Guidelines on Interest Rate Risk Management

STATE BANK OF PAKISTAN

BANKING POLICY & REGULATIONS DEPARTMENT

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1. Introduction

1.1 Banks as financial intermediaries accept short term deposits from many customers to make fewer relatively long term loans. The scale of this maturity transformation embedded in the balance sheet structure determines the interest rate risk to which a bank is exposed. Interest rate risk is the exposure of a bank's financial condition to adverse movements in interest rates. The changes in interest rates can have considerable negative impact on a bank's earnings (referred to as earnings perspective) or value of a portfolio causing reduction of its equity (referred to as economic value perspective).

1.2 In order to measure the exposure to unfavorable and unanticipated Interest rate movements, banks usually split their interest rate risk into the following two components;

i. Interest rate risk in the trading book – also called traded interest rate risk - arises from the trading activities of the financial institutions in the interest rate markets. Generally, when the positions are sold before their stated maturities, the potential loss may arise from both general market price movements and from price movements specific to particular issuer.

ii. Interest rate risk in the banking book – also called Non-Traded interest rate risk - comprises of all positions which are not part of trading book e.g. loans and advances, interbank placements etc.

1.3 Presently, the banks are required to hold capital against interest rate risk in the trading book as part of market risk under Pillar 1 of Basel Capital Accord. The capital requirement is calculated considering separate capital charge for specific and general risks. Whereas for interest rate risk in the banking book, the State Bank has already advised banks to develop internal methodologies to estimate interest rate exposure and allocate adequate capital under Internal Capital Adequacy Assessment Process (ICAAP) of Pillar II of the Basel Capital Accord as adopted in Pakistan.

1.4 Since the current SBP Basel regulations do not stipulate standardized capital charge for the interest rate risk in the banking book, an arbitrage opportunity exists in shape of reduced capital charge. However, the Basel Committee has initiated work to remove this arbitrage and is also considering the possibility of developing a Pillar-1 capital charge for interest rate risk in the banking book.

1.5 These guidelines are intended to provide high level guidance on identification, measurement and management of interest rate risk, both in the trading and banking books. The banks are expected to follow these guidelines while developing their interest rate risk management framework. In this regard, the other relevant guidelines/instructions include the following:

i. Risk Management Guidelines issued vide BSD circular No. 7 of August 15, 2003 that provided broad level guidance on various risks faced by the banks.

ii. Guidelines on Stress Testing issued vide BSD Circular No. 1 of May 11, 2012.

iii. SBP Implementation of Basel II guidelines issued vide BSD Circular # 8 of June 27, 2006 which in addition to credit and operational risks also requires banks to allocate capital for Market Risk (Traded interest rate risk).

2. Sources of interest rate risk[1]

2.1 The main components of interest rate risk are repricing or maturity mismatch risk, yield curve risk, basis risk, options risk and price risk. The brief description of each type is given as under:

2.2 **Repricing risk**

Repricing or maturity mismatch risk occurs when the repricing schedules of assets, liabilities and off-balance sheet items are not identical. For example, if a bank sells a three year car financing which it funds with a one year deposit, the bank is exposed to a risk because both products do not re-price at the same time.

2.3 **Yield curve risk**

Yield curve risk is the risk of non-parallel shifts in the yield curve, thus causing a flatter or steeper curve. Yield curve risk emanates from unanticipated shifts, change in slope or shape of the yield curve.

2.4 **Basis risk**

Basis risk arises when two yield curves which normally act together suddenly follow different paths. This is simply from the imperfect correlation in the adjustment of rates earned and paid on different instruments or products. For example, one year loan that reprices quarterly based on three month T-bill rate is funded by one year liability that also reprices quarterly based on three month KIBOR may expose the bank to the risk that the spread between the two rates (T-bill and KIBOR) may change unexpectedly.

2.5 **Options risk**

Options risk results from the options embedded in the bank's assets, liabilities, and off-balance sheet instruments or products. Examples of embedded options are; withdrawal or early redemption option, prepayment option, embedded caps and/or floors, choice option etc.

2.6 **Price risk**

Price risk results from changes in the value of marked-to-market financial instruments which occur when interest rates change. It is closely associated with trading book. For example, trading portfolios and held-for-sale portfolios declines in value when interest rate increases.

[1] *Principles for the Management and Supervision of Interest Rate Risk – July 2004* issued by Basel Committee on Banking Supervision may be consulted for the detailed discussion on the subject.

3. Effects of interest rate risk movements

3.1 Variations in interest rates can have adverse effects both on a bank's earnings and its economic value. There are two different perspectives i.e. earnings and economic value, for assessing a bank's interest rate risk exposure.

3.2 Earnings perspective focuses on the impact of changes in interest rates on accounting earnings in the near term, typically one or two years. Net interest income, difference between total interest income and total interest expense, is the most important component of the bank's overall earnings and has direct link to changes in interest rates. Net interest income will vary due to different interest rate risk sources like repricing, shift and movement in yield curve and underlying options in the products. Traditionally, net interest income was the only focal point, however recently net income incorporating both interest and non-interest income and expenses is considered better indicator of earnings.

3.3 Economic value perspective provides a more comprehensive outlook of the potential longer-term effects of changes in interest rates on the market value of a portfolio. The economic value of a bank can be viewed as the present value of the bank's expected net cash flows, defined as the expected cash flows on assets minus the expected cash flows on liabilities plus the expected net cash flows on off-balance sheet positions. The changes in interest rates directly affect the economic value of a bank's assets, liabilities and off-balance sheet positions. In essence, the economic value perspective explains the impact of interest rate fluctuations on the banks' net worth.

3.4 Notably, earnings and economic value sensitivities may give different perspective of risk. A bank may show improved earnings in a rising interest rate environment but the economic value may deteriorate under the same scenario. While fundamentally different, these two measures are interrelated and there exists a trade-off between them. Therefore, having both the short-term earnings perspective and the long-term economic value perspective of risk, add value to bank's risk management framework. However, the State Bank will focus mainly on measuring interest rate risk in relation to economic value while risk in relation to earnings would serve as a supplementary measure.

4. Governance structure and policy formulation

4.1 SBP has been emphasizing the importance of corporate governance, policies and procedures, adequate risk measuring system, monitoring and control mechanism, stress testing and appropriate public disclosure of the risk management framework.

4.2 Sound interest rate risk management involves the application of four basic elements in the management of assets, liabilities and off-balance sheet instruments:

- appropriate board and senior management oversight;
- adequate risk management policies and procedures;
- appropriate risk measurement, monitoring and control functions; and
- comprehensive internal controls and independent audits

4.3 The sophistication of adopted framework depends on bank's size, nature of business, complexity of its operations and risk profile. The bank with limited products and scale of operations may select less sophisticated risk management systems, however, all procedures should be clearly documented and responsibilities of each constituent should be mentioned.

4.4 The Board of Director (board) will approve an overall risk strategy defining the risk appetite and risk tolerance of the bank. The board or a sub-committee of the board should approve the risk policy encompassing processes and procedures for the identification, measurement, monitoring and control of all major risk exposures including interest rate risk. The board should ensure that senior management takes necessary steps to monitor and control interest rate risk consistent with the approved strategies and policies.

4.5 The board members have the responsibility to understand the sources, nature, and scope of interest rate risk exposures and that how this risk fits within the overall business strategy of the bank. The board will continually review the policy to make it aligned with changing business environment and strategic plan for the bank. The board or its sub-committee shall seek regular reports on interest rate risk management and ensure compliance with the board-approved policy.

4.6 The board or its designated sub-committee will determine appropriate risk limits, on the recommendation of the senior management, considering the bank's earnings and capital volatility for the given interest rate movements. These risk limits should adequately prevent any significant safety and soundness concerns.

4.7 Interest rate risk management policy should spell out the role of each key stakeholder namely the Board or its sub-committee, asset-liability management committee, business units (risk takers), risk management function and internal audit function. Larger or more complex banks should have a designated independent unit responsible for the design and administration of the bank's interest rate risk measurement, monitoring, and control functions. The control functions carried out by this unit, such as administering the risk limits, are part of the overall internal control system.

4.8 The bank's management will design and prepare risk policies, procedures, and systems for the approval of the board. The management will implement the board-approved policies that are translated into clear standard operating procedures. Likewise, the management is responsible for execution of board-approved strategies, policies, and procedures for managing interest rate risk. The management should ensure that the structure of the bank's business and level of interest rate risk it assumes are effectively managed, and the resources are available for evaluating and controlling interest rate risk. The management must identify the risks inherent in new products and activities before these are launched or acquired.

All major hedging and risk management initiatives should be approved by the management committee and the Board or its sub-committee should be informed about these decisions on a quarterly basis.

4.9 The management is responsible for maintaining:

- appropriate limits on risk taking;
- adequate systems and standards for measuring risk;
- standards for valuing positions and measuring performance;
- interest rate risk reporting and review process and
- effective internal controls.

4.10 A high level management team or committee should be responsible, inter alia, for the management of interest rate risk. The committee should comprise the heads of functional areas dealing with the transactions and the activities which involve interest rate exposures. The committee should be actively involved in establishing plans, procedures and controls that maintain interest rate risk exposure within predetermined risk tolerance established by the board of directors. The committee should meet frequently to discuss and evaluate the risks of all business units including capital allocation for risk taking activities.

4.11 The management committee should suggest data requirements and underlying assumptions for the risk measurement system. The committee should evaluate the results of the system and also review the gap reports produced by alternative measurement methods or peer results or market benchmarks. The detailed reports may be requisitioned or generated to test the reasonableness, consistency and accuracy of the outcomes. The committee should have formal procedures to present results and reports to the board or its sub-committee. The committee must maintain record of its actions and meetings for independent review.

4.12 Banks should clearly specify the individuals and/or committee(s) responsible for managing interest rate risk and should ensure that there is adequate separation of duties in key elements of the risk management process to avoid potential conflicts of interest. Banks should have risk measurement, monitoring, and control functions with clearly defined duties that are sufficiently independent from position-taking functions of the bank and which report risk exposures directly to the senior management and the board of directors or its designated sub-committee.

5. Interest rate risk management and measurement

Keeping in view the size, sophistication, nature of operations and underlying risks; the banks should follow the following guidelines:

5.1 Each transaction of a bank may affect its interest rate profile. Some banks tend to minimize their interest rate exposure and do not deliberately take positions to benefit from a particular movement in interest rates and try to match the maturities and repricing dates of their assets and liabilities. Other banks assume a greater level of interest rate risk and may chose to take deliberate interest rate positions or leave the

existing position open. Hence, given the diversity of balance sheet profile, it may not be appropriate to adopt a uniform framework for management of risks.

5.2 Globally, banks are encouraged to establish a centralized interest rate risk management structure within integrated treasury management function (or asset-liability management) to benefit from information on aggregate exposure, natural netting of exposures, economies of scale and easier reporting to top management. These banks often use a fund transfer pricing system to isolate the interest rate risk management and positioning in the treasury unit of the bank.

5.3 Internal Fund Transfer Pricing (FTP) mechanism plays key role in the management of interest rate and liquidity risks. Banks' FTP policy should define the objectives of transfer pricing and mention the appropriate standards to achieve these objectives. Centralized responsibility and control over transfer pricing mechanism, visibility of risk positions across the bank and adequate oversight by independent risk management personnel over the mechanism are important for both effective risk management and operating efficiency. The banks should develop their FTP model considering the size of their operations and complexity of products along with underlying risks. They are encouraged to adopt more sophisticated and comprehensive transfer pricing approaches such as matched-maturity fund method after making cost-benefit analysis.

5.4 While reviewing a bank’s interest rate risk profile, management should take into account the bank’s liquidity and ability to access various funding markets. A bank having stable sources of liquidity is assumed to be in a better position to withstand short term earning pressures from adverse interest rate movements than a bank which is heavily dependent on wholesale, short term funding sources.

5.5 A bank’s interest rate risk measurement system should address all material sources of interest rate risk including repricing, yield curve, basis and option risk exposures. 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.

Data gathering

5.6 The foundation of reliable risk measurement is heavily dependent upon the accuracy and timeliness of the relevant data. The bank must build data repository encompassing information on all material interest-sensitive assets, liabilities, off balance sheet financial instruments, rate-sensitive fee income as well as cash flow of individual products.

5.7 For every material type of financial instrument or portfolio, the bank must have data which may include current balances, contractual rate of interest, repricing, reset dates, scheduled repayments and maturities. In case of variable rate items, interest rate benchmark along with ceilings or floors needs to be captured. Depending upon the size, complexity and nature of underlying risks and operations, a bank may need to collect additional information on certain products to have a complete picture of bank’s

interest rate exposure, including seasonal loans, embedded options, early redemption of deposits, premature or accelerated repayment of loans, etc.

5.8 All the major sources of data used in the bank's measurement process needs to be fully documented. It needs to be ensured that the management information system (MIS) captures interest rate risk data on all of the bank's material positions.

5.9 The bank should maintain a reliable database for all kinds of data relevant to risk management. The bank must have transparent and verifiable processes for collecting relevant data inputs. All data inputs i.e. exposure information, maturity profiles, interest rate histories of liability and asset products, history of benchmark rates, size of off-balance sheet items etc. will be maintained on an ongoing basis considering the relevance to the bank's own business activities. The banks intending to adopt Internal Model Approach for calculating the Market Risk under Pillar I of Basel capital accord will have to further enhance its data collection capacity and capability.

5.10 With the progress in information technology, the banks are better placed to employ more sophisticated systems to build data repositories for the risk measurement and management. The banks should automate their risk management systems for internal credit rating and data scoring, credit modeling, trading risk management, valuation purposes, and asset-liability management etc. Institutions dealing in complex products and large scale of operations are encouraged to apply statistical tools and models for enterprise-wide risk management, internal profitability, transfer pricing and economic capital modeling.

5.11 Banks should document its data management policies and procedures which may cover:

- The collection of data.
- Processes for ensuring integrity, completeness, consistency and accuracy.
- Data storage and purpose
- An outline of all data flows between systems

Developing Assumptions

5.12 Banks must have an interest rate risk measurement system that assesses the effects of interest rate changes on both earnings and economic value in ways that are consistent with the scope of their activities. Banks should provide explanation of their current and anticipated levels of interest rate risk exposure. The assumptions underlying the system should be clearly understood by risk managers and management. Interest rate risk measurement system should:

- Determine the range of potential interest rate movements over which it will measure its exposure i.e. from simple parallel movement assumption to more complex rate scenarios.
- Ensure that risk is measured over a reasonable range of potential rate changes including meaningful stress scenarios.

- Consider a variety of factors such as the shape and level of the current term structure of interest rate, historical and implied volatilities of interest rates.
- Estimate time to reduce or unwind unfavorable risk positions.
- Select scenarios that provide wide range of risk estimates.

5.13 The assumption about an instrument's actual maturity or repricing behavior may differ from the contractual terms. Hence, the State Bank has advised[2] that the expected maturities of non-contractual assets and liabilities should be calculated based on an objective and systematic behavioral study by adopting an appropriate methodology i.e. using regression, volatility, maximum withdrawal or any other approach which objectively defines the behavioral maturities of non-contractual assets and liabilities.

5.14 It is suggested that the behavioral studies should be based on the data of at least three years or longer period to cover a stressed period or event in the near past. For these studies, banks are required to document the process to conduct such studies in a consistent manner, detailed framework to review the studies and their output on annual basis.

5.15 While assessing interest rate exposure, banks need to make assumptions about the loan repayments and behavior of non-maturity deposits. The assumptions used by a bank needs to be consistent and reasonable for each interest rate scenario used. Banks should document all types of analysis underlying key assumptions and these key assumptions are to be evaluated at least annually for reasonableness.

5.16 Besides assessing the risk arising from existing business and risk position, the banks are encouraged to anticipate future risk exposures and compute their interest rate risk under the projected Profit & Loss and Balance Sheet.

Measurement of Risk

5.17 The quantification of risk depends on the methods of risk measurement; however, the system should address all material sources of interest rate risk including repricing, yield curve, basis, option risk exposures and price risk.

5.18 There are a number of techniques for measuring the interest rate risk exposure of both earnings and economic value. The earning perspective is mostly measured with the tools of asset-liability management such as cash matching, gap analysis, earning simulation, earning at risk and duration. While the economic perspective uses some of the techniques like gap analysis and duration but the tools mostly focus on the economic values like delta, PV01, value-at-risk etc. The complexity of these techniques ranges from simple calculations to static simulations using current

[2] BSD Circular Letter No. 03 dated Feb. 22, 2011 on the subject of Maturity and Interest Rate Sensitivity Gap Reporting.

holdings to highly sophisticated dynamic modeling techniques that reflect potential future business activities.

5.19 The techniques also vary in terms of their ability to capture the different factors of interest rate risk. The simplest techniques primarily capture repricing risk. Whereas, more sophisticated techniques are able to incorporate a whole range of interest rate risk sources and can therefore provide a better measure of interest rate risk exposure

5.20 **Annexure-1** provides detailed overview of the various measurement systems to quantify risk exposures while **Annexure-2** provides the SBP's supervisory expectations regarding "Monitoring of Interest Rate Risk".

6. Limits

6.1 The management must establish prudent limits to maintain bank's interest rate risk exposure within the board's approved risk tolerances over a range of possible changes in interest rates.

6.2 These limits should be approved by the senior management committee; however, the board of directors or its designated committee should review the appropriateness of these limits periodically.

6.3 Limit system should allocate appropriate thresholds to instrument types, individual portfolios or business units. Limit mechanism should set trigger points for prompt attention by the senior management. There should be a clear policy as to how senior management will be informed and what action should be taken by management in case of limit breaches.

6.4 Limits need to be consistent with a bank's overall approach to measure interest rate risk. Limits should address the potential impact of changes in interest rates on a bank's earnings and economic value of equity. From an earnings perspective, limits should specify acceptable level of earnings volatility (e.g. net interest margin, net operating income or net income) under particular interest rate scenarios whereas limits for addressing the effect of rate changes on bank's economic value of equity/ regulatory capital should be appropriate for the size and volume of its business.

6.5 Interest rate risk limits may be based on specific scenarios of movements in market interest rates such as an increase or decrease of a particular magnitude. The rate movement used in developing these limits should represent meaningful stress situations. Limit may also be based on measures derived from the underlying statistical distribution of interest rates such as earnings at risk or economic value techniques.

7. Stress testing

7.1 The risk measurement systems should measure the vulnerability of bank's losses under stressful market conditions – including the breakdown of key assumptions and

consider those results when establishing and reviewing their policies and limits for interest rate risk.

7.2 In addition to the mandatory regulatory stress testing exercises prescribed by the SBP, the banks are encouraged to develop an array of sensitivity tests including appropriate scenarios into their stress testing programs so as to adequately assess all material risks. An individual bank is free to design its stress testing mechanism according to its own size, scale of operations and business activities. However the bank should document the processes, procedures, frequency of carrying out stress testing exercises, reporting of the results to the board or its sub-committee and the senior management. The banks' management should take suitable corrective measures if the stress testing results indicate any significant damage to expected income or impairment to economic value.

7.3 The stress testing of assumptions used for illiquid instruments, instruments with uncertain contractual maturities and instruments where concentration exists is particularly critical to understanding the bank's risk profile.

7.4 The banks should consider "worst case" scenarios in addition to more probable events. The management and the board of directors should periodically review both the design and the results of such stress tests and ensure that appropriate contingency plans are in place.

8. Risk Monitoring and Reporting

8.1 An accurate, informative and timely management information system (MIS) is essential for managing interest rate risk exposure, both to inform the management and to support compliance with the board approved policy. Reporting should clearly compare currency exposure to policy limits and forecast/ risk estimates should be compared with actual results to identify any shortcomings.

8.2 Keeping in view the size, sophistication and nature of operations and underlying risks, a bank should have adequate mechanism for monitoring and reporting interest rate risk that adequately covers all material risks. The reporting system should be clearly documented providing formats and frequency of the reports for the board or its sub-committee and different hierarchical levels of the management. These reports should include, but not limited to:

- convey the magnitude, sources and trends of the bank's aggregated interest rate risk exposures;
- demonstrate the bank's compliance with policies and limits;
- the reasonableness of key assumptions for movement in the interest rate risk and changes in the shape of yield curve;
- results of stress tests including those assessing breakdowns in key assumptions and parameters; and

- summaries of the findings of reviews of interest rate risk policies, procedures and the adequacy of the interest rate risk measurement systems, including any findings of internal and external auditors.

8.3 Moreover the banks are advised to suitably enhance their risk management disclosure bearing in mind the regulatory requirements for their quarterly and annual financial statements. The information on the risk management framework including risk governance and infrastructure, risk exposures and monitoring mechanism should be properly disclosed in the financial statements. The banks are advised to publish sufficient data and its explanation in the notes to the financial statements for the use of all stakeholders particularly for the benefit of small investors and depositors.

9. Internal control and review

9.1 The banks should have adequate internal control measures to ensure the integrity of their interest rate risk management processes. An effective system of internal control for interest rate risk includes:

- a strong control environment;
- an adequate process for identifying and evaluating risk;
- establishment of control activities such as policies, procedures and methodologies;
- adequate information systems; and
- periodic/ frequent review of adherence to established policies and procedures.

9.2 Control policies and procedures must take into account appropriate approval processes, exposure limits and other steps taken to provide reasonable assurance that a bank’s interest rate risk management objectives are achieved. An important element of a bank's internal control system over its interest rate risk management process is regular evaluation and review. These reviews should ensure compliance with established processes and procedures while accepting any significant change for effective control mechanism. However, all such reviews and evaluations must be conducted regularly by individuals who are independent of the function they are assigned to review.

9.3 The frequency and magnitude of the reviews depend on the level of interest rate risk exposures of a particular bank and nature of market interest rate changes. The banks with complex risk exposures should have their measurement, monitoring, and control functions reviewed on a regular basis by independent internal or external reviewers. In cases where the independent review is conducted by internal auditors, the banks are encouraged to have the risk measurement, monitoring and control functions periodically reviewed by external auditors. This does not have to involve a full replication of the internal audit process.

9.4 It is essential that the independent reviewer ensures that the bank's risk measurement system is sufficient to capture all material elements of interest rate risk, whether arising from on- or off-balance-sheet activities. The reviewer must consider quantity of interest rate risk as well as quality of interest rate risk management and

measurement system. More importantly, the review process should be properly documented for evaluation by the external auditors and banking supervisors and the findings should be shared with the board or its committee and management. A reviewer should consider the following factors in making interest rate risk assessment:

a) Quantitative factors

- Volume and price sensitivity of various products;
- Vulnerability of earnings and capital under differing rate changes; and
- Exposure of earnings and economic value to various forms of interest rate risk.

b) Qualitative factors

- Appropriateness of a bank's internal measurement system in relation to the nature, scope and complexities of its activities;
- Independence of the risk control unit responsible for the design and administration of the risk measurement, monitoring and control functions;
- Involvement of the board of directors and senior management in the risk control process;
- Well documented internal policies, controls and procedures concerning interest rate risk;
- Well documented assumptions of the risk measurement system, accurate processing of data and reliable data aggregation; and
- Adequacy & skill set of the staff to conduct a sound risk management process.

10. Capital planning and interest rate risk

10.1 Banks must hold capital proportionate to the level of interest rate risk they assume for different business activities. Changes in interest rates expose a bank to potential operating loss which may, in extreme cases, threaten its survival. Capital plays an important role in supporting and providing cushion to all risks including interest rate exposure. Banks are supposed to determine the level of interest rate risk they undertake for their trading and non-trading activities and assess adequate capital to absorb losses arising from adverse interest rate movements.

10.2 The banks are required to determine and hold capital for interest rate risk arising from trading activities as a component of market risk under Pillar I of the Basel Accord instructions issued by the State Bank of Pakistan. As regards interest rate risk in banking book, the banks are required to estimate capital needs under Internal Capital Adequacy Assessment Process of Pillar II. The banks must determine adequate capital against interest rate exposures emerging from the balance sheet and off-balance sheet positions. It is the responsibility of banks to establish internal measurement system that adequately captures interest rate risk in the banking book. A bank’s internal system must meet the following criteria:

- All material interest rate risk associated with a bank’s assets, liabilities and off-balance sheet positions in the banking book must be assessed. To do this, internal

systems must accurately incorporate all of a bank's interest rate sensitive on- and off-balance sheet exposures.

- Generally accepted financial concepts and risk measurement techniques must be utilized. In particular, internal systems must be capable of measuring risk using both earnings and economic value approach. The monitoring of interest rate risk in the banking book for supervisory purposes should be based on risk as measured by the economic value approach.
- Data inputs need to be adequately specified (commensurate with the nature and complexity of a bank's holdings) with regard to rates, maturities, re-pricing, embedded options and other details to provide a reasonably accurate estimate of changes in economic value or earnings.
- The system's assumptions (used to transform positions into cash flows) are reasonable, properly documented and stable over time. This is especially important for assets and liabilities whose behaviour differs markedly from contractual maturity or repricing and for new products. Material changes to assumptions should be documented, justified and approved by the management.
- Interest rate risk measurement systems must be integrated into the bank's daily risk management practices. The output of the systems should be used in characterizing the level of interest rate risk to senior management and board of directors.
- The interest rate shock (or equivalent parameters) for the exposure(s) as determined by the Board of Directors or its sub-committee should be properly incorporated into the systems.

10.3 Moreover, the bank will record detail of the results obtained from stress testing i.e. sensitivity analyses and/or simulated scenario, and outcome of any statistical model used for the purpose of determining the impact of interest rate risk in the banking book on the bank's capital. In case, a bank does not present any logical explanation for its inability to maintain adequate capital cushion for interest rate exposures then the State Bank may consider a plausible remedial action. The ensuing action may warrant advising the bank for reduction in interest rate exposure, and / or suitable increase in the capital.

10.4 Material weaknesses in the interest rate measurement system will necessitate corrective measures including;

- Allocation of additional capital;
- Reduction in level of interest rate exposure;
- Enhancement of interest rate risk management expertise and
- Improvement in measurement system.

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Annex 1[3] Interest rate risk measurement techniques

This annexure 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 repricing 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 repricing mismatches, while the more sophisticated methods can more easily capture the full range of risk exposures.

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 characterize each of the major interest rate risk measurement techniques.

A. Repricing schedules

The simplest techniques for measuring a bank's interest rate risk exposure begin with a maturity/repricing 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 repricing (if floating-rate). Those assets and liabilities lacking definitive repricing 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 repricing time bands according to the judgment and past experience of the bank.

1. Gap analysis

Simple maturity/repricing 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

[3] Modified version of "Principles for the management and supervision of Interest Rate Risk" issued by Basel Committee on Banking Supervision (BCBS)

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 repricing "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 judgment of bank management.

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.

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.

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 reprice 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

A maturity/repricing 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.[4] It reflects the timing and size of cash flows that occur before the instrument's contractual maturity. Generally, the longer the maturity or next repricing date of the instrument and the smaller the payments that occur before

[4] 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.

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.

Duration-based weights can be used in combination with a maturity/repricing 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.

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.

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.[5]

B. Simulation approaches

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

[5] Modified duration - which is standard duration divided by 1 + r, where r is the level of market interest rates – is 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.

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.

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

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.[6]

2. Dynamic simulation

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.

> 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

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

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.

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.

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/repricing 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.

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.

Annex 2 Monitoring of interest rate risk by SBP

This annex sets out the methodology and calculation process for SBP reporting purposes only, and it is not intended to represent an exhaustive 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, trading book and all OBS items 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. 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. installment 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) Derivatives are converted into positions in the relevant underlying. The amounts considered are the principal amount of the underlying or of the notional underlying.

(g) 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.

(h) 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.

(i) 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 may be set out based on assumed change of X 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 Y%.

(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.

C. Time bands

4. SBP has already defined time bands in the Revised Forms of Annual Financial Statements issued vide BSD circular No. 4 of 2006 and under reporting of Quarterly Data File Structure (DFS) under Reporting Chart of Accounts (RCOA) through Data Acquisition Portal vide OSED circular letter No. 1 of 2009. The bank shall follow the existing instructions pertaining to number of time banks the gap reporting.

However, banks for their internal risk management are free to decide on the number of time bands. Generally, the narrower the time bands are, the more accurate the risk it measures. The number of time bands in a repricing ladder framework always reflects a decision regarding the necessary level of precision and the cost of pursuing greater accuracy. The repricing ladder in the standardised approach of the Market Risk may also be used as a starting point when developing a reporting framework that meets their particular needs. The breakdown can, of course, be modified either in a general way or in a specific way where the nature of business activities warrants or justifies a different reporting form. In this regard, banks which are actively involved into financing long term assets (e.g. home mortgage loans, infrastructure projects etc.) may bifurcate the longer time bucket (e.g. over 10 years) into several long time buckets (e.g. “over 10 years and upto 15 years” and “over 15 years” buckets) for internal risk management of banks.

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