Basel Committee on Banking Supervision

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SRP98

Application guidance on interest rate risk in the banking book

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BANK FOR INTERNATIONAL SETTLEMENTS

Definition of interest rate risk in the banking book

98.1 Interest rate risk in the banking book (IRRBB) refers to the current or prospective risk to a bank's capital and to its earnings, arising from the impact of adverse movements in interest rates on its banking book.

98.2 Excessive IRRBB can pose a significant threat to a bank's current capital base or future earnings if not managed appropriately. Changes in interest rates can affect the underlying economic value of the bank's assets, liabilities and off-balance sheet instruments, because the present value of future cash flows (and, in many cases, the amounts of cash flows themselves) change when interest rates change. Changes in interest rates also affect a bank's earnings by increasing or decreasing its net interest income (NII) and the level of other interest rate-sensitive income and operating expenses.

98.3 Fundamentally, there are two distinct methods for valuing banking book items, namely:

(1) "amortised" (or "historical") cost, where values are based on initial cost less accumulated depreciation, taking account of the expected life / maturity of the item; and

(2) "fair" (or "market") value, where values are based on market prices (where available) or on the net present value of expected cash flows, discounted at the prevailing rate (where no market price is available).

98.4 For items held at amortised cost, market interest rate changes do not significantly impact profit recognition or accounting values for existing instruments (significant changes in values would be from impairment that needs to be recognised as a permanent diminution in value). Income/cost on items held at amortised cost therefore emerges over time in line with maturity-adjusted cash flows.[1]

Footnotes

[1] *However, the accounting value may not be the same as the balance that needs to be managed for IRRBB purposes, because of the impact of effective interest rate calculations and the treatment of loan loss provisions.*

98.5 Accounting values of fair valued instruments can vary significantly from period to period, due to changes to external factors (eg interest rate changes can impact both the expected future cash flows and the discount rate used for calculation purposes). Income and cost are recognised either through profit and loss (P&L) or through equity, on the basis of changes to embedded value.

98.6 Since most IRRBB economic value measures aim to estimate the change in economic value under shocks and stresses, the presence or absence of higher /lower accounting values for amortised cost instruments is effectively ignored, as is the emergence of profit over time. It is therefore important to note that a loss in economic value does not automatically equate with accounting losses for this element of the banking book. Conversely, for assets held at fair value/mark-to-market, changes in interest rates directly affect current accounting values, and thus have an immediate impact on both P&L and available capital.

98.7 Every interest rate earned by a bank on its assets, or paid on its liabilities, is a composite of a number of price components – some more easily identified than others. Theoretically, all rates contain five elements.

(1) The risk-free rate: this is the fundamental building block for an interest rate, representing the theoretical rate of interest an investor would expect from a risk-free investment for a given maturity.

(2) A market duration spread: the prices/valuations of instruments with long durations are more vulnerable to market interest rate changes than those with short durations. To reflect the uncertainty of both cash flows and the prevailing interest rate environment, and consequent price volatility, the market requires a premium or spread over the risk-free rate to cover duration risk.

(3) A market liquidity spread: even if the underlying instrument were risk-free, the interest rate may contain a premium to represent the market appetite for investments and the presence of willing buyers and sellers.

(4) A general market credit spread: this is distinct from idiosyncratic credit spread, and represents the credit risk premium required by market participants for a given credit quality (eg the additional yield that a debt instrument issued by an AA-rated entity must produce over a risk-free alternative).

(5) Idiosyncratic credit spread: this reflects the specific credit risk associated with the credit quality of the individual borrower (which will also reflect assessments of risks arising from the sector and geographical/currency location of the borrower) and the specifics of the credit instrument (eg whether a bond or a derivative).

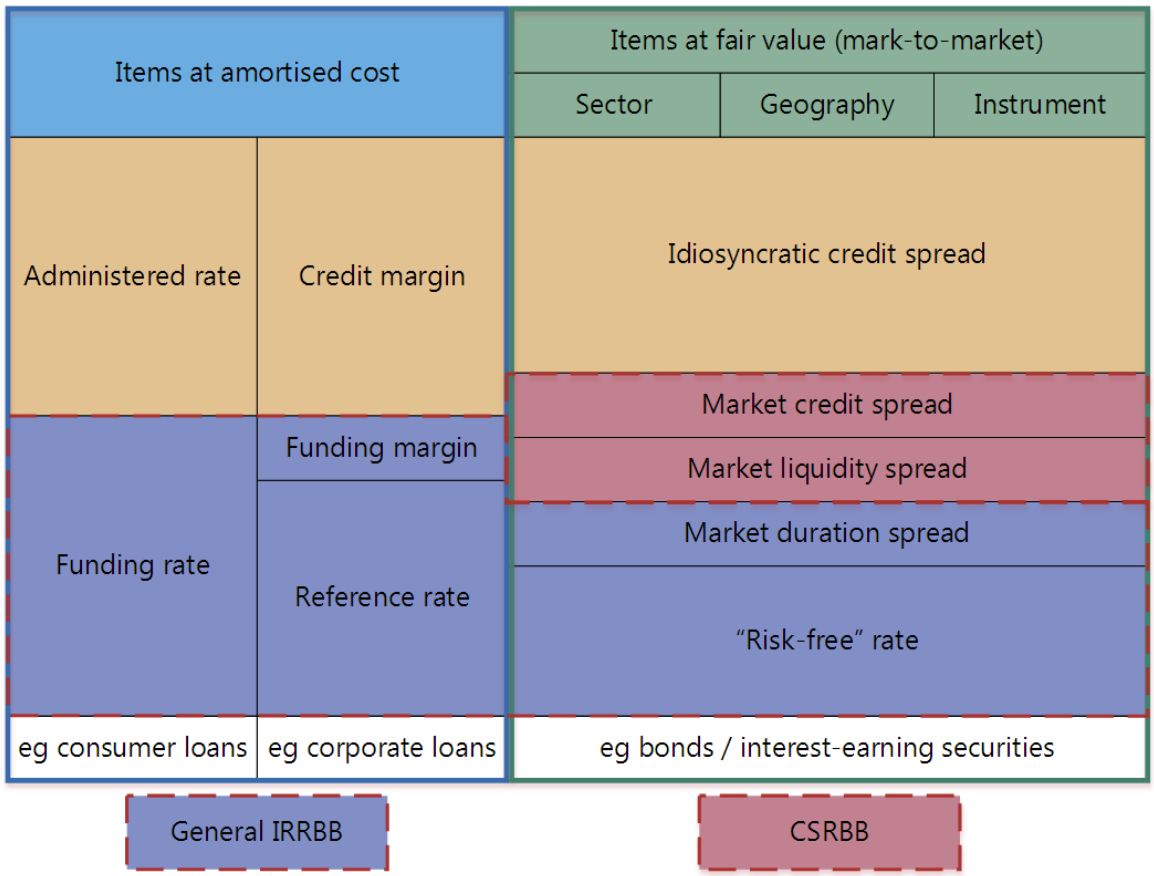
98.8 In theory these rate components apply across all types of credit exposure, but in practice they are more readily identifiable in traded instruments (eg bonds) than in pure loans. The latter tend to carry rates based on two components:

(1) The funding rate, or a reference rate plus a funding margin: the funding rate is the blended internal cost of funding the loan, reflected in the internal funds transfer price (for larger and more sophisticated banks); the reference rate is an externally set benchmark rate, such as the London Interbank Offered Rate (LIBOR) or the federal funds rate, to which a bank may need to add (or from which it may need to subtract) a funding margin to reflect its own all-in funding rate. Both the funding rate and the reference rate incorporate liquidity and duration spread, and potentially some elements of market credit spread. However, the relationship between the funding rate and market reference rate may not be stable over time – this divergence is an example of basis risk.

(2) The credit margin (or commercial margin) applied: this can be a specific add-on (eg LIBOR + 3%, where the 3% may include an element of funding margin) or built into an administered rate (a rate set by and under the absolute control of the bank).

98.9 In practice, decomposing interest rates into their component parts is technically demanding and the boundaries between the theoretical components cannot easily be calculated (eg changes to market credit perceptions can also change market liquidity spreads). As a result, some of the components may be aggregated for interest rate risk management purposes.

98.10 Changes to the risk-free rate, market duration spread, reference rate and funding margin all fall within the definition of IRRBB. Changes to the market liquidity spreads and market credit spreads are combined within the definition of credit spread risk in the banking book (CSRBB). The diagram below gives a visual representation of how the various elements fit together.



98.11 The main driver of IRRBB is a change in market interest rates, both current and expected, as expressed by changes to the shape, slope and level of a range of different yield curves that incorporate some or all of the components of interest rates.

98.12 When the level or shape of a yield curve for a given interest rate basis changes, the relationship between interest rates of different maturities of the same index or market, and relative to other yield curves for different instruments, is affected. This may result in changes to a bank's income or underlying economic value.

98.13 CSRBB is driven by changes in market perception about the credit quality of groups of different credit-risky instruments, either because of changes to expected default levels or because of changes to market liquidity. Changes to underlying credit quality perceptions can amplify the risks already arising from yield curve risk. CSRBB is therefore defined as any kind of asset/liability spread risk of credit-risky instruments which is not explained by IRRBB, nor by the expected credit/jump-to-default risk.

98.14 This chapter and SRP31 focus mainly on IRRBB. CSRBB is a related risk that needs to be monitored and assessed.

98.15 IRRBB derives from three fundamental aspects relating to the level and structural characteristics of interest rates, and the effects on these of changes to yield curves. These aspects of interest rate risk can occur simultaneously, and therefore need to be managed holistically.

(1) Gap risk arises from the term structure of banking book instruments, and describes the risk arising from the timing of instrument rate changes. 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, or reduces on assets before liabilities. 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 risk) or differentially by period (non-parallel risk).[2]

(2) Basis risk describes the impact of relative changes in interest rates for financial instruments that have similar tenors but are priced using different interest rate indices (bases) (eg an asset priced off LIBOR funded by a liability priced off US Treasuries). It arises from the imperfect correlation in the adjustment of the rates earned and paid on different instruments with otherwise similar rate change characteristics. For the purposes of this chapter, IRRBB is defined as excluding changes in idiosyncratic credit margins.

(3) Option risk arises from option derivative positions or from the optional elements embedded in many bank assets, liabilities and off-balance sheet items, where the bank or its customers can alter the level and timing of their cash flows. For IRRBB purposes, option risk can be broken down into two distinct but related sub-types:

(a) automatic option risk arising from standalone instruments, such as exchange-traded and over-the-counter 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 their financial interest to do so; and

(b) behavioural option risk arising from flexibility embedded implicitly or within the terms of financial contracts, such that changes in interest rates may effect 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 their balance in search of higher yield).

Footnotes

[2] *This may sometimes be referred to as "yield curve risk".*

98.16 In addition to the pure economic risks that can arise from changes to the level and structure of interest rates, risks can arise from:

(1) currency mismatches, ie where the interest rate risks are in addition to normal exchange rate risks (this falls within a wider definition of basis risk); or

(2) accounting treatment of risk positions, ie where interest rate hedging activity may achieve the desired economic effect, but fail to achieve hedge accounting treatment.

Measurement of IRRBB

98.17 There are two complementary methods of measuring the potential impact of IRRBB:

(1) changes in expected earnings (earnings-based measures); and

(2) changes in economic value (EV, or EVE when measuring the change in value relative to equity).

98.18 The two methods are complementary in that:

(1) both measures reflect the impact of changing cash flows arising from changing interest rates;

(2) the change in expected earnings is reflected in the change in economic value; and

(3) they are affected by common assumptions.

98.19 The key differences between the measures include:

(1) Outcome measure: EV measures compute a change in the net present value of the balance sheet under an interest rate stress. In undertaking such a calculation, a decision has to be made about whether the outcome should be computed as a change in the theoretical economic value of equity (EVE) – in which case, equity is either excluded from the EV calculation or included with a very short (overnight) duration; or whether the outcome should measure the change in economic value other than for assets representing equity – in which case, equity is either included with the same duration as the assets which it is deemed to be financing, or else both equity and its portfolio of financed assets are excluded (this is earnings-adjusted EV). EVE and earnings-adjusted EV are therefore specific forms of an EV measure. All EV measures can be expressed relative to equity, but EVE includes the change to equity value that would result from revaluing under stress its own financed portfolio of assets. Earnings-based measures focus on changes to future profitability. To the extent that future earnings eventually affect levels of future equity, the two measures are aligned, but the value changes estimated include adjustments to net income that occur beyond the horizon for earnings measures.

(2) Time horizon: EV measures reflect changes in value relative to equity over the remaining life of the balance sheet, ie until all positions have run off. Earnings-based measures cover only the short to medium term, and therefore do not capture in full those risks that will continue to impact profit and loss accounts beyond the period of estimation.

(3) Future transactions: EV measures usually just focus on changes to cash flows of instruments already on the balance sheet. Earnings-based measures can be based on balance sheet run-off, or a static balance sheet, but more sophisticated or dynamic models tend to consider the impact of new business/production that is expected to be written in the future, as well as the run-off of existing business.

98.20 For earnings-based measures, the focus for analysis is the impact of changes in interest rates on future accrued or reported earnings.

98.21 The component of earnings that has traditionally received the most attention is NII, ie the difference between total interest income and total interest expense, taking account of hedging activity (eg via derivatives). This focus reflects both the importance of NII in banks' overall earnings and its direct link to changes in interest rates.[3]

Footnotes

[3] *Note, however, that, as some banks have expanded increasingly into activities that generate fee-based and other non-interest income, a broader focus on operating earnings/overall net income, incorporating both interest and non-interest income and expenses, has become more common.*

98.22 An earnings-based measure offers the possibility of measuring risk under a range of different time horizons. The normal focus is on the short/medium-term horizon (typically one to three years, no more than five years), to limit the cumulative impact of underlying assumptions and the complexity of the calculations. As a consequence, an earnings-based measure is better suited to measuring the short- and medium-term vulnerabilities of the bank to IRRBB, assuming that it is able to continue in business (a going-concern viewpoint).

98.23 An earnings-based measure is therefore commonly used to assess the ability of a bank to generate stable earnings over a medium-term horizon, which will allow it to pay a stable level of dividend and reduce the beta on its equity price and therefore reduce its cost of capital. Hence, it is a measure in line with internal management and asset and liability management objectives.

98.24 In order to be able to calculate changes in expected earnings under different interest rate shocks and stress scenarios, an institution will need to be able to project future earnings under both the expected economic scenario that informs its corporate plan, and the interest rate shock and stress scenarios so that the differences can be measured. Such projections involve a range of further assumptions about client/market behaviour, and the bank's own management response to the evolving economic climate, including:

(1) the volume and type of new/replacement assets and liabilities expected to be originated over the evaluation period;

(2) the volume and type of asset and liability redemptions/reductions over that period;

(3) the interest rate basis and margin associated with the new assets and liabilities, and with those redeemed/withdrawn; and

(4) the impact of any fees collected/paid for exercise of options.

98.25 In practical terms, this may result in modelling of earnings under three different states:

(1) run-off balance sheet: existing assets and liabilities not replaced as they mature, except to the extent necessary to fund the remaining balance sheet;

(2) constant balance sheet: total balance sheet size and shape maintained by assuming like-for-like replacement of assets and liabilities as they run off; and

(3) dynamic balance sheet: incorporating future business expectations, adjusted for the relevant scenario in a consistent manner, ie this is the most meaningful approach.

98.26 Under an economic value approach, the measure of IRRBB is the theoretical change in the net embedded market value of the whole banking book.

98.27 The EV of a tradable instrument is its present value (PV). In the absence of embedded options, the PV of the instrument is determined from its contractual cash flows, which are discounted to reflect current market rates. As a first implication, instruments with short-term or variable rate cash flows have a present value that more nearly equals their face value (ie their carrying value). As a second implication, a change in market rates would not change the EV of such instruments. Third, the PV of an interest rate-sensitive instrument with uncertain contractual cash flows can only be valued on the basis of assumptions about behaviour and timing, which will tend to vary dependent upon external factors.

98.28 Applying the concept of EV to the whole balance sheet of a bank is more challenging: the banking book contains assets and liabilities that are accounted for at held-to-maturity valuation, and for which there may not be observable market prices (eg loans and receivables are not as readily marketable and their market value cannot be determined directly). Moreover, there may be embedded under- and overvaluations in the book on a mark-to-market basis, representing income or costs that will emerge in future reported earnings. In addition, margins on loans may be very heterogeneous, thus making determination of an appropriate discount rate problematic, and the cash flows that are being valued are subject to variation depending upon customer behaviour in response to rate changes (and customers may not behave as might rationally be expected). Finally, there may be structural positions (eg assets held to stabilise return on non-maturity deposits and/or equity) which will produce a significant change in value under EV measurement, but where the risk measured is a direct corollary of risk reduction from an earnings volatility perspective.[4]

Footnotes

[4] *For example, a bank with $100 of capital could manage its earnings volatility by investing all capital in a long-dated fixed rate government security – which would lock in a consistent income but produce economic value risk if market rates changed and the mark-to-market value of the security declined. If its aim was to achieve economic value stability, it could invest its capital in the overnight market, but its earnings would then fluctuate with market interest rates. It is not possible for it to eliminate both EV and earnings risks simultaneously, so a trade-off is needed.*

98.29 To avoid the complexity of measuring total EV, banks typically therefore focus on measuring the level of change to the net present value of the relevant balance sheet items, based on existing or adjusted cash flows that are revalued in line with the interest rate shock and stress scenarios. The change in the valuation is a measure of the level of IRRBB, and can be compared with the current value of equity to determine the change to the EVE.

Key considerations and assumptions

98.30 Both measures of IRRBB are significantly impacted by assumptions made for the purposes of risk quantification:

(1) the range of shocks to the possible changes in the level, slope and shape of interest rate yield curves that are required to produce an IRRBB effect on EV or earnings, and the economic stress scenarios that would be consistent with these shocks;

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

(3) treatment in risk quantifications of balances and interest flows arising from non-maturity deposits (NMDs);

(4) the bank's own determination of the implied investment term of the bank's own equity capital liability; and

(5) the implications for IRRBB of adopted accounting practices.

98.31 In order to produce a quantitative estimate of IRRBB, it is necessary to assume a shock to current interest rate levels, which would allow the change in EV or earnings, and ultimately the effect on equity, to be computed. The size and shape of the shock will determine the measured outcome, and a range of shocks may be needed to identify all the potential facets of IRRBB (eg basis risks would not be captured by shocks that assume only parallel shifts of similar quantum in all yield curves). Designing interest rate change scenarios that are relevant to the business and sufficiently stressful is a key element of IRRBB management

98.32 Behaviour of option positions is one of the key set of assumptions that drive risk quantification measures. The approach taken by banks generally differs between automatic options, where the customer and bank can assume that the exercise of options will be based on rational expectations, and behavioural options, where behaviour will not always be rational and behavioural assumptions need to be used instead.

98.33 Automatic option positions can therefore be valued on the basis that exercise will always (and only) occur when there is financial benefit (with valuation based on standard financial modelling techniques and the results are fed into EV estimates). The rational expectation that the options will be exercised can also be readily fed into forward projections of interest margin under earnings-based measures.

98.34 Behavioural option positions require more complex analysis of expected outcomes, since customers may exercise some options even when it is not in their financial interest to do so, or may not exercise options even when it would be to their benefit. The most complex area of behavioural analysis is for prepayment options on loans: the right to redeem early may be included voluntarily in a loan contract, or imposed on the lender by operation of national law; there may or may not be early redemption penalties payable, but again the size of these penalties may not reflect the actual economic costs and benefits involved (eg if limited by law or by operation of customer redress policy); and customers may choose to redeem for other reasons than the availability of a new loan at lower cost (eg due housing prices, borrowers' demographics, changing family composition, tax changes).

98.35 However, not all borrowers will act irrationally, and exercise of early redemption options will tend to have a detrimental effect on either an EV or an earnings-based measurement, ie in a classic case of convexity risk, borrowers will tend to repay fixed rate borrowings when rates fall (so that they can borrow again at a lower rate) and retain fixed rate positions when market rates rise (so that banks are unable to lend at the higher rates). In order to manage this redemption or extension risk, banks model their books to establish how much should be hedged, and for what period, in order to match their best expectations of cash flows. Such behavioural modelling is clearly prone to error, and needs frequent updating so that hedge positions can be adjusted. Therefore, when using economic value and earnings-based measures, banks need to review and adjust their calculations to account for any expected behaviours.

98.36 The use of economic value and earnings-based measures involves estimating cash flows, but the content and treatment is different: for EV measures, all existing balance sheet items (both principal and interest flows) are discounted at a relevant rate, whereas NII measures include all cash flows, including all margins and principal flows from expected future business, and are normally not discounted.

98.37 NMDs are liabilities of the banks in which the depositor is free to withdraw at any time since they have no contractually agreed maturity date. Notwithstanding, NMD balances have historically proved to be relatively stable in practice, even when market rates change, and balances lost can usually be replaced with new deposits at the same rate – so, overall, NMDs behave differently to other more rate-sensitive funding.[5] Any interest paid on NMDs is usually at rates significantly below those paid for wholesale or larger-denomination deposits, so NMD balances have historically represented an important source of stable and cost-effective funding.[6]

Footnotes

[5] *A subset of NMDs is non-interest bearing current accounts, where balances may fluctuate but are generally not interest bearing: current account customers hold balances mainly for transactional purposes, and are more sensitive to service levels.*

[6] *However, NMD sensitivity may have increased as a result of the sustained period of accommodative monetary policy in some of the world's largest economies.*

98.38 In considering IRRBB, the focus for some banks is therefore primarily on managing the risk of earnings volatility arising from NMDs. In order to achieve this, banks first identify core deposits, ie that element of NMDs that can be considered to be particularly stable under different interest rate scenarios so that a behavioural maturity can be ascribed specifically to them and matching assets allocated to stabilise earnings. In assessing core balances, banks discount those elements of transactional accounts which are subject to regular fluctuation (withdrawal followed by re-deposit) and overall seasonality of the NMD book.

98.39 The matching book of assets may then be managed dynamically to adjust for changes in levels of core deposits, and to maintain a constant maturity in line with expected behaviour and the bank's risk appetite. Although the behavioural maturity may be determined to be very long, the matching asset position carries risk to a bank's EV since, being fixed rate and of some duration, the net present value of this portfolio will vary with general interest rates. The maturity profile chosen will therefore be a compromise between protection of earnings for an extended period and increased risk to EV that could materialise on a shock event (eg a deposit run on NMDs, failure of the bank). Internal risk measures can be used to evaluate the extent and impact of the compromise made.[7]

Footnotes

[7] *One common technique for achieving a constant maturity profile is a replicating portfolio of matching assets that produces a moving average fixed return in line with the risk appetite (eg a portfolio where one sixtieth of the total is reinvested each month for five years fixed will deliver a weighted average maturity of 2.5 years and a moving average of the five-year rate).*

98.40 In the same way as with NMDs, a bank's own equity capital liability represents an important source of structural risk and endowment return – in accounting terms, equity is the net value of assets less liabilities, so it represents assets for which there are no funding liabilities. Equity usually has a cost in the form of a dividend (although not in the case of mutual or cooperative organisations), and banks therefore seek to stabilise the earnings that can be made on assets funded by equity.

98.41 The technique involves defining net equity capital that is eligible for behavioural treatment – some assets are non-interest bearing (eg land and buildings) and may be considered to be financed by equity, so the value of equity available for behavioural treatment may be reduced accordingly.[8] Since equity capital has no contractual price reset date, banks determine their own strategies for managing the earnings volatility that arises from it using techniques similar to those for NMDs. Given that equity may be written down as a result of losses, regulators will normally focus on the EVE risk associated with any earnings profile ascribed to equity that may materialise as losses under stress events.

Footnotes

[8] *Banks may also determine that a portion of equity should remain invested short-term as a buffer against losses that may be incurred under a more general business stress.*

Quantifying IRRBB: economic value

98.42 Change in economic value can be measured using a variety of techniques, the most common of which are:

(1) PV01: present value of a single basis point change in interest rates based on gap analysis;

(2) EVE: economic value of equity; and

(3) EVaR: economic value at risk.

98.43 The techniques differ in their complexity and ability to capture different types of interest rate sensitivity (gap risk (parallel and non-parallel), yield curve risk, basis risk and option risk). Multiple measures of EV sensitivity therefore produce a better overall understanding of risks embedded in the banking book.

98.44 Gap analysis can be used to derive the duration profile of the banking book or, equivalently, the profile of the present value of a single basis point change in interest rates (PV01). Gap analysis allocates all relevant interest rate-sensitive assets and liabilities to a certain number of predefined time buckets according to their next contractual reset date. The analysis also allocates equity, NMDs, prepaying loans or other instruments with future cash flows subject to customer behaviours according to general/behavioural assumptions regarding their maturity or reset date. It then measures the arithmetic difference (the gap) between the amounts of assets and liabilities in each time bucket, in absolute terms. Each time bucket gap can be multiplied by an assumed change in interest rates to yield an approximation of the change in NII that would result from an increase in interest rates. This method gives a visual impression of the risk exposure dispersion relative to the repricing profile, reflecting exposures to parallel as well as non-parallel gap risk. It does not, however, quantify this risk.[9] The measure assumes that all positions within a particular time bucket mature and reprice simultaneously, ignoring potential basis risks within the gaps.

Footnotes

[9] *A variant of the technique, modified duration, could be applied, which shows the relative change in the market value of a financial instrument corresponding to marginal parallel shift of the yield curve (eg by 1 percentage point). The weakness of this technique is that it measures only marginal shifts of the yield curve and works only for parallel shifts.*

98.45 EV measures mainly focus on valuing the cash flows arising from existing assets and liabilities under different future interest scenarios, ignoring future business flows. The change in EV (ie the change in the NPV of future cash flows as a result of a change in rates) can be calculated across all types of assets and liabilities. When a change in the EV of the whole banking book is calculated, the outcome is highly influenced by the treatment of the bank's own equity capital liability in the calculation. There are two possible approaches:

(1) Since accounting equity is the net residual figure that arises from subtracting total liabilities from total assets (including off-balance sheet items), measuring the change in the net present value of those assets and liabilities under a stressed interest rate scenario shows the actual level of risk to the economic value of equity. In this calculation, therefore, no rate or term is applied to equity itself, which is therefore excluded, and the NPV outcome is compared with the starting value of equity in order to measure the proportionate size of the change. This is the EVE measure.

(2) Given that equity finances surplus assets that earn an endowment return for the bank, the change in value of any asset portfolio that has been created to reduce the volatility of earnings on equity is not a relevant EV risk for the bank (ie it has taken the EV risk specifically to hedge earnings risk). In this calculation, therefore, equity is included in the calculation and treated as having the same interest rate/term characteristics as the portfolio of assets that hedges the earnings on it. The NPV outcome is still compared with the starting value of equity, but measures only risks arising from non-structural positions. This measure is earnings-adjusted EV

98.46 EVE measures the theoretical change in the net present value of the balance sheet excluding equity. The measure therefore depicts the change in equity value resulting from an interest rate shock. Under this method, the value of equity under alternative stress scenarios is compared with the value under a base scenario. All cash flows from on-balance sheet and off-balance sheet interest rate-sensitive items in the banking book may be included in the computation. The market value of equity is computed as the present value of asset cash flows, less the present value of liability cash flows, without including assumptions on the interest rate sensitivity of equity. For internal measurement purposes, a bank may complement its computation of EVE with a separate earnings-adjusted EV model that uses assumptions about the investment term of equity, whereby its interest rate sensitivity is taken into account.

98.47 The accuracy of the measure is extremely dependent upon the precision of the cash flows calculated, and on the discount rates used in the calculation. When the expected cash flows are calculated, any likelihood that the size and the timing of future cash flows may differ between scenarios depending upon customer behaviour in reaction to the rate environment needs to be considered.

98.48 Depending on its specific design, an EV/EVE measure can capture all types of interest rate sensitivity. Gap risk (parallel and non-parallel) will be captured depending on the specific yield curve risk used in the alternative scenario. In computing EV, a full revaluation of automatic options would be normal under each of the alternative scenarios, so automatic option risk measurement is an integral part of a standard EV measure. Behavioural optionality can also be captured if stressed behavioural assumptions are used in alternative scenarios. Banks can then compute the EV effect of a change in customer behaviour either separately or in conjunction with a yield curve shift.

98.49 EV is a technique that can also be used to estimate basis risk in the banking book, either in isolation, or when combined with a general yield curve shift or with a change in assumed parameters. Basis risk can be measured by designing a scenario under which there is a divergence in the different base rates to which a bank is specifically sensitive.

98.50 Economic value at risk (EVaR) measures the expected maximum reduction of market value that can be incurred under normal market circumstances over a given time horizon or holding period and subject to a given confidence level. For calculation of EVaR in the banking book, the changes in the market value of the banking book and thus of the equity are computed for a set of alternative yield curve scenarios. When the EVaR approach is applied to the banking book, the time horizon is normally consistent with the economic model of the banking book. The standard VaR approach comprises three different techniques: historical simulation, variance-covariance approach[10] and Monte Carlo simulation.

Footnotes

[10] *Under this approach, interest rates of different tenors are derived from historical observations of changes and a variance-covariance matrix is constructed to account for the correlations between the rate shocks across tenors.*

98.51 EVaR models are suited to capture all types of interest rate sensitivity such as EVE. However, EVaR measurement techniques have their limitations. EVaR is designed for normal market circumstances and does not adequately assess tail risk. Both historical value-at-risk (VaR) and variance-covariance VaR are backward-looking methods which are prone to missing the tail events that carry significant risks. The Monte Carlo simulation method is very demanding in terms of technology and computational power.

Quantifying IRRBB: earnings-based measures

98.52 Earnings-based measures look at the expected increase or reduction in NII over a shorter time horizon (typically one to three years, up to a maximum five years) resulting from interest rate movements that are composed of either a gradual or a one-time large interest rate shock. The change in NII is the difference in the expected NII between a base scenario and an alternative, more stressful scenario. The base case scenario reflects the bank's current corporate plan in projecting the volume, pricing and repricing dates of future business transactions. Interest rates used for resetting transactions in the base scenario can be derived from market expected rates or from spot rates. The rate for each instrument will also contain appropriate projected spreads and margins.

98.53 In assessing the possible extent of change in NII, banks can use models to predict the path of rates and the run-off of existing assets and liabilities. Earnings measures can be differentiated according to the complexity of their forward calculations of income, from simple run-off models which assume that existing assets and liabilities mature without replacement, to constant balance sheet models which assume that assets and liabilities are replaced like for like, to the most complex dynamic models which reflect the changes in the volumes and types of business that will be undertaken (or not undertaken) in differing interest rate environments, with the expected level of prices in those circumstances.

98.54 An earnings-based measure analyses the interest rate risk profile of the banking book in a detailed way tailored to the bank's specific circumstances. As it can account for new business, it reflects a full going-concern perspective. Depending on the design of the alternative scenarios, this method is able to capture all different types of interest rate risk sensitivity. Banks are able to incorporate fully the cash flow changes that occur under alternative scenarios due to automatic options.

98.55 However, the results of the modelling are highly sensitive to assumptions about customer behaviour as well as to the anticipated management responses to different rate scenarios. Earnings-based measures cover a relatively short time horizon, so changes in earnings falling beyond the observation period are ignored (including those arising from any behavioural treatment of NMDs and/or equity that involves long-term structural positions to reduce earnings volatility). Last but not least, earnings-based measures do not necessarily identify the risks to capital that can arise from revaluation of available-for-sale portfolios.

Derivation of the interest rate shocks

98.56 SRP31 describes six prescribed interest rate shock scenarios that banks should apply to parallel and non-parallel gap risks for EVE and two prescribed interest rate shock scenarios for NII. In order to derive these shocks, the following general steps are taken.

98.57 Step 1: generate a 16-year time series of daily average interest rates for each currency c. The average daily interest rates from the year 2000 (3 January 2000) to 2015 (31 December 2015) are contained in Table 1. The average local percentile of the rate series is determined by calculating the average rate across all daily rates in time buckets 3m, 6m, 1Y, 2Y, 5Y, 7Y, 10Y, 15Y and 20Y.

Average interest rates by currency — Table 1

	ARS	AUD	BRL	CAD	CHF	CNY	EUR	GBP	HKD	IDR	INR
Average	3363	517	1153	341	183	373	300	375	295	1466	719

	JPY	KRW	MXN	RUB	SAR	SEK	SGD	TRY	USD	ZAR
Average	89	471	754	868	360	330	230	1494	329	867

98.58 Step 2: 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:

Baseline global interest rate shock parameters — Table 2

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

98.59 Applying the α_i from Table 2 to the average long-term rates from Table 1 results in the revised interest rate shocks by currency for parallel, short and long segments of the yield curve in Table 3.

Revised interest rate shocks, $\Delta\bar{R}_{shocktype,c}$ Table 3

	ARS	AUD	BRL	CAD	CHF	CNY	EUR	GBP	HKD	IDR	INR
Parallel	2018	310	692	204	110	224	180	225	177	880	431
Short	2858	440	980	290	155	317	255	319	251	1246	611
Long	1345	207	461	136	73	149	120	150	118	586	288

	JPY	KRW	MXN	RUB	SAR	SEK	SGD	TRY	USD	ZAR
Parallel	53	283	452	521	216	198	138	896	197	520
Short	75	401	641	738	306	280	196	1270	279	737
Long	35	188	301	347	144	132	92	597	131	347

98.60 However, the proposed interest rate shock calibration can lead to unrealistically low interest rate shocks for some currencies and to unrealistically high interest rate shocks for others. In order to ensure a minimum level of prudence and a level playing field, a floor of 100 basis points and variable caps (denoted as $\Delta\bar{R}_j$) are set for the scenarios concerned, those caps being 500 basis points for the short-term, 400 basis points for the parallel and 300 basis points for the long-term interest rate shock scenario.

98.61 The change in the risk-free interest rate for shock scenario j and currency c can be defined as follows, where $\Delta\bar{R}_j$ is 400, 500 or 300 when j is parallel, short or long respectively.[11]

$$\bar{R}_{j,c} = \max\left(100, \min(\Delta\bar{R}_{j,c}, \Delta\bar{R}_j)\right)$$

Footnotes

[11] *In the case of the rotation scenarios, $\Delta\bar{R}_{j,c}$ cannot exceed 500 basis points and $\Delta\bar{R}_{j,c}(t_k)$ cannot exceed 300 basis points.*

98.62 Applying the caps and floors to the shocks described in Table 3 results in the final set of interest rate shocks by currency that is shown in SRP31.90.

98.63 Supervisors may, applying national discretion, set a higher floor under the local interest rate shock scenarios for their home currency. Supervisors may also, applying national discretion, set a zero or negative lower bound for the post-shock interest rates, where:

$$\overline{R}_{j,c}(t_k) = \max\left(\overline{R}_{0,c}(t_k) + \Delta\overline{R}_{j,c}(t_k), (\textit{zero or negative lower bound set})\right)$$