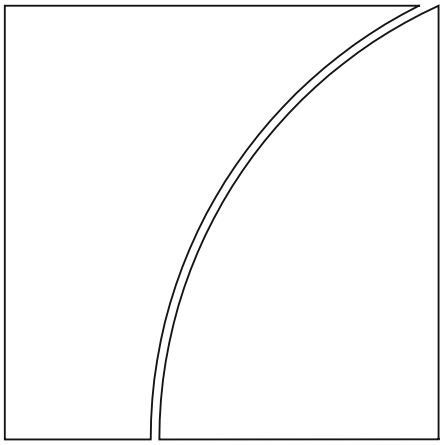
Basel Committee on Banking Supervision

Consultative Document



Interest rate risk in the banking book

Issued for comment by 11 September 2015

June 2015

BANK FOR INTERNATIONAL SETTLEMENTS

This publication is available on the BIS website (www.bis.org).

ISBN 978-92-9197-115-2 (print)

ISBN 978-92-9197-114-5 (online)

Contents

Interest rate risk in the banking book

Executive summary

Interest rate risk in the banking book (IRRBB) is currently part of the Basel capital framework's Pillar 2 (Supervisory Review Process). Most jurisdictions follow this approach, which is based on the Committee's guidance set out in the 2004 *Principles for the management and supervision of interest rate risk* (henceforth the IRR Principles).[1] The IRR Principles lay out the Committee's expectations for banks' identification, measurement, monitoring and control of IRRBB as well as its supervision.

The Committee is proposing changes to the regulatory capital treatment and supervision of IRRBB for two reasons. First, to help ensure that banks have appropriate capital to cover potential losses from exposures to changes in interest rates. This is particularly important in the light of the current exceptionally low interest rates. Second, to limit incentives for capital arbitrage between the trading book and the banking book, as well as between banking book portfolios that are subject to different accounting treatments. This is particularly important given the enhancements to the capital treatment of positions in the trading book, including the Committee's ongoing *Fundamental Review of the Trading Book* (FRTB).[2]

This consultative document presents two options for the regulatory treatments of IRRBB: a standardised Pillar 1 (Minimum Capital Requirements) approach and an enhanced Pillar 2 approach (which also includes elements of Pillar 3 – Market Discipline). By adopting a uniformly applied Pillar 1 measure for calculating minimum IRRBB capital requirements, the framework would have the benefit of promoting greater consistency, transparency and comparability. This would have the advantage of promoting market confidence in banks' capital adequacy and a level playing field internationally. Conversely, an advantage of a Pillar 2 approach is that it can better accommodate differing market conditions and risk management practices across jurisdictions. Moreover, the required calculation of a standardised framework, embedded in a Pillar 2 approach, represents a new hybrid intersection between a capital requirement (Pillar 1) and a supervisory review process (Pillar 2) and would have served to promote greater consistency, transparency and comparability.

Given the motivations behind this new proposal, the Committee is of the view that a strengthened framework for IRRBB is necessary.

Consistent with Part I (Scope of Application) of the Basel II framework, the proposed framework would be applied to large internationally active banks on a consolidated basis. Supervisors would have the national discretion to apply the IRRBB framework to other non-internationally active institutions.[3]

The Committee is seeking comments on the proposed approaches, which share a number of common features. The Committee will carefully review the comments received with the aim of narrowing down its policy options. In doing so, the Committee will also take into account progress made by other areas on the Committee's efforts to balancing risk sensitivity, simplicity and comparability.

[1] www.bis.org/publ/bcbs108.htm.

[2] The first consultative paper is available at www.bis.org/publ/bcbs219.pdf.

[3] See BCBS, *International Convergence of Capital Measurement and Capital Standards: A Revised Framework - Comprehensive Version*, June 2006.

This consultation paper is structured as follows. Section I provides an introduction to IRRBB, reviews the lessons from the crisis and summarises past and new policy aspects and challenges related to IRRBB. Section II presents the proposal for a standardised Pillar 1 capital framework for IRRBB. Using an economic value of equity (EVE) measure, interest rate risk exposure is measured against several interest rate shock scenarios (ie parallel up and downwards shifts in the yield curve, steepening, flattening, as well as short-term up and down interest rate shocks). These scenarios are designed to be sensitive to local economic conditions and also reflective of measures of global interest rate volatility.

The proposal recognises that not all banking book positions are easily amenable to standardisation, given uncertainty about the timing of cash flows due to behavioural aspects and embedded options (eg non-maturity deposits, loan prepayment). The proposal provides flexibility to allow banks to use internal parameter estimates for certain products – subject to constraints as well as supervisory review and approval.

The Committee acknowledges the risk of unintended consequences if an IRRBB framework were to create incentives to exclusively mitigate possible declines in EVE. There is a trade-off between optimal duration of equity and earnings stability. To address this issue, the Committee is proposing overlaying the EVE measure with an earnings-based metrics in the Pillar 1 framework.

Section III presents revised principles, which would apply as an alternative to the Pillar 1 framework and are intended to replace the IRR Principles for defining supervisory expectations on the management of IRRBB (including credit spread risk in the banking book (CSRBB)). The nine principles addressed to banks set out expectations on the corporate and risk governance framework, as well as on the disclosure of banks' IRRBB exposures and capital as well as earnings measures, and include an expectation that a bank will allocate adequate internal capital to cover the risk. The three principles addressed to supervisors cover supervisory reporting, data-gathering, assessment and capital review.

Section III also expands on the enhanced Pillar 2 approach. Under this approach, banks would be allowed to use their internal measurement systems (IMS) for assessing their capital adequacy subject to supervisory approval. The standardised approach outlined in Section II of this consultative document would serve as a fallback to a bank's IMS. The Pillar 2 approach includes standardised disclosure of a bank's IRRBB risk profile, key measurement assumptions, qualitative and quantitative assessment of IRRBB levels and quantitative disclosure of IRRBB metrics, including the standardised calculation framework. The proposal also includes guidance for supervisory responses with a strong presumption for capital consequences for banks with high levels of IRRBB relative to their level of capital and sophistication of risk management.

The Committee is seeking comments specifically on:

(i) technical aspects, particularly regarding the approaches for behavioural options, the earnings overlay and basis risk;

(ii) specification and values of the standardised risk parameters (eg pass-through rate, stability rate, maturity cap, conditional prepayment rate, pull-through rate, term deposit redemption rate, time horizon of the earnings measure, basis risk parameters) as well as constraints on the own estimate risk parameters (eg stability cap, pass-through floor, maturity cap);

(iii) specification, selection and calibration of the prescribed interest rate shock scenarios;

(iv) specification of the candidate minimum capital requirements calculations, in particular on a possible earnings-based overlay to the EVE measure, the scenario-consistency principle and currency aggregation rule;

(v) the mandatory disclosure of the standardised framework under the Pillar 2 alternative; and

(vi) information as to how the standardised framework measure compares to banks' internal interest rate risk in the banking book measures.

I. Introduction

Interest rate risk is a bank's exposure to adverse movements in interest rates. Interest rate risk in the banking book (IRRBB) more specifically refers to the current or prospective risk to the bank's capital and earnings arising from adverse movements in interest rates that affect the institution's banking book positions. When interest rates change, the present value and timing of future cash flows change. This in turn changes the underlying value of a bank's assets, liabilities and off-balance sheet instruments and hence its economic value (EV). Changes in interest rates also affect a bank's earnings by altering interest-sensitive income and expenses, affecting its net interest income (NII). This risk is inherent to the banking business and its successful management can have an important impact on profitability and shareholder value. Indeed, excessive interest rate risk can pose a significant threat to a bank's current capital base and/or future earnings if not managed appropriately.

1. Lessons from the crisis and the Fundamental Review of the Trading Book

Financial instruments subject to similar interest rate risk and credit spread risk could result in materially different minimum capital requirements, depending on whether the positions are held in the regulatory trading book or banking book. This reflects the different notions of risk between positions in the two books. Banking book instruments are generally intended to be held to maturity, with changes in market value not necessarily reflected in financial accounts or capital requirements. Credit default risk is the primary focus of such exposures. By contrast, banks holding a similar portfolio of financial contracts in the trading book are exposed to fair value losses through income associated with both general movements in market interest rates and idiosyncratic changes in credit spreads, along with default risk. As a result, each of these market risk elements is treated under the trading book's Pillar 1 framework, while IRRBB has remained within the Pillar 2 framework.

In the lead-up to the crisis, banks could designate instruments with observable market prices to the trading book by claiming trading intent – a subjective concept which was difficult for supervisors to invalidate. During the crisis, many positions became illiquid and some banks avoided the impact on income by redesignating such positions to the banking book and subjecting them only to the minimum capital requirements for credit default risk.

Further, under current accounting designations, fair value option positions could also be allocated to the banking book. Gains and losses from available-for-sale (AFS) positions were accounted for directly through equity and, in many jurisdictions, were partially filtered out of regulatory capital.[4]

Post-crisis, the Committee initiated a fundamental review of the capital framework for market risk, which, among other things, identified the different capital treatment of similar types of risks across a bank's balance sheets. The first consultative document on the *Fundamental Review of the Trading Book* (FRTB) published in May 2012 described the losses suffered from several banks' investment banking activities during the period from January 2007 to March 2009. Although most of the losses in the analysis crystallised on instruments held in the (regulatory) trading book, a material proportion were held in the banking book. In one jurisdiction, losses in the regulatory banking book arose from instruments originally accounted for as held-for-trading (HFT) that had been transferred from the

[4] Note, however, that according to paragraph 52 of the Basel III framework (www.bis.org/publ/bcbs189.pdf), unrealised fair value gains and losses are no longer filtered from regulatory capital. Common Equity Tier 1 (CET1) is directly impacted by changes in both fair value through the profit and loss accounts and equity (accounted for under accumulated other comprehensive income (AOCI)).

regulatory trading book. The current Pillar 1 capital framework for the banking book has not addressed these issues. Banks can take an interest rate position in the banking book, rather than the trading book, and would not be subject to a Pillar 1 minimum capital requirements.

In the FRTB, the Committee decided to pursue the revised boundary supplemented with a list of instruments presumed to be designated to the trading book.[5] In taking this path, the Committee has remained focused on addressing potential regulatory arbitrage across the banking book/trading book boundary. This includes investigating the possible development of a Pillar 1 capital requirement for IRRBB, addressing CSRBB, placing restrictions on shifting positions across boundaries, and limitations on internal risk transfers (IRT).[6]

2. Current treatment of interest rate risk in the banking book

In 2004, the Committee issued the *Principles for the management and supervision of interest rate risk*, which set out the Committee's expectations for banks' identification, measurement, monitoring and control of IRRBB. Due to differences in the management and measurement of IRRBB across banks and jurisdictions, as well as markets and products, the IRR Principles adopted a Pillar 2 approach that relied on banks' internal risk measurement systems (IMS) to adequately capture IRRBB. According to Principle 14, supervisors are expected to assess the adequacy of such measurement systems for the purposes of managing the risk, based on six broad criteria, namely that:

(i) systems should incorporate all of a bank's interest rate sensitive positions;

(ii) systems should be capable of measuring interest rate risk using both earnings and economic value approaches;

(iii) data inputs should provide a reasonably accurate portrayal of changes in economic value and earnings;

(iv) model risk management and control systems should be based on assumptions that are reasonable and stable over time, with proper documentation and changes subject to approval by senior management;

(v) interest rate risk measurement systems should satisfy a *use test*; and

(vi) a standardised parallel interest rate shock (or equivalent parameters) should be incorporated properly into such systems.

Although there is no recommended benchmark for earnings risk, Principle 15 articulates an outlier concept based on EV. Supervisors should consider remedial actions for banks for which the decline in EV, resulting from a prescribed interest rate shock, is greater than 20% of Tier 1 and Tier 2 capital (outlier test). Regardless of this benchmark, whenever a supervisor deems that a bank does not hold capital commensurate with its exposure to IRRBB, it should take remedial actions, requiring the bank to either increase capital and/or reduce its exposure to interest rate risk.

[5] Other policy measures include restrictions on the boundary permeability combined with capital arbitrage mitigating measures requiring that the differences in capital requirements following a re-designation into the banking book of instruments or portfolios initially designated to the trading book (measured at the point of the switch) be imposed as an additional, disclosed Pillar 1 capital requirement. Note, however, that this no capital benefit restriction only addresses the cases of re-designation of existing instruments or portfolios as opposed to newly entered positions.

[6] See BCBS, *Fundamental Review of the Trading Book: outstanding issues*, February 2015, www.bis.org/bcbs/publ/d305.pdf.

If the supervisor is not satisfied with the bank's IMS (which includes EV as well as earnings measures), it must take actions in order to attain access to sufficient information to make its own estimate of the risk. One such example of a possible standardised framework based on EV is the fallback approach summarised in Table 1 of Section II. This approach bears many methodological resemblances to the standardised treatment for general interest rate risk in the trading book. Namely, for any interest rate-sensitive instrument or position it prescribes:

- time bucketing procedures allowing for full offsetting within a currency (unlike for the trading book) but not across currencies (much like the trading book);
- risk weights that are based on a measure of duration and assumed parallel interest rate shocks that capture repricing risk but ignore non-parallel gap risk[7] and basis risk; and
- a time bucket slotting methodology based on notional or book value concepts, and which does not consider any loan amortisations or coupon payments.

Although a delta-equivalent approach is prescribed for interest rate option positions, limited guidance is provided on the bucketing of positions with optionalities. This does not fully capture automatic (eg caps, floors) or behavioural interest rate-sensitive optionalities (eg prepayment). With respect to non-maturity deposits (NMDs), notional balances of so-called core deposits should be slotted to maturity buckets of no longer than five years.

Although banks are expected to incorporate the effects of interest rate risk on earnings, guidance has so far been limited as to what supervisors expect. The original consultative document on the *Measurement of banks' exposure to interest rate risk* in 1993[8] (henceforth 1993 IRR Principles) laid out the issue. It identified the need to track the sensitivity of short-term earnings to interest rate fluctuations, whether or not short-term losses were covered ultimately by longer-term earnings. An initial proposition focused on gap positions in the time buckets under one year given a static assumption that the gap would not close following an adverse and instantaneous interest rate shock. The Committee asked for feedback on whether it would be useful to supplement (or substitute at national discretion) an economic value measurement system by measuring this risk to current earnings.

Although an earnings-based measure could be more suitable for some business lines where marking to market is not applied,[9] the Committee ultimately decided to restrict its focus to an EV-based metric in order to assess IRRBB.

3. Banking and supervisory practices

According to a survey of supervisory and regulatory practices with respect to IRRBB among member jurisdictions of the Committee, most jurisdictions employ a Pillar 2 approach based on an *economic value* (EV) or *economic value of equity* (EVE)[10] measure, together with some version of Pillar 3 or other disclosure standard. IRRBB frameworks in these jurisdictions are typically applied to all legal entities. Two

[7] Referred to as yield curve risk in the IRR Principles.

[8] Available at www.bis.org/publ/bcbs11.pdf.

[9] This was also recognised in the Committee's 2009 review on the *Range of practices and issues in economic capital frameworks* (www.bis.org/publ/bcbs152.pdf), which identified particular business models as being more suited to an earnings-based than to an EV risk management approach (eg credit card banks).

[10] The economic value of equity (EVE) measure refers to a calculation of the change in the net present value of notional repricing cash flows for the whole banking book, excluding the bank's own equity capital.

jurisdictions employ a Pillar 1 approach to IRRBB, at least to a subset of banks. A couple of other jurisdictions either employ a softer form of Pillar 1 or automatically impose capital requirements once certain EV reduction thresholds are breached.

Most jurisdictions have issued guidelines consistent with the IRR Principles document. Value-at-risk (VaR) on EV/EVE and earnings-at-risk (EaR) on NII are the most commonly prescribed metrics. In addition, some national supervisors monitor changes to EV/EVE, to the expected shortfall (ES) of the EV/EVE, and/or require gap reports. About half of the jurisdictions that participated in the survey did not prescribe any particular methodology and left banks the flexibility to choose what they considered to be the most appropriate. Almost all jurisdictions impose a standardised parallel 200 basis points (bps) interest rate shock scenario while some consider other alternatives.[11] In some jurisdictions, banks are required to consider regional or macroeconomic factors for their interest rate risk assessments. Some jurisdictions use multi-year stress tests, including specific interest rate stress scenarios and projections of the impact on income and capital.

Most jurisdictions require homogenous reporting in a manner consistent with the IRR Principles while only a few provide greater prescriptions on bucketing, including on the duration of non-maturity deposits (NMDs). One jurisdiction in the survey is more prescriptive with respect to financial options. Most member jurisdictions rely on banks' internal models, but some have attempted to impose additional constraints on bank-specific assumptions.

Some jurisdictions consider other, tighter, thresholds for the EVE impact, but also take into account the impact on earnings relative to total income and/or the capital base. Most jurisdictions have identified the proportion and duration of core deposits under interest rate shocks to be the most complex component of this framework.[12] Also, several jurisdictions do not allow for the recognition of hedging and offsetting of positions across currencies. Finally, only a handful of jurisdictions recognise embedded gains and losses, albeit there is variation in the interpretation and implementation practices.

With respect to supervision, offsite monitoring assessments tend to occur every four to six months against the prescribed risk metrics, whereas onsite and peer group analysis tend to be performed less frequently, say, every one to three years. A few jurisdictions rely on an audit process to augment supervision. Assessments tend to focus on the standardised outlier test, albeit most jurisdictions have not observed many breaches among internationally active banks as of yet.

None of the jurisdictions in the survey have laid down explicit definitions for credit spread risk in the banking book (CSRBB). Only one country has reported having an indirect reference to CSRBB in its current Pillar 1 regulatory framework within the IRRBB regime, by using the corresponding relevant yield curves for discounting in the case of instruments with liquid markets. For those assets, credit spread risk (such as basis and liquidity risk) is implicitly reflected in the modelling of the multiple relevant yield curves. Note that, in this particular case, the Pillar 1 treatment is confined to banks seeking supervisory approval for the IRB and AMA approaches.

Most jurisdictions have reported covering CSRBB under Pillar 2. One jurisdiction has implemented additional Pillar 2 capital requirements where Pillar 1 capital requirements on certain sovereign securities have been assessed to be insufficient.

[11] Percentile worst interest rate moves and yield curve twists were noted in a few jurisdictions.

[12] Other instruments observed to be difficult to quantify include fixed rate mortgages and mortgage-backed securities (MBS) with prepayment risk; variable rate mortgages with embedded options; mortgage commitments; cashable and structured deposits; investments in funds; and non-performing loans.

4. Key policy issues with respect to the measurement of IRRBB

4.1. What types of interest rate risk should be captured by the IRRBB framework?

IRRBB refers more generally to the *current or prospective risk to both the bank's capital and earnings arising from adverse movements in risk-free interest rates, which affect the bank's banking book exposures*. Four main subtypes of IRRBB are defined in the literature:

(a) *Gap risk*: refers to the most common form of IRRBB and describes the *risk arising from the timing of instrument rate changes*. *Gap risk* arises from the term structure of banking book instruments. Since rate resets on different instruments occur at different tenors, the risk to the bank arises when the rate of interest paid on liabilities increases before the rate of interest received on assets does so, or the rate received on assets falls before the rate paid on liabilities does. Unless hedged in terms of tenor and amount, the bank may be exposed to a period of reduced or negative interest margins, or may experience changes in the relative economic values of assets and liabilities. The extent of gap risk depends also on whether changes to the term structure of interest rates occur consistently across the yield curve (*parallel gap risk*) or differentially by period (*non-parallel gap risk*).

(b) *Non-parallel gap risk*: refers to the *risk associated with a change in the relative interest rates of instruments at different tenors, which invalidate hedge ratios between instruments repricing at different maturities*. In other words, it represents the risk arising from changes in the *slope* and the *shape* of the yield curve as opposed to a parallel shift.[13]

(c) *Optionality risk*: refers to the *risk that arises from price movements in instruments that are either automatic or behavioural to changes in interest rates*. This implies a potential non-linear response to a change in interest rates, which is challenging for a financial institution to hedge as it usually requires dynamic adjustments in the hedge ratios. In the banking book context, many instruments with embedded optionalities are difficult to value given their held-to-maturity nature, and the lack of markets that buy and sell equivalent option products or given client behaviours. For IRRBB purposes, option risk can be characterised into two distinct but related subtypes:

- *automatic* option risk: arising from standalone instruments, such as exchange-traded and over-the-counter interest rate option contracts, or explicitly embedded within the contractual terms of an otherwise standard financial instrument (eg a capped rate loan) and where the holder will almost certainly exercise the option if it is in the holder's financial interest to do so;
- *behavioural* option risk: arising from flexibility embedded, implicitly or within the terms of financial contracts, such that changes in interest rates may affect a change in the behaviour of the client (eg rights of a borrower to prepay a loan, with or without penalty, or the right of a depositor to withdraw his/her balance in search of higher yield); the exercise of those options is that the decision to exercise may be subject not only to interest rate risk factors but also to client behaviour (eg demographics, social factors etc).

(d) *Basis risk*: refers to the impact of relative changes in interest rates for financial instruments that have: (i) either similar tenors but are priced using different interest rate reference curves

[13] Traditionally this type of risk, in a standardised context, has been captured either by considering multiple interest rate shock scenarios or by introducing horizontal disallowances or correlation factors across tenors that reduces some of the hedging recognition across long and short positions of different tenors.

(reference rate basis risk); or which have (ii) different tenors but the same reference curve (tenor basis risk or short-term non-parallel gap risk); or which have (iii) similar tenors and reference curves but in different currencies (currency basis risk). All types of basis risk could lead to margin compression and differential EV effects.[14]

While the Committee recognises that these risks have historically been recognised as the main subtypes of IRRBB, it has become apparent that a robust understanding of the drivers and manifestation of these risks is required to facilitate better risk management, supervision and potentially capitalisation. In summary, the following sections explain that changes to the yield curve drive general IRRBB, which then manifests itself as gap risk, options risk and basis risk.[15] All types of IRRBB ultimately result in the potential for change in the price/value or earnings/costs of interest-sensitive assets, liabilities and/or off-balance sheet items in a way, or at a time, that can adversely affect a bank's financial condition. This outcome of general interest rate risk is often known as repricing risk or revaluation risk.

4.2. Economic value and earnings-based measures

While the EV and earnings-based measures share certain commonalities, the Committee observes that most commercial banks primarily utilise the latter for internal interest rate risk management, whereas regulators have tended to endorse the former as a benchmark for comparability and capital adequacy. That said, the Committee acknowledges the importance of dual management through EV and earnings measures. If a bank minimises its EVE risk by matching the repricing of its assets with liabilities beyond the short term, it runs the risk of earnings volatility.

The Committee acknowledges that a Pillar 1 capital framework for IRRBB which creates incentives to exclusively minimise reductions in EVE may lead to unintended consequences. Indeed, there is a trade-off between optimal duration of equity and earnings stability that supervisors may wish to preserve in a capital framework. A pure EVE approach would also be likely to underestimate short-term earnings risk and largely fail to incorporate short-term gains resulting from an upward interest rate shock scenario. The Committee is therefore proposing alternative measures for its Pillar 1 capital framework for IRRBB that integrates both gains *and* losses in the EVE and earnings-based metrics.

4.3 How compatible should the IRRBB framework be with the standardised GIRR and CSR in the trading book framework?

Prior to the crisis, the Basel capital framework focused on short-term market (valuation) risk in the trading book and longer-term credit (default) practices in the banking book. This was consistent with private risk management practices at the time, whereby a banking book business line took a longer-term perspective to position-taking and matching than a trading desk would. Such treatment also reflected some of the differences in accounting treatments. Since then, improvements have been made in risk capture and capital coverage (especially for the trading book), while the notion of the scope of fair valued instruments has continued to evolve. Even within the banking book, a growing number of instruments are increasingly held at fair value, including AFS securities. Unlike in the trading book, these fair valued positions have tended to be managed within a treasury function responsible for the asset and liability management (ALM) of accrual instruments, focusing more on liquidity and interest rate risk management. Accordingly, such positions tend to be held for longer time horizons in support of the banking book, and are not managed with a trading intent.

[14] Basis risk is typically captured either by modelling the basis exactly between the yield curves or captured indirectly through vertical disallowances on the amount of hedge recognition between long and short positions in each tenor bucket.

[15] Section III also includes CSRBB.

Recognising the legitimate and practical differences between the trading and banking book positions, compatibility of capital treatments does not necessarily require identical capital treatments on both sides of the boundary, but rather an approach that does not create undue regulatory arbitrage opportunities. Hence, the Committee aims to retain methodological compatibility between the trading and the banking books, while ensuring that any material differences in the prudential treatment between the two books reflect the fundamental differences in the purposes and functions of banking and trading books – not just different accounting treatments.

4.4 Pillar 1 versus Pillar 2 approaches

The Committee first consulted on the measurement of interest rate risk in 1993, seeking a common measurement framework for what it then recognised was a *significant risk*. The Committee consulted a second time in 1997, setting out general principles for the management of interest rate risk. In its third review in 2003, the Committee consulted on a widening of the scope to *Principles for the management and supervision of interest rate risk* (IRR Principles). In the finalised IRR Principles, the Committee concluded that management and measurement of interest rate risk was not amenable to an internationally harmonised Pillar 1 capital framework and focused instead on how banks should manage and regulators supervise IRRBB within the remit of a Pillar 2 framework. This framework included a simple 200 basis points parallel shock (or 1st and 99th percentile of the observed interest rate shocks) for the identification of *outlier* banks with material IRRBB exposures.

Since the global financial crisis, supervisors have pursued regulatory reforms to strengthen the prudential framework and reduce incentives for regulatory arbitrage. Regulatory reforms relevant to interest rate risk were included in the Basel 2.5 reform package, followed by the FRTB and the review of the securitisation framework, which together should have reduced incentives to book credit-risky securitisation instruments in a trading book. This backdrop provided two broad motivations for the Committee to look again at IRRBB, namely:

(i) to ensure that banks adequately prepare for the eventual normalisation of interest rates, including potential unexpected shocks; and

(ii) to mitigate potential unintended consequences from regulatory reform by limiting the incentives for *regulatory arbitrage* between the trading and the banking book, and between banking book portfolios with differing accounting treatments.

As a result, one motivation for considering a possible Pillar 1 capital framework for IRRBB is to promote greater international consistency in implementation. As described in Subsection I.3, the IRR Principles have been implemented differently across jurisdictions. To date, a Pillar 2 approach has not produced consistent outcomes across jurisdictions. The methodologies and scope of national IRRBB calculations, while all inspired by the same IRR Principles, vary significantly between countries. The resulting amount of IRRBB capital expected therefore also varies considerably across countries, due to difficult-to-disentangle combinations of differences in methodologies, varying interest rates and interest rate volatility, and differing bank balance sheet structures and markets. An agreed Pillar 1 approach to measuring IRRBB could therefore promote greater comparability and a more level playing field, though at the expense of less precision when compared to internal model estimates.

Indeed, the reasons which led the Committee to conclude in 2003 that IRRBB be captured under a Pillar 2 approach still retain some validity. These reasons primarily relate to the complexities of implementing a standardised model across heterogeneous markets and banks, and across a diverse range of products. The Committee is therefore also consulting on an enhanced Pillar 2 option.

The enhanced Pillar 2 approach outlined in Section II could increase transparency and explain why IRRBB calculations across jurisdictions produce varying results. By increasing transparency, the enhanced Pillar 2 approach could encourage greater understanding of the relative drivers of interest rate risk, as well as improving comprehensive risk capture. Under this approach, banks would hence be

allowed to use their internal measurement systems (IMS) for assessing their capital adequacy subject to supervisory approval. The standardised approach outlined in Section II would serve as a fallback to a bank's IMS. This includes standardised disclosure of a bank's IRRBB risk profile, key measurement assumptions, qualitative and quantitative assessment of IRRBB levels and quantitative disclosure of IRRBB metrics, including a standardised calculation framework. The proposal also includes guidance for supervisory responses with a strong presumption for capital consequences for banks with high levels of IRRBB.

4.5. Is a standardised Pillar 1 methodology appropriate for all banking book positions?

In theory, the design of a standardised capital framework should prescribe how to determine the risk across the entire banking book, including both on- and off-balance sheet instruments. In practice, this is not always straightforward. This is due to both continuing financial innovation and the nature of banking book products, where risks are not always amenable to standardised parameters or measurement techniques.

In the context of IRRBB, a number of instruments exhibit non-linear or complex responses to changes in interest rates. While in some cases it may be reasonable to assume that options will be exercised based on pure economic factors, certain instruments have embedded options where the decision to exercise that option is driven by behavioural factors. Such behavioural factors are difficult to model, and even more difficult to standardise.

On the liability side, non-maturity deposits (NMDs) are instruments for which there are two embedded options. One option held by the bank (ie the right to change the interest rate) and one behavioural option held by the depositor (ie the right to withdraw their funds). This creates a volume risk for a bank that cannot be hedged in any market. Instead, banks have typically relied on behavioural models to forecast the asymmetric and dynamic responses in NMD volumes arising from differences between market rates and banks' interest rates together with inbuilt customer inertia.

Given the above complexities, the Committee recognises that the constrained use of internal models to capture the heterogeneous risk is warranted. As a consequence, some reliance on internal modelling has been permitted in the proposed Pillar 1 capital framework, subject to adequate controls on use as well as a demonstration of the accuracy of the metrics through independent validation.

II. Minimum capital requirements for interest rate risk in the banking book (IRRBB)

1. Criteria and overall structure of the Pillar 1 capital framework for IRRBB

1.1. Criteria for developing an IRRBB standardised approach

The Committee has established the following criteria to guide its development choices for IRRBB minimum capital requirements:

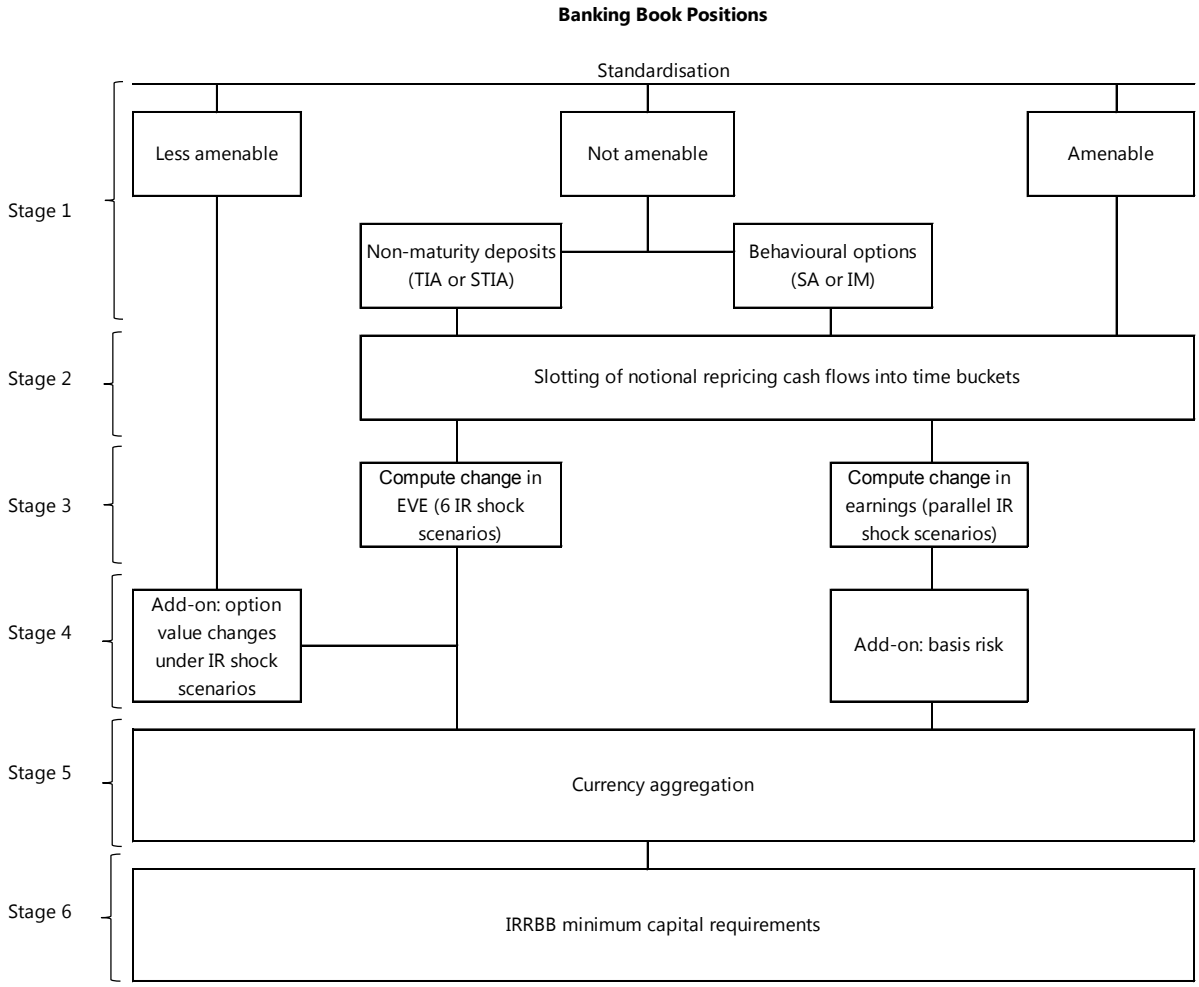
- *Risk sensitivity*: reflecting the risk characteristics of instruments while giving prudent recognition of genuine hedging, and diversification within currency books;
- *Credible calibration* under stressed market conditions: reflecting differences in both the level and volatility of interest rates along with differences between instrument types;
- *Simplicity, comparability and consistency* of the chosen methodology: including alignment with the trading book whenever possible and desirable, to limit the burden imposed on banks and supervisors, and leading to comparable outputs across banks and jurisdictions;

- *Limited reliance on banks' internal assessment of parameters*: standardised approach must not excessively rely on banks' internal modelling;
- *Credible fallback*: a standardised approach for capital requirements that is reasonable and comparable to well specified and prudent internal models.

1.2. Overview on the computation of minimum capital requirements for IRRBB

The flowchart in Figure 1 illustrates the steps required to compute the required capital charge for IRRBB, taking into account both the EVE and earnings-based approaches

Figure 1: Flowchart for computing minimum capital requirements for IRRBB



– *Stage 1*. Interest rate-sensitive banking book positions are allocated to one of three categories (ie amenable, less amenable and not amenable to standardisation).

– *Stage 2*. Determination of slotting of cash flows based on repricing maturities. This is a straightforward translation for positions amenable to standardisation. For positions less amenable to standardisation, they are excluded from this step. In particular, for positions

with embedded automatic interest rate options, the optionality should be ignored for the purpose of slotting of notional repricing cash flows.[16]

For positions that are not amenable to standardisation, there is a separate treatment for:

(a) *Non-maturity deposits* – according to Subsection II.2.5 separation of core and non-core cash flows via either (i) the Time Series Approach (TIA); or (ii) for small and medium-sized banks that might not have sufficient capacity to estimate core NMDs in a consistent manner, via a simpler alternative (simplified TIA (STIA)).

(b) *Behavioural options (*term deposit, fixed rate loan commitments/pipelines and prepayments) – behavioural parameters relevant to the position type must rely on a scenario-dependent look-up table under the standardised approach. Under the internal estimates approach, with supervisory permission banks will be permitted to compute behavioural parameters through internal models to allocate cash flows. This is described in Subsection II.2.6.

Table 1 below summarises the proposed treatments under the hybrid and standardised fallback for positions that are not amenable to standardisation in the IRRBB EVE framework:

Table 1. The hybrid approach with standardised fallback

	Risk parameters	Internal estimates	Fallback
Non-maturity deposits	Core deposit/non-core deposit breakdown and treatment of core deposit slotting	Time series approach (TIA)	Simplified TIA (STIA) with lower core deposit caps
Term deposits with redemption risk	Determination of impact of behavioural elements in redemption rates on cash flow profile	Internally measured redemption speed (IMRS)	Standardised
Fixed rate loans with prepayment risk	Determination of impact of behavioural elements in prepayment speed (ie conditional prepayment rate (CPR)) on the cash flow profile	Internally measured prepayment speed (IMPS)	Standardised
Fixed rate loan commitments (pipelines)	Determination impact of behaviour on pull-through ratio (PTR) based on behavioural assumptions	Internally measured pull-through rates (IMPTR)	Standardised

– *Stage 3*. Determination of change in EVE and change in earnings for relevant interest rate shock scenarios for each currency. The change in EVE is measured per currency for all six prescribed interest rate shock scenarios, while the change to net interest income (NII) is measured per currency for the two parallel interest rate shock scenarios. The change in EVE is described in Subsection II.3.1 while the change in NII is described in Subsection II.4.

– *Stage 4*. Add-ons for changes in the value of *automatic* interest rate options (whether explicit or embedded) are added to the EVE changes and basis risk add-ons to changes in

[16] That is the embedded automatic interest rate option is stripped out from the process of slotting notional repricing cash flows in Stage 2 and treated together with other automatic interest rate options under Stage 4.

earnings. Automatic interest rate options sold are subject to full revaluation (possible net of automatic interest rate options bought) under each of the six prescribed interest rate shock scenarios for each currency. This is described in Subsection II.2.7. Changes in values of options are then added to the changes in the EVE measure under each interest rate shock scenario on a per currency basis. Likewise, the risk measure for basis risk, described in Subsection II.4.3, on a per currency basis is added to the general NII measure under the two parallel interest rate shock scenarios.[17]

– *Stage 5*. Currency aggregation. For both EVE capital requirements and NII capital requirements, currencies incurring losses are offset by some weighted sum of currencies that incur gains for each scenario under consideration. In each case, the ultimate capital requirement will be based on the interest rate shock scenario resulting in the worst outcome (Subsection II.5).

– *Stage 6*. IRRBB minimum capital requirements. Depending on the various potential options, minimum capital requirements will be some maximum of worst aggregated reductions to EVE and, where applicable, NII across the six prescribed interest rate shock scenarios (Subsection II.5).

2. Components of an IRRBB standardised approach under Pillar 1

Consistent with options identified by the Committee the following elements of a standardised framework for IRRBB are specified.

2.1 Cash flow bucketing

Banks must project all future notional repricing cash flows arising from interest rate-sensitive:

- *assets*, which are not deducted from CET1 capital and excluding (i) fixed assets such as real estate or intangible assets; as well as (ii) equity exposures in the banking book;
- *liabilities* (including all non-remunerated deposits), other than liabilities constituting regulatory capital instruments of the respective capital ratios of the Basel III framework (ie Common Equity Tier 1 (CET1), additional Tier 1 (AT1) or Tier 2 capital); and
- *off-balance sheet items* (OBS);

onto 19 predefined *time buckets* (indexed numerically by k) as set out in Table 2 into which they fall according to their repricing dates.

A notional repricing cash flow $\mathrm{CF}(k)$ is defined as:

- any repayment of principal (eg at contractual maturity);
- any repricing of principal; repricing is said to occur at the earliest date at which either the bank or its counterparty is entitled to unilaterally change the interest rate, or at which the rate on a floating rate instrument changes automatically in response to a change in an external benchmark; or

[17] Note that the basis risk measure is independent of the interest rate risk shock scenarios being considered for in the general NII measure and are thus just added to the latter.

- any interest payment on a tranche of principal that has not yet been repaid or repriced; where material, spread components of interest payments on a tranche of principal that has not yet been repaid and which do not reprice must be slotted until their contractual maturity irrespective of whether the non-amortised principal has been repriced or not.

The date of each repayment, repricing or interest payment is referred to as its repricing date.

Floating rate instruments are assumed to reprice fully at the first reset date. Hence, the entire principal amount is slotted into the bucket in which that date falls with no additional slotting of notional repricing cash flows to later time buckets (other than the spread component which is not repriced).

Table 2. The maturity schedule with 19 time buckets for notional repricing cash flows repricing at t^{CF}

	Time bucket intervals (M: months; Y: years)							
Short-term rates	Overnight	O/N< t^{CF} ≦1M	1M< t^{CF} ≦3M	3M< t^{CF} ≦6 M	6M< t^{CF} ≦9 M	9M< t^{CF} ≦1 Y	1Y< t^{CF} ≦1.5Y	1.5Y< t^{CF} ≦2Y
Medium-term rates	2Y< t^{CF} ≦3Y	3Y< t^{CF} ≦4Y	4Y < t^{CF} ≦ 5Y	5Y< t^{CF} ≦6Y	6Y< t^{CF} ≦7Y			
Long-term rates	7Y< t^{CF} ≦8Y	8Y < t^{CF} ≦ 9Y	9Y < t^{CF} ≦ 10Y	10Y< t^{CF} ≦ 15Y	15Y< t^{CF} ≦ 20Y	t^{CF} > 20Y		

2.2. Interest rate shock scenario design

With respect to absolute interest rate shock scenarios, the following criteria should apply to this specification process:[18]

- The rate shocks should reflect a stressful rate environment.
- The magnitude of the interest rate shock scenarios should be significant enough to capture the effects of automatic and behavioural options, and convexity within a bank's assets and liabilities, so that the underlying risks are measured.
- The magnitude of the shocks should be compatible with the normal horizon over which most institutions have the ability to assess and restructure their IRRBB exposures.
- The underlying methodology should provide relevant and, if possible, proportionate shocks determined at the global level for all material currency exposures.
- The shocks should not be left to the discretion of national supervisors and should ideally reflect each country's local economic environment, including in particular the level and the volatility of the interest rate.
- The underlying methodology should be simple and adaptable to implement for supervisors.

[18] These principles build on those developed for the standardised interest rate shock methodology in Annex 2 of the IRR Principles.

Multiple scenarios (shock scenario discrimination)

Multiple shock scenarios are used to capture parallel as well as non-parallel gap risk measured in terms of EVE.[19] In order for shock scenarios to reflect local economic environments, a limited number of related shock scenarios that span the relevant spectrum of yield curves, together with a methodology for prescribing the level of *absolute* shocks in each currency, have been developed.

Under this approach, capital requirements for IRRBB are measured by the scenario that results in the largest decline in EVE.[20]

The six interest rate shock scenarios for the Pillar 1 capital framework for IRRBB are:[21]

(i) parallel shock up;

(ii) parallel shock down;

(iii) steepener shock (short rates down and long rates up);

(iv) flattener shock (short rates up and long rates down);

(v) short rates shock up; and

(vi) short rates shock down.

Interest rate shock scenario specification

Interest rate shock scenarios are broken down into the product of three elements:

1. a measure of current local risk-free, continuously compounded zero-coupon rates in currency *c*, $\bar{R}_c(t_k)$ averaged in each time bucket *k* and where t_k is the tenor midpoint of bucket *k* expressed in years (and where t_{19} is set at 25 years);

2. a *global* shock parameter, $\bar{\alpha}_j$, that reflects the average observed volatility across all currencies under interest rate shock scenario representation *j*, with $j = \{parallel, short, long\}$; and

3. a scalar, $S_j(t_k)$, that reflects the characteristics of shock scenario representation *j* at each time bucket midpoint t_k.[22]

In its generic form the shock to the risk-free interest rate at tenor midpoint t_k, for the parallel and short rate scenario and currency *c* can be defined as

$$\Delta R_{j,c}(t_k) = \bar{R}_c(t_k) \cdot \bar{\alpha}_j \cdot S_j(t_k),$$

[19] In the case of NII only parallel interest rate shock scenarios will apply.

[20] In order to determine the set of interest rate shock scenarios on which to assess the change in EVE and/or NII for each bank, the Committee initially considered 12 candidate scenarios, which reflected parallel shocks, shocks with the greatest impact at the short rates, medium-term rates (ie a hump) and long rates, as well as twists, steepeners and flatteners. In order to select the set of relevant shocks, the Committee has applied the following principles: (i) severity: the IRRBB framework should reflect interest rate shock scenarios that in general produce the highest change in EVE; (ii) redundancy: the IRRBB framework should avoid specifying scenarios for which the EVE reductions are highly correlated; and (iii) frequency: all else equal, the IRRBB framework should aim at covering interest rate shock scenarios that are more frequent.

[21] In order to respond to micro- and macroprudential considerations, national supervisors may, in a Pillar 2 context, supplement the above interest rate shock scenarios with national scenarios.

[22] For instance, for a $S_{average}(t_k) = 1$, $S_{short}(t_k) = 1 - t_k/t_K$, and $S_{long}(t_k) = t_k/t_K$.

Depending on the direction, these shocks can be added to or subtracted from the local current rates $R_c(t_k)$ in order to determine the post-shock interest rate for scenario *j*, $R_{j,c}(t_k)$.[23] This same procedure can be applied across all tenor midpoints to generate a new yield curve under each scenario *j*.

Holding period

The Committee is proposing a six-month holding period for the interest rate shock calibration to be suitable for IRRBB capital purposes. Most institutions appear to have the ability to adjust their asset/liability profile in a period much shorter than one year. There are reasonable arguments to be made that banks would be able to "de-risk" their ALM books in a timeframe as short as three months, but the Committee believes that this applies only at the individual bank level. During a system-wide move in interest rates, however, banks might look for the same type of instruments to hedge their positions and may not be able to change their asset/liability profiles within the same short period and at the currently available costs.

Global shock calibration and local environment capture

To account for heterogeneity in the volatility of rates across currencies, the Committee has explored the possibility of applying local volatility shock parameters, but it concluded that this would imply the following disadvantages:

(i) backward-looking historical information based on benign local conditions will not pick up the possibility of severe and plausible shocks that have been observed in other jurisdictions and yet be plausible scenarios for any local environment; and

(ii) in terms of process, measures of local volatility are more difficult to update in an international capital standard than local rates.

Conversely, applying local shocks is advantageous because it does not over- or understate the interest rate shock in cases where the local volatility is relatively lower (higher) than average or global volatility.

At this stage, the Committee believes that applying global interest rate shock parameters to local rates is an acceptable trade-off between maintaining an international standard with some minimum level of commonality across jurisdictions and enabling the capture of the local rate environment. Additionally, in order to warrant some stability in the international standard, measures of global interest rate shock parameters should be derived from sufficiently long observation periods. To adjust for cases where an interest rate shock that is above (below) the bounds of possibility (prudence), absolute caps (floors) are proposed.

Table 3 summarises the global shock parameters:[24]

[23] Note that this approach assumes a *zero lower bound* on $R_{j,c}(t_k)$, at each tenor point t_k and currency *c*.

[24] Calibration inputs and methodology: yield curves in 16 currencies, from January 2000 to April 2014. Tenors were: three months, six months, one year, two years, five years, seven years, 10 years, 15 years and 20 years. Simple averages are taken of the 99th and absolute value of the 1st percentile semi-annual returns.

Table 3. Global interest rate shock parameters[25]

Parallel	$\bar{\alpha}_{parallel}$	60%
Short rate	$\bar{\alpha}_{short}$	85%
Long rate	$\bar{\alpha}_{long}$	40%

Caps and floors

The proposed interest rate shock calibration can, in some circumstances, lead to unrealistically low interest rate shocks for some currencies and to unrealistically high interest rate shocks for others. To address this concern, a floor of 100 basis points is applied to all *local* interest rate changes as a result of the interest rate shock scenarios in order to ensure a minimum level of prudence and a level playing field.[26] Likewise, interest rate shock scenarios are capped based on the observed average volatility. Variable caps (denoted as $\Delta\bar{R}_j(t_k)$) are proposed to be 500 basis points for the short-term shock, 400 basis points for the parallel shock and 300 basis points for the long-term interest rate shock scenario. The Committee is conscious that there appears to be a monotonic relationship between absolute rate levels and absolute rate volatilities, which suggests that, as the global economy exits the current benign rate environment, it might need to update these caps. Consequently, the Committee intends to keep this area under close review.

In more technical terms, the change in the risk-free interest rate for shock scenario j and currency c, at time bucket tenor midpoint t_k can be defined as:

$$\left|\Delta\tilde{R}_{j,c}(t_k)\right| = \max\left\{100, \min\left\{\text{abs}\left(\Delta R_{j,c}(t_k)\right), \Delta\bar{R}_j\right\}\right\},^{27}$$

where $\Delta\bar{R}_j = \{400, 500, 300\}$, for *j=parallel*, *short* and *long*, respectively. The post-shock interest rates may also need to satisfy the following *zero lower bound* condition:

$$\bar{R}_{j,c}(k) = max\{R_{0,c}(t_k) + \Delta\tilde{R}_{j,c}(t_k), 0\}.^{28}$$

Updating scenario selection and calibrations over time

The Committee acknowledges that there is an element of timely updating of scenarios, their shock calibration as well as possibly shock floors and caps that is required across different currencies to reflect local conditions. The Committee will consider develop a process including a methodology for updating the interest rate shock scenario selection and interest rate shock scenario calibration.

2.3. Process for slotting and decomposing banking book instruments

Banks must account for all notional repricing cash flows arising from interest rate-sensitive assets, liabilities and off-balance sheet positions. Notional repricing cash flows associated with interest rate-

[25] The global interest rate shock parameters, $\bar{\alpha}_j$, were calibrated to swap LIBOR curves at nine tenor points based on averages of upper and lower percentiles of daily overlapping observations of semi-annual returns.

[26] Supervisors may under national discretion set a higher floor to the local interest rate shock scenario for their home currency.

[27] In the case of rotation shock scenarios, $\Delta\tilde{R}_{j,c}(t_1)$ cannot exceed 500 bps and $\Delta\tilde{R}_{j,c}(t_K)$ cannot exceed 300 basis points.

[28] Note that that for parallel interest rate shock scenarios and in low interest rate environments the shocks post application of the zero lower bound condition are no longer parallel.

sensitive assets, liabilities and off-balance sheet positions, for each currency, must be allocated to the prescribed time buckets (in what follows denoted by $CF_{i,c}(k)$ under interest rate shock scenario i and currency c) based on their amenability to standardisation:

- *amenable*: any position that can be decomposed into notional repricing cash flows where the maturity or time to repricing is unambiguous;
- *less amenable*: any position where the notional repricing cash flows have maturity or repricing uncertainties that can be quantified and thus prescribed in a standardised framework or possibly as a fallback to a hybrid approach; or
- *not amenable*: positions that are better suited to banks' own independently validated estimates of key risk parameters; if a supervisor is not satisfied with the internal estimation process the bank would be required to apply a standardised fallback approach.

Process for positions that are amenable to standardisation

A feature common to positions that are amenable to standardisation is that notional repricing cash flows can be slotted into appropriate time buckets based on their contractual maturity, if subject to fixed coupons, or into the next repricing period if coupons are floating. The vast majority of instruments generally fall into this category. However, many types of positions potentially have an element of uncertainty as to the timing of cash flows due to either automatic or behavioural optionality. Based on materiality, supervisors may allow banks to categorise these positions as amenable to standardisation and ignore the optionality if it can be shown to be of immaterial consequence.

Process for positions that are less amenable to standardisation

Positions that are less amenable to standardisation, if material, require additional prescription in a standardised framework or in a hybrid methodology. A common feature of these positions is *optionality* that makes the timing of notional repricing cash flows uncertain. This optionality introduces a non-linearity, which suggests that delta-equivalent approximations are imprecise for large interest rate shock scenarios. Explicit automatic interest rate options, as well embedded automatic interest rate options[29] that are separated or stripped out from the bank's assets or liabilities (ie the host contract), would typically fall under the types of positions less amenable to standardisation.

As a consequence, for each of these position types, methodologies for prescribing the slotting of notional repricing cash flows into specific time buckets have been developed or separate calculations based on a pre-defined scenario based approach (eg sold automatic interest rate options) to be added as separate line items have been devised.

Process for positions not amenable to standardisation

Positions not amenable to standardisation include the following:

1. non-maturity deposits (NMDs);
2. term deposits subject to early redemption (or break) risk;
3. mortgages subject to prepayment risk; and

[29] An example of a product with embedded automatic interest rate options is a floating rate mortgage loan with embedded caps and/or floors. Notional repricing cash flows for those loans are treated as a fixed rate loan until the next repricing date, thereby ignoring the option, which instead is treated like a separate automatic interest rate option.

4. fixed rate loan commitments.

For these positions, hybrid approaches are proposed whereby banks may be permitted by their supervisor to use a *constrained* version of their internal estimates.

2.4 Treatment of positions amenable to standardisation

Positions that are amenable to standardisation fall into two categories:

1. *Fixed rate positions*: such positions generate cash flows that are certain out to contractual maturity. Examples include fixed rate loans without embedded prepayment options, term deposits without *redemption* risk and other amortising products such as mortgage loans. The Committee expects all coupon cash flows and periodic or final principal repayments to be allocated to the time bucket tenor midpoints closest to the contractual maturity.

2. *Floating rate positions*: such positions generate cash flows out to maturity that are not predictable past the next repricing date other than that the present value would be reset to par. Accordingly such instruments can be treated as a series of coupon payments until the next repricing and a par notional cash flow at the time bucket tenor midpoint closest to the next reset date bucket. Where material, cash flows associated with the spread component (attributable to a non-amortised principal tranche), which does not reprice, must be slotted until the contractual maturity (of the corresponding tranche).

Positions amenable to standardisation include positions with embedded automatic interest rate options where the optionality (whether sold or bought) should be ignored for the purpose of slotting of notional repricing cash flows.[30] That is, the stripped out embedded automatic interest rate option must be treated according to the provisions in Subsection II.2.7, together with explicit automatic interest rate options.

2.5. Treatment of non-maturity deposits (NMDs)

Non-maturity deposits (NMDs) are defined as liabilities of banks in which depositor is free to withdraw at any time since they have no contractually agreed maturity date. Despite the contractual position, part of the balances of NMDs behaves as a long term, rate-insensitive liability (insensitive even to large interest rate shocks). Such NMDs are called core deposits.

In an EVE framework, the fundamental issue for NMDs is how to identify the aggregate balances of core NMDs and how to appropriately slot these liabilities into time buckets. The Committee is cognisant that NMDs could include many diverse products where the customers respond differently to interest rate changes. Furthermore, there is no consensus on whether there is a unique, robust and prudent process for identifying core deposits that can be applied uniformly across all jurisdictions (given the diversity of specific interest rate levels and volatilities, combined with other local conventions and banking models, as well as customer-specific behaviour). There is therefore the need for a trade-off between accuracy and simplicity in developing a standardised slotting method for NMDs.

Two approaches have been developed, namely (i) the Time Series Approach (TIA) which is the baseline proposal; and (ii) a simpler variant – the simplified TIA (STIA) – is expected to be applied by

[30] For example, a floating rate loan or debt security with a floor would be treated as if there were no floor; hence it would be treated as if it fully repriced at the next reset date, and its full outstanding balance slotted in the corresponding time band. Similarly, a callable bond issued by a bank at a fixed yield would be treated as if it matured at its longest contractual term, ignoring the call option.

small and medium sized banks. It is recognised that these banks may not have sufficient capacity to estimate core NMDs in a consistent manner.

The parameter and constraints in this subsection will be subject to further empirical analysis.

Time Series Approach (TIA)

The general approach under the TIA is to separate NMDs into two categories (core and non-core) and then determine a cash flow slotting procedure for each.

(a) NMD categories

NMDs must be segmented into retail and wholesale NMDs. Retail deposits are defined as deposits placed with a bank by an individual person. Deposits from legal entities, sole proprietorships or partnerships are captured in wholesale deposit categories. Deposits made by small business customers[31] and managed as retail exposures are considered as having similar interest rate risk characteristics to retail accounts and thus can be treated as retail deposits (provided the total aggregated liabilities raised from one small business customer is less than €1 million).

Retail deposits may be considered as held in a transactional account when regular transactions are carried out in that account (eg when salaries are regularly credited) or when the deposit is non-interest bearing. Indeed, the absence of remuneration on a deposit may be an indication that the deposit is not used as a savings account by the depositor and thus can be considered as transactional. However, when making this determination, banks must take the general level of interest rates into consideration.

The categorisation of a deposit as transactional thus relies exclusively on qualitative criteria. Banks must apply their own criteria based on historical data or local/business model features. Such a proposed approach is intended to allow for a certain degree of recognition of local conditions, but is subject to supervisory review and approval.

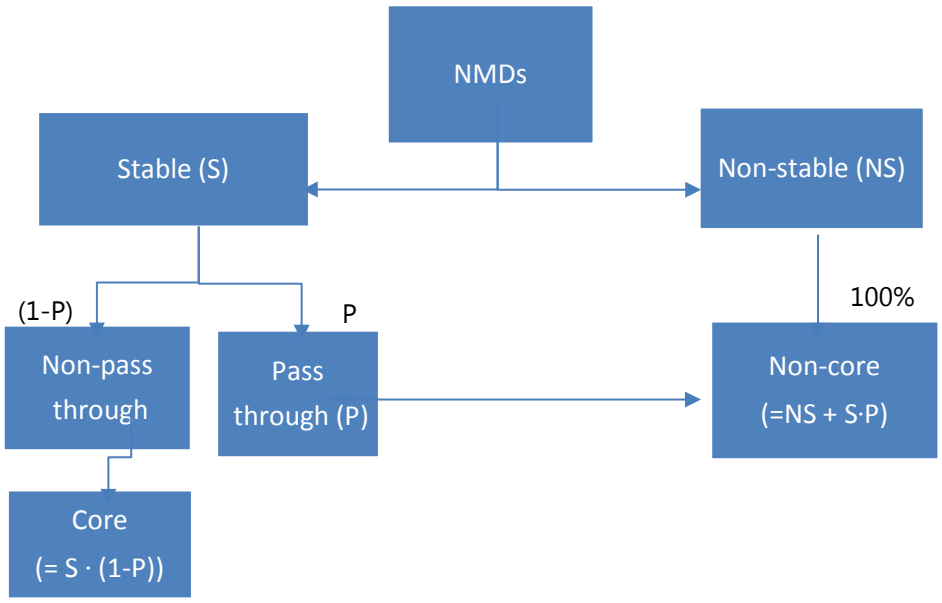
(b) Separation of NMDs.

The first step is to distinguish between the stable and the non-stable parts of NMDs using observed volume changes over the past 10 years. The stable NMD portion is the portion that is found to remain undrawn with a high degree of likelihood. In a second step, the stable subset of NMDs is further broken down into a core component and a non-core component. To achieve this, a pass-through rate concept is applied to determine the rate-sensitive part of the stable subset.[32] Core deposits are the proportion of stable NMDs that do not reprice. The remainder constitutes non-core NMDs. Figure 5 illustrated this two-step procedure for segmenting NMDs into core and non-core components.

[31] As defined in paragraph 231 of the Basel II framework.

[32] The pass-through rate refers to the proportion of a market interest rate change that the bank will pass onto its customers in order to maintain the same level of stable deposit balances. Equivalently, it represents the proportion of stable deposits that reprice due to the market rate change. Banks must measure pass-through rates in response to a shift in interest rates over the time horizon they deem most relevant or until the full effect of the market rate move has been passed through to the customers according to banks' internal estimates.

Figure 5: Separation of NMDs



Banks are required to estimate their level of core deposits using this two-step procedure for each deposit category, and then to aggregate the results to determine the overall volume of core deposits subject to imposed category-dependent stability caps and pass-through floors as shown in Table 4.

Table 4. Stability caps and pass-through floors for NMDs by category

	Stability cap (%)	Pass-through floor (%)	Implied cap on core NMDs (%)
Retail/transactional	80	25	60 (=0.8(1-0.25))
Retail/non-transactional	70	30	49
Wholesale	65	50	33

The segmentation assumes that wholesale NMDs fluctuate more than retail NMDs and that the stable wholesale portion is more sensitive to market rates than for stable retail deposits. Furthermore, transactional deposits are assumed to be more stable and less sensitive to market rates than non-transactional deposits are.

(c) Cash flow slotting

Banks must slot the notional repricing cash flows of the obtained *core* and *non-core* NMDs into appropriate time buckets as follows:

- *non-core NMDs*: reprice immediately and accordingly must be placed into the overnight time bucket (k=1);

- *core NMDs*: must be slotted into time buckets of no longer than six years using two alternative approaches:

  (i) *uniform approach*: core deposit balances are allocated uniformly to each bucket up to six years. Table 5 below shows the weights given to core deposits under the uniform slotting approach;[33]

Table 5. Weight of time buckets (*k*) for core deposits under the uniform slotting

ON	O/N<t_2≦1M	1M< t_3 ≦3M	3M< t_4 ≦6 M	6M< t_5 ≦9 M	9M< t_6 ≦1 Y	1Y< t_7 ≦1.5Y	1.5Y< t_8 ≦2Y	2Y< t_9 ≦3Y	3Y< t_{10} ≦4Y	4Y < t_{11} ≦ 5Y	5Y< t_{12} ≦6Y	$t_{k:k>12}$ > 6Y
0	1/72	2/72	3/72	3/72	3/72	6/72	6/72	12/72	12/72	12/72	12/72	0

or

(ii) *discretionary approach*: core deposits must be slotted across time buckets up to six years at the bank's discretion provided that the average maturity weighted by notional repricing cash flows of core deposits does not exceed three years.

Simplified TIA (STIA)

Under the STIA banks must use one of the following two alternative segmentations:

1. NMDs are segmented into retail and wholesale deposits. Banks must estimate core NMDs as a proportion of total NMDs based on one year of banks' internal data on NMD balance subject to the caps set out in Table 6. Finally, banks must use the uniform slotting approach as set out above for the TIA to slot notional repricing cash flows of the resulting core deposits. Non-core deposits must be slotted into the overnight time bucket.

Table 6. Proportion of NMD amounts eligible to core NMDs in the simplified-TIA (alternative 1)

	Retail	Wholesale
Eligible core NMDs	40%	20%

2. NMDs are segmented into retail and wholesale deposits and according to the deposit volume per depositor. Deposit amounts are based on the banks' last reporting date and need to be provided for all six segments as set out in Table 7.[34]

[33] Note that when using a uniform slotting the weighted average maturity of core deposits is three years.

[34] The rationale for considering deposit volumes per depositor is based on economic theory, ie the higher the amount of NMDs per depositor, the larger the opportunity costs of inaction after an interest rate shock.

Table 7. Proportion of NMD currency equivalent amounts eligible to core NMDs in the simplified-TIA (alternative 2)

	Retail				Wholesale	
	≤ €20,000	> €20,000 to ≤100,000 EUR	> €100,000 to ≤500,000 EUR	> €500,000	≤ €500,000	>€500,000
Eligible core NMDs	65%	45%	30%	20%	30%	15%

For the first € 20,000 of a retail deposit, a proportion of 65% is eligible to be classified as a core NMD. Then, for the part between €20,000 and €100,000, a smaller proportion of 45% is eligible to be a core NMD. This is continued until the whole deposit is considered. For example, given a €50,000 retail deposit, an amount of €26,500 would be eligible to be treated as a core NMD (€20,000/65% + €30,000/45%). Notional repricing cash flows of core NMDs must be slotted according to the uniform slotting approach.

2.6. Treatment of positions with behavioural options other than NMDs

The treatment set out in this section only applies to behavioural options related to retail customers. Where a non-retail customer has a behavioural option that may change the pattern of notional repricing cash flows, such options must be included within the category of automatic interest rate options set out in Subsection II.2.7.[35] The framework covers the major sources of behavioural options. If other material behavioural options are identified, they may subsequently be added to this proposed framework. This section outlines the standardised approaches as well as internal estimates approaches for positions with behavioural options.

Standardised approaches for positions with behavioural options other than NMDs

The standardised approach is applied to fixed rate loans subject to prepayments; fixed rate loan commitments; and term deposits subject to early redemption risk. In each case the customer has an option, which, if exercised, will alter the timing of a bank's cash flows. The customer's exercise of the option is, among other factors, influenced by changes in interest rates. In the case of the fixed rate loan, the customer has an option to repay the loan early (ie prepay); in a loan commitment, the customer has an option to draw down a credit line at a committed rate; and for a fixed-term deposit the customer may have an option to withdraw their deposit before the scheduled date.

Under the standardised approach, the optionality in these products is estimated using a two-step approach. Firstly, baseline estimates of loan prepayments, loan draw-down rates and early withdrawal of fixed term deposits are calculated given the prevailing term structure of interest rates. These baseline parameter estimates may be:

- determined by the bank subject to supervisory review and approval; or
- prescribed by the supervisor.[36]

[35] An example of such an option would be a puttable fixed-coupon bond issued by the bank in the wholesale market, for which the owner has the right to sell the bond back to the bank at a fixed price at any time.

[36] In this case, the Committee may develop further guidance as to how supervisors should prescribe the baseline estimates.

In the second stage, the baseline estimates are multiplied by supervisory determined scalars that reflect the likely behavioural changes in the exercise of the options, given a particular interest rate shock scenario. In general, under falling interest rate scenarios, the prepayment of fixed rate loans is expected to increase, while the early withdrawal of fixed-term deposits and draw-down of fixed rate loan commitments would be expected to decrease relative to the baseline scenario.

Prepayments on fixed rate loans

The ability of a borrower to prepay a fixed rate loan is an important behavioural option. Such loans are referred to as prepayment-exposed loan products. Prepayments, or parts thereof, for which the economic cost is not charged to the borrower, are referred to as uncompensated prepayments. For loan products where the economic cost of prepayments is never charged, or only charged for prepayments above a certain threshold, the standardised or internal estimate approach for fixed rate loans subject to prepayments set out below must be used to assign notional repricing cash flows.

The conditional prepayment rate (CPR) for each portfolio p of homogeneous prepayment-exposed loan products denominated in currency *c*, under interest rate scenario i is given as:

$$CPR_{i,c}^{p} = \min(1, \gamma_i \cdot CPR_{0,c}^{p})$$

where $CPR_{0,c}^{p}$ is the (constant) base CPR of a portfolio p of homogeneous prepayment-exposed loans given in currency c[37] and given the prevailing term structure of interest rates. γ_i is a multiplier applied for scenario i as given in Table 8. Prepayment speeds vary according to the interest rate shock scenario. The multipliers (γ_i) reflect the expectation that prepayments will generally be higher during periods of falling interest rates and lower during periods of rising interest rates.

Table 8: CPRs under the shock scenarios

Scenario number (i)	Interest rate shock scenarios	γ_i (Scenario multiplier)
1	Parallel up	0.75
2	Parallel down	2.0
3	Steepener	0.85
4	Flattener	1.5
5	Short up	0.9
6	Short down	1.2

The prepayments on the fixed rate loans must ultimately be reflected in the relevant cash flows (scheduled payments on the loans, prepayments and interest payments). These payments can be broken up into scheduled payments adjusted for prepayment and uncompensated prepayments:[38]

$$CF_{i,c}^{P}(k) = CF_{i,c}^{S}(\mathrm{k}) + CPR_{i,c}^{p} \cdot N_{i,c}^{p}(k-1)$$

[37] Alternatively, the base CPR may also vary over the life of each loan in the portfolio. In that case, it is denoted as $CPR(\mathrm{k})_{0,c}^{p}$ for each time bucket *k*.

[38] For simplicity, we have assumed there is no annual limit on prepayments. If a bank has an annual limit on uncompensated prepayments, this limit will apply.

where $CF^{S}_{i,c}(\mathrm{k})$ refers to the scheduled interest and principal repayment, and $N^{p}_{i,c}(k-1)$ denotes the notional outstanding at time bucket *k-1*. The base cash flows (ie given the current interest rate yield curve and the base CPR) are given by *i*=0, while the interest rate shock scenarios are given for *i=1 to 6*.

To illustrate the process, consider the following simplified example. Assume a bank has a 100 unit portfolio of interest-only loans at a fixed rate of 10% with a contractual maturity of two periods, and that the bank estimates (or supervisor sets) the base CPR at 20% during the first period. The cash flows in the base scenario (0) and scenario (2) would be as follows:

Table 9: Example of a fixed rate loan subject to prepayments with two periods under the baseline and parallel down interest rate shock scenario (scenario 2)

	Time bucket		
	k=0	k=1	k=2
	Base scenario		
Notional loan amount outstanding	100	80	0
Scheduled loan repayments		0	80
Interest payments		10	8
Prepayments (Base CPR = 20%)		20	0
Notional repricing cash flows		30	88
	Interest rate shock scenario 2		
Notional loan amount outstanding	100	60	0
Scheduled loan repayments		0	60
Interest payments		10	6
Prepayments (multiplier =2)		40	0
Notional repricing cash flows		50	66

Fixed rate loan commitments

Under a fixed rate loan commitment, a borrower is entitled to draw down a credit line up to a specified amount, at a fixed rate, for a specified term, at any time within a specified period. The portion of the fixed rate commitment that a bank expects to be drawn down is known as the pull-through ratio (PTR), while the remainder (1-PTR) is known as the lapse ratio. When providing such commitments, banks will typically hedge the interest rate risk on the amount of the loan expected to be drawn, but with the risk that actual draw-down amounts will differ from the initially assumed amounts on which the particular hedge is based.

As in the approach for fixed rate loans, the standardised approach for fixed rate loan commitments requires an initial estimate of the baseline PTR again either determined by the bank or prescribed by the supervisor. The baseline pull-through ratio $PTR^{p}_{0,c}(\mathrm{k})$ is estimated for each homogeneous portfolio p of fixed rate loan commitments in currency c and time bucket k.[39] These

[39] Note also that $\sum_{k \le k^{LC}} PTR^{p}_{0,c}(\mathrm{k}) \le 1$, where k^{LC} is the time bucket of the maturity of the commitment.

baseline PTRs determine the baseline notional repricing cash flows. To determine the draw-down ratios under a specific interest rate shock scenario, the baseline draw-down estimates are adjusted by the scalar multiplier m_i shown in Table 10. Note that the multipliers in Table 10 are applied to the *lapse ratio* (1-PTR) rather than the PTR directly. The PTR in scenario i and bucket k is hence calculated as:

$$PTR_{i,c}^{p}(k) = \min\left(1 - \sum_{\kappa \le k} PTR_{i,c}^{p}(\kappa), \max\left(0, 1 - m_i \cdot \left(1 - PTR_{0,c}^{p}(k)\right)\right)\right)$$

Table 10. Multipliers applied to the PTRs under the shock scenarios

Scenario number (i)	Interest rate shock scenarios	Scalar multiple applied to (1-PTR)
1	Parallel up	0.7
2	Parallel down	2.5
3	Steepener	0.8
4	Flattener	2.0
5	Short up	0.9
6	Short down	1.3

Each interest rate shock scenario i results in different PTRs, which in turn affect the slotting of notional repricing cash flows. The notional repricing cash flows under scenario i are given by:

$$CF_{i,c}^{p}(k) = TN_{0,c}^{p} \cdot PTR_{i,c}^{p}(\mathrm{k})$$

where $TN_{0,c}^{p}$ is the total undrawn amount of the fixed rate loan commitment associated with the homogeneous portfolio p. For each homogeneous portfolio p of fixed rate loan commitments, the proportion $(1 - PTR_{i,c}^{p}(k))$ is assumed not to be exercised in scenario i.

To illustrate the process, consider the following simplified example. Assume a bank has a 100-unit portfolio of loan commitments with a maturity of two periods, and that the bank estimates (or supervisor sets) the base PTR at 20% in the first period and 30% in the second period. This implies that, under the baseline scenario, 20 units of the commitment would be drawn-down in the first period and 30 units in the second period. The PTRs under interest rate shock scenario 1 are determined by first multiplying the scalar (m_1) to the lapse ratios. The resulting cash flows are simply the PTRs multiplied by the portfolio of loan commitments, which in this example is equal to 100. Given that scenario 1 is a rise in interest rates, under this interest rate shock scenario, a higher proportion of fixed rate loan commitments are exercised relative to the estimation.

Table 11: Example of a fixed rate loan commitment with two periods under the baseline and parallel up interest rate shock scenario (scenario 1)

	Pull-through ratios			Lapse ratios		Expected amount drawn	
Scenario	PTR(1)	PTR(2)	m	L(1)	L(2)	CF(1)	CF(2)
0	0.2	0.3		0.8	0.7	20	30
1	0.44	0.51	0.7	0.56	0.49	44	51

Term deposits subject to early redemption risk

Term deposits lock in a fixed rate for a fixed term and would usually be hedged on that basis. However, term deposits may be subject to the risk of early withdrawal, also called early redemption risk. Consequently, term deposits may only be treated as fixed rate liabilities and their notional repricing cash flows slotted in the time buckets up to their corresponding contractual maturity dates if it can be shown to the satisfaction of the supervisor that:

- the depositor has no legal right to withdraw the deposit; or
- an early withdrawal results in a significant penalty that at least compensates for the loss of interest between the date of withdrawal and the contractual maturity date and the economic cost of breaking the contract.[40]

If neither of these conditions is met, the depositor holds an option to withdraw and the term deposits are deemed to be subject to early redemption risk. Further, if a bank issues term deposits that do not meet the above criteria to non-retail customers, it must assume that the customer will always exercise the right to withdraw in the way that is most disadvantageous to the bank (ie the deposit is classified as an automatic interest rate option and treated according to Subsection II.2.7.

Banks must determine or supervisors prescribe the baseline term deposit redemption ratio $TDRR_{o,c}^{p}$ applicable to each homogenous portfolio p of term deposits in currency c and use it to slot the notional repricing cash flows. Term deposits which are expected to be redeemed early are slotted into the overnight time bucket (k=1).

The term deposit redemption ratio for time bucket k applicable to each homogenous portfolio p of term deposits in currency c and under scenario i is obtained by multiplying $TDRR_{o,c}^{p}$ by a scalar u_i that depends on the scenario i, as follows:

$$TDRR_{i,c}^{p} = \min(1, u_i \cdot TDRR_{o,c}^{p})$$

where the values of the scalars u_i are set out in Table 12.

Table 12. Term deposit redemption rate (TDRR) scalars under the shock scenarios

Scenario number (i)	Interest rate shock scenarios	Scalar multipliers u_i
1	Parallel up	1.5
2	Parallel down	0.75
3	Steepener	0.8
4	Flattener	1.3
5	Short up	1.4
6	Short down	0.8

The notional repricing cash flows which are expected to be withdrawn early under any interest rate shock scenario i are described as:

$$CF_{i,c}^{p}(1) = TD_{0,c}^{p} \cdot TDRR_{i,c}^{p}$$

where $TD_{0,c}^{p}$ is the outstanding amount of term deposits of type p.

Internal estimates approaches for positions with behavioural options other than NMDs

Subject to supervisory approval, banks may use internal estimates approaches for behavioural options other than NMDs. In so doing, banks' estimates must incorporate all relevant, material and available data, information and methods. Duly documented model development, review and independent

[40] However, often penalties do not reflect such an economic calculation but instead are based on a simpler formula such as a percentage of accrued interest. In such cases there is potential for changes to profit or loss arising from differences between the penalty charged and the actual economic cost of early withdrawal.

validation procedures must be followed. Particular scrutiny will be warranted if assumptions appear to be arbitrary or not based on experience and portfolio performance. Management must document the types of analyses underlying key parameters. Such documents, which typically describe the types of analyses, must facilitate the periodic review of assumptions. The volume and detail of that documentation must be consistent with the significance of the risk.

The Committee will do further work to develop minimum qualifying criteria for the use of internal estimates approaches.

Prepayments on fixed rate loans

Subject to supervisory approval, a bank may use an internal estimate approach for slotting notional repricing cash flows on prepayment-exposed loan products arising from each of the six prescribed interest rate shock scenarios. That is, the multiplicative factors γ_i noted in Table 8 above would be replaced by the bank's internal estimates of measured prepayment speed (IMPS). Because each of the interest rate shock scenarios will result in a different shock to the term structure of interest rates, the bank's internal risk measurement system must generate an appropriate and prudent estimate of the average prepayment speed applicable to each portfolio under each interest rate shock scenario.

As noted above, there are several factors that are important determinants of the bank's estimate of the effect of each interest rate shock scenario on the average prepayment speed. In considering a request for approval to use the IMPS, supervisors must review the bank's independent internal validation process and review the prepayment assumptions. Specifically, a bank must assess the likelihood that customers will elect to exercise their option under each scenario.

Banks must carefully consider how these likelihoods will vary not only under the interest rate shock scenario but also at a minimum for loans of different (i) size; (ii) loan-to-value ratio (LTV); (iii) borrower characteristics, including demographics; (iv) contractual interest rates; (v) seasoning; (vi) geographic location; (vii) original (vintage) and remaining maturity; and (viii) other historical factors. With respect to loan prepayment models, a bank's parameters need to be consistent and reasonable for each interest rate shock scenario used.

Fixed rate loan commitments

Under the internal estimates approach to fixed rate loan commitments, banks must develop and implement prudent risk management policies and procedures, backed by robust governance structures, to estimate internally measured pull-through rates (IMPTR) on fixed-rate loan commitments. These parameters must be developed for each of the prescribed six interest rate shock scenarios and may include the effect of a bank's hedging practices, since assumptions on pull-through depend on how the bank manages its loan portfolios and hedges its forward risks. In addition, given the difficulties in ex post validation of accurate behavioural predictions, banks must stress their assumptions to assess the impact of positive and negative errors in measurement.

Term deposits subject to early redemption risk

Under the internal estimates approach to term deposits subject to early redemption risk, banks must develop and implement prudent risk management policies and procedures, backed by robust governance structures, to estimate the unique internally measured redemption speed (IMRS) for each of the six prescribed interest rate shock scenarios.

2.7. Automatic interest rate options

This section describes the method for calculating minimum capital requirements for automatic interest rate options, whether explicit or embedded.[41,42] This applies to sold automatic interest rate options and bought automatic options used for hedging sold automatic interest rate options:

1. For each sold automatic option *o* in currency *c*, the value change, denoted $\Delta\text{FVAO}^{\text{o}}_{\text{i,c}}$, must be calculated for each interest rate shock scenario i. The value change is given by:

   (i) an estimate of the value of the option to the option holder, given:

   a. a yield curve in currency *c* as described by the $K \times 1$ rate vector $R_{i,c}$ under the interest rate shock scenario i; and

   b. a relative increase in the implicit volatility of 25%;

   minus

   (ii) the value of the sold option to the option holder, given the yield curve in currency *c* at the valuation date (ie the $K \times 1$ rate vector $R_{0,c}$).

   The estimate in (i) must be calculated by a method approved by the supervisor.

2. Likewise, for each bought automatic interest rate option q used for used for hedging sold automatic interest rate options the bank must determine the change in value of the option between interest rate shock scenario i and the current interest rate term structure combined with a relative increase in the implicit volatility of 25%. This is denoted as $\Delta\text{FVAO}^{\text{q}}_{\text{i,c}}$. Since the bought option is held by the bank, any increase in value would be beneficial to it.

3. The bank's total measure for automatic interest rate options risk under interest rate shock scenario *i* in currency *c* is calculated as:

$$KAO_{i,c} = \sum_{o=1}^{n_c} \Delta FVAO^{o}_{i,c} - \sum_{q=1}^{m_c} \Delta FVAO^{q}_{i,c}$$

   where n_c (m_c) is the number of sold (bought) options in currency c.

Positions on bought automatic interest rate options that are not used for hedging sold automatic interest rate options are exempted from the provisions of this subsection. In this case, banks must instead add any changes in market values associated with those bought automatic interest rate options not used for hedging sold automatic interest rate options which is reflected in the regulatory capital measure of the respective capital ratio (ie CET1, AT1 or total capital) to the total automatic interest rate options risk measure $KAO_{i,c}$.

[41] The most important automatic interest rate options likely to occur in the banking book are caps and floors, which are often embedded in banking products. Options of the swaption type, such as prepayment options over non-retail products, may also be treated as automatic interest rate option: where such options are held by sophisticated financial market counterparties, the option holder will almost certainly exercise the option if it is in their financial interest to do so.

[42] Also, in line with Subsection II.2.6 any behavioural option positions with non-retail customer that may change the pattern of notional repricing cash flows are considered as embedded automatic interest rate options for the purposes of this subsection.

3. EVE measure

3.1. Calculation of the EVE measure

The loss in economic value of equity $\Delta EVE_{i,c}$ under scenario i and currency c is calculated as follows:

1. Under each scenario i, all notional repricing cash flows are slotted to the respective time bucket $k \in \{1,2,\dots,K\}$. Within a given time bucket k, all positive and negative notional repricing cash flows are netted[43] to form a single long or short position, with the cancelled parts removed from the calculation. Following this process across all time buckets leads to a set of notional repricing cash flows $CF_{i,c}(k), k \in \{1,2,\dots,K\}$.[44]

2. Net notional repricing cash flows in each time bucket k are weighted by a continuously compounded discount factor:

$$DF_{i,c}(t_k) = \exp\left(-R_{i,c}(t_k) \cdot t_k\right)$$

that reflects the interest rate shock scenario i in currency c as set out in Subection II.2.2. and where t_k is the midpoint of time bucket k. This results in a weighted net position, which may be positive or negative for each time bucket. The discount factors must be representative of a *risk-free* zero-coupon rate. An example of an acceptable yield curve is a *secured* interest rate swap curve.

3. These risk-weighted net positions are summed to determine the EVE in currency c under scenario i (excluding automatic interest rate option positions):

$$EVE_{i,c}^{nao} = \sum_{k=1}^{K} CF_{i,c}(k) \cdot DF_{i,c}(t_k)$$

4. Finally, the full change in EVE in currency c associated with scenario i is obtained by subtracting $EVE_{i,c}^{nao}$ from the EVE under the current interest rate term structure $EVE_{0,c}^{nao}$ and by adding the the total measure for automatic interest rate rate option risk $KAO_{i,c}$ as follows:

$$\Delta EVE_{i,c} = \sum_{k=1}^{K} CF_{0,c}(k) \cdot DF_{0,c}(t_k) - \sum_{k=1}^{K} CF_{i,c}(k) \cdot DF_{i,c}(t_k) + KAO_{i,c}$$

3.2. Additional EVE considerations

Embedded gains and losses

As most banking book assets and liabilities are reported on a historical costs basis, embedded gains and losses are likely to be present. Here, the term embedded gains refers to assets (liabilities) where fair values exceed (are below) the amounts recorded on the balance sheet. Similarly, embedded losses are where assets (liabilities) have fair values that are less (greater) than the current balance sheet carrying value. These gains and losses might be the result of previous changes in risk-free interest rates, or changes in the market's required credit spreads for a borrower or for the bank itself.

[43] Intra-bucket mismatch risk arises as notional repricing cash flows with different maturity dates, but falling within the same time bucket, are assumed to match perfectly. This is mitigated by introducing a high number of time buckets (ie K=19).

[44] Note that, depending on the approach taken for NMDs, prepayments and products with other embedded behavioural options, the notional repricing cash flows may vary by scenario i (scenario-dependent cash flow products).

Conceptually, any embedded gains on assets that originated due to a previous fall in rates are a de facto buffer against a subsequent increase in rates. However, to obtain a measure of the net embedded gains (or losses) across all banking book assets and liabilities requires that all the balance sheet (and possibly off-balance sheet) positions that are not fair-valued under the operative accounting framework to be fair-valued both at origination and currently. This requires knowledge of the current term structure of risk-free interest rates and the prevailing term structure when the asset (or liability) was entered into. It also requires the assignment of an appropriate borrower-specific credit spread to each credit risky asset at origination and currently. In addition, a policy determination would need to be made on whether to incorporate changes in the fair value of a bank's own liabilities. Due to the added complexity, the Committee decided not to include offsets for embedded gains and losses in the EVE measure of risk.

4. Earnings-based measures and basis risk

4.1. Components of the regulatory earnings-based (NII) approach

The regulatory earnings-based (NII) measure under scenario i and currency c is the sum of two earnings components, namely the *general* earnings measure ($\Delta NII^{g}_{i,c}$) based on shock scenarios on the risk-free interest rate and the earnings-based measure subject to *basis risk* (ΔNII^{b}_{c}), ie

$$\Delta NII_{i,c} = \Delta NII^{g}_{i,c} + \Delta NII^{b}_{c}$$

4.2. General earnings-based (NII) measure

The proposed *general* earnings-based (NII) measure is a simple approximation of expected changes in earnings levels based on the same notional repricing cash flow data as used for the EVE approach and can be interpreted as a continuation of the EVE method for the short term. In this approach, the accumulated effect of an interest rate shock on *net interest income* (NII) up to a time horizon of [T] years is calculated.

The notional repricing cash flow data from the EVE approach does not contain information about the repricing conditions or about new business/future production. Therefore, the NII approach ignores assumptions about a bank's future business. Moreover, for the sake of simplicity and robustness, it should be based only on parallel interest rate shock scenarios $i \in \{1,2\}$. Moreover, this approach considers only a short time horizon T.

The formula for the *general* NII measure for currency $c \in \{1, \dots, C\}$ in scenario $i \in \{1,2\}$ is given by:

$$\Delta NII^{g}_{i,c} = NII^{g}_{0,c} - NII^{g}_{i,c} = \overline{\Delta R_{\iota,c}} \cdot \sum_{k:t_k \le T} CF_{i,c}(k) \cdot \left(t_k \cdot DF_{0,c}(t_k) - T \cdot DF_{0,c}(T)\right)$$

where $\overline{\Delta R_{\iota,c}} = R_{i,c}(t_k) - R_{0,c}(t_k)$ denotes the parallel up/down interest rate shock scenarios i={1,2} in currency c. k runs over the different time buckets from overnight to the horizon of T years, t_k is the midpoint of time bucket k, and $CF_{i,c}(k)$ is the notional repricing cash flow for scenario i, currency c in time bucket k including, where applicable, the scenario-dependent adjustments as set out in Table 8, Table 10, and Table 12. Finally, $DF_{0,c}(t_k)$ is the current, unshocked discount factor for time to maturity t_k. The use of the present value of future earnings is made for the sake of consistency with the EVE measure.

4.3. Basis risk including short-term non-parallel gap risk

Banks can have positions (i) to more than one reference rate curve within the same currency; as well as (ii) to different tenors of the same reference rate curve. Dislocations between these rates can occur which could lead to significant losses, a risk commonly known as basis risk.

Basis risk shocks impact banks' earnings whenever some offsetting is achieved between notional repricing cash flows which reprice based on different reference rates or repricing frequencies. The proposed Pillar 1 basis risk measure is based on two metrics, namely the reference rate basis risk and the short term non parallel gap risk. Each metric relies on a measure of the net notional repricing cash flow exposed to basis risk and the realised historical shock of a particular basis. This shock parameter will be calibrated based on the 99th percentile of the moving average of the daily differential between two reference rates at the three-month repricing frequency over a 10-year historical period.

Reference rate basis risk

Reference rate basis risk arises from repricing notional cash flows of different reference rates. The net notional repricing cash flows exposed to reference basis risk is calculated in a two-step procedure:

(i) for each reference rate, net notional repricing cash flows up to one year are first aggregated;

(ii) the net cash flow exposed to basis risk between each pair of reference rates is computed as the minimum of the associated aggregated net notional repricing cash flows.

This procedure is repeated for all combination of pairs of reference rates. Formulaically, for any currency *c* the change in the NII measure for reference rate basis risk is:

$$\Delta NII_c^{rb} = \sum_{Y=2}^{RR}\sum_{X=1}^{Y}\left(\left(min\left(max\left(CF^*_{0,c,rr_X};0\right);\left|min\left(CF^*_{0,c,rr_Y};0\right)\right|\right)\right.\right.$$
$$\left.\left.+\,min\left(\left|min\left(CF^*_{0,c,rr_X};0\right)\right|;max\left(CF^*_{0,c,rr_Y};0\right)\right)\right)\cdot HS^c_{rr_X,rr_Y}\right)$$

where $CF^*_{0,c,rr} = \sum_{k:\, t_k \le 1} CF_{0,c,rr}(k)$, *rr* the reference rate, *RR* the number of reference rates which the bank is exposed to, k the time buckets from overnight to the horizon of one year and finally $CF_{0,c,rr}(k)$ the notional repricing cash flow (with negative sign in case of an outflow) in time bucket k under the baseline scenario for the given currency *c* and reference rate *rr* for maturity bucket k. Note that the two *min* operators inside the double sum control for the fact that CF^*_{0,c,rr_X} and CF^*_{0,c,rr_Y} must be of opposite sign in order to offset each other in the general IRRBB measure and thereby creating an exposure to reference rate basis risk.

$HS^c_{rr_X,rr_Y}$ is the historical basis risk shock between two reference rates and can either (i) be obtained by calculating the 99th percentile of the three-month moving average of the rate differentials between the pair of the three-month reference rates (eg of the three- month government bond vs the three-month Libor rate) observed over the latest 10-year period; or (ii) looked up in Table 13 below.

For the computation of the reference rate basis, banks must use the following minimum segmentation of reference rates:

(i) *policy* rate, ie monetary policy tool used for controlling inflation, determining day-to-day liquidity operations and/or for determining other market rates;[45]

(ii) *interbank offered* rate (IBOR), ie interest rate at which banks lend to each other in the interbank market (eg EURIBOR, LIBOR);

(iii) *administered* rate, ie interest rates determined by the lender (eg loan rate);

[45] The Committee is aware that some central banks in certain jurisdictions may not target inflation or control market rates. Hence, central bank policy rates are not available in such jurisdictions. In such cases, banks are not required to compute the reference rate basis for policy rates in the local currencies of such jurisdictions.

(iv) *government bond yield*, ie the yield earned on zero-coupon government securities.[46]

Short-term non-parallel gap risk

Short-term non-parallel gap risk arises between different reference rate re-pricing frequencies of the same yield curve at the short end of the yield curve.[47] The net cash flow exposed to short-term non-parallel gap risk is calculated in a two-step procedure:

(i) for each repricing term of a given reference rate curve, the net notional repricing cash flows up to one year are first aggregated and then slotted in the three-month bucket; and

(ii) the net amount exposed to basis risk between the repricing terms of this reference rate curve is computed as the minimum of each pair of aggregated net notional repricing cash flows.

This procedure is repeated for all pairs of repricing terms of a reference rate curve. The basis shock will then be applied. Formulaically, for any currency *c* the change in the NII measure for short-term non-parallel gap risk is:

$$\Delta NII_c^{npg} = \sum_{Y=2}^{RR}\sum_{X=1}^{Y}\left(\left(min\left(max\left(CF^*_{0,c,rr,rf_X};0\right);\left|min\left(CF^*_{0,c,rr,rf_Y};0\right)\right|\right)\right.$$
$$\left. + min\left(\left|min\left(CF^*_{0,c,rr,rf_X};0\right)\right|;max\left(CF^*_{0,c,rr,rf_Y};0\right)\right)\right)\cdot HS^c_{rr,rf_X,rf_Y}\Bigg)$$

where $CF^*_{0,c,rr,rf} = \sum_{k:\, t_k \le 1} CF_{0,c,rr,rf}(k)$, *rf* is the reset frequency, the *rr* the reference rate and $CF_{0,c,rr,rf}(k)$ the notional repricing cash flow for the baseline scenario (with negative sign in case of an *outflow*) at time bucket *k*. Note that the two *min* operators inside the double sum control for the fact that CF^*_{0,c,rr,rf_X} and CF^*_{0,c,rr,rf_Y} must be of opposite sign in order to offset each other in the general IRRBB measure and thereby creating an exposure to non-parallel short-term gap risk.

HS^c_{rr,rf_X,rf_Y} is the historical basis risk shock scenario between two repricing frequencies of a particular reference rate and can either (i) be obtained by calculating the 99th percentile of the three-month moving average of the rate differentials between the pairs of repricing terms in the three-month bucket of a given reference rate observed over the last 10-year period; or (ii) be looked up in Table 13 below.

Standardised approach for basis risk in IRRBB

For banks not able to source or validate data for the calibration of the historical basis risk shocks, and/or for markets where a sufficiently long historical time series of a particular reference rate or short-term tenor is not available, the standardised parameters for $HS^c_{rr_X,rr_Y}$ and HS^c_{rr,rf_X,rf_Y} from Table 13 below may be used.

[46] Notional repricing cash flows of all debt securities and credit derivatives in the banking book (including any notional repricing cash flows contingent on those instruments) where the coupon is not indexed to any of the other reference rate segments of the bank must be slotted into the government bond yield reference rate segment.

[47] Note that the design of the interest rate shock scenarios as set out in Subsection II.2.2 stresses levels and slopes (but not curvature) of the yield curves to account for non-parallel gap risk. However, the non-parallel interest rate shock scenarios have been calibrated on the full-term structure and the shocks are hence less pronounced at the short end (ie below one year), although historically observed rate volatilities have periodically been higher than suggested by those shock scenarios at the short end.

Table 13. Standardised basis risk shock parameters

Reference rate basis risk ($HS^{c}_{rr_X,rr_Y}$)	Short-term non-parallel gap risk (HS^{c}_{rr,rf_X,rf_Y})
[50] in bps	[20] in bps

Earnings-based measure for basis risk

The earnings-based measure for basis risk is obtained by the sum of the earnings-based measure for reference rate basis risk and short-term non-parallel gap risk:

$$\Delta NII^{b}_{c} = \Delta NII^{rb}_{c} + \Delta NII^{npg}_{c}$$

5. Minimum capital requirements

5.1. Specification of the Pillar 1 capital measure

There are four sets of proposals with regard to the calculation of minimum capital requirements (MCR) in the Pillar 1 approach. When aggregating the outcomes of the components of minimum capital requirements across currencies, some consideration needs to be made as to the degree of offsetting and/or diversification along with the dependency between rate movements across different currencies. Given that it is fairly unlikely that similar interest rate shock scenarios occur simultaneously (each in a different currency) prudent offsetting of losses through gains across currencies can be justified.

Given the dimensionality of possible correlations, a pragmatic approach based on the notion of scenario consistency is proposed that means that each of the six prescribed interest rate shock scenarios is individually assessed at the same time for all the currencies, whereby minimum capital requirements are based on whichever scenario creates the largest cumulative currency-weighted minimum capital requirements.

Separate calculations are needed for each currency with material exposures, ie those accounting for more than [5]% of either banking book assets or liabilities.

5.2. Pure EVE minimum capital requirements measure (option 1)

The first option being considered is based on the pure EVE-based measure augmented by the bank's total measure for automatic interest rate option risk (KAO) under the prescribed six interest rate shock scenarios. Under this option, EVE results across currencies are aggregated under a given interest rate shock scenario to recognise prudent partial offsetting between net EVE reductions against weighted net increases in EVE across different currencies. The formula for calculating minimum capital requirements under multiple currencies (MRC) associated with the change to EVE hence yields:

$$MRC_1 = \max_{i\in\{1,2,\ldots,6\}}\left\{\mathbf{max}\left(\mathbf{0};\ \sum_{c_{\Delta\mathrm{EVE}_{i,c}>0}} \underbrace{\Delta\mathrm{EVE}_{i,c}}_{\textbf{loss in currency } c} + \boldsymbol{w}\cdot \sum_{c_{\Delta\mathrm{EVE}_{i,c}<0}} \underbrace{\Delta\mathrm{EVE}_{i,c}}_{\textbf{gain in currency } c}\right)\right\}$$

where C is the number of currencies to which the bank is exposed and w is the parameter for recognising a partial offsetting. Note that in a given currency $\Delta\mathrm{EVE}_{i,c}$ is either positive (loss) or negative (gain), but not both. The parameter $w \in [0; 0.5]$ needs to be calibrated in a prudentially sound way. The view of the Committee is that w should not take values higher than 0.5 and has decided that the preliminary value of w to be 0.25. The same aggregation methodology would apply for the net interest income components.

The main benefit with this approach is its simplicity. However, such an approach does not consider potential short-term gains or losses in earnings across scenarios, which could offset or exceed

the EVE loss. Consequently, such an approach might generate adverse incentives for banks to change the repricing profiles of their banking book in order to drive the duration of assets (and hence minimum capital requirements) towards zero – at the expense of greater earnings volatility. Given that basis risk is measured through an earnings approach, this risk type is not captured under option 1.

Options 2 to 4 instead all incorporate various forms of earnings overlay mechanisms.

5.3. Highest of the EVE and NII capital requirements measures (option 2)

Under the second option, the earnings overlay extends the EVE framework to better reflect short-term risks by making minimum capital requirements also conditional on the potential worst change in earnings from the six prescribed interest rate shock scenarios. Here, the Pillar 1 capital requirements for IRRBB would be the maximum of the capital associated with the change in the EVE and earnings measure, allowing for partial offsetting across currencies within each measure. That is:

$$MRC_2 = \max[MRC_1; MRC_{NII}]$$

where

$$MRC_{NII} = \max_{i\in\{1,2\}}\left\{\mathbf{max}\left(\mathbf{0}; \sum_{c_{\Delta EVE_{i,c}>0}} \underbrace{\Delta NII_{i,c}}_{\textbf{loss in currency } c} + \boldsymbol{w}\cdot \sum_{c_{\Delta EVE_{i,c}<0}} \underbrace{\Delta NII_{i,c}}_{\textbf{gain in currency } c}\right)\right\}$$

and $\mathbf{w_{NII}} \in [0,0.5]$ and not necessarily equal to $\mathbf{w}$. Note again that in a given currency $\Delta NII_{i,c}$ is either positive (loss) or negative (gain), but not both.

Option 2 addresses the concerns about incentives to capture short-term risks to earnings. The scenario that generates the highest minimum capital requirements based on EVE losses may not necessarily be the same scenario that determines minimum capital requirements under the NII measure. The NII measure is fairly simplistic in that it derives many of its inputs from the EVE framework and only considers up and down parallel shocks. Distortions from the EVE framework are lessened but are still likely to be dependent on open calibration issues.[48] This option fails to consider some degree of earnings benefit either directly or indirectly.

5.4. Highest of the EVE and NII capital requirements measures with short-term offsetting of EVE reductions (option 3)

Under the third option, short-term gains may offset losses associated with the change from EVE, conditional on scenario consistency:

$$MRC_3 = \max\left[\max_{i\in\{1,2,\ldots,6\}}\left[0; \sum_{\boldsymbol{c}_{\Delta EVE_{i,c}^{benefit}>0}} \underbrace{\Delta EVE_{i,c}^{benefit}}_{\textbf{loss in currency } c} + \boldsymbol{w}\cdot \sum_{\boldsymbol{c}_{\Delta EVE_{i,c}^{benefit}<0}} \underbrace{\Delta EVE_{i,c}^{benefit}}_{\textbf{gain in currency } c}\right]; MRC_{NII}\right].$$

where $\Delta EVE_{i,c}^{benefit} = \Delta EVE_{i,c} + min\left[\Delta NII_{i,c}^{benefit}; 0\right]$ is the EVE measure augmented to allow for offsets for short-term gains and $\Delta NII_i^{benefit}$ is the outcome of the NII measure under the interest rate shock scenario that is most consistent (ie parallel up or down) with the EVE loss-based measure which again is either positive (loss) or negative (gain), but not both. If the measure is positive, ie it generates a

[48] The appropriate time horizon T for determining the general NII measure has not yet been set. There are trade-offs between a shorter horizon of one year versus a longer horizon of up to five years.

loss, it will not be considered.[49] This option improves upon the recognition of short-term gains but this comes with increased complexity and additional distortion.

There are possibilities to reduce this distortion from the NII measure such that non-parallel interest rate shocks could be applied as well. If so, full scenario consistency between the EVE and NII approaches could be achieved. However, in that case assumptions would have to be made about the repricing characteristics of the notional repricing cash flows. Where this approach could capture short-term gains, it is likely to be too complex to design. Additionally, such an approach could introduce additional distortions in incentives away from the optimal balance of duration and earnings stability.

5.5. Highest of the EVE and NII capital requirements measures with a risk-based threshold (option 4)

In the fourth option a risk-based threshold is introduced below which there will be no capital requirements. This approach recognises greater potential earnings, measured by net interest profit (NIP):

$$MRC_4 = \max\begin{bmatrix} 0; \\ MRC_1 - \max[NIP; 0]; \\ MRC_{NII} - \max[NIP; 0] \end{bmatrix}.$$

NIP is a proxy for banking book earnings that are expected based on locked-in margins in the near future after adjusting for expenses and costs associated with banking book activities. Since the NIP is subtracted from the minimum capital requirements associated with the change to EVE and earnings, it functions as a risk-sensitive threshold. Annex 3 elaborates further on this approach.

The main benefit with this approach is that it does not capitalise a portion of the highest minimum capital requirements based on EVE losses or NII measures because, irrespective of the worst-case interest rate scenario, some locked in-margin would remain as an income buffer, once operating costs are subtracted. The main drawback is whether the determination of NIP raises complexity or is too reliant on accounting information. Currently, the Committee believes that NIP should be some fraction of a bank's recent net interest income in the banking book to be tested further.

III. Review of the IRR Principles and proposal for an enhanced Pillar 2 capital treatment for IRRBB

1. Introduction

1.1. An enhanced Pillar 2 approach

The Committee is also considering adopting and implementing an enhanced Pillar 2 capital framework for IRRBB, which would apply as an alternative to the Pillar 1 framework. The enhanced Pillar 2 capital framework includes:

(i) a methodology for assessing banks' capital adequacy with respect to interest rate risk (including credit spread risk) in the banking book;

(ii) guidance for supervisory responses with a strong presumption for capital consequences;

[49] Note that the time horizon for of $\Delta NII_i^{benefit}$ may be different from *T*.

(iii) appropriate disclosure requirements of the Pillar 2 framework; and

(iv) a well-defined peer review process as well as a quantitative assessment of the effectiveness of the framework to ensure consistent implementation.

The Committee is committed to seeking improved risk management of IRRBB in banks whatever approach is finally adopted, and has therefore updated the IRR Principles to form the basis of a revised Pillar 2 framework that would operate in conjunction with the Pillar 1 capital framework set out in Section II or, alternatively, as a standalone Pillar 2 framework as set out later in this Section.

As with all other material risks, the intention is that each bank should evaluate its internal capital adequacy, based on its own measurements and internal limits, and should set these out as part of its internal capital adequacy assessment process (ICAAP). Supervisors will then review both the bank's risk management and controls, as well as its ICAAP capital allocation by undertaking a supervisory review and evaluation process (SREP). Under the enhanced Pillar 2 approach, however, the bank is subject to additional standards regarding the calculation and supervisory reporting. In addition, the BCBS would propose disclosure of a common standardised measure based on the Pillar 1 framework. The Pillar 2 approach would also include additional guidance for supervisors to collect regular standardised information on the level of IRRBB from banks and to review banks' internal measures of IRRBB, with a strong presumption for capital consequences in the case a bank has undue IRRBB relative to its capital or earnings. In the Pillar 2 approach, the standardised framework calculation serves as a fallback for assessing banks' capital levels and sit alongside the bank's own calculations in arriving at a capital outcome.

1.2. Structure of the high-level principles for the management of IRRBB

Set out below are 12 high-level principles for the management of IRRBB. These replace the 15 existing IRR Principles. Principles 1 to 9 are intended to be of general application for the management of interest rate risk arising through banks' non-trading activities. They cover expectations for a bank's interest rate risk management process, including the development of a business strategy, the structure of assets and liabilities and the system of internal controls. In particular, they address the need for effective interest rate risk identification, measurement, monitoring and control activities within the interest rate risk management process. Principle 8 sets out expectations for the reporting and disclosure of IRRBB measurements to regulators and to the market more generally, whereas Principle 9 sets out expectations regarding banks' internal allocation of capital for IRRBB.

Principles 10 to 12, on the other hand, specifically address the supervisory approach to and treatment of banks' IRRBB management framework and internal capital adequacy, and are therefore more preliminary, pending a final decision on what capital framework will be adopted. The principles are intended to be of general application, even though their specific application will depend to some extent on the complexity and range of activities undertaken by individual banks.

The principles set out in this section are specific to banks' management and supervision of IRRBB and should be read in conjunction with existing standards published by the Committee.

2. Overview of the high-level principles for IRRBB

2.1 Principles for banks

1. IRRBB (including CSRBB) is an important risk for all banks that should be specifically identified, measured, monitored and controlled.

2. The board of directors of each bank is responsible for oversight of the IRRBB risk management framework, and for agreeing the bank's risk appetite for IRRBB. Directors should collectively have adequate knowledge and understanding of IRRBB for this task. Monitoring and

management of IRRBB may be delegated by the board to appropriate expert individuals or groups/committees.

3. The risk appetite of a bank for IRRBB should be calibrated in terms of both risk to economic value and risk to earnings. Risk appetite should be expressed through appropriate policy limits and internal controls.

4. Measurement of IRRBB should be based on outcomes for both economic value and earnings arising from a wide and appropriate range of interest rate shock scenarios (including stress scenarios) that result in changes to interest rates across the term structure.

5. In measuring IRRBB, key behavioural and strategic assumptions should be fully understood, conceptually sound and documented. Such assumptions should be rigorously tested and should be aligned with the corporate plan. Assumptions should not be adjusted solely to take account of expectations for changes in interest rates.

6. Measurement systems and models used for IRRBB should be based on complete and accurate data, and subject to appropriate documentation, testing and controls to give assurance on the accuracy of calculations. Models used to measure IRRBB should be comprehensive and covered by strong internal validation processes.

7. Measurement outcomes of IRRBB levels and hedging strategies should be reported to management and the board on a regular basis, at relevant levels of aggregation (by consolidation level and currency).

8. Information on IRRBB positions and limits should be reported to supervisors when requested and public disclosure should be made to the market on a regular basis.

9. Internal capital should be specifically allocated to IRRBB as approved by the board, in line with the agreed risk appetite.

2.2 Principles for supervisors

10. Supervisors should collect regular standardised information from banks on the level of IRRBB, in terms of both economic value and earnings, and use this to identify potential outlier banks for more intensive supervision and for capital consequences.

11. Supervisors should have specialist resources in the area of IRRBB and perform regular assessments of the effectiveness of each bank's approach to the identification, measurement, monitoring and control of IRRBB.

12. Supervisors should review the amount of internal capital allocated by banks to mitigate IRRBB and to identify potential outlier banks. If a bank's IRRBB management is deemed to be inadequate, supervisors should require additional mitigation actions and/or capital to be allocated.

2.3 Proportionality principle

The implementation of these principles should be commensurate with the bank's nature, size and complexity as well as its structure, economic significance, and general risk profile. This requires that supervisors gauge their responses where appropriate for banks with low IRRBB profiles. In particular, supervisors will be focused on systemic risks that are inherent in large, complex or internationally active banks.

3. Principles for banks

Principle 1

IRRBB (including CSRBB) is an important risk for all banks that should be specifically identified, measured, monitored and controlled.

Background

IRRBB is one of the most important types of risk that arises from banking activities, and is encountered by all banks, whether internationally active or not. It arises because market interest rates vary significantly over time and by currency, while the business of banking typically involves intermediation activity that produces exposures to both maturity mismatch (eg long maturity assets funded by short maturity liabilities) and rate mismatch (eg fixed rate loans funded by variable rate deposits).

IRRBB includes credit spread risk in the banking book (CSRBB), which is defined here in broad terms as any kind of asset spread risk of credit risky instruments that is not explained by general interest rate risk in the banking book (IRRBB) or by the expected credit/jump to default risk.

Expectations

As an important risk type, all banks should ensure that they are fully familiar with all elements of IRRBB, should actively identify their IRRBB exposures and should take appropriate steps to measure, monitor and control it.

Banks should identify the IRRBB inherent in new products and activities, or in the case of a new use of an already approved product, and ensure that these are subject to adequate procedures and controls before they become material. Significant hedging or risk management initiatives should be approved in advance by the board or its delegated committee. Products and activities that are new to a bank should undergo a careful pre-acquisition review to ensure that the IRRBB risk characteristics are well understood and that they are subject to a predetermined test phase before being fully rolled out. Prior to introducing a new product, hedging, or position-taking strategy, boards (or their committees) should ensure that adequate operational procedures and risk control systems are in place.

Principle 2

The board of directors of each bank is responsible for oversight of the IRRBB risk management framework, and for agreeing the bank's risk appetite for IRRBB. Directors should collectively have adequate knowledge and understanding of IRRBB for this task. Monitoring and management of IRRBB may be delegated by the board to appropriate expert individuals or groups/committees.

Risk management framework

The board has ultimate responsibility for understanding the nature and the level of interest rate risk taken by the bank. The board should approve broad business strategies and policies that govern or influence the bank's interest rate risk. It should review the overall objectives with respect to IRRBB and ensure that there is clear guidance regarding the acceptable level of those risks. The board should also approve policies that identify lines of authority and responsibility for managing IRRBB exposures.

Accordingly, the board of directors is responsible for approving the overall policies of the bank with respect to IRRBB and for ensuring that senior management takes the steps necessary to identify, measure, monitor and control these risks consistent with the approved strategies and policies. The board should be informed regularly and at least semi-annually of the level and trend of the interest rate risk exposure of the bank and should periodically review information that is sufficiently detailed and timely to allow it to understand and assess the performance of senior management in monitoring and

controlling these risks in compliance with the board-approved policies. Such reviews should be conducted regularly, being carried out more frequently where the bank runs significant IRRBB positions or significant positions in complex IRRBB instruments.

In addition, the board or one of its committees should oversee the establishment, approval, implementation and annual review of IRRBB management strategies, policies, procedures and limits. Board directors should understand the implications of their IRRBB strategies, including the potential interlinkages with and impacts on market, liquidity, credit and operational risks.

The board should ensure that the bank's organisational structure enables it and senior management to carry out their responsibilities and facilitates effective decision-making and good governance. The board should encourage discussions between its members and senior management – as well as between senior management and others in the bank – regarding the IRRBB management process.

Board members do not need individually to have detailed technical knowledge of complex financial instruments, or of quantitative risk management techniques, but among their members there should be some who have sufficient technical knowledge to question and challenge the reports made to the board by senior management. Board members are responsible for ensuring that the senior management team has the capability and skills to fully understand IRRBB risks, and that adequate resources are devoted to IRRBB risk management.

Delegation and committees

Many boards delegate the task for establishing IRRBB risk policies and practices to an asset and liability management committee (ALCO) or other committees of managers. To be effective, any such committee should meet regularly and include representatives from each major department of the bank.

The board should clearly identify the individuals and/or committees responsible for managing IRRBB and, to avoid potential conflicts of interest, should ensure that there is adequate separation of duties in key elements of the risk management process. Banks should have risk measurement, monitoring, and control functions with clearly defined duties that are sufficiently independent from position-taking functions of the bank and that report risk exposures directly to senior management and the board of directors. Large or more complex banks should have a designated independent unit responsible for the design and administration of the bank's interest rate risk identification, measurement, monitoring, and control functions (eg chief risk officer (CRO)). The risk management and strategic planning areas of the bank should communicate regularly to facilitate evaluations of risk arising from future business.

Management committees with delegated responsibility for IRRBB should comprise members who are senior managers with clear lines of authority over the units responsible, where appropriate, for establishing and managing positions, and a channel should exist for clear communication of the committee's directives to these line units.

Senior management should ensure that the structure of the bank's business and the level of IRRBB are effectively managed, that appropriate procedures are established to control and limit these risks, and that resources are available for evaluating and controlling such risks.

Senior management is responsible for ensuring that the bank complies with board policies and has put in place procedures for managing IRRBB on both a long-term and on a day-to-day basis. It should maintain clear lines of authority and responsibility for managing and controlling IRRBB risks. The organisation, procedures and decision-making of senior management should be clear and transparent with respect to the role and authority of positions within senior management.

Banks should have adequate internal controls to ensure the integrity of their IRRBB management process. These internal controls should be an integral part of the bank's overall system of

internal control. They should promote effective and efficient operations, reliable financial and regulatory reporting, and compliance with relevant laws, regulations and bank policies.

With regard to IRRBB control policies and procedures, banks should have appropriate approval processes, exposure limits, reconciliations, reviews and other mechanisms designed to provide a reasonable assurance that risk management objectives are achieved. Many attributes of a sound risk management process, including risk measurement, monitoring and control functions, are important features of an effective system of internal controls.

In addition, a bank should be subject to regular evaluation and review of its internal control system and risk management process. This includes ensuring that personnel are following established policies and procedures. Such reviews should also address any significant change that may affect the effectiveness of controls, such as changes in market conditions, personnel, technology and structures of compliance with exposure limits, and should ensure that appropriate follow-up with management has occurred for any limits that were exceeded. Management should ensure that all such reviews and evaluations are conducted regularly by individuals who are independent of the function they are assigned to review.

Banks, particularly those with IRRBB exposures in complex instruments, should have their IRRBB identification, measurement, monitoring and control processes reviewed by an independent party (such as an internal or external auditor) on a regular basis. In such cases, reports written by internal/external auditors or other outside parties should be made available to relevant supervisory authorities. An independent reviewer should assess whether the bank's risk measurement system is sufficient to capture all material elements of IRRBB.

Principle 3

The risk appetite of a bank for IRRBB should be calibrated in terms of both risk to economic value and risk to earnings. Risk appetite should be expressed though appropriate policy limits and internal controls.

Banks should have clearly defined board-approved risk appetite statements (RAS), ie written articulation of the aggregated level and types of risks that a bank will accept, or avoid, in order to achieve its business objectives, for IRRBB, as well as risk appetite frameworks (RAF), ie policies and procedures for limiting and controlling IRRBB. Banks' interest rate policies and procedures should be clearly defined and be consistent with the nature, size and complexity of their activities. These policies should be applied on a consolidated basis and, as appropriate, at the level of individual affiliates, especially when recognising legal distinctions and possible obstacles to cash or other movements exist among affiliates. They should delineate delegated powers, lines of responsibility and accountability over IRRBB management decisions and should clearly define authorised instruments, hedging strategies and position-taking opportunities. Policies should also specify quantitative limits that define the acceptable level of IRRBB for the bank. All IRRBB policies should be reviewed periodically (at least annually) and revised as needed.

Boards are responsible for setting:

- appropriate limits on IRRBB risk taking and ensuring compliance with those limits;
- adequate systems and standards for measuring IRRBB;
- standards for valuing IRRBB positions and measuring their performance;
- a comprehensive IRRBB reporting and review process; and
- effective internal controls and management information systems(MIS).

Policy limits should be consistent with the bank's overall approach to measuring IRRBB and should address the potential impact of changes in market rates on both EV and earnings: aggregate risk limits clearly articulating the amount of IRRBB risk acceptable to the bank should be approved by the

board. Limits may be associated with specific scenarios of changes in interest rates and/or term structures, such as an increase or decrease of a particular size or a change in shape. The interest rate movements used in developing these limits should represent meaningful stress situations taking into account historic interest rate volatility and the time required by management to mitigate those risk exposures.

Policy limits should be appropriate to the nature, size, complexity and capital adequacy of the bank, as well as its ability to measure and manage its risks. As well as taking due account of the impact of an interest rate shock on its EV, a bank's policy approach should focus on its ability to generate stable earnings sufficient to maintain its normal business operations. Depending on the nature of a bank's activities and business model, sublimits may also be identified for individual business units, portfolios, instrument types, or specific instruments. The level of detail of risk limits should reflect the characteristics of the bank's holdings, including the various sources of IRRBB to which the bank is exposed. Limit systems should ensure that positions that exceed, or are likely to exceed, certain predetermined levels receive prompt management attention.

Boards should define the specific procedures and approvals necessary for exceptions to policies, limits and authorisations. Limit exceptions should be brought to the attention of appropriate management without delay. There should be a clear policy on how management will be informed and what action will be taken in response to an exception. Particularly important is whether limits are absolute in the sense that they should never be exceeded or whether, under specific circumstances, breaches of limits can be tolerated for a predetermined short period of time.

Boards, or their appropriate delegated committees, should approve major hedging or risk position-taking initiatives in advance of implementation. Proposals to use new instrument types or new strategies should be assessed to ensure that the resources required to establish sound and effective IRRBB risk management of the product or activity have been identified; that an assessment of the reasonableness of the proposed activities in relation to the bank's overall financial condition and capital levels has been undertaken; and that procedures have been established to identify, measure, monitor and control the risks of the proposed product or activity.

Principle 4

Measurement of IRRBB should be based on outcomes for both economic value and earnings arising from a wide and appropriate range of interest rate shock scenarios (including stress scenarios) that result in changes to interest rates across the term structure.

Economic value and earnings measures

Banks should have internal interest rate risk measurement systems (IMS) that capture all material sources of interest rate risk and that assess the effect of market changes on both EV and earnings in ways that are consistent with the scope of their activities.

That is, in their risk and internal capital assessments banks should pay due regard to the complementary nature of EV and earnings measures, in particular in terms of:

- *outcomes*: EV measures compute a change in the net present value of the balance sheet subject to specific interest rate shock scenarios, while earnings measures focus on changes to future profitability within a given time horizon eventually affecting future levels of a bank's own equity capital;
- *assessment horizons*: EV measures reflect changes in value relative to equity over the remaining life of the balance sheet, ie until all positions have run off, while earnings measures only cover the short to medium term, and therefore do not capture those risks that will continue to impact profit and loss accounts beyond the period of estimation in full; and

- *future business/production*: EV measures typically consider the net present value of notional repricing cash flows of instruments already on the balance sheet (ie a static view), while earnings measures may, in addition to a static view, assess the scenario-consistent impact on the bank's future earnings inclusive of future business (ie a dynamic view). [50]

Interest rate shock scenarios

Banks' IMS for IRRBB should be able to accommodate the calculation of the impact on EV and earnings of multiple scenarios, including as a minimum:

(i) internally selected interest rate shock scenarios (including stress scenarios) addressing the bank's unique risk profile, according to its internal capital adequacy assessment process (ICAAP);

(ii) the six supervisory prescribed interest rate shock scenarios set out in Section II; and

(iii) any additional interest rate shock scenarios (including stress scenarios) required by supervisors.

Developing internal interest rate stress scenarios

Roles and objectives

Banks should measure their vulnerability to loss under stressful market conditions – including the breakdown of key assumptions – and consider those results when establishing and reviewing their policies and limits for IRRBB (including CSRBB).

Banks should have the capacity to fully understand their risks and the potential impact of stressful events and circumstances on their financial condition. A bank should develop and implement an effective stress-testing framework for interest rate risk (including basis risk) and credit spread risk as part of its broader risk management and governance processes. As part of a more holistic approach, banks' stress-testing programmes should feed into the decision-making process at the appropriate management level, including strategic decisions of the board and senior management such as business and capital planning decisions. In particular, interest rate risk (including basis risk) and credit spread risk stress testing should form an integral part of the ICAAP, which requires banks to undertake rigorous, forward-looking stress testing that identifies severe events of changes in market conditions which could adversely impact the bank's capital, earnings and/or liquidity positions.

A bank's stress-testing framework for IRRBB should be commensurate with its nature, size and complexity, as well as business activities and overall risk profile. The framework should include clearly defined objectives, scenarios tailored to the bank's businesses and risks, well documented assumptions, sound methodologies to assess the potential impact on the bank's financial condition, informative management reports, ongoing and effective review processes for stress tests and recommended actions based on stress test results. IRRBB/CSRBBB stress tests should play an important role in the communication of risks both within the bank and externally with supervisors and the market through appropriate disclosures.

[50] A dynamic view can be useful for business planning and budgeting purposes. However, dynamic approaches are dependent on key variables and assumptions that are extremely difficult to project with accuracy over an extended period and can potentially hide certain key underlying risk exposures.

Selection process for stress events

The identification of relevant stress events for interest rate risk (including basis risk) and credit spread risk, the application of sound modelling approaches and the appropriate use of the stress-testing results require the collaboration of different senior experts within a bank such as the governing bodies for day-to-day management (eg traders, treasury and/or the finance department, the ALCO, the asset and liability management team), the risk management and risk control departments or, where available, the bank's economists. A stress-testing programme for interest rate risk and credit spread risk stress testing should ensure that the opinions of all relevant experts are taken into account.

A bank should determine the range of potential interest rate movements by currency over which it will measure its exposure. Management should ensure that risk is measured over a reasonable range of potential rate change scenarios, including some containing severe stress elements. In developing scenarios, banks should consider a variety of factors, such as the shape and level of the current term structure of interest rates and the historical and implied volatility of interest rates.

A bank should consider the nature and sources of its risk exposure, the time the bank would need to take action to reduce or unwind unfavourable risk positions, and its capability/willingness to withstand accounting losses in order to reposition its risk profile. Banks should select scenarios that provide meaningful estimates of risk and include a range of shocks that is sufficiently wide to allow boards and management to understand the risk inherent in the bank's products and activities. When choosing stress test scenarios for IRRBB, banks should assess a range of alternative scenarios. These scenarios should be wide-ranging enough to identify gap risk, yield curve risk, optionality risk and basis risk. In many cases, static interest rate shocks may not be sufficient to assess IRRBB exposure adequately. As a result, banks should regularly assess IRRBB exposures beyond typical industry conventions, including more extreme changes in interest rates. Banks should ensure their scenarios are both severe and plausible in the light of the existing level of interest rates and the interest rate cycle. For example, in low-rate environments, scenarios involving significant declines in market rates should be de-emphasised in favour of increasing the number and magnitude of rising-rate scenarios.

In particular, stress testing is important after long periods of benign economic and financial conditions, when the fading memory of adverse conditions can lead to complacency and the underpricing of risks, as may occur after prolonged periods of low interest rate and credit spread levels and/or volatilities. Forward-looking scenarios should incorporate changes in the portfolio composition due to factors under the control of the bank (eg the bank's acquisition and production plans), as well as external factors (eg changing competitive, legal or tax environments); new products where only limited historical data are available; new market information and new emerging risks that are not necessarily covered by historical stress episodes. Banks should also perform qualitative and quantitative reverse stress tests in order to (i) identify interest rate and credit spread scenarios that could severely threaten a bank's capital and earnings; (ii) reveal (hidden) vulnerabilities and inconsistencies in hedging strategies (including basis risk); or (iii) reveal (hidden) vulnerabilities due to behavioural reactions on the part of the bank's customers.

In conducting stress tests, special consideration should be given to instruments or markets where concentrations exist, because those positions may be more difficult to liquidate or offset in a stressful market environment. Similarly, firm-wide stress-testing programmes should dynamically examine the effects of interest rate and credit spread risk shocks across all relevant risk factors, taking into account interlinkages of interest rate and credit spread risk with other risk factors (eg market liquidity, quality of the bank's portfolio of credit exposures, including counterparty credit risk exposures), even where those interlinkages materialise at longer time horizons.

Banks with significant optionality risk should include scenarios that capture the exercise of such options. For example, banks that have products with sold caps or floors should include scenarios that assess how the risk positions would change should those caps or floors move into the money. Because the market value of options also fluctuates with changes in the volatility of interest rates, banks should

also develop interest rate risk assumptions to measure their IRRBB exposure to changes in interest rate volatilities.

The method used to develop specific interest rate scenarios may vary from bank to bank. In building an interest rate shock scenario, the bank should specify:

- the term structure of interest rates that will be incorporated in its interest rate shock scenario; as well as
- the basis relationships between yield curves, rate indices etc.

The bank also should estimate how interest rates that are administered or managed by management (eg prime rates or retail deposit rates, as opposed to those that are purely market-driven) might change. Management should document how these assumptions are derived.

From these specifications, the bank should develop interest rate shock scenarios over which exposures will be measured. The complexity of the actual scenarios used may range from a simple assumption that all interest rates move simultaneously in a parallel fashion to more complex interest rate shock scenarios involving multiple yield curves.

Principle 5

In measuring IRRBB, key behavioural and strategic assumptions should be fully understood, conceptually sound and documented. Such assumptions should be rigorously tested and should be aligned with the corporate plan. Assumptions should not be adjusted solely to take account of expectations for changes in interest rates.

Background

Both EV and earnings measures of IRRBB are significantly impacted by a number of assumptions made for the purposes of risk quantification, namely:

– expectations for the exercise of interest rate options (explicit and implicit) by both the bank itself and its customers under the given scenarios;

– treatment in risk quantifications of balances and interest flows arising from NMDs and non-interest bearing current accounts; and

– the implications of accounting practices on IRRBB.

Hence, when assessing the bank's IRRBB exposures, management should make judgments and assumptions about how an instrument's actual maturity or repricing behaviour may vary from the instrument's contractual terms because of optionalities (eg prepayment of loans, early withdrawal of deposits).

In so doing, management should consider factors such as the responsiveness of product rates to changes in market interest rates, the current level of market interest rates and the spread between a bank's offering rate and market rates; competition from other firms; its geographic location and the demographic and other relevant characteristics of its customer base. Banks should also be able to test the appropriateness of key behavioural assumptions compared to the fallback standardised approach (including the use of the TIA for NMDs) as set out in Section II.

The most significant assumptions underlying the system should be documented and clearly understood by risk managers and senior management. Documentation should also include descriptions on how those assumptions affect the bank's hedging strategies.

Modelling assumptions should be conceptually sound and reasonable, and consistent with historical experience. Because market conditions, competitive environments and strategies change over time, management should review significant measurement assumptions (as distinct from behavioural

and strategic assumptions covered by Principle 5) at least annually and more frequently during rapidly changing market conditions. For example, if the competitive market has changed, such that consumers now have lower transaction costs available to them for refinancing their residential mortgages, prepayments may become more sensitive to smaller reductions in interest rates. Management should periodically perform sensitivity analyses for key assumptions to confirm their reasonableness.

Key behavioural assumptions

Prepayments

Management should understand the nature of prepayment risk for their portfolio and make reasonable and prudent estimates of the expected prepayments. Management should document the assumptions underlying the estimates.

Non-maturity deposits

Behavioural assumptions for deposits that have no specific repricing date can be a major determinant of the level of IRRBB as measured by EV and earnings techniques. Banks should document, monitor and regularly update key assumptions for NMD balances and behaviour used in their IMS.

To determine the appropriate assumptions for its NMDs, management should analyse the depositor base including the demographics of its market in order to identify stable and less stable deposits. Also banks should be able to establish appropriate assumptions regarding the proportion of a market interest rate change (pass-through rate) that the bank will have to pass onto its depositors in order to maintain the same level of stable deposit balances. Assumptions should vary according to depositor characteristics (eg retail/wholesale) and account characteristics (eg transactional/non-transactional, remunerated/non-remunerated).

The reasonableness of key assumptions should be reviewed regularly, and the balance between the benefits for earnings should be weighed against the additional EV risk.

Principle 6

Measurement systems and models used for IRRBB should be based on complete and accurate data, and subject to appropriate documentation, testing and controls to give assurance on the accuracy of calculations. Models used to measure IRRBB should be comprehensive and covered by strong internal validation processes.

Model integrity

Banks should develop and use their own measurement systems for IRRBB in accordance with their risk profile and in a manner proportionate to the nature, scale and complexity of their activities.

Accurate and timely measurement of IRRBB is necessary for effective risk management and control. A bank's risk measurement system should be able to identify and quantify the major sources of a bank's IRRBB exposures. The mix of a bank's business lines and the risk characteristics of its activities should guide management's selection of the most appropriate form of measurement system.

Because every risk measurement system has limitations and all these systems vary in how they capture the components of interest rate positions, banks should not rely on a single measure of risk. Instead, banks should use a variety of systems to measure their IRRBB exposure to both EV and earnings risk, ranging from simple calculations based on static simulations using current holdings to more sophisticated dynamic modelling techniques that reflect potential future business activities.

A bank should maintain management information systems (MIS) that allow it to retrieve appropriate and accurate information in a timely manner. The MIS should capture interest rate risk data

on all the bank's material positions. There should be sufficient documentation of the major data sources used in the bank's risk measurement process.

Data inputs should be automated as much as possible to reduce errors. Data mapping should be periodically reviewed and tested. Management should monitor the type of data extracts and set appropriate controls.

Banks' internal measurement systems (IMS) should be based on EV as well as on earnings (ie on net interest income (NII)) and other metrics as prescribed by supervisors). IMS should also be able to incorporate not only a bank's internally selected set of interest rate shock scenarios addressing its unique risk profile, but also supervisory-prescribed interest rate shock scenarios. It should also be sufficiently flexible to incorporate supervisory-imposed constraints on banks' internal risk parameter estimates.

Model governance process

Model risk management should encompass not only technical model validation, but also the model development process, implementation and use, and should include third-party vendor models used for IRRBB management. In particular, if a bank has developed an IMS, it should have a robust validation cycle that includes independent reviews of key areas. Model inputs or assumptions may also be sourced from related modelling processes or submodels (both in-house and vendor-sourced), and should be included in the validation process. Management should also document and explain model specification choices as part of the validation process.

Banks that purchase IRRBB models should ensure proper documentation of their use of those systems, including any specific customisation. If vendors provide input for market data, behavioural assumptions or model settings, management should have a process in place to determine if those inputs are reasonable for their unique circumstances.

The model risk management process should be included in a formal policy that should be reviewed and approved by the appropriate board function. The policy should specify the management roles that are responsible for model oversight, evaluation of results and development of validation procedures.

When developing a model risk management programme, management should consider all the components involved and acquire sufficient knowledge concerning the model's processes and operations in order to implement appropriate controls and reviews, as well as to develop contingency plans if elements of the model become unavailable.

The policy should address the expected validation activities, set the frequency and extent of the reviews and designate who is responsible for the activities. Internal audit should review the model risk management process as part of its annual risk assessment and audit plans. The audit activity should not duplicate model risk management processes, but should review the integrity and effectiveness of the risk management system and the model risk management process.

An effective validation framework should include three core elements:

- evaluation of conceptual soundness, including developmental evidence;
- ongoing monitoring, including process verification and benchmarking; and
- outcomes analysis, including backtesting of key internal parameters (eg stability of deposits, pass-through rates, prepayments, early redemptions, pricing of instruments etc).

The review of significant assumptions should include an assessment of the effect of those assumptions on the measured exposure. By conducting sensitivity analyses, management can determine which assumptions are the most important and, therefore, warrant more frequent monitoring or more rigorous methods to ensure their reasonableness. These analyses also serve as a type of stress test that

can help management to ensure that the bank's soundness would not be impaired if future events vary from current expectations such as:

- failing to assess potential risk exposures over a sufficiently wide range of interest rate movements to identify vulnerabilities and stress events;
- failing to modify or vary assumptions for products with optionalities to be consistent with individual interest rate scenarios;
- basing assumptions solely on past customer behaviour and performance without considering how the bank's competitive market and customer base may change in the future; or,
- more generally, failing to periodically reassess the reasonableness and accuracy of assumptions.

Principle 7

Measurement outcomes of IRRBB levels and hedging strategies should be reported to management and the board on a regular basis, at relevant levels of aggregation (by consolidation level and currency).

Banks should have adequate MIS for identifying, measuring, monitoring and controlling IRRBB exposures. Reports should be provided on a timely basis to the bank's board of directors, senior management and, where appropriate, individual business line managers.

IRRBB reports to board and senior management should provide aggregate information as well as sufficient supporting detail to enable management to assess the sensitivity of the bank to changes in market conditions. Senior management should review the bank's IRRBB management policies and procedures to ensure that they remain appropriate and sound. Senior management should also encourage and participate in discussions with members of the board and, where appropriate to the size and complexity of the bank, with risk management staff regarding risk measurement, reporting and control procedures.

Management should ensure that analysis and risk management activities related to IRRBB are conducted by competent staff with technical knowledge and experience, consistent with the nature and scope of the bank's activities.

An accurate, informative and timely MIS should be maintained for managing IRRBB exposures, both to inform management and to support compliance with board policies. Reporting of risk measures should be regular and should clearly compare current exposure to policy limits. In particular, reporting should include the results of the periodic model reviews and audits as well as comparisons of past forecasts or risk estimates to actual results to inform on potential modelling shortcomings on a regular basis.

Reports detailing the IRRBB exposure of the bank should be reviewed by the board on a regular basis. While the types of reports prepared for the board and for various levels of management will vary based on the bank's portfolio composition, they should include the following:

– summaries of the bank's aggregate exposures;
– reports demonstrating the bank's compliance with policies and limits;
– key assumptions, for example, NMD behaviour and prepayment information;
– results of stress tests, including assessing sensitivity to key assumptions and parameters; and
– summaries of the findings of reviews of IRRBB policies, procedures and adequacy of the measurement systems, including any findings of internal and external auditors and/or consultants.

Principle 8

Information on IRRBB positions and limits should be reported to supervisors when requested and public disclosure should be made on a regular basis.

Reporting to supervisors

Banks should report the results of their internal models for quantification of IRRBB, in terms of impact on both EV and earnings to their supervisors when requested.[51] Banks should also report all material assumptions that are made in arriving at their internal estimates of risk.

Banks should also notify their supervisors in advance of any significant changes proposed for:

– internal limit structures relating to IRRBB;

– internal modelling systems or methodologies for quantifying IRRBB; and/or

– strategic/behavioural assumptions relating to the treatment of optionalities.

Public disclosure

Banks should publicly disclose information on the level of IRRBB risk measured using their internal model as well as the fallback standardised approach framework outlined in Section II.[52] IRRBB should be measured by both EV and NII approaches. Such disclosure should also encompass practices for identifying, measuring, monitoring and controlling IRRBB risk.

In order to improve comparability across banks, the following IRRBB positions should be disclosed to the market. The IRRBB positions should include the following:

– IRRBB levels computed by internal measurement system and the fallback standardised approach (including the use of the TIA for NMDs) as set out in Section II;

– key assumptions, for example relating to NMDs and prepayments

– qualititative and quantitative assessment of IRRBB levels, and modelling methodology.

Details of the disclosure requirements are shown in Table 14 and Table 15 below:

[51] This may include information on IRRBB exposure such as through gap reports.

[52] Note that in the context of disclosure the fallback standardised framework allows for the use of the TIA for NMDs (see Table 1 for a summary).

Table 14

Purpose: To provide a description of the risk management objectives and policies concerning interest rate risk in the banking book.
Scope of application: Mandatory for all banks within the scope of application as set out in Section IV.
Content: Qualitative and quantitative information.
Frequency: Annual.
Format: Flexible.

	Qualitative disclosures
a	IRRBB risk profile.
b	Periodicity of IRRBB measurement.
c	Governance and risk management framework (policies and procedures) for IRRBB.
d	Behavioural assumptions and hedging strategies: (i) non-maturity deposits ; (ii) loans subject to prepayment risk; (iii) term deposits subject to early redemption risk; (iv) fixed-rate loan commitments; (v) other. This would also include behavioural assumptions used for the baseline bahavioural parameter estimates used in the standardised framework.
f	Scenarios used for IRRBB measurement (definition, summary of calibration methodology, reference yield curve).
g	IRRBB risk measurement assumptions for both economic value (modelling assumptions) and earnings (components of earnings measure, balance sheet dynamicity, measurement horizon and other modelling assumptions).
h	Other key qualitative assumptions (eg CSRBB, basis risk).
	Quantitative disclosures
i	The increase/decline in economic value (or relevant measure used by management) according to the bank's internally selected interest rate shock scenarios measuring IRRBB, broken down by significant currencies.
j	The increase/decline in earnings (or relevant internal measure) according to the bank's internally selected interest rate shock scenarios measuring IRRBB, broken down by significant currencies.
k	Banks should complement the qualitative disclosure on model assumptions above with quantitative disclosure over key model parameters (eg average prepayment rates, average redemption ratios, average pull-through ratios).

Table 15

Purpose: To report the change in economic value (or relevant measure used by management) and earnings based on the bank's internal measurement system and the standardised framework.

Scope of application: Mandatory for all banks within the scope of application as set out in Section IV.

Content: Quantitative information.

Frequency: Annual.

Format: Fixed.

Accompanying narrative: Banks should comment on significant changes in the risk measures over the two observation periods.

	$\frac{\Delta EVE}{CET1}$ (%)		$\frac{\Delta NII}{NII}$ (%)		Standardised framework	
Period	**T**	**T-1**	**T**	**T-1**	**T**	**T-1**
Scenario 1						
Scenario 2						
Scenario 3						
Scenario 4						
Scenario 5						
Scenario 6						
Maximum						

Definitions

For each of the supervisory prescribed common interest rate shock scenarios, banks must report (i) the percentage change in the ratio of the change in the economic value of equity to Common Equity Tier 1 $\frac{\Delta EVE}{CET1}$; (ii) the percentage change in projected net interest income (NII) measure [over T years] $\frac{\Delta NII}{NII}$; and (iii) the result of the fallback standardised framework (including the TIA) as set out in Section II. The data should be reported for the current and previous period.

Principle 9

Internal capital should be specifically allocated to IRRBB as approved by the board, in line with the agreed risk appetite.

Banks are responsible for evaluating the level of their internal capital that should be allocated against IRRBB, based on their IMS and assumptions. The level of internal capital should be commensurate with both the actual measured level of risk and the bank's risk appetite and be duly documented in their ICAAP report.

Banks should not only rely on supervisory measures of capital required for IRRBB, but should develop their own methodologies for internal capital allocation, based on their risk methodologies and appetite. In determining the appropriate level of internal capital to be allocated for IRRBB, banks should consider both the amount and quality of capital that is required.

Given that EV risks are embedded in the valuation of the bank's assets and liabilities, the internal capital allocated for EV risk should be a part of the internal capital requirement to support the current business. For earnings risks that arise against future profits not yet included in the current capital stock, banks should consider the adequacy of capital buffers held against the risk that future earnings may be lower than expected, and the impact this could have on the corporate plan and/or business model (eg if reductions in interest margins could lead to uncovered operating costs).

Quantification of internal capital allocations should take account of:

- the size and tenor of internal limits on IRRBB (including CSRBB) positions, and whether these are fully used at the point of capital calculation;
- the effectiveness and expected cost of hedging open positions that are intended to take advantage of internal expectations for the future level of interest rates;
- the sensitivity of the internal measures of IRRBB to key modelling assumptions and the implications of relying on them for capital allocation purposes;
- the impact of positions priced off different interest rate indices (basis risk);
- the impact of CSRBB;
- the impact of mismatched positions in different currencies;
- the capital impact of embedded losses if significant; and
- the alignment of internal capital allocated and IRRBB risks within legal entities that form part of a capital consolidation group, in addition to the adequacy of overall allocation on a consolidated basis.

The quality of internal capital allocated to IRRBB should take account of:

- the drivers of the underlying risk; and
- the circumstances under which the risk might crystallise.

The outcomes of the ICAAP on IRRBB (including CSRBB) should be reflected in banks' modelling of internal capital requirements and flow through to internal allocations to business lines of capital costs that align incentives with risks.

4. Principles for supervisors

Principle 10

Supervisors should collect regular standardised information from banks on the level of IRRBB, both in terms of economic value and earnings, and use this to identify potential outlier banks for more intensive supervision and for capital consequences.

To facilitate monitoring of banks' IRRBB exposures, to ensure consistent implementation in the review of the soundness of the IMS and to improve comparability of measures across banks, supervisors should obtain information from banks on a regular basis on:

– the outcomes of banks' IMS, expressed in terms of both the threat to EV and to earnings, using at least (i) the six prescribed interest rate shock scenarios specified in Section II; (ii) any additional interest rate shock scenarios required by their supervisors; as well as (iii) banks' internally selected interest rate shock scenarios (including stress scenarios);

– the outcome of the fall-back standardised framework as set out in Section II; this encompasses the fallback option summarised in Table 1 and the TIA for NMDs;

– at national discretion, on (i) maturity gaps by significant currencies of notional repricing cash flows associated with their risk-sensitive assets, liabilities and off-balance sheet items; (ii) other metrics with respect to IRRBB (including CSRBB); and (iii) the assumptions used regarding products with behavioural optionalities.

Supervisors should review the information provided by banks under Principle 8, including particularly behavioural assumptions for NMDs and prepayments, in order to establish their reasonableness. Supervisors should understand the sensitivity of the bank's EV and NII measures to these assumptions.

In this regard, the standardised framework would be used at a minimum as a:

(i) common metric for supervisors to compare and assess banks' internal measures; and

(ii) a fallback if the supervisor is not satisfied with the review as set out in Principle 11.

Any material differences between the IMS and the outcome of the standardised framework would be the subject of supervisory review and dialogue with banks.

The identification of outlier banks is described in Principle 12.

Principle 11

Supervisors should have specialist resources in the area of IRRBB and perform regular assessments of the effectiveness of each bank's approach to the identification, measurement, monitoring and control of IRRBB.

Supervisors should determine the adequacy and effectiveness of a bank's IRRBB management framework, the level (point in time) and trends in the risk, and the adequacy of a bank's capital relative to its IRRBB exposures and risk management processes.

Supervisors should discuss the major sources of IRRBB exposures and evaluate whether measurement systems provide a sufficient basis for identifying and quantifying those exposures. In addition, supervisors should evaluate the integrity and effectiveness of the associated controls and management processes to ensure that the practices comply with the stated objectives and risk tolerances set by the bank's board of directors. The supervisory evaluation would be made on a standalone basis or, as appropriate, by making comparisons with banks that have a similar business model.

In forming conclusions about the quality of interest rate risk management and interest rate risk exposures of each bank, supervisors should consider:

– the complexity and level of risk posed by the assets, liabilities and off-balance sheet activities;

– the adequacy and effectiveness of board and senior management oversight;

– management's knowledge and ability to identify and manage the sources of IRRBB;

– the adequacy of internal validation of measures, including sensitivity analysis and backtesting;

– the adequacy of internal monitoring and MIS;

– the effectiveness of risk limits and controls that set tolerances on EV and earnings;

– the effectiveness of the bank's IRRBB/CSRBB stress-testing programme;

– the adequacy and frequency of the internal review and audit of the risk management process, including independent model validation and oversight of model risk;

– the adequacy and effectiveness of risk management practices and strategies as evidenced in past and projected financial performance; and

– the appropriateness of the level of IRRBB (possibly including embedded losses) in relation to the bank's capital, earnings and risk management systems.

In addition, supervisors should set constraints on the internal risk parameters used by a bank, ie based on adequate and objective criteria identified by supervisors (eg through peer group analysis).

Supervisors should employ specialist resources that can undertake the assessment of IRRBB levels and controls in the banks that they supervise. Therefore, supervisory bodies should:

(i) ensure that line supervisors are appropriately trained and sufficiently knowledgeable to identify all relevant aspects of IRRBB in the banks that they regulate;

(ii) employ an adequate number of IRRBB specialists to provide expert support and advice to line supervisors.

Supervisory bodies should promote the development of professional qualifications that lead to improved understanding of IRRBB, by providing regulatory input and encouraging their staff to become qualified.

Principle 12

Supervisors should review the amount of internal capital allocated by banks to mitigate IRRBB and to identify potential outlier banks. If a bank's IRRBB management is deemed to be inadequate, supervisors should require additional mitigation actions and/or capital to be allocated.

Supervisors expect all banks to hold adequate internal capital for the risks they undertake. With regard to IRRBB, supervisors should evaluate whether the bank has earnings and a capital base that are commensurate with the level of short-term and long-term risk exposure as well as the risk those exposures may pose to future financial performance. Supervisors should consider the following factors:

– strength and stability of the earnings stream and the level of income needed to generate and maintain normal business operations; a high level of IRRBB exposure is one that could, under a reasonable range of market scenarios, result in the bank reporting losses or curtailing normal dividend and business operations; in such cases, management should ensure that it has the capital and liquidity to withstand the possible adverse impact of such events until it can implement corrective action by reducing exposures or increasing capital; and

– level of current and potential depreciation in the underlying EV should be reassessed due to changes in market rates; when a bank has significant embedded losses, the supervisor should evaluate the impact of such depreciation, which if recognised would impact capital levels and ratios; in making this determination, supervisors should consider the degree to which liabilities or off-balance-sheet positions may offset the asset depreciation; such offsets may include NMDs for which the management can demonstrate that they represent a stable source of fixed-rate funding.

When a supervisor assesses that a bank's IMS is insufficient to cover its IRRBB exposures or that its internal risk management framework is insufficient, the supervisor should require the bank to submit a plan to improve its risk management. In this plan, the standardised framework calculation should be used as a fallback for assessing capital requirements.

Moreover, a bank should be considered an outlier if the interest rate shock scenarios specified in Principle 4 result in a measured change in:

(i) economic value of equity (ΔEVE) as a proportion of Common Equity Tier 1 (CET1) or Tier 1 exceeds a threshold of [X]%; or

(ii) earnings are such that the bank may not have sufficient income to maintain its normal business operations.

Outlier banks are considered as possibly having undue interest rate risk in the banking book relative to capital or earnings.

When a national supervisor concludes that a bank has undue interest rate risk in the banking book relative to its capital or earnings, or relative to its general risk profile, the supervisor should require the bank to reduce its interest rate risk exposure and/or allocate additional capital. Moreover, when a national supervisor concludes that a bank has an inadequate risk management framework, it should require the bank to improve its risk management framework. The supervisor may consider requiring additional capital until the improvements have been implemented.

IV. Scope of Application

The application of the proposed framework presented within this consultative document follows the scope of application set out in Part I (Scope of Application) of the Basel II framework.[53] The framework should be applied to all large internationally active banks on a consolidated basis, but may also be used for other banks and on any subset of entities of internationally active banks as well to ensure greater consistency and a level playing field between domestic and cross-border banks.

[53] See *International Convergence of Capital Measurement and Capital Standards: A Revised Framework – Comprehensive Version*, June 2006, www.bis.org/publ/bcbs128.pdf.

Annex 1

Methodology for the interest rate shock scenario design

Measure of local interest rates

For the purposes of capturing the local rate environment, the most recent observed interest rate is used in the base construction for scenario i and currency c. Scenario i will dictate which local rate measure is used. For instance, if one considers a parallel shift to the term structure of interest rates, then the measure of local rates will be an average of the benchmark rates at each tenor point. If the scenario involves a shock to the short end of the term structure, then the measure of local rates will be an average of short-term tenor local benchmark rates (ie the overnight, one-month, three-month, six-month and one-year rates).

Interest rate shock parameters

In order to derive the shock parameter for scenario i, the following general steps are undertaken:

Step 1. Generate time series of relative return data at liquid tenor points $k = 1, \dots, K$ for each currency c.

Step 2. Next, banks must determine the current local risk-free, continuously compounded observed zero-coupon rate for currency c, $\bar{R}_c(t_k)$, where t_k is the tenor midpoint of bucket k expressed in years (and where t_{19} is set at 25 years).

Step 3. The average local percentile of the rate series that is dependent on scenario i as a precursor to prescribing the global shock parameters in step 4. For instance, if one considers a parallel shock scenario, the relevant return series is based on the average rate across all tenor points. Similarly, if one considers a short rate shock scenario then the relevant shock series would be the average of short rate percentiles.

Table A1. Interest rate shock parameters by time bucket

Interest rate shock parameter	**Interest rate**	**Time buckets used**
Parallel shock rate series	$\bar{R}_{parallel,c}$	{3m,6m,1Y,2Y,5Y,7Y,10Y,15Y,20Y}
Short rate series	$\bar{R}_{short,c}$	{3m,6m,1Y }
Medium rate series	$\bar{R}_{medium,c}$	{2Y,5Y,7Y}
Long rate series	$\bar{R}_{long,c}$	{10Y,15Y,20Y}

Using various time series of the level of risk-free zero coupon rates at various tenor points for each currency c, a new time series of proportional rate changes can be formed using overlapping time horizons of $h = 6$ months:

$$P_{i,c,h}(t) = \frac{R_{i,c}(t+h) - R_{i,c}(t)}{R_{i,c}(t)}$$

Here i refers to a scenario dependent subscript and h refers to the desired holding period. For instance, one might wish to consider the average of proportional changes across tenor points, a measure of proportional changes at the short end of the term structure, the medium term and the long term, or a

tenor point k. From this time series, some percentile or extremum that represents an estimate of the relevant interest rate shock in currency c can be generated. The 99th percentile and the absolute value of the first percentile of average returns are used. This process generates a country-specific shock parameter, $\alpha_{i,c,h}$ calculated by the average of the 99th percentile and the absolute value of the 1st percentile.

Step 4. The global shock parameter is prescribed based on the weighted average of the currency-specific shock parameters: $\bar{\alpha}_i$. The shock parameter for scenario i is a weighted average of the $\alpha_{i,c,h}$ across all currencies and defined as α_i. The following baseline global parameters are obtained:

Table A2. Baseline global interest rate shock parameters

Parallel	$\bar{\alpha}_{parallel}$	60%
Short rate	$\bar{\alpha}_{short}$	85%
Medium rate	$\bar{\alpha}_{medium}$	55%
Long rate	$\bar{\alpha}_{long}$	40%

Step 5. In order to determine an interest rate shock scenario scalar,. the interest rate shock scenario needs to describe in basis points the exact movement at the midpoint of each time bucket $k = 1, \dots, K$. This will be defined by a scalar that varies depending on the tenor point. For instance, the short rate scalar $S_{short}(t_k)$ is a scalar, between zero and one that is at its greatest for the tenor point $k = 1$ and diminishes linearly towards zero for tenor point K.

The following table summarises the scenario-specific scalars:

Table A3. Specification of scalar adjustment functions by interest rate shock scenario

	$S_j(t_k)$	Formula
Parallel shock scalar	$S_{parallel}(t_k)$	1
Short rate shock scalar	$S_{short}(t_k)$	$1 - t_k/t_K$
Medium rate shock scalar	$\mathrm{S_{medium}}(t_k)$	$\max\left(0{,}1 - \left\lvert\frac{2 \cdot \mathrm{k}}{\mathrm{K}} - 1\right\rvert\right)$
Long rate shock scalar	$S_{long}(t_k)$	t_k/t_K

Specification of candidate interest rate shock scenarios

Given the above parameter formulations, the following 12 candidate interest rate shock scenarios have been investigated:

(i) *Parallel shock for currency c*: a constant parallel shock up or down across all time buckets dependent on the average local interest rate in currency c and a global shock parameter:

$$\Delta R_{parallel,c}(t_k) = \pm\, \bar{R}_c(t_k) \cdot \bar{\alpha}_{parallel} \cdot S_{parallel}(t_k).$$

(ii) *Short rate shock for currency c*: shock up or down that is greatest at the shortest tenor midpoint and is dependent on the current local short rate in currency c and the global interest rate shock parameter. That shock, through the scalar, diminishes toward zero at tenor midpoint further out towards K:

$$\Delta R_{short,c}(t_k) = \pm\, \bar{R}_c(t_k) \cdot \bar{\alpha}_{short} \cdot S_{short}(t_k).$$

(iii) *Medium rate (hump) shock for currency c*: Here the shock is greatest at the middle tenor midpoint ($K/2$) and is dependent on the average local medium rate in currency c. That shock, through the scalar, diminishes towards zero at tenor midpoints further away:

$$\Delta R_{medium,c}(t_k) = \pm \bar{R}_c(t_k) \cdot \bar{\alpha}_{medium} \cdot S_{medium}(t_k).$$

(v) *Long rate shock for currency c*: Here the shock is greatest at the longest tenor midpoint K and is dependent on the average local long rate in currency c and the global shock parameter. That shock, through the scalar, diminishes towards zero at tenor midpoints closer to the short end:

$$\Delta R_{long,c}(t_k) = \pm \bar{R}_c(t_k) \cdot \bar{\alpha}_{long} \cdot S_{long}(t_k).$$

(v) *Rotation shocks for currency c*: involving rotations to the term structure (ie *steepeners* and *flatteners*, among others) of the interest rates whereby both the long and short rates are shocked and the shift at each tenor midpoint obtained through interpolation of those shocks:

$$\Delta R_{rot,c}(t_k) = \pm \Delta R_{short,c}(t_1) \cdot S_{short}(t_k) \pm \Delta R_{long,c}(t_K) \cdot S_{long}(t_k).$$ [54]

[54] Note that when implementing the shock to a specific yield curve in a currency the respective caps and floors are to be applied $\Delta R_{short,c}(t_1)$ and $\Delta R_{long,c}(t_K)$ separately..

Annex 2

Constructing a NII measure from cash flows

The building blocks for constructing an earnings-based (NII) measure are the aggregated notional repricing cash flows of the assets and liabilities for the 19 time buckets. In this annex, the way these cash flows are used in order to construct a simplified earnings measure is described. This is done by rolling over an asset cash flow, then calculating its present value, and finally calculating the impact on this of a parallel shock to the yield curve. The result can be easily generalised to liability cash flows. For the sake of simplicity, throughout this annex, the yield curves are assumed to be continuously compounded.

Net interest income

The impact of interest rate changes on NII can be calculated by comparing NII for a baseline interest rate scenario with the outcome for a scenario where interest rates are shocked. The NII for both scenarios can be obtained by starting with the cash flows for the assets and liabilities and rolling them over.

Available cash flows

A cash flow in a certain time bucket could consist of several notionals of positions with different fixed terms that reprice in that time bucket (as well as interest and spread cash flows). Therefore, it is in principle impossible to determine the interest rate after repricing, since this will depend on the tenor. However, for parallel interest rate shocks, the repricing term would not matter, since for parallel shocks the yield curve is shocked equally at all tenors. In addition, the shock to the forward rates will be equal to the shock to the yield curve. Therefore, it does not matter at which rate a position will reprice when calculating the change in NII. This is because the change in NII is calculated by taking the difference between a baseline and a shocked interest rate scenario, and the only variable that changes between the two scenarios is the shock magnitude that is added to the risk-free component.

Interest income on an asset cash flow

Consider an asset cash flow of amount A that reprices at time t. Until time t, the asset will yield a rate R_t. After time t, the asset will yield a forward rate that depends on the rollover term. If the interest income until a certain horizon T is to be calculated, then it does not matter if the cash flow is rolled over repeatedly until T, or rolled over to the horizon at once. This is because forward rates are used. So, the yield after time t until the horizon will be the forward rate between time t and T. Using the definition of the forward rate for a continuous compounded yield curve, the interest income earned on an asset cash flow of magnitude A for the period between t and T is given by:

$$NII = A \cdot \left[e^{F_{tT} \times (T-t)} - 1\right] = A \cdot \left[e^{\frac{R_T \cdot T - R_t \cdot t}{T-t}(T-t)} - 1\right] = A \cdot \left[e^{R_T \cdot T - R_t \cdot t} - 1\right],$$

where R_T is the rate between 0 and T. The term "-1" between the brackets is for subtracting the cash flow A, so that the interest income remains. Taking the present value of this interest income at time T gives:

$$PV(NII) = A \cdot \left[e^{R_T \cdot T - R_t \cdot t} - 1\right] \cdot e^{-R_T \cdot T} = A \cdot \left[e^{-R_t \cdot t} - e^{-R_T \cdot T}\right]. \quad (1)$$

Interest income after application of an interest rate shock

When calculating the NII for a scenario where the yield curve is shocked, the repricing term of the asset flow could make a difference. However, when only parallel interest rate shocks are applied, the magnitude of the shock for all the forward rates will be equal to the magnitude of the parallel shock. So, when a parallel shock of ΔR is applied to the yield curve, the rate of the asset after repricing will be the forward rate between time t and T plus the shock magnitude ΔR. This shifted rate will continue to apply until the calculation horizon T. So, after applying the shock in expression (1), $R_k \rightarrow R_k + \Delta R$, and the present value of the interest income on the asset cash flow becomes:

$$PV(NII)_{shocked} = A \cdot \left[e^{-(R_t+\Delta R)\cdot t} - e^{-(R_T+\Delta R)\cdot T}\right] = A \cdot [e^{-\Delta R\cdot t} \cdot e^{-R_t\cdot t} - e^{-\Delta R\cdot T} \cdot e^{-R_T\cdot T}].$$

Taking the first-order expansion of the shock terms, $e^{-\Delta R\cdot t} \approx (1 - \Delta R \cdot t)$ and $e^{-\Delta R\cdot T} \approx (1 - \Delta R \cdot T)$, gives:

$$PV(NII)_{shocked} \approx A \cdot [(1 - \Delta R \cdot t) \cdot e^{-R_t\cdot t} - (1 - \Delta R \cdot T) \cdot e^{-R_T\cdot T}].$$

Change in the present value of the NII due to a parallel shock

Using the results from the preceding two sections, the expression for the change in the present value of the NII for a parallel interest rate shock of magnitude ΔR is given by:

$$\begin{aligned}\Delta PV(NII) &= PV(NII)_{shocked} - PV(NII)\\ &= A \cdot [(1 - \Delta R \cdot t) \cdot e^{-R_t\cdot t} - (1 - \Delta R \cdot T) \cdot e^{-R_T\cdot T} - (e^{-R_t\cdot t} - e^{-R_T\cdot T})]\\ &= A \cdot \Delta R \cdot (T \cdot e^{-R_T\cdot T} - t \cdot e^{-R_t\cdot t}).\end{aligned}$$

By rewriting the discount factors, the expression for the impact on the present value of the net interest income due to a parallel interest rate shock of magnitude ΔR is obtained:

$$\Delta PV(NII) = A \cdot \Delta R \cdot (T \cdot DF_T - t \cdot DF_t),$$

which corresponds to $-\Delta NII^g_{i,c}$ in Subsection II.4.2.

The interpretation of this formula is straightforward: if the asset cash flow would reprice at $t = 0$, then until the horizon T the impact of the shock ΔR would be $A \cdot \Delta R \cdot T$, ie the size of the asset multiplied by the shock size and the time to the horizon. The present value of this would be $A \cdot \Delta R \cdot T \cdot DF_T$. Since the cash flow reprices at t instead of now, the total impact on the NII measure would have to be corrected by the impact on the period from 0 to t, since the interest income over that period is not affected by interest rate changes. This impact is given by $A \cdot \Delta R \cdot t$, and the present value is $A \cdot \Delta R \cdot T \cdot DF_t$. Subtracting this term from the impact on the whole period from $t = 0$ to T, gives the change on the present value of the NII measure. Although the above formula has been derived for an assets cash flow, it would apply also to a liability cash flow.

Annex 3

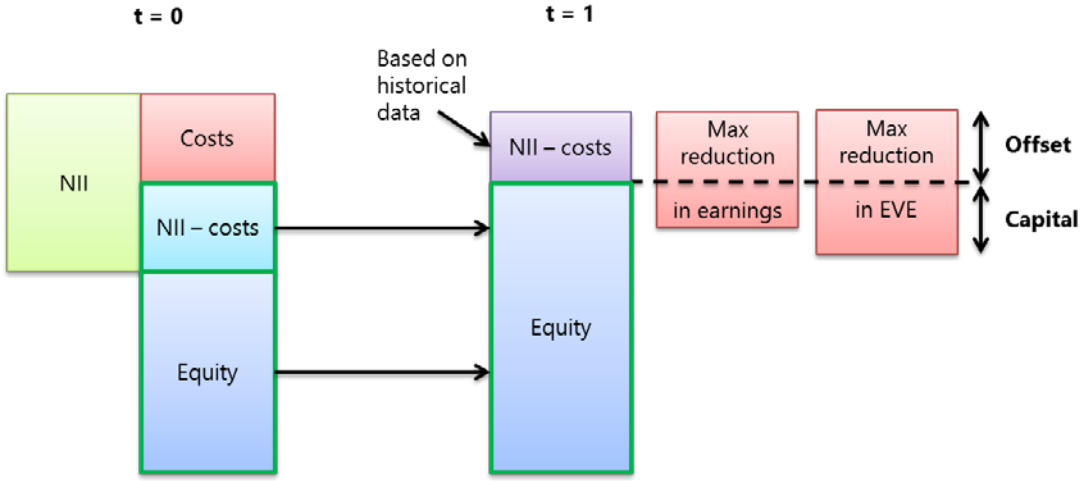
The risk-sensitive threshold capital framework

In this annex, we expand on the risk-sensitive threshold outlined in Subsection II.5. The idea is to use an historical average of banking-book profit as a partial offset for the capital requirements. Figure 1 provides the intuition behind this approach. The rationale for this offsetting term is that there are, in general, many positions in the banking book that have a locked-in margin, which will generate a positive net interest income even when EVE is at its highest point. Note that, unlike for the trading book, for the majority of positions in the banking book future profits are not reflected in the bank's equity capital. Formulaically, the approach for including currency offsetting can be represented as:

$$\mathrm{MRC}_4 = \max[0;\ \mathrm{MRC}_1 - \max[NIP; 0]\,;\ \mathrm{MRC}_{\mathrm{NII}} - \max[NIP; 0]]$$

where NIP is net-interest profit, which is the NII attributable to banking book positions minus costs.

Figure A1: Offsetting the maximum reduction in earnings and EVE by future net interest income from banking book positions minus costs.



NIP will be a prudent number based on realised historical values, since it will be hard to develop a simple, reliable standardised method that is forward-looking. Formulaically, the NIP looks like:

$$\mathrm{NIP} = \max[0, \alpha \cdot \mathrm{NII}_{\mathrm{BB}}].$$

Notice that, defined in this way, the NIP always will be positive. This is done in order to avoid double-counting, since downward risks are included in the capital associated to changes in EVE and earnings. The percentage α may be a common, supervisory-determined parameter, which may be calibrated using Quantitative Impact Study (QIS). Alternatively, it could be bank-specific. Several options may be considered. For example, a measure linked to accounting data could be used, such as the ratio of gross operating income to total revenue – all of which could be identified annually on the profit and loss statement. Alternatively, total costs could be scaled by the total size of the banking book balance sheet.