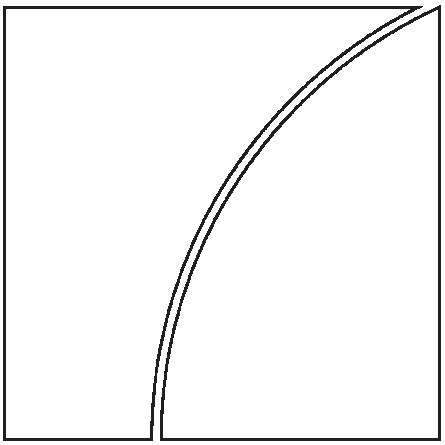
Basel Committee
on Banking Supervision

Consultative document



Fundamental review of the trading book

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Contents

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Abbreviations

CDS	Credit default swap
CRM	Comprehensive risk measure
CTP	Correlation trading portfolio
CVA	Credit valuation adjustment
ES	Expected shortfall
GAAP	Generally Accepted Accounting Principles
IFRS	International Financial Reporting Standards
IRC	Incremental risk charge
MTM	Mark-to-market
OTC	Over-the-counter
P&L	Profit and loss
PVBP	Present value of a basis point
RWA	Risk-weighted assets
SDR	Special drawing rights
SMM	Standardised measurement method
VaR	Value-at-risk

Fundamental review of the trading book

Executive summary

This consultative document presents the initial policy proposals emerging from the Basel Committee's[1] ("the Committee") fundamental review of trading book capital requirements.[2] These proposals will strengthen capital standards for market risk, and thereby contribute to a more resilient banking sector.

The policy directions set out in this paper form part of the Committee's broader agenda of reforming bank regulatory standards to address the lessons of the financial crisis. These initial proposals build on the series of important reforms that the Committee has already delivered through Basel III[3] and set out the key approaches under consideration by the Committee to revise the market risk framework.

These proposals also reflect the Committee's increased focus on achieving a regulatory framework that can be implemented consistently by supervisors and which achieves comparable levels of capital across jurisdictions.[4] The Committee's policy orientations with regard to the trading book are a vital element of the objective to achieve comparability of capital outcomes across banks, particularly those which are most systemically important.

Background

The financial crisis exposed material weaknesses in the overall design of the framework for capitalising trading activities and the level of capital requirements for trading activities proved insufficient to absorb losses. As an important response to the crisis, the Committee introduced a set of revisions to the market risk framework in July 2009[5] (part of the "Basel 2.5" rules). These sought to reduce the cyclicality of the market risk framework and increase the overall level of capital, with particular focus on instruments exposed to credit risk (including securitisations), where the previous regime had been found especially lacking.

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[1] The Basel Committee on Banking Supervision provides a forum for regular cooperation on banking supervisory matters. It seeks to promote and strengthen supervisory and risk management practices globally. The Committee comprises representatives from Argentina, Australia, Belgium, Brazil, Canada, China, France, Germany, Hong Kong SAR, India, Indonesia, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, Russia, Saudi Arabia, Singapore, South Africa, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. Observers on the Basel Committee are: the European Banking Authority, the European Central Bank, the European Commission, the Financial Stability Institute and the International Monetary Fund.

[2] Throughout this consultative paper, the term "trading book capital requirements" is used as a shorthand to refer to capital charges against market risk in the trading book as well as FX and commodity risk in the banking book.

[3] Basel Committee on Banking Supervision, *Basel III: A global regulatory framework for more resilient banks and banking systems (revised June 2011)*, June 2011 (www.bis.org/publ/bcbs189.pdf).

[4] Remarks of Stefan Ingves, "Talk is cheap – putting policies into practice", November 2011 (www.bis.org/speeches/sp111116.htm).

[5] Basel Committee on Banking Supervision, *Revisions to the Basel II market risk framework, updated as of 31 December 2010*, February 2011 (www.bis.org/publ/bcbs193.pdf).

However, the Committee recognised at the time that the Basel 2.5 revisions did not fully address the shortcomings of the framework. As a result, the Committee initiated a fundamental review of the trading book regime, beginning with an assessment of "what went wrong". The fundamental review seeks to address shortcomings in the overall design of the regime as well as weaknesses in risk measurement under both the internal models-based and standardised approaches. This consultative paper sets out the direction the Committee intends to take in tackling the structural weaknesses of the regime, in order to solicit stakeholders' comments before proposing more concrete revisions to the market risk capital framework.

Key areas of Committee focus

The Committee has focused on the following key areas in its review:

The trading book/banking book boundary

The Committee believes that its definition of the regulatory boundary has been a source of weakness in the design of the current regime. A key determinant of the boundary is banks' intent to trade, an inherently subjective criterion that has proved difficult to police and insufficiently restrictive from a prudential perspective in some jurisdictions. Coupled with large differences in capital requirements against similar types of risk on either side of the boundary, the overall capital framework proved susceptible to arbitrage.

While the Committee considered the possibility of removing the boundary altogether, it concluded that a boundary will likely have to be retained for practical reasons. The Committee is now putting forth for consideration two alternative boundary definitions:

- **"Trading evidence"-based boundary:** Under this approach the boundary would be defined not only by banks' intent, but also by evidence of their ability to trade and risk manage the instrument on a trading desk. Any item included in the regulatory trading book would need to be marked to market daily with changes in fair value recognised in earnings. Stricter, more objective requirements would be used to ensure robust and consistent enforcement. Tight limits to banks' ability to shift instruments across the boundary following initial classification would also be introduced. Fundamental to this proposal is a view that a bank's intention to trade – backed up by evidence of this intent and a regulatory requirement to keep items in the regulatory trading book once they are placed there – is the relevant characteristic for determining capital requirements. In some jurisdictions, application of this type of definition of the boundary could result in regulatory trading books that are considerably narrower than at present.
- **Valuation-based boundary:** This proposal would move away from the concept of "trading intent" and construct a boundary that seeks to align the design and structure of regulatory capital requirements with the risks posed to a bank's regulatory capital resources. Fundamental to this proposal is a view that capital requirements for market risk should apply when changes in the fair value of financial instruments, whether recognised in earnings or flowing directly to equity, pose risks to the regulatory and accounting solvency of banks. This definition of the boundary would likely result in a larger regulatory trading book, but not necessarily in a much wider scope of application for market risk models or necessarily lower capital requirements.

Stressed calibration

The Committee recognises the importance of ensuring that regulatory capital is sufficient in periods of significant market stress. As the crisis showed, it is precisely during stress periods that capital is most critical to absorb losses. Furthermore, a reduction in the cyclicality of market risk capital charges remains a key objective of the Committee. Consistent with the direction taken in Basel 2.5, the Committee intends to address both issues by moving to a capital framework that is calibrated to a period of significant financial stress in both the internal models-based and standardised approaches.

Moving from value-at-risk to expected shortfall

A number of weaknesses have been identified with using value-at-risk (VaR) for determining regulatory capital requirements, including its inability to capture "tail risk". For this reason, the Committee has considered alternative risk metrics, in particular expected shortfall (ES). ES measures the riskiness of a position by considering both the size and the likelihood of losses above a certain confidence level. In other words, it is the expected value of those losses beyond a given confidence level. The Committee recognises that moving to ES could entail certain operational challenges; nonetheless it believes that these are outweighed by the benefits of replacing VaR with a measure that better captures tail risk. Accordingly, the Committee is proposing the use of ES for the internal models-based approach and also intends to determine risk weights for the standardised approach using an ES methodology.

A comprehensive incorporation of the risk of market illiquidity

The Committee recognises the importance of incorporating the risk of market illiquidity as a key consideration in banks' regulatory capital requirements for trading portfolios. Before the introduction of the Basel 2.5 changes, the entire market risk framework was based on an assumption that trading book risk positions were liquid, ie that banks could exit or hedge these positions over a 10-day horizon. The recent crisis proved this assumption to be false. As liquidity conditions deteriorated during the crisis, banks were forced to hold risk positions for much longer than originally expected and incurred large losses due to fluctuations in liquidity premia and associated changes in market prices. Basel 2.5 partly incorporated the risk of market illiquidity into modelling requirements for default and credit migration risk through the incremental risk charge (IRC) and the comprehensive risk measure (CRM). The Committee's proposed approach to factor in market liquidity risk comprehensively in the revised market risk regime consists of three elements:

- First, operationalising an assessment of market liquidity for regulatory capital purposes. The Committee proposes that this assessment be based on the concept of "liquidity horizons", defined as the time required to exit or hedge a risk position in a stressed market environment without materially affecting market prices. Banks' exposures would be assigned into five liquidity horizon categories, ranging from 10 days to one year.
- Second, incorporating varying liquidity horizons in the regulatory market risk metric to capitalise the risk that banks might be unable to exit or hedge risk positions over a short time period (the assumption embedded in the 10-day VaR treatment for market risk).
- Third, incorporating capital add-ons for jumps in liquidity premia, which would apply only if certain criteria were met. These criteria would seek to identify the set of instruments that could become particularly illiquid, but where the market risk metric, even with extended liquidity horizons, would not sufficiently capture the risk to solvency from large fluctuations in liquidity premia.

Additionally, the Committee is consulting on two possible options for incorporating the "endogenous" aspect of market liquidity. Endogenous liquidity is the component that relates to bank-specific portfolio characteristics, such as particularly large or concentrated exposures relative to the market. The main approach under consideration by the Committee to incorporate this risk would be further extension of liquidity horizons; an alternative could be application of prudent valuation adjustments specifically targeted to account for endogenous liquidity.

Treatment of hedging and diversification

Hedging and diversification are intrinsic to the active management of trading portfolios. Hedging, while generally risk reducing, also gives rise to basis risk[6] that must be measured and capitalised. In addition, portfolio diversification benefits, whilst seemingly risk-reducing, can disappear in times of stress. Currently, banks using the internal models-based approach are allowed large latitude to recognise the risk-reducing benefits of hedging and diversification, while recognition of such benefits is strictly limited under the standardised approach. The Committee is proposing to more closely align the treatment of hedging and diversification between the two approaches. In part, this will be achieved by constraining diversification benefits in the internal models-based approach to address the Committee's concerns that such models may significantly overestimate portfolio diversification benefits that do not materialise in times of stress.

Relationship between internal models-based and standardised approaches

The Committee considers the current regulatory capital framework for the trading book to have become too reliant on banks' internal models that reflect a private view of risk. In addition, the potential for very large differences between standardised and internal models-based capital requirements for a given portfolio is a major level playing field concern and can also leave supervisors without a credible option of removing model permission when model performance is poor. To strengthen the relationship between the models-based and standardised approaches the Committee is consulting on three proposals:

- First, establishing a closer link between the calibration of the two approaches;
- Second, requiring mandatory calculation of the standardised approach by all banks; and
- Third, considering the merits of introducing the standardised approach as a floor[7] or surcharge to the models-based approach.

Revised models-based approach

The Committee has identified a number of weaknesses with risk measurement under the models-based approach. In seeking to address these problems, the Committee intends to (i) strengthen requirements for defining the scope of portfolios that will be eligible for internal

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[6] Basis risk is the risk that prices of financial instruments in a hedging strategy will move in a way that reduces the effectiveness of the hedging strategy.

[7] A floor on internal models capital charges could, for example, be set at a percentage of the capital charge under the standardised measurement method.

models treatment; and (ii) strengthen the internal model standards to ensure that the output of such models reflects the full extent of trading book risk that is relevant from a regulatory capital perspective.

To strengthen the criteria that banks must meet before regulatory capital can be calculated using internal models, the Committee is proposing to break the model approval process into smaller, more discrete steps, including at the trading desk level. This will allow model approval to be "turned-off" more easily than at present for specific trading desks that do not meet the requirements. At the trading desk level, where the bank naturally has an internal profit and loss (P&L) available, model performance can be verified more robustly.

The Committee is considering two quantitative tools to measure the performance of models. First, a P&L attribution process that provides an assessment of how well a desk's risk management model captures risk factors that drive its P&L. Second, an enhanced daily backtesting framework for reconciling forecasted losses from the market risk metric with actual losses. Although the market risk regime has always required backtesting of model performance, the Committee is proposing to apply it at a more granular trading desk level in the future. Where a trading desk does not achieve acceptable P&L attribution or backtesting results, the bank would be required to calculate capital requirements for that desk using the standardised approach.

To strengthen model standards, the Committee is consulting on limiting diversification benefits, moving to an expected shortfall metric and calibrating to a period of market stress. In addition, it is consulting on introducing a more robust process for assessing whether individual risk factors would be deemed as "modellable" by a particular bank. This would be a systematic process for identifying, recording and calculating regulatory capital against risk factors deemed not to be amenable to market risk modelling.

Revised standardised approach

The Committee has identified a number of important shortcomings with the current standardised approach. A standardised approach serves two main purposes. Firstly, it provides a method for calculating capital requirements for banks with business models that do not require sophisticated measurement of market risk. This is especially relevant to smaller banks with limited trading activities. Secondly, it provides a fallback in the event that a bank's internal market risk model is deemed inadequate as a whole or for specific trading desks or risk factors. This second purpose is of particular importance for larger or more systemically important banks. In addition, the standardised approach could allow for a harmonised reporting of risk positions in a format that is consistent across banks and jurisdictions. Apart from allowing for greater comparability across banks and jurisdictions, this could also allow for aggregation of risk positions across the banking system to obtain a macroprudential view of market risks. With those objectives in mind the Committee has adopted the following principles for the design of the revised standardised approach: simplicity, transparency and consistency, as well as improved risk sensitivity; a credible calibration; limited model reliance; and a credible fallback to internal models.

In seeking to meet these objectives, the Committee proposes a "partial risk factor" approach as a revised standardised approach. The Committee also invites feedback on a "fuller risk factor" approach as an alternative. More specifically:

(a) **Partial risk factor approach:** Instruments that exhibit similar risk characteristics would be grouped in buckets and Committee-specified risk weights would be applied to their market value. The number of buckets would be approximately 20 across five broad classes of instruments, though the exact number would be determined empirically. Hedging and diversification benefits would be better captured than at

present by using regulatory correlation parameters. To improve risk sensitivity, instruments exposed to "cross-cutting" risk factors that are pervasive across the trading book (eg FX and interest rate risk) would be assigned to more than one bucket. For example, a foreign-currency equity would be assigned to the appropriate equity bucket and to a cross-cutting FX bucket.

(b) **Fuller risk factor approach:** This alternative approach would map instruments to a set of prescribed regulatory risk factors to which shocks would be applied to calculate a capital charge for the individual risk factors. The bank would have to use a pricing model (likely its own) to determine the size of the risk positions for each instrument with respect to the applicable risk factors. Hedging would be recognised for more "systematic" risk factors at the risk factor level. The capital charge would be generated by subjecting the overall risk positions to a simplified regulatory aggregation algorithm.

The appropriate treatment of credit

A particular area of Committee focus has been the treatment of positions subject to credit risk in the trading book. Credit risk has continuous (credit spread) and discrete (default and migration) components. This has implications for the types of models that are appropriate for capturing credit risk. In practice, including default and migration risk within an integrated market risk framework introduces particular challenges and potentially makes consistent capital charges for credit risk in the banking and trading books more difficult to achieve. The Committee is therefore considering whether, under a future framework, there should continue to be a separate model for default and migration risk in the trading book.

Areas outside the scope of these proposals

The Committee thinks it is important to note that there are two particular areas that it has considered, but are not subject to any detailed proposals in this consultative document.

Interest rate risk in the banking book

Although the Committee has determined that removing the boundary between the banking book and the trading book may be impractical, it is concerned about the possibility of arbitrage across the banking book/trading book boundary. A major contributor to arbitrage opportunities are different capital treatments for the same risks on either side of the boundary. One example is interest rate risk, which is explicitly captured in the trading book under a Pillar 1 capital regime, but subject to Pillar 2 requirements in the banking book. The Committee has therefore undertaken some preliminary work on the key issues that would be associated with applying a Pillar 1 capital charge for interest rate risk in the banking book. The Committee intends to consider the timing and scope of further work in this area later in 2012.

Interaction of market and counterparty risk

Basel III introduced a new set of capital charges to capture the risk of changes to credit valuation adjustments (CVA). This is known as the CVA risk capital charge and will be implemented as a "stand alone" capital charge under Basel III, with a coordinated start date of 1 January 2013. The Committee is aware that some industry participants believe that CVA risk, as the market component of credit risk, should be captured in an integrated fashion with other forms of market risk within the market risk framework. The Committee has agreed to consider this question, but remains cautious of the degree to which these risks can be

effectively captured in a single integrated modelling approach. It observes that there is no clear market standard for the treatment of CVA risk in banks' internal capital. Occasionally, even within individual banks, different treatments for CVA risk seem to exist. For the time being, the Committee anticipates that open questions regarding the practicality of integrated modelling of CVA and market risk could constrain moving towards such integration. In the meantime, the industry should focus on ensuring a high-quality implementation of the new stand-alone charge on 1 January 2013. This is consistent with the Committee's broader concerns over the degree of reliance on internal models and the over-estimation of diversification benefits.

For this reason, this consultative document sets out initial proposals on revisions to the capital framework for capturing market risk and does not offer specific proposals for dealing with CVA risk. Nonetheless, stakeholders may wish to provide their views on whether CVA risk should be incorporated into the market risk framework and, if so, how this could be achieved in the context of the emerging revisions to the market risk framework presented in this paper.

Next steps

The Committee welcomes comments from the public on all aspects of this consultative document and in particular on the questions in the text (summarised at the end of this document) by **7 September 2012** by e-mail to baselcommittee@bis.org. Alternatively, comments may be sent by post to:

Basel Committee on Banking Supervision
Bank for International Settlements
Centralbahnplatz 2
CH-4002 Basel
Switzerland

All comments will be published on the Bank for International Settlements' website unless a commenter specifically requests confidential treatment.

Once the Committee has reviewed responses, it intends to release for comment a more detailed set of proposals to amend the Basel III framework. As is its normal process, the Committee will subject such proposals to a thorough Quantitative Impact Study.

1. Shortcomings of the framework exposed by the financial crisis

The recent crisis exposed material weaknesses in the capital treatment of banks' trading activities. Some of the most pressing deficiencies of the trading book regime were addressed by the July 2009 revisions to the market risk framework,[8] while others have been dealt with as part of Basel III. However, the Committee has agreed that a number of the market risk framework's fundamental shortcomings remain unaddressed and require further attention. The Committee has agreed that the future trading book regime must address the weaknesses set out below, which are discussed in more detail in Annex 1.

The crisis and pre-crisis experience highlighted a number of shortcomings in the trading book regime. These can be broadly categorised into weaknesses arising from:

(a) The overall design of the regulatory capital framework, especially the inclusion of instruments exposed to credit risk in the trading book;

(b) The risk measurement methodologies used under the models-based and standardised approaches; and

(c) The valuation framework applied to traded instruments.

In combination, these shortcomings resulted in materially undercapitalised trading book exposures prior to the crisis.

1.1 Weaknesses in the design of the regulatory capital framework

While the undercapitalisation of trading book exposures has often been the result of the methodologies used for risk measurement and valuation (both of which are discussed later in this section), elements of the overall design of the regime also contributed to, and amplified, the problems exposed during the crisis. These include:

- **The role of the regulatory boundary:** The Committee believes that its definition of the regulatory boundary has been a key source of weakness in the design of the current regime. A key determinant of the boundary is banks' intent to trade, an inherently subjective criterion that has proved difficult to police and insufficiently restrictive from a prudential perspective in some jurisdictions. Coupled with large differences in capital requirements against similar types of risks across either side of the boundary, the capital framework proved susceptible to arbitrage. For example, prior to the crisis, it was advantageous for banks to classify an increasing number of instruments as "held with trading intent" (even if there was no evidence of regular trading of these instruments) in order to benefit from lower trading book capital requirements. During the crisis the opposite movement of positions from the trading book to the banking book was evident at times in some jurisdictions.
- **The lack of credible options for the withdrawal of model approvals:** The design of the current framework does not embed a clear link between the models-based and standardised approaches either in terms of calibration or in terms of the

[8] Basel Committee on Banking Supervision, *Revisions to the Basel II market risk framework, updated as of 31 December 2010*, February 2011 (www.bis.org/publ/bcbs193.pdf).

conceptual approach to risk measurement. In part as a consequence of this, a key weakness of the design of the current framework has been the lack of credible options for the withdrawal of model approval. This can be a particular problem in stress periods, where supervisors witness a deterioration in model performance at the same time as raising new capital becomes very difficult.

1.2 Weaknesses in risk measurement

In addition to the flaws in the overall design of the framework, risk measurement under both the models-based and the standardised approaches proved wanting:

- **Shortcomings of the models-based approach:** The metric used to capitalise trading book exposures was the 10-day value-at-risk (VaR) computed at the 99th percentile, one-tailed confidence interval. By construction, this is a measure aimed at capturing the risk of short-term fluctuations in market prices. While a 10-day VaR might be useful for day-to-day internal risk management purposes, it is questionable whether it meets the objectives of prudential regulation which seeks to ensure that banks have sufficient capital to survive low probability, or "tail", events. Weaknesses identified with the 10-day VaR metric include: its inability to adequately capture credit risk; its inability to capture market liquidity risk; the provision of incentives for banks to take on tail risk; and, in some circumstances, the inadequate capture of basis risk. Perhaps more fundamentally, the models-based capital framework for market risk relied on a bank-specific perspective of risk, which might not be adequate from the perspective of the banking system as a whole. The pro-cyclicality of VaR-based capital charges based on recent historic data and the large number and size of backtesting exceptions observed during the crisis serve to highlight regulatory concerns with continued reliance on VaR.
- **Shortcomings of the standardised approach:** Although the crisis largely brought to the fore problems with the models-based approach to market risk, the Committee has also identified important shortcomings with the standardised approach. These include a lack of risk sensitivity, a very limited recognition of hedging and diversification benefits and an inability to sufficiently capture risks associated with more complex instruments.

1.3 Weaknesses in valuation practices

The recent crisis highlighted the importance of robust valuation practices, especially of complex or illiquid financial instruments, in times of stress. Different valuation methodologies can have a very material impact on estimated capital resources. Therefore, in assessing capital adequacy, supervisors need to be confident that valuation methodologies are in line with prudential objectives. It is at least as important to have prudent, reliable and comparable estimates of capital resources as to have prudent, reliable and comparable estimates of capital requirements. The crisis highlighted key weaknesses in the valuation framework, including the lack of application of prudent valuation adjustments and the emergence of valuation uncertainty as a key source of solvency concerns.

2. Initial policy responses

In response to the weaknesses highlighted by the crisis, the Committee agreed on a set of revisions to the market risk framework in July 2009, which have become known as Basel 2.5. These were intended to address some of the immediate concerns arising from the

undercapitalisation of banks' trading books. Moreover, some elements of the Basel III package of reforms, whilst not introducing any further amendments to the market risk framework, relate to the capitalisation of banks' trading activities.

2.1 The 2009 revisions to the market risk framework ("Basel 2.5")

The key elements of these revised market risk standards were:

- **The introduction of the IRC:** In recognition of the fact that the 10-day VaR metric does not sufficiently capture banks' exposures to credit risk, the 2009 amendments introduced an additional capital charge intended to capture both default risk and credit rating migration risk. The IRC is estimated based on a one-year capital horizon at a 99.9 percent confidence level, consistent with the treatment of credit exposures in the banking book. However, it also takes into account the liquidity of individual instruments or sets of instruments. Unlike the banking book treatment of credit risk, it allows banks to estimate their own asset value correlation parameters.
- **The introduction of stressed VaR:** In addition to the 10-day VaR requirements, the 2009 amendments require banks to calculate a "stressed VaR" measure. The stressed VaR is intended to replicate a VaR calculation that would be generated on the bank's current portfolio if the relevant market factors were experiencing a period of stress. It should be based on the 10-day, 99th percentile, one-tailed confidence interval VaR measure, with model inputs calibrated to historical data from a continuous 12-month period of significant financial stress. The introduction of stressed VaR is intended, in part, to dampen the cyclicality of the VaR measure and to mitigate the problem of market stresses falling out of the data period used to calibrate the VaR after some time.
- **Alignment of the treatment of securitisation exposures across the banking book and the trading book:** As of July 2009, the Committee as a whole had not agreed that modelling methodologies used by banks adequately captured the risks of securitised products. As a result, it agreed to apply the standardised capital charges based on the banking book risk weights to these exposures. However, the Committee agreed on a limited exception for certain correlation trading activities, where banks are allowed by their supervisor to calculate capital charges based on the CRM. This new model is subject to a strict set of minimum requirements, including the regular application of specific, predetermined stress scenarios and a floor expressed as a percentage of the charge applicable under the standardised approach.
- **Improved risk factor coverage of internal models:** Banks are now explicitly required to incorporate all risk factors in their VaR models that are deemed relevant for pricing purposes, or to justify their omission. Basis risks are also expected to be captured by banks to the satisfaction of the supervisor, as well as event risk (not covered in IRC), which must be included in the VaR measurement. Banks can no longer rely on a surcharge model to capture these risks.
- **Enhanced prudent valuation guidance:** The Committee extended the scope of the prudent valuation guidance to all instruments subject to fair value accounting, including those in the banking book. The Committee also clarified that regulators retain the ability to require adjustments to the current value beyond those required by financial reporting standards, in particular where there is uncertainty around the current realisable value of an instrument due to illiquidity. This guidance focuses on the current valuation of the instrument and is a separate concern from the risk that market conditions and variables might change before the instrument is liquidated (or closed out).

The recently published results of the Basel III monitoring exercise as of 30 June 2011 show that the Basel 2.5 revisions to the market risk framework have led to an increase of overall capital requirements of large banks by 6.1%.[9] This means that, on average, the market risk capital requirements of large banks would more than double. These latest revisions came into force at the end of 2011 in most jurisdictions and now form the basis of the rules for capitalising trading book exposures.

2.2 Relevant aspects of the Basel III reforms

In December 2010, the Committee issued the Basel III rules text,[10] covering details of reforms to bank regulatory standards agreed by the Governors and Heads of Supervision and endorsed by the G20 Leaders earlier that year. Three changes of the Basel III package relate to the capital treatment of trading activities and market risk:

- **Capital charges against credit valuation adjustment (CVA) volatility risk:** The Committee made a number of amendments to strengthen the counterparty credit risk framework. Among the most important elements of the reform package was a requirement that banks be subject to a capital charge against potential mark-to-market losses associated with deterioration in the creditworthiness of a counterparty (CVA risk). Most of the affected instruments, such as OTC derivatives and securities financing transactions (SFTs), are held in the trading book.
- **Treatment of unrealised gains and losses:** Under the changes to the definition of capital, unrealised gains and losses will no longer be filtered out of Common Equity Tier 1 capital. This means that changes to the valuation of all financial instruments held at fair value for accounting purposes will flow directly through to regulatory capital resources.
- **Eligible capital for trading book risks:** As part of the general improvements in the quality of eligible regulatory capital, Tier 3 capital, previously available to meet market risks, will no longer form part of the regulatory capital structure.

2.3 Drawbacks of the current market risk regime

The July 2009 amendments to the market risk framework were judged by the Committee to be an essential immediate response to the severe undercapitalisation of banks' trading books. But from the onset, the Committee also recognised the need for initiating a longer-term, fundamental review of the risk-based capital framework for trading activities. In part this is because the current treatment of market risk exposures, while a material improvement relative to the previous regime, does not address all of the shortcomings highlighted in Annex 1 and suffers from a number of drawbacks:

- **The framework lacks coherence:** The current framework does not have a single, overarching view of how trading risks should be categorised and capitalised, leading to the concern that some capital charges appear overlapping, for example, the

[9] Basel Committee on Banking Supervision, *Results of the Basel III monitoring exercise as of 30 June 2011*, April 2012, pp 15–16 (www.bis.org/publ/bcbs217.pdf).

[10] Basel Committee on Banking Supervision, *Basel III: A global regulatory framework for more resilient banks and banking systems (revised June 2011)*, June 2011 (www.bis.org/publ/bcbs189.pdf).

additive approach taken for VaR and stressed VaR. Moreover, the diverse array of capital charges within the amended framework requires the development and validation of several distinct sets of models. These not only require a substantial amount of bank resources to maintain but have also put a severe strain on supervisory oversight.

- **The boundary issue has not been fully addressed:** The July 2009 revisions to the market risk framework made only minor amendments regarding the set of products that should be excluded from the trading book.[11] However, securitisation exposures other than those eligible for the correlation trading portfolio are treated broadly consistently across the regulatory boundary in the 2009 revisions. In spite of those amendments, similar risks continue to be treated differently across the balance sheet. For example, interest rate risk is only capitalised under the Pillar 1 regime if the bank runs this risk in its trading book. Differences in capital requirements across the regulatory boundary can foster incentives for banks to shift instruments to the regulatory regime that treats them more favourably. Where the boundary is not well monitored, banks could act upon those incentives.
- **Market liquidity risk is not evenly captured:** Although the July 2009 revisions introduce elements that better capture market liquidity risk, they are not comprehensive or complete. The IRC and CRM metrics introduce the concept of varying liquidity horizons to account for the fact that banks might be unable to exit risk positions in short time periods due to market illiquidity. But the IRC and CRM cover mainly credit-related exposures and focus on default and credit rating migration risk. Similarly, stressed VaR implicitly captures variations in liquidity premia in times of stress. However, stressed VaR is still based on a 10-day holding period which is, almost by definition, insufficient to capture the risks associated with market illiquidity. Moreover, stressed VaR implicitly assumes that the markets most likely to turn illiquid in the future are those that turned illiquid in a previously observed period of stress.
- **The bank-specific notion of risk is upheld:** Many of the new approaches are still based on a bank-specific view of risk. For example, stressed VaR still relies on an implicit assumption that all banks can exit or hedge their risks within a 10-day horizon, which was not the case in the recent crisis as many banks tried to exit risk positions simultaneously.
- **Standardised approach problems remain unaddressed:** The July 2009 revisions to the market risk framework did not fundamentally change the standardised approach for market risk. The revisions did adjust some risk weights for equity specific risk and required banking book risk weights for the capitalisation of specific interest rate risk in securitisations. But the structural shortcomings of the standardised approach remain unaddressed.
- **There remains a lack of credible options for withdrawal of model approval:** Aside from multipliers on VaR and stressed VaR, there are limited options for supervisors to deal with poorly-specified internal models. The approaches adopted to backstop the CRM (standardised floor and supplemental capital add-ons from prescribed stress tests) suggest possible alternatives for limiting the reliance on

[11] Paragraph 14 of the *Revisions to the Basel II market risk framework* states that positions in securitisation warehouses also "do not meet the definition of the trading book, owing to significant constraints on the ability of banks to liquidate these positions and value them reliably on a daily basis."

models. The evaluation of backtesting results also suggests a need for regulators to determine specific areas of imprecision, versus focusing on the top-of-the-house risk measure.

- **The relationship between the capital charges for CVA risk and the trading book regime has not been clarified:** The introduction of the new capital charge for CVA risk under Basel III uses elements of the market risk framework. In fact, in the advanced approach, CVA risk is measured through the internal market risk models. This makes it advisable to consider the treatment of CVA risks in the revised market risk framework.

3. Towards a revised framework

A number of the Committee's policy proposals affect both the models-based and the standardised approaches to market risk measurement. This section outlines the Committee's proposals for reforms to key elements of the overall framework for capitalising trading activities and the rationale motivating each of them. The Committee's proposed reforms to the models-based and standardised approaches to market risk are then discussed in more detail in Sections 4 and 5 of this document. In its deliberations towards a revised prudential regime for trading activities, the Committee has drawn on lessons both from the academic literature and banks' current and emerging risk management practices. A summary of these findings is presented in Annex 2.

3.1 Reassessment of the boundary

As discussed in Annex 1 and Section 2, weaknesses in the definition of the trading book/banking book boundary have been identified as a key fault-line of the design of the trading book regime. These weaknesses led to the allocation of particular instruments to a regulatory regime that was not sufficiently equipped to capture their risks. In turn, this led to insufficient capital being held against the risks that banks were running.[12] The various reforms to the trading book regime since the financial crisis have not changed the definition of the boundary in any material way.

In light of these observed weaknesses, the Committee has considered the merits of removing the trading book/banking book boundary altogether. However, it is clear that doing so would necessitate a fundamental re-consideration of the current credit risk framework for banking book instruments, which is not equipped to deal with long/short portfolios. The Committee considers that there are major practical implications of engaging in such a course of action. In light of the wide range of improvements to the Basel capital framework that will be delivered by Basel III, the Committee does not believe such a review would, at this stage, provide sufficient benefits to outweigh the costs. However, given the weaknesses described above, the fundamental review needs to deliver both an improved boundary which better meets the goals of supervisors and an improved capital requirements regime for those

[12] An inappropriate capital charge may not just be calculated for trading book exposures. It may be the case that the current regulatory capital requirements fail to properly capture the market risks of some positions held in the banking book. As discussed in Section 3.3 of Annex 1 this had a material impact for some jurisdictions in the recent crisis.

instruments that form part of a revised trading book. The Committee intends to consider the timing and scope of further work on the capitalisation of interest rate risk in the banking book later in 2012.

This section considers the desirable properties of such a new boundary and presents two alternatives that may form the basis of a viable new approach. Improvements to the capital requirements regime are dealt with in following sections.

3.1.1 The purpose, limitations, and desirable properties of a new boundary

The boundary is, at its heart, an operational construct. It acts as an asset allocation device that seeks to allocate instruments/portfolios into the prudential capital regime that is best equipped to deliver the appropriate level of capital for that instrument/portfolio. Therefore, the boundary will not "fix" the issues identified with the regulatory risk measurement methodologies, but it should ensure the most appropriate risk calculation methodologies are applied.

To do this effectively, the boundary should, ideally, have the following characteristics:

- Be easy to understand and apply in a consistent manner in theory **and** in practice;
- Be objective;
- Be sufficiently robust to arbitrage; and
- Be able to deal with new products.

In addition to these key high level characteristics, further important considerations include:

- Whether the boundary delivers demonstrably comparable allocations of instruments to the different books across banks;
- The extent to which the boundary may open up the possibility for arbitrage and whether the costs of such arbitrage opportunities outweigh the potential benefits of the approach;
- The extent to which the boundary aligns with banks' current risk management processes, and whether this is desirable; and
- The degree to which the boundary should be permeable, if at all.

3.1.2 Options for a new boundary to address current observed weaknesses

No new boundary will fix all known issues with the current boundary without presenting some further difficulties. Therefore, in considering alternative options, their advantages and disadvantages need to be assessed. The Committee recognises that any disadvantages and unresolved issues identified from the ultimate choice of boundary will need to be addressed by other changes to the capital regime. This clearly includes the proposed revisions to trading book capital requirements stemming from the fundamental review.

The Committee has considered a range of options for the basis of a revised trading book boundary, in addition to the removal of the boundary:

(a) Trading intent of bank management (a "trading evidence-based boundary");

(b) Functions provided by the bank, eg market making or underwriting;

(c) Real or perceived liquidity of instruments;

(d) Risk characteristics of instruments; and

(e) The valuation methodology applied to an instrument (a "valuation-based approach").

Boundary options based on the characteristics of instruments, or the functions provided by the bank, have conceptual merits. Nevertheless, they were considered to be too subjective to deliver a boundary that could be subject to demonstrably consistent implementation within, and across, all jurisdictions. Of the remaining three boundary options considered, the Committee felt that the benefits of considering the liquidity of instruments could be better incorporated into revised capital requirements for the trading book (rather than in the definition of the trading book itself).[13] The Committee therefore believes that there are two approaches that are most likely to meet the described objectives whilst addressing the issues of the current boundary. These approaches are described in more detail below, and a detailed comparison is included in Annex 3.

A. A trading evidence-based boundary

The trading evidence-based boundary is an enhanced version of the current intent-based boundary. As such, it retains the link between the regulatory trading book and the set of instruments which a bank deems to be held for the purposes of trading (or to hedge trading book risk positions[14]), adding more objective evidential requirements to support this principle. Fundamental to this version of the boundary is a view that a bank's intention in holding an instrument determines the risk management strategy applied to it, and therefore is the relevant characteristic for regulators in determining its capital requirements. The proposed enhancements to the core principle of "trading intent", the most prominent of which are set out below, are intended to provide more objective criteria for entry to the trading book and therefore make the boundary more enforceable and consistent across jurisdictions:

- As an entry requirement, instruments must be held for trading purposes (or to hedge trading book risk positions) and marked to market daily, with valuation changes recognised through the P&L account, using market data that are sufficiently robust to support this frequency of valuation.[15]
- Banks would be required to have formal policies and documented practices for determining what instruments should be included in the trading book. This would include a description of what constitutes trading or hedging activity, and therefore what instruments should customarily be held in the trading book.
- Banks would be subject to a requirement that internal control functions conduct ongoing evaluation of instruments both in and out of the trading book, to assess whether the bank's instruments are being properly assigned as trading or non-trading instruments in the context of the bank's trading activities.

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[13] See Section 3.2.

[14] Internal hedges to banking book instruments/portfolios are envisaged to be within the scope of this definition. As is the case under the current framework, it is envisaged that commodity and FX risk positions would remain within the scope of market risk capital requirements regardless of whether they are in the trading book or in the banking book (with the exception of structural FX positions).

[15] Market data that are sufficiently robust for these purposes could come from either transactions on the instrument itself or its key risk factors.

- Banks would be required to provide objective evidence that trading instruments are actively managed.[16] This would include setting, and enforcing, limits both on an instrument and on a risk position basis. Also, in addition to clearly documented hedging strategies, banks would be required to monitor market liquidity levels (including availability of market data) and also to specify an expected maximum holding period for instruments, with potential penalties (such as required valuation adjustments/increased supervisory scrutiny) if that period is exceeded.
- There would be stricter requirements on the feasibility of trading an instrument, which would supplement a requirement to have trading/hedging intent. These would include proof of access to relevant markets for trading and hedging (such as historical data on trading in those markets, or a plausible plan for how a bank would trade on a market in which it had limited experience). Banks would also need to meet minimum standards related to the periodic monitoring and assessment of the risk of trading instruments.
- If the above supervisory criteria are not met, banks would be required to designate their instruments to the banking book. At the same time, there would be a strict limit on the ability of banks to move instruments between the trading book and the banking book after initial designation at their own choice, with movement only allowed in extraordinary circumstances which would be defined in the framework. Possible examples could be a major publicly announced event, such as a bank restructuring.

Many of these controls – such as the requirement for trading policies and procedures – are not new, but would be strengthened with the more detailed objective metrics to be specified.

A feature of this approach is that two banks could hold the same instrument but allocate it to different books, depending upon their intention with respect to the instrument, as long as the criteria specified above are met.[17] Thus, banks could continue to have material exposures to fair valued instruments located in the regulatory banking book that are subject only to credit risk, and not to market risk, Pillar 1 capital requirements. As such, further consideration would need to be given to whether banking book capital requirements should be adjusted to address the risk posed by such instruments.

[16] Evidence of active trading could, for example, include statistics on the turnover of positions, rebalancing frequency for their hedges, and/or their average age.

[17] For example, one bank could hold a treasury security in its available for sale account in its banking book, for the intermediate or longer term purpose of liquidity or hedging its banking book interest rate risk, while another could hold the same security in its trading book as part of its short term interest rate risk trading strategy. The current banking book treatment of the treasury security would not require Pillar 1 capital to reflect the possibility that its market value could be reduced owing to changes in interest rates, while the trading book treatment would do so.

Table 1

Possible advantages and disadvantages of the trading evidence-based approach

Advantages	Disadvantages
• An instrument held with trading/hedging intent, provided it is feasible that it can be freely traded or completely hedged in the short-term, appears to naturally fit into the market risk framework. The proposed changes would seek to introduce more objective conditions to improve its enforceability. • This approach requires fewer changes to the current boundary relative to valuation-based approaches (described below), and therefore would result in less disruption to banks and supervisors upon introduction. • The instruments within the trading book would more closely resemble the instruments held within the parts of banks that are internally described and risk managed as "trading", as well as to trading risk metrics, which should make the framework simpler for banks to implement, and easier for supervisors with trading expertise to oversee.	• The trading book boundary would still be under the control of banks, allowing them (restricted to some extent by the new conditions on the boundary) some flexibility to choose the designation of their instruments provided they are willing to fair value them daily through P&L and accept treatment in the trading book as long as the bank holds the position. • There would remain a set of fair valued instruments in the banking book, which would not receive Pillar 1 market risk capital requirements. • The consistency of the approach would rely on each jurisdiction performing sufficiently reasonable judgments on the feasibility of trading in different markets – leading to potential disparities in application across jurisdictions.

B. A valuation-based boundary

The core principle of the valuation-based boundary would move away from the concept of "trading intent" to instead construct a boundary that focuses on aligning the design and structure of regulatory capital charges with the risks posed by an instrument to the regulatory capital position of a bank. This approach would recognise the link between capital resources and capital requirements and attempt to more fully address the fact that market price changes in all instruments held at fair value immediately impact the solvency of banks.

To achieve this objective, one option would be to require any fair valued balance sheet asset or liability to be subject to market risk capital charges. Strictly defined, however, this could result in a potentially large number of non-traded assets and liabilities requiring market risk capital (for example, including assets such as patents, property). A more feasible approach, which the Committee believes would avoid this complication, would be to only apply the boundary to fair-valued financial instruments.[18] Moreover, a strict link between accounting fair value and market risk capital requirements would also potentially misalign market risk capital requirements with the instruments whose fair value movements impact capital resources under Basel III. To address this, the Committee proposes that the boundary be reduced in

[18] Under this approach, as with the trading evidence-based approach, the Committee envisages that commodity and FX positions would fall within the scope of market risk capital requirements regardless of whether they are in the regulatory trading or banking book (with the exception of structural FX positions).

scope to ensure that it only covers those financial instruments where a movement in their value could lead to a reduction in capital resources under the Basel III definition of capital requirements[19] – **this aligns capital requirements with risks to capital resources.**

Under this approach, in current accounting terms, the new trading book would include held for trading financial instruments, available for sale financial instruments and other financial instruments to which fair value is applied either as an option or a requirement. The Committee would need to consider whether the framework's current definition of financial instruments[20] is sufficiently clear to ensure consistent enforcement. A new "trading book" under this approach would likely be significantly larger than the current trading book for many banks, increase the number of banks subject to market risk capital requirements and may differ across banks and jurisdictions due to differences in accounting standards.[21] However, as previously discussed, this boundary would not necessarily lead to a wider scope of modelled risk positions.

Potential adjustment to the valuation-based boundary: Whilst conceptually sound, the above valuation-based approach could, in some circumstances, disincentivise prudent hedging of interest rate risk in the banking book because hedges held at fair value would be split from the hedged risk position. The Committee is considering a potential adjustment to the valuation-based boundary such that banks could be permitted to include some fair valued financial instruments in the banking book if they can provide clear evidence that those financial instruments are specifically used to hedge other banking book risk positions as part of interest rate risk management arrangements.[22] Under this option, the trading book boundary would be again partly under the control of banks, allowing them some flexibility to choose the designation of their instruments.[23]

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[19] This would, for example, exclude positions in a bank's own debt and cash flow hedges.

[20] A definition of "financial instrument" exists in paragraph 686 of the Basel III framework:

"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 both 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 the contractual right to exchange financial assets on potentially favourable terms, or an equity instrument. A financial liability is the contractual obligation to deliver cash or another financial asset or to exchange financial liabilities under conditions that are potentially unfavourable."

[21] The Committee recognises that accounting standard setters are reviewing classification and measurement standards, and that the final form these standards take could affect the impact of a valuation-based boundary. The Committee will continue to monitor accounting developments that would impact this approach to the boundary.

[22] These could be macro or micro hedges, and would need to be supported with quantitative evidence on the effectiveness of the hedges and rebalancing activity.

[23] This approach will be referenced as the "adjusted valuation based approach" in Annex 3.

Table 2

Possible advantages and disadvantages of the valuation-based approach

Advantages	Disadvantages
• All financial instruments held at fair value and so subject to market risk (because changes in fair value could lead to a reduction in capital resources under the Basel III definition of capital) would be required to have market risk capital against that risk. • The trading book boundary would more closely align with the accounting divide between instruments that are recorded at fair value, and instruments that are recorded at amortised cost. Supervisors could expend less resource monitoring the regulatory boundary, with auditors, as part of their current duties, verifying accounting classification. Some of the goals of auditors and supervisors could be better aligned. • The default choice of whether to hold a financial instrument in the trading book or not would be largely dependent on the accounting rules and filters in the Basel III framework.[24] Although the accounting rules may still leave flexibility when designating financial instruments at fair value, arbitrage opportunities are likely to be reduced.	• The link to accounting fair value would make the trading book boundary largely dependent on decisions and changes made by accounting standard setters, and auditors' interpretation of those standards, neither of which are under the control of the Committee. • Jurisdictional differences in accounting, for example with regard to tainting of held to maturity securities, could result in large disparities in the scope of the trading book across banks in different countries and potentially significant increases in their regulatory trading book portfolios. • The set of fair value financial instruments may encompass instruments that a bank does not trade. Thus, the boundary would not align with banks' internal risk management practices for trading activities.

Changes common to both boundary options

Regardless of the final choice of the core principle underpinning a future boundary, there are a number of issues/improvements common to both options:

- To encourage market discipline, a set of disclosure requirements regarding the composition of the trading book would also be developed. For example, banks could be required to publish detailed information about the nature of instruments included in the trading book.
- The ability to change the designation of an instrument between trading book and banking book at the bank's own choice would be significantly restricted either through the explicit limitation imposed by the trading evidence-based boundary or through the link to the fair value accounting requirements in the valuation-based approach.

[24] So any fair-valued instrument would be in the trading book unless it were subject to a filter.

- Stronger, more specific, prudent valuation requirements would be developed and applied to all fair valued financial instruments, regardless of trading book or banking book designation.

A detailed comparison of each boundary option is set out in Annex 3. The final decision on a future boundary will naturally be impacted by the capital regime delivered by the fundamental review, discussed in the remaining sections of this paper.

1.	Which boundary option do you believe would best address the weaknesses identified with the current boundary, whilst meeting the Committee's objectives?

3.2 Choice of risk metric and calibration to stressed conditions

The Committee has identified the choice of the regulatory risk metric and the market conditions to which it is calibrated as key policy decisions in the context of revising both the internal models-based and standardised approaches to market risk.

3.2.1 Moving to expected shortfall

As discussed in Annex 1, the current framework's reliance on VaR as a quantitative risk metric stems largely from historical precedent and common industry practice. This has been reinforced over time by the requirement to use VaR for regulatory capital purposes. However, a number of weaknesses have been identified with VaR, including its inability to capture "tail risk". The Committee therefore believes it is necessary to consider alternative risk metrics that may overcome these weaknesses.

Expected shortfall (ES) is an example of a risk metric that considers a broader range of potential outcomes than VaR. Unlike VaR, ES measures the riskiness of an instrument by considering both the size and likelihood of losses above a certain threshold (eg the 99th percentile). In this way, ES accounts for tail risk in a more comprehensive manner.[25] Accordingly, the Committee proposes the use of ES for the internal models-based approach and also intends to determine risk weights for the standardised approach using an ES methodology.

3.2.2 Calibration to stressed conditions

A key feature of the trading book regime pre-crisis was its reliance on risk metrics calibrated to current market conditions. As explained in Annex 1, this resulted both in undercapitalised trading book exposures going into the crisis and market risk capital charges that proved pro-cyclical at the height of the crisis. In response, Basel 2.5 introduced an additional capital charge based on "stressed VaR". The Committee recognises the importance of ensuring that regulatory capital is sufficient not only in benign market conditions but also in periods of

[25] Other risk measures, such as lower partial moments of higher order and the tail index, are also sensitive to the full range of extreme losses to which an instrument is exposed. For more detail see Annex 2 and Basel Committee on Banking Supervision, *Messages from the academic literature on risk measurement for the trading book*, working paper no 19, January 2011 (www.bis.org/publ/bcbs_wp19.pdf).

significant financial stress. Indeed, it is precisely during such stress periods that capital is required to absorb losses and safeguard the stability of the banking system. Accordingly, the Committee intends to move to a framework that is calibrated to a period of significant financial stress. This should also serve to simplify the capital framework by moving away from the additive nature of VaR and stressed VaR under Basel 2.5. The same principle will apply both to the models-based approach and the calibration of the revised standardised approach, covered in more detail in Sections 4 and 5 of this document.

3.3 Factoring in market liquidity

As discussed in detail in Section 3 of Annex 1, the recent financial crisis was characterised by a sudden and severe impairment of liquidity across a range of asset markets. As a result, banks were often unable to exit or hedge certain illiquid risk positions over a short period of time without materially affecting market prices. This violated a key assumption that was implicit in the 10-day VaR treatment of market risk. Moreover, large swings in liquidity premia, defined as the additional compensation required by investors to hold illiquid instruments, led to substantial mark-to-market losses on fair-valued instruments as liquidity conditions deteriorated.

Although Basel 2.5 introduced requirements to better capture market liquidity risk, these focused on the modelling of default and ratings migration risk associated with credit-related exposures via the IRC and CRM charges. The Committee recognises the importance of incorporating the risk of market illiquidity in a more comprehensive manner across the trading book as a whole. This section sets out: (i) the overall proposed framework for assessing market liquidity risk across the trading book; and (ii) the way in which this assessment will be incorporated under the revised trading book capital requirements.

3.3.1 Assessing market liquidity

The main elements of the proposed framework for assessing the risk of market illiquidity are outlined below.

- **Definition of market liquidity**: Broadly, market liquidity can be defined as the capacity to offset or eliminate a risk position, over a short time period, at current market prices. For the purposes of the revised trading book capital requirements, the Committee has agreed that the differentiation of market liquidity across trading risk positions will be based on the concept of liquidity horizons.[26] A liquidity horizon represents the time required to sell a financial instrument, or hedge all its material risks, in a stressed market, without materially affecting market prices.
- **Granularity of assessment**: In principle, there is likely to be a continuous spectrum of liquidity across different markets and risk positions. In practice, the Committee believes that a less granular approach might prove more tractable for the purposes of incorporating market liquidity risk in the capital framework. Therefore, the Committee proposes that a set of generic "liquidity horizon" buckets be incorporated in the revised trading book regime. A larger number of buckets would allow for a greater degree of risk sensitivity and a finer calibration. This would, however, come

[26] This concept has already been introduced in the July 2009 revisions to the market risk framework. However, it has only been used in the context of the IRC and CRM measures to capture specific credit-related risks.

at a cost of greater complexity of the regime and presume a greater degree of precision of liquidity measurement than is perhaps realistic given current practices.

- **Basis of assessment**: The Committee proposes that liquidity horizons be assigned to risk factors. At the same time, the Committee recognises that the assessment of market liquidity needs to start from the level of traded instruments. This requires a mapping process between the liquidity of financial instruments and that of risk factors. This is outlined in more detail in Annex 4. Conceptually, the ideal metric of market liquidity would be based on the price impact of a trade. In practice, though, this is difficult to estimate. So the Committee has agreed that the allocation of risk factors into liquidity horizon buckets should be determined using a combination of simple quantitative metrics as well as qualitative criteria. The Committee intends to explore a range of possible observable characteristics that could be used to assess market liquidity, which are set out in Annex 4. The Committee also intends to set out more explicit qualitative criteria for the assignment of liquidity horizons.
- **Regulatory constraints to the assessment of liquidity**: The Committee has decided that the allocation of risk factors into different liquidity horizon categories will be subject to regulatory constraints. These constraints will likely take the form of floors to banks' own assignment of liquidity horizons, determined by the Committee at the level of broad asset classes/risk factors. The Committee will consider the need for periodic updates to its assessment of market liquidity to account for changes in market structures over time.

3.3.2 Incorporating the assessment of market liquidity into trading book capital requirements

Once the allocation of risk factors into different liquidity horizons has been achieved, the Committee is considering two complementary approaches for incorporating this assessment into trading book capital requirements: (i) a requirement to incorporate varying liquidity horizons within the regulatory market risk metric; and (ii) a requirement for banks to hold additional capital against the risks to the valuation of financial instruments from jumps in liquidity premia when the latter are not sufficiently reflected in historical price data. These two approaches are discussed in more detail below and in Annex 4. Additionally, the Committee is consulting on two possible options for incorporating the endogenous aspect of market liquidity – that is, the component that relates to bank-specific portfolio characteristics such as particularly large or concentrated exposures relative to the market.

(1) Varying liquidity horizons in the regulatory market risk metric

The concept of varying liquidity horizons was introduced into modelling requirements as part of the July 2009 revisions in the context of the IRC and the CRM. The Committee is considering a refined version of this concept for the trading book as a whole to capture market liquidity risk in a more comprehensive manner.

The Committee is proposing that varying liquidity horizons be incorporated in the market risk metric under the assumption that banks are able to shed their risk at the end of the liquidity horizon. Accordingly, a liquidity horizon of, say, three months would mean that the calculation of the regulatory capital charge would assume that the bank can hedge or exit its risk positions after three months and not require any rebalancing assumptions. This is a departure from the current requirements under the IRC, which require banks to calculate capital using a constant level of risk over a one-year capital horizon. This proposed "liquidation" approach recognises the dynamic nature of banks' trading portfolios but, at the same time, it also recognises that not all risks can be unwound over a short time period, which was a major flaw of the 1996 framework.

The Committee recognises that there are different ways in which this approach could be implemented in practice. This is discussed further in Annex 4. The Committee is seeking input from industry on the likely operational constraints associated with these approaches and how they might be best overcome. The Committee also intends to assess the impact of these different modelling approaches on capital outcomes as part of its quantitative impact studies and to provide further guidance on the incorporation of varying liquidity horizons in the regulatory market risk metric.

(2) Capital add-ons for the potential for jumps in liquidity premia

Market illiquidity poses risks to banks' solvency not only because banks might be unable to exit their risk positions over a short period of time, but also because of swings in liquidity premia that occur in times of stress. Ideally, capital requirements would recognise the time-varying nature of liquidity conditions through a forward-looking component, as historical price data used in the regulatory market risk metric might not sufficiently reflect this risk. This was the case, for example, with some structured credit products ahead of the crisis. These had been judged to be illiquid by both market participants and regulators, but the very limited price variation of these instruments prior to the crisis did not sufficiently reflect the risk posed to the solvency of banks. During the crisis, banks incurred substantial mark-to-market losses on these instruments because of large variations in liquidity premia. Simply extending liquidity horizons in the regulatory risk metric would not have sufficiently captured this risk.

The Committee's decision to calibrate the regulatory market risk metric to stressed market conditions should, to some extent, capture volatility in liquidity premia in times of stress. However, as it is backward looking, the market risk metric is unlikely to sufficiently capture the risk posed by fluctuations in liquidity premia for new products or in the context of changing market structures. To better capture market liquidity risk in the revised regime, the Committee is considering requiring banks to hold capital for jumps in liquidity premia. This approach complements the proposal to vary liquidity horizons within the regulatory risk metric discussed above.

The Committee recognises that, in many cases, liquidity premia will be reflected in historical price data used to calibrate the market risk metric and, so, requiring additional capital against these exposures could double-count risk. To guard against that, such capital add-ons will only be applied if certain criteria are met. The criteria that the Committee is considering are described in more detail in Annex 4. The objective of these criteria is to act as a filter that would identify the set of instruments that could become particularly illiquid but where the market risk metric, even with extended liquidity horizons, will not sufficiently capture the risk of jumps in liquidity premia.

Once these instruments have been identified, a capital add-on for jumps in liquidity premia would be applied as a standardised capital charge. The capital charges would be calibrated based on the price experience of similar instruments in previous periods of market liquidity stress. The application and calibration of the capital add-ons is discussed further in Annex 4.

(3) Accounting for endogenous liquidity risk

The Committee has discussed the possibility of also accounting for endogenous liquidity risk in the revised trading book framework. Broadly, the endogenous aspect of liquidity relates to portfolio-specific characteristics (for example, particularly large or concentrated exposures relative to the market) that might imply that the cost of unwinding portfolios cannot be taken as given (exogenous) but might be affected by the bank's own trading behaviour (endogenous).

The Committee is considering incorporating endogenous liquidity risk in the revised trading book regime by further extending liquidity horizons. This would mean that, – in assigning liquidity horizons above the regulatory floors, banks would be required to account for two broad sets of factors: (i) the characteristics of the market itself in times of stress; and (ii) the characteristics of banks' portfolios relative to the market (eg size of exposures relative to the market). Increasing the liquidity horizon to account for portfolio-specific charcteristics would capture the endogenous aspect of liquidity. This approach retains a single concept within the revised trading book regime – that of liquidity horizons.

The Committee also seeks industry views on whether endogenous liquidity risk can be incorporated through prudent valuation adjustments. This would mean that, in assigning liquidity horizons above the regulatory floors, banks would only be required to account for the characteristics of the market (the exogenous component). Factors relating to banks' own portfolios (eg size of positions relative to the market) would be accounted for by adjusting the valuation of the portfolio for regulatory capital purposes. This approach would operate outside of the market risk metric – so it could increase the consistency of the framework by introducing a uniform approach to accounting for endogenous liquidity risk for banks in the revised models-based and standardised approaches.

2. What are commenters' views on the likely operational constraints with the Committee's proposed approach to capturing market liquidity risk including the endogenous component and how might these be best overcome?

3.4 Treatment of hedging and diversification

Calculating portfolio risk requires an estimate of correlations between different asset values. The current market risk framework allows banks to internally model correlations within different market risk measures (VaR, stressed VaR, IRC, CRM), and then requires the summation of these different measures. In contrast, under the capital framework for credit risk in the banking book, asset value correlations are regulatory-determined parameters, even for banks using internal models. Particularly in the context of trading portfolios, which typically include a range of long and short risk positions, the treatment of asset value correlations (and, implicitly, the capital treatment of hedging and diversification benefits) can have a material impact on capital outcomes.

Additionally, in some cases, there are currently material differences between the treatment of imperfect hedges under the models-based and standardised approaches. The former places virtually no limits on the recognition of hedging within a particular risk measure as long as market-implied correlations are reflected in recent historical data (and provided backtesting exceptions have not exceeded thresholds). The latter, on the other hand, provides a highly restrictive recognition of hedging, effectively only providing a capital benefit for perfect, or near-perfect, hedges. This discrepancy contributes to the observed large differences in capital requirements between the two approaches.

The Committee's guiding principle is that the capital framework should only recognise hedges if they are likely to prove effective – and can be maintained – during periods of market stress. Different elements of the Committee's proposed reforms seek to ensure that both the models-based and standardised approaches take a more nuanced approach to the treatment of imperfect hedges going forward:

- The Committee has agreed that the capital framework for market risk should be calibrated to a period of stress (see Section 3.2). This should contribute to a more robust treatment of hedging strategies that might not prove effective in times of stress – at least to the extent that basis risk is reflected in market price data from previous stress periods.
- The model approval process will be broken into smaller, more discrete steps, and be applied at a more granular, trading desk level (see Section 4). This should contribute to a more robust identification of risk factors affecting the valuation of a portfolio, reducing the possibility that market risk models fail to capture basis risk by either using proxies or mapping different instruments (eg bonds and CDS) to the same underlying risk factor.
- The Committee is considering how best to incorporate rollover assumptions in market risk modelling to reflect the risk of hedge slippage in the context of maturity mismatches within hedging strategies (see Section 4.4.4).
- A key objective of the revisions to the standardised approach is to improve its risk sensitivity, in part by allowing for increased recognition of hedging (see Section 5).

More broadly, the Committee has expressed concern that the current models-based approach may lead to significant over-estimation of overall portfolio diversification benefits across broad categories of exposures and consequent underestimation of the actual risk and required capital. Historically, estimated correlation parameters have been empirically shown to be extremely unstable, particularly during times of stress. Assumed diversification benefits can disappear, with hedges no longer functioning as intended. In light of this, the Committee is considering different options for constraining diversification benefits by determining supervisory correlations across broad risk classes (interest rates, foreign exchange (FX), equity, credit, commodities).

A similar parameterisation is expected to be used under the revised models-based and standardised approaches. This should enhance the consistency of the overall revised framework and reduce the potential for the observed material divergences in capital outcomes between the two approaches.

3.5 Relationship between standardised and internal models-based approaches

As discussed in Section 3.1 of Annex 1, the Committee judges that a key weakness of the current regime is the material differences between internal models-based and standardised capital charges. This makes it difficult for supervisors to remove model approval and require capital calculation under the standardised approach. The Committee believes that a stronger relationship between the standardised and models-based approaches is desirable.

3.5.1 Calibration

As a *first step* in tackling this issue, the Committee intends to establish a stronger relationship in the initial calibration of the two approaches.

3.5.2 Mandatory standardised measurement

As a *second step,* the Committee proposes that all banks regularly calculate the standardised capital requirements for all instruments in their trading books. This would be beneficial to:

- Generate information on the capital outcomes of internal models relative to a consistent benchmark and facilitate comparison in implementation between banks and/or across jurisdictions;[27]
- Reduce reliance on models and/or identify models which undercapitalise certain risks;
- Monitor over time the relative calibration of standardised and modelled approaches, facilitating adjustments as needed (benchmarking);
- Provide macroprudential insight in an ex ante consistent format instead of relying on ad hoc scenario analysis using banks internal models ex post;[28]
- Provide a directly available fallback to internal models if they are deemed to be inadequate for determining regulatory capital.

Moreover, Section 4 proposes that any trading desk that fails internal model entry criteria must fall back to standardised measurement methods for the purpose of regulatory capital determination. In light of this requirement, the Committee believes it is essential that a bank must be able to measure a standardised capital charge for each representative desk (regardless of its approval status) in a timely manner and upon request of the regulator.

3.5.3 Floor (or surcharge) based on the standardised approach

As a final step, the Committee is considering the merits of introducing a standardised floor (or surcharge) on the regulatory capital that is generated from banks' approved internal models (ie the total regulatory capital associated with trading desks that are deemed eligible for modelling).[29] Such an approach could foster a level playing field by creating a common application of the new trading book regime across banks and jurisdictions. Early experiences with the standardised floor on the CRM suggest that, especially for complex products and risk models, it could be beneficial to have such an additional safeguard in place. Table 3 provides a description of the relative merits of different policy options under consideration by the Committee.

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[27] The Committee's Standards Implementation Group (SIG) is currently reviewing the implementation of the Basel 2.5 framework rules and trying to find out if there are large differences in RWA estimates and why. Comparing model-estimated RWA across banks is challenging because it is not readily obvious if a difference in RWA is the result of a bank's portfolio composition or its model implementation decisions. Utilising common portfolios for comparison provides, at best, only a partial picture. In this regard a mandatory requirement to calculate standardised capital charges would give the SIG additional information (RWA for different bank-specific portfolios but with a consistent standardised approach) which could help in analysing the origin of RWA differences.

[28] Internal models might not reveal system-wide risk build up across banks. Depending on the design it is conceivable that a standardised framework could provide regulators and policy stakeholders with early warning indicators within a sufficient time frame to react to, and possible levers to mitigate, system-wide risk.

[29] Whether a floor or surcharge was chosen the level would be set below 100% of the standardised approach. The original Market Risk Amendment included such a floor for specific risk capital charges but this was removed in 1997 and replaced with a "surcharge model" (see Basel Committee on Banking Supervision, *Modification of the Basle Capital Accord of July 1988, as amended in January 1996*, press release, 19 September 1997 (www.bis.org/press/p970918a.htm)).

Table 3

Generalised trade-offs between floors, surcharges, benchmarks and fallbacks[30]

	Pros	Cons
Floor	Safeguard against model risk/measurement error through reduced reliance on bank-specific models and by identifying models that undercapitalise risks. Greater assurances of a level playing field and common supervisory standard across jurisdictions.	Risk insensitivity might distort incentives to improve modelling standards and hedge trading book risk positions. Risk insensitivity might result in regulatory arbitrage. Inconsistent with capital interactions between internal model and standardised approaches for credit and operational risk.
Surcharge	As above, but attempts to re-align incentives to hedge trading book risk positions and improve modelling standards.	As above, but more challenging to calibrate without incentivising "cherry picking" (ie opting for the standardised approach).
Benchmark	Provides flexible use of standardised fallback mechanisms and is least distortive.	Discretion in application across jurisdictions undermines level playing field and common application of standards. Less effective deterrent against model risk/measurement error if applied ex post (ie once the model has proved inadequate and capital insufficient).
Fallback	Credible tool for penalising internal models applied at a desk or sub-portfolio level.	Is reliant on supervisory validation techniques to identify models which undercapitalise risks.

3. What are commenters' views on the proposed regime to strengthen the relationship between the standardised and internal models-based approaches?

4. Revised models-based approach

4.1 The overall approach to internal models-based risk measurement

The Committee's objective for the models-based approach to calculating regulatory capital for the trading book is to estimate the amount of capital required to cover a potential loss in a period of stress from all sources of risk. The approach should in principle be based on the full

[30] When analysing these trade-offs mandatory standardised measurement framework is assumed.

capture and symmetric treatment of all risk factors, regardless of the contractual form or instrument category in which they are embedded.

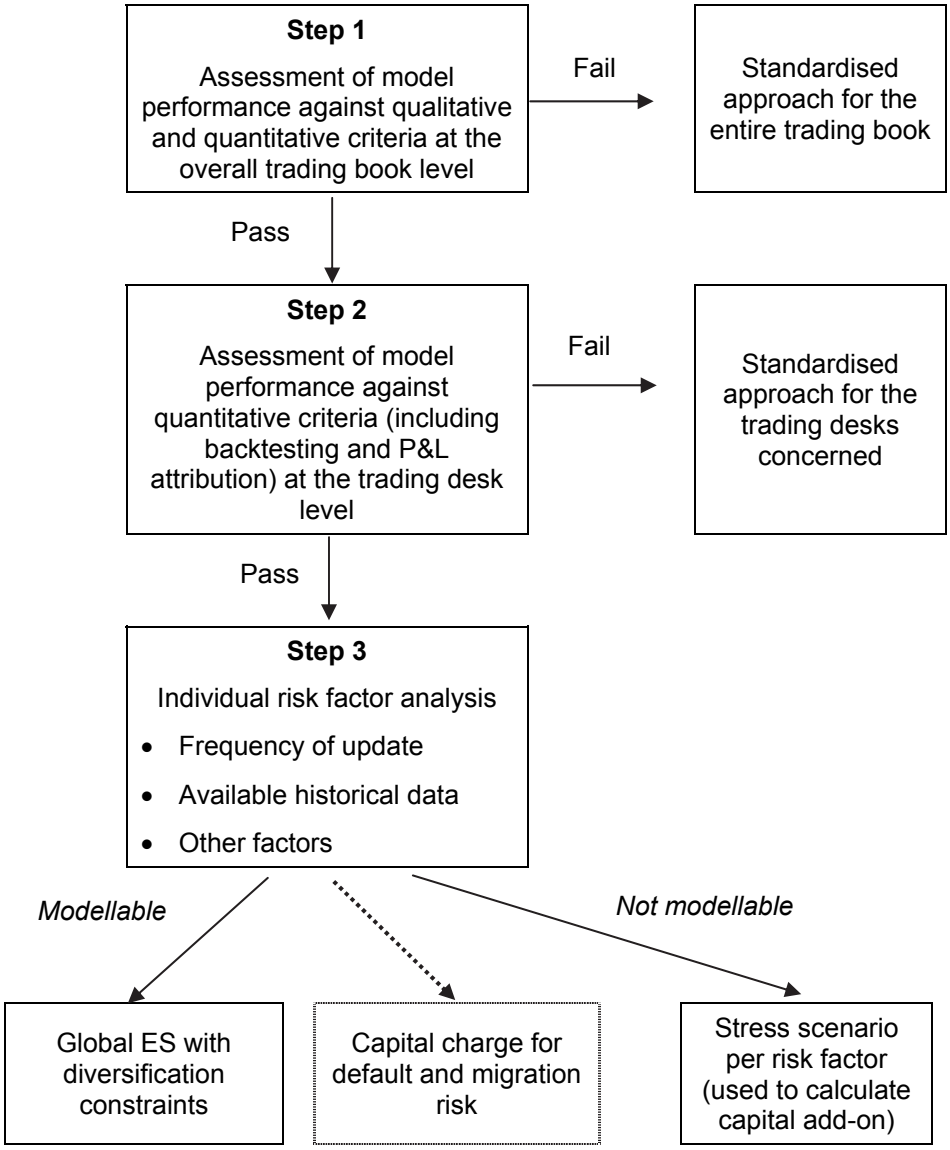
A sound approach to achieving this objective would be the development of an integrated framework in the sense that it (i) identifies and captures all material risk factors; and (ii) provides a common treatment of exposures to common risks. An integrated framework for capturing and quantifying risk, however, need not consist of a single unified model for all risks across the bank. As set out in Section 3.4, it should allow for hedging of risks, to the extent that such hedges are based on sound risk management principles and there is clear and convincing empirical evidence that such hedges "perform" in periods of stress.

The current internal models-based approach is based on a number of, often-overlapping, capital charges. Viewed in isolation, each of these models reasonably addresses an important and specific issue. However, taken as a whole, the current regime lacks a unified and consistent approach to risk measurement. The framework put forward in this section is designed to meet the core principle of delivering capital charges consistent with the full range of market risks taken within the trading book, whilst creating a simpler and more coherent overall approach.

A capital framework that relies on the use of internal models requires a clear and effective process for determining the scope of trading activities that are suitable for internal models-based capital treatment. Trading activities that are capitalised using internal models-based estimates of their underlying risks must be able to meet concrete, objective and verifiable criteria to demonstrate that the underlying risks being assumed can be reliably modelled for regulatory capital and risk management purposes. The Committee's proposed process for defining the parts of the trading book that would be eligible for an internal models-based capitalisation would follow the steps outlined in Figure 1. The details of the individual steps are described in the remaining parts of this section.

Figure 1

Process for determining eligibility of trading activities for the internal models-based approach



Step 1 of the proposed process is broadly comparable to the current model approval process and focuses on the overall assessment of a bank's internal model and its organisational infrastructure. In the event that a bank's model fails the assessment in Step 1 the entire trading book would be capitalised according to the standardised approach.

Step 2 breaks the model approval process up into smaller, more discrete elements. Model assessment would be performed at the trading desk level. This would allow approval to be "turned-off" for desks where the internal model does not meet the required standards, while not forcing the bank to move its entire trading book to the standardised approach. A trading desk that is not approved for internal model use would be capitalised using the standardised approach that is appropriate for the trading desk's assets. Among other benefits, this would provide a "credible threat" of model approval being revoked for particular trading activities. This step represents a significant change to the model approval process in most jurisdictions.

Step 3 is a risk factor analysis. Following the identification of eligible trading desks, this step determines which risk factors within those desks are eligible for modelling. A risk factor's eligibility for modelling would be determined by evaluating the relative quality of data, such as the availability of historical data, and the frequency with which such data can be updated. Risk factors which are eligible for modelling would be capitalised using an ES model with diversification constraints (as described later in this section). Those risk factors which are deemed not to be eligible for modelling, or are not included in the desk's risk management model at a bank but are relevant for the desk, would be capitalised via capital add-ons based on a stress scenario. The Committee is also considering whether default and migration risk should be treated separately from other risk factors, and be capitalised via a separate model.[31]

Under the above approach, if a bank fails to meet the requirements of step 1 the entire capital requirement for the trading book would be calculated using the standardised approach. If a bank meets the step 1 requirements, then step 2 would require evaluation of individual trading desks, in order to determine their respective eligibility for modelling, using quantitative criteria such as backtesting and P&L attribution.

The **capital charge for eligible trading desks** would be the aggregated ES model requirement for modellable risk factors, plus the sum of the individual capital requirements for non-modellable risk factors, plus a possible separate capital charge for default and migration risk.

The **aggregate capital charge for market risk** under this process would consist of the capital requirement for eligible trading desks, plus the standardised capital charge for ineligible trading desks.

4.2 Defining the scope of instruments eligible for internal models treatment (steps 1 and 2)

4.2.1 Identification of eligible and ineligible trading desks

The proposed process, set out in Figure 1, seeks to maintain a trading book-wide quantitative and qualitative requirement for an internal model at the trading book level (step 1). Importantly, this is supplemented with a more granular assessment of model performance (step 2) to identify specific trading activities that are not sufficiently accurately modelled. This more granular assessment of models at a trading desk level would be based, among other factors, on the model's performance against two measures:

- P&L attribution; and
- backtesting.

P&L attribution

For the P&L attribution assessment, all of the instruments held within a particular trading desk would be identified and considered as a distinct portfolio, consistent with their treatment in the bank's internal risk management procedures and models. All of the risk factors for a portfolio that enter into the desk's risk management model and that contribute to the

[31] This is indicated by the dotted arrow and box in Figure 1. For more details see Section 4.5.4.

regulatory capital calculation would be used to calculate a "risk-theoretical" P&L. This risk-theoretical P&L would be compared to the actual daily desk-level P&L, based on the mark-to-market value of the trading desk's instruments used for the books and records of the bank. The P&L attribution should not take account of any risk factors that the bank does not include in its desk's risk management model.

The desk's risk management model, for the above purpose, includes all risk factors which the bank includes in its internal ES model. These may include any risk factors that the supervisor subsequently, in step 3, deems to be unmodellable.

This comparison between the theoretical and actual P&L is performed to determine whether the risk factors included in the desk's risk management model capture the material drivers of the bank's actual P&L. A significant degree of association between the two P&L measures, observed over a suitable time period, would be required for the trading desk to be deemed eligible for internal modelling. The Committee accepts that the theoretical P&L can vary from the actual daily P&L for a number of reasons.[32] However, the rationale for this assessment is that a desk's 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.

The precise relationship and degree of fit that must be obtained between the theoretical P&L and actual P&L are still being considered by the Committee. Two complementary and specific metrics that could be used to determine whether the degree of fit is sufficient are being considered:

- The mean of the difference between the theoretical and actual P&L (unexplained P&L) divided by the standard deviation of the actual P&L; and
- The variance of the unexplained P&L divided by the variance of the actual P&L.

The specific time period that would be used in the computation of the above metrics requires further study once the overall framework is agreed. A guiding principle is if the sample period is too long it may be difficult to detect a breakdown in the desk's risk management model in a timely manner. If the sample period is too short, it could result in an erratic signal that is not indicative of true model performance. Irrespective of the period used to compute the above metrics, banks would be required to estimate and report these ratios on a monthly basis. The decision to include or exclude a specific desk in the perimeter of the internal model would be taken if the averages of the proposed measures are below supervisory-specified thresholds over a given period.

Backtesting assessment

In addition to P&L attribution, the performance of a trading desk's risk management model is proposed to be tested through daily backtesting. The backtesting assessment is considered to be complementary to the P&L attribution assessment when determining the eligibility of a trading desk for the internal models-based approach. This is because the P&L attribution does not give any information on the quality of the modelling of the risk factor distribution.

[32] The risk-theoretical and books and records P&L of a trading desk will differ for a variety of reasons, including the omission of certain risk factors from the model (either due to immateriality or modelling error) and the use of approximations or other shortcuts in the risk-theoretical P&L (due to computational or other operational considerations).

Details on how the backtesting assessment could be best implemented are currently being explored by the Committee.

Together, P&L attribution and backtesting thresholds would be used to determine which trading desks are eligible for internal model treatment for regulatory capital purposes. Although this will be a pass or fail regime, the Committee may allow for a remediation period. For example, a trading desk that begins to exhibit poor, but not catastrophic, P&L attribution or backtesting performance may be given a limited period to improve the underlying risk model before being deemed ineligible. However, if the failure were catastrophic, breaching a lower absolute threshold, internal model treatment would be suspended.

The designation of being ineligible for internal modelling is not, however, envisaged as being permanent. If P&L attribution and backtesting performance sufficiently improved for a reasonable period of time, the designation for the relevant internal models-based approach could be changed from ineligible to eligible.

4.2.2 Definition of trading desk for the purposes of step 2

A key component of the above process is the identification of a bank's "trading desks". While the exact identification is subject to some judgement, in general trading desks will be defined by internal bank organisational structures, policies and procedures, and trading infrastructure.

There are some key indicators that different trading activities are part of the same trading desk that the Committee believes could aid consistency in this identification process:

- Coordinated structure and control of the activities;
- Joint management of risk levels and limits;
- Coordinated control of inventory levels;
- Links between the compensation of traders and the performance of the different activities; and
- Unified booking of trades from different activities.

Banks with large and sophisticated trading operations would be expected to operate a significant number of trading desks across a wide range of asset classes such as equity, credit, FX, fixed income and commodities. Table 4 below has a stylised example of trading desks, intended to provide a reasonable sense of the range of trading activities at a large, complex banking organisation.

Each bank would be required to establish and document a trading desk structure conceptually similar to the one in Table 4. In support of this trading desk structure, the bank should have an internal process for determining the business strategy of each trading desk and the range of instruments and strategies that may be employed by the desk in the normal course of business. Changes to the trading desk structure that are precipitated by innovation and market evolution or changes in overall business strategy would need to be documented on an ongoing basis. As some types of market risk capital requirements also apply to certain banking book instruments, a specific approach might be required to classify these risk positions within the trading desk structure. This issue is set out in more detail in Box 1.

Table 4

Stylised example of "trading desk" structure at a large bank

Equity	Fixed income/currency	Commodity
Domestic cash equity	Domestic interest rates and derivatives	Commodities – agricultural
Domestic equity derivatives	International interest rates and derivatives	Commodities – energy
Quantitative equity strategies	Spot FX	Commodities – metals
	FX derivatives	
Foreign equities	Domestic structured products	
Emerging markets equities	Global structured products	
	Distressed debt	
	High grade credit	
	High yield credit	
	Syndicated loans	
	Multi-asset trading units	
	Special opportunities	
	Strategic capital	
	Quantitative strategies	

The Committee envisages that regulators and bank supervisors would need to compare and contrast trading desk structures across banks with similar activities to ensure that the enumerated structures are reasonably consistent across similarly situated banks, reflect the actual execution of business strategies and risk management structures and are not primarily driven by regulatory capital considerations.

4. What are commenters' views on the Committee's proposed desk-level approach to achieve a more granular model approval process, including the implementation of this approach for banking book risk positions? Are there alternative classifications that might deliver the same objective?

Box 1:
Internal model treatment of FX and commodity risk positions in the banking book

The trading desk classification implicitly assumes that all traded instruments are held in banks' trading books. However, all FX and commodity risk positions throughout a given bank are currently subject to market risk capital requirements, and this is envisaged to remain the case going forward. This raises the question of how the trading desk concept, and especially the desk-level assessment of model eligibility in step 2 of the proposed process (Figure 1), would be performed for banking book instruments. In particular, banks may not have an actual daily P&L, which would be used for comparison to the theoretical P&L in the banking book. Therefore, the P&L attribution requirement could not be completed in the same way as specified in Section 4.2.1. The Committee considers there to be three options for how this issue could be addressed in practice:

- All banking book instruments subject to the market risk capital framework could be assumed to automatically fail step 2 of the process and need to be capitalised under the standardised approach for FX and commodity risk. Under this approach, if banks wanted to include banking book market risk positions in their internal models, they would need to internally transfer the risk positions to an eligible trading desk. Disadvantages of this approach could include greater organisational complexity within banks (eg commercial businesses would need to build up the facility for executing and managing internal transfers on a frequent basis) and commensurately increased operational risk.
- All banking book instruments could be assumed to automatically pass step 2 of the process and therefore be deemed modellable. This approach would assume that no complex, illiquid FX and commodity instruments would be held in the banking book. A potential issue, however, is that banks could then choose to hold more complex instruments in the banking book and therefore gain access to the modelled approach.
- A third solution would be to define two notional trading desks for banking book FX and commodity risk positions and require banks to internally construct an "actual" P&L for the respective instruments. This would allow the same tests of accuracy of the internal model for these risks to be applied as is the case for trading book instruments.

4.3 Identification of modellable and non-modellable risk factors (step 3)

Following the identification of trading desks which are eligible for modelling, the next step for the bank would be to identify the risk factors required to comprehensively model each eligible trading desk. There are two elements to this step: (i) the identification of risk factors included in the desk's risk management model; and (ii) the identification (to the extent possible) of risk factors missing from the model.[33]

[33] P&L attribution at step 2 may not help to identify the missing factors, but it should provide an estimate as to the magnitude of the effect of the missing risk factors.

"Modellable" risk factors would be defined as those included in the desk's risk management model for which there are a sufficient set[34] of representative transactions necessary to determine their value. Sufficiency relies on prices for such factors being (i) "continuously available" and (ii) "real".

Prices for a set of representative transactions would be considered as "continuously" available if the bank had available prices at a frequency corresponding to the liquidity horizon of the risk factor in question.[35]

In this context, the Committee considers a price to be "real" if:

- It is a price for an actual transaction conducted by the bank;
- It is a price for an actual transaction between other parties, eg a price for a transaction conducted at an exchange; or
- The price is taken from a firm quote (ie a price at which the bank could transact).

4.4 Capitalisation of non-modellable risk factors at eligible trading desks

Material risk factors not included in the desk's risk management model, together with those within the desk's risk management model that are not considered modellable for regulatory purposes, would be capitalised individually using a stress scenario calibrated to the same confidence level as those deemed modellable. These capital requirements would then be added (on a simple sum basis) to the capital requirements calculated via the ES approach for the other (modellable) risk factors.

4.5 Capitalisation of modellable risk factors at eligible trading desks

4.5.1 Choice of risk measure and approach to measurement

As discussed in Section 3.2, the Committee is proposing the use of ES for the internal models-based approach.

While ES has certain benefits relative to VaR, it also has drawbacks. Constructing a risk measure that considers extreme losses beyond the 99th percentile would require modelling of events that are rarely (if ever) observed. Therefore, validating an ES-type risk measure would require a more complex and data-intensive model validation procedure than required for VaR. Notwithstanding these challenges, the Committee believes that these are outweighed by the benefits of replacing VaR-based models with a measure that better captures tail risk.

With respect to the VaR measurement approach the 1996 Market Risk Amendment offered banks the option to use a parametric approach, historical simulation or Monte-Carlo simulation. The Committee's analysis to date has not suggested any systematic problem that can be attributed to any of these approaches. However, in the context of ES, the Committee

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[34] A sufficient set of risk factors could be, for example, a single transaction (in the case of an equity) or a set of transactions (in the case of a swap curve).

[35] On liquidity horizons see Section 3.2.

is of the view that any methods which do not rely on full repricing would not be appropriate given the importance of modelling the tail of the loss distribution.

4.5.2 Calibration and parameters of the ES measure

VaR for regulatory capital purposes is currently parameterised according to a 10-day, 99th percentile loss across the entire trading book (multiplied by a minimum of three).[36]

The Committee believes that the new ES measure should also focus on the tail of the distribution. However, challenges associated with validation of risk measures calibrated to extreme scenarios might suggest considering a confidence level below 99%. With respect to credit risk, the Committee is considering maintaining a higher level in the case where this is capitalised via a separate model (see Section 4.5.4). In all cases, as set out in Section 3.2, the risk metric would be calibrated to a stress period rather than current market data.

The experience gained through the implementation of stressed VaR has highlighted that calibration of models to stress periods entails practical difficulties. The process of identifying a stress period by using a full set of risk factors and a full ES model (the "direct method"), in order to find the historical period which maximises the risk measure, is practical for a relatively short window of historical data. But if it is applied over a longer period, the calibration of the full ES model could require significant approximations (for example where risk factors in the current portfolio did not exist in the historical period). There is also a significant computational burden when searching over longer periods using all risk factors.

To overcome these issues, the Committee is also considering possible alternative approaches to delivering a stressed calibration that rely on a reduced set of risk factors. One approach, which may reduce the computational burden of searching for a stress period, would be to allow banks to identify a subset of risk factors which are a strong indicator of the risk of their portfolio and search for a relevant historical period using that subset. This would still require approximations/proxies to be used once the stress period is identified and the full ES model to be calibrated to that period for the current portfolio.

Other approaches may overcome the need for approximations when calibrating the ES measure. For example an alternative approach (the "indirect method") would be to calculate a maximum stress loss in the historical period for the reduced set of risk factors, and then scale up that loss by the ratio of the current ES measure using the full set of risk factors to the current ES measure (based on current market data) using the reduced set of risk factors. This method however assumes that the scaling factor (which would vary with current market data) would not introduce undue cyclicality to the estimate of the stressed ES for the current portfolio.

Further details on the above direct and indirect methods are given in Annex 5. The Committee will consider on balance which option best ensures a consistent and practical approach to the determination of a stress period for the ES model and would welcome industry feedback on these or other potential approaches.

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[36] Here the term VaR is being used only to refer to the standard 10-day, 99th percentile VaR and the stressed VaR. The IRC and CRM can be viewed as VaR-type calculations, and both the IRC and the CRM take a longer view of risk (one year) and a higher confidence interval (99.9%).

5. What are commenters' views on the merits of the "direct" and "indirect" approaches to deliver the Committee's objectives of calibrating the framework to a period of significant financial stress?

4.5.3 Conversion of trading desks into risk factor classes for capital calculation

Although the model approval criteria would be trading desk-based, the capital calculation would be risk factor-based. In the context of the Committee's proposed approach to limit diversification benefits (see Section 4.5.6), risk aggregation could be achieved in different ways:

- One approach would be to decompose the risks inherent in each eligible trading desk into the component risk factors and map these individual risk factors to their respective risk factor classes such as equity, credit, interest rate, commodities and FX. Modelling would then be performed separately for each class. This could be achieved in one of two ways. One could simultaneously shock all risk factors which belong to a given risk factor class, while holding the other risk factors constant; or one could take the partial derivatives with respect to all risk factors in the relevant class.

  Under this approach, a hybrid instrument like a convertible bond would be decomposed into the relevant risk factors (eg equity underlying, equity volatility, credit spread and general interest rate). These risk factors would then be mapped to the risk factor classes (eg equity underlying and equity volatility → equity, credit spread → credit, general interest rate → interest rate).

- A second approach would be to group desks according to primary risk factors, such as equity, credit, interest rate, commodities and FX that primarily drive their performance and then compute ES capital for each grouping of similar desks on a portfolio basis.

  Under this approach each primary risk class would encompass a set of trading desks that are exposed to largely similar risk factors. For example, an equity trading desk and an equity option trading desk may be managed separately, may be subject to different risk limits and may be risk managed separately. However, equities and equity options are subject to common, though not completely overlapping risks. For trading desks exposed to a range of risk factors this approach would require some judgement to determine the primary risk class to which they would best be assigned.

The first approach builds upon a risk management framework with regard to risk factors which cut across eligible trading desks (eg managing the overall credit spread risk), while the second approach builds upon a risk management on an eligible trading desk level (eg price risk associated with a convertible). In each case, an ES model would be calculated on the risk class (either risk factor class or primary risk class), the result of which would feed into the capital aggregation as discussed in Section 4.5.6.

6. What are commenters' views on the merits of the desk-based and risk-factor-based aggregation mechanisms to deliver the Committee's objectives of constraining diversification benefits?

4.5.4 Discrete credit risk modelling

Credit risk has continuous (credit spread) and discrete (default and migration) components which has implications for the types of models that are appropriate for these risks. While this might also be the case for other risk classes (eg event risk for equities), default and migration risk in the trading book are considered more significant for most banks. Therefore, possible approaches for capitalising these risks have been considered in detail by the Committee.

Currently, under the Basel 2.5 framework, default and migration risk in the trading book are treated separately via the IRC and the CRM. One motivation behind the fundamental review of the trading book was to simplify the patchwork of capital charges. A more holistic capital framework should, at least in principle, consider integrating the capitalisation of default and migration risk with that of market risk. For example, in a risk-factor-based framework default and migration risk could be represented by risk factors in the same manner as other forms of market risk.

In practice, however, combining default and migration risk within an integrated market risk framework introduces unique challenges. First, defaults and migrations are discrete, low-probability events, which make the tail of the (marginal and joint) loss distribution difficult to fully articulate and validate, while other forms of market risk can be represented continuously. Second, the problem of "survivorship bias" (which presents an overly optimistic history of loss outcomes) is further exacerbated within an integrated model because of the requirement to calculate correlations between default and other market risk parameters. Finally, the complexity of models that attempt to combine all risk factors reduces the supervisability of the framework. The Committee is considering whether, under a future framework, there should continue to be a separate model for default and migration risk in the trading book. Two policy options are being considered:

- **Integrated:** Treating default and migration risks like any other risk factor. This would mean incorporating these factors into the ES model together along with other continuous credit risks in the credit risk class provided they passed the test in step 3. This would allow for a fully integrated model and a backtesting framework that would include default and migration risks; or
- **Separated:** Treating default and migration differently to other risk factors and calculating a separate models-based capital charge for all default and migration risk factors recognising correlations between those risk factors. This could be seen as conceptually comparable with the current IRC modelling framework. The separate modelling of default and migration risk would allow more flexibility to potentially allow the quantile of the market risk ES model to be set at a lower level, which would make validation and backtesting easier. In this case the capital requirement for default and migration risk for a risk class would be added to the capital requirement for other risk factors, with no diversification benefit within the credit risk factor class.

The Committee is also considering whether further specification of asset correlation parameters for credit risk models would be appropriate to constrain diversification benefits and at the same time improve consistency across jurisdictions.

7.	How can regulators ensure robust supervision of integrated market and credit risk modelling? In particular, how would an integrated modelling approach affect other elements of the proposed framework (eg the choice of the quantile parameter for ES, the P&L attribution and backtesting processes, etc)?

4.5.5 Treatment of risk position/hedge rollover within internal models

As set out in Section 3.3, the Committee is proposing to incorporate varying liquidity horizons in the market risk capital calculation, in recognition of the fact that there is a range of liquidity observed in traded instruments in current financial markets. The proposed "liquidation" approach set out in that section partly avoids the need for explicit roll-over assumptions to be incorporated in the internal models framework, as risk positions are assumed to be closed out at the end of their liquidity horizon.

There still remain two situations, however, where an assumption on rollover needs to be addressed in the internal models-based approach:

- When instruments mature before the end of their liquidity horizon; and
- When hedges mature before the end of the hedged instrument's liquidity horizon.

In considering how to address roll-over in these situations, the Committee recognises that roll-over assumptions are difficult to define in a prudential capital framework (as defining a rational assumption that is prudent in all situations may not be possible), and to operationalise in a model. Moreover, realistic modelling can be procyclical. The benefits of a more realistic modelling assumption therefore need to be weighed against these practical difficulties.

In both of the above situations, having an explicit "no rollover" assumption could result in instruments which mature/expire before the end of a liquidity horizon receiving no capital requirement. Similarly, if an explicit roll-over assumption is modelled, then instruments with a very short maturity would need to be rolled over a large number of times in order to calculate a capital requirement.

To overcome these issues, the Committee is considering not requiring an explicit rollover assumption but rather requiring that internal models-based capital be calculated based on an "instantaneous shock" approach. This would implicitly assume positions remained constant throughout the relevant liquidity horizon.

This approach, whilst practical to implement, would not however address all of the risks related to the rollover of risk positions. In particular, it would not take into account the costs of hedging a portfolio over time or the risk that in stressed conditions it is not possible to rollover hedges. The Committee therefore seeks feedback on whether it is correct that the practical and conceptual difficulties with defining explicit rollover assumptions cannot be overcome, and if so how these risks not captured in the instantaneous shock approach could be addressed elsewhere in the capital framework.

4.5.6 Calculation and aggregation of capital requirements across risk classes: treatment of hedging and diversification

The final step in the internal models-based approach is to calculate capital requirements for each risk class and define the approach for aggregation across those classes.

As set out in Section 3.4, the Committee believes that the capital framework should only recognise hedging and diversification to the extent that it will remain during periods of market stress. This is to address the observed issue that estimated correlation parameters have been empirically shown to be extremely unstable, particularly during times of stress. To implement this in the internal models-based approach, the Committee intends to place greater constraints on correlation assumptions across risk classes.

The Committee is proposing that aggregate models-based regulatory capital is computed as:

$$\max\left(\sqrt{\sum_{i=1}^{N} IMCC^2(C_i) + \sum_{i \neq j} \rho_{ij} L_i L_j IMCC(C_i) IMCC(C_j)}, IMCC(C)\right), \quad (1)$$

where *IMCC* refers to the internally modelled capital charge approved by supervisors to set regulatory capital calibrated to a period of financial stress associated with a given risk class C_i, L_i is equal to 1 if risk *i* is long and -1 if risk *i* is short, and the correlation parameter ρ_{ij} is a supervisor-prescribed parameter that determines the degree to which the risks associated with one risk class hedges or offsets that of another risk class. This approach would directly constrain diversification across the *N* risk classes.

Capital requirements within risk classes ($IMCC(C_i)$) would be based entirely on (approved) internal models. Banks would be unrestricted in their application of correlations within a particular risk class, provided they could offer evidence of their suitability, with the exception of default and migration risk where the Committee is also considering constraining the diversification assumed within the primary risk class. The constraint on the correlation parameter could be through the prescription of supervisory-specified values or through the implementation of parameter floors (or ceilings).[37]

IMCC(C) refers to the internally modelled capital charge calculated at the bank-wide level without supervisory-prescribed correlations (equivalent to treating all desks as a single risk class). This comparison would be required to guard against situations in which the regulatory aggregation scheme fails to be a conservative measure of risk.

4.6 Ongoing monitoring of approved models

The above sections address the initial approval of internal models and trading desks and the approach for the calculation of their capital requirements. Although improving the process for testing eligibility of models is important, the Committee also believes the process for monitoring the use of models should be improved. This section completes the discussion on the internal models-based approach by describing the enhancements the Committee is considering.

The proposed approach for determining the eligibility of a trading desk introduces a number of measures to allow the ongoing validation of models – the P&L attribution and backtesting requirements. The Committee intends that these requirements would be tested on an ongoing basis after initial approval as a key element of ongoing monitoring.

In addition to these threshold requirements for eligibility of a trading desk, the Committee also intends to continue with the current approach of using backtesting[38] performance to adjust capital requirements based on model performance. In this respect, the Committee is considering two adjustments to the current backtesting regime:

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[37] The supervisory-specified parameters would have to reflect whether the bank was long or short the specific risk factor.

[38] Backtesting in this context means the comparison of an internal model's estimate of risk to the realised level of risk. The current framework compares a one-day VaR measure of a portfolio (calculated at the end of the previous business day) to the realised P&L for that day – over the course of a year if the number of days for which the loss exceeds the VaR measure indicates the model is not performing well (meeting the required 99% confidence level) then additional capital is required.

- **Increased granularity:** The results of backtesting at the trading desk or risk factor class level would allow a more granular approach to the use of regulatory multiplier(s) that scale regulatory capital.
- **Taking account of the size of backtesting exceptions:** As Section 3.2.1 of Annex 1 highlights, a criticism of the current regime's approach to taking account of backtesting exceptions is that the size of backtesting exceptions is not factored into the VaR multiplier "plus" factor. Both the number of exceptions and their size provide information on the performance of the internal model. A new regime could reflect both size and number of exceptions in any multiplier.

In combination, the Committee believes these enhancements to the monitoring of internal model performance can complement the proposed revised internal models-based approach.

8.	What are the likely operational constraints with moving from VaR to ES, including any challenges in delivering robust backtesting, and how might these be best overcome?

5. Revised standardised approach

A standardised approach serves two main purposes. First, it provides a method for calculating capital requirements for banks whose business model does not require sophisticated measurement of market risk (eg small banks or banks which are engaged only in relatively simple financial instruments). Second, it provides a fallback in case a bank's (or some of its trading desks') internal market risk model is inadequate. With those objectives in mind, the Committee has adopted the following principles for the design of the revised standardised approach:

- **Improved risk sensitivity:** The approach should give prudent recognition of genuine hedging and diversification and reduce the risk sensitivity gap between the standardised and the models-based approaches.
- **Credible calibration:** It needs to be calibrated via a clear, logical and specified process that can reflect regional differences in asset volatility and differences between instrument types and risk classes.
- **Simplicity, transparency and consistency:** It must calculate capital requirements according to a simple and transparent methodology, imposing a limited burden on banks and regulators, and lead to consistent outputs for a similar portfolio across banks and jurisdictions.
- **Limited model reliance:** It must not rely on a bank's modelling of loss distributions, and should place little or no reliance on a bank's pricing model.
- **Credible fallback:** It must provide a credible fallback in case a bank's risk management model is inadequate. In particular it must provide capital charges that are reasonable in terms of magnitude compared to those produced by a well-specified and prudent internal model.

To address shortcomings of the current standardised measurement method (SMM), the Committee proposes a "partial risk factor" approach as a revised standardised approach. This is based on applying risk weights to the market values of instruments, with enhancements to prudently reflect hedging and diversification. The Committee also invites

feedback on a "fuller risk factor" approach as an alternative to the revised standardised approach. This measures risk based on the distribution of regulator-prescribed risk factors. It is the Committee's intention to implement a single standardised approach for all banks.

To ensure consistency with the models-based approach, separate capital charges will be determined by risk class. These capital charges will then be aggregated using a variant of the risk aggregation formula (1) in Section 4.5.6.

As per Section 4.5.4, the Committee is considering whether credit default and migration risk can be sufficiently captured by any method that is based on historical market data of non-defaulted instruments. The Committee's decision would need to be reflected in a consistent manner in the internal models-based and standardised approaches.

The rest of this section sets out details of both approaches.

5.1 The partial risk factor approach

Under the partial risk factor approach, capital requirements are determined in three steps:

1. Assign all instruments in scope to prescribed asset "buckets" unless they require "decomposition" (see below).

2. Calculate each bucket's capital charge using supervisor-determined risk weights and correlations.

3. Aggregate the buckets using a supervisor-provided method, in order to determine the capital requirement.

Step 1: Assign instruments to asset "buckets"

Instruments would be grouped according to their risk similarity. The expectation is to have approximately 20 asset buckets per risk class, with five risk classes: interest rates, equities, credit (including securitisations), FX and commodities.[39] The determination of buckets would be driven by empirical analysis to create risk-homogeneous groups. Details on the calibration procedure are discussed later in this section. There would be one bucket, with conservatively calibrated risk weights, under each risk class to handle exotic or innovative instruments that do not belong to any other buckets. Whilst the intention is to assign an instrument to a single bucket, the Committee currently considers the following would be exceptions:

(i) **Instruments where the market values (MV) are not reflective of risk:** Because capital would ultimately be based on the MV of the transaction, instruments such as futures, forwards and swaps would need to be separated into two or more elementary instruments to obtain meaningful MVs (as in the current standardised measurement method). These elementary instruments would then be placed into the appropriate buckets.[40]

[39] As in the internal models-based approach, securitisations would be under the "credit" asset class.

[40] As per the current standardised framework it is possible that the Committee would provide a list of those instrument types that are needed to be decomposed.

(ii) **Instruments that are exposed to "cross-cutting" risk factors:** FX risk and general interest rate risk are examples of risks that are pervasive across the trading book (and, in some cases, the bank as a whole). The Committee therefore proposes to treat FX and general interest rate risk as cross-cutting risk factors. For instance, a Sterling-denominated corporate bond in the trading book of a US bank would be exposed to the Sterling-Dollar exchange rate, the "risk-free" (or reference) yield curve and credit spreads. Under the proposed approach, this type of instrument would be decomposed into three risk positions in the form of elementary instruments of the same market value as the original bond:[41]

1. A cash holding of zero maturity in Sterling that would go into a cross-cutting FX bucket;
2. A credit-risk-free bond that would go into the cross-cutting general interest rate bucket using the cash flow vertices method described below (the risk weights applicable to this bucket would reflect only general interest rate volatility); [42] and
3. A corporate bond (free of general interest rate risk) that would go into a credit-risk related bucket (the risk weights applicable to this bucket would only reflect credit spread volatility).

A limited number of other cross-cutting risk factors, including equity general market risk, may be considered as part of the calibration exercise, bearing in mind the goal of simplicity.

(iii) **Options requiring recognition of delta-hedging**: A delta-equivalent risk position would be assigned to the bucket of the underlying instrument to recognise delta hedging. The delta would be taken from an exchange, data provider or the bank's own pricing model (subject to supervisory review). The delta component from the options is removed during the calibration of the option buckets to avoid double-counting the directional risk associated with the underlying. The option is then assigned to a bucket whose risk weights are calibrated to represent the effect of all non-delta risks, including vega and gamma risks.[43] The assignment of options to the buckets for the non-delta risks will be driven by a number of factors, moneyness in particular.[44]

Step 2: Calculate each bucket's risk measure

After assigning instruments to buckets, a risk measure will be calculated for each bucket using a regulator-specified formula. The basic concept of this risk measure is to multiply the instrument's market value by a risk weight.

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[41] See Annex 6, Section 1, for a justification of this decomposition.

[42] Further work will need to be undertaken to ensure that "general" interest rate risk is more clearly defined and subject to more consistent implementation than is currently the case.

[43] See Annex 6, Section 4 for an example on the calibration of option buckets with delta risk removed.

[44] Moneyness would be normalised by the empirical standard deviation of the daily returns of the underlying, which the bank is required to determine.

The capital requirement K_b for each bucket b with instruments $i = 1, 2, \ldots, I$ is given by[45]

$$K_b = \sqrt{\sum_{i=1}^{I} RW_i^2 MV_i^2 + \sum_{i=1}^{I} \sum_{j \neq i} \rho_{ij} RW_i MV_i RW_j MV_j} \quad (2)$$

where:

MV_i Current market value (or mark-to-model value) of instrument *i;*

RW_i Regulatory risk weight of instrument *i;*

ρ_{ij} Correlation between the changes in value of instruments *i* and *j.*

RW_i and ρ_{ij} are specified by the Committee. ρ_{ij} can take on several values depending on the relationship between *i* and *j*. For bonds and other interest rate related instruments, ρ_{ij} would be higher if instruments *i* and *j* refer to the same issuer and have similar maturities than if maturity and issuer differed. The treatment of other risk classes is expected to follow a similar approach but with different "hedging characteristics". Hedges are recognised in the second part of the formula by picking up different signs of the market value for long and short risk positions. The risk weights and correlation parameters are bucket-specific and are calibrated and determined by regulators.

Cross-cutting general interest rate risk would be captured by decomposing each risk position into cash flows. These cash flows are then assigned to vertex points on the interest rate curve, depending on their maturity.[46] Formula (2) would be used to calculate the general interest rate risk charge, except that MV_i would be the net cash flow assigned to maturity vertex *i*, and RW_j and ρ_{ij} the risk weight and correlation parameters specific to maturity vertices *i* and *j*. The parameters would be calibrated by the Committee based on the movements of general interest rate term structures (eg the LIBOR swap curve). The Committee intends to specify a list of products that would require general interest rate risk treatment. The cash flow vertices method will not apply to general interest rate instruments that feature optionality for interest rate risk (eg bond options, caps and floors on interest rates, swaptions). These would instead be assigned to separate buckets that are calibrated to capture their entire risk.

The maturity method of the current SMM (which is based on a different and less risk-sensitive formula than the one described above) applies the same risk weights to general interest rate risk positions regardless of the currency or jurisdiction in which they are written. It only allows offsetting between long and short risk positions within each currency. It is proposed to adopt a more risk-sensitive approach by (i) recognising hedging across currencies by placing in the same bucket groups of currencies for which the yield curves have high long-term stable correlations, and (ii) by applying more than one set of risk weights

[45] A derivation of this formula can be found in Section 2 of Annex 6. An application of the formula, as well as examples of values for ρ_{ij}, RW_i, can be found in Section 5 of Annex 6.

[46] For instance, suppose there is a cash flow of $100 to be received in 25 days, and sits between two regulator-determined vertices, eg 20 days and 40 days. Then, $75 (= $100 * (40 – 25) / (40 – 20)) will be assigned to the 20 days vertex, while $25 will be assigned to the 40 days vertex.

if justified by varying degrees of yield curve volatility. The Committee intends to do further work on the optimal number of yield curves and buckets.

Step 3: Aggregating the buckets

The risk measures of individual buckets are aggregated to obtain the capital requirement for the trading book. Aggregation is done using the following formula:

$$capital = \sqrt{\sum_{b=1}^{B} K_b^2 + \sum_{b=1}^{B} \sum_{c \neq b} \gamma_{bc} S_b S_c} \tag{3}$$

where $S_b = \sum_{i \in b} RW_i MV_i$, and γ_{bc} is a regulator-defined correlation parameter between buckets *b* and *c* that does not depend on the composition or directional biases of the buckets. Intuitively, the first part of the formula aggregates risk across buckets without considering cross-bucket diversification (the "sum of squares"). Then, the second part adjusts the "same direction" correlation between the asset types in *b* and *c* (ie, long/long or short/short), γ_{bc}, by a risk-weighted sum of the mark-to-market values in buckets *b* and *c*. The risk-weighted sum controls for the directional biases of the buckets. The idea behind this aggregation formula is similar to the aggregation formula (1) used in the internal models-based approach (see Section 4.5.6). A derivation of this formula can be found in Section 3 of Annex 6.

Calibration of the partial risk factor approach

This section describes how the key components of the standardised approach will be determined by the Committee. Historical prices are the starting point for the calibration of buckets, risk weights and correlation parameters. First, a data set of returns of instruments falling into a particular broad risk class (eg bonds, equities), is constructed from a stress period. Then, through statistical methods, the characteristics to be used to "bucket" instruments with similar risk profiles are identified.[47] The risk weights of each bucket would then be estimated by taking the ES of the distribution of returns of the instrument group. Correlation parameters for each bucket could be estimated either by averaging pairwise correlations between instruments, or by regression techniques.

Consistent with the models-based approach, liquidity horizons would be determined for each bucket and used to calibrate the risk weights. For instance, if a particular bond bucket is determined to have a liquidity horizon of one month, the risk weight of that bucket would be calibrated to a one-month returns distribution of bonds.

The calibration process should also recognise the effects of cross-cutting risk factors. To accomplish this, bucket risk weights would be calibrated after filtering out the contribution of movements in cross-cutting risk factors. For instance, the contribution of general interest rates movements to bond returns would be filtered out to calibrate the risk weight for a corporate bond bucket.

[47] For example, discriminatory analysis such as a regression tree could be used to identify the set of characteristics that minimise differences in risk characteristics within each bucket.

To ensure that the calibration remains up-to-date it could be repeated periodically, though a stressed calibration should reduce the likelihood of significant changes over time. For an example of the calibration of buckets and parameters for equity options, see Section 5 of Annex 6.

5.2 The fuller risk factor approach

The fuller risk factor approach works by mapping the instruments to a set of prescribed regulatory risk factors and then apply empirically calibrated standard deviations of risk factor shocks to these underlying risk factors. Banks would generally use a pricing model (likely their own) to determine the size of the risk positions from each instrument with respect to the applicable risk factors, except for simple linear instruments which are insufficiently complex to justify the use of a pricing model. The size of the risk positions would be based on the sensitivity of the instruments to the prescribed risk factors. Hedging would be recognised for risk factors which are common to more than one instrument (ie "hedgeable" risk factors). The capital charge would be generated by subjecting the risk position to a regulatory algorithm. A detailed example of how this approach would work in practice is provided in Annex 7.

Step 1: Assign each instrument to applicable risk factors

The Committee would define a set of risk factors and associated shocks that aim to explain the variation in the value of a bank's instruments. A number of risk factors would be set for each risk factor class. A balance would need to be struck between accuracy (more detailed risk factors and more detailed calibration of the shocks) and simplicity (less detailed risk factors and less detailed calibration of the shocks).

The rules would provide a description of the mapping procedure that banks would need to undertake to map their instruments to the regulatory risk factors. Banks would determine from this description which risk factors influence the value of their instruments.

The risk factors would be arranged in a hierarchy. The higher up a risk factor in the hierarchy, the larger the number of instruments it would impact. Further down the hierarchy the risk factors would become more specific in nature; changes in these risk factors would impact a smaller range of instruments, eg only those with single equity risk. Finally, at the bottom of the hierarchy, there would be a number of non-hedgeable risk factors. Hedging would be recognised with respect to each hedgeable risk factor.

Step 2: Determine the size of the net risk position in each risk factor

Once the bank has determined which risk factors apply to its instruments, it must then calculate a gross risk position for each of the relevant risk factors for each instrument. This would be done by calculating the sensitivity of the instrument to a single shift in the risk factors for linear risks, and to multiple shifts for non-linear risks. Banks' own pricing models would be used to do this, except for simple linear instruments (such as equities or commodities) where the calculations are likely to be insufficiently complex to justify the use of a pricing model. For each hedgeable risk factor banks would be required to aggregate all negative and positive gross risk positions to determine the net risk position. When an instrument is non-linear in a risk factor, a set of different shifts of the risk factor would be used, and for each of these shifts a separate risk position would be determined for that risk factor.

For non-hedgeable risk factors the gross risk position would equal the net risk position.

Step 3: Aggregating overall risk positions across risk factors

The net risk positions are aggregated to compute the overall capital requirement for each risk factor class. This requires a distribution of the risk factors to be specified by regulators. One option to simplify the calculation is to assume that all risk factors of the same risk factor class are independently distributed,[48] ie that all pairwise correlations are set to zero. The joint variation in the risk factors is calculated using a sum of squares methodology multiplied by a scalar that approximates the average across the tail of the portfolio loss distribution (eg ES). Finally, the capital requirements calculated for each risk factor class are aggregated using a regulatory formula similar to that applied in the internal models approach (Section 4.5.6).

Calibration of the fuller risk factor approach

The calibration of the risk factor shifts will be driven by stressed historical data on the returns associated with the risk factors. Varying liquidity horizons will be taken into account in the calibration of the risk factor shocks. There may be occasions where the data are not deemed to adequately reflect a stressed environment (eg because of government interventions) and in these instances the Committee considers the use of its judgement to determine the appropriate calibration.

5.3 Comparison of the two approaches

Table 5 compares the partial risk factor approach and the fuller risk factor approach. This is followed by a comparison against the high-level principles around changes to the standardised approach. The differences in capital required, and determination of credibility as a fallback device, by the two approaches can only be assessed when both approaches are calibrated, so the discussion below is limited to a conceptual comparison.

The fundamental difference between these two proposals is their starting point. While the partial risk factor approach is based on a risk weight multiplied by the market value of an instrument, the fuller risk factor approach is based on a regulatory mapping to a wide set of risk factors.

This is related to another key difference, the number of cross-cutting risk factors. The partial risk factor approach groups instruments with similar risk characteristics into the same bucket, which recognises hedging of instruments within each bucket. Cross-bucket hedging will only be roughly recognised, and only a small number of risk factors are allowed to be cross-cutting across buckets (eg FX and general interest rate risk). In contrast, the fuller risk factor approach regards any risk factor other than an idiosyncratic risk factor as cross-cutting (and hedgeable), much like an internal model.

The third key difference is the degree of reliance on banks' pricing models, as highlighted above.

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[48] Assuming that risk factors are independently distributed means that zero correlation is imposed between them, ie they are orthogonal to each other. This implies that having a portfolio that is spread over more than one risk factor automatically means the portfolio is more diversified. This simplifies the method since it is not necessary to set out correlations between risk factors. However, it comes at the cost of potentially reducing risk sensitivity.

Table 5

Comparing the partial risk factor approach and fuller risk factor approach

Features	Partial risk factor approach	Fuller risk factor approach
Treatment of cross-cutting risk factors and hedging	A small number of cross-cutting risk factors may apply to any instrument – eg FX risk and general interest rate risk. Common risk factors are also recognised within regulator-defined buckets – eg bonds in same industry are in the same bucket and hedge each other.	Any risk factor other than the idiosyncratic risk factors is cross-cutting. Hedging is recognised by mapping instruments to systematic risk factors (the higher the level of the risk factor, the wider the recognition of hedging).
Extent of reliance on banks' pricing models for revaluation	The bank has to supply MV of instruments. For options, the bank may use deltas from its own pricing models or from third parties (eg exchanges), subject to supervisory review.	Where banks commonly use pricing models to value an instrument, the bank has to use a pricing model for determining the size of its risk positions of instruments in the underlying risk factors. For options and other non-linear instruments such as securitisation tranches the pricing models that are required could be quite sophisticated.
Treatment of non-linear instruments	The delta-equivalent risk position of an option is stripped out and placed in the bucket of the underlying (except for general interest rate instruments that feature optionality for interest rate risk). Non-delta risks (including vega risk) is captured by separate buckets, with call options and put options assigned to different buckets.	The bank must combine the size of the risk positions from its non-linear instruments with the regulatory shocks for the risk factors, and determine the capital charge according to the rules on aggregation across risk factors.
Method of calibration	Risk weights and correlation parameters are calibrated using a historical distribution of returns under stressed conditions. This implicitly assumes a joint distribution of risk factors given the stress period chosen.	The joint distribution of the (shocks of the) regulatory risk factors would be calibrated based on empirical experience, in particular in various episodes of stress, and where relevant, be subject to the judgment of the Committee.
What do regulators have to do?	Set out a definition of buckets – approximately five risk classes, each with around 20 buckets. Set out risk weights and correlation parameters for each bucket (including cross-cutting buckets), correlations across buckets. Set out a list of instruments that need to be split into two or more elementary instruments (eg a swap or future).	Regulators must describe the risk factors and explain which risk factors the bank will have to apply to any given instrument. They must also provide the shocks to the risk factors and specify how the bank must aggregate across risk factors to determine the capital charge. The bank's pricing models will be subject to risk-based supervisory oversight.
What do banks have to do?	Assign instruments to buckets and carry out calculation according to regulatory formulas.	Map instruments to relevant risk factors, and determine the gross risk positions, then carry out calculation according to regulatory algorithms.

In terms of the principles set out at the beginning of this section, the two approaches place more emphasis on different objectives:

Risk sensitivity: Although both approaches are intended to be substantially more risk-sensitive than the current standardised measurement method, the fuller risk factor approach, subject to appropriate specification and calibration, has the potential to provide a greater level of risk sensitivity, since the risk contribution from any included risk factor can be captured accurately provided that there is an adequate pricing model, and realistic risk factor shocks.

Simplicity, transparency and consistency: Once instruments are assigned to buckets, capital requirements in the partial risk factor approach are very simple to calculate, though this approach does require some additional calculation of some cross-cutting risk factors and a different treatment for options. The fuller risk factor approach requires more complex calculations and probably more supervisory oversight. The partial risk factor approach relies less on a bank's pricing models than the alternative, so it would likely achieve greater consistency of capital requirements.

Limited model reliance: Neither approach relies on banks' risk factor scenarios or forecast distributions. The partial risk factor approach relies on banks' pricing models only for the determination of deltas for options. The fuller risk factor approach relies more on banks' pricing models as those are also used to determine sensitivities to interest rates and credit spreads, and for risks from nonlinear instruments not captured by delta.

Finally it is noted that for simple linear instruments such as equities, the two approaches may likely lead to similar capital outcomes (assuming they are calibrated consistently). In particular, although the mechanics of the approaches differ, both recognise risk drivers common to multiple equities such as possibly industry, national market/index and FX in order to recognise hedging between equities. However, for more complex portfolios, such as those with complex derivative instruments, the difference may be more significant, because the partial risk factor approach is based on implicitly capturing all drivers of risk in the risk weights and, therefore, is not able to capture cross-cutting risk drivers as thoroughly as the fuller risk factor approach's mapping to risk factors.[49]

9.	Which of the two approaches better meets the Committee's objectives for a revised standardised approach?
10.	Do commenters propose any amendments to these approaches?

[49] For example a combination of short call and long puts can synthetically offset a long cash position in equity. Basis risks aside, the fuller risk factor approach would also map positions to common risk factors (including implied volatility) whereas a partial risk factor approach might disregard vega (non-delta) offsets between the puts and calls due to the bucketing criteria.

Annex 1

Lessons from the crisis

1. The history of trading book capital requirements

The original 1988 Basel Accord focused almost entirely on international capital adequacy standards for banks' exposures to credit risk. At the time, though, the Committee had recognised that other risks (including market risk) were also important in assessing banks' overall capital adequacy. A major amendment to the Basel Accord was agreed in 1996 (the "Market Risk Amendment"),[50] introducing additional capital charges against banks' exposures to market risk. These were based on two alternative methodologies: a standardised approach which used formula-based, regulatory-determined capital charges; or, subject to supervisory approval, a bank's internal VaR model. The 1996 Market Risk Amendment also introduced the concept of the regulatory trading book to the Basel framework and established standards for determining what instruments were subject to Pillar 1 market risk charges.

When the Market Risk Amendment was agreed, most banks' trading books comprised of relatively simple risk positions trading in liquid markets. Over time, both the structure of banks' trading books and the nature of international capital markets changed dramatically. Arguably, the most significant development was the large growth in, often highly structured, traded credit exposures. This led to concerns that the regulatory capital treatment of trading activities did not adequately capture risk exposures. In response, the Committee agreed in 2005 on a set of reforms to the capital regime for trading book exposures. These included, among other things, a requirement that banks hold capital against default risk that was incremental to that captured in VaR models.

With the onset of the recent crisis, it became clear that these changes did not go far enough. There were more fundamental problems with the trading book regime. As a short-term response to the crisis, the Committee introduced a set of revisions to the market risk framework in July 2009 (the "Basel 2.5 rules"), which were further amended in June and December 2010.[51] These included requirements for banks to hold additional capital against ratings migration as well as default risk, calculate an additional VaR capital charge calibrated to stressed market conditions (stressed VaR), and remove most securitisation exposures from internal models.

In 2009, the Committee also initiated a fundamental review of the trading book framework (the "fundamental review") to identify and tackle the deep-rooted, structural weaknesses of the regime. The Committee's Trading Book Group has spent considerable time analysing the

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[50] Basel Committee on Banking Supervision, *Amendment to the Capital Accord to incorporate market risks*, January 1996 (www.bis.org/publ/bcbs24.pdf).

[51] See Basel Committee on Banking Supervision, *Revisions to the Basel II market risk framework*, July 2009 (www.bis.org/publ/bcbs158.pdf); Basel Committee on Banking Supervision, *Adjustments to the Basel II market risk framework announced by the Basel Committee*, press release, 18 June 2010 (www.bis.org/press/p100618.htm); Basel Committee on Banking Supervision, *Revisions to the Basel II market risk framework, updated as of 31 December 2010*, February 2011 (www.bis.org/publ/bcbs193.pdf).

lessons learnt from, and before, the crisis. Some of the most pressing deficiencies identified were addressed by the July 2009 revisions. However, the Committee has agreed that a number of the framework's shortcomings remain unaddressed and require further attention. Whilst experience differed somewhat in different jurisdictions, the Committee has agreed that the future trading book regime must significantly tackle the weaknesses set out in this paper.

2. Weaknesses shown before and during the crisis

The crisis and pre-crisis experience highlighted a number of shortcomings in the trading book regime. These can be broadly categorised into weaknesses arising from:

(a) The overall design of the regulatory capital framework;

(b) The risk measurement methodologies used to determine capital requirements; and

(c) The valuation framework applied to traded instruments.

In combination, these shortcomings resulted in materially undercapitalised trading book exposures.

2.1 Weaknesses in the design of the regulatory capital framework

While the undercapitalisation of trading book exposures can sometimes be traced back to the methodologies used for risk measurement and valuation (both of which are discussed subsequently), elements of the overall design of the regime also contributed to, and amplified, the problems exposed during the crisis.

2.1.1 The role of the boundary

The role of the regulatory boundary is an operational one. It seeks to classify instruments into a prudential regime that is equipped to deliver the appropriate level of capital given the nature of the risks that regulators choose to capitalise under Pillar 1. The current boundary is intent-based. Positions must be managed on a trading desk, subject to position limits, and fair-valued at least daily. Some of the features of the boundary may have exacerbated problems exposed by the recent crisis – albeit to varying degrees across jurisdictions. More specifically:

- **Incentives to arbitrage the boundary:** Before the crisis, banks holding similar types of instruments on either side of the boundary may have faced materially different capital charges. While such instruments in isolation are affected by the same risks, the concept of risk is viewed quite differently in the trading book versus the banking book. The former's capital requirements depend on the role an instrument plays in the overall risk of the portfolio, while the latter depends on stand-alone evaluations. Reasons for differences in capital treatment of similar types of instruments were also due to the broad mapping of the regulatory trading book with "market risk" and the regulatory banking book with "credit risk". Furthermore, the binary view of market liquidity embedded in the regime also contributed to significant differences in capital requirements on either side of the boundary. At its inception, the conceptual framework underpinning the capital treatment of trading activities was that the regulatory trading book consisted of exposures that banks could hedge or exit in a very short time period. Implicitly, therefore, the design of the entire

framework was based on an assumption that trading book exposures were liquid. As a result, for example, banks holding a long portfolio of bonds in the banking book would calculate capital charges for credit risk based on a one-year capital horizon (under Basel II). In contrast, banks holding a long portfolio of bonds in the trading book would calculate capital charges for general and specific interest rate risk based on a 10-day capital horizon (under the models-based approach). These inconsistent treatments created incentives for banks to shift exposures to where capital charges were lower.

- **Ability to arbitrage the boundary:** In principle, if the boundary were robustly policed, the regulatory framework could guard against possible incentives for banks to arbitrage the regime by shifting exposures across the balance sheet. But the definition of the boundary under the Market Risk Amendment was largely based on banks' intent to trade. This was inherently difficult to police and, as a result, proved to be insufficiently restrictive in some jurisdictions. On the one hand, prior to the crisis, some instruments designated as held for trading did not meet basic criteria for the regulatory trading book. For instance, they may have been held for longer-term investment purposes and not as part of an overall trading strategy and may not have been fair valued daily through the P&L account. Identifying such positions and removing them from the trading book can be challenging from a supervisory perspective. On the other hand during the crisis, many positions held in the trading book became illiquid and experienced rapid declines in fair value. Some banks then re-designated such positions to the banking book. These shifts indicated too much subjectivity and flexibility in the criteria for allocating positions on either side of the boundary.

- **Interactions between the regulatory and accounting boundaries:** Accounting standard setters also classify banks' assets and liabilities into different categories.[52] Financial instruments falling into fair value through P&L and available-for-sale classifications are both carried at fair value. Although regulatory trading book positions need to be held at fair value for accounting purposes, not all positions with this accounting classification are held in the regulatory trading book. Fair value option positions may also be placed in either the banking book or the trading book. Under major accounting standards such as IFRS and US GAAP, the range of positions held at fair value can be wider than the current definition of the regulatory trading book, which currently is limited to positions that are fair valued through P&L. From an accounting perspective, gains and losses from fair value through P&L positions flow through to P&L whereas gains and losses from available-for-sale positions are taken directly to equity and in many countries a part of them was previously "filtered out" from regulatory capital. Under Basel III, unrealised fair value gains and losses will no longer be filtered out from regulatory capital, so changes in value of both fair value through P&L and available-for-sale positions will flow through directly to capital resources.

[52] Under IFRS, financial instruments may be classified as: loans and receivables, available-for-sale, fair value through profit and loss, or held to maturity.

2.1.2 Significant differences between internal models-based and standardised capital requirements

The design of the current framework does not embed a clear link between models-based and standardised approaches, either in terms of calibration or in terms of the conceptual approach to risk measurement. Historically, the two approaches have been seen as catering to different sets of banks. So the Committee has been prepared to allow a significant divergence of capital charges for a given portfolio under the two approaches, partly in the belief that there should be significant capital benefits for the models-based approach. This has been justified on the basis that it is appropriate to provide regulatory capital incentives, over and above the private incentives that banks should have on their own, for good risk management. In this respect, different jurisdictions have had vastly different experiences on the use of models. In some jurisdictions, the models-based capital charges (which tend to apply to the larger, more systemically important banks[53]) can be a very small fraction of the standardised charges, sometimes by an order of magnitude or more. In other jurisdictions, generally those whose markets exhibit high volatility, standardised approaches appear to deliver lower capital charges, thus diminishing banks' incentives to move to internal models.

2.1.3 Lack of credible options for the withdrawal of model approvals

In part as a consequence of the above, a key weakness of the design of the current framework has been the lack of credible options for the withdrawal of model approval. This is a particular problem in stress periods, where supervisors may witness a deterioration in model performance at the same time as raising new capital becomes very difficult. The lack of a credible threat of removing model approval may also hinder supervisory efforts to improve banks' risk management. In some countries, the response to this problem has been to introduce capital add-ons. But this can lead to substantial inconsistencies across jurisdictions in the treatment of similar portfolios. Furthermore, if the risk-based requirements are failing to capture a significant risk, then an add-on calculated as a percentage of the risk-based requirements will tend to fail to capture it as well. More broadly, models are by definition imperfect representations of reality and therefore not all risks will be captured in the capital figures. This may result in significant increases in trading book risk whilst the capital figures appear benign. The Committee believes that additional focus on non-risk-based measures such as the Basel III leverage ratio can help mitigate this risk.

2.2 Weaknesses in risk measurement

In addition to the flaws in the overall design of the framework discussed above, risk measurement under both the models-based and the standardised approaches proved wanting. This section describes the major shortcomings of each in turn.

2.2.1 Shortcomings of the models-based approach

The metric used to capitalise trading book exposures was the 10-day VaR computed at the 99th percentile, one-tailed confidence interval. While potentially useful for day-to-day internal risk management, it is questionable whether a 10-day VaR meets prudential objectives:

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[53] Almost all of the largest internationally active banks have trading book model approval, and more than half of their market risk capital requirements are determined by internal models-based approaches.

- **Inability to adequately capture credit risk:** It is widely recognised that 10-day, 99th percentile VaR does not adequately capture banks' exposures to credit risk. This had been identified as a possible concern as early as the introduction of the Market Risk Amendment in 1996. But the structure of banks' trading books was very different two decades ago. The rapid growth in the market for traded credit since the early 2000s meant that banks held increasingly large exposures to credit-related instruments in their regulatory trading books. In fact, in response to a survey by the Committee in 2005 pointing to a material build-up of credit-related exposures – and in recognition of the inability of the 10-day VaR to adequately capture their risks – the Committee agreed to introduce the so-called incremental default risk charge (which subsequently evolved into the IRC as part of the Basel 2.5 package).
- **Inability to capture market liquidity risk:** During the crisis, banks were often unable to exit or hedge certain trading positions in a short time period due to market illiquidity. Moreover, the sharp rise in liquidity premia at the height of the crisis led to banks incurring substantial mark-to-market losses on a range of positions. Overall, in light of the severe illiquidity in some asset markets – most prominently in this crisis, the markets for certain structured credit products – the 10-day VaR metric proved inadequate in capturing risk ex ante.
- **Incentives to take on tail risk:** By not looking beyond the 99th percentile, VaR – and hence regulatory capital requirements – fails to capture so-called "tail risks". This might provide perverse incentives to the banking system. For example, providing insurance against tail events can appear to be a "risk-less" strategy from a regulatory perspective under most states of the world. But when a tail event does occur, losses can be very large. Increasing exposures to super-senior securitisation tranches were one example of the build-up of exposures to tail events not adequately captured by the regulatory capital framework.[54]
- **Inadequate capture of basis risk:** Ahead of the crisis, internal models often did not capture the basis risk between market parameters as they were often "mapped" to the same underlying risk factor. For example, in the case where a bank held a long position on a corporate bond, hedged by buying credit protection in the form of CDS, internal models would tend to map CDS and bond spreads to the same risk factor. So, from the perspective of VaR and the regulatory capital framework, these portfolios would appear risk-free. More broadly, the entire framework was based on estimates of correlations derived from historical data based on "normal" market conditions. Hedging benefits that were assumed to hold in normal times proved illusory as correlations broke down in times of stress.
- **A bank-specific notion of risk:** Perhaps most fundamentally, the internal models-based capital framework relied on a bank-specific perspective of risk. But individual banks' risk assessments might not be adequate from the perspective of the banking system as a whole. A clear manifestation of that was the lack of incorporation of market liquidity risk. For example, individual banks might judge that they can all exit or hedge their exposures over a short time period without affecting market prices. But if the banking system as a whole holds similar exposures in a market (as was, for example, the case with super-senior tranches of securitisation exposures ahead

[54] Investing in super-senior tranches of securitisation positions can be seen as equivalent to writing deep-out-of-the-money options, with returns that appear risk-free except in those tail states of the world when borrowers default en masse.

of the crisis), that market is likely to rapidly turn illiquid in times of banking system stress.

A number of these problems manifested themselves with force at the height of the crisis. Two observations in particular highlight regulatory concerns with continued reliance on VaR:

- **Pro-cyclicality of market-implied measures of risk:** The behaviour of VaR-based capital charges proved highly pro-cyclical as it allowed banks to take on more risk in the upside of the cycle and amplified shocks in the downturn. In part, this was a reflection of the reliance of the metric on short periods of historical market data to estimate risk. In the pre-crisis period, as asset prices were rising and volatility was falling, VaR-based capital charges tended to remain remarkably low. This allowed banks to take on more risk in the upswing of the credit cycle. But as the crisis intensified, asset prices fell and volatility increased, VaR-based capital charges also rose dramatically. In response, banks sought to shed risk by exiting positions, contributing to further asset price falls and market illiquidity.
- **Large VaR backtesting exceptions:** Prior to the crisis, VaR exceptions – the number of instances when actual losses are larger than the estimated daily VaR – rarely exceeded the expected number.[55] The recent crisis, though, was very different. Banks posted daily trading losses that were many times greater than their VaR estimates – and much more often than would have been expected. The number of exceptions was pointing to VaR models that were severely mis-specified – and the large size of exceptions further questioned the basis of using VaR as the main regulatory market risk metric. Furthermore, the crisis experience raised questions over supervisory reliance on "top of the house" VaR backtesting to assess model performance. Backtesting only proved a useful indicator of model weakness ex post – ie once the crisis had hit. In seeking to draw lessons from the crisis on the performance of VaR, the Trading Book Group undertook analysis of backtesting exceptions during the crisis. Box 2 presents a summary of the main conclusions.

Box 2: Analysis of VaR backtesting exceptions

The Trading Book Group analysed VaR exceptions during the crisis to understand the size and timeline of exceptions; determine the main drivers behind these exceptions; and assess the performance of different types of VaR models.

The main conclusions emerging from this analysis were:

- At a high level, the exercise confirmed that VaR models did not perform adequately during the crisis. The number of exceptions observed per bank was much higher relative to what would have been expected under the capital standards.
- The backtesting data showed two clear peaks in both the number and the size of exceptions: August 2007 and October 2008. These peaks correspond to the

[55] Statistically, the number of exceptions should not exceed between two and three per year for VaR estimated at the 99% confidence level.

[56] This distinction divides interest rate risks into those arising from general interest rate movements and those arising from issuer specific factors, including credit risk.

significant rise in inter-bank funding spreads and other credit spreads in the summer of 2007 and the fall-out of the Lehman Brothers collapse in autumn 2008.

- The main cause of exceptions were interest rate movements (both general and specific[56]). Secondary causes were general equity and FX movements, the latter likely tied to general interest rate movements. Commodity and specific equity movements contributed to only a small number of exceptions in the time period.
- Qualitative analysis by the Trading Book Group shed some further light on the reasons for VaR not reflecting losses incurred. Specifically, many banks did not regularly update time series data and some key risk factors driving the observed losses were not incorporated into their VaR models.

2.2.2 Shortcomings of the standardised approach

The Committee has also identified important shortcomings with the standardised approach. These include:

- **Lack of risk sensitivity:** Although the standardised approach will, by definition, be less risk-sensitive than the models-based approach, the current standards often fail to distinguish, even at a very high level, the riskiness of different portfolios. As a result, capital charges are often the same across a range of products that share very different risk characteristics. For example, positions such as collateralised mortgage obligations are generally treated in the same way as simple bonds which can exhibit much lower price volatility.
- **Limited recognition of hedging and diversification:** Certain areas of the standardised rules for market risk provide very limited recognition of hedging and diversification benefits. For example, specific interest rate risk charges require exact matches of reference names, maturity and currency. Even if the issuer is the same, no offsetting is permitted between different issues where differences in coupon rates, call features, etc might mean that prices could diverge in the short run.
- **Insufficiently addressing complex instruments:** The standardised approach is inadequate for complex or innovative products, as it essentially tries to force these into simpler categories. This means that the rules can be easy to arbitrage by banks willing to design product features to minimise capital charges and likely inappropriate for larger more sophisticated internationally active banks.

2.3 Weaknesses in valuation practices

The crisis served to highlight the importance of valuation practices, especially of complex or illiquid financial instruments in times of stress, for the regulatory assessment of capital adequacy. Different valuation methodologies can have a material impact on estimated capital resources, so supervisors need to be confident that these methodologies are in line with prudential objectives. It is at least as important to have prudent, reliable and comparable reported capital resources as to have prudent, reliable and comparable capital requirements. The crisis highlighted a number of weaknesses in the valuation framework:

- **Application of prudent valuation adjustments:** The Basel framework requires banks to ensure their valuations are prudent, taking into account factors such as liquidity, funding costs, and model risk. These valuation adjustments or reserves were rarely applied in practice ahead of the crisis. When they were applied, they were not calculated in a consistent manner across banks or jurisdictions.

- **Valuation uncertainty:** Valuation uncertainty was a significant source of solvency concerns during the crisis, particularly for complex instruments. Notwithstanding any valuation adjustments taken (which appear to have been minimal), the regulatory framework implicitly assumes that current valuations are known with near-certainty.

A number of the issues highlighted above were also corroborated from the Trading Book Group's own analysis on the losses suffered by banks in their investment banking operations during the crisis. These are summarised in Box 3.

Box 3: Loss attribution analysis

The Trading Book Group collected data on losses suffered on banks' investment banking activities during the period from January 2007 to March 2009. The objective of the exercise was to analyse the sources of losses and assess how the regulatory regime was placed to cover the risks that crystallised. Quantitative data was collected from five US banks and 10 (domestic and foreign) banks operating in the UK. Qualitative analysis was also provided from other jurisdictions.

The main messages emerging from the loss attribution exercise were:

- Traded credit caused the vast majority of losses in this crisis (Figure 2). Structured credit, in particular, accounted for a very large proportion of total writedowns. But substantial losses were also observed in business lines such as "loan origination and syndication", highlighting the risks associated with market illiquidity even for relatively simple products.
- The majority of losses in the analysis crystallised on instruments held in the (regulatory) trading book. However, a material proportion of loss-making exposures were also held in the banking book at the time of loss.
- The vast majority of loss-making instruments, $349 billion, were held at fair value for accounting purposes (Table 6). Nearly 90 percent of this amount, $309 billion, was on instruments accounted for as held for trading, including $49 billion held in the regulatory banking book at the time of loss. Altogether, $84 billion (or approximately 25% of the losses by value) were on instruments accounted for at fair value and held in the banking book for regulatory purposes at the time of loss.
- More detailed data from internationally active banks operating in the UK show that $41 billion of losses in the regulatory banking book arose from instruments accounted for as held for trading that had been transferred from the regulatory trading book. Additional instruments representing $21 billion of losses were transferred to the banking book after the loss took place. With those, about a third of instruments that suffered a loss included in the UK study ($62 of $186 billion) had switched from the regulatory trading book to the banking book during the period of the study. Changing the regulatory classification did not impact the accounting classification which was kept as held for trading. Notably, no instruments moved in the other direction.

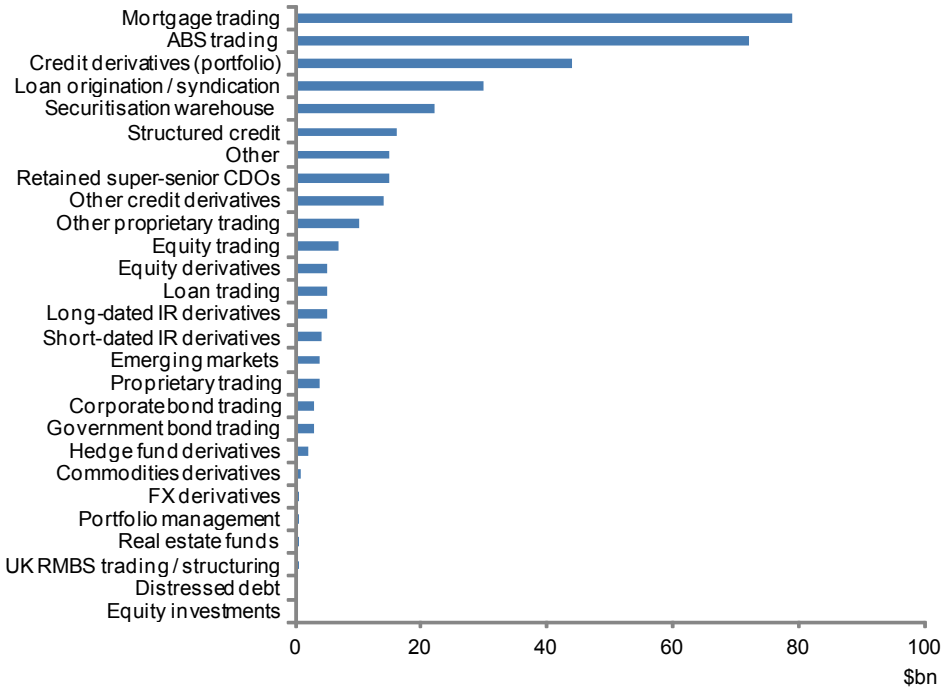
Table 6

Accounting classification versus regulatory classification of losses from investment banking activities (at time of loss in billions USD)

Accounting classification		Regulatory classification	
Fair value	349	Trading book	265
Amortised cost	15	Banking book	100
Total	**365**	**Total**	**365**

Figure 2

Losses by business line



Annex 2

Lessons from the academic literature and banks' risk management practices

In its deliberations on revising the prudential regime for trading activities, the Trading Book Group has drawn on lessons both from the academic literature and banks' current and emerging risk management practices.

1. Messages from the academic literature on risk measurement in the trading book[57]

Selected lessons on VaR implementation:

(a) There is no unique solution to the problem of the appropriate time horizon for risk measurement. The horizon depends on characteristics of the portfolio and the economic purpose of measuring its risk.

(b) Commonly used square-root-of-time VaR scaling rules (which ignore future changes in the portfolio) have been found to be an inaccurate approximation in many studies. That said, no widely accepted alternative has emerged.

(c) There are limitations of VaR models that rely on the use of continuous stochastic processes with only deterministic volatility assumptions. Introducing either stochastic volatility assumptions or stochastic jump process into modelling of risk factors will help to overcome these shortcomings.

(d) Backtesting procedures that only focus on the number of VaR violations are insufficient to determine the appropriateness of the model assumptions. The use of conditional backtesting procedures or other techniques (like the timing of violations or the magnitude of the VaR exceptions) can improve the backtesting process.

(e) No consensus has yet emerged on the relative benefits of using actual or hypothetical results (ie P&L) to conduct backtesting exercises.

Incorporating market liquidity risk: The literature distinguishes, first, between exogenous and endogenous market liquidity risks; and, second, between normal (or current) liquidity risk

[57] These represent the findings of a specifically convened group of the Committee's Research Task Force based on its review of the academic literature relevant to the regulatory framework for the trading book. This project was carried out in the first half of 2010 acting upon a request from the Trading Book Group. See Basel Committee on Banking Supervision, *Messages from the academic literature on risk measurement for the trading book*, working paper no 19, January 2011 (www.bis.org/publ/bcbs_wp19.pdf).

and extreme (or stressed) liquidity risk.[58] Portfolios may be subject to significant endogenous liquidity costs under all market conditions, depending on their size or on the risk positions of other market participants. According to accounting standards, endogenous liquidity costs are not taken into account in the valuation of the trading books. A first step to incorporating this risk in a VaR measure would be to take it into account in the valuation method. In practice, the time it takes to liquidate a risk position varies, depending on its transaction costs, the size of the risk position in the market, the trade execution strategy, and market conditions. Some studies suggest that, for some portfolios, this aspect of liquidity risk could also be addressed by extending the VaR risk measurement horizon.

Risk measures: VaR has been criticised in the literature for lacking subadditivity.[59] A prominent alternative to VaR is ES, which is subadditive. Despite criticism focused on the complexity, computational burden, and backtesting issues associated with ES, the recent literature suggests that many issues have been resolved or have been identified as less severe than originally expected. Spectral risk measures are a promising generalisation of ES that is cited in the literature.

Stress testing practices for market risk: Stress testing often was implemented as an ad hoc exercise without any estimate of scenario probability or use of a bank's VaR risk measurement framework. More recent research advocates the integration of stress testing into the risk modelling framework. This would overcome the drawbacks of reconciling stand-alone stress test results with standard VaR model output. Progress has also been achieved in theoretical research on the selection of stress scenarios. The regulatory stressed VaR approach has not been analysed in the academic literature.

Unified versus compartmentalised risk measurement: Recently, attention has shifted towards unified approaches to risk measurement that consider all risk categories jointly. Theoretically, an integrated approach is needed to capture potential compounding effects that are ignored in traditional compartmentalised risk measurement approaches (eg separate measures for interest rate, market, credit and operational risk). These might underestimate risk if a portfolio cannot be cleanly divided into sub-portfolios along risk categories. Irrespective of the separation of assets into "books", it is not always true that calculating different risks for the *same* portfolio in a compartmentalised fashion and adding up the compartmentalised measures will be a conservative estimate of the true risk. This insight is particularly important for "back-fitting packages", such as the IRC.

Risk management and VaR in a systemic context: A number of studies criticise VaR-based capital rules as being procyclical in nature. This may induce cyclical lending behaviour by banks and exacerbate the business cycle. Another criticism of VaR-based capital rules is that banks may fail to consider system-wide endogeneity in their internal decisions. If all banks do this, they may act uniformly in booms and busts leading to instabilities in asset markets. Unfortunately, the literature does not offer convincing alternatives.

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[58] *Exogenous liquidity* refers to market-specific, average transaction costs and can be captured by a "liquidity-adjusted VaR" approach. *Endogenous liquidity* refers to the price impact of the liquidation of specific positions. Endogenous liquidity depends on trade size and is relevant for orders that are large enough to move market prices; that is, it is the elasticity of prices to volumes.

[59] A property that implies that compartmentalised (say, desk-wise) risk measurement based on VaR is not necessarily conservative.

2. Key findings from a survey of industry practices

The Trading Book Group conducted a survey of industry practices in risk management, capital allocation and other measures for the trading book that could be used to inform the development of regulatory capital standards. The key findings are as follows.

Length of holding period for risk assessment: For day-to-day risk management the use of one-day VaR is universal among banks surveyed. However, for internal capital adequacy and strategic risk management, banks are generally moving beyond short-horizon models (eg one-day and 10-day VaR). It is now acknowledged that, to determine the level of capital necessary to remain in business after sustaining a large loss, risk must be assessed over a longer holding period. Shorter horizons do not address the liquidity risk for all exposures and do not capture tail events that are important for capital adequacy. Some banks are developing risk models with varying holding periods for risk assessment across products and conditional on the market liquidity of the exposure, though validation will be difficult.

Alternatives to traditional VaR models: Many banks see the need for a measure of risk for exposures that are hard to capture in traditional VaR models. Stress tests are utilised but most view that risk needs to be assessed over a range of possible scenarios because the nature of the next crisis cannot be predicted. Consequently, more ambitious comprehensive statistical models of stress scenarios are used.[60] Such models allow systematic assessment of risk across multiple stress scenarios beyond those present in historical data sets. These approaches are similar to reverse stress tests in that they are sensitive to the scenario to which the bank is most exposed. Alternatively, some banks recommend the use of risk-sensitive add-ons to risk model outputs for exposures whose risks cannot be reliably measured with VaR. These banks believe that use of add-ons where complexity and model uncertainty exist would be preferable to blunt risk-insensitive standardised measures. The same complexity and measurement issues that are challenges for VaR models are likely to affect the robustness of standardised risk weights.

Model validation: The emerging modelling approaches for assessment of exposure to stress events will present a challenge for model validation because of the paucity of relevant historical data. In addition, models that assess risk over long holding periods such as in the IRC model present a validation challenge because some products have less than 10 years of historical data. In cases where historical data are not sufficient for traditional backtesting, several banks suggested using benchmark portfolios to discover which models were outliers in underestimating of risk.

Scaling of VaR and nonlinearities: Nonlinearities in exposures are captured in most banks' models to some degree albeit imperfectly. Almost all banks' VaR models capture nonlinearities at a local level (small price changes) for much of their market risk exposure, but many banks' VaR models fail to capture non-linearity at a global level (large price changes). A common weakness in the capture of non-linearity is the use of scaling of one-day VaR to estimate exposures at longer holding periods. Such scaling only captures local non-linearity in the range of one-day price changes and can underestimate non-linear exposure over longer horizons, even when full revaluation is used.

[60] Such models assign probabilities to multiple stress scenarios with VaR models in a stressed Monte-Carlo simulation to generate a loss distribution and tail loss for internal capital allocation.

Annex 3

Comparison of the current trading evidence and valuation-based boundaries

	Current boundary	Trading evidence-based boundary	Valuation-based boundary
Entry requirements			
Valuation	All instruments in the trading book must be held at fair value, and be subject to **high level** prudent valuation requirements.	All instruments in the trading book must be held at fair value, and be subject to **specific** prudent valuation requirements.	All instruments in the trading book must be held at fair value, and be subject to **specific** prudent valuation requirements.
Risk management standards	High level risk management standards related to policies/ procedures for active management of instruments.	More comprehensive internal control requirements to ensure instruments in the trading book are actively managed and monitored to address emerging risks: • Documented hedging strategies; • Internal audit to review the bank's ability to hedge trading book instruments; • Monitoring liquidity of related markets; • Documentation of the expected holding horizon for each instrument.	N/A as an entry requirement for trading book. Under the adjusted valuation-based boundary for financial instruments that are held at fair value but which the bank wishes to designate as banking book instruments, clearly documented hedging strategy evidence and quantitative measures of hedge effectiveness would be required to demonstrate the instruments hedge other banking book instruments as part of interest rate risk management.

	Current boundary	Trading evidence-based boundary	Valuation-based boundary
Trading intent	Instruments must be held with trading intent, ie held intentionally for short-term resale and/or with the intent of benefiting from actual or expected short-term price movements, or to lock in arbitrage profits.	Requirement to document trading strategies. Stricter requirements on the feasibility of trading an instrument, such as proof of access to relevant markets for trading and hedging. Stronger evidential requirements that trading instruments are actively managed, such as daily monitoring of instrument pricing and liquidity.	Applicable only to the extent that trading intent is part of the underlying reason for accounting designation as fair value. Under the adjusted valuation-based boundary, no trading intent must be proven for fair value interest rate hedges which would stay in the banking book.
Liquidity	N/A as an entry requirement for the trading book. Liquidity is reflected in the capital charge of positions subject to the IRC.	As above, stricter requirements on the feasibility of trading an instrument, such as proof of access to relevant markets for trading and hedging. Liquidity is also reflected in the capital charge.	N/A as an entry requirement for trading book. Liquidity is reflected in the capital charge.
Characteristics			
Ability to change designation	There is little effective restriction on moving instruments between the trading and banking books. One restriction is that amortised cost instruments would fail the fair value requirement of the trading book, so banks could not change their designation.	Switching between the trading and banking books after initial designation at the choice of the bank would only be allowed in extraordinary circumstances. Possible examples would include a major publicly announced event, such as a bank restructuring.	Instruments would switch designation where their valuation basis changes, which would be unusual. Under the adjusted valuation-based boundary, instruments would also switch from the banking book to the trading book if they no longer hedge a banking book transaction.

	Current boundary	Trading evidence-based boundary	Valuation-based boundary
Enforcement	Full reliance on banks' internal policies and procedures and supervisory scrutiny of the trading book. The 2005 Basel Committee survey showed there was a lack of precision in some policy requirements.	Internal audit would be the first line of control to ensure positions meet the criteria. Supervisors would scrutinize the internal audit control process as well as the composition of the trading book.	External auditors have to enforce the fair value designation. It may be necessary for supervisors to periodically evaluate the banks' designations. But once an instrument's fair-value designation is determined, the boundary should be relatively easy to enforce. The adjusted valuation-based approach would require supervisors to monitor documentation supporting designation of fair valued instruments to the banking book.
Implementation	Inconsistent and even insufficient implementation of some existing boundary criteria. The boundary criteria were not sufficiently clear to ensure that only appropriate instruments remained in the trading book.[61]	Stricter criteria and more objective standards should result in more consistent implementation across jurisdictions, helped by limiting trading positions to items that are fair valued through earnings.	Implementation standards should be generally consistent within an accounting regime. However, differences in accounting regimes, could result in structural differences across jurisdictions.

[61] Per a 2005 Basel Committee survey, a "strict" application of the existing boundary criteria would have left "structured credit" and other illiquid/complex instruments out of the trading book.

	Current boundary	Trading evidence-based boundary	Valuation-based boundary
Consequences			
Arbitrage opportunities	Banks have significant latitude to pursue arbitrage, because of the subjective nature of the boundary and there being no restriction on switching. Areas of uneven capital treatment created specific areas where switching provided capital arbitrage opportunities.	A significant limitation on switching between the trading book and banking book would mean there would be little opportunity for arbitrage after the initial investment in an instrument. Arbitrage opportunities could exist at the point of initial investment. Stricter requirements to be applied to the classification policies and procedures may minimise such arbitrage.	Some arbitrage opportunities would still exist, to the extent that banks can influence auditor's agreement to fair value designations. If not appropriately enforced, the designation of fair valued financial instruments to the banking book under the adjusted valuation-based approach would present additional arbitrage opportunities.
Impact on treatment of instruments/ implications for other areas of the regulatory regime		The impact on banks' designation of instruments to the trading book and banking book is unclear. Should there be an increase in the range of instruments with market risk in the banking book, consideration would need to be given to whether Pillar 1 or Pillar 2 banking book capital requirements should be adjusted to address the risk posed by such instruments.	The larger trading book would mean a wider spectrum of liquidity in trading book instruments. This would impact the range of liquidity horizons used in the capital framework. Credit risk positions would likely increase significantly, requiring consistent treatment of credit risk between the trading and banking books. The valuation-based boundary would be substantially under the control of accounting standard setters.
Impact on hedging		No significant change from current boundary.	Broken hedges may occur under the (pure) valuation-based approach. Under the adjusted valuation-based approach broken hedges can be avoided, provided the bank proofs the hedging relationship.

	Current boundary	Trading evidence-based boundary	Valuation-based boundary
Alignment with capital resources		It is possible that fair valued financial instruments would not have market risk capital against them, even though their valuation changes are recognised in capital.	All fair valued financial instruments whose value movements flow through to capital resources would have market risk capital requirements. The adjusted valuation-based approach would allow an exception for instruments held to hedge interest rate risk in the banking book.
Size of trading book relative to current size		The same or smaller.	Larger.
Level of consistency of boundary across banks	Significant inconsistency.	Some inconsistency.	Some inconsistency.
Fair value financial instruments in banking book without market risk capital	Yes – relatively small amounts, but led to large losses in the crisis in some jurisdictions.	Yes – possibly increased amounts, due to stricter criteria to enter the trading book.	Not for those financial instruments whose value movements flow through to capital resources. Yes – in the adjusted valuation-based approach if an instrument is designated as hedging banking book interest rate risk.

Annex 4

Further detail on the Committee's proposed approach to factoring in market liquidity

This Annex provides more detail on the Committee's proposed approach to factoring in the risk of market illiquidity in the revised trading book regime. It is structured in three parts. First, it outlines the proposed framework for operationalising an assessment of market liquidity. Second, it describes different options under consideration by the Committee for incorporating varying liquidity horizons in the regulatory market risk metric. Third, it outlines the proposed framework for introducing capital add-ons for jumps in liquidity premia.

1. Assessment of market liquidity

The Committee has agreed that the differentiation of market liquidity across the trading book will be based on the concept of liquidity horizons. It proposes that banks' trading book exposures be assigned to a small number of liquidity horizon categories. These are shown in Table 7 below. The shortest liquidity horizon (most liquid exposures) is in line with the current 10-day VaR treatment in the trading book. The longest liquidity horizon (least liquid exposures) matches the banking book horizon at one year. The Committee believes that such a framework will deliver a more graduated treatment of risks across the balance sheet. Among other benefits, this should also serve to reduce arbitrage opportunities between the banking and trading books.

Table 7

	Category 1	**Category 2**	**Category 3**	**Category 4**	**Category 5**
Liquidity horizon	10 days	1 month	3 months	6 months	1 year

As discussed in Section 3.3.2, the Committee proposes that liquidity horizons be assigned to risk factors. However, the assessment of market liquidity needs to start from the level of traded instruments. This would require a mapping process between the liquidity of financial instruments and that of risk factors. The mechanics of market risk models already require banks to identify a set of risk factors that affect the valuation of financial instruments. As long as these risk factors have been identified, the assignment of liquidity horizons would be determined as follows:

- If a risk factor is derived from a single traded instrument (eg credit spread), the liquidity horizon of that risk factor would map directly to the liquidity horizon of that instrument;
- If a risk factor is derived from several traded instruments (eg implied volatility is derived from an option's price and the price of the underlying), the liquidity horizon of that risk factor would be defined as the longest liquidity horizon of the instruments used to calibrate it;

- If a risk factor is derived from statistical analysis and proxies, with no corresponding traded instrument, it would be assigned to the longest liquidity horizon category and designated as a risk not amenable to modelling (subject to the treatment defined in Section 4).

The Committee intends to develop detailed quantitative and qualitative guidelines on the assignment of liquidity horizons by banks. Moreover, the Committee has agreed to incorporate a regulatory assessment of market liquidity in the revised trading book regime. This will likely take the form of floors to banks' own assignment of liquidity horizons, determined by the Committee at the level of broad asset classes/risk factors. This is equivalent to the way in which liquidity horizons operate within the IRC framework currently, whereby banks' own estimates of liquidity horizons are restricted to a minimum of three months.

A key policy consideration is the degree of granularity of the regulatory assessment of market liquidity. Assigning regulatory liquidity horizon floors at a very high level of disaggregation (eg to the five broad asset classes/risk factors) might prove insufficiently granular to be effective. For example, the broad class of "credit" is likely to include instruments/risk factors of widely varying degrees of market liquidity (eg sovereign, corporate or structured credit). The Committee will consider different options for incorporating a regulatory assessment of market liquidity to best manage what is effectively a trade-off between simplicity and risk sensitivity. Irrespective of the degree of granularity, the Committee believes that the classification of the trading book used for the purposes of the regulatory assessment of liquidity should be consistent with that developed for the revised standardised approach. This would simplify the framework and ensure consistency across the differences elements of the revised trading book regime.

The assignment of liquidity horizon floors by the Committee will involve a degree of judgement. This judgement will, however, be informed by quantitative analysis based on observable market data. In principle, the ideal metric of market liquidity would be based on the price impact of trades – the larger that price impact of a trade, the longer the associated liquidity horizon. In practice, though, the price impact of trades is difficult to estimate. Overall, the Committee intends to consider a range of quantitative, market-based indicators to allocate broad asset classes/risk factors into the different liquidity horizon categories. Possible metrics could include:

- Level and volatility of bid-ask spreads;
- Daily/monthly total volumes traded;
- Outstanding amounts of the instrument;
- Number of dealers quoting prices;
- Risk characteristics of the instrument (eg credit quality or sector);
- Characteristics of market participants;
- Infrastructure characteristics of markets.

The Committee will be embarking on a work programme to assess the scale of data constraints, including by examining new sources of data (eg from trade repositories). The Committee also intends to consider options for collecting data on a subset of these indicators from banks to inform this calibration.

2. Incorporating varying liquidity horizons in the regulatory market risk metric

The Committee proposes that, to incorporate varying liquidity horizons for modelling purposes, an underlying assumption would be that banks are able to shed risk at the end of the liquidity horizon, with required capital covering the risk measured over that period. This would be a departure from the current requirements under the IRC/CRM, where the underlying modelling assumption is that banks maintain a constant level of risk over a one-year capital horizon. This requires introducing rebalancing or roll-over of risk positions at the end of each liquidity horizon to new risk positions with the same initial level of risk as at the start of the liquidity horizon.

In practice, the experience with the IRC/CRM has shown that there are implementation challenges with this approach. For example, it is difficult to define a set of underlying behavioural assumptions to underpin the regulatory rollover requirements; in practice, the rollover assumptions embedded within the IRC have sometimes resulted in higher capital charges for more liquid risk positions; and the operational burden of implementing the constant level of risk requirements can be material. Moving to a "liquidation" regime – whereby banks are assumed to shed risk at the end of the liquidity horizon should mitigate some of these concerns.

A key operational consideration in the context of incorporating varying liquidity horizons in the regulatory market risk metric is how to apply risk factor shocks over longer and varying horizons. The Committee has identified three broad options for doing so. The first is to apply shocks directly at longer horizons. The second is to apply short-term shocks and scale the inputs of the market risk model to varying longer horizons. The third is to apply short-term shocks and scale the output of the market risk model to a single longer horizon. Each of these options is discussed in more detail below.

- **Option 1: Historical or simulated long-horizon shocks**

  Under this approach, banks would be required to apply simulated or historical shocks consistent with the regulatory liquidity horizon. In the former case, for a given sample path, the risk factors of a given risk position would be simulated until the end of the liquidity horizon and the P&L would be computed at that date. The use of simulation models would also allow for a specific treatment of different roll-over assumptions for short-dated hedging instruments that mature before the liquidity horizon of their hedged risk positions. Applying long-horizon historical shocks faces the challenge of extracting long-term independent returns from historical time series data. The use of non-overlapping returns appears to be impracticable for risk factors with relatively long liquidity horizons. For example, a sample of 100 returns would require more than eight years of historical data if the liquidity horizon were set at one month. Although overlapping returns could be used to tackle this issue, a drawback of this approach would be to underestimate the tail of the distribution because sudden extreme shocks might be smoothed over time.

- **Option 2: Historical or simulated one-day shocks directly scaled up to each liquidity horizon (ie scaling of the inputs rather than the outputs)**

  Under this approach, banks would be required to derive long horizon risk factor shocks by scaling one-day shocks with the square root of time and subsequently computing the risk measure based on these returns. This would address the problem of aggregation across different liquidity horizons, as scaling of the inputs would leave the estimated diversification benefit unchanged. A possible drawback of this approach is that it may generate some unrealistically large risk factor shocks. For example, forward rates calculated using a scaled term structure could become

negative in some cases. Another possible weakness of this approach is that the scaling technique might not respect the observed correlations between risk factors associated with different liquidity horizons: after scaling, the correlations of the risk factors might be significantly different from observed correlations. This could lead to significant over- or under-estimation of risk. To deal with this, a variant of this approach would be to use a common multiplier to scale up short-term shocks. For instance, suppose an equity risk position has a 10-day liquidity horizon while a credit risk position has a 60-day liquidity horizon. Under this approach, one-day shocks to the risk factors of the equity risk position and six-day shocks to the risk factors of the credit risk position would all be scaled up by the square root of 10. This technique would have the advantage of preserving correlations between risk factors at different horizons and may more realistically capture long horizon shocks by preserving attributes such as mean reversion.

- **Option 3: Historical or simulated one-day shocks with the aggregate risk measure scaled up to a unified weighted-average liquidity horizon.**

  Under this approach, the aggregate one-day risk measure would be scaled up to the "weighted average liquidity horizon" of the portfolio using the square root of time. Effectively, this approach is very similar to the current one-day scaled VaR practice. However, instead of scaling up to a unified horizon of 10 days, the risk measure would now be scaled up to a longer horizon depending on an assessment of the ability to unwind the portfolio as a whole without materially affecting market prices. The key challenge with this approach is how to calculate the weighted average liquidity horizon – and more specifically, what measure of exposures to use for weighting different liquidity horizon categories to arrive at a weighted average liquidity horizon. One option would be to use the mark-to-market value of different instruments. But this might not be suitable: with this choice, derivative contracts with very low mark-to-market values would have no effect on the weighted average liquidity horizon. Two simple alternatives include: (i) the use of notionals (or equivalent) at day one; or (ii) the use of the exposure at default as computed under the "current exposure method" of the Basel II framework.

The Committee recognises that the different approaches might present different implementation challenges. It is therefore seeking input from industry on how material these operational constraints are likely to be and how they might be best overcome. The Committee also recognises that the application of the different modelling approaches might result in materially different capital outcomes for a given portfolio. As a result, it intends to undertake more detailed analysis of the degree of variation in capital outcomes as part of a quantitative impact study, with a view to providing more specific guidance on how to incorporate varying liquidity horizons within the regulatory market risk metric.

3. Incorporating capital add-ons for jumps in liquidity premia

Market illiquidity can also pose risks to banks' solvency due to large fluctuations in liquidity premia in times of stress. In some cases, historical price data might not sufficiently reflect that risk. In those cases, extending liquidity horizons in the regulatory risk metric will not sufficiently capture the risks associated with market illiquidity in times of stress. To deal with this, the Committee is considering requiring banks to hold capital add-ons for potential future jumps in liquidity premia.

These capital add-ons would fit within the proposed framework for capitalising "risks not amenable to modelling". As outlined in Section 4, some types of risk may not be adequately

captured through an ES measure. In those cases, complementary capital requirements need to be defined. Volatility in liquidity premia – when not sufficiently evident in historical price data – can be seen as one example of risks not amenable to modelling.

The assessment of liquidity would be based on the same framework as that outlined in Section 1 of this Annex. There is a very clear mapping between the concept of liquidity horizons and that of liquidity premia. The latter relates to the additional compensation required by investors to hold instruments they cannot exit instantaneously due to market illiquidity. So the longer the liquidity horizon, the higher the liquidity premium investors will demand to hold an instrument in times of stress, and *vice versa*. It therefore follows that a common framework for the assessment of market liquidity can be used for the two approaches. That said, there are two elements that are specific to the application of these capital add-ons:

- First, setting out the criteria for determining whether capital add-ons for jumps in liquidity premia should be applied.
- Second, determining the precise application of the capital add-on and its calibration.

Each is discussed in turn below.

3.1 Criteria for assessing whether the capital add-on should be applied

A key operational issue is determining the scope of application of the capital add-on for jumps in liquidity premia. To mitigate the risk of double-counting, an add-on would be applied only if certain criteria are met. The objective of these criteria is to filter out the set of instruments that (i) are assessed to be less liquid (as set out under Section 1 of this Annex); and (ii) for which the market risk metric does not sufficiently incorporate the risk of future fluctuations in liquidity premia in times of stress. The conditions that the Committee is considering are set out below:

(1) **Instruments mapped to less liquid risk factors that do not exhibit sufficient volatility:** The Committee would set out "benchmark" volatilities associated with each of the liquidity horizon categories. These would increase with the length of the liquidity horizon (ie less liquid categories would be associated with higher "benchmark" volatilities). Banks would be required to compare the actual volatility of risk factors used in their internal models with these benchmarks. Instruments mapped to less liquid risk factors that exhibit insufficient volatility (so, for example, where risk factors are in the one-year liquidity horizon category but exhibit very little volatility – as would likely have been the case, for example, with some structured credit products ahead of the crisis) would be subject to a capital add-on for jumps on liquidity premia. Banks would only be required to perform this calculation on a periodic basis.

(2) **Instruments that are marked to model using unobservable inputs:** The capital charge would always apply to instruments that are marked to model based on unobservable inputs. The valuation of these financial instruments is unlikely to sufficiently reflect liquidity premia and, by extension, market risk models are also unlikely to sufficiently incorporate risks from the volatility in liquidity premia in times of stress.

(3) **Set of instruments identified by the Committee:** In certain circumstances, the Committee might mandate a set of instruments for which the capital add-on would apply. For example, the Committee might choose to apply this capital charge to asset classes that are judged not to have experienced a period of market liquidity

stress (say the 2007–9 crisis) or asset classes where the banking system as a whole or other leveraged investors are taking highly concentrated, one-way risk positions. This would deal with new products whose price behaviour has not been tested in a liquidity crisis and changes in market structures.

Going forward, the Committee will be assessing the performance of these – or additional – criteria as part of its calibration work. It would welcome feedback from industry on how additional criteria might be used to reduce the risk of double-counting in the framework and identify instruments that should receive a capital add-on for jumps in liquidity premia.

3.2 Application and calibration of capital add-ons

The Committee proposes that the capital add-on for jumps in liquidity premia be applied as a standardised capital charge. Calibrating this charge requires using information from asset prices to estimate the size of liquidity premia – effectively, seeking to disentangle the impact of (il)liquidity from other factors that affect the price of financial instruments. A number of methodologies for estimating liquidity premia have been put forward in the literature, of varying degrees of complexity.

Broadly, the calibration of the capital charge would be based on the pricing history of similar instruments that have experienced market liquidity stress in the past. Effectively, the impact of illiquidity on the pricing of these instruments would be used as a proxy to capitalise the risks associated with other instruments of a similar degree of market illiquidity, but whose price history does not sufficiently reflect volatility in liquidity premia.

More specifically, the proposed calibration process would involve the following steps:

(a) A range of financial instrument of varying degrees of market liquidity where there is a sufficiently long time series of price data reflective of actual transactions is identified;

(b) The variation in liquidity premia in previous times of market liquidity stress for these instruments is estimated using a subset of the methodologies proposed in the academic literature or by industry itself;

(c) The resulting standardised capital add-on is determined as a weighted measure across different instruments and different methodologies – to reduce model risk and parameter uncertainty.

One key outstanding issue is the degree of granularity of the capital charge. One option would be to have a relatively coarse classification, with a capital charge associated with each of the five liquidity horizon buckets. Another option would be to also vary the size of the capital add-on by broad asset class. The latter might increase risk sensitivity but also the complexity of the framework and its calibration. It is expected that further empirical work on the calibration of the capital add-ons will shed more light on this trade-off.

Annex 5

Internal models-based approach: Stressed ES

This Annex describes two possible approaches for identifying a stress period and calculating capital requirements under the internal models-based approach.

1. Direct method

The direct method is based on the approach used in the Basel 2.5 stressed VaR approach. The bank would search the entire historical period and identify the period which produces the highest ES result when all risk factors are included. Mathematically this could be written as:

$$ES_{\alpha,[t_0+f,t_0+1]} \mid x_{[t^*,t^*-g+1];1,\ldots,n} \tag{4}$$

where

- $ES_{\alpha,[t_0+f,t_0+1]}$ denotes the ES at probability level α for the next f business days after today given today's values of the full set of risk factors, and which is conditioned on
- $x_{[t^*,t^*-g+1];1,\ldots,n}$ which is a $(g \times n)$ matrix containing necessary information for the full set of n risk factors during a stress period of g business days, which ended at $t^* \left(g \geq f\right)$.

In this context f denotes the longest of all the liquidity horizons that are relevant for the bank given the risks covered by its model.

A difference to the Basel 2.5 stressed VaR approach would be that the bank would be required to determine the stressed period on the basis of a reduced set of risk factors. Once it has identified the stressed period, it would still have to determine the ES for the full set of risk factors for the stress period.

2. Indirect method

The indirect method uses a reduced set of risk factors to identify the relevant historical period of stress, but instead of calibrating the full ES model to that period only calculates a loss based on that reduced set of risk factors. That calculated loss is then scaled using the ratio of the full ES model using current market data to the full ES model using the reduced set of risk factors using current market data. Mathematically this could be written as:

$$\left(ES_{\alpha,[t_0+f,t_0+1]} \mid x_{[t^*,t^*-f+1];1,\ldots,m}\right)\left(\frac{ES_{\alpha,t_0+1} \mid x_{[t_0,t_0-g+1];1,\ldots,n}}{ES_{\alpha,t_0+1} \mid x_{[t_0,t_0-g+1];1,\ldots,m}}\right) \tag{5}$$

where

- $ES_{\alpha,[t_0+f,t_0+1]} \mid x_{[t^*,t^*-f+1];1,\ldots,m}$ denotes the change in value of the portfolio over the next *f* days given today's values of the full set of risk factors (and further valuation parameters) and given the values of the **m** risk factors in the reduced set (*m*<*n*) over a stress period of length *f* which is as long as the longest of all the liquidity horizons that are relevant for the bank given the risks covered by its model. In other words, it is the potential loss over a stress period of equal length as the forecasting period for the reduced set of risk factors. This results from a fixed scenario and is not a quantile of a distribution (despite the notation used).
- $ES_{\alpha,t_0+1} \mid x_{[t_0,t_0-g+1];1,\ldots,n}$ denotes an ES based on the **full set of n** risk factors with "tomorrow" as forecasting horizon (single-day shock) that is estimated from the period of g most recent business days.
- $ES_{\alpha,t_0+1} \mid x_{[t_0,t_0-g+1];1,\ldots,m}$ denotes an ES based on the **reduced set of m** risk factors with "tomorrow" as forecasting horizon (single-day shock) that is estimated from the period of g most recent business days.

Annex 6

Derivations and examples of the partial risk factor approach

1. Decomposition of cross-cutting risk factors

Under step 1 of the partial risk factor approach, instruments with the cross-cutting risk factors are decomposed into elementary risk positions, each with the same market value as the original instrument. Simple calculations show that this approach is valid when cross-cutting risk factors are multiplicative to the instrument's intrinsic value. For instance, consider a US bank holding a £ denominated corporate bond. Ignoring the separation of general interest rate risk and credit risk, in this case, the value of the bond can be written as $MV = S \cdot B$, where S is the Sterling-Dollar exchange rate, and B is the price of the bond in Sterling. The P&L is then $\Delta MV \approx B \cdot \Delta S + S \cdot \Delta B = MV \cdot r_S + MV \cdot r_B$. The last equation is due to the fact that $\Delta S = S \cdot r_S$ and $\Delta B = B \cdot r_B$, where r_S and r_B are percentage returns on the exchange rate risk factor and the bond's intrinsic value, respectively. In this case, the impact of FX risk ($MV \cdot r_S$) and bond risk ($MV \cdot r_B$) can be separated and are additive. Importantly, each risk is a scale of the mark-to-market value of the original position.

2. Derivation of formula (2)

Assume the P&L of instrument i can be written as:

$$P\&L_i = r_i MV_i$$

where MV_i is the mark-to-market value of instrument i, and r_i is the percentage return on the instrument. Suppose that within a bucket there are a total of I instruments. The return on instrument i, r_i, is assumed to depend on four factors:

- A systematic factor *Z;*
- A maturity factor $M_{m(i)}$, where *m(i)* is the remaining maturity of instrument *i;*
- A firm-specific factor $F_{f(i)}$, where *f(i)* is the underlying firm/name/issuer for instrument *i;* and
- An idiosyncratic (instrument-specific) factor ε_i.

In particular:

$$r_i = \rho_z Z + \rho_m M_{m(i)} + \rho_f F_{f(i)} + \sqrt{1 - \rho_z^2 - \rho_m^2 - \rho_f^2}\,\varepsilon_i$$

Similar to the Gaussian Copula model used in the Basel II internal ratings-based approaches, assume that Z, M, F and ε_i are mutually independent, and normally distributed.[62] Furthermore, for two instruments i and j that have quite different maturities (underlying firms), so that $\left|m(i)-m(j)\right|<T$, for a regulator-specified maturity gap T (respectively $f(i)\neq f(j)$), $M_{m(i)}$ and $M_{m(j)}$ (respectively $F_{f(i)}$ and $F_{f(j)}$) are assumed to be mutually independent.

This setup has two results:

(a) The correlation between returns of instruments i and j in the same bucket, ρ_{ij}, can be one of four things:

- ρ_z^2: baseline correlation for any two instruments in the bucket, because any instrument is correlated to the systematic factor.
- $\rho_z^2+\rho_m^2$: if instruments i and j have similar maturities (difference not bigger than T).
- $\rho_z^2+\rho_f^2$: if instruments i and j have the same underlying firm or name.
- $\rho_z^2+\rho_m^2+\rho_f^2$: if instruments i and j have the same underlying and similar maturity.

(b) The P&L distribution of the bucket is also normally distributed:

$$\sum_{i=1}^{I} P\&L_i=\sum_{i=1}^{I} MV_i r_i \sim N\left(0,\mathbf{V}'\mathbf{\Omega}\mathbf{V}\right)$$

where $\mathbf{V}$ is a vector of mark-to-market values $\mathbf{V}'=\left(MV_1,MV_2,\ldots,MV_I\right)$ and $\mathbf{\Omega}$ is a correlation matrix with the (i,j)th entry equal to ρ_{ij}. This result follows directly from the additive properties of multivariate normal distributions.

These two results imply that a VaR-type risk measure for bucket b takes the form of:

$$K_b=RW\sqrt{\mathbf{V}'\mathbf{\Omega}\mathbf{V}}$$

where RW is the quantile of the normal distribution associated with a certain confidence level, or it can be a tail average, to achieve an ES-type risk weight. To allow for more flexibility, this risk weight can be generalised to vary across instruments depending on maturity, so that the risk weight for instrument i is RW_i instead.[63] Making this generalisation and writing out the inner product inside the square root results in the risk measure formula in (2).

[62] Normal distribution is assumed for theoretical tractability. Many financial instruments violate this assumption, and the calibration process allows for non-normal returns distributions.

[63] See Section 5 of this annex for an example.

3. Derivation of formula (3)

First note that under the partial risk factor approach, for bucket *b*

$$K_b = \sqrt{\sum_{i\in b} RW_i^2 MV_i^2 + \sum_{i\in b}\sum_{j\in b, j\neq i} \rho_{ij} RW_i MV_i RW_j MV_j}$$

The goal is to find expression *y* in the following equation:

$$capital = \sqrt{\sum_{b=1}^{B} K_b^2 + y}$$

such that this externally aggregated capital would be equal to the risk calculation if the **entire trading book was treated as one bucket**. Suppose the total number of instruments in the trading book is *N*. Then:

$$y = \underbrace{\sum_{i}^{N} RW_i^2 MV_i^2 + \sum_{i}^{N}\sum_{j\neq i}^{N} \rho_{ij} RW_i MV_i RW_j MV_j}_{\text{Square of capital if entire trading book is one bucket}}$$
$$- \underbrace{\sum_{b=1}^{B}\left(\sum_{i\in b} RW_i^2 MV_i^2 + \sum_{i\in b}\sum_{j\in b, j\neq i} \rho_{ij} RW_i MV_i RW_j MV_j\right)}_{\sum_{b=1}^{B} K_b^2}$$
$$= \sum_{b=1}^{B}\sum_{i\in b} RW_i MV_i \left(\sum_{j\notin b} \rho_{ij} RW_j MV_j\right)$$

Assuming that $\rho_{ij} = \gamma_{bc}$, for any $i \in b$ and any $j \in c$ (ie, any one instrument in bucket *b* and any one instrument in bucket *c* has the same correlation γ_{bc}), then

$$y = \sum_{b}^{B}\sum_{c\neq b} \gamma_{bc} \left(\sum_{i\in b} RW_i MV_i\right)\left(\sum_{j\in c} RW_j MV_j\right)$$

Using the definition of S_b and S_c results in the aggregation formula in (3).

4. A worked example

This example explores the mechanics of the partial risk factor approach and its treatment of FX and interest rate risks.

(a) A Brazilian bank takes a (i) USD 100 million 9 month loan (assuming the loan is in the trading book) to fund the purchase of (ii) a GBP 62 million (USD 100 million equivalent at current FX rates, or BRL 172 million) six-year UK Gilt.

(b) The Real-based bank adds the following cross-currency swap to portfolio (a): (i) receiving leg in USD; (ii) paying leg in GBP. The contract is a fixed-to-fixed five-year contract with a notional value of USD 100 million (or its equivalent to corresponding FX rates) and their current mark-to-market value is zero.

Instrument	Bucketing	Comment
(a)(i) – loan	-BRL 172 mn in general interest rate risk buckets	Negative cash flows on deposit payments, use cash flow vertex method
	-BRL 172 mn in USD/BRL bucket	Short FX since payments in USD, not BRL
(a)(ii) – six-year Gilt	+BRL 172 mn in the IG sovereign bond bucket (Gilt spreads only)	Captures credit risk of the UK sovereign bond, including spread risk.
	+BRL 172 mn in general interest rate risk buckets	General interest rate risk of the sovereign bond, use cash flow vertex method
	+BRL 172 mn in GBP/BRL bucket	Long FX because the bond pays in GBP, not BRL
(b) cross-currency swap: receive in USD pay GBP	+BRL 172 mn in general interest rate risk buckets	Positive cash flows from receive leg, use cash flow vertex method
	+BRL 172 mn in USD/BRL bucket	Long USD since receiving USD not BRL
	-BRL 172 mn in general interest rate risk buckets	Negative cash flows from pay leg, use cash flow vertex method
	-BRL 172 mn in GBP/BRL	Short GBP since paying GBP, not BRL

Analysis: there are total of three instruments in this portfolio that combines (a) and (b). Assuming the interest rates that determine the coupon/payments are all the same (eg three-month LIBOR), the FX risk is treated as completely hedged. The interest rate risk is hedged, except for the maturity mismatch between the legs of the cross-currency swap, and the cash instrument in the same currency. Apart from this, the only risk in this transaction is credit risk to the UK government. This is what the partial risk factor approach isolates. (Counterparty credit risk and CVA risk are treated according to Basel III.)

5. An example of the calibration process

The calibration process for the partial risk factor standardised approach is illustrated in this section of this Annex using an equity options example. Note that this example is an illustration, and details of the calibration processes are subjected to further refinements. When formal calibration is conducted the definition of the buckets would likely changes; the values of the regulatory parameters will almost surely change.

As discussed in step 1 of Section 5.1, there will be a set of “options” buckets under the equities asset class that will be part of the delta-equivalent treatment of options. The following is an example of the calibration process for these options buckets *net of delta risks*.

Data: September 2008 data from Ivy DB’s OptionMetrics.

- Includes all options traded in exchanges located in the US.
- Approximately 250,000 options in the data set covering roughly a combined 15,000 firm/index underlyings, ranging across maturities and strikes. Most single name options have American exercise style, while most index options have European exercise style.

- Prices are available on most days in the month for the majority of these options.
- Greeks are available for the majority of these options.

Data filters: the unit of observation in this dataset is option-date. The following observations are removed:

- Options with zero open interests (ie no outstanding contracts).
- Options with zero or negative bids, and those with zero or negative bid-ask spreads.
- Options that do not have deltas.
- Options for which the price of the underlying is not available.

Delta-adjusted returns: for a given option, the trade-gap adjusted returns are calculated through the month (eg if there are five days in between a pair of trades, the return calculated using this pair is scaled back using the square root of time as a proxy for the one day return). These returns are then delta-adjusted (or the delta effects "stripped out") by subtracting delta × stock return from the option return. The mean and standard deviation of these delta-adjusted returns are calculated for the month. The standard deviation is used as the dependent variable in the bucketing regression tree analysis.[64]

Independent variables or predictors: a snapshot of option characteristics are taken at the beginning of the month. These include:

- Moneyness normalised by realised volatility: defined as $\ln\left(\frac{S_0}{K}\right) \div \sigma_{past\ six\ months}$, where $\sigma_{past\ six\ months}$ is the realised volatility of daily stock returns calculated using six months of historical data up to September 2008.
- Remaining maturity of the option, in calendar days.
- The industry of the underlying: 1 for financials and 0 otherwise.
- Whether the underlying is an index: 1 for index options and 0 otherwise.

The choice of a normalised moneyness is consistent with a strand of option pricing literature.[65] The idea is that the greater the discrepancy between the implied volatility (as reflected by option price) and the realised volatility, the more volatile the option returns. The same literature finds that, after controlling for realised volatility, firm-specific variables such as industry, size and book-to-market have little impact on option returns. Thus, controlling for this normalised moneyness reduces the number of variables in the analysis.

Calibration of buckets: using the standard deviation of delta-adjusted returns of the dependent variable and the aforementioned independent variables, regression trees for call

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[64] In future work, the Committee would consider using a VaR/ES on the returns distribution as a risk measure, rather than standard deviations. This is probably more appropriate given that option returns distributions are typically asymmetric, with a strong skew to the right. In particular, if one buys an option, the maximum downside is -100% while the upside is in theory unlimited.

[65] See, for example, A Goyal and A Saretto (2009), "Cross-section of option returns and volatility", *Journal of Financial Economics*, 94, pp 310–326.

options and put options are fitted. The trees are pruned at nine call option buckets and nine put option buckets.

Calibration of correlations within a bucket: each bucket has four correlation parameters: "Corr1" if the pair of options have same underlying and maturity difference less than one standard deviation of the distribution of option maturities in the bucket; "Corr2" if the pair have same underlying; "Corr3" if the pair have maturity difference less than one standard deviation; and "Corr4" for all remaining pairs. Each parameter is calibrated by taking the median of the distribution of pairwise correlations of delta-adjusted returns within each group. In future work, we can improve this correlation calibration by more formally selecting the variables that best capture the within bucket correlation – for instance, similarities in moneyness may be more important as a correlation dimension than similarities in maturities. Formal statistical inference may affirm or refute this type of claims.

Calibration of risk weights within a bucket: for risk weights, the delta-adjusted returns standard deviation for each option is modeled as a quadratic function of the option's maturity. In future work, three potential improvements can be made. First, we may focus on a VaR/ES measure of returns rather than standard deviation. Second, we may consider the risk weight as a continuous function of moneyness instead of maturity (or both), and third the risk weight might even be different for longs and shorts. The risk weights take the form of:

$$RW_i = r_0 + (r_1 \times maturity) + (r_2 \times maturity^2).$$

Calibration results: two (out of nine) call options buckets and two (out of nine) put option buckets are presented here for brevity.

Bucket	Call option bucket #1	Call option bucket #2	Put option bucket #5	Put option bucket #8
Maturity	< 56.5	< 56.5	[78.5, 164.5)	>= 74.5
Moneyness	< -4.5	>= -4.5	< .5	[.5, 5.5)
Industry	All	Non-fin	All	All
Index option	All	Non-index	All	All
# of options	6,596	3,452	15,858	10,645
Corr1	91.1%	77.57%	93.4%	98.1%
Corr2	90.0%	N/A	95.1%	92.1%
Corr3	28.8%	9.78%	50.1%	44.8%
Corr4	32.8%	N/A	49.9%	45.4%
r_0	50.23%	15.8%	54.3%	16.9%
r_1	-0.3%	1.3%	-0.29%	-0.037%
r_2	-0.00003%	-0.02%	-0.0006%	-0.000003%

Applying the calibration results to a stylised options portfolio: five put options on financial sector equities are used to illustrate how the partial risk factor approach works. These options all fall into "put option bucket #5" in the above table:

Underlying name	Option price	Number	Market value	Contract size	Underlying price	Delta	Delta-equiv. risk position [mn]	Strike	Moneyness	Maturity (days)
HSBC	19.25	35	673.75	1000	466.85	-0.51	-8,322	470	-0.07	106
Standard Chartered	47.5	24	1140	1000	1268	-0.43	12,937	1250	0.16	106
Wells	1.04	-88	-91.52	100	23.21	-0.45	91	23	0.1	107
London Stock Exchange	32.5	56	1820	1000	800	-0.54	24,320	800	0	106
Citigroup Inc	1.09	-78	-85.02	100	30.2	-0.45	107	30	0.07	107

A delta-equivalent risk position is first allocated into the relevant underlying equity bucket, based on the characteristics of the underlying. These risk positions will be treated like any other equity risk position in the underlying. It should be noted the delta-equivalent risk position is large compared with the options' market values.[66]

The risk weight of option *i* (RW_i) can be calculated using

$$RW_i = r_0 + (r_1 \times maturity) + (r_2 \times maturity^2).$$

Because all options are in "put option bucket #5", using the relevant parameters in that bucket, those options that have maturity of 106 days have a risk weight of 16.8%, while those with maturity of 107 days have a risk weight of 16.4%. The pairwise correlation between each pair of options in this portfolio is 50.1%, or "Corr3", since all options have different underlyings but very similar maturities.

Using the bucket risk measure formula

$$K_b = \sqrt{\sum_{i=1}^{I} RW_i^2 MV_i^2 + \sum_{i=1}^{I} \sum_{j \neq i} \rho_{ij} RW_i MV_i RW_j MV_j} \ ,$$

with $\rho_{ij} = 0.501$, the risk weights discussed above and the MV of the instruments, the estimate of the non-delta risks of this options portfolio under the partial risk factor approach is 491, or 13% of the sum of absolute MV of the options.

[66] Calibration of equity buckets has not been completed, therefore no results at this point.

Annex 7

Fuller risk factor approach

This Annex describes in further detail how the fuller risk factor approach described in Section 5.2 might be implemented. This annex is presented in the same three step framework as Section 5.2. Throughout this annex the following simple example is used for illustrative purposes:

The bank holds 1,000 Daimler shares at a share price of €101, and it has sold 500 Volkswagen shares under a forward contract that matures in one year. The current share price for Volkswagen is €20.

Step 1: The bank maps each instrument to applicable risk factors

As described in Section 5.2, the rules would define a set of regulatory risk factors and describe which risk factors the bank would have to apply to any given instrument (ie a "mapping" function). Most risk factors would be defined as hedgeable and designed to reflect hedging across instruments, and these would apply to all instruments that are subject to the risk that the respective risk factor is designed to capture. Other risk factors are non-hedgeable and capture residual risks that are not captured by the hedgeable risk factors. The hedgeable risk factors would be set up in a hierarchy. For risk factors at the higher end of the hierarchy hedging would be recognised across a wider range of instruments than for risk factors at the lower end. Table 8 gives an example of what the hierarchy of risk factors could look like for the five risk factor classes (further risk factors such as implied volatility and credit risk correlation might be added).

Some risk factors would be deemed non-hedgeable in order to capture basis risk (ie risk that cannot easily be hedged in stressed conditions). Hence, for simple cash instruments such as cash equities all risks would be captured by hedgeable risk factors. For other instruments, such as bonds and derivatives, non-hedgeable risk factors would also be used.

This approach could result in a large number of risk factors. In order to keep the approach simple, a smaller set of calibrations of the standard deviation or shock applied to the risk factor would be allocated to different risk factors. For example, all name-specific equity risk factors could be assigned the same standard deviation.

Example: In the equity example, hedgeable risk factors would include movements in global equity markets, sectoral equity indices and individual equity prices. Daimler and Volkswagen have the same hedgeable risk factors at levels I and II in Table 8, ie global and industry-specific equity indices. They do not have the same risk factor at level III as they would be mapped to different individual equity risk factors. However, these risk factors would be able to be hedged with other positions that shared this risk factor such as Daimler equity options. There would also be a non-hedgeable risk factor for the Volkswagen equity price to capture basis risk from the forward. The interest rate risk from the payment leg of the forward would be captured by risk factors for interest rate risk.

Table 8

Hierarchy of hedgeable risk factors under fuller risk factor approach

Level	FX risk	Interest rate risk	Equity risk	Credit risk	Commodity risk
I	Exchange rate of domestic currency to worldwide currency basket	Worldwide interest rate index	Worldwide equity index	Worldwide credit spread index	Commodity price index
II	Exchange rate of worldwide currency basket to respective foreign currency	Level of money market/swap rate curve in respective currency	Equity index by broad industry category	Credit spread index by industry category	Price index for commodity type
III		Slope of money market/swap rate curve in respective currency	Price of individual equity	Credit spread for individual issuer	Price index for physical type of commodity
IV		Money market/ swap rate between vertex points in respective currency (residual)			

Step 2: For each risk factor the bank determines the net risk position

For each risk factor the bank determines a net risk position, which is the sum of gross risk positions for all instruments that are subject to that risk factor.

For linear instruments, the size of the gross risk position is the market value of the instrument. For equities this is equivalent to assuming that equity betas are homogeneous and equal to one. This is conceptually similar to how specific and general market risk are handled for equities in the current SMM. For FX the size of the gross risk position is the market value of the instrument converted to the reporting currency of the bank. For linear interest rate risk and credit risk related instruments the size of the gross risk position is determined by applying a small shift to the respective risk factor and determining the value change of the instrument in relation to the shift applied.

Capturing the risks of non-linear instruments is more complicated since the sensitivity of the value to a risk factor can no longer be accurately represented by a linear shock. This difficulty may be overcome by permitting use of pricing models to calculate the impact on the price of shifts to the risk factors, similar to the current scenario-based approach to options. In order to capture curvature, non-linear instruments are revalued with respect to a range of deterministic shifts for the underlying risk factors (eg six with three positive, three negative). For each shift the size of the gross risk position would be determined and summed across instruments, taking into account linear instruments as well. In this way hedging is recognised across linear and non-linear instruments.

Example: The table below shows the gross and net risk positions for Daimler and Volkswagen equities for the equity risk factor class.

Level	Equity risk	Daimler Gross risk position	Volkswagen Gross risk position	Total Size of net risk position
I	Worldwide equity index	€101,000	€-10,000	€91,000
II	Industry equity index	€101,000	€-10,000	€91,000
III	Daimler share price	€101,000	–	€101,000
	Volkswagen share price	–	€-10,000	€-10,000
n-h*	Volkswagen share price	–	€-10,000	€-10,000

* For "non-hedgeable risk factor".

For example, the size of the gross risk position from the Daimler shares for the applicable risk factors at all levels is determined as: number of shares (1,000) times share prices (€101).

Step 3: Aggregate net risk positions to determine a capital requirement for each risk class

The net risk positions then need to be converted into a capital charge. To this end the shifts combined with net risk positions are calculated for each risk factor class (which then represents the variance of the portfolio). To recognise diversification it would be necessary to impose a distribution on the risk factors. However, specifying a distribution of risk factors, with appropriate pairwise correlations between risk factors, is likely to be a burdensome and complex task for regulators and would also complicate banks' calculations considerably. The computationally simplest approach is to treat all risk factors of the same risk factor class as independently distributed.

Curvature of the value with respect to a risk factor is captured for each risk factor separately, where relevant. When no curvature is involved the variance is the product of the size of the net risk position and the standard deviation (ie risk factor shift) assigned to the risk factor. When curvature is involved the variance is determined using the six shifts applied to the risk factor as described above, combined using a regulatory formula.

In a final calculation, the square root is taken from the portfolio variance. This portfolio standard deviation is multiplied by a scalar to achieve the overall desired level of prudence. To be consistent with the models-based approach, this would be chosen to reflect an estimated expected shortfall of the regulatory risk factors. Finally, the capital requirements for each risk factor class are aggregated using a formula similar to the regulatory algorithm applied in the models approach (see formula (1) in Section 4.5.6).

Note that the approach described above may not capture the risks of exotic instruments in detail. For example, no particular time paths are specified for the risk factors, which means that the risks from path-dependent instruments (eg Asian options, barrier options) are not well captured. This could be addressed by imposing higher standard deviations for the non-hedgeable risk factors for more exotic products, driving higher capital charges for these products which cannot be reduced by hedging.

Example: Below an example shows the calculation of the capital charge for equity risk for the equities portfolio based on illustrative parameters.

Level	Equity risk: portfolio	Net risk position (EUR)	Standard deviation (ie shift) of risk factor	Standard deviation of net risk position	Square the standard deviation of the net risk position (ie variance)
I	Worldwide equity index	91,000	5%	4,550	20,702,500
II	Industry equity index	91,000	7%	6,370	40,576,900
III	Price of Daimler share	101,000	10%	10,100	102,010,000
III	Price of Volkswagen share	-10,000	-10%	1,000	1,000,000
n-h*	Volkswagen share price	-10,000	1%	100	10.000
Portfolio	Sum the squared standard deviations (portfolio variance)				164,289,400
Portfolio	Take the square root (portfolio standard deviation)				12,818
Portfolio	Multiply by scalar to obtain expected shortfall				51,270

* For “non-hedgeable risk factor”.

Calibration of the fuller risk factor approach

The standard deviation assigned to a risk factor has a similar role as a risk weight in the current standardised measurement method (like, for example, the percentage changes of share prices applied in the calculation of general and specific equity risk in the current standardised rules). The standard deviations should be calibrated to capture tail properties of the joint distribution of the risk factors under stress. The empirical estimates may then be adjusted by the Committee to provide a prudent treatment of hedging. This could be done by increasing the relative size of standard deviations applied to risk factors lower in the hierarchy. Adjustments could also be made to reflect variable liquidity horizons.

An issue common to both the partial risk factor approach and the fuller risk factor approach is whether they are calibrated to a single stressed period (eg the Lehman episode in late 2008) or whether they may be based on experience across several stress periods. This is an important issue since risk factors may move in the same direction in one stress period and in different directions in another stress period.[67] The fuller risk factor approach seeks to deal with this issue by combining standard deviations observed in different crisis periods, and by making prudent adjustments to shifts at lower levels (as described above) when high level (ie “more hedgeable”) risk factors are found to have relatively unstable correlations. However, if risk factors are assumed to be independently distributed as suggested above, no correlations are specified and so changes in correlations over different stressed periods cannot be reflected in detail.

[67] For example, Yen and Dollar 5y zero coupon rates moved together in the 2008 stress but diverged in the 1999 stress.

Glossary

Actual daily desk-level P&L: The daily desk-level economic P&L based on the mark-to-market of the books and records of the bank.

Backtesting: The process of comparing daily profits and losses with model-generated risk measures to gauge the quality and accuracy of risk measurement systems.

Basis risk: The risk that prices of financial instruments in a hedging strategy will move in a way that reduces the effectiveness of the hedging strategy.

Benchmark (in the context of the SMM/internal models-based approach relationship): The use of SMM capital charges as a consistent metric of comparison of capital charges calculated using internal models-based approaches both across banks and through time.

Component risk factor: An instrument is decomposed into individual component risk factors which are then mapped to a risk factor class

"Cross-cutting" risk factor: A risk factor that affects the valuation of a large number of instruments across the trading book. Examples include exchange rates and interest rates from money market or swap curves.

Credit Valuation Adjustment (CVA): An adjustment to the valuation of a derivative transaction to account for the credit risk of contracting parties.

Current expected shortfall: ES based on current data history of the risk factors (in contrast to the stressed data history).

CVA risk: The risk of changes to CVA arising from changes in credit spreads of the contracting parties, perhaps compounded by changes to the value of the underlying of the derivative transaction.

Desk's risk management model: The desk's risk management model includes all risk factors which are included in the bank's internal ES with supervisory parameters. Risk factors which are deemed not modellable by the supervisor in step 3 and which are therefore not included in the ES for calculating the respective regulatory capital charge might be still included in the bank's internal ES.

Diversification: The process of constructing a portfolio of instruments that are relatively uncorrelated with one another, in order to minimise exposure to individual risks, such as issuers or risk classes.

Expected holding period: The time period banks expect to hold risk positions as part of their documented trading strategies.

Endogenous liquidity: The relative effect on the sale price from the act of liquidating exposures or portfolios within a certain amount of time.

Fallback (in the context of the SMM /internal models-based approach relationship): The process of requiring banks to switch to the SMM when internal models are not performing to adequate standards.

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 both primary financial instruments (or cash instruments) and derivative financial instruments.

Floor (in the context of the SMM /internal models-based approach relationship): A level of capital charges (calculated as a percentage of the SMM capital charges) acting as a minimum to the Pillar 1 internal models-based capital charges.

Liquidity horizon: The time required to exit or hedge a risk position without materially affecting market prices in stressed market conditions.

Liquidity premium: The additional premium demanded by investors to hold financial instruments that cannot be readily liquidated in the market.

Market risk: The risk of losses in on- and off-balance-sheet risk positions arising from movements in market prices.

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. The latter kind of pricing models may be simpler than the former. A pricing model may be the combination of several calculations; for example a first valuation technique to compute a price, followed by valuation adjustments for risks that are not incorporated in the first step.

Primary risk class: A set of trading desks that are exposed to largely similar primary risk factors.

Primary risk factor: The risk factor which is most important for a specific instrument.

Profit and loss (P&L) attribution: A backtesting method for assessing the robustness of banks' risk management models by comparing the hypothetical P&L predicted by risk management models to the actual P&L.

"Real" prices: A criterion for assessing whether risk factors will be amendable to modelling. A price will be considered "real" if: it is a price from an actual transaction conducted by the bank; it is a price from an actual transaction between other parties (eg at an exchange); or it is a price taken from a firm quote (ie a price at which the bank could transact).

Risk class: Either a primary risk class or a risk factor class depending on the method used to aggregate risk positions in the internal models-based approach. Across risk classes supervisory determined/restricted correlations have to be used to determine regulatory capital.

Risk factor: A principal determinant of the change in value of a transaction that is used for the quantification of risk. Risk positions are modelled by risk factors.

Risk factor class: (Component) Risk factors are mapped to the risk factor classes equity, credit, interest rate, commodities and FX.

Risk position: A risk position is a conceptual construct that represents a particular aspect of risk that is associated with a transaction within a market risk model or a standardised approach for market risk. Example: A bond denominated in a currency different to a bank's reporting currency may be mapped to a risk position for FX risk, a number of risk positions for interest rate risk (in the foreign currency) and one or more risk positions for credit risk.

"Risk-theoretical" P&L: The daily desk-level (hypothetical) P&L that is predicted by the risk management model conditional on a realisation of all relevant risk factors that enter the model.

Trading desk: A separately managed business line within a bank that follows defined trading strategies with certain instruments, with the goal of generating revenues or maintaining market presence while from assuming and managing risk.

Surcharge (in the context of the SMM/internal models-based approach relationship): A Pillar 1 capital charge (calculated as a percentage of the SMM capital charges) required in addition to the capital charge under the internal models-based approach.

Interest rate risk in the banking book: The exposure of a bank's financial condition to adverse movements in interest rates stemming from banking book assets and liabilities.

Summary of questions

1. Which boundary option do you believe would best address the weaknesses identified with the current boundary, whilst meeting the Committee's objectives?

2. What are commenters' views on the likely operational constraints with the Committee's proposed approach to capturing market liquidity risk and how might these be best overcome?

3. What are commenters' views on the proposed regime to strengthen the relationship between the standardised and internal models-based approaches?

4. What are commenters' views on the Committee's proposed desk-level approach to achieve a more granular model approval process, including the implementation of this approach for banking book risk positions? Are there alternative classifications that might deliver the same objective?

5. What are commenters' views on the merits of the "direct" and "indirect" approaches to deliver the Committee's objectives of calibrating the framework to a period of significant financial stress?

6. What are commenters' views on the merits of the desk-based and risk-factor-based aggregation mechanisms to deliver the Committee's objectives of constraining diversification benefits?

7. How can regulators ensure robust supervision of integrated market and credit risk modelling? In particular, how would an integrated modelling approach affect other elements of the proposed framework (eg the choice of the quantile parameter for ES, the P&L attribution and backtesting processes, etc)?

8. What are the likely operational constraints with moving from VaR to ES, including any challenges in delivering robust backtesting, and how might these be best overcome?

9. Which of the two approaches better meets the Committee's objectives for a revised standardised approach?

10. Do commenters propose any amendments to these approaches?