)*, as defined in paragraph 236, is modified and applied to net short positions in that bucket as in the formula below, where the subscript *ctp* for the term HBR_{ctp} indicates that the HBR is determined using the combined long and short positions across all indices in the CTP (i.e. not only the long and short positions of the bucket by itself). The summation of risk-weighted amounts in the formula spans all exposures relating to the index (i.e. index tranche, bespoke, non-tranche index or single name).

(2) A deviation from the approach for non-securitizations is that no floor at zero applies at the bucket level, and consequently, the DRC requirement at the index level (DRC_b) can be negative.

$$DRC_b = \left(\sum_{i \in Long} RW_i \cdot net\ JTD_i\right) - HBR_{ctp} \cdot \left(\sum_{i \in Short} RW_i \cdot |net\ JTD_i|\right)$$

[Basel Framework, MAR22.44]

258. The total DRC requirement for securitizations (CTP) is calculated by aggregating bucket level capital amounts as follows. For instance, if the DRC requirement for the index CDX North America IG is +100 and the DRC requirement for the index Major Sovereign (G7 and Western Europe) is -100, the total DRC requirement for the CTP is $100 - 0.5 \times 100 = 50$.[54]

[54] The procedure for the DRC_b and DRC_{CTP} terms accounts for the basis risk in cross index hedges, as the hedge benefit from cross-index short positions is discounted twice, first by the hedge benefit ratio HBR in DRC_b, and again by the term 0.5 in the DRC_{CTP} equation.

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

[Basel Framework, MAR22.45]

9.5.4 RESIDUAL RISK ADD-ON

This section sets out the calculation of residual risk add-on under the standardized approach for market risk.

9.5.4.1 Introduction

259. The residual risk add-on (RRAO) is to be calculated for all instruments bearing residual risk separately in addition to other components of the capital requirement under the standardized approach. [Basel Framework, MAR23.1]

9.5.4.2 Instruments Subject To the Residual Risk Add-On

260. Instruments with an exotic underlying and instruments bearing other residual risks are subject to the RRAO. [Basel Framework, MAR23.2]

261. Instruments with an exotic underlying are trading book instruments with an underlying[55] exposure that is not within the scope of delta, vega or curvature risk treatment in any risk class under the sensitivities-based method or default risk capital (DRC) requirements in the standardized approach.[56] [Basel Framework, MAR23.3]

262. Instruments bearing other residual risks are those that meet any of the three criteria below:

(1) Instruments subject to vega or curvature risk capital requirements in the trading book and with pay-offs that cannot be written or perfectly replicated as a finite linear combination of vanilla options with a single underlying equity price, commodity price, exchange rate, bond price, credit default swap price or interest rate swap;

(2) Instruments which fall under the definition of the correlation trading portfolio (CTP) in paragraph 112, except for those instruments that are recognized in the market risk framework as eligible hedges of risks within the CTP;

(3) Transactions executed by the internal risk transfer desk giving rise to residual risk between the internal hedge and the external hedge, as specified in paragraph 84.

Bonds with multiple call dates would be considered as instruments bearing other residual risks, as they are path-dependent options.

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[55] Future realised volatility is considered an exotic underlying for the purpose of the RRAO.

[56] Examples of exotic underlying exposures include: longevity risk, weather, natural disasters, future realised volatility (as an underlying exposure for a swap).

[Basel Framework, MAR23.4]

263. A non-exhaustive list of other residual risks types and instruments that may fall within the criteria set out in the paragraph above include:

(1) Gap risk: risk of a significant change in vega parameters in options due to small movements in the underlying, which results in hedge slippage. Relevant instruments subject to gap risk include all path dependent options, such as barrier options, and Asian options as well as all digital options.

(2) Correlation risk: risk of a change in a correlation parameter necessary for determining the value of an instrument with multiple underlyings. Relevant instruments subject to correlation risk include all basket options, best-of-options, spread options, basis options, Bermudan options and quanto options.

(3) Behavioural risk: risk of a change in exercise/prepayment outcomes such as those that arise in fixed rate mortgage products where retail clients may make decisions motivated by factors other than pure financial gain (such as demographical features and/or and other social factors). A callable bond may only be seen as possibly having behavioural risk if the right to call lies with a retail client.

[Basel Framework, MAR23.5]

264. When an instrument is subject to one or more of the following risk types, this by itself will not cause the instrument to be subject to the RRAO:

(1) Risk from a cheapest-to-deliver option;

(2) Smile risk: the risk of a change in an implied volatility parameter necessary for determining the value of an instrument with optionality relative to the implied volatility of other instruments optionality with the same underlying and maturity, but different moneyness;

(3) Correlation risk arising from multi-underlying European or American plain vanilla options, and from any options that can be written as a linear combination of such options. This exemption applies in particular to the relevant index options;

(4) Dividend risk arising from a derivative instrument whose underlying does not consist solely of dividend payments; and

(5) Index instruments and multi-underlying options of which treatment for delta, vega or curvature risk are set out in paragraphs 143 and 144. These are subject to the RRAO if they fall within the definitions set out in this section. For funds that are subject to the treatment specified in paragraph 148(3) (i.e. treated as an unrated "other sector" equity), institutions shall assume the fund is exposed to exotic underlying exposures, and to other residual risks, to the maximum possible extent allowed under the fund's mandate.

[Basel Framework, MAR23.6]

265. In cases where a transaction exactly matches with a third-party transaction (i.e. a back-to-back transaction), the instruments used in both transactions must be excluded from the RRAO capital requirement. Any instrument that is listed and/or eligible for central clearing must be

excluded from the RRAO for other residual risks as defined in paragraph 262. Any instrument that is listed and/or eligible for central clearing with an exotic underlying must be included in the RRAO.

Hedges may be excluded from the RRAO only if the hedge exactly matches the trade (i.e. via a back-to-back transaction). For the example, when dividend swaps hedging dividend risks, dividend swaps should remain within the RRAO.

A TRS on an underlying product may be excluded from the RRAO capital requirement if there is an equal and opposite exposure in the same TRS. If no exactly matching transaction exists, the entire notional of the TRS would be allocated to the RRAO.

[Basel Framework, MAR23.7]

9.5.4.3 Calculation of the Residual Risk Add-On

266. The residual risk add-on must be calculated in addition to any other capital requirements within the standardized approach. The residual risk add-on is to be calculated as follows.

(1) The scope of instruments that are subject to the RRAO must not have an impact in terms of increasing or decreasing the scope of risk factors subject to the delta, vega, curvature or DRC treatments in the standardized approach.

(2) The RRAO is the simple sum of gross notional amounts of the instruments bearing residual risks, multiplied by a risk weight.

  (a) The risk weight for instruments with an exotic underlying specified in paragraph 261 is 1.0%.

  (b) The risk weight for instruments bearing other residual risks specified in paragraph 262 is 0.1%.[57]

[Basel Framework, MAR23.8]

9.6. Internal Models Approach

9.6.1 GENERAL PROVISIONS

This section sets out the general criteria for institutions' use of the internal models approach.

9.6.1.1 General Criteria

267. The use of internal models for the purposes of determining market risk capital requirements is conditional upon the explicit approval of OSFI. [Basel Framework, MAR30.1]

[57] Where the institution cannot satisfy OSFI that the RRAO provides a sufficiently prudent capital charge, OSFI will address any potentially under-capitalised risks by imposing a conservative additional capital charge under Pillar 2.

268. OSFI will only approve an institution's use of internal models to determine market risk capital requirements if, at a minimum:

(1) OSFI is satisfied that the institution's risk management system is conceptually sound and is implemented with integrity;

(2) the institution has, in OSFI's view, a sufficient number of staff skilled in the use of sophisticated models not only in the trading area but also in the risk control, audit and, if necessary, back office areas;

(3) the institution's trading desk risk management model has, in OSFI's judgement, a proven track record of reasonable accuracy in measuring risk;

(4) the institution regularly conducts stress tests along the lines set out in paragraphs 285 to 289; and

(5) the positions included in the institution's internal trading desk risk management models for determining minimum market risk capital requirements are held in trading desks that have been approved for the use of those models and that have passed the required tests described in paragraph 283.

Institutions applying to use internal models to determine market risk capital requirements are required to meet an internal models coverage threshold of 50% at all times. This coverage ratio is calculated as the ratio of the standardized market risk capital requirements of internal model approved in-scope desks divided by the standardized market risk capital requirement of all desks (including out of scope desks but excluding those portfolios captured in paragraph 50). For clarity, only instruments for which the standardized approach must be used by all institutions, as specified in paragraph 50, and their capital contribution should be excluded from the numerator and the denominator, along with their respective hedges. Once an institution has received the approval to use internal models, OSFI will monitor the institution's compliance with the 50% threshold.

$$Coverage\ Ratio^{58} = \frac{SA_{IMA}}{SA_{all\ desks}}$$

The scope of desks approved and eligible for the IMA capital requirement calculation at the end of the quarter should be based on the results of backtesting and PLAT at the trading desk level. The PLAT and RFET must be performed quarterly. Risk measures (ES, SES, DRC) entering the 60-day (or 12-week) averages used for IMA capital computation at the end of the quarter should be calculated based on a stable set of desks. To calculate those risk measures, the results of the backtesting, PLAT and RFET should be used to update the set of eligible trading desks as well as the reduced set and the stressed period at the beginning of the 60-day (or 12-week) calculation period. To ensure representativeness, banks should ensure that the dates on which the backtesting and PLAT conclude and the RFET is performed are sufficiently close to the beginning of the 60-day (or 12-week) calculation period (the end of the previous quarter).

[Basel Framework, MAR30.2]

[58] SA_{IMA} refers to the standardized capital requirements across all IMA in-scope desks. $SA_{all\ desks*}$ refers to the standardized capital requirements across all desks aside from desks with paragraph 50 instruments.

269. OSFI may insist on a period of initial monitoring and live testing of an institution's internal trading desk risk management model before it is used for the purposes of determining the institution's market risk capital requirements. [Basel Framework, MAR30.3]

270. The scope of trading portfolios that are eligible to use internal models to determine market risk capital requirements is determined based on a three-prong approach as follows:

(1) The institution must satisfy OSFI that both the institution's organizational infrastructure (including the definition and structure of trading desks) and its institution-wide[59] internal risk management model meet qualitative evaluation criteria, as set out in paragraphs 271 to 282.

(2) The institution must nominate individual trading desks, as defined in paragraphs 52 to 57, for which the institution seeks model approval in order to use the internal models approach (IMA).

   (a) The institution must nominate trading desks that it intends to be in-scope for model approval and trading desks that are out-of-scope for the use of the IMA. The institution must specify in writing the basis for these nominations.

   (b) The institution must not nominate trading desks to be out-of-scope for model approval due to capital requirements for a particular trading desk determined using the standardized approach being lower than those determined using the IMA.

   (c) The institution must use the standardized approach to determine the market risk capital requirements for trading desks that are out-of-scope for model approval. The positions in these out-of-scope trading desks are to be combined with all other positions that are subject to the standardized approach in order to determine the institution's standardized approach capital requirements.

   (d) Trading desks that the institution does not nominate for model approval at the time of model approval will be ineligible to use the IMA for a period of at least one year from the date of the latest internal model approval.

(3) The institution must receive OSFI's approval to use the IMA on individual trading desks. Following the identification of eligible trading desks, this step determines which trading desks will be in-scope to use the IMA and which risk factors within in-scope trading desks are eligible to be included in the institution's internal expected shortfall (ES) models to determine market risk capital requirements as set out in section 9.6.4.

   (a) Each trading desk must satisfy profit and loss (P&L) attribution (PLA) tests on an ongoing basis to be eligible to use the IMA to determine market risk capital requirements. In order to conduct the PLA test, the institution must identify the set of risk factors to be used to determine its market risk capital requirements.

[59] The term "institution-wide" is defined as pertaining to the group of trading desks that the institution nominates as in-scope in their application for the IMA.

(b) Each trading desk also must satisfy backtesting requirements on an ongoing basis to be eligible to use the IMA to determine market risk capital requirements as set out in paragraphs 320 to 335.

(c) Institutions must conduct PLA tests and backtesting on a quarterly basis to update the eligibility and trading desk classification in PLA for trading desks in-scope to use the IMA.

(d) The market risk capital requirements for risk factors that satisfy the risk factor eligibility test as set out in paragraphs 328 to 340 must be determined using ES models as specified in paragraphs 362 to 376.

(e) The market risk capital requirements for risk factors that do not satisfy the risk factor eligibility test must be determined using stressed expected shortfall (SES) models as specified in paragraphs 377 to 378.

Securitization positions are out of scope for IMA regulatory capital treatment, and as a result they are not taken into account for the model eligibility tests. This implies that institutions are not allowed to include securitizations in trading desks for which they determine market risk capital requirements using the IMA. Securitizations must be included in trading desks for which capital requirements are determined using the standardized approach. Institutions are allowed to also include hedging instruments in trading desks which include securitizations and are capitalised using the standardized approach.

[Basel Framework, MAR30.4]

9.6.1.2 Qualitative Standards

271. In order to use the IMA to determine market risk capital requirements, the institution must have market risk management systems that are conceptually sound and implemented with integrity. Accordingly, the institution must meet the qualitative criteria set out below on an ongoing basis. OSFI will assess that the institution has met the criteria before the institution is permitted to use the IMA. [Basel Framework, MAR30.5]

272. The institution must have an independent risk control unit that is responsible for the design and implementation of the institution's market risk management system. The risk control unit should produce and analyse daily reports on the output of the trading desk's risk management model, including an evaluation of the relationship between measures of risk exposure and trading limits. This risk control unit must be independent of business trading units and should report directly to senior management of the institution. [Basel Framework, MAR30.6]

273. The institution's risk control unit must conduct regular backtesting and PLA assessments at the trading desk level. The institution must also conduct regular backtesting of its institution-wide internal models used for determining market risk capital requirements. [Basel Framework, MAR30.7]

274. A distinct unit of the institution that is separate from the unit that designs and implements the internal models must conduct the initial and ongoing validation of all internal models used to

determine market risk capital requirements. The model validation unit must validate all internal models used for purposes of the IMA on at least an annual basis. [Basel Framework, MAR30.8]

275. The senior management of the institution must be actively involved in the risk control process and must devote appropriate resources to risk control as an essential aspect of the business. In this regard, the daily reports prepared by the independent risk control unit must be reviewed by a level of management with sufficient seniority and authority to enforce both reductions of positions taken by individual traders and reductions in the institution's overall risk exposure. [Basel Framework, MAR30.9]

276. Internal models used to determine market risk capital requirements are likely to differ from those used by an institution in its day-to-day internal risk management functions. Nevertheless, the core design elements of both the market risk capital requirement model and the internal risk management model should be the same.

(1) Valuation models that are a feature of both models should be similar. These valuation models must be an integral part of the internal identification, measurement, management and internal reporting of price risks within the institution's trading desks.

(2) Internal risk management models should, at a minimum, be used to assess the risk of the positions that are subject to market risk capital requirements, although they may assess a broader set of positions.

(3) The construction of a trading desk risk management model must be based on the methodologies used in the institution's internal risk management model with regard to risk factor identification, parameter estimation and proxy concepts and deviate only if this is appropriate due to regulatory requirements. An institution's market risk capital requirement model and its internal risk management model should address an identical set of risk factors.

[Basel Framework, MAR30.10]

277. A routine and rigorous programme of stress testing is required. The results of stress testing must be:

(1) reviewed at least monthly by senior management;

(2) used in the institution's internal assessment of capital adequacy; and

(3) reflected in the policies and limits set by the institution's senior management.

[Basel Framework, MAR30.11]

278. Where stress tests reveal particular vulnerability to a given set of circumstances, the institution must take prompt action to mitigate those risks appropriately (e.g. by hedging against that outcome, reducing the size of the institution's exposures or increasing capital). [Basel Framework, MAR30.12]

279. The institution must maintain a protocol for compliance with a documented set of internal manuals, policies, controls and procedures concerning the operation of the internal market risk management model. The institution's risk management model must be well documented. Such

documentation may include a comprehensive risk management manual that describes the basic principles of the risk management model and that provides a detailed explanation of the empirical techniques used to measure market risk. [Basel Framework, MAR30.13]

280. The institution must receive approval from OSFI prior to implementing any significant changes to its internal models used to determine market risk capital requirements. [Basel Framework, MAR30.14]

281. The institution's internal models for determining market risk capital requirements must address the full set of positions that are in the scope of application of the model. All models' measurements of risk must be based on a sound theoretical basis, calculated correctly, and reported accurately. [Basel Framework, MAR30.15]

282. The institution's internal audit and validation functions or external auditor must conduct an independent review of the market risk measurement system on at least an annual basis. The scope of the independent review must include both the activities of the business trading units and the activities of the independent risk control unit. The independent review must be sufficiently detailed to determine which trading desks are impacted by any failings. At a minimum, the scope of the independent review must include the following:

(1) the organization of the risk control unit;

(2) the adequacy of the documentation of the risk management model and process;

(3) the accuracy and appropriateness of market risk management models (including any significant changes);

(4) the verification of the consistency, timeliness and reliability of data sources used to run internal models, including the independence of such data sources;

(5) the approval process for risk pricing models and valuation systems used by the institution's front- and back-office personnel;

(6) the scope of market risks reflected in the trading desk risk management models;

(7) the integrity of the management information system;

(8) the accuracy and completeness of position data;

(9) the accuracy and appropriateness of volatility and correlation assumptions;

(10) the accuracy of valuation and risk transformation calculations;

(11) the verification of trading desk risk management model accuracy through frequent backtesting and PLA assessments; and

(12) the general alignment between the model to determine market risk capital requirements and the model the institution uses in its day-to-day internal management functions.

[Basel Framework, MAR30.16]

9.6.1.3 Model Validation Standards

283. Institutions must maintain a process to ensure that their internal models have been adequately validated by suitably qualified parties independent of the model development process to ensure that each model is conceptually sound and adequately reflects all material risks. Model validation must be conducted both when the model is initially developed and when any significant changes are made to the model. The institution must revalidate its models periodically, particularly when there have been significant structural changes in the market or changes to the composition of the institution's portfolio that might lead to the models no longer being adequate. Model validation must include PLA and backtesting, and must, at a minimum, also include the following:

(1) Tests to demonstrate that any assumptions made within internal models are appropriate and do not underestimate risk. This may include reviewing the appropriateness of assumptions of normal distributions and any pricing models.

(2) Further to the regulatory backtesting programmes, model validation must assess the hypothetical P&L (HPL) calculation methodology.

(3) The institution must use hypothetical portfolios to ensure that internal models are able to account for particular structural features that may arise. For example, where the data history for a particular instrument does not meet the quantitative standards in paragraphs 362 to 373 and the institution maps these positions to proxies, the institution must ensure that the proxies produce conservative results under relevant market scenarios, with sufficient consideration given to ensuring:

   (a) that material basis risks are adequately reflected (including mismatches between long and short positions by maturity or by issuer); and

   (b) that the models reflect concentration risk that may arise in an undiversified portfolio.

[Basel Framework, MAR30.17]

9.6.1.4 External Validation

284. The model validation conducted by external auditors and/or OSFI of an institution's internal model to determine market risk capital requirements should, at a minimum, include the following steps:

(1) Verification that the internal validation processes described in the paragraph above are operating in a satisfactory manner;

(2) Confirmation that the formulae used in the calculation process, as well as for the pricing of options and other complex instruments, are validated by a qualified unit, which in all cases should be independent from the institution's trading area;

(3) Confirmation that the structure of internal models is adequate with respect to the institution's activities and geographical coverage;

(4) Review of the results of both the institution's backtesting of its internal models (i.e. comparison of value-at-risk with actual P&L and HPL) and its PLA process to ensure that

the models provide a reliable measure of potential losses over time. On request, an institution should make available to OSFI and/or to its external auditors the results as well as the underlying inputs to ES calculations and details of the PLA exercise; and

(5) Confirmation that data flows and processes associated with the risk measurement system are transparent and accessible. On request and in accordance with procedures, the institution should provide OSFI and its external auditors access to the models' specifications and parameters.

[Basel Framework, MAR30.18]

9.6.1.5 Stress Testing

285. Institutions that use the IMA for determining market risk capital requirements must have in place a rigorous and comprehensive stress testing programme both at the trading desk level and at the institution-wide level. [Basel Framework, MAR30.19]

286. Institutions' stress scenarios must cover a range of factors that (i) can create extraordinary losses or gains in trading portfolios, or (ii) make the control of risk in those portfolios very difficult. These factors include low-probability events in all major types of risk, including the various components of market, credit and operational risks. An institution must design stress scenarios to assess the impact of such factors on positions that feature both linear and non-linear price characteristics (i.e. options and instruments that have option-like characteristics). [Basel Framework, MAR30.20]

287. Institutions' stress tests should be of a quantitative and qualitative nature, incorporating both market risk and liquidity risk aspects of market disturbances.

(1) Quantitative elements should identify plausible stress scenarios to which institutions could be exposed.

(2) Qualitatively, an institution's stress testing program should evaluate the capacity of the institution's capital to absorb potential significant losses and identify steps the institution can take to reduce its risk and conserve capital.

[Basel Framework, MAR30.21]

288. Institutions should routinely communicate results of stress testing to senior management. [Basel Framework, MAR30.22]

289. Institutions should combine the use of OSFI's stress scenarios with stress tests developed by the institution itself to reflect its specific risk characteristics. Stress scenarios may include the following:

(1) OSFI's scenarios requiring no simulations by the institution. An institution should have information on the largest losses experienced during the reporting period and may be required to make this available for OSFI's review. OSFI may compare this loss information to the level of capital requirements that would result from an institution's internal measurement system. For example, the institution may be required to provide

OSFI with an assessment of how many days of peak day losses would have been covered by a given ES estimate.

(2) Scenarios requiring a simulation by the institution. Institutions should subject their portfolios to a series of simulated stress scenarios and provide OSFI with the results. These scenarios could include testing the current portfolio against past periods of significant disturbance (e.g. the 1987 equity crash, the Exchange Rate Mechanism crises of 1992 and 1993, the increase in interest rates in the first quarter of 1994, the 1998 Russian financial crisis, the 2000 bursting of the technology stock bubble, the 2007–08 subprime mortgage crisis, or the 2011–12 Euro zone crisis) incorporating both the significant price movements and the sharp reduction in liquidity associated with these events. A second type of scenario would evaluate the sensitivity of the institution's market risk exposure to changes in the assumptions about volatilities and correlations. Applying this test would require an evaluation of the historical range of variation for volatilities and correlations and evaluation of the institution's current positions against the extreme values of the historical range. Due consideration should be given to the sharp variation that at times has occurred in a matter of days in periods of significant market disturbance. For example, the above-mentioned situations involved correlations within risk factors approaching the extreme values of 1 or –1 for several days at the height of the disturbance.

(3) Institution-developed stress scenarios. In addition to the scenarios prescribed by OSFI under paragraph 289(1), an institution should also develop its own stress tests that it identifies as most adverse based on the characteristics of its portfolio (e.g. problems in a key region of the world combined with a sharp move in oil prices). An institution should provide OSFI with a description of the methodology used to identify and carry out the scenarios as well as with a description of the results derived from these scenarios.

[Basel Framework, MAR30.23]

9.6.2 MODEL REQUIREMENTS

This section sets out specification and model eligibility for risk factors per the internal models approach.

9.6.2.1 Specification of Market Risk Factors

290. An important part of an institution's trading desk internal risk management model is the specification of an appropriate set of market risk factors. Risk factors are the market rates and prices that affect the value of the institution's trading positions. The risk factors contained in a trading desk risk management model must be sufficient to represent the risks inherent in the institution's portfolio of on- and off-balance sheet trading positions. Although institutions will have some discretion in specifying the risk factors for their internal models, the following requirements must be fulfilled. [Basel Framework, MAR31.1]

291. An institution's market risk capital requirement models should include all risk factors that are used for pricing. In the event a risk factor is incorporated in a pricing model but not in the trading desk risk management model, the institution must support this omission to the satisfaction of OSFI. [Basel Framework, MAR31.2]

292. An institution's market risk capital requirement model must include all risk factors that are specified in the standardized approach for the corresponding risk class, as set out in sections 9.5.1 to 9.5.3.

(1) In the event a standardized approach risk factor is not included in the market risk capital requirement model, the institution must support this omission to the satisfaction of OSFI.

(2) For securitized products, institutions are prohibited from using internal models to determine market risk capital requirements. Institutions must use the standardized approach to determine the market risk capital requirements for securitized products as set out in paragraph 51. Accordingly, an institution's market risk capital requirement model should not specify risk factors for securitizations as defined in paragraphs 122 to 123.

[Basel Framework, MAR31.3]

293. An institution's market risk capital requirement model and any stress scenarios calculated for non-modellable risk factors must address non-linearities for options and other relevant products (e.g. mortgage-backed securities), as well as correlation risk and relevant basis risks (e.g. basis risks between credit default swaps and bonds). [Basel Framework, MAR31.4]

294. An institution may use proxies for which there is an appropriate track record for their representation of a position (e.g. an equity index used as a proxy for a position in an individual stock). In the event an institution uses proxies, the institution must support their use to the satisfaction of OSFI. [Basel Framework, MAR31.5]

295. An institution is expected to develop an internal process that describes minimum conditions under which a proxy has a good track record; a methodology for assessing proxies against those conditions (including independent validations); and steps to address the use of proxies that fail to meet that standard.

296. For general interest rate risk, an institution must use a set of risk factors that corresponds to the interest rates associated with each currency in which the institution has interest rate sensitive on- or off-balance sheet trading positions.

(1) The trading desk risk management model must model the yield curve using one of a number of generally accepted approaches (e.g. estimating forward rates of zero coupon yields).

(2) The yield curve must be divided into maturity segments in order to capture variation in the volatility of rates along the yield curve.

(3) For material exposures to interest rate movements in the major currencies and markets, institutions must model the yield curve using a minimum of six risk factors.

(4) The number of risk factors used ultimately should be driven by the nature of the institution's trading strategies. An institution with a portfolio of various types of securities across many points of the yield curve and that engages in complex arbitrage strategies would require the use of a greater number of risk factors than an institution with less complex portfolios.

[Basel Framework, MAR31.6]

297. The trading desk risk management model must incorporate separate risk factors to capture credit spread risk (e.g. between bonds and swaps). A variety of approaches may be used to reflect the credit spread risk arising from less-than-perfectly correlated movements between government and other fixed income instruments, such as specifying a completely separate yield curve for non-government fixed income instruments (e.g. swaps or municipal securities) or estimating the spread over government rates at various points along the yield curve. [Basel Framework, MAR31.7]

298. For exchange rate risk, the trading desk risk management model must incorporate risk factors that correspond to the individual foreign currencies in which the institution's positions are denominated. Because the output of an institution's risk measurement system will be expressed in the institution's reporting currency, any net position denominated in a foreign currency will introduce foreign exchange risk. An institution must utilise risk factors that correspond to the exchange rate between the institution's reporting currency and each foreign currency in which the institution has a significant exposure. [Basel Framework, MAR31.8]

299. For equity risk, an institution must utilise risk factors that correspond to each of the equity markets in which the institution holds significant positions.

(1) At a minimum, an institution must utilize risk factors that reflect market-wide movements in equity prices (e.g. a market index). Positions in individual securities or in sector indices may be expressed in beta-equivalents relative to a market-wide index.

(2) An institution may utilize risk factors that correspond to various sectors of the overall equity market (e.g. industry sectors or cyclical and non-cyclical sectors). Positions in individual securities within each sector may be expressed in beta-equivalents relative to a sector index.

(3) An institution may also utilize risk factors that correspond to the volatility of individual equities.

(4) The sophistication and nature of the modelling technique for a given market should correspond to the institution's exposure to the overall market as well as the institution's concentration in individual equities in that market.

[Basel Framework, MAR31.9]

300. For commodity risk, institutions must utilise risk factors that correspond to each of the commodity markets in which the institution holds significant positions.

(1) For institutions with relatively limited positions in commodity-based instruments, the institution may utilize a straightforward specification of risk factors. Such a specification could entail utilizing one risk factor for each commodity price to which the institution is exposed (including different risk factors for different geographies where relevant).

(2) For an institution with active trading in commodities, the institution's model must account for variation in the convenience yield[60] between derivatives positions such as forwards and swaps and cash positions in the commodity.

[Basel Framework, MAR31.10]

301. For the risks associated with equity investments in funds (EIFs):

(1) For funds that meet the criterion set out in paragraph 65(5)(a) (i.e. funds with look-through possibility), institutions must consider the risks of the fund, and of any associated hedges, as if the fund's positions were held directly by the institution (taking into account the institution's share of the equity of the fund, and any leverage in the fund structure). The institution must assign these positions to the trading desk to which the fund is assigned.

Institutions must make reasonable efforts to gather the latest information related to these structures. OSFI may require, as needed, that institutions increase the frequency of their look through, and/or incorporate additional controls and oversight in order to monitor the EIFs during intra-quarterly periods. Such measures could consist of and depend on these factors:

a. Historical divergences by tracking and comparing the funds' daily price (based on Net Asset Value) versus the price if the fund were to hold the same portfolio as of the last look through date. If a threshold for tolerable deviations were breached, the institution would need to conduct more frequent look through than quarterly if data is available.

b. The level and frequency of the turnover of the fund.

c. The threshold and significance of such line of business versus other trading portfolios.

(2) For funds that do not meet the criterion set out in paragraph 65(5)(a), but meet both the criteria set out in paragraph 65(5)(b) (i.e. daily prices and knowledge of the mandate of the fund), institutions must use the standardized approach to calculate capital requirements for the fund.

[Basel Framework, MAR31.11]

9.6.2.2 Model Eligibility of Risk Factors

302. An institution must determine which risk factors within its trading desks that have received approval to use the internal models approach as set out in section 9.6.3 are eligible to be included in the institution's internal expected shortfall (ES) model for regulatory capital

[60] The convenience yield reflects the benefits from direct ownership of the physical commodity (e.g. the ability to profit from temporary market shortages). The convenience yield is affected both by market conditions and by factors such as physical storage costs.

requirements as set out in section 9.6.4. For a risk factor to be classified as modellable by an institution, a necessary condition is that it passes the risk factor eligibility test (RFET). This test requires identification of a sufficient number of real prices that are representative of the risk factor. Collateral reconciliations or valuations cannot be considered real prices to meet the RFET. A price will be considered real if it meets at least one of the following criteria:

(1) It is a price at which the institution has conducted a transaction;

(2) It is a verifiable price for an actual transaction between other arms-length parties;

(3) It is a price obtained from a committed quote[61] made by (i) the institution itself or (ii) another party. The committed quote must be collected and verified through a third-party vendor, a trading platform or an exchange. or

(4) It is a price that is obtained from a third-party vendor, where:

(a) the transaction or committed quote has been processed through the vendor;

(b) the vendor agrees to provide evidence of the transaction or committed quote to OSFI upon request; or

(c) the price meets any of the three criteria immediately listed in paragraph 302(1) to (3).

Orderly transactions and eligible committed quotes with a non-negligible volume, as compared to usual transaction sizes for the institution, reflective of normal market conditions can be generally accepted as valid.

[Basel Framework, MAR31.12]

303. To pass the RFET, a risk factor that an institution uses in an internal model must meet either of the following criteria on a quarterly basis. Any real price that is observed for a transaction should be counted as an observation for all of the risk factors for which it is representative.

(1) The institution must identify for the risk factor at least 24 real price observations per year (measured over the period used to calibrate the current ES model, with no more than one real price observation per day to be included in this count).[62,63] Moreover, over the previous 12 months there must be no 90-day period in which fewer than four real price observations are identified for the risk factor (with no

[61] A committed quote is a price from an arm's length provider at which the provider of the quote must buy or sell the financial instrument.

[62] When an institution uses data for real price observations from an external or an internal source, and those observations are provided with a time lag (e.g. data provided for a particular day is only made available a number of weeks later), the period used for the RFET may differ from the period used to calibrate the current ES model. The difference in periods used for the RFET and calibration of the ES model should not be greater than one month, i.e. an institution could use, for each risk factor, a one-year time period finishing up to one month before the RFET assessment instead of the period used to calibrate the current ES model.

[63] In particular, an institution may add modellable risk factors, and replace non-modellable risk factors by a basis between these additional modellable risk factors and these non-modellable risk factors. This basis will then be considered a non-modellable risk factor. A combination between modellable and non-modellable risk factors will be a non-modellable risk factor.

more than one real price observation per day to be included in this count). The above criteria must be monitored on a monthly basis; or

(2) The institution must identify for the risk factor at least 100 “real” price observations over the previous 12 months (with no more than one “real” price observation per day to be included in this count).

Regarding the reform of benchmark rate reference rates, risk factors must have sufficient market liquidity, evidenced by records of trades, to be eligible for modelling. The replacement of risk factors due to benchmark rate reform could raise particular challenges for the count of real price observations for the RFET. Hence, when conducting the RFET for a new benchmark rate, institutions can count both: (i) real price observations of the old benchmark rate (that has been replaced by the new benchmark rate) from before the discontinuation of this rate and until one year after the discontinuation; and (ii) real price observations of the new benchmark rate. In this context, discontinuation includes cessation of the old benchmark rate or an event whereby the old benchmark rate is deemed by OSFI to no longer be representative of the underlying market.

[Basel Framework, MAR31.13]

304. In order for a risk factor to pass the RFET, an institution may also count real price observations based on information collected from a third-party vendor provided all of the following criteria are met:

(1) The vendor communicates to the institution the number of corresponding real prices observed and the dates at which they have been observed.

(2) The vendor provides, individually, a minimum necessary set of identifier information to enable institutions to map real prices observed to risk factors.

(3) The vendor is subject to an audit regarding the validity of its pricing information. The results and reports of this audit must be made available on request to OSFI and to institutions as a precondition for the institution to be allowed to use real price observations collected by the third-party vendor. If the audit of a third-party vendor is not satisfactory, OSFI may decide to prevent the institution from using data from this vendor.[64]

[Basel Framework, MAR31.14]

305. A real price is representative for a risk factor of an institution where the institution is able to extract the value of the risk factor from the value of the real price. The institution must have policies and procedures that describe its mapping of real price observations to risk factors. The institution must provide sufficient information to OSFI in order to determine if the methodologies the institution uses are appropriate. [Basel Framework, MAR31.15]

[64] In this case, the institution may be permitted to use real price observations from this vendor for other risk factors.

Bucketing approach for the RFET

306. Where a risk factor is a point on a curve or a surface (and other higher dimensional objects such as cubes), in order to count real price observations for the RFET, institutions may choose from the following bucketing approaches:

(1) The *own bucketing approach*. Under this approach, the institution must define the buckets it will use and meet the following requirements:

(a) Each bucket must include only one risk factor, and all risk factors must correspond to the risk factors that are part of the risk-theoretical profit and loss (RTPL) of the institution for the purpose of the profit and loss (P&L) attribution (PLA) test.[65]

(b) The buckets must be non-overlapping.

(2) The *regulatory bucketing approach*. Under this approach, the institution must use the following set of standard buckets as set out in Table 16.

(a) For interest rate, foreign exchange and commodity risk factors with one maturity dimension (excluding implied volatilities) (t, where t is measured in years), the buckets in row (A) below must be used.

(b) For interest rate, foreign exchange and commodity risk factors with several maturity dimensions (excluding implied volatilities) (t, where t is measured in years), the buckets in row (B) below must be used.

(c) Credit spread and equity risk factors with one or several maturity dimensions (excluding implied volatilities) (t, where t is measured in years), the buckets in row (C) below must be used.

(d) For any risk factors with one or several strike dimensions (delta, δ; i.e. the probability that an option is "in the money" at maturity), the buckets in row (D) below must be used.[66]

(e) For expiry and strike dimensions of implied volatility risk factors (excluding those of interest rate swaptions), only the buckets in rows (C) and (D) below must be used.

(f) For maturity, expiry and strike dimensions of implied volatility risk factors from interest rate swaptions, only the buckets in row (B), (C) and (D) below must be used.

Standard buckets for the regulatory bucketing approach **Table 16**

[65] The requirement to use the same buckets or segmentation of risk factors for the PLA test and the RFET recognises that there is a trade-off in determining buckets for an ES model. The use of more granular buckets may facilitate a trading desk's success in meeting the requirements of the PLA test, but additional granularity may challenge an institution's ability to source a sufficient number of real observed prices per bucket to satisfy the RFET. Institutions should consider this trade-off when designing their ES models.

[66] For options markets where alternative definitions of moneyness are standard, institutions shall convert the regulatory delta buckets to the market-standard convention using their own approved pricing models.

Row	Bucket								
	1	2	3	4	5	6	7	8	9
(A)	0≤t<0.75	0.75≤t<1.5	1.5≤t<4	4≤t<7	7≤t<12	12≤t<18	18≤t<25	25≤t<35	35≤t<∞
(B)	0≤t<0.75	0.75≤t<4	4≤t<10	10≤t<18	18≤t<30	30≤t<∞			
(C)	0≤t<1.5	1.5≤t<3.5	3.5≤t<7.5	7.5≤t<15	15≤t<∞				
(D)	0≤δ<0.05	0.05≤δ<0.3	0.3≤δ<0.7	0.7≤δ<0.95	0.95≤δ<1.00				

[Basel Framework, MAR31.16]

307. Institutions may count all real price observations allocated to a bucket to assess whether it passes the RFET for any risk factors that belong to the bucket. A real price observation must be allocated to a bucket for which it is representative of any risk factors that belong to the bucket. [Basel Framework, MAR31.17]

308. As debt and commodity instruments mature, real price observations for those products that have been identified within the prior 12 months are usually still counted in the maturity bucket to which they were initially allocated per paragraph 307. When institutions no longer need to model a credit spread risk or commodity risk factor belonging to a given maturity bucket, institutions are allowed to re-allocate the real price observations of this bucket to the adjacent (shorter) maturity bucket.[67] A real price observation may only be counted in a single maturity bucket for the purposes of the RFET. [Basel Framework, MAR31.18]

309. Where an institution uses a parametric function to represent a curve/surface and defines the function's parameters as the risk factors in its risk measurement system, the RFET must be passed at the level of the market data used to calibrate the function's parameters and not be passed directly at the level of these risk factor parameters (due to the fact that real price observations may not exist that are directly representative of these risk factors). [Basel Framework, MAR31.19]

310. An institution may use systematic credit or equity risk factors within its models that are designed to capture market-wide movements for a given economy, region or sector, but not the idiosyncratic risk of a specific issuer (the idiosyncratic risk of a specific issuer would be a non-modellable risk factor (NMRF) unless there are sufficient real price observations of that issuer). Real price observations of market indices or instruments of individual issuers may be considered representative for a systematic risk factor as long as they share the same attributes as the systematic risk factor. [Basel Framework, MAR31.20]

311. In addition to the approach set out in the above paragraph, where systematic risk factors of credit or equity risk factors include a maturity dimension (e.g. a credit spread curve), one of

[67] For example, if a bond with an original maturity of four years, had a real price observation on its issuance date eight months ago, institutions can opt to allocate the real price observation to the bucket associated with a maturity between 1.5 and 3.5 years instead of to the bucket associated with a maturity between 3.5 and 7.5 years to which it would normally be allocated.

the bucketing approaches set out above must be used for this maturity dimension to count "real" price observations for the RFET. [Basel Framework, MAR31.21]

312. Once a risk factor has passed the RFET, the institution should choose the most appropriate data to calibrate its model. The data used for calibration of the model does not need to be the same data used to pass the RFET. [Basel Framework, MAR31.22]

313. Once a risk factor has passed the RFET, the institution must demonstrate that the data used to calibrate its ES model are appropriate based on the principles contained in paragraphs 315 to 316. Where an institution has not met these principles to the satisfaction OSFI for a particular risk factor, OSFI may choose to deem the data unsuitable for use to calibrate the model and, in such case, the risk factor must be excluded from the ES model and subject to capital requirements as an NMRF. [Basel Framework, MAR31.23]

314. There may, on very rare occasions, be a valid reason why a significant number of modellable risk factors across different institutions may become non-modellable due to a widespread reduction in trading activities (for instance, during periods of significant cross-border financial market stress affecting several institutions or when financial markets are subjected to a major regime shift). One possible OSFI's response in this instance could be to consider as modellable a risk factor that no longer passes the RFET. However, such a response should not facilitate a decrease in capital requirements. OSFI will only pursue such a response under the most extraordinary, systemic circumstances. [Basel Framework, MAR31.24]

Principles for the modellability of risk factors that pass the RFET

315. Institutions use many different types of models to determine the risks resulting from trading positions. The data requirements for each model may be different. For any given model, institutions may use different sources or types of data for the model's risk factors. Institutions must not rely solely on the number of observations of real prices to determine whether a risk factor is modellable. The accuracy of the source of the risk factor real price observation must also be considered. [Basel Framework, MAR31.25]

316. In addition to the requirements specified in paragraphs 302 to 313, institutions must apply the principles below to determine whether a risk factor that passed the RFET can be modelled using the ES model or should be subject to capital requirements as an NMRF. Institutions are required to demonstrate to OSFI that these principles are being followed. OSFI may determine risk factors to be non-modellable in the event these principles are not applied.

(1) *Principle one*. The data used may include combinations of modellable risk factors. Institutions often price instruments as a combination of risk factors. Generally, risk factors derived solely from a combination of modellable risk factors are modellable. For example, risk factors derived through multifactor beta models for which inputs and calibrations are based solely on modellable risk factors, can be classified as modellable and can be included within the ES model. A risk factor derived from a combination of modellable risk factors that are mapped to distinct buckets of a given curve/surface is modellable only if this risk factor also passes the RFET.

(a) Interpolation based on combinations of modellable risk factors should be consistent with mappings used for PLA testing (to determine the RTPL) and should not be based on alternative, and potentially broader, bucketing approaches. Likewise, institutions may compress risk factors into a smaller dimension of orthogonal risk factors (e.g. principal components) and/or derive parameters from observations of modellable risk factors, such as in models of stochastic implied volatility, without the parameters being directly observable in the market.

(b) Subject to the approval of OSFI, institutions may extrapolate up to a reasonable distance from the closest modellable risk factor. The extrapolation should not rely solely on the closest modellable risk factor but on more than one modellable risk factor. In the event that an institution uses extrapolation, the extrapolation must be considered in the determination of the RTPL.

(2) *Principle two*. The data used must allow the model to pick up both idiosyncratic and general market risk. General market risk is the tendency of an instrument's value to change with the change in the value of the broader market, as represented by an appropriate index or indices. Idiosyncratic risk is the risk associated with a particular issuance, including default provisions, maturity and seniority. The data must allow both components of market risk to be captured in any market risk model used to determine capital requirements. If the data used in the model do not reflect either idiosyncratic or general market risk, the institution must apply an NMRF charge for those aspects that are not adequately captured in its model.

(3) *Principle three*. The data used must allow the model to reflect volatility and correlation of the risk positions. Institutions must ensure that they do not understate the volatility of an asset (e.g. by using inappropriate averaging of data or proxies). Further, institutions must ensure that they accurately reflect the correlation of asset prices, rates across yield curves and/or volatilities within volatility surfaces. Different data sources can provide dramatically different volatility and correlation estimates for asset prices. The institution should choose data sources so as to ensure that (i) the data are representative of real price observations; (ii) price volatility is not understated by the choice of data; and (iii) correlations are reasonable approximations of correlations among real price observations. Furthermore, any transformations must not understate the volatility arising from risk factors and must accurately reflect the correlations arising from risk factors used in the institution's ES model.

(4) *Principle four*. The data used must be reflective of prices observed and/or quoted in the market. Where data used are not derived from real price observations, the institution must demonstrate that the data used are reasonably representative of real price observations. To that end, the institution must periodically reconcile price data used in a risk model with front office and back office prices. Just as the back office serves to check the validity of the front office price, risk model prices should be included in the comparison. The comparison of front or back office prices with risk prices should consist of comparisons of risk prices with real price observations, but front office and back office prices can be used where real price observations are not widely available. Institutions must document their approaches to deriving risk factors from market prices.

(5) *Principle five*. The data used must be updated at a sufficient frequency. A market risk model may require large amounts of data, and it can be challenging to update such large data sets frequently. Institutions should strive to update their model data as often as possible to account for frequent turnover of positions in the trading portfolio and changing market conditions. Institutions should update data at a minimum on a monthly basis, but preferably daily. Additionally, institutions should have a workflow process for updating the sources of data. Furthermore, where the institution uses regressions to estimate risk factor parameters, these must be re-estimated on a regular basis, generally no less frequently than every two weeks. Calibration of pricing models to current market prices must also be sufficiently frequent, ideally no less frequent than the calibration of front office pricing models. Where appropriate, institutions should have clear policies for backfilling and/or gap-filling missing data.

(6) *Principle six*. The data used to determine stressed expected shortfall ($ES_{R,S}$) must be reflective of market prices observed and/or quoted in the period of stress. The data for the $ES_{R,S}$ model should be sourced directly from the historical period whenever possible. There are cases where the characteristics of current instruments in the market differ from those in the stress period. Nevertheless, institutions must empirically justify any instances where the market prices used for the stress period are different from the market prices actually observed during that period. Further, in cases where instruments that are currently traded did not exist during a period of significant financial stress, institutions must demonstrate that the prices used match changes in prices or spreads of similar instruments during the stress period.

(a) In cases where institutions do not sufficiently justify the use of current market data for products whose characteristics have changed since the stress period, the institution must omit the risk factor for the stressed period and meet the requirement of paragraph 366(2)(b) that the reduced set of risk factors explain 75% of the fully specified ES model. Moreover, if name-specific risk factors are used to calculate the ES in the actual period and these names were not available in the stressed period, there is a presumption that the idiosyncratic part of these risk factors are not in the reduced set of risk factors. Exposures for risk factors that are included in the current set but not in the reduced set need to be mapped to the most suitable risk factor of the reduced set for the purposes of calculating ES measures in the stressed period.

(7) *Principle seven*. The use of proxies must be limited, and proxies must have sufficiently similar characteristics to the transactions they represent. Proxies must be appropriate for the region, quality and type of instrument they are intended to represent. OSFI will assess whether methods for combining risk factors are conceptually and empirically sound.

(a) For example, the use of indices in a multifactor model must capture the correlated risk of the assets represented by the indices, and the remaining idiosyncratic risk must be demonstrably uncorrelated across different issuers. A multifactor model must have significant explanatory power for the price movements of assets and must provide an assessment of the uncertainty in the final outcome due to the use of a proxy. The coefficients (betas) of a multifactor model must be empirically based and must not be determined based on judgment. Instances where coefficients are set by judgment generally should be considered as NMRFs.

(b) If risk factors are represented by proxy data in the current period ES model, the proxy data representation of the risk factor – not the risk factor itself – must be used in the RTPL unless the institution has identified the basis between the proxy and the actual risk factor and properly capitalised the basis either by including the basis in the ES model (if the risk factor is a modellable) or capturing the basis as a NMRF. If the capital requirement for the basis is properly determined, then the institution can choose to include in the RTPL either:

(i) the proxy risk factor and the basis; or

(ii) the actual risk factor itself.

[Basel Framework, MAR31.26]

9.6.3 BACKTESTING AND P&L ATTRIBUTION TEST REQUIREMENTS

This section sets out the profit and loss attribution test and backtesting requirements for institutions that use the internal models approach.

317. As set out in paragraph 270, an institution that intends to use the internal models approach (IMA) to determine market risk capital requirements for a trading desk must conduct and successfully pass backtesting at the institution-wide level and both the backtesting and profit and loss (P&L) attribution (PLA) test at the trading desk level as identified in paragraph 270(2). [Basel Framework, MAR32.1]

318. Paragraph 268 describes the criteria that an institution must meet in order to remain eligible to use the IMA to determine market risk capital requirements. The institution's aggregated market risk capital requirement must be based on positions held in trading desks that qualify for use of the institution's internal models for market risk capital requirements by satisfying the backtesting and PLA test as set out in this section. This criterion must be assessed by the institution on a quarterly basis when calculating the aggregate capital requirement for market risk according to paragraph 404. [Basel Framework, MAR32.2]

319. The implementation of the backtesting programme and the PLA test must begin on the date that the internal models capital requirement becomes effective.

(1) For OSFI's approval of a model, the institution must provide a one-year backtesting and PLA test report to confirm the quality of the model.

(2) OSFI may require backtesting and PLA test results prior to that date.

(3) OSFI will determine any necessary response to backtesting results based on the number of exceptions over the course of 12 months (i.e. 250 trading days) generated by the institution's model.

(a) Based on the assessment on the significance of exceptions, OSFI may initiate a dialogue with the institution to determine if there is a problem with an institution's model.

(b) In the most serious cases, OSFI will impose an additional increase in an institution's capital requirement or disallow use of the model.

[Basel Framework, MAR32.3]

9.6.3.1 Backtesting Requirements

320. Backtesting requirements compare the value-at-risk (VaR) measure calibrated to a one-day holding period against each of the actual P&L (APL) and hypothetical P&L (HPL) over the prior 12 months. Specific requirements to be applied at the institution-wide level and trading desk level are set out below. [Basel Framework, MAR32.4]

321. Backtesting of the institution-wide risk model must be based on a VaR measure calibrated at a 99th percentile confidence level.

(1) An exception or an outlier occurs when either the actual loss or the hypothetical loss of the institution-wide trading book registered in a day of the backtesting period exceeds the corresponding daily VaR measure given by the model. As per paragraph 415, exceptions for actual losses are counted separately from exceptions for hypothetical losses; the overall number of exceptions is the greater of these two amounts.

(2) In the event either the P&L or the daily VaR measure is not available or impossible to compute, it will count as an outlier.

[Basel Framework, MAR32.5]

322. In the event an outlier can be shown by the institution to relate to a non-modellable risk factor, and the capital requirement for that non-modellable risk factor exceeds the actual or hypothetical loss for that day, it may be disregarded for the purpose of the overall backtesting process if OSFI is notified accordingly and does not object to this treatment. In these cases, an institution must document the history of the movement of the value of the relevant non-modellable risk factor and have supporting evidence that the non-modellable risk factor has caused the relevant loss.

If the backtesting exception at a desk-level test is being driven by a non-modellable risk factor that receives an SES capital requirement that is in excess of the maximum of the APL loss or HPL loss for that day, it is permitted to be disregarded for the purposes of the desk-level backtesting. The institution must be able to calculate a non-modellable risk factor capital requirement for the specific desk and not only for the respective risk factor across all desks. For example, if the P&L for a desk is EUR –1.5 million and VaR is EUR 1 million, a non-modellable risk factor capital requirement (at desk level) of EUR 0.8 million would not be sufficient to disregard an exception for the purpose of desk-level backtesting. The non-modellable risk factor capital requirement attributed to the standalone desk level (without VaR) must be greater than the loss of EUR 1.5 million in order to disregard an exception for the purpose of desk-level backtesting. [Basel Framework, MAR32.6]

323. The scope of the portfolio subject to institution-wide backtesting should be updated quarterly based on the results of the latest trading desk-level backtesting, risk factor eligibility test and PLA tests. [Basel Framework, MAR32.7]

324. The framework for OSFI's interpretation of backtesting results for the institution-wide capital model encompasses a range of possible responses, depending on the strength of the signal

generated from the backtesting. These responses are classified into three backtesting zones, distinguished by colours into a hierarchy of responses.

(1) *Green zone*. This corresponds to results that do not themselves suggest a problem with the quality or accuracy of an institution's model.

(2) *Amber zone*. This encompasses results that do raise questions in this regard, for which such a conclusion is not definitive.

(3) *Red zone*. This indicates a result that almost certainly indicates a problem with an institution's risk model.

[Basel Framework, MAR32.8]

325. These zones are defined according to the number of exceptions generated in the backtesting programme considering statistical errors as explained in paragraphs 416 to 428. Table 17 sets out boundaries for these zones and the presumptive supervisory response for each backtesting outcome, based on a sample of 250 observations. [Basel Framework, MAR32.9]

Backtesting zones **Table 17**

Backtesting zone	**Number of exceptions**	**Backtesting dependent multiplier (to be added to any qualitative add-on per paragraph 405**
Green	0	1.50
Green	1	1.50
Green	2	1.50
Green	3	1.50
Green	4	1.50
Amber	5	1.70
Amber	6	1.76
Amber	7	1.83
Amber	8	1.88
Amber	9	1.92
Red	10 or more	2.00

326. The backtesting green zone generally would not initiate OSFI's increase in capital requirements for backtesting (i.e. no backtesting add-on would apply). [Basel Framework, MAR32.10]

327. Outcomes in the backtesting amber zone could result from either accurate or inaccurate models. However, they are generally deemed more likely for inaccurate models than for accurate

models. Within the backtesting amber zone, OSFI will impose a higher capital requirement in the form of a backtesting add-on. The number of exceptions should generally inform the size of any backtesting add-on, as set out in Table 17 of paragraph 325. [Basel Framework, MAR32.11]

328. An institution must also document all of the exceptions generated from its ongoing backtesting programme, including an explanation for each exception. [Basel Framework, MAR32.12]

329. An institution may also implement backtesting for confidence intervals other than the 99th percentile, or may perform other statistical tests not set out in this standard. [Basel Framework, MAR32.13]

330. Besides a higher capital requirement for any outcomes that place the institution in the backtesting amber zone, in the case of severe problems with the basic integrity of the model, OSFI may consider whether to disallow the institution's use of the model for market risk capital requirement purposes altogether. [Basel Framework, MAR32.14]

331. If an institution's model falls into the backtesting red zone, OSFI will automatically increase the multiplication factor applicable to the institution's model or may disallow use of the model. [Basel Framework, MAR32.15]

Backtesting at the trading desk level

332. The performance of a trading desk's risk management model will be tested through daily backtesting. [Basel Framework, MAR32.16]

333. The backtesting assessment is considered to be complementary to the PLA assessment when determining the eligibility of a trading desk for the IMA. [Basel Framework, MAR32.17]

334. At the trading desk level, backtesting must compare each desk's one-day VaR measure (calibrated to the most recent 12 months' data, equally weighted) at both the 97.5th percentile and the 99th percentile, using at least one year of current observations of the desk's one-day P&L.

(1) An exception or an outlier occurs when either the actual or hypothetical loss of the trading desk registered in a day of the backtesting period exceeds the corresponding daily VaR measure determined by the institution's model. Exceptions for actual losses are counted separately from exceptions for hypothetical losses; the overall number of exceptions is the greater of these two amounts.

(2) In the event either the P&L or the risk measure is not available or impossible to compute, it will count as an outlier.

Volatility scaling of returns for VaR calculation at the discretion of the institution that results in a shorter observation period being used is not allowed. An institution may scale up the volatility of all observations for a selected (group of) risk factor(s) to reflect a recent stress period. The institution may use this scaled data to calculate future VaR and expected shortfall estimates only after ex ante notification of such a scaling to OSFI.

[Basel Framework, MAR32.18]

335. If any given trading desk experiences either more than 12 exceptions at the 99th percentile or 30 exceptions at the 97.5th percentile in the most recent 12-month period, the capital requirement for all of the positions in the trading desk must be determined using the standardized approach.[68] [Basel Framework, MAR32.19]

9.6.3.2 PLA Test Requirements

336. The PLA test compares daily risk-theoretical P&L (RTPL) with the daily HPL for each trading desk. It intends to:

(1) measure the materiality of simplifications in a institutions' internal models used for determining market risk capital requirements driven by missing risk factors and differences in the way positions are valued compared with their front office systems; and

(2) prevent institutions from using their internal models for the purposes of capital requirements when such simplifications are considered material.

[Basel Framework, MAR32.20]

337. The PLA test must be performed on a standalone basis for each trading desk in scope for use of the IMA. [Basel Framework, MAR32.21]

Definition of profits and losses used for the PLA test and backtesting

338. The RTPL is the daily trading desk-level P&L that is produced by the valuation engine of the trading desk's risk management model.

(1) The trading desk's risk management model must include all risk factors that are included in the institution's expected shortfall (ES) model with OSFI's parameters and any risk factors deemed not modellable by OSFI, and which are therefore not included in the ES model for calculating the respective regulatory capital requirement, but are included in non-modellable risk factors.

(2) The RTPL must not take into account any risk factors that the institution does not include in its trading desk's risk management model.

[Basel Framework, MAR32.22]

339. Movements in all risk factors contained in the trading desk's risk management model should be included, even if the forecasting component of the internal model uses data that incorporates additional residual risk. For example, an institution using a multifactor beta-based index model to capture event risk might include alternative data in the calibration of the residual component to reflect potential events not observed in the name-specific historical time series.

[68] Desks with exposure to issuer default risk must pass a two-stage approval process. First, the market risk model must pass backtesting and PLA. Conditional on approval of the market risk model, the desk may then apply for approval to model default risk. Desks that fail either test must be capitalised under the standardized approach.

The fact that the name is a risk factor in the model, albeit modelled in a multifactor model environment, means that, for the purposes of the PLA test, the institution would include the actual return of the name in the RTPL (and in the HPL) and receive recognition for the risk factor coverage of the model. [Basel Framework, MAR32.23]

340. The PLA test compares a trading desk's RTPL with its HPL. The HPL used for the PLA test should be identical to the HPL used for backtesting purposes. This comparison is performed to determine whether the risk factors included and the valuation engines used in the trading desk's risk management model capture the material drivers of the institution's P&L by determining if there is a significant degree of association between the two P&L measures observed over a suitable time period. The RTPL can differ from the HPL for a number of reasons. However, a trading desk risk management model should provide a reasonably accurate assessment of the risks of a trading desk to be deemed eligible for the internal models-based approach. [Basel Framework, MAR32.24]

341. The HPL must be calculated by revaluing the positions held at the end of the previous day using the market data of the present day (i.e. using static positions). As HPL measures changes in portfolio value that would occur when end-of-day positions remain unchanged, it must not take into account intraday trading nor new or modified deals, in contrast to the APL. Both APL and HPL include foreign denominated positions and commodities included in the banking book. [Basel Framework, MAR32.25]

342. Fees and commissions must be excluded from both APL and HPL as well as valuation adjustments for which separate regulatory capital approaches have been otherwise specified as part of the rules (e.g. credit valuation adjustment and its associated eligible hedges) and valuation adjustments that are deducted from Common Equity Tier 1 (e.g. the impact on the debt valuation adjustment component of the fair value of financial instruments must be excluded from these P&Ls). [Basel Framework, MAR32.26]

343. Any other market risk-related valuation adjustments, irrespective of the frequency by which they are updated, must be included in the APL while only valuation adjustments updated daily must be included in the HPL, unless the institution has received specific agreement to exclude them from OSFI. Smoothing of valuation adjustments that are not calculated daily is not allowed. P&L due to the passage of time should be included in the APL and should be treated consistently in both HPL and RTPL.[69] [Basel Framework, MAR32.27]

344. Valuation adjustments that the institution is unable to calculate at the trading desk level (e.g. because they are assessed in terms of the institution's overall positions/risks or because of other constraints around the assessment process) are not required to be included in the HPL and APL for backtesting at the trading desk level, but should be included for institution-wide backtesting. To the satisfaction of OSFI, the institution must provide support for valuation adjustments that are not computed at a trading desk level. [Basel Framework, MAR32.28]

[69] Time effects can include various elements such as: the sensitivity to time, or theta effect (i.e. using mathematical terminology, the first-order derivative of the price relative to the time) and carry or costs of funding.

345. Both APL and HPL must be computed based on the same pricing models (e.g. same pricing functions, pricing configurations, model parametrisation, market data and systems) as the ones used to produce the reported daily P&L. [Basel Framework, MAR32.29]

PLA test data input alignment

346. For the sole purpose of the PLA assessment, institutions are allowed to align RTPL input data for its risk factors with the data used in HPL if these alignments are documented, justified to OSFI and the requirements set out below are fulfilled:

(1) Institutions must demonstrate that HPL input data can be appropriately used for RTPL purposes, and that no risk factor differences or valuation engine differences are omitted when transforming HPL input data into a format which can be applied to the risk factors used in RTPL calculation.

(2) Any adjustment of RTPL input data must be properly documented, validated and justified to OSFI.

(3) Institutions must have procedures in place to identify changes with regard to the adjustments of RTPL input data. Institutions must notify OSFI of any such changes.

(4) Institutions must provide assessments on the effect these input data alignments would have on the RTPL and the PLA test. To do so, institutions must compare RTPL based on HPL-aligned market data with the RTPL based on market data without alignment. This comparison must be performed when designing or changing the input data alignment process and upon the request of OSFI.

[Basel Framework, MAR32.30]

347. Adjustments to RTPL input data will be allowed when the input data for a given risk factor that is included in both the RTPL and the HPL differs due to different providers of market data sources or time fixing of market data sources, or transformations of market data into input data suitable for the risk factors of the underlying pricing models. These adjustments can be done either:

(1) by direct replacement of the RTPL input data (e.g. par rate tenor x, provider a) with the HPL input data (e.g. par rate tenor x, provider b); or

(2) by using the HPL input data (e.g. par rate tenor x, provider b) as a basis to calculate the risk factor data needed in the RTPL/ES model (e.g. zero rate tenor x).

In the event trading desks of an institution operate in different time zones compared to the location of the institution's risk control department, the institution is permitted to align the snapshot time used for the calculation of the RTPL of a desk to the snapshot time used for the derivation of its HPL. [Basel Framework, MAR32.31]

348. If the HPL uses market data in a different manner to RTPL to calculate risk parameters that are essential to the valuation engine, these differences must be reflected in the PLA test and as a result in the calculation of HPL and RTPL. In this regard, HPL and RTPL are allowed to use the same market data only as a basis, but must use their respective methods (which can differ) to calculate the respective valuation engine parameters. This would be the case, for example, where

market data are transformed as part of the valuation process used to calculate RTPL. In that instance, institutions may align market data between RTPL and HPL pre-transformation but not post-transformation. [Basel Framework, MAR32.32]

349. Institutions are not permitted to align HPL input data for risk factors with input data used in RTPL. Adjustments to RTPL or HPL to address residual operational noise are not permitted. Residual operational noise arises from computing HPL and RTPL in two different systems at two different points in time. It may originate from transitioning large portions of data across systems, and potential data aggregations may result in minor reconciliation gaps below tolerance levels for intervention; or from small differences in static/reference data and configuration. [Basel Framework, MAR32.33]

PLA test metrics

350. The PLA requirements are based on two test metrics:

(1) the Spearman correlation metric to assess the correlation between RTPL and HPL; and

(2) the Kolmogorov-Smirnov (KS) test metric to assess similarity of the distributions of RTPL and HPL.

[Basel Framework, MAR32.34]

351. To calculate each test metric for a trading desk, the institution must use the time series of the most recent 250 trading days of observations of RTPL and HPL. [Basel Framework, MAR32.35]

Process for determining the Spearman correlation metric

352. For a time series of HPL, institutions must produce a corresponding time series of ranks based on the size of the P&L (R_{HPL}). That is, the lowest value in the HPL time series receives a rank of 1, the next lowest value receives a rank of 2 and so on. [Basel Framework, MAR32.36]

353. Similarly, for a time series of RTPL, institutions must produce a corresponding time series of ranks based on size (R_{RTPL}). [Basel Framework, MAR32.37]

354. Institutions must calculate the Spearman correlation coefficient of the two time series of rank values of R_{RTPL} *and* R_{HPL} based on size using the following formula, where $\sigma_{R_{HPL}}$ and $\sigma_{R_{RTPL}}$ are the standard deviations of R_{RTPL} *and* R_{HPL}.

$$r_S = \frac{cov(R_{HPL}, R_{RTPL})}{\sigma_{R_{HPL}} \times \sigma_{R_{RTPL}}}$$

[Basel Framework, MAR32.*38*]

Process for determining Kolmogorov-Smirnov test metrics

355. The institution must calculate the empirical cumulative distribution function of RTPL. For any value of RTPL, the empirical cumulative distribution is the product of 0.004 and the

number of RTPL observations that are less than or equal to the specified RTPL. [Basel Framework, MAR32.39]

356. The institution must calculate the empirical cumulative distribution function of HPL. For any value of HPL, the empirical cumulative distribution is the product of 0.004 and number of HPL observations that are less than or equal to the specified HPL. [Basel Framework, MAR32.40]

357. The KS test metric is the largest absolute difference observed between these two empirical cumulative distribution functions at any P&L value. [Basel Framework, MAR32.41]

PLA test metrics evaluation

358. Based on the outcome of the metrics, upon an initial approval for a trading desk to use internal models, the trading desk may be allocated to the PLA test green zone for one year. After one year, a trading desk is allocated to a PLA test red zone, an amber zone or a green zone as set out in Table 18.

(1) A trading desk is in the PLA test green zone if both

(a) the correlation metric is above 0.80; and

(b) the KS distributional test metric is below 0.09 (p-value = 0.264).

(2) A trading desk is in the PLA test red zone if the correlation metric is less than 0.7 or if the KS distributional test metric is above 0.12 (p-value = 0.055).

(3) A trading desk is in the PLA amber zone if it is allocated neither to the green zone nor to the red zone.

PLA test thresholds Table 18

Zone	Spearman correlation	KS test
Amber zone thresholds	0.80	0.09 (p-value = 0.264)
Red zone thresholds	0.70	0.12 (p-value = 0.055)

[Basel Framework, MAR32.42]

359. If a trading desk is in the PLA test red zone, it is ineligible to use the IMA to determine market risk capital requirements and must be use the standardized approach.

(1) Risk exposures held by these ineligible trading desks must be included with the out-of-scope trading desks for purposes of determining capital requirement per the standardized approach.

(2) A trading desk deemed ineligible to use the IMA must remain out-of-scope to use the IMA until:

(a) the trading desk produces outcomes in the PLA test green zone; and

(b) the trading desk has satisfied the backtesting exceptions requirements over the past 12 months.

[Basel Framework, MAR32.43]

360. If a trading desk is in the PLA test amber zone, it is not considered an out-of-scope trading desk for use of the IMA.

(1) If a trading desk is in the PLA test amber zone, it cannot return to the PLA test green zone until:

(a) the trading desk produces outcomes in the PLA test green zone; and

(b) the trading desk has satisfied its backtesting exceptions requirements over the prior 12 months.

(2) Trading desks in the PLA test amber zone are subject to a capital surcharge as specified in paragraph 404.

[Basel Framework, MAR32.44]

9.6.3.3 Treatment for Exceptional Situations

361. There may, on very rare occasions, be a valid reason why a series of accurate trading desk level-models across different institutions will produce many backtesting exceptions or inadequately track the P&L produced by the front office pricing model (for instance, during periods of significant cross-border financial market stress affecting several institutions or when financial markets are subjected to a major regime shift). One possible OSFI's response in this instance would be to permit the relevant trading desks to continue to use the IMA but require each trading desk's model to take account of the regime shift or significant market stress as quickly as practicable while maintaining the integrity of its procedures for updating the model. OSFI will only pursue such a response under the most extraordinary, systemic circumstances. [Basel Framework, MAR32.45]

9.6.4 CAPITAL REQUIREMENTS CALCULATION

This section sets out the process by which capital requirements are calculated per the internal models approach.

9.6.4.1 Calculation of Expected Shortfall

362. Institutions will have flexibility in devising the precise nature of their expected shortfall (ES) models, but the following minimum standards will apply for the purpose of calculating market risk capital requirements. OSFI will have discretion to apply stricter standards.

The IMA does not require all products to be simulated on full revaluation. Simplifications (e.g. sensitivities-based valuation) may be used provided that OSFI agrees that the method used is adequate for the instruments covered.

[Basel Framework, MAR33.1]

363. ES must be computed on a daily basis for the institution-wide internal models to determine market risk capital requirements. ES must also be computed on a daily basis for each trading desk that uses the internal models approach (IMA). [Basel Framework, MAR33.2]

364. In calculating ES, an institution must use a 97.5th percentile, one-tailed confidence level. [Basel Framework, MAR33.3]

365. In calculating ES, the liquidity horizons described in paragraph 373 must be reflected by scaling an ES calculated on a base horizon. 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 as expressed below, where:

(1) *ES* is the regulatory liquidity-adjusted ES;

(2) *T* is the length of the base horizon, i.e. 10 days;

(3) $ES_T(P)$ is the 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;

(4) $ES_T(P, j)$ is the ES at horizon *T* of a portfolio with positions $P = (p_i)$ with respect to shocks for each position p_i in the subset of risk factors $Q(p_i, j)$, with all other risk factors held constant;

(5) 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;

(6) $Q(p_i, j)_j$ is the subset of risk factors for which liquidity horizons, as specified in paragraph 373, for the desk where p_i is booked are at least as long as LH_j according to the table below. For example, $Q(p_i,4)$ is the set of risk factors with a 60-day horizon and a 120-day liquidity horizon. Note that $Q(p_i, j)$ is a subset of $Q(p_i, j-1)$;

(7) the time series of changes in risk factors over the base time interval *T* may be determined by overlapping observations; and

(8) LH_j is the liquidity horizon *j*, with lengths in the following table:

Liquidity horizons, j **Table 19**

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

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

[Basel Framework, MAR33.4]

366. The ES measure must be calibrated to a period of stress.

(1) Specifically, the ES measure must replicate an ES outcome that would be generated on the institution's current portfolio if the relevant risk factors were experiencing a period of stress. This is a joint assessment across all relevant risk factors, which will capture stressed correlation measures.

(2) This calibration is to be based on an indirect approach using a reduced set of risk factors. Institutions must specify a reduced set of risk factors that are relevant for their portfolio and for which there is a sufficiently long history of observations.

(a) This reduced set of risk factors is subject to OSFI's approval and must meet the data quality requirements for a modellable risk factor as outlined in paragraph 302 to 314.

(b) The identified reduced set of risk factors must be able to explain a minimum of 75% of the variation of the full ES model (i.e. the ES of the reduced set of risk factors should be at least equal to 75% of the fully specified ES model on average measured over the preceding 12-week period).

In terms of indicator for the identification of the stress period, the aggregate capital requirement for modellable risk factors (IMCC) as per paragraph 376 has to be maximised for the modellable risk factors.

The reduced set of risk factors must be able to explain a minimum of 75% of the variation of the full ES model at the group level for the aggregate of all desks with IMA model approval. This may be done by demonstrating that the average of the measurements of the ratio (ES using reduced set of risk factors and current period ($ES_{R,C}$) to ES using full set of risk factors and current period (ESF,C)) over the preceding 12-week period is at least 75%.

Regarding the reform of benchmark reference rates, if the new benchmark rate is currently eligible for modelling according to section 9.6.2 but was not available during the stress period, it may pose a challenge to institutions calculating the expected shortfall (ES) for the current and stress period per section 9.6.4. To address this, if the new benchmark rate is eligible for modelling according to 9.6.2 but was not available during the stress period, institutions may use: (i) for the current period, the new benchmark rate in the full set of risk factors $ES_{F,C}$ and in the reduced set of risk factors $ES_{R,C}$; and (ii) for the stress period, the old benchmark rate in the reduced set of risk factors $ES_{R,S}$. This interpretation does not annul the specification in the above paragraph that the reduced set is subject to OSFI approval and must meet the data quality requirements.

[Basel Framework, MAR33.5]

367. The ES for market risk capital purposes is therefore expressed as follows, where:

(1) The ES for the portfolio using the above reduced set of risk factors ($ES_{R,S}$), is calculated based on the most severe 12-month period of stress available over the observation horizon.

(2) $ES_{R,S}$ is then scaled up by the ratio of (i) the current ES using the full set of risk factors to (ii) the current ES measure using the reduced set of factors. For the purpose of this calculation, this ratio is floored at 1.

(a) $ES_{F,C}$ is the ES measure based on the current (most recent) 12-month observation period with the full set of risk factors; and

(b) $ES_{R,C}$ is the ES measure based on the current period with a reduced set of risk factors.

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

[Basel Framework, MAR33.6]

368. For measures based on stressed observations ($ES_{R,S}$), institutions must identify the 12-month period of stress over the observation horizon in which the portfolio experiences the largest loss. The observation horizon for determining the most stressful 12 months must, at a minimum, include the 2007-09 period[70]. Observations within this period must be equally weighted. Institutions must update their 12-month stressed periods at least quarterly, or whenever there are material changes in the risk factors in the portfolio. Whenever an institution updates its 12-month stressed periods it must also update the reduced set of risk factors (as the basis for the calculations of $E_{R,C}$ and $E_{R,S}$) accordingly. [Basel Framework, MAR33.7]

369. For measures based on current observations ($ES_{F,C}$), institutions must update their data sets no less frequently than once every three months and must also reassess data sets whenever market prices are subject to material changes.

(1) This updating process must be flexible enough to allow for more frequent updates.

(2) OSFI may also require an institution to calculate its ES using a shorter observation period if, in OSFI's judgement, this is justified by a significant upsurge in price volatility. In this case, however, the period should be no shorter than six months.

[Basel Framework, MAR33.8]

370. No particular type of ES model is prescribed. Provided that each model used captures all the material risks run by the institution, as confirmed through profit and loss (P&L) attribution (PLA) tests and backtesting, and conforms to each of the requirements set out above and below, OSFI may permit institutions to use models based on either historical simulation, Monte Carlo simulation, or other appropriate analytical methods. [Basel Framework, MAR33.9]

371. Institutions will have discretion to recognise empirical correlations within broad regulatory risk factor classes (interest rate risk, equity risk, foreign exchange risk, commodity risk and credit risk, including related options volatilities in each risk factor category). Empirical correlations across broad risk factor categories will be constrained by the supervisory aggregation scheme, as described in paragraphs 375 to 376, and must be calculated and used in a

[70] OSFI's approval is required if an institution would like to remove the observation horizon related to the 2007-09 Great Financial Crisis (GFC) period.

manner consistent with the applicable liquidity horizons, clearly documented and able to be explained to OSFI on request. [Basel Framework, MAR33.10]

372. Institutions' models must accurately capture the risks associated with options within each of the broad risk categories. The following criteria apply to the measurement of options risk:

(1) Institutions' models must capture the non-linear price characteristics of options positions.

(2) Institutions' risk measurement systems must have a set of risk factors that captures the volatilities of the rates and prices underlying option positions, i.e. vega risk. Institutions with relatively large and/or complex options portfolios must have detailed specifications of the relevant volatilities. Institutions must model the volatility surface across both strike price and vertex (i.e. tenor).

[Basel Framework, MAR33.11]

373. As set out in paragraph 365, a scaled ES must be calculated based on the liquidity horizon *n* defined below. *n* is calculated per the following conditions:

(1) Institutions must map each risk factor on to one of the risk factor categories shown below using consistent and clearly documented procedures.

(2) The mapping of risk factors must be:

  (a) set out in writing;

  (b) validated by the institution's risk management;

  (c) made available to OSFI; and

  (d) subject to internal audit.

(3) *n* is determined for each broad category of risk factor as set out in Table 20. However, on a desk-by-desk basis, *n* can be increased relative to the values in the table below (i.e. the liquidity horizon specified below can be treated as a floor). 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 OSFI approval. Furthermore, liquidity horizons should be capped at the maturity of the related instrument if the maturity of the instrument is longer than the respective liquidity horizon of the risk factor as prescribed in this paragraph.

Liquidity horizon n by risk factor Table 20

Risk factor category	n	Risk factor category	n
Interest rate: specified currencies - EUR, USD, GBP, AUD, JPY, SEK, CAD and domestic currency of an institution	10	Equity price (small cap): volatility	60
Interest rate: unspecified currencies	20	Equity: other types	60
Interest rate: volatility	60	Foreign exchange (FX) rate: specified currency pairs[71]	10
Interest rate: other types	60	FX rate: currency pairs	20
Credit spread: sovereign (investment grade, or IG)	20	FX: volatility	40
Credit spread: sovereign (high yield, or HY)	40	FX: other types	40
Credit spread: corporate (IG)	40	Energy and carbon emissions trading price	20
Credit spread: corporate (HY)	60	Precious metals and non-ferrous metals price	20
Credit spread: volatility	120	Other commodities price	60
Credit spread: other types	120	Energy and carbon emissions trading price: volatility	60
Equity price (large cap)	10	Precious metals and non-ferrous metals price: volatility	60
Equity price (small cap)	20	Other commodities price: volatility	120
Equity price (large cap): volatility	20	Commodity: other types	120

The liquidity horizon for equity large cap repo and dividend risk factors is 20 days. All other equity repo and dividend risk factors are subject to a liquidity horizon of 60 days.

For mono-currency and cross-currency basis risk, liquidity horizons of 10 days and 20 days for interest rate-specified currencies and unspecified currencies, respectively, should be applied.

The liquidity horizon for inflation risk factors should be consistent with the liquidity horizons for interest rate risk factors for a given currency.

If the maturity of the instrument is shorter than the respective liquidity horizon of the risk factor as prescribed in paragraph 373, the next longer liquidity horizon length (out of the lengths of 10, 20, 40, 60 or 120 days as set out in the paragraph) compared with the maturity of the instrument itself must be used. For example, although the liquidity horizon for interest rate volatility is

71 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. Currency pairs forming first-order crosses across these specified currency pairs are also subject to the same liquidity horizon.

prescribed as 60 days, if an instrument matures in 30 days, a 40-day liquidity horizon would apply for the instrument's interest rate volatility.

To determine the liquidity horizon of multi-sector credit and equity indices, the respective liquidity horizons of the underlying instruments must be used. A weighted average of liquidity horizons of the instruments contained in the index must be determined by multiplying the liquidity horizon of each individual instrument by its weight in the index (i.e. the weight used to construct the index) and summing across all instruments. The liquidity horizon of the index is the shortest liquidity horizon (out of 10, 20, 40, 60 and 120 days) that is equal to or longer than the weighted average liquidity horizon. For example, if the weighted average liquidity horizon is 12 days, the liquidity horizon of the index would be 20 days.

[Basel Framework, MAR33.12]

9.6.4.2 Calculation of Capital Requirement for Modellable Risk Factors

374. For those trading desks that are permitted to use the IMA, all risk factors that are deemed to be modellable must be included in the institution's internal, institution-wide ES model. The institution must calculate its internally modelled capital requirement at the institution-wide level using this model, with no supervisory constraints on cross-risk class correlations (IMCC(C)).

Institutions design their own models for use under the IMA. As a result, they may exclude risk factors from IMA models as long as OSFI does not conclude that the risk factor must be capitalised by either ES or SES. Moreover, at a minimum, the risk factors defined in paragraphs 290 to 301 need to be covered in the IMA. If a risk factor is capitalised by neither ES nor SES, it is to be excluded from the calculation of risk-theoretical P&L.

[Basel Framework, MAR33.13]

375. The institution must calculate a series of partial ES capital requirements (i.e. all other risk factors must be held constant) for the range of broad regulatory risk classes (interest rate risk, equity risk, foreign exchange risk, commodity risk and credit spread risk). These partial, non-diversifiable (constrained) ES values ($IMCC(C_i)$) will then be summed to provide an aggregated risk class ES capital requirement. [Basel Framework, MAR33.14]

376. The aggregate capital requirement for modellable risk factors (*IMCC*) is based on the weighted average of the constrained and unconstrained ES capital requirements, where:

(1) The stress period used in the risk class level $ES_{R,S,i}$ should be the same as that used to calculate the portfolio-wide $ES_{R,S}$.

(2) *Rho (ρ)* is the relative weight assigned to the institution's internal model. The value of ρ is 0.5.

(3) *B* stands for broad regulatory risk classes as set out in paragraph 375.

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

where $IMCC(C) = ES_{R,S}\frac{ES_{F,C}}{ES_{R,C}}$ and $IMCC(C_i) = ES_{R,S,i}\frac{ES_{F,C,i}}{ES_{R,C,i}}$

To calculate the aggregate capital requirement for modellable risk factors (internally modelled capital charge, IMCC) up to 63 daily ES calculations would be necessary if each ES measure were required to be calculated daily.

The formula specified in this paragraph, $IMCC = \rho\big(IMCC(C)\big) + (1-\rho)(\sum_{i=1}^{B} IMCC(C_i))$, can be rewritten as $IMCC = \rho\big(IMCC(C)\big) + (1-\rho)\frac{(\sum_{i=1}^{B} IMCC(C_i))}{(IMCC(C))}\big(IMCC(C)\big)$ with $IMCC(C) = ES_{R,S}\frac{ES_{F,C}}{ES_{R,C}}$. While $ES_{R,S}$, $ES_{F,C}$ and $ES_{R,C}$ must be calculated daily, it is generally acceptable that the ratio of undiversified IMCC(C) to diversified IMCC(C), $\frac{(\sum_{i=1}^{B} IMCC(C_i))}{(IMCC(C))}$, may be calculated on a weekly basis.

By defining ω as $\omega = \rho + (1-\rho)\cdot\frac{(\sum_{i=1}^{B} IMCC(C_i))}{(IMCC(C))}$ the formula for the calculation of IMCC can be rearranged, leading to the following expression of IMCC: $IMCC = \omega \cdot \big(IMCC(C)\big)$. Hence, IMCC can be calculated as a multiple of IMCC(C), where IMCC(C) is calculated daily and the multiplier ω is updated weekly.

Institutions must have procedures and controls in place to ensure that the weekly calculation of the "undiversified IMCC(C) to diversified IMCC(C)" ratio does not lead to a systematic underestimation of risks relative to daily calculation. Institutions must be in a position to switch to daily calculation upon OSFI's direction.

[Basel Framework, MAR33.15]

9.6.4.3 Calculation of Capital Requirement for Non-Modellable Risk Factors

377. Capital requirements for each non-modellable risk factor (NMRF) are to be determined using a stress scenario that is 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 stress). In determining that period of stress, an institution must determine a common 12-month period of stress across all NMRFs in the same risk class. Subject to OSFI's approval, an institution may be permitted to calculate stress scenario capital requirements at the bucket level (using the same buckets that the institution uses to disprove modellability, per paragraph 306) for risk factors that belong to curves, surfaces or cubes (i.e. a single stress scenario capital requirement for all the NMRFs that belong to the same bucket).

(1) For each NMRF, the liquidity horizon of the stress scenario must be the greater of the liquidity horizon assigned to the risk factor in paragraph 373 and 20 days. OSFI may require a higher liquidity horizon.

(2) For NMRFs arising from idiosyncratic credit spread risk, institutions may apply a common 12-month stress period. Likewise, for NMRFs arising from idiosyncratic equity risk arising from spot, futures and forward prices, equity repo rates, dividends and volatilities, institutions may apply a common 12-month stress scenario. Additionally, a

zero correlation assumption may be used when aggregating gains and losses provided the institution conducts analysis to demonstrate to OSFI that this is appropriate.[72] Correlation or diversification effects between other non-idiosyncratic NMRFs are recognized through the formula set out in the paragraph below.

(3) In the event that an institution cannot provide a stress scenario which is acceptable for OSFI, the institution will have to use the maximum possible loss as the stress scenario.

[Basel Framework, MAR33.16]

378. The aggregate regulatory capital measure for *I* (non-modellable idiosyncratic credit spread risk factors that have been demonstrated to be appropriate to aggregate with zero correlation), *J* (non-modellable idiosyncratic equity risk factors that have been demonstrated to be appropriate to aggregate with zero correlation) and the remaining *K* (risk factors in model-eligible trading desks that are non-modellable *(SES)*) is calculated as follows, where:

(1) $ISES_{NM,i}$ is the stress scenario capital requirement for idiosyncratic credit spread non-modellable risk *i* from the *I* risk factors aggregated with zero correlation;

(2) $ISES_{NM,j}$ is the stress scenario capital requirement for idiosyncratic equity non-modellable risk *j* from the J risk factors aggregated with zero correlation;

(3) $SES_{NM,k}$ is the stress scenario capital requirement for non-modellable risk *k from K risk factors; and*

(4) Rho (ρ) is equal to 0.6.

$$SES = \sqrt{\sum_{i=1}^{I} ISES_{NM,i}^{2}} + \sqrt{\sum_{j=1}^{J} ISES_{NM,j}^{2}} + \sqrt{\left(\rho * \sum_{k=1}^{K} SES_{NM,k}\right)^{2} + (1-\rho^{2}) * \sum_{k=1}^{K} SES_{NM,k}^{2}}$$

[Basel Framework, MAR33.17]

9.6.4.4 Calculation of Default Risk Capital Requirement

379. Institutions must have a separate internal model to measure the default risk of trading book positions. The general criteria in paragraphs 267 to 270 and the qualitative standards in paragraphs 271 to 282 also apply to the default risk model. [Basel Framework, MAR33.18]

380. Default risk is the risk of direct loss due to an obligor's default as well as the potential for indirect losses that may arise from a default event. [Basel Framework, MAR33.19]

[72] The tests are generally done on the residuals of panel regressions where the dependent variable is the change in issuer spread while the independent variables can be either a change in a market factor or a dummy variable for sector and/or region. The assumption is that the data on the names used to estimate the model suitably proxies the names in the portfolio and the idiosyncratic residual component captures the multifactor-name basis. If the model is missing systematic explanatory factors or the data suffers from measurement error, then the residuals would exhibit heteroscedasticity (which can be tested via White, Breuche Pagan tests etc.) and/or serial correlation (which can be tested with Durbin Watson, Lagrange multiplier (LM) tests etc.) and/or cross-sectional correlation (clustering).

381. Default risk must be measured using a value-at-risk (VaR) model.

(1) Institutions must use a default simulation model with two types of systematic risk factors. The model should always have two random variables that correspond to the systematic risk factors.

Systematic risk in a DRC requirement model must be accounted for via multiple systematic factors of two different types. The random variable that determines whether an obligor defaults must be an obligor-specific function of the systematic factors of both types and of an idiosyncratic factor. For example, in a Merton-type model, obligor i defaults when its asset return X_i falls below an obligor-specific threshold that determines the obligor's probability of default. Systematic risk can be described via M systematic regional factors Y_j^{region} $(j = 1, \ldots, M)$ and N systematic industry factors $Y_j^{industry}$ $(j = 1, \ldots, N)$. For each obligor i, region factor loadings $\beta_{i,j}^{region}$ and industry factor loadings $\beta_{i,j}^{industry}$ that describe the sensitivity of the obligor's asset return to each systematic factor need to be chosen. There must be at least one non-zero factor loading for the region type and at least one non-zero factor loading for the industry type. The asset return of obligor i can be represented as $X_i = \sum_{j=1}^{M} \beta_{i,j}^{region} \cdot Y_j^{region} + \sum_{j=1}^{N} \beta_{i,j}^{industry} \cdot Y_j^{industry} + \gamma_i \cdot \varepsilon_i$, where ε_i is the idiosyncratic risk factor and γ_i is the idiosyncratic factor loading.

(2) Default correlations must be based on credit spreads or on listed equity prices. Correlations must be based on data covering a period of 10 years that includes a period of stress as defined in paragraph 366 and based on a one-year liquidity horizon. Only credit spreads or listed equity prices are permitted. No additional data sources (e.g. rating time series) are permitted.

(3) Institutions must have clear policies and procedures that describe the correlation calibration process, documenting in particular in which cases credit spreads or equity prices are used.

(4) Institutions have the discretion to apply a minimum liquidity horizon of 60 days to the determination of default risk capital (DRC) requirement for equity sub-portfolios.

Institutions are permitted to calibrate correlations to liquidity horizons of 60 days in the case that a separate calculation is performed for equity sub-portfolios and these desks deal predominately in equity exposures. In the case of a desk with both equity and bond exposures, for which a joint calculation for default risk of equities and bonds needs to be performed, the correlations need to be calibrated to a liquidity horizon of one year.

In this case, an institution is permitted to consistently use a 60-day probability of default (PD) for equities and a one-year PD for bonds.

Institutions are permitted to use a 60-day liquidity horizon for all equity positions but are permitted to use a longer liquidity horizon where appropriate, e.g. where equity is held to hedge hybrid positions (such as convertibles).

(5) The VaR calculation must be conducted weekly and be based on a one-year time horizon at a one-tail, 99.9 percentile confidence level.

[Basel Framework, MAR33.20]

382. All positions subject to market risk capital requirements that have default risk as defined in paragraph 380, with the exception of those positions subject to the standardized approach, are subject to the DRC requirement model.

(1) Sovereign exposures (including those denominated in the sovereign's domestic currency), equity positions and defaulted debt positions must be included in the model.

(2) For equity positions, the default of an issuer must be modelled as resulting in the equity price dropping to zero.

[Basel Framework, MAR33.21]

383. The DRC requirement model capital requirement is the greater of:

(1) the average of the DRC requirement model measures over the previous 12 weeks; or

(2) the most recent DRC requirement model measure.

[Basel Framework, MAR33.22]

384. An institution must assume constant positions over the one-year horizon, or 60 days in the context of designated equity sub-portfolios.

An institution must have constant positions over the chosen liquidity horizon.

The concept of constant positions has changed in the market risk framework because the capital horizon is now meant to always be synonymous with the new definition of liquidity horizon and no new positions are added when positions expire during the capital horizon. For securities with a maturity under one year, a constant position can be maintained within the liquidity horizon but, much like under the Basel II.5 incremental risk charge, any maturity of a long or short position must be accounted for when the ability to maintain a constant position within the liquidity horizon cannot be contractually assured.

[Basel Framework, MAR33.23]

385. Default risk must be measured for each obligor.

(1) Probabilities of default (PDs) implied from market prices are not acceptable unless they are corrected to obtain an objective probability of default.

(2) PDs are subject to floors of:

a. 0.01% for claims on or directly guaranteed by the Government of Canada, the Bank of Canada, and a Canadian provincial or territorial government; and

b. 0.03% for all other claims.

[Basel Framework, MAR33.24]

386. An institution's model may reflect netting of long and short exposures to the same obligor. If such exposures span different instruments with exposure to the same obligor, the

effect of the netting must account for different losses in the different instruments (e.g. differences in seniority). [Basel Framework, MAR33.25]

387. The basis risk between long and short exposures of different obligors must be modelled explicitly. The potential for offsetting default risk among long and short exposures across different obligors must be included through the modelling of defaults. The pre-netting of positions before input into the model other than as described in the above paragraph is not allowed. [Basel Framework, MAR33.26]

388. The DRC requirement model must recognise the impact of correlations between defaults among obligors, including the effect on correlations of periods of stress as described below.

(1) These correlations must be based on objective data and not chosen in an opportunistic way where a higher correlation is used for portfolios with a mix of long and short positions and a low correlation used for portfolios with long only exposures.

(2) An institution must validate that its modelling approach for these correlations is appropriate for its portfolio, including the choice and weights of its systematic risk factors. An institution must document its modelling approach and the period of time used to calibrate the model.

(3) These correlations must be measured over a liquidity horizon of one year.

(4) These correlations must be calibrated over a period of at least 10 years.

(5) Institutions must reflect all significant basis risks in recognizing these correlations, including, for example, maturity mismatches, internal or external ratings, vintage etc.

Paragraph 384 states that an institution must have constant positions over the chosen liquidity horizon, however, an institution must capture material mismatches between the position and its hedge.

[Basel Framework, MAR33.27]

389. The institution's model must capture any material mismatch between a position and its hedge. With respect to default risk within the one-year capital horizon, the model must account for the risk in the timing of defaults to capture the relative risk from the maturity mismatch of long and short positions of less than one-year maturity.

In case of either i) an investment grade[73] bond or a large-cap[74] equity that is hedging a TRS or ii) a bond forward that is hedging a Level 1 High Quality Liquid Asset as defined in Chapter 2 of *OSFI's Liquidity Adequacy Requirements Guideline*, the institution can cap its maturity mismatch at 40 days. To apply this cap, the institution must be able to demonstrate to OSFI the governance capacity to unwind such cash positions within this timeframe. Such recognition is only admissible if the institution:

[73] Investment grade refers to a rating of Baa3 or better by Moody's; a rating of BBB- or better by S&P; and the equivalent investment grade credit rating from any additional rating agency selected by the institution.
[74] Large cap refers to the shares of a company with a market capitalization higher than CAD $6.25 billion.

i) chooses to make use of the rebalancing/liquidation of the hedge consistently over the relevant set of trading book risk positions;
ii) demonstrates that the inclusion of rebalancing/liquidation results in a better risk measurement;
iii) demonstrates that the markets for the security serving as hedge are liquid enough to allow for this kind of rebalancing/liquidation, even during periods of stress; and
iv) establishes a limit system based on instrument exposure relative to average daily traded volume of the cash position.

[Basel Framework, MAR33.28]

390. The institution's model must reflect the effect of issuer and market concentrations, as well as concentrations that can arise within and across product classes during stressed conditions. [Basel Framework, MAR33.29]

391. As part of this DRC requirement model, the institution must calculate, for each and every position subjected to the model, an incremental loss amount relative to the current valuation that the institution would incur in the event that the obligor of the position defaults. [Basel Framework, MAR33.30]

392. Loss estimates must reflect the economic cycle; for example, the model must incorporate the dependence of the recovery on the systemic risk factors. [Basel Framework, MAR33.31]

393. The institution's model must reflect the non-linear impact of options and other positions with material non-linear behaviour with respect to default. In the case of equity derivatives positions with multiple underlyings, simplified modelling approaches (for example modelling approaches that rely solely on individual jump-to-default sensitivities to estimate losses when multiple underlyings default) may be applied (subject to OSFI approval). [Basel Framework, MAR33.32]

394. Default risk must be assessed from the perspective of the incremental loss from default in excess of the mark-to-market losses already taken into account in the current valuation. [Basel Framework, MAR33.33]

395. Owing to the high confidence standard and long capital horizon of the DRC requirement, robust direct validation of the DRC model through standard backtesting methods at the 99.9%/one-year soundness standard will not be possible.

(1) Accordingly, validation of a DRC model necessarily must rely more heavily on indirect methods including but not limited to stress tests, sensitivity analyses and scenario analyses, to assess its qualitative and quantitative reasonableness, particularly with regard to the model's treatment of concentrations.

(2) Given the nature of the DRC soundness standard, such tests must not be limited to the range of events experienced historically.

(3) The validation of a DRC model represents an ongoing process in which OSFI and institutions jointly determine the exact set of validation procedures to be employed.

[Basel Framework, MAR33.34]

396. Institutions should strive to develop relevant internal modelling benchmarks to assess the overall accuracy of their DRC models. [Basel Framework, MAR33.35]

397. Due to the unique relationship between credit spread and default risk, institutions must seek approval for each trading desk with exposure to these risks, both for credit spread risk and default risk. Trading desks which do not receive approval will be deemed ineligible for internal modelling standards and be subject to the standardized capital framework. [Basel Framework, MAR33.36]

398. Where an institution has approved PD estimates as part of the internal ratings-based (IRB) approach, this data must be used. Where such estimates do not exist, or OSFI determines that they are not sufficiently robust, PDs must be computed using a methodology consistent with the IRB methodology and satisfy the following conditions.

(1) Risk-neutral PDs should not be used as estimates of observed (historical) PDs.

(2) PDs must be measured based on historical default data including both formal default events and price declines equivalent to default losses. Where possible, this data should be based on publicly traded securities over a complete economic cycle. The minimum historical observation period for calibration purposes is five years.

(3) PDs must be estimated based on historical data of default frequency over a one-year period. The PD may also be calculated on a theoretical basis (e.g. geometric scaling) provided that the institution is able to demonstrate that such theoretical derivations are in line with historical default experience.

(4) PDs provided by external sources may also be used by institutions, provided they can be shown to be relevant for the institution's portfolio.

[Basel Framework, MAR33.37]

399. Where an institution has approved loss-given-default (LGD)[75] estimates as part of the IRB approach, this data must be used. Where such estimates do not exist, or OSFI determines that they are not sufficiently robust, LGDs must be computed using a methodology consistent with the IRB methodology and satisfy the following conditions.

(1) 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.

(2) LGDs must be based on an amount of historical data that is sufficient to derive robust, accurate estimates.

(3) LGDs provided by external sources may also be used by institutions, provided they can be shown to be relevant for the institution's portfolio.

[75] LGD should be interpreted in this context as 1 – recovery rate.

[Basel Framework, MAR33.38]

400. Institutions must establish a hierarchy ranking their preferred sources for PDs and LGDs, in order to avoid the cherry-picking of parameters. [Basel Framework, MAR33.39]

9.6.4.5 Calculation of Capital Requirement for Model-Ineligible Trading Desks

401. The regulatory capital requirement associated with trading desks that are either out-of-scope for model approval or that have been deemed ineligible to use an internal model (Cu) is to be calculated by aggregating all such risks and applying the standardized approach. [Basel Framework, MAR33.40]

9.6.4.6 Aggregation of Capital Requirements

402. The aggregate (non-DRC) capital requirement for those trading desks approved and eligible for the IMA (i.e. trading desks that pass the backtesting requirements and that have been assigned to the PLA test green zone or amber zone (C_A) in paragraphs 359 to 361) is equal to the maximum of the most recent observation and a weighted average of the previous 60 days scaled by a multiplier and is calculated as follows where *SES* is the aggregate regulatory capital measure for the risk factors in model-eligible trading desks that are non-modellable.

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

[Basel Framework, MAR33.41]

403. The multiplication factor m_c is fixed at 1.5 unless it is set at a higher level by OSFI to reflect the addition of a qualitative add on and/or a backtesting add-on per the following considerations.

(1) Institutions must add to this factor a “plus” directly related to the ex-post performance of the model, thereby introducing a built-in positive incentive to maintain the predictive quality of the model.

(2) For the backtesting add-on, the plus will range from 0 to 0.5 based on the outcome of the backtesting of the institution’s daily VaR at the 99th percentile based on current observations on the full set of risk factors *(VaR_{FC})*.

(3) If the backtesting results are satisfactory and the institution meets all of the qualitative standards set out in paragraphs 271 to 282, the plus factor could be zero. Section 9.6.3 presents in detail the approach to be applied for backtesting and the plus factor.

(4) The backtesting add-on factor is determined based on the maximum of the exceptions generated by the backtesting results against actual P&L (APL) and hypothetical P&L (HPL) as described section 9.6.3.

[Basel Framework, MAR33.42]

404. The aggregate capital requirement for market risk (ACR_{total}) is equal to the aggregate capital requirement for approved and eligible trading desks ($IMA_{G,A} = C_A$ + DRC) plus the standardized approach capital requirement for trading desks that are either out-of-scope for

model approval or that have been deemed ineligible to use the internal models approach (C_u). If at least one eligible trading desk is in the PLA test amber zone, a capital surcharge is added. The impact of the capital surcharge is limited by the formula:

$$ACR_{total} = min\{IMA_{G,A} + Capital\ surcharge + C_U\ ;\ SA_{all\ desk}\} + max\{0;\ IMA_{G,A} - SA_{G,A}\}$$

[Basel Framework, MAR33.43]

405. For the purposes of calculating the capital requirement, the risk factor eligibility test, the PLA test and the trading desk-level backtesting are applied on a quarterly basis to update the modellability of risk factors and desk classification to the PLA test green zone, amber zone, or red zone. In addition, the stressed period and the reduced set of risk factors ($E_{R,C}$ and $E_{R,S}$) must be updated on a quarterly basis. The reference dates to perform the tests and to update the stress period and selection of the reduced set of risk factors should be consistent. Institutions must reflect updates to the stressed period and to the reduced set of risk factors as well as the test results in calculating capital requirements in a timely manner. The averages of the previous 60 days (IMCC, SES) and or respectively 12 weeks (DRC) have only to be calculated at the end of the quarter for the purpose of calculating the capital requirement. [Basel Framework, MAR33.44]

406. The capital surcharge is calculated as the difference between the aggregated standardized capital charges ($SA_{G,A}$) and the aggregated internal models-based capital charges ($IMA_{G,A} = C_A + DRC$) multiplied by a factor k. To determine the aggregated capital charges, positions in all of the trading desks in the PLA green zone or amber zone are taken into account. The capital surcharge is floored at zero. In the formula below:

(1) $k = 0.5 \times \frac{\sum_{i \in A} SA_i}{\sum_{i \in G,A} SA_i}$;

(2) SA_i denotes the standardized capital requirement for all the positions of trading desk "i";

(3) $i \in A$ denotes the indices of all the approved trading desks in the amber zone; and

(4) $i \in G, A$ denotes the indices of all the approved trading desks in the green zone or amber zone.

$$Capital\ surcharge = k \cdot max\{0, SA_{G,A} - IMA_{G,A}\}$$

[Basel Framework, MAR33.45]

407. The risk-weighted assets for market risk under the IMA are determined by multiplying the capital requirements calculated as set out in this section by 12.5. [Basel Framework, MAR33.46]

9.6.5 GUIDANCE ON USE OF THE INTERNAL MODELS APPROACH

This section sets out application guidance for backtesting requirements and principles for risk factor modellability under the internal models approach.

9.6.5.1 Trading Desk-Level Backtesting

408. An additional consideration in specifying the appropriate risk measures and trading outcomes for profit and loss (P&L) attribution test and backtesting arises because the internally modelled risk measurement is generally based on the sensitivity of a static portfolio to instantaneous price shocks. That is, end-of-day trading positions are input into the risk measurement model, which assesses the possible change in the value of this static portfolio due to price and rate movements over the assumed holding period. [Basel Framework, MAR99.1]

409. While this is straightforward in theory, in practice it complicates the issue of backtesting. For instance, it is often argued that neither expected shortfall nor value-at-risk measures can be compared against actual trading outcomes, since the actual outcomes will reflect changes in portfolio composition during the holding period. According to this view, the inclusion of fee income together with trading gains and losses resulting from changes in the composition of the portfolio should not be included in the definition of the trading outcome because they do not relate to the risk inherent in the static portfolio that was assumed in constructing the value-at-risk measure. [Basel Framework, MAR99.2]

410. This argument is persuasive with regard to the use of risk measures based on price shocks calibrated to longer holding periods. That is, comparing the liquidity-adjusted time horizon 99th percentile risk measures from the internal models capital requirement with actual liquidity-adjusted time horizon trading outcomes would probably not be a meaningful exercise. In particular, in any given multi-day period, significant changes in portfolio composition relative to the initial positions are common at major trading institutions. For this reason, the backtesting framework described here involves the use of risk measures calibrated to a one-day holding period. Other than the restrictions mentioned in this paper, the test would be based on how institutions model risk internally. [Basel Framework, MAR99.3]

411. Given the use of one-day risk measures, it is appropriate to employ one-day trading outcomes as the benchmark to use in the backtesting programme. The same concerns about "contamination" of the trading outcomes discussed above continue to be relevant, however, even for one-day trading outcomes. That is, there is a concern that the overall one-day trading outcome is not a suitable point of comparison, because it reflects the effects of intraday trading, possibly including fee income that is booked in connection with the sale of new products. [Basel Framework, MAR99.4]

412. On the one hand, intraday trading will tend to increase the volatility of trading outcomes and may result in cases where the overall trading outcome exceeds the risk measure. This event clearly does not imply a problem with the methods used to calculate the risk measure; rather, it is simply outside the scope of what the measure is intended to capture. On the other hand, including fee income may similarly distort the backtest, but in the other direction, since fee income often has annuity-like characteristics. Since this fee income is not typically included in the calculation of the risk measure, problems with the risk measurement model could be masked by including fee income in the definition of the trading outcome used for backtesting purposes. [Basel Framework, MAR99.5]

413. To the extent that backtesting programmes are viewed purely as a statistical test of the integrity of the calculation of the risk measures, it is appropriate to employ a definition of daily trading outcome that allows for an uncontaminated test. To meet this standard, institutions must have the capability to perform the tests based on the hypothetical changes in portfolio value that would occur were end-of-day positions to remain unchanged. [Basel Framework, MAR99.6]

414. Backtesting using actual daily P&Ls is also a useful exercise since it can uncover cases where the risk measures are not accurately capturing trading volatility in spite of being calculated with integrity. [Basel Framework, MAR99.7]

415. For these reasons, OSFI requires institutions to develop the capability to perform these tests using both hypothetical and actual trading outcomes. In combination, the two approaches are likely to provide a strong understanding of the relation between calculated risk measures and trading outcomes. The total number of backtesting exceptions for the purpose of the thresholds in paragraph 325 must be calculated as the maximum of the exceptions generated under hypothetical or actual trading outcomes. [Basel Framework, MAR99.8]

9.6.5.2 Institution-Wide Backtesting

Statistical considerations in defining the backtesting zones

416. To place the definitions of three zones of the institution-wide backtesting in proper perspective, however, it is useful to examine the probabilities of obtaining various numbers of exceptions under different assumptions about the accuracy of an institution's risk measurement model. [Basel Framework, MAR99.9]

417. Three zones have been delineated and their boundaries chosen in order to balance two types of statistical error:

(1) the possibility that an accurate risk model would be classified as inaccurate on the basis of its backtesting result, and

(2) the possibility that an inaccurate model would not be classified that way based on its backtesting result.

[Basel Framework, MAR99.10]

418. Table 21 reports the probabilities of obtaining a particular number of exceptions from a sample of 250 independent observations under several assumptions about the actual percentage of outcomes that the model captures (i.e. these are binomial probabilities). For example, the left-hand portion of Table 21 sets out probabilities associated with an accurate model (that is, a true coverage level of 99%). Under these assumptions, the column labelled "exact" reports that exactly five exceptions can be expected in 6.7% of the samples.

Probabilities of exceptions from 250 independent observations **Table 21**

Model is accurate			Model is inaccurate: possible alternative levels of coverage							
Exeptions	Coverage = 99%		Coverage = 98%		Coverage = 97%		Coverage = 96%		Coverage = 95%	
	Exact	Type 1	Exact	Type 2	Exact	Type 2	Exact	Type 2	Exact	Type 2
0	8.1%	100.0%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1	20.5%	91.9%	3.3%	0.6%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%
2	25.7%	71.4%	8.3%	3.9%	1.5%	0.4%	0.2%	0.0%	0.0%	0.0%
3	21.5%	45.7%	14.0%	12.2%	3.8%	1.9%	0.7%	0.2%	0.1%	0.0%
4	13.4%	24.2%	17.7%	26.2%	7.2%	5.7%	1.8%	0.9%	0.3%	0.1%
5	6.7%	10.8%	17.7%	43.9%	10.9%	12.8%	3.6%	2.7%	0.9%	0.5%
6	2.7%	4.1%	14.8%	61.6%	13.8%	23.7%	6.2%	6.3%	1.8%	1.3%
7	1.0%	1.4%	10.5%	76.4%	14.9%	37.5%	9.0%	12.5%	3.4%	3.1%
8	0.3%	0.4%	6.5%	86.9%	14.0%	52.4%	11.3%	21.5%	5.4%	6.5%
9	0.1%	0.1%	3.6%	93.4%	11.6%	66.3%	12.7%	32.8%	7.6%	11.9%
10	0.0%	0.0%	1.8%	97.0%	8.6%	77.9%	12.8%	45.5%	9.6%	19.5%
11	0.0%	0.0%	0.8%	98.7%	5.8%	86.6%	11.6%	58.3%	11.1%	29.1%
12	0.0%	0.0%	0.3%	99.5%	3.6%	92.4%	9.6%	69.9%	11.6%	40.2%
13	0.0%	0.0%	0.1%	99.8%	2.0%	96.0%	7.3%	79.5%	11.2%	51.8%
14	0.0%	0.0%	0.0%	99.9%	1.1%	98.0%	5.2%	86.9%	10.0%	62.9%
15	0.0%	0.0%	0.0%	100.0%	0.5%	99.1%	3.4%	92.1%	8.2%	72.9%

This table reports both exact probabilities of obtaining a certain number of exceptions from a sample of 250 independent observations under several assumptions about the true level of coverage, as well as type 1 or type 2 error probabilities derived from these exact probabilities.

The left-hand portion of the table pertains to the case where the model is accurate and its true level of coverage is 99%. Thus, the probability of any given observation being an exception is 1% (100% – 99% = 1%). The column labelled "exact" reports the probability of obtaining exactly the number of exceptions shown under this assumption in a sample of 250 independent observations. The column labelled "type 1" reports the probability that using a given number of exceptions as the cut-off for rejecting a model will imply erroneous rejection of an accurate model using a sample of 250 independent observations. For example, if the cut-off level is set at five or more exceptions, the type 1 column reports the probability of falsely rejecting an accurate model with 250 independent observations is 10.8%.

The right-hand portion of the table pertains to models that are inaccurate. In particular, the table concentrates of four specific inaccurate models, namely models whose true levels of coverage are 98%, 97%, 96% and 95% respectively. For each inaccurate model, the exact column reports the probability of obtaining exactly the number of exceptions shown under this assumption in a sample of 250 independent observations. The type 2 columns report the probability that using a given number of exceptions as the cut-off for rejecting a model will imply erroneous acceptance of an inaccurate model with the assumed level of coverage using a sample of 250 independent observations. For example, if the cut-off level is set at five or more exceptions, the type 2 column for an assumed coverage level of 97% reports the probability of falsely accepting a model with only 97% coverage with 250 independent observations is 12.8%.

[Basel Framework, MAR99.11]

419. The right-hand portion of the table reports probabilities associated with several possible inaccurate models, namely models whose true levels of coverage are 98%, 97%, 96%, and 95%, respectively. Thus, the column labelled “exact” under an assumed coverage level of 97% shows that five exceptions would then be expected in 10.9% of the samples. [Basel Framework, MAR99.12]

420. Table 21 also reports several important error probabilities. For the assumption that the model covers 99% of outcomes (the desired level of coverage), the table reports the probability

that selecting a given number of exceptions as a threshold for rejecting the accuracy of the model will result in an erroneous rejection of an accurate model (type 1 error). For example, if the threshold is set as low as one exception, then accurate models will be rejected fully 91.9% of the time, because they will escape rejection only in the 8.1% of cases where they generate zero exceptions. As the threshold number of exceptions is increased, the probability of making this type of error declines. [Basel Framework, MAR99.13]

421. Under the assumptions that the model's true level of coverage is not 99%, the table reports the probability that selecting a given number of exceptions as a threshold for rejecting the accuracy of the model will result in an erroneous acceptance of a model with the assumed (inaccurate) level of coverage (type 2 error). For example, if the model's actual level of coverage is 97%, and the threshold for rejection is set at seven or more exceptions, the table indicates that this model would be erroneously accepted 37.5% of the time. [Basel Framework, MAR99.14]

422. The results in Table 21 also demonstrate some of the statistical limitations of backtesting. In particular, there is no threshold number of exceptions that yields both a low probability of erroneously rejecting an accurate model and a low probability of erroneously accepting all of the relevant inaccurate models. It is for this reason that OSFI has rejected an approach that contains only a single threshold. [Basel Framework, MAR99.15]

423. Given these limitations, OSFI has classified outcomes for the backtesting of the institution-wide model into three categories. In the first category, the test results are consistent with an accurate model, and the possibility of erroneously accepting an inaccurate model is low (i.e. backtesting "green zone"). At the other extreme, the test results are extremely unlikely to have resulted from an accurate model, and the probability of erroneously rejecting an accurate model on this basis is remote (i.e. backtesting "red zone"). In between these two cases, however, is a zone where the backtesting results could be consistent with either accurate or inaccurate models, and OSFI will encourage an institution to present additional information about its model before taking action (i.e. backtesting "amber zone"). [Basel Framework, MAR99.16]

424. Table 22 sets out the OSFI's agreed boundaries for these zones and the presumptive OSFI response for each backtesting outcome, based on a sample of 250 observations. For other sample sizes, the boundaries should be deduced by calculating the binomial probabilities associated with true coverage of 99%, as in Table 21. The backtesting amber zone begins at the point such that the probability of obtaining that number or fewer exceptions equals or exceeds 95%. Table 22 reports these cumulative probabilities for each number of exceptions. For 250 observations, it can be seen that five or fewer exceptions will be obtained 95.88% of the time when the true level of coverage is 99%. Thus, the backtesting amber zone begins at five exceptions. Similarly, the beginning of the backtesting red zone is defined as the point such that the probability of obtaining that number or fewer exceptions equals or exceeds 99.99%. Table 22 shows that for a sample of 250 observations and a true coverage level of 99%, this occurs with 10 exceptions.

Backtesting zone boundaries **Table 22**

Backtesting zone	Number of exceptions	Backtesting-dependent multiplier (to be added to any qualitative add-on per paragraph 405)	Cumulative probability
Green	0	1.50	8.11%
Green	1	1.50	28.58%
Green	2	1.50	54.32%
Green	3	1.50	75.81%
Green	4	1.50	89.22%
Amber	5	1.70	95.88%
Amber	6	1.76	98.63%
Amber	7	1.83	99.60%
Amber	8	1.88	99.89%
Amber	9	1.92	99.97%
Red	10 or more	2.00	99.99%

This table defines the backtesting green, amber and red zones that OSFI will use to assess backtesting results in conjunction with the internal models approach to market risk capital requirements. The boundaries shown in the table are based on a sample of 250 observations. For other sample sizes, the amber zone begins at the point where the cumulative probability equals or exceeds 95%, and the red zone begins at the point where the cumulative probability equals or exceeds 99.99%.

The cumulative probability is simply the probability of obtaining a given number or fewer exceptions in a sample of 250 observations when the true coverage level is 99%. For example, the cumulative probability shown for four exceptions is the probability of obtaining between zero and four exceptions.

Note that these cumulative probabilities and the type 1 error probabilities reported in Table 21 do not sum to one because the cumulative probability for a given number of exceptions includes the possibility of obtaining exactly that number of exceptions, as does the type 1 error probability. Thus, the sum of these two probabilities exceeds one by the amount of the probability of obtaining exactly that number of exceptions.

[Basel Framework, MAR99.17]

425. The backtesting green zone needs little explanation. Since a model that truly provides 99% coverage would be quite likely to produce as many as four exceptions in a sample of 250 outcomes, there is little reason for concern raised by backtesting results that fall in this range. This is reinforced by the results in Table 21, which indicate that accepting outcomes in this range leads to only a small chance of erroneously accepting an inaccurate model. [Basel Framework, MAR99.18]

426. The range from five to nine exceptions constitutes the backtesting amber zone. Outcomes in this range are plausible for both accurate and inaccurate models, although Table 21 suggests that they are generally more likely for inaccurate models than for accurate models. Moreover, the results in Table 21 indicate that the presumption that the model is inaccurate should grow as the number of exceptions increases in the range from five to nine. [Basel Framework, MAR99.19]

427. Table 22 sets out the OSFI's agreed guidelines for increases in the multiplication factor applicable to the internal models capital requirement, resulting from backtesting results in the backtesting amber zone. [Basel Framework, MAR99.20]

428. These particular values reflect the general idea that the increase in the multiplication factor should be sufficient to return the model to a 99th percentile standard. For example, five exceptions in a sample of 250 imply only 98% coverage. Thus, the increase in the multiplication factor should be sufficient to transform a model with 98% coverage into one with 99% coverage. Needless to say, precise calculations of this sort require additional statistical assumptions that are not likely to hold in all cases. For example, if the distribution of trading outcomes is assumed to be normal, then the ratio of the 99th percentile to the 98th percentile is approximately 1.14, and the increase needed in the multiplication factor is therefore approximately 1.13 for a multiplier of 1. If the actual distribution is not normal, but instead has "fat tails", then larger increases may be required to reach the 99th percentile standard. The concern about fat tails was also an important factor in the choice of the specific increments set out in Table 22. [Basel Framework, MAR99.21]

9.6.5.3 Examples of the Application of the Principles for Risk Factor Modellability

429. Although OSFI may use discretion regarding the types of evidence required of institutions to provide risk factor modellability, the following are examples of the types of evidence that institutions may be required to provide.

(1) *Regression diagnostics for multi-factor beta models*. In addition to showing that indices or other regressors are appropriate for the region, asset class and credit quality (if applicable) of an instrument, institutions must be prepared to demonstrate that the coefficients used in multi-factor models are adequate to capture both general market risk and idiosyncratic risk. If the institution assumes that the residuals from the multi-factor model are uncorrelated with each other, the institution should be prepared to demonstrate that the modellable residuals are uncorrelated. Further, the factors in the multi-factor model must be appropriate for the region and asset class of the instrument and must explain the general market risk of the instrument. This must be demonstrated through goodness-of-fit statistics (e.g. an adjusted-R^2 coefficient) and other diagnostics on the coefficients. Most importantly, where the estimated coefficients are not used (i.e. the parameters are judgment-based), the institution must describe how the coefficients are chosen and why they cannot be estimated, and demonstrate that the choice does not underestimate risk. In general, risk factors are not considered modellable in cases where parameters are set by judgment.

(2) *Recovery of price from risk factors*. The institution must periodically demonstrate and document that the risk factors used in its risk model can be fed into front office pricing models and recover the actual prices of the assets. If the recovered prices substantially deviate from the actual prices, this can indicate a problem with prices used to derive the risk factors and call into question the validity of data inputs for risk purposes. In such cases, OSFI may determine that the risk factor is non-modellable.

(3) *Risk pricing is periodically reconciled with front office and back office prices*. While institutions are free to use price data from external sources, these external prices should

periodically be reconciled with internal prices (from both front office and back office) to ensure they do not deviate substantially, and that they are not consistently biased in any fashion. Results of these reconciliations should be made available to OSFI, including statistics on the differences of the risk price from front office and back office prices. It is standard practice for institutions to conduct reconciliation of front office and back office prices; the risk prices must be included as part of the reconciliation of the front office and whenever there is a potential for discrepancy. If the discrepancy is large, OSFI may determine that the risk factor is non-modellable.

(4) *Risk factors generated from parameterised models*. For options, implied volatility surfaces are often built using a parameterised model based on single-name underlyings and/or option index RPOs and/or market quotes. Liquid options at moneyness, tenor and option expiry points may be used to calibrate level, volatility, drift and correlation parameters for a single-name or benchmark volatility surface. Once these parameters are set, they are derived risk factors in their own right that must be updated and recalibrated periodically as new data arrive and trades occur. In the event that these risk factors are used to proxy for other single-name option surface points, there must be an additional-basis non-modellable risk factor overlay for any potential deviations.

[Basel Framework, MAR99.22]