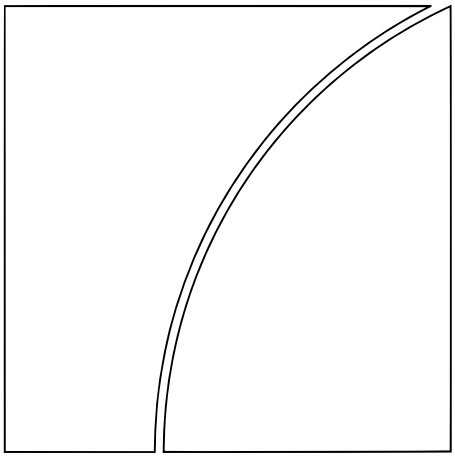
Basel Committee on Banking Supervision

MAR

Calculation of RWA for market risk

MAR30

Internal models approach



This chapter sets out minimum requirements for banks to use internal models to calculate risk-weighted assets for market risk.

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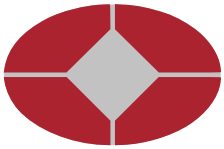
First version in the format of the consolidated framework.



BANK FOR INTERNATIONAL SETTLEMENTS

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General criteria

30.1

The risk-weighted assets for market risk under the internal models approach are determined by multiplying the capital requirements calculated as set out in this chapter by 12.5.

30.2

The use of an internal model will be conditional upon the explicit approval of the bank's supervisory authority. Home and host country supervisory authorities of banks that carry out material trading activities in multiple jurisdictions intend to work co-operatively to ensure an efficient approval process. The supervisory authority will only give its approval if at a minimum:

1. It is satisfied that the bank's risk management system is conceptually sound and is implemented with integrity;
2. The bank has in the supervisory authority's view sufficient numbers 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 bank's models have in the supervisory authority's judgement a proven track record of reasonable accuracy in measuring risk;
4. The bank regularly conducts stress tests along the lines discussed in MAR30.18 to MAR30.25.

30.3

Supervisory authorities will have the right to insist on a period of initial monitoring and live testing of a bank's internal model before it is used for supervisory capital purposes.

30.4

In addition to these general criteria, banks using internal models for capital purposes will be subject to the requirements detailed in MAR30.5 to MAR30.71.

Qualitative standards

30.5

It is important that supervisory authorities are able to assure themselves that banks using models have market risk management systems that are conceptually sound and implemented with integrity. Accordingly, the supervisory authority will specify a number of qualitative criteria that banks would have to meet before they are permitted to use a models-based approach. The extent to which banks meet the qualitative criteria may influence the level at which supervisory authorities will set the multiplication factor referred to in MAR30.16. Only those banks whose models are in full compliance with the qualitative criteria will be eligible for application of the minimum multiplication factor. The qualitative criteria include:

1. The bank should have an independent risk control unit that is responsible for the design and implementation of the bank's risk management system. The unit should produce and analyse daily reports on the output of the bank's risk measurement model, including an evaluation of the relationship between measures of risk exposure and trading limits. This unit must be independent from business trading units and should report directly to senior management of the bank.

2. The unit should conduct a regular back-testing programme, ie an ex-post comparison of the risk measure generated by the model against actual daily changes in portfolio value over longer periods of time, as well as hypothetical changes based on static positions.
3. The unit should also conduct the initial and on-going validation of the internal model.
4. Board of directors and senior management should be actively involved in the risk control process and must regard risk control as an essential aspect of the business to which significant resources need to be devoted. 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 bank's overall risk exposure.
5. The bank's internal risk measurement model must be closely integrated into the day-to-day risk management process of the bank. Its output should accordingly be an integral part of the process of planning, monitoring and controlling the bank's market risk profile.
6. The risk measurement system should be used in conjunction with internal trading and exposure limits. In this regard, trading limits should be related to the bank's risk measurement model in a manner that is consistent over time and that is well understood by both traders and senior management.
7. A routine and rigorous programme of stress testing should be in place as a supplement to the risk analysis based on the day-to-day output of the bank's risk measurement model. The results of stress testing should be reviewed periodically by senior management, used in the internal assessment of capital adequacy, and reflected in the policies and limits set by management and the board of directors. Where stress tests reveal particular vulnerability to a given set of circumstances, prompt steps should be taken to manage those risks appropriately (eg by hedging against that outcome or reducing the size of the bank's exposures, or increasing capital).
8. Banks should have a routine in place for ensuring compliance with a documented set of internal policies, controls and procedures concerning the operation of the risk measurement system. The bank's risk measurement system must be well documented, for example, through a risk management manual that describes the basic principles of the risk management system and that provides an explanation of the empirical techniques used to measure market risk.
9. An independent review of the risk measurement system should be carried out regularly in the bank's own internal auditing process. This review should include both the activities of the business trading units and of the independent risk control unit. A review of the overall risk management process should take place at regular intervals (ideally not less than once a year) and should specifically address, at a minimum:
    1. The adequacy of the documentation of the risk management system and process;
    2. The organisation of the risk control unit;
    3. The integration of market risk measures into daily risk management;
    4. The approval process for risk pricing models and valuation systems used by front and back-office personnel;
    5. The validation of any significant change in the risk measurement process;
    6. The scope of market risks captured by the risk measurement model;
    7. The integrity of the management information system;
    8. The accuracy and completeness of position data;
    9. The verification of the consistency, timeliness and reliability of data sources used to run internal models, including the independence of such data sources;
    10. The accuracy and appropriateness of volatility and correlation assumptions;
    11. The accuracy of valuation and risk transformation calculations;

12. The verification of the model's accuracy through frequent back-testing as described in MAR30.5(2) and in MAR99.

Specification of market risk factors

30.6

An important part of a bank's internal market risk measurement system is the specification of an appropriate set of market risk factors, ie the market rates and prices that affect the value of the bank's trading positions. The risk factors contained in a market risk measurement system should be sufficient to capture the risks inherent in the bank's portfolio of on- and off-balance sheet trading positions. Although banks will have some discretion in specifying the risk factors for their internal models, the following guidelines should be fulfilled.

30.7

Factors that are deemed relevant for pricing should be included as risk factors in the value-at-risk model. Where a risk factor is incorporated in a pricing model but not in the value-at-risk model, the bank must justify this omission to the satisfaction of its supervisor. In addition, the value-at-risk model must capture nonlinearities for options and other relevant products (eg mortgage-backed securities, tranched exposures or n-th-to-default credit derivatives), as well as correlation risk and basis risk (eg between credit default swaps and bonds). Moreover, the supervisor has to be satisfied that proxies are used which show a good track record for the actual position held (ie an equity index for a position in an individual stock).

30.8

For interest rates, there must be a set of risk factors corresponding to interest rates in each currency in which the bank has interest-rate-sensitive on- or off-balance sheet positions.

1. The risk measurement system should model the yield curve using one of a number of generally accepted approaches, for example, by estimating forward rates of zero coupon yields. The yield curve should be divided into various maturity segments in order to capture variation in the volatility of rates along the yield curve; there will typically be one risk factor corresponding to each maturity segment. For material exposures to interest rate movements in the major currencies and markets, banks must model the yield curve using a minimum of six risk factors. However, the number of risk factors used should ultimately be driven by the nature of the bank's trading strategies. For instance, a bank with a portfolio of various types of securities across many points of the yield curve and that engages in complex arbitrage strategies would require a greater number of risk factors to capture interest rate risk accurately.
2. The risk measurement system must incorporate separate risk factors to capture spread risk (eg between bonds and swaps). A variety of approaches may be used to capture the spread risk arising from less than perfectly correlated movements between government and other fixed-income interest rates, such as specifying a completely separate yield curve for non-government fixed-income instruments (for instance, swaps or municipal securities) or estimating the spread over government rates at various points along the yield curve.

30.9

For exchange rates (which may include gold), the risk measurement system should incorporate risk factors corresponding to the individual foreign currencies in which the bank's positions are

denominated. Since the value-at-risk figure calculated by the risk measurement system will be expressed in the bank's domestic currency, any net position denominated in a foreign currency will introduce a foreign exchange risk. Thus, there must be risk factors corresponding to the exchange rate between the domestic currency and each foreign currency in which the bank has a significant exposure.

30.10

For equity prices, there should be risk factors corresponding to each of the equity markets in which the bank holds significant positions:

1. At a minimum, there should be a risk factor that is designed to capture market-wide movements in equity prices (eg a market index). Positions in individual securities or in sector indices could be expressed in "beta-equivalents" relative to this market-wide index;
2. A somewhat more detailed approach would be to have risk factors corresponding to various sectors of the overall equity market (for instance, industry sectors or cyclical and non-cyclical sectors). As above, positions in individual stocks within each sector could be expressed in beta-equivalents relative to the sector index;
3. The most extensive approach would be to have risk factors corresponding to the volatility of individual equity issues.
4. The sophistication and nature of the modelling technique for a given market should correspond to the bank's exposure to the overall market as well as its concentration in individual equity issues in that market.

30.11

For commodity prices, there should be risk factors corresponding to each of the commodity markets in which the bank holds significant positions (also see MAR20.70):

1. For banks with relatively limited positions in commodity-based instruments, a straightforward specification of risk factors would be acceptable. Such a specification would likely entail one risk factor for each commodity price to which the bank is exposed. In cases where the aggregate positions are quite small, it might be acceptable to use a single risk factor for a relatively broad sub-category of commodities (for instance, a single risk factor for all types of oil);
2. For more active trading, the model must also take account of variation in the "convenience yield" between derivatives positions such as forwards and swaps and cash positions in the commodity.

30.12

It is essential that the methodology used for commodities risk encompasses:

1. Directional risk, to capture the exposure from changes in spot prices arising from net open positions;
2. Forward gap and interest rate risk, to capture the exposure to changes in forward prices arising from maturity mismatches; and
3. Basis risk, to capture the exposure to changes in the price relationships between two similar, but not identical, commodities.

30.13

It is also particularly important that such models take proper account of market characteristics - notably delivery dates and the scope provided to traders to close out positions.

Quantitative standards: value-at-risk (VaR) and stressed value-at-risk (sVaR)

30.14

Banks will have flexibility in devising the precise nature of their models, but the following minimum standards will apply for the purpose of calculating their capital requirement. Individual banks or their supervisory authorities will have discretion to apply stricter standards.

1. “Value-at-risk” must be computed on a daily basis.
2. In calculating the value-at-risk, a 99th percentile, one-tailed confidence interval is to be used.
3. In calculating value-at-risk, an instantaneous price shock equivalent to a 10 day movement in prices is to be used, ie the minimum “holding period” will be ten trading days. Banks may use value-at-risk numbers calculated according to shorter holding periods scaled up to ten days by, for example, the square root of time (for the treatment of options, also see MAR30.14(8)). A bank using this approach must periodically justify the reasonableness of its approach to the satisfaction of its supervisor.
4. The choice of historical observation period (sample period) for calculating value-at-risk will be constrained to a minimum length of one year. For banks that use a weighting scheme or other methods for the historical observation period, the “effective” observation period must be at least one year (that is, the weighted average time lag of the individual observations cannot be less than 6 months).
5. Banks must update their data sets no less frequently than once every month and also reassess them whenever market prices are subject to material changes. This updating process must be flexible enough to allow for more frequent updates. The supervisory authority may also require a bank to calculate its value-at-risk using a shorter observation period if, in the supervisor’s judgement, this is justified by a significant upsurge in price volatility.
6. No particular type of model is prescribed. So long as each model used captures all the material risks run by the bank, as set out in MAR30.6 to MAR30.11, banks will be free to use models based, for example, on variance-covariance matrices, historical simulations, or Monte Carlo simulations.
7. Banks will have discretion to recognise empirical correlations within broad risk categories (eg interest rates, exchange rates, equity prices and commodity prices, including related options volatilities in each risk factor category). The supervisory authority may also recognise empirical correlations across broad risk factor categories, provided that the supervisory authority is satisfied that the bank’s system for measuring correlations is sound and implemented with integrity.
8. Banks’ models must accurately capture the unique risks associated with options within each of the broad risk categories. The following criteria apply to the measurement of options risk:
    1. Banks’ models must capture the non-linear price characteristics of options positions;
    2. Banks are expected to ultimately move towards the application of a full 10 day price shock to options positions or positions that display option-like characteristics. In the interim, national authorities may require banks to adjust their capital measure for options risk through other methods, eg periodic simulations or stress testing;

3. Each bank's risk measurement system must have a set of risk factors that captures the volatilities of the rates and prices underlying option positions, ie vega risk. Banks with relatively large and/or complex options portfolios should have detailed specifications of the relevant volatilities. This means that banks should measure the volatilities of options positions broken down by different maturities.

9. In addition, a bank must calculate a stressed value-at-risk (sVaR) measure. This measure is intended to replicate a value-at-risk calculation that would be generated on the bank's current portfolio if the relevant market factors were experiencing a period of stress; and should therefore be based on the 10-day, 99th percentile, one-tailed confidence interval value-at-risk measure of the current portfolio, with model inputs calibrated to historical data from a continuous 12-month period of significant financial stress relevant to the bank's portfolio. The period used must be approved by the supervisor and regularly reviewed. As an example, for many portfolios, a 12-month period relating to significant losses in 2007/2008 would adequately reflect a period of such stress; although other periods relevant to the current portfolio must be considered by the bank.
10. As no particular model is prescribed under MAR30.14(6), different techniques might need to be used to translate the model used for value-at-risk into one that delivers a stressed value-at-risk. For example, banks should consider applying anti-thetic data, or applying absolute rather than relative volatilities to deliver an appropriate stressed value-at-risk. The stressed value-at-risk should be calculated at least weekly.

30.15

A bank must meet, on a daily basis, a capital requirement calculated based on the value-at-risk measure and stressed value-at-risk measure (c) as follows, where the formula is expressed as the sum of:

1. The higher of:
    1. its previous day's value-at-risk number measured according to the parameters specified in this chapter (VAR_{t-1}) and
    2. an average of the daily value-at-risk measures on each of the preceding sixty business days (VAR_{avg}), multiplied by a multiplication factor (m_c); plus
2. The higher of:
    1. its latest available stressed-value-at-risk number calculated according to MAR30.15(1)(a) ($sVaR_{t-1}$) and
    2. an average of the stressed value-at-risk numbers calculated according to MAR30.15(1)(b) over the preceding sixty business days ($sVaR_{avg}$), multiplied by a multiplication factor (m_s).

$$c = \max\left(VaR_{t-1}, m_c \times VaR_{avg}\right) + \max\left(sVaR_{t-1}, m_s \times sVaR_{avg}\right)$$

30.16

The multiplication factors m_c and m_s in MAR30.15 will be set by individual supervisory authorities on the basis of their assessment of the quality of the bank's risk management system, subject to an absolute minimum of 3 for m_c and an absolute minimum of 3 for m_s. Banks will be required to add to these factors 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. The plus will range from 0 to 1 based on the outcome of the "backtesting". The backtesting results applicable for calculating the plus are based on value-at-risk only and not stressed value-at-risk. If the backtesting results are satisfactory and the bank meets all of the qualitative standards set out in MAR30.5, the plus factor could be zero. MAR99

presents in detail the approach to be applied for backtesting and the plus factor. Supervisors will have national discretion to require banks to perform backtesting on either hypothetical (ie using changes in portfolio value that would occur were end-of-day positions to remain unchanged), or actual trading (ie excluding fees, commissions, and net interest income) outcomes, or both.

30.17

Banks using models will also be subject to a capital charge to cover specific risk (as defined in MAR20) of interest rate related instruments and equity securities. The manner in which the specific risk capital requirement is to be calculated under the internal models approach is set out in MAR10.15 to MAR10.18 and MAR30.28 to MAR30.43.

Stress testing

30.18

Banks that use the internal models approach for meeting market risk capital requirements must have in place a rigorous and comprehensive stress testing program. Stress testing to identify events or influences that could greatly impact banks is a key component of a bank's assessment of its capital position.

30.19

Banks' stress scenarios need to cover a range of factors that can create extraordinary losses or gains in trading portfolios, or make the control of risk in those portfolios very difficult. These factors include low-probability events in all major types of risks, including the various components of market, credit, and operational risks. Stress scenarios need to shed light on the impact of such events on positions that display both linear and nonlinear price characteristics (ie options and instruments that have options-like characteristics).

30.20

Banks' stress tests should be both of a quantitative and qualitative nature, incorporating both market risk and liquidity aspects of market disturbances. Quantitative criteria should identify plausible stress scenarios to which banks could be exposed. Qualitative criteria should emphasise that two major goals of stress testing are to evaluate the capacity of the bank's capital to absorb potential large losses and to identify steps the bank can take to reduce its risk and conserve capital. This assessment is integral to setting and evaluating the bank's management strategy and the results of stress testing should be routinely communicated to senior management and, periodically, to the bank's board of directors.

30.21

Banks should combine the use of supervisory stress scenarios with stress tests developed by banks themselves to reflect their specific risk characteristics. Specifically, supervisory authorities may ask banks to provide information on stress testing in three broad areas, which are discussed in MAR30.22 to MAR30.25.

30.22

Supervisory scenarios requiring no simulations by the bank: banks should have information on the largest losses experienced during the reporting period available for supervisory review. This loss information could be compared to the level of capital that results from a bank's

internal measurement system. For example, it could provide supervisory authorities with a picture of how many days of peak day losses would have been covered by a given value-at-risk estimate.

30.23

Scenarios requiring a simulation by the bank: banks should subject their portfolios to a series of simulated stress scenarios and provide supervisory authorities with the results. These scenarios could include testing the current portfolio against past periods of significant disturbance, for example, the 1987 equity crash, the Exchange Rate Mechanism crises of 1992 and 1993, the fall in bond markets in the first quarter of 1994, the 1998 Russian financial crisis, the 2000 bursting of the technology stock bubble or the 2007/2008 sub-prime crisis, incorporating both the large price movements and the sharp reduction in liquidity associated with these events. A second type of scenario would evaluate the sensitivity of the bank'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 bank'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.

30.24

Scenarios developed by the bank itself to capture the specific characteristics of its portfolio: in addition to the scenarios prescribed by supervisory authorities under MAR30.22 and MAR30.23, a bank should also develop its own stress tests which it identifies as most adverse based on the characteristics of its portfolio (eg problems in a key region of the world combined with a sharp move in oil prices). Banks should provide supervisory authorities 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.

30.25

The results should be reviewed periodically by senior management and should be reflected in the policies and limits set by management and the board of directors. Moreover, if the testing reveals particular vulnerability to a given set of circumstances, the national authorities would expect the bank to take prompt steps to manage those risks appropriately (eg by hedging against that outcome or reducing the size of its exposures).

External validation

30.26

The validation of models' accuracy by external auditors and/or supervisory authorities should at a minimum include the following steps:

1. Verifying that the internal validation processes described in MAR30.5(9) are operating in a satisfactory manner;
2. Ensuring 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 trading area;
3. Checking that the structure of internal models is adequate with respect to the bank's

activities and geographical coverage;

4. Checking the results of the banks' back-testing of its internal measurement system (ie comparing value-at-risk estimates with actual profits and losses) to ensure that the model provides a reliable measure of potential losses over time. This means that banks should make the results as well as the underlying inputs to their value-at-risk calculations available to their supervisory authorities and/or external auditors on request;
5. Making sure that data flows and processes associated with the risk measurement system are transparent and accessible. In particular, it is necessary that auditors or supervisory authorities are in a position to have easy access, whenever they judge it necessary and under appropriate procedures, to the models' specifications and parameters.

Model validation standards

30.27

It is important that banks have processes in place to ensure that their internal models have been adequately validated by suitably qualified parties independent of the development process to ensure that they are conceptually sound and adequately capture all material risks. This validation should be conducted when the model is initially developed and when any significant changes are made to the model. The validation should also be conducted on a periodic basis but especially where there have been any significant structural changes in the market or changes to the composition of the portfolio which might lead to the model no longer being adequate. More extensive model validation is particularly important where specific risk is also modelled and is required to meet the further specific risk criteria. As techniques and best practices evolve, banks should avail themselves of these advances. Model validation should not be limited to backtesting, but should, at a minimum, also include the following:

1. Tests to demonstrate that any assumptions made within the internal model are appropriate and do not underestimate risk. This may include the assumption of the normal distribution, the use of the square root of time to scale from a one day holding period to a 10 day holding period or where extrapolation or interpolation techniques are used, or pricing models;
2. Further to the regulatory backtesting programmes, testing for model validation must use hypothetical changes in portfolio value that would occur were end-of-day positions to remain unchanged. It therefore excludes fees, commissions, bid-ask spreads, net interest income and intra-day trading. Moreover, additional tests are required which may include, for instance:
    1. Testing carried out for longer periods than required for the regular backtesting programme (eg 3 years). The longer time period generally improves the power of the backtesting. A longer time period may not be desirable if the VaR model or market conditions have changed to the extent that historical data is no longer relevant;
    2. Testing carried out using confidence intervals other than the 99 percent interval required under the quantitative standards;
    3. Testing of portfolios below the overall bank level;
3. The use of hypothetical portfolios to ensure that the model is able to account for particular structural features that may arise, for example:
    1. Where data histories for a particular instrument do not meet the quantitative standards in MAR30.14 to MAR30.17 and where the bank has to map these positions to proxies, then the bank must ensure that the proxies produce conservative results under relevant market scenarios;

2. Ensuring that material basis risks are adequately captured. This may include mismatches between long and short positions by maturity or by issuer;
3. Ensuring that the model captures concentration risk that may arise in an undiversified portfolio.

Treatment of specific risk

30.28

The criteria for supervisory recognition of banks' modelling of specific risk require that a bank's model must capture all material components of price risk and be responsive to changes in market conditions and compositions of portfolios. In particular, the model must:

1. explain the historical price variation in the portfolio;
2. capture concentrations (magnitude and changes in composition);
3. be robust to an adverse environment;
4. capture name-related basis risk;
5. capture event risk;
6. be validated through backtesting.

30.29

The bank's model must conservatively assess the risk arising from less liquid positions and/or positions with limited price transparency under realistic market scenarios. In addition, the model must meet minimum data standards. Proxies may be used only where available data is insufficient or is not reflective of the true volatility of a position or portfolio, and only where they are appropriately conservative.

30.30

Further, as techniques and best practices evolve, banks should avail themselves of these advances.

30.31

Banks which apply modelled estimates of specific risk are required to conduct backtesting aimed at assessing whether specific risk is being accurately captured. The methodology a bank should use for validating its specific risk estimates is to perform separate backtests on sub-portfolios using daily data on subportfolios subject to specific risk. The key sub-portfolios for this purpose are traded-debt and equity positions. However, if a bank itself decomposes its trading portfolio into finer categories (eg emerging markets, traded corporate debt, etc.), it is appropriate to keep these distinctions for sub-portfolio backtesting purposes. Banks are required to commit to a sub-portfolio structure and stick to it unless it can be demonstrated to the supervisor that it would make sense to change the structure.

30.32

Banks are required to have in place a process to analyse exceptions identified through the backtesting of specific risk. This process is intended to serve as the fundamental way in which banks correct their models of specific risk in the event they become inaccurate. There will be a presumption that models that incorporate specific risk are "unacceptable" if the results at the sub-portfolio level produce a number of exceptions commensurate with the Red Zone as

defined in MAR99. Banks with “unacceptable” specific risk models are expected to take immediate action to correct the problem in the model and to ensure that there is a sufficient capital buffer to absorb the risk that the backtest showed had not been adequately captured.

Incremental risk capital requirement and comprehensive risk measure

Overview of the incremental risk capital requirement

30.33

In addition, the bank must have an approach in place to capture in its regulatory capital default risk and migration risk in positions subject to a capital requirement for specific interest rate risk, with the exception of securitisation exposures and n-th-to-default credit derivatives, that are incremental to the risks captured by the VaR-based calculation as specified in MAR30.28 (“incremental risks”). No specific approach for capturing the incremental risks is prescribed.

30.34

The bank must demonstrate that the approach used to capture incremental risks meets a soundness standard comparable to that of the internal-ratings based (IRB) approach for credit risk as set forth in CRE30 to CRE36, under the assumption of a constant level of risk, and adjusted where appropriate to reflect the impact of liquidity, concentrations, hedging, and optionality. A bank that does not capture the incremental risks through an internally developed approach must use the specific risk capital requirements under the standardised measurement method as set out in MAR20.

Comprehensive risk measure

30.35

Subject to supervisory approval, a bank may incorporate its correlation trading portfolio in an internally developed approach that adequately captures not only incremental default and migration risks, but all price risks (“comprehensive risk measure”). The value of such products is subject in particular to the following risks which must be adequately captured:

1. the cumulative risk arising from multiple defaults, including the ordering of defaults, in tranched products;
2. credit spread risk, including the gamma and cross-gamma effects;
3. volatility of implied correlations, including the cross effect between spreads and correlations;
4. basis risk, including both
    1. the basis between the spread of an index and those of its constituent single names; and
    2. the basis between the implied correlation of an index and that of bespoke portfolios;
5. recovery rate volatility, as it relates to the propensity for recovery rates to affect tranche prices; and
6. to the extent the comprehensive risk measure incorporates benefits from dynamic hedging, the risk of hedge slippage and the potential costs of rebalancing such hedges.

30.36

The approach for modelling specific risk of correlation trading portfolio specified in MAR30.35 must meet all of the requirements specified in MAR30.34, and MAR30.37 to MAR30.39. For the exposures that the bank does incorporate in this internally developed approach, the bank will be required to subject them to a capital requirement equal to the higher of the capital requirement according to this internally developed approach and 8% of the capital requirement for specific risk according to the standardised measurement method. It will not be required to subject these exposures to the treatment of the incremental risk capital (IRC) requirement as set out in MAR30.33 and MAR30.34. It must, however, incorporate them in both the value-at-risk and stressed value-at-risk measures.

30.37

For a bank to apply this exception as set out in MAR30.35, it must

1. have sufficient market data to ensure that it fully captures the salient risks of these exposures in its comprehensive risk measure in accordance with the standards set forth above;
2. demonstrate (for example, through backtesting) that its risk measures can appropriately explain the historical price variation of these products; and
3. ensure that it can separate the positions for which it holds approval to incorporate them in its comprehensive risk measure from those positions for which it does not hold this approval.

30.38

In addition to these data and modelling criteria as set out in MAR30.37, for a bank to apply this exception it must regularly apply a set of specific, predetermined stress scenarios to the portfolio that receives internal model regulatory capital treatment (ie the correlation trading portfolio). MAR99 sets out stress testing guidance for the correlation trading portfolio. These stress scenarios will examine the implications of stresses to:

1. default rates;
2. recovery rates;
3. credit spreads; and
4. correlations on the correlation trading desk’s profit and loss.

30.39

The bank must apply these stress scenarios at least weekly and report the results, including comparisons with the capital requirements implied by the banks’ internal model for estimating comprehensive risks, at least quarterly to its supervisor. Any instances where the stress tests indicate a material shortfall of the comprehensive risk measure must be reported to the supervisor in a timely manner. Based on these stress testing results, the supervisor may impose a supplemental capital requirement against the correlation trading portfolio, to be added to the bank’s internally modelled capital requirement.

Calculation of the IRC requirement and the comprehensive risk measure

30.40

A bank must calculate the IRC requirement according to MAR30.33 and the comprehensive risk measure according to MAR30.35 at least weekly, or more frequently as directed by its

supervisor.

30.41

The capital requirement for incremental risk is given by a scaling factor of 1.0 times the maximum of

1. the average of the IRC requirements over 12 weeks; and
2. the most recent IRC requirement.

30.42

Likewise, the capital requirement for comprehensive risk is given by a scaling factor of 1.0 times the maximum of

1. the average of the comprehensive risk measures over 12 weeks; and
2. the most recent comprehensive risk measure.

30.43

Both capital requirements for incremental risk and comprehensive risk are added up. There will be no adjustment for double counting between the comprehensive risk measure and any other risk measures.

Specific treatment of the IRC requirement

30.44

According to MAR30.33, the IRC requirement encompasses all positions subject to a capital requirement for specific interest rate risk according to the internal models approach to specific market risk but not subject to the treatment outlined in MAR20.14, regardless of their perceived liquidity.

30.45

With supervisory approval, a bank can choose consistently to include all listed equity and derivatives positions based on listed equity of a desk in its incremental risk model when such inclusion is consistent with how the bank internally measures and manages this risk at the trading desk level. If equity securities are included in the computation of incremental risk, default is deemed to occur if the related debt defaults (as defined in CRE36.69 and CRE36.70).

30.46

However, when computing the IRC requirement, a bank is not permitted to incorporate into its IRC requirement model any securitisation positions, even when securitisation positions are viewed as hedging underlying credit instruments held in the trading account.

30.47

For IRC requirement-covered positions, the IRC requirement captures:

1. Default risk. This means the potential for direct loss due to an obligor's default as well as the potential for indirect losses that may arise from a default event;
2. Credit migration risk. This means the potential for direct loss due to an internal/external

rating downgrade or upgrade as well as the potential for indirect losses that may arise from a credit migration event.

30.48

For all IRC requirement-covered positions, a bank's IRC requirement model must measure losses due to default and migration at the 99.9 percent confidence interval over a capital horizon of one year, taking into account the liquidity horizons applicable to individual trading positions or sets of positions. Losses caused by broader market-wide events affecting multiple issues/issuers are encompassed by this definition.

30.49

As described immediately below, for each IRC requirement-covered position the model should also capture the impact of rebalancing positions at the end of their liquidity horizons so as to achieve a constant level of risk over a one-year capital horizon. The model may incorporate correlation effects among the modelled risk factors, subject to validation standards set forth in MAR30.68. The trading portfolio's IRC requirement equals the IRC requirement model's estimate of losses at the 99.9 percent confidence level.

IRC requirement: Constant level of risk over one-year capital horizon

30.50

An IRC requirement model should be based on the assumption of a constant level of risk over the one-year capital horizon.

30.51

This constant level of risk assumption implies that a bank rebalances, or rolls over, its trading positions over the one-year capital horizon in a manner that maintains the initial risk level, as indicated by a metric such as VaR or the profile of exposure by credit rating and concentration. This means incorporating the effect of replacing positions whose credit characteristics have improved or deteriorated over the liquidity horizon with positions that have risk characteristics equivalent to those that the original position had at the start of the liquidity horizon. The frequency of the assumed rebalancing must be governed by the liquidity horizon for a given position.

30.52

Rebalancing positions does not imply, as the IRB approach for the banking book does, that the same positions will be maintained throughout the capital horizon. Particularly for more liquid and more highly rated positions, this provides a benefit relative to the treatment under the IRB framework. However, a bank may elect to use a one-year constant position assumption, as long as it does so consistently across all portfolios.

IRC requirement: Liquidity horizon

30.53

Stressed credit market events have shown that firms cannot assume that markets remain liquid under those conditions. Banks experienced significant illiquidity in a wide range of credit products held in the trading book, including leveraged loans. Under these circumstances,

liquidity in many parts of the securitisation markets dried up, forcing banks to retain exposures in securitisation pipelines for prolonged periods of time. The Committee therefore expects firms to pay particular attention to the appropriate liquidity horizon assumptions within their IRC requirement models.

30.54

The liquidity horizon represents the time required to sell the position or to hedge all material risks covered by the IRC requirement model in a stressed market. The liquidity horizon must be measured under conservative assumptions and should be sufficiently long that the act of selling or hedging, in itself, does not materially affect market prices. The determination of the appropriate liquidity horizon for a position or set of positions may take into account a bank's internal policies relating to, for example, prudent valuation (as per the prudent valuation guidance of CAP50), valuation adjustments and the management of stale positions.

30.55

The liquidity horizon for a position or set of positions has a floor of three months.

30.56

In general, within a given product type a non-investment-grade position is expected to have a longer assumed liquidity horizon than an investment-grade position. Conservative assumptions regarding the liquidity horizon for non-investment-grade positions are warranted until further evidence is gained regarding the market's liquidity during systematic and idiosyncratic stress situations. Firms also need to apply conservative liquidity horizon assumptions for products, regardless of rating, where secondary market liquidity is not deep, particularly during periods of financial market volatility and investor risk aversion. The application of prudent liquidity assumptions is particularly important for rapidly growing product classes that have not been tested in a downturn.

30.57

A bank can assess liquidity by position or on an aggregated basis ("buckets"). If an aggregated basis is used (eg investment-grade European corporate exposures not part of a core credit default swap index), the aggregation criteria would be defined in a way that meaningfully reflect differences in liquidity.

30.58

The liquidity horizon is expected to be greater for positions that are concentrated, reflecting the longer period needed to liquidate such positions. This longer liquidity horizon for concentrated positions is necessary to provide adequate capital against two types of concentration: issuer concentration and market concentration.

IRC requirement: Correlations and diversification

30.59

Economic and financial dependence among obligors causes a clustering of default and migration events. Accordingly, the IRC requirement includes the impact of correlations between default and migration events among obligors and a bank's IRC requirement model must include the impact of such clustering of default and migration events.

30.60

The impact of diversification between default or migration risks in the trading book and other risks in the trading book is not currently well understood. Therefore, the impact of diversification between default or migration events and other market variables would not be reflected in the computation of capital for incremental risk. This is consistent with the Basel framework, which does not allow for the benefit of diversification when combining capital requirements for credit risk and market risk. Accordingly, the capital requirement for incremental default and migration losses is added to the VaR-based capital requirement for market risk.

IRC requirement: Concentration

30.61

A bank's IRC requirement model must appropriately reflect issuer and market concentrations. Thus, other things being equal, a concentrated portfolio should attract a higher capital requirement than a more granular portfolio (see also MAR30.58). Concentrations that can arise within and across product classes under stressed conditions must also be reflected.

IRC requirement: Risk mitigation and diversification effects

30.62

Within the IRC requirement model, exposure amounts may be netted only when long and short positions refer to the same financial instrument. Otherwise, exposure amounts must be captured on a gross (ie non-netted) basis. Thus, hedging or diversification effects associated with long and short positions involving different instruments or different securities of the same obligor ("intra-obligor hedges"), as well as long and short positions in different issuers ("inter-obligor hedges"), may not be recognised through netting of exposure amounts. Rather, such effects may only be recognised by capturing and modelling separately the gross long and short positions in the different instruments or securities.

30.63

Significant basis risks by product, seniority in the capital structure, internal or external rating, maturity, vintage for offsetting positions as well as differences between offsetting instruments, such as different payout triggers and procedures, should be reflected in the IRC requirement model.

30.64

If an instrument has a shorter maturity than the liquidity horizon or a maturity longer than the liquidity horizon is not contractually assured, the IRC requirement must, where material, include the impact of potential risks that could occur during the interval between the maturity of the instrument and the liquidity horizon.

30.65

For trading book risk positions that are typically hedged via dynamic hedging strategies, a rebalancing of the hedge within the liquidity horizon of the hedged position may also be recognised. Such recognition is only admissible if the bank

1. chooses to model rebalancing of the hedge consistently over the relevant set of trading book risk positions,
2. demonstrates that the inclusion of rebalancing results in a better risk measurement, and
3. demonstrates that the markets for the instruments serving as hedge are liquid enough to allow for this kind of rebalancing even during periods of stress.

30.66

Any residual risks resulting from dynamic hedging strategies must be reflected in the capital requirement. A bank should validate its approach to capture such residual risks to the satisfaction of its supervisor.

30.67

The IRC requirement model must reflect the impact of optionality. Accordingly, banks' models should include the nonlinear impact of options and other positions with material nonlinear behaviour with respect to price changes. The bank should also have due regard to the amount of model risk inherent in the valuation and estimation of price risks associated with such products.

IRC requirement: Validation

30.68

Banks should apply the validation principles described in MAR30.27 in designing, testing and maintaining their IRC requirement models. This includes evaluating conceptual soundness, ongoing monitoring that includes process verification and benchmarking, and outcomes analysis. Some factors that should be considered in the validation process include:

1. Liquidity horizons should reflect actual practice and experience during periods of both systematic and idiosyncratic stresses.
2. The IRC requirement model for measuring default and migration risks over the liquidity horizon should take into account objective data over the relevant horizon and include comparison of risk estimates for a rebalanced portfolio with that of a portfolio with fixed positions.
3. Correlation assumptions must be supported by analysis of objective data in a conceptually sound framework. If a bank uses a multi-period model to compute incremental risk, it should evaluate the implied annual correlations to ensure they are reasonable and in line with observed annual correlations. A bank must validate that its modelling approach for correlations is appropriate for its portfolio, including the choice and weights of its systematic risk factors. A bank must document its modelling approach so that its correlation and other modelling assumptions are transparent to supervisors.
4. Owing to the high confidence standard and long capital horizon of the IRC requirement, robust direct validation of the IRC requirement model through standard backtesting methods at the 99.9%/one-year soundness standard will not be possible. Accordingly, validation of an IRC requirement 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. Given the nature of the IRC requirement soundness standard such tests must not be limited to the range of events experienced historically. The validation of an IRC requirement model represents an ongoing process in which supervisors and firms jointly determine the exact set of

validation procedures to be employed.

5. Firms should strive to develop relevant internal modelling benchmarks to assess the overall accuracy of their IRC requirement models.

IRC requirement: Use of internal risk measurement models to compute the IRC requirement

30.69

As noted above, the market risk framework does not prescribe any specific modelling approach for capturing incremental risk. Because a consensus does not yet exist with respect to measuring risk for potentially illiquid trading positions, it is anticipated that banks will develop different IRC requirement modelling approaches.

30.70

The approach that a bank uses to measure the IRC requirement is subject to the “use test”. Specifically, the approach must be consistent with the bank’s internal risk management methodologies for identifying, measuring, and managing trading risks.

30.71

Ideally, the supervisory principles set forth in MAR30.44 to MAR30.71 would be incorporated within a bank’s internal models for measuring trading book risks and assigning an internal capital requirement to these risks. However, in practice a bank’s internal approach for measuring trading book risks may not map directly into the above supervisory principles in terms of capital horizon, constant level of risk, rollover assumptions or other factors. In this case, the bank must demonstrate that the resulting internal capital requirement would deliver a charge at least as high as the charge produced by a model that directly applies the supervisory principles.