

Guidelines for the Supervisory Review and Evaluation Process (SREP) of the RBI and the Internal Capital Adequacy Assessment Process (ICAAP) of the banks

The Background

While the Basel - I framework was confined to the prescription of only minimum capital requirements for banks, the Basel II framework expands this approach not only to capture certain additional risks in the minimum capital ratio but also includes two additional areas, namely, the Supervisory Review Process and Market Discipline through increased disclosure requirements for banks. Thus, the Basel II framework rests on the following three mutually-reinforcing pillars:

Pillar 1: Minimum Capital Requirements — which prescribes a risk-sensitive calculation of capital requirements that, for the first time, explicitly includes operational risk in addition to market and credit risk.

Pillar 2: Supervisory Review Process (SRP) — which envisages the establishment of suitable risk management systems in banks and their review by the supervisory authority.

Pillar 3: Market Discipline — which seeks to achieve increased transparency through expanded disclosure requirements for banks.

2. The Basel II document of the Basel Committee also lays down the following four key principles in regard to the SRP envisaged under Pillar 2:

Principle 1 : Banks should have a process for assessing their overall capital adequacy in relation to their risk profile and a strategy for maintaining their capital levels.

Principle 2 : Supervisors should review and evaluate the banks' internal capital adequacy assessments and strategies, as well as their ability to monitor and ensure their compliance with the regulatory capital ratios. Supervisors should take appropriate supervisory action if they are not satisfied with the result of this process.

Principle 3 : Supervisors should expect banks to operate above the minimum regulatory capital ratios and should have the ability to require the banks to hold capital in excess of the minimum.

Principle 4 : Supervisors should seek to intervene at an early stage to prevent capital from falling below the minimum levels required to support the risk characteristics of a particular bank and should require rapid remedial action if capital is not maintained or restored.

3. It would be seen that the principles 1 and 3 relate to the supervisory expectations from the banks while the principles 2 and 4 deal with the role of the supervisors under Pillar 2. The Pillar 2 (Supervisory Review Process - SRP) requires banks to implement an internal process, called the Internal Capital Adequacy Assessment Process (ICAAP), for assessing their capital adequacy in relation to their risk profiles as well as a strategy for maintaining their capital

levels. The Pillar 2 also requires the supervisory authorities to subject all banks to an evaluation process, hereafter called Supervisory Review and Evaluation Process (SREP), and to initiate such supervisory measures on that basis, as might be considered necessary. An analysis of the foregoing principles indicates that the following broad responsibilities have been cast on the banks and the supervisors:

Banks' responsibilities

- a) Banks should have in place a process for assessing their overall capital adequacy in relation to their risk profile and a strategy for maintaining their capital levels (Principle 1)
- b) Banks should operate above the minimum regulatory capital ratios (*Principle 3*)

Supervisors' responsibilities

- a) Supervisors should review and evaluate a bank's ICAAP. (Principle 2)
- b) Supervisors should take appropriate action if they are not satisfied with the results of this process. (Principle 2)
- c) Supervisors should review and evaluate a bank's compliance with the regulatory capital ratios. (Principle 2)
- d) Supervisors should have the ability to require banks to hold capital in excess of the minimum. (Principle 3)
- e) Supervisors should seek to intervene at an early stage to prevent capital from falling below the minimum levels. (Principle 4)
- f) Supervisors should require rapid remedial action if capital is not maintained or restored. (Principle 4)

4. Thus, the ICAAP and SREP are the two important components of Pillar 2 and could be broadly defined as follows:

The ICAAP comprises a bank's procedures and measures designed to ensure the following:

- a) An appropriate identification and measurement of risks;
- b) An appropriate level of internal capital in relation to the bank's risk profile; and
- c) Application and further development of suitable risk management systems in the bank.

The SREP consists of a review and evaluation process adopted by the supervisor, which covers all the processes and measures defined in the principles listed above. Essentially, these include the review and evaluation of the bank's ICAAP, conducting an independent assessment of the bank's risk profile, and if necessary, taking appropriate prudential measures and other supervisory actions.

5. These guidelines seek to provide broad guidance to the banks by outlining the manner in which the SREP would be carried out by the RBI, the expected scope and design of their ICAAP, and the expectations of the RBI from the banks in regard to implementation of the ICAAP.

Conduct of the SREP by the RBI

6. Capital helps protect individual banks from insolvency, thereby promoting safety and soundness in the overall banking system. Minimum regulatory capital requirements under Pillar 1 establish a threshold below which a sound bank's regulatory capital must not fall. Regulatory capital ratios permit some comparative analysis of capital adequacy across regulated banking entities because they are based on certain common methodology / assumptions. However, supervisors need to perform a more comprehensive assessment of capital adequacy that considers risks specific to a bank, conducting analyses that go beyond minimum regulatory capital requirements.

7. The RBI generally expects banks to hold capital above their minimum regulatory capital levels, commensurate with their individual risk profiles, to account for all material risks. Under the SREP, the RBI will assess the overall capital adequacy of a bank through a comprehensive evaluation that takes into account all relevant available information. In determining the extent to which banks should hold capital in excess of the regulatory minimum, the RBI would take into account the combined implications of a bank's compliance with regulatory minimum capital requirements, the quality and results of a bank's ICAAP, and supervisory assessment of the bank's risk management processes, control systems and other relevant information relating to the bank's risk profile and capital position.

8. The SREP of the banks would, thus, be conducted by the RBI periodically, generally, along with the RBI's Annual Financial Inspection (AFI) of the banks and in the light of the data in the off-site returns received from the banks in the RBI, in conjunction with the ICAAP document, which is required to be submitted every year by the banks to the RBI (Cf. Para 11.3 below). Through the SREP, the RBI would evaluate the adequacy and efficacy of the ICAAP of the banks and the capital requirements derived by them therefrom. While in the course of evaluation, there would be no attempt to reconcile the difference between the regulatory minimum CRAR and the outcome of the ICAAP of a bank (as the risks covered under the two processes are different), the banks would be expected to demonstrate to the RBI that the ICAAP adopted by them is fully responsive to their size, level of complexity, scope & scale of operations and the resultant risk profile / exposures, and adequately captures their capital requirements. Such an evaluation of the effectiveness of the ICAAP would help the RBI in understanding the capital management processes and strategies adopted by the banks. If

considered necessary, the SREP could also involve a dialogue between the bank's top management and the RBI from time to time. In addition to the periodic reviews, independent external experts may also be commissioned by the RBI, if deemed necessary, to perform *ad hoc* reviews and comment on specific aspects of the ICAAP process of a bank; the nature and extent of such a review shall be determined by the RBI.

9. Under the SREP, the RBI would also seek to determine whether a bank's overall capital remains adequate as the underlying conditions change. Generally, material increases in risk that are not otherwise mitigated should be accompanied by commensurate increases in capital. Conversely, reductions in overall capital (to a level still above regulatory minima) may be appropriate if the RBI's supervisory assessment leads it to a conclusion that risk has materially declined or that it has been appropriately mitigated. Based on such an assessment, the RBI could consider initiating appropriate supervisory measures to address its supervisory concerns. The measures could include requiring a modification or enhancement of the risk management and internal control processes of a bank, a reduction in risk exposures, or any other action as deemed necessary to address the identified supervisory concerns. These measures could also include the stipulation of a bank-specific minimum CRAR that could potentially be even higher, if so warranted by the facts and circumstances, than the regulatory minimum stipulated under the Pillar 1. In cases where the RBI decides to stipulate a CRAR at a level higher than the regulatory minimum, it would explain the rationale for doing so, to the bank concerned. However, such an add-on CRAR stipulation, though possible, is not expected to be an automatic or inevitable outcome of the SREP exercise, the prime objective being improvement in the risk management systems of the banks.

10. As and when the advanced approaches envisaged in the Basel II document are permitted to be adopted in India, the SREP would also assess the ongoing compliance by the banks with the eligibility criteria for adopting the advanced approaches.

The structural aspects of the ICAAP

11. This section outlines the broad parameters of the ICAAP that the banks are required to comply with in designing and implementing their ICAAP.

11.1 Every bank to have an ICAAP

Reckoning that the Basel II framework is applicable to all commercial banks (except the Local Area Banks and the Regional Rural Banks), both at the solo level (global position) as well as at the consolidated level, the ICAAP should be prepared, on a solo basis, at every tier for each banking entity within the banking group, as also at the level of the consolidated bank (i.e., a group of entities where the licensed bank is the controlling entity). This requirement would also apply to the foreign banks which have a branch presence in India and their ICAAP should

cover their Indian operations only.

11.2 ICAAP to be a Board-approved process

The ultimate responsibility for designing and implementation of the ICAAP lies with the bank's board of directors of the bank and with the Chief Executive Officer in the case of the foreign banks with branch presence in India. The structure, design and contents of a bank's ICAAP should be approved by the board of directors to ensure that the ICAAP forms an integral part of the management process and decision making culture of the bank. Since a sound risk management process provides the basis for ensuring that a bank maintains adequate capital, the board of directors of a bank shall:

- a) set the tolerance level for risk;
- b) ensure that the senior management of the bank:
 - i. establishes a risk framework in order to assess and appropriately manage the various risk exposures of the bank;
 - ii. develops a system to monitor the bank's risk exposures and to relate them to the bank's capital and reserve funds;
 - iii. establishes a method to monitor the bank's compliance with internal policies, particularly in regard to risk management;
 - iv. effectively communicates all relevant policies and procedures throughout the bank;
- c) adopt and support strong internal controls;
- d) ensure that the bank has appropriate written policies and procedures in place;
- e) ensure that the bank has an appropriate strategic plan in place, which, as a *minimum*, shall duly outline
 - i. the bank's current and future capital needs;
 - ii. the bank's anticipated capital expenditure; and
 - iii. the bank's desired level of capital.

11.3 Submission of the outcome of the ICAAP to the Board and the RBI

As the ICAAP is an ongoing process, a written record on the outcome of the ICAAP should to be periodically submitted by the banks to their board of directors. Such written record of the internal assessment of its capital adequacy should include, *inter alia*, the risks identified, the manner in which those risks are monitored and managed, the impact of the bank's changing risk profile on the bank's capital position, details of stress tests/scenario analysis conducted and the resultant capital requirements. The reports shall be sufficiently detailed to allow the Board of Directors to evaluate the level and trend of material risk exposures, whether the bank maintains adequate capital against the risk exposures and in case of additional capital being needed, the plan for augmenting capital. The board of directors would be expected make timely adjustments to the strategic plan, as necessary.

Based on the outcome of the ICAAP as submitted to and approved by the Board, the ICAAP Document, in the format furnished at Annex II, should be furnished to the RBI (i.e., to the CGM-in-Charge, Department of Banking Supervision, Central Office, Reserve Bank of India, World Trade Centre, Centre I, Colaba, Cuffe Parade, Mumbai – 400 005). To begin with, the Document, duly approved by the Board, should be sent to the RBI only once a year, for the year ending March 31, but the frequency of submission could be reviewed in due course. The first such submission should be for the year ending March 31, 2008 by the banks which are migrating to Basel II framework from that date while the remaining banks would submit their first ICAAP Document for the year ending March 31, 2009, the date from which they would switch over to the Basel II framework. The document should reach the RBI latest by June 30 of the respective years.

11.4 Review of the ICAAP outcomes

The board of directors shall, at least once a year, assess and document whether the processes relating the ICAAP implemented by the bank successfully achieve the objectives envisaged by the board. The senior management should also receive and review the reports regularly to evaluate the sensitivity of the key assumptions and to assess the validity of the bank's estimated future capital requirements. In the light of such an assessment, appropriate changes in the ICAAP should be instituted to ensure that the underlying objectives are effectively achieved.

11.5 ICAAP to be an Integral part of the management and decision-making culture

The ICAAP should form an integral part of the management and decision-making culture of a bank. This integration could range from using the ICAAP to internally allocate capital to various business units, to having it play a role in the individual credit decision process and pricing of products or more general business decisions such as expansion plans and budgets. The integration would also mean that ICAAP should enable the bank management to assess, on an ongoing basis, the risks that are inherent in their activities and material to the institution.

11.6 The Principle of proportionality

The implementation of ICAAP should be guided by the principle of proportionality. Though the banks are encouraged to migrate to and adopt progressively sophisticated approaches in designing their ICAAP, the RBI would expect the degree of sophistication adopted in the ICAAP in regard to risk measurement and management to be commensurate with the nature, scope, scale and the degree of complexity in the bank's business operations. The following paragraphs **illustratively** enumerate the broad approach which could be considered by the banks with varying levels of complexity in their operations, in formulating their ICAAP.

11.6.1 In relation to a bank that defines its activities and risk management practices as **simple**, in carrying out its ICAAP, that bank could:

- a) identify and consider that bank's largest losses over the last 3 to 5 years and whether those losses are likely to recur;
- b) prepare a short list of the most significant risks to which that bank is exposed;
- c) consider how that bank would act, and the amount of capital that would be absorbed in the event that each of the risks identified were to materialise;
- d) consider how that bank's capital requirement might alter under the scenarios in (c) and how its capital requirement might alter in line with its business plans for the next 3 to 5 years; and
- e) document the ranges of capital required in the scenarios identified above and form an overall view on the amount and quality of capital which that bank should hold, ensuring that its senior management is involved in arriving at that view.

11.6.2 In relation to a bank that define its activities and risk management practices as **moderately complex**, in carrying out its ICAAP, that bank could:

- a) having consulted the operational management in each major business line, prepare a comprehensive list of the major risks to which the business is exposed;
- b) estimate, with the aid of historical data, where available, the range and distribution of possible losses which might arise from each of those risks and consider using shock stress tests to provide risk estimates;
- c) consider the extent to which that bank's capital requirement adequately captures the risks identified in (a) and (b) above;
- d) for areas in which the capital requirement is either inadequate or does not address a risk, estimate the additional capital needed to protect that bank and its customers, in addition to any other risk mitigation action that bank plans to take;
- e) consider the risk that the bank's own analyses of capital adequacy may be inaccurate and that it may suffer from management weaknesses which affect the effectiveness of its risk management and mitigation;
- f) project that bank's business activities forward in detail for one year and in less detail for the next 3 to 5 years, and estimate how that bank's capital and capital requirement would alter, assuming that business develops as expected;
- g) assume that business does not develop as expected and consider how that bank's capital and capital requirement would alter and what that bank's reaction to a range of adverse economic scenarios might be;
- h) document the results obtained from the analyses in (b), (d), (f), and (g) above in a detailed report for that bank's top management / board of directors; and
- i) ensure that systems and processes are in place to review the accuracy of the estimates made in (b), (d), (f) and (g) (i.e., systems for back testing) vis-à-vis the performance / actuals.

11.6.3 In relation to a bank that define its activities and risk management practices as **complex**, in carrying out its ICAAP, that bank could follow a proportional approach to that bank's ICAAP which should cover the issues identified at (a) to (d) in paragraph 11.6.2 above, but is likely also to involve the use of models, most of which will be integrated into its day-to-day management and operations.

Models of the kind referred to above may be linked so as to generate an overall estimate of the amount of capital that a bank considers appropriate to hold for its business needs. A bank may also link such models to generate information on the economic capital considered desirable for that bank. A model which a bank uses to generate its target amount of economic capital is known as an economic capital model (ECM). Economic capital is the target amount of capital which optimises the return for a bank's stakeholders for a desired level of risk. For example, a bank is likely to use value-at-risk (VaR) models for market risk, advanced modelling approaches for credit risk and, possibly, advanced measurement approaches for operational risk. A bank might also use economic scenario generators to model stochastically its business forecasts and risks. However, the advanced approaches envisaged in the Basel II Framework are not currently permitted by the RBI and the banks would need prior approval of the RBI for migrating to the advanced approaches.

Such a bank is also likely to be part of a group and to be operating internationally. There is likely to be centralised control over the models used throughout the group, the assumptions made and their overall calibration.

11.7 Regular independent review and validation

The ICAAP should be subject to regular and independent review through an internal or external audit process, separately from the SREP conducted by the RBI, to ensure that the ICAAP is comprehensive and proportionate to the nature, scope, scale and level of complexity of the bank's activities so that it accurately reflects the major sources of risk that the bank is exposed to. A bank shall ensure appropriate and effective internal control structures, particularly in regard to the risk management processes, in order to monitor the bank's continued compliance with internal policies and procedures. As a minimum, a bank shall conduct periodic reviews of its risk management processes, which should ensure:

- a) the integrity, accuracy, and reasonableness of the processes;
- b) the appropriateness of the bank's capital assessment process based on the nature, scope, scale and complexity of the bank's activities;
- c) the timely identification of any concentration risk;
- d) the accuracy and completeness of any data inputs into the bank's capital assessment process;
- e) the reasonableness and validity of any assumptions and scenarios used in the capital assessment process;
- f) that the bank conducts appropriate stress testing;

11.8 ICAAP to be a forward-looking process

The ICAAP should be forward looking in nature, and thus, should take into account the expected / estimated future developments such as strategic plans, macro economic factors, etc., including the likely future constraints in the availability and use of capital. As a minimum, the management of a bank shall develop and maintain an appropriate strategy that would ensure that the bank maintains adequate capital commensurate with the nature, scope, scale, complexity and risks inherent in the bank's on-balance-sheet and off-balance-sheet activities, and should demonstrate as to how the strategy dovetails with the macro-economic factors.

Thus, the banks shall have an explicit, Board-approved capital plan which should spell out the institution's objectives in regard to level of capital, the time horizon for achieving those objectives, and in broad terms, the capital planning process and the allocate responsibilities for that process. The plan shall outline:

- a) the bank's capital needs;
- b) the bank's anticipated capital utilisation;
- c) the bank's desired level of capital;
- d) limits related to capital;
- e) a general contingency plan for dealing with divergences and unexpected events.

11.9 ICAAP to be a risk-based process

The adequacy of a bank's capital is a function of its risk profile. Banks shall, therefore, set their capital targets which are consistent with their risk profile and operating environment. As a minimum, a bank shall have in place a sound ICAAP, which shall include all **material** risk exposures incurred by the bank. There are some types of risks (such as reputation risk and strategic risk) which are less readily quantifiable; for such risks, the focus of the ICAAP should be more on qualitative assessment, risk management and mitigation than on quantification of such risks. Banks' ICAAP document shall clearly indicate for which risks a quantitative measure is considered warranted, and for which risks a qualitative measure is considered to be the correct approach.

11.10 ICAAP to include stress tests and scenario analyses

As part of the ICAAP, the management of a bank shall, as a minimum, conduct relevant stress tests periodically, particularly in respect of the bank's material risk exposures, in order to evaluate the potential vulnerability of the bank to some unlikely but plausible events or movements in the market conditions that could have an adverse impact on the bank. The use of stress testing framework can provide a bank's management a better understanding of the bank's likely exposure in extreme circumstances. In this context, the attention is also invited to the RBI circular DBOD.No.BP.BC.101/21.04.103/2006-07 dated June 26, 2007 on stress testing wherein the banks were advised to put in place appropriate stress testing policies and stress test frameworks, incorporating "sensitivity tests" and "scenario tests", for the various risk factors, by September 30, 2007, on a trial / pilot basis and to operationalise formal stress testing frameworks from March 31, 2008. The banks are urged to take necessary measures for implementing an appropriate formal stress testing framework by the date specified which would also meet the stress testing requirements under the ICAAP of the banks.

11.11 Use of capital models for ICAAP

While the RBI does not expect the banks to use complex and sophisticated econometric models for internal assessment of their capital requirements, and there is no RBI-mandated requirement for adopting such models, the banks, with international presence, were required, in terms of paragraph 17 of our Circular DBOD.No.BP(SC).BC98/21.04.103/99 dated October 7, 1999, to develop suitable methodologies, by March 31, 2001, for estimating and maintaining economic capital. However, some of the banks which have relatively complex operations and are adequately equipped in this regard, may like to place reliance on such models as part of their ICAAP. While there is no single prescribed approach as to how a bank should develop its capital model, a bank adopting a model-based approach to its ICAAP shall be able to, *inter alia*, demonstrate:

- a) Well documented model specifications, including the methodology / mechanics and the assumptions underpinning the working of the model;
- b) The extent of reliance on the historical data in the model and the system of back testing to be carried out to assess the validity of the outputs of the model vis-à-vis the actual outcomes;
- c) A robust system for independent validation of the model inputs and outputs;
- d) A system of stress testing the model to establish that the model remains valid even under extreme conditions / assumptions;
- e) The level of confidence assigned to the model outputs and its linkage to the bank's business strategy;
- f) The adequacy of the requisite skills and resources within the banks to operate, maintain and develop the model.

Select operational aspects of the ICAAP

12. This Section outlines in somewhat greater detail the scope of the risk universe expected to be normally captured by the banks in their ICAAP.

Identifying and measuring material risks in ICAAP

12.1 The first objective of an ICAAP is to identify all material risks. Risks that can be reliably measured and quantified should be treated as rigorously as data and methods allow. The appropriate means and methods to measure and quantify those material risks are likely to vary across banks.

12.2 Some of the risks to which banks are exposed include credit risk, market risk, operational risk, interest rate risk in the banking book, credit concentration risk and liquidity risk (as briefly outlined below). The RBI has issued guidelines to the banks on asset liability management, management of country risk, credit risk, operational risk, etc., from time to time. A bank's risk management processes, including its **ICAAP, should, therefore, be consistent with this existing body of guidance**. However, certain other risks, such as reputational risk and business or strategic risk, may be equally important for a bank and, in such cases, should be given same consideration as the more formally defined risk types. For example, a bank may be engaged in businesses for which periodic fluctuations in activity levels, combined with relatively high fixed costs, have the potential to create unanticipated losses that must be supported by adequate capital. Additionally, a bank might be involved in strategic activities (such as expanding business lines or engaging in acquisitions) that introduce significant elements of risk and for which additional capital would be appropriate.

Additionally, if banks employ risk mitigation techniques, they should understand the risk to be mitigated and the potential effects of that mitigation, reckoning its enforceability and effectiveness, on the risk profile of the bank.

12.3 **Credit risk**: A bank should have the ability to assess credit risk at the portfolio level as well as at the exposure or counterparty level. Banks should be particularly attentive to identifying credit risk concentrations and ensuring that their effects are adequately assessed. This should include consideration of various types of dependence among exposures, incorporating the credit risk effects of extreme outcomes, stress events, and shocks to the assumptions made about the portfolio and exposure behavior. Banks should also carefully assess concentrations in counterparty credit exposures, including counterparty credit risk exposures emanating from trading in less liquid markets, and determine the effect that these might have on the bank's capital adequacy.

12.4 **Market risk**: A bank should be able to identify risks in trading activities resulting from a movement in market prices. This determination should consider factors such as illiquidity of instruments, concentrated positions, one-way markets, non-linear/deep out-of-the money positions, and the potential for significant shifts in correlations. Exercises that incorporate extreme events and shocks should also be tailored to capture key portfolio vulnerabilities to the relevant market developments.

12.5 **Operational risk**: A bank should be able to assess the potential risks resulting from inadequate or failed internal processes, people, and systems, as well as from events external to the bank. This assessment should include the effects of extreme events and shocks relating to operational risk. Events could include a sudden increase in failed processes across business units or a significant incidence of failed internal controls.

12.6 **Interest rate risk in the banking book (IRRBB)**: A bank should identify the risks associated with the changing interest rates on its on-balance sheet and off-balance sheet exposures in the banking book from both, a short-term and long-term perspective. This might include the impact of changes due to parallel shocks, yield curve twists, yield curve inversions, changes in the relationships of rates (basis risk), and other relevant scenarios. The bank should be able to support its assumptions about the behavioral characteristics of its non-maturity deposits and other assets and liabilities, especially those exposures characterised by embedded optionality. Given the uncertainty in such assumptions, stress testing and scenario analysis should be used in the analysis of interest rate risks. While there could be several approaches to measurement of IRRBB, an **illustrative** approach for measurement of IRRBB is furnished at **Appendix 1**. The banks would, however, be free to adopt any other variant of these approaches or entirely different methodology for computing / quantifying the IRRBB

provided the technique is based on objective, verifiable and transparent methodology and criteria.

12.7 **Credit concentration risk**: A risk concentration is any single exposure or a group of exposures with the potential to produce losses large enough (relative to a bank's capital, total assets, or overall risk level) to threaten a bank's health or ability to maintain its core operations. Risk concentrations have arguably been the single most important cause of major problems in banks. Concentration risk resulting from concentrated portfolios could be significant for most of the banks.

The following **qualitative criteria** could be adopted by the banks to demonstrate that the credit concentration risk is being adequately addressed:

- a) While assessing the exposure to concentration risk, a bank should keep in view that the calculations of Basel II framework are based on the assumption that a bank is well diversified.
- b) While the banks' single borrower exposures, the group borrower exposures and capital market exposures are regulated by the exposure norms prescribed by the RBI, there could be concentrations in these portfolios as well. In assessing the degree of credit concentration, therefore, a bank shall consider not only the foregoing exposures but also consider the degree of credit concentration in a particular economic sector or geographical area. The banks with operational concentration in a few geographical regions, by virtue of the pattern of their branch network, shall also consider the impact of adverse economic developments in that region, and their impact on the asset quality.
- c) The performance of specialised portfolios may, in some instances, also depend on key individuals / employees of the bank. Such a situation could exacerbate the concentration risk because the skills of those individuals, in part, limit the risk arising from a concentrated portfolio. The impact of such key employees / individuals on the concentration risk is likely to be correspondingly greater in smaller banks. In developing its stress tests and scenario analyses, a bank shall, therefore, also consider the impact of losing key personnel on its ability to operate normally, as well as the direct impact on its revenues.

As regards the **quantitative criteria** to be used to ensure that credit concentration risk is being adequately addressed, the credit concentration risk calculations shall be performed at the counterparty level (i.e., large exposures), at the portfolio level (i.e., sectoral and geographical concentrations) and at the asset class level (i.e., liability and assets concentrations). In this regard, a reference is invited to paragraph 3.2.2 (c) of the Annex to our Circular DBOD.No.BP.(SC).BC.98/ 21.04.103/ 99 dated October 7, 1999 regarding Risk Management System in Banks in terms of which certain prudential limits have been stipulated in regard to 'substantial exposures' of banks. As a prudent practice, the banks may like to ensure that their aggregate exposure (including non-funded exposures) to all 'large borrowers' does not exceed at any time, 800 per cent of their 'capital funds' (as defined for the purpose of extant exposure norms of the RBI). The 'large borrower' for this purpose could be taken to mean as one to whom the bank's aggregate exposure (funded as well as non-funded) exceeds 10 per cent of the bank's capital funds. The banks would also be well advised to pay special attention to their

industry-wise exposures where their exposure to a particular industry exceeds 10 per cent of their aggregate credit exposure (including investment exposure) to the industrial sector as a whole.

There could be several approaches to the measurement of credit concentration the banks' portfolio. One of the approaches commonly used for the purpose involves computation of Herfindahl-Hirshman Index (HHI). It may please be noted that the HHI as a measure of concentration risk is only one of the possible methods and the banks would be free to adopt any other appropriate method for the purpose, which has objective and transparent criteria for such measurement.

12.8 **Liquidity risk**: A bank should understand the risks resulting from its inability to meet its obligations as they come due, because of difficulty in liquidating assets (market liquidity risk) or in obtaining adequate funding (funding liquidity risk). This assessment should include analysis of sources and uses of funds, an understanding of the funding markets in which the bank operates, and an assessment of the efficacy of a contingency funding plan for events that could arise.

12.9 The risk factors discussed above should not be considered an exhaustive list of those affecting any given bank. All relevant factors that present a material source of risk to capital should be incorporated in a well-developed ICAAP. Furthermore, banks should be mindful of the capital adequacy effects of concentrations that may arise within each risk type.

Quantitative and qualitative approaches in ICAAP

12.10 All measurements of risk incorporate both quantitative and qualitative elements, but to the extent possible, a quantitative approach should form the foundation of a bank's measurement framework. In some cases, quantitative tools can include the use of large historical databases; when data are more scarce, a bank may choose to rely more heavily on the use of stress testing and scenario analyses. Banks should understand when measuring risks that measurement error always exists, and in many cases the error is itself difficult to quantify. In general, an increase in uncertainty related to modeling and business complexity should result in a larger capital cushion.

12.11 Quantitative approaches that focus on most likely outcomes for budgeting, forecasting, or performance measurement purposes may not be fully applicable for capital adequacy because the ICAAP should also take less likely events into account. Stress testing and scenario analysis can be effective in gauging the consequences of outcomes that are unlikely but would have a considerable impact on safety and soundness.

12.12 To the extent that risks cannot be reliably measured with quantitative tools – for example, where measurements of risk are based on scarce data or unproven quantitative methods – qualitative tools, including experience and judgment, may be more heavily utilised. Banks should be cognisant that qualitative approaches have their own inherent biases and assumptions that affect risk assessment; accordingly, banks should recognise the biases and assumptions embedded in, and the limitations of, the qualitative approaches used.

Risk aggregation and diversification effects

12.13 An effective ICAAP should assess the risks across the entire bank. A bank choosing to conduct risk aggregation among various risk types or business lines should understand the challenges in such aggregation. In addition, when aggregating risks, banks should ensure that any potential concentrations across more than one risk dimension are addressed, recognising that losses could arise in several risk dimensions at the same time, stemming from the same event or a common set of factors. For example, a localised natural disaster could generate losses from credit, market, and operational risks at the same time.

12.14 In considering the possible effects of diversification, management should be systematic and rigorous in documenting decisions, and in identifying assumptions used in each level of risk aggregation. Assumptions about diversification should be supported by analysis and evidence. The bank should have systems capable of aggregating risks based on the bank's selected framework. For example, a bank calculating correlations within or among risk types should consider data quality and consistency, and the volatility of correlations over time and under stressed market conditions.

**An Illustrative Approach for Measurement of
Interest Rate Risk in the Banking Book (IRRBB) under Pillar II**

The Basel-II Framework (Paras 739 and 762 to 764) require the banks to measure the interest rate risk in the banking book (IRRBB) and hold capital commensurate with it. If supervisors determine that banks are not holding capital commensurate with the level of interest rate risk, they must require the bank to reduce its risk, to hold a specific additional amount of capital or some combination of the two. To comply with the requirements of Pillar II relating to IRRBB, the guidelines on Pillar II issued by many regulators contain definite provisions indicating the approach adopted by the supervisors to assess the level of interest rate risk in the banking book and the action to be taken in case the level of interest rate risk found is significant.

In terms of para 764 of the Basel II framework, the banks can follow the indicative methodology prescribed in the supporting document "Principles for the Management and Supervision of Interest Rate Risk" issued by BCBS for assessment of sufficiency of capital for IRRBB.

2. The approach prescribed in the BCBS Paper on "Principles for the Management and Supervision of Interest Rate Risk"

The main components of the approach prescribed in the above mentioned supporting document are as under:

- a) The assessment should take into account both the earnings perspective and economic value perspective of interest rate risk.
- b) The impact on income or the economic value of equity should be calculated by applying a notional interest rate shock of 200 basis points.
- c) The usual methods followed in measuring the interest rate risk are :
 - a) ***Earnings perspective***
Gap Analysis, simulation techniques and Internal Models based on VaR
 - b) ***Economic perspective***
Gap analysis combined with duration gap analysis, simulation techniques and Internal Models based on VaR

3. Methods for measurement of the IRRBB

3.1 Impact on Earnings

The major methods used for computing the impact on earnings are the gap Analysis, Simulations and VaR based Techniques. Banks in India have been using the Gap Reports to assess the impact of adverse movements in the interest rate on income through gap method. The banks may continue with the same. However, the banks may use the simulations also. The banks may calculate the impact on the earnings by gap analysis or any other method with the assumed change in yield on 200 bps over one year. However, no capital needs to be allocated for the impact on the earnings.

3.2 Impact of IRRBB on the Market Value of Equity (MVE)

The banks may use the Method indicated in the Basel Committee on Banking Supervision (BCBS) Paper "Principles for the Management and Supervision of Interest rate Risk" (July 2004) for computing the impact of the interest rate shock on the MVE.

3.2.1 Method indicated in the BCBS Paper on "Principles for the Management and Supervision of Interest Rate Risk"

The following steps are involved in this approach:

- a) The variables such as maturity/re-pricing date, coupon rate, frequency, principal amount for each item of asset/liability (for each category of asset / liability) are generated.
- b) The longs and shorts in each time band are offset.
- c) The resulting short and long positions are weighted by a factor that is designed to reflect the sensitivity of the positions in the different time bands to an assumed change in interest rates. These factors are based on an assumed parallel shift of 200 basis points throughout the time spectrum, and on a proxy of modified duration of positions situated at the middle of each time band and yielding 5%.
- d) The resulting weighted positions are summed up, offsetting longs and shorts, leading to the net short- or long-weighted position.
- e) The weighted position is seen in relation to capital.

For details banks may refer to the captioned paper issued by BCBS. For the sake of convenience, Annex 3 and 4 of the Paper containing the framework and an example of the standardised framework are reproduced in **Appendix 1 - A** and **1 – B**.

3.2.2 Other techniques for Interest rate risk measurement

The banks can also follow different versions / variations of the above techniques or entirely different techniques to measure the IRRBB if they find them conceptually sound. In this

context, Annex 1 and 2 of the BCBS paper referred to above provide broad details of interest rate risk measurement techniques and overview of some of the factors which the supervisory authorities might consider in obtaining and analysing the information on individual bank's exposures to interest rate risk. These Annexes are reproduced in **Appendix 1 – C** and **Appendix 1 – D**, respectively.

4. Suggested approach for measuring the impact of IRRBB on capital

4.1 As per Basel II Framework, if the supervisor feels that the bank is not holding capital commensurate with the level of IRRBB, it may either require the bank to reduce the risk or allocate additional capital or a combination of the two.

4.2 The banks can decide, with the approval of the Board, on the appropriate level of interest rate risk in the banking book which they would like to carry keeping in view their capital level, interest rate management skills and the ability to re-balance the banking book portfolios quickly in case of adverse movement in the interest rates. In any case, a level of interest rate risk which generates a drop in the MVE of more than 20% with an interest rate shock of 200 basis points, will be treated as excessive and such banks would normally be required by the RBI to hold additional capital against IRRBB as determined during the SREP. The banks which have IRRBB exposure equivalent to less than 20% drop in the MVE may also be required to hold additional capital if the level of interest rate risk is considered, by the RBI, to be high in relation to their capital level or the quality of interest rate risk management framework obtaining in the bank. While the banks may on their own decide to hold additional capital towards IRRBB keeping in view the potential drop in their MVE, the IRR management skills and the ability to re-balance the portfolios quickly in case of adverse movement in the interest rates, the amount of exact capital add-on, if considered necessary, will be decided by the RBI as part of the SREP, in consultation with the bank.

5. Limit setting

The banks would be well advised to consider setting the internal limits for controlling their IRRBB. The following are some of the indicative ways for setting the limits:

- a) Internal limits could be fixed in terms of the maximum decline in earnings (as a percentage of the base-scenario income) or decline in capital (as a percentage of the base-scenario capital position) as a result of 200 or 300 basis point interest-rate shock.
- b) The limits could also be placed in terms of PV01 value (present value of a basis point) of the net position of the bank as a percentage of net worth/capital of the bank.

Annex 3
(To the BCBS Paper on Principles for Management and Supervision of IRR, July 2004)

The standardised interest rate shock

1. To facilitate supervisors' monitoring of interest rate risk exposures across institutions, banks would have to provide the results of their internal measurement systems, expressed in terms of the change in economic value relative to capital, using a standardised interest rate shock. This annex gives the technical background to the selection of the standardised rate shock. In selecting the shock, the following guiding principles were followed:

- The rate shock should reflect a fairly uncommon and stressful rate environment;
- The magnitude of the rate shock should be significant enough to capture the effects of embedded options and convexity within bank assets and liabilities so that underlying risk may be revealed;
- The rate shock should be straightforward and practical to implement, and should be able to accommodate the diverse approaches inherent in single-rate-path simulation models and statistically driven value-at-risk models for banking book positions;
- The underlying methodology should provide relevant shocks for both G10 and material non-G10 currency exposures; and
- The underlying methodology should be adaptable for those non-G10 supervisors who wish to implement this approach in their own countries.

2. With these principles in mind, the proposed rate shock should in principle be determined by banks, based on the following:

- For exposures in G10 currencies, either:
 - (a) An upward and downward 200 basis point parallel rate shock; or
 - (b) 1st and 99th percentile of observed interest rate changes using a one-year (240 working days) holding period and a minimum five years of observations.
- For exposures in non-G10 currencies, either:
 - (a) A parallel rate shock substantially consistent with 1st and 99th percentile of observed interest rate changes using a one-year (240 working days) holding period and a minimum five years of observations for the particular non-G10 currency; or
 - (b) 1st and 99th percentile of observed interest rate changes using a one-year (240 working days) holding period and a minimum five years of observations.

3. In considering potential rate shocks, historical rate changes among a number of G10 countries were analysed. A one-year holding period (240 business days) was selected both for practical purposes and in recognition that within a one-year period most institutions have the ability to restructure or hedge their positions to mitigate further losses in economic value should rates appear to be exceptionally volatile. Five years worth of rate change observations require a minimum of six years of historical data to calculate rate differences for a one-year holding period on a rolling basis. For example, the first observation from five years ago must look back to the rate environment six years ago to calculate the first rate change.

4. A five-year historical observation period (six years of data) was thought to be long enough to capture more recent and relevant interest rate cycles. That time period also appears to offer a reasonably manageable set of data for institutions that wish to incorporate such data into their statistically driven value-at-risk models or in their own evaluations of a suitable parallel rate shock for non-G10 currencies. In defining uncommon and stressful scenarios, rate shocks of a magnitude that would not be expected to be exceeded with a 99 percent confidence interval were considered adequate.

5. In evaluating the data for G10 shocks, rate moves at the 1st and 99th percentile were roughly comparable across most currencies, especially for longer maturities. A 200 basis point up and down rate shock appears to adequately cover volatilities across G10 currencies. The appropriateness of the proposed shock will need to be monitored on an ongoing basis, and recalibrated should the rate environment shift materially. Importantly, by calibrating the parallel shock to be roughly consistent with shocks that would be implemented through more sophisticated, statistically driven approaches using standard parameters (99 percent confidence interval, one-year holding period, five years of observations), this approach does not foreclose the use of more innovative risk measurement systems. It also allows institutions to use these parameters for calculating appropriate shocks themselves when they have material exposures outside G10 countries and for supervisors in emerging market and other non-G10 countries to derive simple shocks that are appropriate for their own countries.

6. The analysis so far has implicitly assumed that banks only carry interest rate risk in their home currency. However, many banks will be exposed to interest rate risk in more than one currency. In such cases, banks should carry out a similar analysis for each currency accounting for 5% or more of either their banking book assets or liabilities, using an interest rate shock calculated according to one of the methodologies set out above. To ensure complete coverage of the banking book, remaining exposures should be aggregated and subjected to a 200 basis point shock.

7. The relative simplicity of a 200 basis point parallel rate shock has the disadvantage of ignoring exposures that might be revealed through scenarios that include yield curve twists, inversions, and other relevant scenarios. Such alternative scenarios are a necessary component of the overall management of interest rate risk as noted elsewhere in this paper. Supervisors will continue to expect institutions to perform multiple scenarios in evaluating their interest rate risk as appropriate to the level and nature of risk they are taking.

8. While more nuanced rate scenarios might tease out certain underlying risk characteristics, for the more modest objectives of supervisors in detecting institutions with significant levels of interest rate risk, a simple parallel shock is adequate. Such an approach also recognises the potential for spurious precision that occurs when undue attention to fine detail is placed on one aspect of a measurement system without recognition that assumptions employed for certain asset and liability categories, such as core deposits, are by necessity blunt and judgmental. Such judgmental aspects of an interest rate risk model often drive the resulting risk measure and conclusion, regardless of the detailed attention paid to other aspects of the risk measure.

Annex 4

(To the BCBS Paper on Principles for Management and Supervision of IRR, July 2004)

An example of a standardised framework

1. This annex contains an example setting out the methodology and calculation process in one version of a standardised framework. Other methodologies and calculation processes could be equally applicable in this context, depending on the circumstances of the bank concerned. Such a framework is intended for supervisory reporting purposes only, and is not intended to represent an adequate framework for internal risk management purposes.

A. Methodology

2. Positions on the bank's balance sheet would be slotted into the maturity approach according to the following principles:

- (a) All assets and liabilities belonging to the banking book and all OBS items belonging to the banking book which are sensitive to changes in interest rates (including all interest rate derivatives) are slotted into a maturity ladder comprising a number of time bands large enough to capture the nature of interest rate risk in a national banking market. Annex 2 discusses issues relating to the selection of appropriate time bands. Separate maturity ladders are to be used for each currency accounting for more than 5% of either banking book assets or liabilities.
- (b) On-balance-sheet items are treated at book value.
- (c) Fixed-rate instruments are allocated according to the residual term to maturity and floating-rate instruments according to the residual term to the next repricing date.
- (d) Exposures which create practical processing problems because of their large number and relatively small individual amount (e.g. instalment or mortgage loans) may be allocated on the basis of statistically supported assessment methods.
- (e) Core deposits are slotted according to an assumed maturity of no longer than five years.
- (f) National supervisors will provide guidance on how other items with a behavioural maturity or repricing that differ from contractual maturity or repricing are to be slotted into the time band structure.
- (g) Derivatives are converted into positions in the relevant underlying. The amounts considered are the principal amount of the underlying or of the notional underlying.
- (h) Futures and forward contracts, including forward rate agreements (FRA), are treated as a combination of a long and a short position. The maturity of a future or a FRA will be the period until delivery or exercise of the contract, plus - where applicable - the life of the underlying instrument. For example, a long position in a June three-month interest rate future (taken in April) is to be reported as a long position with a maturity of five months and a short position with a maturity of two months.

- (i) Swaps are treated as two notional positions with relevant maturities. For example, an interest rate swap under which a bank is receiving floating-rate interest and paying fixed-rate interest will be treated as a long floating-rate position of maturity equivalent to the period until the next interest fixing and a short fixed-rate position of maturity equivalent to the residual life of the swap. The separate legs of cross-currency swaps are to be treated in the relevant maturity ladders for the currencies concerned.
- (j) Options are considered according to the delta equivalent amount of the underlying or of the notional underlying.

B. Calculation process

3. The calculation process consists of five steps.

- (a) The first step is to offset the longs and shorts in each time band, resulting in a single short or long position in each time band.
- (b) The second step is to weight these resulting short and long positions by a factor that is designed to reflect the sensitivity of the positions in the different time bands to an assumed change in interest rates. The set of weighting factors for each time band is set out in Table 1 below. These factors are based on an assumed parallel shift of 200 basis points throughout the time spectrum, and on a proxy of modified duration of positions situated at the middle of each time band and yielding 5%.
- (c) The third step is to sum these resulting weighted positions, offsetting longs and shorts, leading to the net short- or long-weighted position of the banking book in the given currency.
- (d) The fourth step is to calculate the weighted position of the whole banking book by summing the net short- and long-weighted positions calculated for different currencies.
- (e) The fifth step is to relate the weighted position of the whole banking book to capital.

Table 1**Weighting factors per time band (second step in the calculation process)**

Time band	Middle of time band	Proxy of modified duration	Assumed change in yield	Weighting factor
Up to 1 month	0.5 months	0.04 years	200 bp	0.08%
1 to 3 months	2 months	0.16 years	200 bp	0.32%
3 to 6 months	4.5 months	0.36 years	200 bp	0.72%
6 to 12 months	9 months	0.71 years	200 bp	1.43%
1 to 2 years	1.5 years	1.38 years	200 bp	2.77%
2 to 3 years	2.5 years	2.25 years	200 bp	4.49%
3 to 4 years	3.5 years	3.07 years	200 bp	6.14%
4 to 5 years	4.5 years	3.85 years	200 bp	7.71%
5 to 7 years	6 years	5.08 years	200 bp	10.15%
7 to 10 years	8.5 years	6.63 years	200 bp	13.26%
10 to 15 years	12.5 years	8.92 years	200 bp	17.84%
15 to 20 years	17.5 years	11.21 years	200 bp	22.43%
Over 20 years	22.5 years	13.01 years	200 bp	26.03%

Annex 1
(To the BCBS Paper on Principles for Management and Supervision of IRR, July 2004)

Interest rate risk measurement techniques

1. This annex provides a brief overview of the various techniques used by banks to measure the exposure of earnings and of economic value to changes in interest rates. The variety of techniques ranges from calculations that rely on simple maturity and re-pricing tables, to static simulations based on current on- and off-balance-sheet positions, to highly sophisticated dynamic modelling techniques that incorporate assumptions about the behaviour of the bank and its customers in response to changes in the interest rate environment. Some of these general approaches can be used to measure interest rate risk exposure from both an earnings and an economic value perspective, while others are more typically associated with only one of these two perspectives. In addition, the methods vary in their ability to capture the different forms of interest rate exposure: the simplest methods are intended primarily to capture the risks arising from maturity and re-pricing mismatches, while the more sophisticated methods can more easily capture the full range of risk exposures.

2. As this discussion suggests, the various measurement approaches described below have their strengths and weaknesses in terms of providing accurate and reasonable measures of interest rate risk exposure. Ideally, a bank's interest rate risk measurement system would take into account the specific characteristics of each individual interest sensitive position, and would capture in detail the full range of potential movements in interest rates. In practice, however, measurement systems embody simplifications that move away from this ideal. For instance, in some approaches, positions may be aggregated into broad categories, rather than modelled separately, introducing a degree of measurement error into the estimation of their interest rate sensitivity. Similarly, the nature of interest rate movements that each approach can incorporate may be limited: in some cases, only a parallel shift of the yield curve may be assumed or less than perfect correlations between interest rates may not be taken into account. Finally, the various approaches differ in their ability to capture the optionality inherent in many positions and instruments. The discussion in the following sections will highlight the areas of simplification that typically characterise each of the major interest rate risk measurement techniques.

A. Re-pricing schedules

3. The simplest techniques for measuring a bank's interest rate risk exposure begin with a maturity/re-pricing schedule that distributes interest-sensitive assets, liabilities, and OBS positions into a certain number of predefined time bands according to their maturity (if fixed-rate) or time remaining to their next re-pricing (if floating-rate). Those assets and liabilities lacking definitive re-pricing intervals (e.g. sight deposits or savings accounts) or actual maturities that could vary from contractual maturities (e.g. mortgages with an option for early repayment) are assigned to re-pricing time bands according to the judgement and past experience of the bank.

1. Gap analysis

4. Simple maturity/re-pricing schedules can be used to generate simple indicators of the interest rate risk sensitivity of both earnings and economic value to changing interest rates. When this approach is used to assess the interest rate risk of current earnings, it is typically referred to as gap analysis. Gap analysis was one of the first methods developed to measure a bank's interest rate risk exposure, and continues to be widely used by banks. To evaluate earnings exposure, interest rate-sensitive liabilities in each time band are subtracted from the corresponding interest rate-sensitive assets to produce a re-pricing "gap" for that time band. This gap can be multiplied by an assumed change in interest rates to yield an approximation of the change in net interest income that would result from such an interest rate movement. The size of the interest rate movement used in the analysis can be based on a variety of factors, including historical experience, simulation of potential future interest rate movements, and the judgement of bank management.

5. A negative, or liability-sensitive, gap occurs when liabilities exceed assets (including OBS positions) in a given time band. This means that an increase in market interest rates could cause a decline in net interest income. Conversely, a positive, or asset-sensitive, gap implies that the bank's net interest income could decline as a result of a decrease in the level of interest rates.

6. These simple gap calculations can be augmented by information on the average coupon on assets and liabilities in each time band. This information can be used to place the results of the gap calculations in context. For instance, information on the average coupon rate could be used to calculate estimates of the level of net interest income arising from positions maturing or repricing within a given time band, which would then provide a "scale" to assess the changes in income implied by the gap analysis.

7. Although gap analysis is a very commonly used approach to assessing interest rate risk exposure, it has a number of shortcomings. First, gap analysis does not take account of variation in the characteristics of different positions within a time band. In particular, all positions within a given time band are assumed to mature or re-price simultaneously, a simplification that is likely to have greater impact on the precision of the estimates as the degree of aggregation within a time band increases. Moreover, gap analysis ignores differences in spreads between interest rates that could arise as the level of market interest rates changes (basis risk). In addition, it does not take into account any changes in the timing of payments that might occur as a result of changes in the interest rate environment. Thus, it fails to account for differences in the sensitivity of income that may arise from option-related positions. For these reasons, gap analysis provides only a rough approximation of the actual change in net interest income which would result from the chosen change in the pattern of interest rates. Finally, most gap analyses fail to capture variability in non-interest revenue and expenses, a potentially important source of risk to current income.

2. Duration

8. A maturity/re-pricing schedule can also be used to evaluate the effects of changing interest rates on a bank's economic value by applying sensitivity weights to each time band. Typically, such weights are based on estimates of the duration of the assets and liabilities that fall into each time band. Duration is a measure of the percentage change in the economic value of a position that will occur given a small change in the level of interest rates.¹³ It reflects the timing and size of cash flows that occur before the instrument's contractual maturity. Generally, the longer the maturity or next re-pricing date of the instrument and the smaller the payments that occur before maturity (e.g. coupon payments), the higher the duration (in absolute value). Higher duration implies that a given change in the level of interest rates will have a larger impact on economic value.

9. Duration-based weights can be used in combination with a maturity/re-pricing schedule to provide a rough approximation of the change in a bank's economic value that would occur given a particular change in the level of market interest rates. Specifically, an "average" duration is assumed for the positions that fall into each time band. The average durations are then multiplied by an assumed change in interest rates to construct a weight for each time band. In some cases, different weights are used for different positions that fall within a time band, reflecting broad differences in the coupon rates and maturities (for instance, one weight for assets, and another for liabilities). In addition, different interest rate changes are sometimes used for different time bands, generally to reflect differences in the volatility of interest rates along the yield curve. The weighted gaps are aggregated across time bands to produce an estimate of the change in economic value of the bank that would result from the assumed changes in interest rates.

10. Alternatively, an institution could estimate the effect of changing market rates by calculating the precise duration of each asset, liability, and OBS position and then deriving the net position for the bank based on these more accurate measures, rather than by applying an estimated average duration weight to all positions in a given time band. This would eliminate potential errors occurring when aggregating positions/cash flows. As another variation, risk weights could also be designed for each time band on the basis of actual percentage changes in market values of hypothetical instruments that would result from a specific scenario of changing market rates. That approach - which is sometimes referred to as effective duration - would better capture the non-linearity of price movements arising from significant changes in market interest rates and, thereby, would avoid an important limitation of duration.

¹³ In its simplest form, duration measures changes in economic value resulting from a percentage change of interest rates under the simplifying assumptions that changes in value are proportional to changes in the level of interest rates and that the timing of payments is fixed. Two important modifications of simple duration are commonly used that relax one or both of these assumptions. The first case is so-called modified duration.

11. Estimates derived from a standard duration approach may provide an acceptable approximation of a bank's exposure to changes in economic value for relatively non-complex banks. Such estimates, however, generally focus on just one form of interest rate risk exposure - repricing risk. As a result, they may not reflect interest rate risk arising, for instance, from changes in the relationship among interest rates within a time band (basis risk). In addition, because such approaches typically use an average duration for each time band, the estimates will not reflect differences in the actual sensitivity of positions that can arise from differences in coupon rates and the timing of payments. Finally, the simplifying assumptions that underlie the calculation of standard duration means that the risk of options may not be adequately captured.

B. Simulation approaches

12. Many banks (especially those using complex financial instruments or otherwise having complex risk profiles) employ more sophisticated interest rate risk measurement systems than those based on simple maturity/repricing schedules. These simulation techniques typically involve detailed assessments of the potential effects of changes in interest rates on earnings and economic value by simulating the future path of interest rates and their impact on cash flows.

13. In some sense, simulation techniques can be seen as an extension and refinement of the simple analysis based on maturity/repricing schedules. However, simulation approaches typically involve a more detailed breakdown of various categories of on- and off balance-sheet positions, so that specific assumptions about the interest and principal payments and non-interest income and expense arising from each type of position can be incorporated. In addition, simulation techniques can incorporate more varied and refined changes in the interest rate environment, ranging from changes in the slope and shape of the yield curve to interest rate scenarios derived from Monte Carlo simulations.

1. Static simulation

14. In static simulations, the cash flows arising solely from the bank's current on- and off-balance-sheet positions are assessed. For assessing the exposure of earnings, simulations estimating the cash flows and resulting earnings streams over a specific period are conducted based on one or more assumed interest rate scenarios. Typically, although not always, these simulations entail relatively straightforward shifts or tilts of the yield curve, or changes of spreads between different interest rates. When the resulting cash flows are simulated over the entire expected lives of the bank's holdings and discounted back to their present values, an estimate of the change in the bank's economic value can be calculated.¹⁴

2. Dynamic simulation

15. In a dynamic simulation approach, the simulation builds in more detailed assumptions about the future course of interest rates and the expected changes in a bank's business activity over that time. For instance, the simulation could involve assumptions about a bank's strategy for changing administered interest rates (on savings deposits, for example), about the behaviour of the bank's customers (e.g. withdrawals from sight and savings deposits), and/or about the future stream of business (new loans or other transactions) that the bank will encounter. Such simulations use these assumptions about future activities and reinvestment strategies to project expected cash flows and estimate dynamic earnings and economic value outcomes. These more sophisticated techniques allow for dynamic interaction of payments streams and interest rates, and better capture the effect of embedded or explicit options.

¹⁴ The duration analysis described in the previous section can be viewed as a very simple form of static simulation.

16. As with other approaches, the usefulness of simulation-based interest rate risk measurement techniques depends on the validity of the underlying assumptions and the accuracy of the basic methodology. The output of sophisticated simulations must be assessed largely in the light of the validity of the simulation's assumptions about future interest rates and the behaviour of the bank and its customers. One of the primary concerns that arises is that such simulations do not become "black boxes" that lead to false confidence in the precision of the estimates.

C. Additional issues

17. One of the most difficult tasks when measuring interest rate risk is how to deal with those positions where behavioural maturity differs from contractual maturity (or where there is no stated contractual maturity). On the asset side of the balance sheet, such positions may include mortgages and mortgage-related securities, which can be subject to prepayment. In some countries, borrowers have the discretion to prepay their mortgages with little or no penalty, which creates uncertainty about the timing of the cash flows associated with these instruments. Although there is always some volatility in prepayments resulting from demographic factors (such as death, divorce, or job transfers) and macroeconomic conditions, most of the uncertainty surrounding prepayments arises from the response of borrowers to movements in interest rates. In general, declines in interest rates result in increasing levels of prepayments as borrowers refinance their loans at lower yields. In contrast, when interest rates rise unexpectedly, prepayment rates tend to slow, leaving the bank with a larger than anticipated volume of mortgages paying below current market rates.

18. On the liability side, such positions include so-called non-maturity deposits such as sight deposits and savings deposits, which can be withdrawn, often without penalty, at the discretion of the depositor. The treatment of such deposits is further complicated by the fact that the rates received by depositors tend not to move in close correlation with changes in the general level of market interest rates. In fact, banks can and do administer the rates on the accounts with the specific intention of managing the volume of deposits retained.

19. The treatment of positions with embedded options is an issue of special concern in measuring the exposure of both current earnings and economic value to interest rate changes. In addition, the issue arises across the full spectrum of approaches to interest rate measurement, from simple gap analysis to the most sophisticated simulation techniques. In the maturity/re-pricing schedule framework, banks typically make assumptions about the likely timing of payments and withdrawals on these positions and "spread" the balances across time bands accordingly. For instance, it might be assumed that certain percentages of a pool of 30-year mortgages prepay in given years during the life of the mortgages. As a result, a large share of the mortgage balances that would have been assigned to the time band containing 30-year instruments would be spread among nearer-term time bands. In a simulation framework, more sophisticated behavioural assumptions could be employed, such as the use of option-adjusted pricing models to better estimate the timing and magnitude of cash flows under different interest rate environments. In addition, simulations can incorporate the bank's assumptions about its likely future treatment of administered interest rates on non-maturity deposits.

20. As with other elements of interest rate risk measurement, the quality of the estimates of interest rate risk exposure depends on the quality of the assumptions about the future cash flows on the positions with uncertain maturities. Banks typically look to the past behaviour of such positions for guidance about these assumptions. For instance, econometric or statistical analysis can be used to analyse the behaviour of a bank's holdings in response to past interest rate movements. Such analysis is particularly useful to assess the likely behaviour of non-maturity deposits, which can be influenced by bank-specific factors such as the nature of the bank's customers and local or regional market conditions. In the same vein, banks may use statistical prepayment models - either models developed internally by the bank or models purchased from outside developers - to generate expectations about mortgage-related cash flows. Finally, input from managerial and business units within the bank could have an important influence, since these areas may be aware of planned changes to business or repricing strategies that could affect the behaviour of the future cash flows of positions with uncertain maturities.

Modified duration - which is standard duration divided by $1 + r$, where r is the level of market interest rates - is an elasticity. As such, it reflects the percentage change in the economic value of the instrument for a given percentage change in $1 + r$. As with simple duration, it assumes a linear relationship between percentage changes in value and percentage changes in interest rates. The second form of duration relaxes this assumption, as well as the assumption that the timing of payments is fixed. Effective duration is the percentage change in the price of the relevant instrument for a basis point change in yield.

Annex 2

(To the BCBS Paper on Principles for Management and Supervision of IRR, July 2004)

Monitoring of interest rate risk by supervisory authorities

1. This annex provides a brief overview of some of the factors that supervisory authorities might consider in obtaining and analysing information on individual banks' exposures to interest rate risk. As discussed in Section VII, supervisory authorities should obtain information sufficient to assess banks' exposures to interest rate risk in a timely fashion. Such information may be obtained through on-site examinations, through reports that are submitted by banks on a regular basis, or through other means.

2. While the precise information that is obtained will differ across supervisory authorities, one approach that some may adopt is a reporting framework that collects information on a bank's positions by remaining maturity or time to next re-pricing. Under such an approach, a bank would categorise its interest-sensitive assets, liabilities, and OBS positions into a series of re-pricing time bands or maturity categories. The two sections that follow discuss the considerations that a supervisor should take into account in specifying the number of time bands and the grouping of positions in the reporting framework. The final section of this annex describes some general approaches that supervisory authorities may wish to consider in analysing the information that is obtained through such a reporting framework.

A. Time bands

3. If a reporting framework is used in which information is collected by time to next re-pricing, the number and specific categories of time bands chosen should be sufficient to provide supervisors with a reasonable basis for identifying potentially significant re-pricing mismatches. The bands, however, could vary materially across countries, both in number and in range, depending on the lending and investing practices and experiences of banks in individual markets.

4. The usefulness of supervisory analysis crucially depends on the precision with which maturities of the positions and cash flows are recorded in the system. In analysing interest rate sensitivities, it is not enough to know when an instrument matures. Rather, the critical factor is when the instrument re-prices. Therefore, the emphasis of this section is on re-pricing rather than maturity. For cash flows whose re-pricing is unambiguous, the most precise approach is to use the exact re-pricing date. Any aggregation of positions/cash flows in time bands or zones necessarily implies a loss of information and a lower degree of precision. For this reason, the number of time bands in a re-pricing ladder framework always reflects a decision regarding the necessary level of precision and the cost of pursuing greater accuracy. Supervisory authorities could use the re-pricing ladder in the standardised approach of the Market Risk Amendment as a starting point when developing a reporting framework that meets their particular needs. The breakdown can, of course, be modified by supervisors either in a general way or in a specific way for banks where the nature of business activities warrants or justifies a different reporting form.

B. Items

5. As with the time bands, the breakdown of assets and liabilities could differ among supervisors. A reporting system should include information for all rate-sensitive assets, liabilities, and OBS positions, and should also identify balances, by specific types of instruments, when those instruments have or may have materially different cash flow characteristics. Specific attention should be given to items whose behavioural re-pricings differ from contractual maturities, such as savings deposits and, in some countries, mortgage-related instruments. Further information on these issues is provided in Annex 1. If the volume of these positions is significant, they should be reported separately so as to facilitate an assessment of the underlying options risk in the bank's balance sheet structure.

6. The analysis of interest rate risk may be more difficult if a bank is engaged in trading activities. As a general rule, it is desirable for any measurement system to incorporate interest rate risk exposures arising from the full scope of a bank's activities, including both trading and non-trading sources. This does not preclude different measurement systems and risk management approaches being used for different activities; however, management should have an integrated view of interest rate risk across products and business lines. Supervisors may wish to permit banks that manage their interest rate risk exposures on an integrated basis to aggregate trading and non-trading positions in the overall reporting framework. However, it is important to recognise that in many countries different accounting rules may apply to the trading book and the traditional banking book. Under these accounting rules, losses in the trading book may not always be offset by profits in the banking book if the latter are unrealised. Furthermore, unlike the banking book, the composition of the trading portfolio changes significantly from week to week or even day to day because it is managed separately and according to a different (shorter) risk horizon than the banking book. This means that a hedge that is present on a given day may disappear a few days later. Supervisors should, therefore, review the risk management practices and information systems of banks that conduct material trading activities and should obtain the information necessary to ensure that interest rate risk in both trading and non-trading activities is properly managed and controlled.

C. Supervisory analysis

7. A reporting framework designed along these lines may provide supervisors with a flexible tool for analysing interest rate risk. Supervisors can use this basic information to perform their own assessments of a bank's exposure and risk profile.

8. Such assessments may provide insights regarding an institution's exposure to parallel shifts, or to a flattening, steepening, or inversion of the yield curve with rate changes of different magnitude based on either statistical probabilities or a worst-case analysis. For banks with important exposures in foreign currencies, analysis investigating different assumptions regarding correlations between interest rates in different currencies can be useful. With respect to instruments with behavioural maturities, supervisors may wish to assess assumptions that differ from those used by the institution.

9. The focus of supervisors' quantitative analysis can be the impact of interest rate changes on either current earnings or the economic value of the bank's portfolio. In conducting their analysis, information about average yields on assets and liabilities in each time band may be useful and supervisors may wish to collect such information in addition to pure position data.

10. Depending on their overall approach, supervisors may conduct their analysis of interest rate risk either on a case-by-case basis or as part of a broader system designed to identify outliers with apparently excessive risk-taking.

11. By conducting an assessment of interest rate risk using the proposed framework, supervisors may gain more insight into an institution's risk profile than with a reporting system that reduces the complexity of interest rate risk to a single number. In doing so, supervisors can become more familiar with the sensitivity of risk measures to changes in the underlying assumptions, and the evaluation process may produce as many insights as the quantitative result itself.

12. Regardless of the extent of a supervisor's own independent quantitative analysis, a bank's own interest rate risk measure, whether reported as part of a basic supervisory reporting system or reviewed as part of an individual assessment of a bank's risk management, is an important consideration in the supervisory process. Reviewing the results of a bank's internal model can be highly informative, but can also be a difficult process because of the multitude of important assumptions and modelling techniques which need to be made transparent to supervisors. To be most useful, the information received should indicate the contribution of principal elements of a bank's portfolio to the risk profile under different assumptions with respect to interest rate changes and the market response. Finally, any quantitative analysis should be supplemented by a review of internal management reports in order to gain greater insights into management's evaluation and management of risks, its methods for measuring exposures, and factors not reflected in the information available in the limited reporting to supervisors.