IR-1	Interest Rate Risk in the Banking Book	V.2 – 14.12.18

This module should be read in conjunction with the Introduction and with the Glossary, which contains an explanation of abbreviations and other terms used in this Manual. If reading on-line, click on blue underlined headings to activate hyperlinks to the relevant module.

Purpose

To set out the approach which the HKMA will adopt in the supervision of interest rate risk in the banking book (IRRBB) and in monitoring AIs' level of IRRBB exposures

Classification

A non-statutory guideline issued by the MA as a guidance note

Previous guidelines superseded

IR-1 "Interest Rate Risk Management" (V.1) dated 13.12.2002 (attached in the Appendix for reference)

Application

To all AIs

Structure

1. Introduction

1.1 Terminology

1.1.1 In this module

- "IRRBB" means the risk to an AI's financial condition resulting from adverse movements in interest rates that affect the AI's banking book positions; and
- "OBS" means off-balance sheet.

1.2 Background

1.2.1 AIs' normal activities of lending, taking deposits with differing maturities and interest rates and buying securities may expose them to IRRBB.

1.2.2 While accepting some IRRBB is inherent in banking business, excessive IRRBB can pose a significant threat to AIs' earnings and capital adequacy. AIs should therefore have a process to identify, measure, monitor and control IRRBB in a timely and comprehensive fashion.

1.3 Scope

1.3.1 This module:

- provides guidance on the processes for effective IRRBB management;
- aims to help AIs evaluate the adequacy and effectiveness of their IRRBB management; and
- sets out how the HKMA monitors and supervises AIs' level and management of IRRBB.

1.3.2 The main focus of this module is on the management and measurement of IRRBB. For locally incorporated AIs that are exempted from the market risk capital adequacy regime[1] and overseas incorporated AIs that are not exempted from the local IRRBB framework[2], this

[1] Details of the market risk capital adequacy regime and the de-minimis exemption criteria as well as the requirements relevant to exempted AIs are set out in the Banking (Capital) Rules.

[2] Details of the exemption criteria are set out in the circular to all AIs dated 31 August 2018.

module applies to their positions in both the banking book and the trading book. Overseas incorporated AIs that are exempted from the local IRRBB framework are expected to manage their IRRBB together with their parent groups based on the IRRBB standards of their home jurisdictions and in accordance with the BCBS standards.

1.3.3 This module should be read in conjunction with IC-1 "Risk Management Framework". The criteria and sound practices for general risk management contained therein are also applicable to effective IRRBB management.

2. Sources of IRRBB

2.1 Summary

2.1.1 The following subsections describe the primary forms of IRRBB faced by AIs. They can be divided into three broad categories:

- gap risk;
- basis risk; and
- option risk.

2.1.2 Gap risk and basis risk, in particular, are the major sources of risk underlying the IRRBB exposures of AIs that are active in retail banking activities.

2.2 Gap risk

2.2.1 Gap risk is the risk arising from changes in the interest rates on instruments of different maturities. The extent of gap risk depends on whether changes to the term structure of interest rates occur consistently across the yield curve (parallel risk) or differentially by period (non-parallel risk).

2.2.2 Parallel risk is fundamental to banking business and some AIs may take on this risk in their balance sheet as part of their strategy to improve earnings. It can, however, affect the income and economic value of an AI as interest rates fluctuate. For example, an AI that has funded a long-term fixed rate loan with a short-term deposit could face a decline in future income if interest rates increase. This is because the cash flows from the loan are fixed while interest payable on replacement

funding will be higher after the short-term deposit matures.

2.2.3 Non-parallel risk materialises when unanticipated changes in the shape of the yield curve have adverse effects on an AI's income or economic value. As an example, the economic value of an AI's long position in ten-year government bonds hedged by a short position in five-year government bonds could decline sharply if the yield curve steepens, even if the position is hedged against parallel movements in the yield curve.

2.3 Basis risk

2.3.1 Basis risk arises from imperfect correlation between changes in the rates earned and paid on different instruments with otherwise similar repricing characteristics. As a result of these differences, the cash flows and earnings spread between assets, liabilities and OBS instruments of similar maturities or repricing frequencies will change.

2.3.2 For example, an AI may have mortgage loans priced at a different rate to that for its funding, e.g. priced at the prime rate and funded by HIBOR. HIBOR may rise while the prime rate remains unchanged. The AI has the option of increasing its prime rate but in practice its scope to do so may depend on whether other AIs will do the same.

2.3.3 This scenario affects the AI's current net interest margin through changes in the spread between earnings and payments on instruments that are being repriced. It will also affect future cash flows from these instruments, which will in turn affect the economic value of the AI.

2.4 Option risk

2.4.1 Option risk arises from interest rate option derivatives or from optional elements embedded in an AI's assets, liabilities and/or OBS instruments, where the AI or its customer can alter the level and timing of their cash flows. Option risk can be further characterised into automatic option risk and behavioural option risk.

2.4.2 Automatic option risk arises from standalone instruments, such as exchange-traded and over-the-counter option contracts, or options explicitly embedded within an otherwise standard financial instrument, where

the option will almost certainly be exercised if it is in the holder's financial interest to do so.

2.4.3 Behavioural option risk arises from the flexibility embedded implicitly or within the terms of financial contracts, such that changes in interest rates may affect the behaviour of the client. For example, AIs may experience a higher proportion of fixed rate loan commitments to be drawn down when the spread increases, and vice versa.

2.4.4 On the deposit side, customers can generally withdraw early. Early withdrawal rights are equivalent to put options on deposits. If rates increase, the market value of customer deposits declines and customers may withdraw them and place them with the same AI, or a different one, at a higher rate. Another common product with behavioural optionality is non-maturity deposits (NMDs) which can be withdrawn at any time without notice, but a portion of which tend to remain with the AI in practice (i.e. core deposits).

2.5 Credit spread risk

2.5.1 While the three sources of risks listed above are directly linked to IRRBB, credit spread risk in the banking book (CSRBB) is a related risk that AIs need to monitor and assess in their interest rate risk management framework. CSRBB refers to any kind of asset/liability spread risk of credit-risky instruments that is not explained by IRRBB or by the expected credit risk or jump to default risk.

3. Effects of IRRBB

3.1 Summary

3.1.1 As described in section 2 above, changes in interest rates can have adverse effects both on an AI's earnings and economic value. Its IRRBB exposure therefore must be assessed from two separate but complementary perspectives, i.e. earnings and economic value.

3.2 Earnings perspective

3.2.1 In this traditional approach to IRRBB assessment, the analysis focuses on the impact of changes in interest rates on accruing or reported earnings. Reduced earnings or outright losses can threaten the financial

stability of an AI by undermining its capital adequacy and by reducing market confidence in it.

3.2.2 The component of earnings that usually receives most attention is net interest income (NII), i.e. the difference between total interest income and total interest expense, taking account of hedging activity (e.g. via derivatives). This focus reflects both the importance of NII in AIs' overall earnings and its direct link to changes in interest rates.

3.2.3 Market interest rate changes can also have an impact on banking activities that generate fee-based and other non-interest income. Non-interest income arising from many activities such as loan servicing and asset securitisation programmes can be highly sensitive to market interest rates.

3.3 Economic value perspective

3.3.1 Variations in market interest rates can affect the economic value of an AI's assets, liabilities and OBS positions. The economic value of an instrument represents an assessment of the present value of its expected net cash flows, discounted to reflect market rates. As fluctuations in interest rates will affect an AI's earnings, they will also affect its net worth.

3.3.2 The economic value perspective reflects this sensitivity. It provides a more comprehensive view of the potential long-term effects of changes in interest rates than is offered by the earnings perspective. In contrast, changes in short-term earnings, the typical focus of the earnings perspective, may not provide an accurate indication of the impact of interest rate movements on an AI's overall positions.

3.4 Embedded losses

3.4.1 An AI should also consider the impact that past interest rates may have on future performance. Instruments that are not marked-to-market may already contain embedded gains or losses due to past rate movements. These gains or losses may be reflected over time in the AI's earnings. For example, a long-term fixed rate loan entered into when interest rates were low will result in an embedded loss when its funding is subsequently

replaced by liabilities bearing higher interest rates over the remaining life of the loan. This embedded loss will be materialised over time until the loan is settled.

4. Supervisory approach to IRRBB

4.1 Objectives and process

4.1.1 The HKMA adopts a risk-based supervisory approach which enables continuous supervision of AIs' IRRBB through a combination of on-site examinations, off-site reviews and prudential meetings. The objective is to assess the adequacy and effectiveness of an AI's IRRBB management process, the level and trend of the AI's risk exposure and, in the case of a locally incorporated AI, the adequacy of its capital relative to the size of its exposure. See SA-1 "Risk-based Supervisory Approach" for details of the HKMA's risk-based supervisory methodology.

4.1.2 AIs, unless exempted from the local IRRBB framework, are required to submit timely and comprehensive information on their IRRBB exposures through the "Return of Interest Rate Risk in the Banking Book – MA(BS)12A" ("IRRBB Return") on a quarterly basis. The HKMA uses this Return to evaluate AIs' level of IRRBB based on both the earnings approach and the economic value approach (see subsections 4.4 and 4.5 below for more details). The information collected takes appropriate account of the range of maturities and currencies in each AI's portfolio, including OBS items, as well as other relevant factors such as basis risk.

4.1.3 Overseas incorporated AIs that are exempted from the local IRRBB framework are required to submit timely information on their interest rate risk exposures through the "Interest Rate Risk Return – MA(BS)12" ("IRR Return") on a quarterly basis based on the previous version of Supervisory Policy Manual IR-1 in the Appendix of this document.

4.1.4 Locally incorporated AIs that are exempted from the market risk capital adequacy regime and overseas incorporated AIs that are not exempted from the local IRRBB framework are required to report in the IRRBB Return the aggregate of their interest rate risk exposures

in the trading book and banking book. Where necessary, the HKMA may request individual overseas incorporated AIs that have material trading positions to comply with additional reporting requirements in order to distinguish between their trading and non-trading activities for monitoring purposes.

4.1.5 Locally incorporated AIs that are subject to the market risk capital adequacy regime are only required to report their interest rate risk exposures in the banking book in the IRRBB Return as their trading positions in interest rate risk are monitored through the "Return of Capital Adequacy Ratio – MA(BS)3".

4.1.6 The HKMA will discuss with an AI's management to identify the major sources of the AI's IRRBB exposures and evaluate whether its measurement systems can identify and quantify adequately such risk exposures. The HKMA will also analyse the integrity and effectiveness of the AI's IRRBB management process to ensure that its practices comply with the objectives and risk tolerance limits approved by the Board of Directors.

4.1.7 In considering whether an AI has appropriate systems for managing IRRBB, the HKMA will have regard to the nature and complexity of the AI's IRRBB exposures and its compliance with the standards and sound practices set out in IC-1 "Risk Management Framework" and this module.

4.2 Basel Committee principles

4.2.1 The supervisory approach to IRRBB set out in this module is based on the principles and practices expounded in the Basel Committee on Banking Supervision ("Basel Committee") paper of April 2016, "Interest rate risk in the banking book". Details of the principles are listed in Annex 1.

4.3 Factors to be considered

4.3.1 In assessing the safety and soundness of an AI's IRRBB management and exposures, the HKMA will consider:

- the complexity and level of risk posed by its assets, liabilities and OBS activities;

- the adequacy and effectiveness of Board and senior management oversight;
- management's knowledge and ability to identify and manage sources of IRRBB;
- the adequacy of internal validation of IRRBB measures, including sensitivity analysis and backtesting, in particular where changes in key parameters have occurred;
- the adequacy of internal measurement, monitoring and management information systems;
- the adequacy and effectiveness of risk limits on and controls over income and capital losses;
- the effectiveness of the AI's IRRBB stress testing programme;
- the adequacy of the AI's internal review and audit of its interest rate risk management process;
- the adequacy and effectiveness of the AI's risk management practices and strategies, as evidenced from past and projected financial performance;
- the effectiveness of hedging strategies used by the AI to control IRRBB; and
- the appropriateness of the AI's level of IRRBB in relation to its earnings, capital and risk management systems.

4.3.2 These topics are discussed further in sections 6 and 7 below.

4.4 Monitoring of IRRBB (earnings approach)

4.4.1 For AIs that are not exempted from the local IRRBB framework ("IRRBB-Reporting AIs"), the HKMA reviews the level and trend of these AIs' IRRBB exposures using the quarterly IRRBB Return. The Return collects information on the following:

- the repricing positions of interest rate-sensitive assets, interest rate-sensitive liabilities and interest rate-sensitive OBS positions by different time bands and major currencies (i.e. Hong Kong

dollar, US dollar and any other foreign currency that accounts for 5% or more of an AI's total on-balance sheet interest rate-sensitive position in all currencies);

- a breakdown of interest rate-sensitive assets and liabilities into fixed rate, floating rate and managed rate items[3] which have different repricing features and reference rates;
- the repricing positions of residential mortgage loans and deposits, which are the major components of AIs' interest rate-sensitive assets and liabilities respectively;
- the weighted average yield and interest costs of interest rate-sensitive assets and liabilities, which provide more information for analysing AIs' net interest income;
- a breakdown of the major types of interest rate-sensitive OBS positions (e.g. interest rate swaps, cross currency swaps and options); and
- the impact of interest rate shock scenarios on economic value of equity (EVE) and earnings.

4.4.2 IRRBB-Reporting AIs should follow the Completion Instructions for the purpose of reporting IRRBB in the IRRBB Return. The HKMA may review these AIs' internal processes and assumptions for determining the behavioural maturity of interest rate risk positions in their portfolios.

4.4.3 Based on the reported interest rate repricing positions in the IRRBB Return, the HKMA assesses the impact on an IRRBB-Reporting AI's earnings over the next 12 months based on two standardised interest rate shock scenarios (parallel up and parallel down) as set out in subsection 5.3. The HKMA will be particularly attentive to those IRRBB-Reporting AIs whose IRRBB leads to a significant

[3] Fixed rate items are those assets and liabilities with interest rates fixed up to their final maturities. Floating rate items are those which will automatically be repriced at the next repricing date during the life of the items in accordance with movements in the relevant "reference rates" (such as HIBOR) and include those items for which the interest rates can be varied at the discretion of the counterparty. Managed rate items are those variable rate items (e.g. mortgage loans and non-maturity deposits) for which there are no fixed repricing dates and the interest rates can be adjusted at any time at the discretion of the reporting AI.

decline in earnings having regard to the nature and complexity of their activities.

4.4.4 As basis risk is a major risk factor underlying AIs' IRRBB exposures, the HKMA assesses the impact of changes in the relationships between key market rates on IRRBB-Reporting AIs' earnings using two hypothetical stress scenarios set out in the IRRBB Return. They are:

- all rates except for fixed and managed rates (e.g. the prime rate) on interest rate-sensitive assets are subject to the parallel up shock; and
- managed rates on interest rate-sensitive assets are subject to the parallel down shock while other rates remain unchanged.

The changes are assumed to last for one month, three months, six months and 12 months, respectively. The HKMA will be particularly attentive to those IRRBB-Reporting AIs whose basis risk leads to a significant decline in earnings having regard to the nature and complexity of their activities.

4.4.5 Where an AI has significant exposures to gap risk or basis risk, the HKMA may review information from the AI's internal management reports such as maturity/repricing gaps, earnings and economic value simulation estimates and the results of stress tests conducted. The HKMA will also discuss with the AI's management to evaluate its strategy for managing those exposures and assess its capacity to absorb the risk of loss. Depending on the circumstances of each case, the AI may be asked to strengthen its capital position or reduce its IRRBB (through, for example, hedging or restructuring existing positions) if necessary.

4.5 Review of capital adequacy (economic value approach)

4.5.1 Capital has an important role to play in mitigating and absorbing the risk of loss from changes in interest rates. As part of sound management, AIs should incorporate the level of IRRBB they undertake into their overall evaluation of capital adequacy. Where AIs undertake significant IRRBB in the course of their business, an appropriate amount of capital should be allocated specifically to support this risk.

4.5.2 The HKMA expects locally incorporated AIs to maintain adequate capital for IRRBB and to develop their own processes for internal assessment of capital adequacy. Specifically, locally incorporated AIs should consider their capital adequacy for IRRBB as part of the capital adequacy assessment process (CAAP, see CA-G-5 "Supervisory Review Process"), taking into account the following:

- the size and tenor of internal limits on IRRBB, and whether they have been reached;
- the effectiveness and expected cost of open hedging positions;
- the sensitivity of IRRBB measures to key assumptions;
- basis risk;
- the impact on economic value and earnings of mismatched positions in different currencies;
- the impact of embedded losses;
- the distribution of capital relative to risks across legal entities in the consolidation group;
- the drivers of the underlying risk; and
- the circumstances under which the risk might crystallise.

4.5.3 The HKMA will evaluate whether a locally incorporated AI has adequate capital to support its level of IRRBB exposures and the risk those exposures may pose to its future financial performance. To facilitate the monitoring of a locally incorporated AI's IRRBB and its capital adequacy, the HKMA prescribes six interest rate shock scenarios for the AI to measure its IRRBB exposures as reported in the IRRBB Return[4], and measure the EVE impact of the shocks using the standardised framework (see section 5).

4.5.4 The HKMA will be particularly attentive to the capital sufficiency of "outlier AIs" – those locally incorporated

[4] An IRRBB-Reporting AI's exposures at quarter-ends reported in the IRRBB return should not be systematically lower than the average exposures during the quarter.

AIs whose IRRBB leads to an EVE decline of more than 15% of their Tier 1 capital as a result of applying one of the six standardised interest rate shocks.

4.5.5 Where the HKMA is of the view that a locally incorporated AI's level of IRRBB exposures is high in relation to its capital, the HKMA will discuss the concern with the AI's management. Depending on the circumstances of each case, the AI may be asked to strengthen its capital position or reduce its IRRBB (through, for example, hedging or restructuring existing positions). The AI may also be subject to additional reporting requirements for its IRRBB exposures. However, the AI may not need to take any action if it can demonstrate that (i) its outlier status results from the AI's specific IRRBB profile that is not adequately captured by the standardised framework; and (ii) the AI's firm-specific internal model would be able to better reflect its actual IRRBB exposure.

4.5.6 While overseas incorporated IRRBB-Reporting AIs are not subject to the capital adequacy regime in Hong Kong, the HKMA uses the standardised interest rate shocks to monitor their IRRBB in terms of economic value. In view of the limitations of the earnings approach, the economic value approach provides supplementary information about the impact of interest rate movements on an AI's overall positions (see para. 3.3.2 above).

4.5.7 In monitoring the impact of the standardised interest rate shock on the economic value of overseas incorporated IRRBB-Reporting AIs, the HKMA will have regard to the Tier 1 capital of their head office. Nevertheless, the 15% benchmark mentioned in para. 4.5.4 above will not apply.

4.6 Criteria for adequate internal systems

4.6.1 The HKMA will assess whether an AI's internal measurement system for IRRBB is adequate for managing risk in a safe and sound manner and for evaluation of its capital adequacy[5] in the case of a locally incorporated AI.

4.6.2 An AI's IRRBB management system should meet the criteria set out in subsection 7.3 below. The system

[5] But it is the AI's responsibility to ensure that its capital is adequate.

should be integrated into the AI's daily risk management practices and its output should be used in reporting the level of IRRBB to the Board of Directors and senior management and, where appropriate, individual business line managers. The system should be capable of measuring risk under both the earnings approach and the economic value approach.

4.6.3 The HKMA will require AIs to bring their internal measurement system up to standard if deficiencies are identified. Until the HKMA is satisfied that an AI's measurement system is adequate, it may require the AI concerned to increase the frequency of reporting, to supply additional information and to keep its exposures within more prudent limits.

5. Local standardised framework for measuring IRRBB exposure

5.1 Standardised EVE risk measure

5.1.1 The calculation of the standardised EVE risk measure involves the following key steps:

- For a given currency c and time band k, calculate the net position $CF_{0,c}(k)$ (and $CF_{i,c}(k)$ under interest rate shock scenario i) by slotting cash flows into time bands based on their earliest interest rate repricing dates, both under current conditions and under each of the six interest rate shock scenarios (see subsection 5.3). Both notional principals and coupon cash flows should be slotted. Note that the net position under interest rate shock scenarios may vary depending on the way cash flows with optionality are slotted (see subsection 5.2).
- For each scenario i, calculate the impact on EVE ($\Delta E_{i,c}(k)$) for a given currency and time band as

  $$\Delta E_{i,c}(k) = CF_{0,c}(k) \cdot \exp\left(-r_{0,c}(k) \cdot t_k\right) - CF_{i,c}(k) \cdot \exp\left(-r_{i,c}(k) \cdot t_k\right),$$

  where $r_{0,c}(k)$ denotes the current risk-free rate[6] (at the midpoint of the time band), $r_{i,c}(k)$ denotes

[6] This may be determined, for example, based on an interest rate swap curve.

the risk-free rate under scenario i (at the midpoint of the time band) and t_k denotes the midpoint of each time band k (measured in years).

- Calculate the interest rate option risk measure $KAO_{i,c}$ under each scenario i as the current net value of interest rate options[7] ($VAO_{0,c}$) minus the net value of interest rate options under the interest rate shock scenario ($VAO_{i,c}$), i.e. $KAO_{i,c} = VAO_{0,c} - VAO_{i,c}$. The net value of interest rate options under the interest rate shock scenario should be calculated using the new yield curve under scenario i, and assuming a relative increase in the implicit volatility of 25%.
- Calculate the impact on EVE across all time bands for a given currency and scenario as $\Delta E_{i,c} = max\left(0, \sum_k \Delta E_{i,c}(k) + KAO_{i,c}\right)$.
- Repeat the above for all applicable currencies. The aggregate EVE risk measure (ΔE) across all applicable currencies is calculated as the maximum loss across the six interest rate shock scenarios:

$$\Delta E = \max_{i \in \{1,2,\ldots,6\}} \left(\sum_c \Delta E_{i,c} \right)$$

5.1.2 Cash flows should generally be slotted into time bands according to the earliest interest repricing date. However, there is a separate methodology for slotting cash flows with optionality, including retail fixed rate loans subject to prepayment risk, retail term deposits subject to early redemption risk and non-maturity deposits – see subsection 5.2 for details.

5.2 Slotting cash flows with optionality

5.2.1 Retail fixed rate loans subject to prepayment risk

- Fixed rate loans subject to prepayment risk are fixed rate loan products where the full economic cost of prepayments cannot be charged, or

[7] This includes both bought and sold options and should be estimated according to the IRRBB-Reporting AI's proprietary options pricing model.

charged only for prepayments above a certain threshold, to the borrower.

- This section applies to retail fixed loans only. Retail loans are defined as loans granted to customers satisfying the criteria in section 64(1)(a) and 64(1)(b) of the Banking (Capital) Rules. Non-retail fixed loans subject to prepayment risk should be considered as positions with embedded interest rate options.

- AIs should determine, using own estimates, the baseline conditional prepayment rate $CPR_{0,c,p}$ for a given portfolio p of homogeneous loan products subject to prepayment risk denominated in a given currency c, under the prevailing term structure of interest rates[8]. The conditional prepayment rate (CPR) under interest rate shock scenario i is then given by:

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

where $CPR_{0,c,p}$ is the (constant) baseline CPR and γ_i is a multiplier for scenario i as given in the table below.

Scenario number (i)	Interest rate shock scenarios	γ_i (scenario multiplier)
1	Parallel up	0.8
2	Parallel down	1.2
3	Steepener	0.8
4	Flattener	1.2
5	Short rate up	0.8
6	Short rate down	1.2

- The prepayments on the fixed rate loans can be broken down into scheduled payments adjusted for prepayment and uncompensated prepayments. The cash flows to be slotted into time band k is given by:

[8] The baseline CPR may vary over the life of the loan. In this case, it is denoted $CPR_{0,c,p}(k)$.

$$CF_{i,c,p}(k) = CF_{i,c,S}(k) + CPR_{i,c,p} \cdot NO_{i,c,p}(k-1)$$

where $CF_{i,c,S}(k)$ refers to the scheduled interest payment [9] and principal repayment, and $NO_{i,c,p}(k-1)$ denotes the notional outstanding at the end of the previous time band[10]. AIs should repeat the above for each loan portfolio and applicable currency to calculate the aggregate position in each time band.

5.2.2 Retail term deposits subject to early redemption risk

- Term deposits subject to early redemption risk are term deposits that can be withdrawn early at the discretion of the customer. Term deposits may only be treated as a standard fixed rate deposit and be slotted into the time band according to their contractual maturity dates if
  - the depositor has no legal right to withdraw the deposit; or
  - an early withdrawal results in a penalty that at least compensates for the loss of interest between the date of withdrawal and the contractual maturity date and the economic cost of breaking the contract[11].

  If neither of these conditions is met, the depositor holds an option to withdraw and the term deposits are deemed to be subject to early redemption risk.
- This section applies to retail term deposits subject to early redemption risk only. Retail deposits are defined as deposits placed with a bank by individual persons. Deposits made by small business customers, as defined in rule 39 of the

[9] The scheduled interest payment should only be included when reporting net positions including coupon cash flows.

[10] For simplicity, it is assumed that there is no annual limit on prepayments. If an AI has imposed an annual limit on uncompensated prepayments, this limit will apply.

[11] The economic cost of breaking the contract is the additional funding cost the AI would incur due to the early redemption, assuming the AI obtained term funding at the current interest rate, or the interest rate under the relevant interest rate shock scenario, to cover the remaining life of the original term deposit.

Banking (Liquidity) Rules[12], can also be treated as retail deposits. Deposits from legal entities, sole proprietorships or partnerships should be categorised as non-retail deposits. Non-retail term deposits subject to early redemption risk should be considered as positions with embedded interest rate options.

- For each homogeneous portfolio p of term deposits in a given currency c, AIs must determine the baseline term deposit redemption ratio $TDRR_{0,c,p}$ and use it to slot the notional repricing cash flows. Term deposits which are expected to be redeemed early should be slotted into the overnight time band ($k = 1$).
- The term deposit redemption ratio for time band k under scenario i is obtained by multiplying $TDRR_{0,c,p}$ by a scalar u_i as follows:

$$TDRR_{i,c,p} = min\left(1, u_i \cdot TDRR_{0,c,p}\right)$$

where the values of the scalars u_i are set out in the table below.

Scenario number (i)	Interest rate shock scenarios	u_i (scenario multiplier)
1	Parallel up	1.2
2	Parallel down	0.8
3	Steepener	0.8
4	Flattener	1.2
5	Short rate up	1.2
6	Short rate down	0.8

- The notional repricing cash flows which are expected to be withdrawn early under interest rate shock scenario i are given by:

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

[12] This definition, for the purpose of this Supervisory Policy Manual, applies to both Category 1 and Category 2 institutions.

where $TD_{0,c,p}$ is the outstanding amount of term deposits in portfolio p. AIs should repeat the above for each deposit portfolio and applicable currency to calculate the aggregate position in each time band.

5.2.3 Non-maturity deposits (NMDs)

- IRRBB-Reporting AIs have a choice to either slot NMDs into the appropriate time bands according to the earliest date on which their interest rates can be adjusted, or estimate their behavioural maturity using the methodology below.
- NMDs should first be segmented into retail and non-retail categories. Retail deposits should be considered as held in a transactional account when regular transactions are carried out in that account (e.g. when salaries are regularly credited) or when the deposit is non-interest bearing. Other retail deposits should be considered as held in a non-transactional account.
- The AIs estimating behavioural maturities should first identify stable NMDs, i.e. those that are found to remain undrawn with a high probability, using observed volume changes over the past 10 years. The AIs should then identify core deposits, which are stable NMDs that are unlikely to reprice even under significant changes in the interest rate environment. All other NMDs are non-core deposits. The AIs are required to estimate the level of core deposits using this two-step procedure for each NMD category, subject to the caps in the table below.

	Cap on proportion of core deposits to total NMDs (%)	Cap on average maturity of core deposits (years)
Retail/transactional	90	5
Retail/non-transactional	70	4.5
Non-retail	50	4

- NMDs should finally be slotted into the appropriate time bands. Non-core deposits should be considered as overnight deposits and accordingly should be placed into the overnight time band. Core deposits should be slotted according to their average behavioural maturity, which should be determined by the AIs using an appropriate procedure subject to the caps in the table above.

5.3 Standardised interest rate shock scenarios

5.3.1 The change in the risk-free interest rate $\Delta r_{i,c}(k)$ for interest rate shock scenario i, currency c and time band k is calculated according to the equations below (see table below for values of $\bar{R}$):

(i) parallel shock up:

$$\Delta r_{1,c}(k) = \bar{R}_{parallel,c}$$

(ii) parallel shock down:

$$\Delta r_{2,c}(k) = -\bar{R}_{parallel,c}$$

(iii) steepener shock:

$$\Delta r_{3,c}(k) =$$

$$-0.65 \cdot \bar{R}_{short,c} \cdot e^{\frac{-t_k}{4}} + 0.9 \cdot \bar{R}_{long,c} \cdot \left(1 - e^{\frac{-t_k}{4}}\right)$$

(iv) flattener shock:

$$\Delta r_{4,c}(k) =$$

$$0.8 \cdot \bar{R}_{short,c} \cdot e^{\frac{-t_k}{4}} - 0.6 \cdot \bar{R}_{long,c} \cdot \left(1 - e^{\frac{-t_k}{4}}\right)$$

(v) short rates shock up:

$$\Delta r_{5,c}(k) = \bar{R}_{short,c} \cdot e^{\frac{-t_k}{4}}$$

(vi) short rates shock down:

$$\Delta r_{6,c}(k) = -\bar{R}_{short,c} \cdot e^{\frac{-t_k}{4}}$$

5.3.2 The final post-shock interest rate, subject to a −2% floor, is given by[13]

$$r_{i,c}(k) = max\left(r_{0,c}(k) + \Delta r_{i,c}(k), -2\%\right)$$

Specified size of interest rate shocks ($\bar{R}_{shocktype,c,}$ in bps)								
	ARS	AUD	BRL	CAD	CHF	CNY	CNH	EUR
Parallel	400	300	400	200	100	250	250	200
Short	500	450	500	300	150	300	300	250
Long	300	200	300	150	100	150	150	100

	GBP	HKD	IDR	INR	JPY	KRW	MXN
Parallel	250	200	400	400	100	300	400
Short	300	250	500	500	100	400	500
Long	150	100	300	300	100	200	300

	RUB	SAR	SEK	SGD	TRY	USD	ZAR
Parallel	400	200	200	150	400	200	400
Short	500	300	300	200	500	300	500
Long	300	150	150	100	300	150	300

5.3.3 The table above will be updated from time to time based on parameter updates provided by the Basel Committee. IRRBB-Reporting AIs should contact the HKMA if they need to report a currency for which no shock data are provided in the table.

6. Oversight by AIs

6.1 Responsibilities of Board and senior management

6.1.1 An AI's Board of Directors and senior management are responsible for oversight of the IRRBB management framework and the AI's risk appetite for IRRBB, which

[13] For AIs taking spreads into account, the final post-shock interest rate is given by $r_{i,c}^{incl.spread,assets}(k) = \left(r_{i,c}(k) + asset\ spread\right)$ for assets and $r_{i,c}^{incl.spread,liabilities}(k) = max\ \left(r_{i,c}(k) - liability\ spread, -2\%\right)$ for liabilities, where $r_{i,c}(k)$ is defined as in para. 5.3.2.

should be articulated in terms of the risk to both economic value and earnings. AIs must implement policy limits that are consistent with their risk appetite. See CG-1 "Corporate Governance of Locally Incorporated Authorized Institutions" and IC-1 "Risk Management Framework" for details of their risk management responsibilities. Many of the requirements and practices cited have a general application.

6.2 Asset and Liability Management Committee

6.2.1 The Board of Directors may delegate responsibility for monitoring and management of IRRBB to the Asset and Liability Committee ("ALCO"), which is a designated committee usually composed of senior staff. Larger or more complex AIs should have such committees, responsible for the design and administration of IRRBB management. The ALCO should include members with clear lines of authority over the units responsible for establishing and managing positions. The Board should ensure that the AI's organisational structure enables the ALCO to carry out its responsibilities.

6.2.2 The main role and functions of the ALCO are described in CG-1 "Corporate Governance of Locally Incorporated Authorized Institutions".

6.3 Independent risk management

6.3.1 The Board or senior management should assign responsibility for managing IRRBB to individuals or units with appropriate experience and expertise. The responsible personnel should have an adequate understanding of all types of IRRBB faced throughout the AI.

6.3.2 There should be adequate segregation of duties in key elements of the risk management process to avoid potential conflicts of interest. For example, the level of IRRBB is determined by how a particular transaction is evaluated based on current market rates. Such evaluation is normally conducted by the risk management or operations department of an AI while the actual transaction is performed by a risk-taking unit or front office. This is to ensure independent risk assessment of the transactions.

7. Risk management policies, procedures and controls

7.1 Coverage

7.1.1 Whatever the methodology chosen, an AI's IRRBB management procedures should be clearly defined and consistent with the nature and complexity of its activities.

7.1.2 The policies, procedures and limits (e.g. limits to fixed rate deals, use of interest rate swaps, etc.) should be properly documented, drawn up after careful consideration of IRRBB associated with different types of lending, and approved and reviewed (at least annually) by management at the appropriate level. The policies and procedures should delineate delegated powers, lines of responsibility and accountability over IRRBB management decisions and should clearly define authorised instruments, hedging strategies and risk-taking opportunities.

7.1.3 There should also be an accurate, informative and timely management information system for IRRBB. This is essential both to keep senior management and, where appropriate, individual business line managers in the picture and to facilitate compliance with Board policy.

7.1.4 AIs' policies and procedures for IRRBB management should cover the general criteria set out in IC-1 "Risk Management Framework" and other criteria specific to IRRBB as discussed in the following subsections.

7.2 New services and strategies

7.2.1 AIs should identify the interest rate risks inherent in new services and activities and ensure that these are subject to adequate procedures and controls before being introduced or undertaken. For example, an AI specialising in prime-based mortgage loans that then engages in HIBOR-based mortgage loans with interest rate caps for customers should be aware of the volatility of HIBOR and the embedded option features.

7.2.2 AIs may be exposed to additional interest rate risk if they develop products or services that enable greater access to customers who primarily seek the best rate. The introduction of e-banking services is an example of such services. This reinforces the need for AIs to react quickly to changing market conditions and to ensure that their

pricing strategy has catered for an adequate interest spread to absorb any additional interest rate risk.

7.2.3 AIs should consider balancing cash flows and managing the interest rate risk arising from new services or strategies through hedging, e.g. using swaps or other derivative instruments. Major hedging or risk management initiatives should be approved in advance by the Board or a committee such as the ALCO.

7.3 Risk measurement, monitoring and control

7.3.1 AIs should have IRRBB measurement systems that encompass all significant causes of such risk. The systems should evaluate the effect of rate changes on both earnings and economic value meaningfully and accurately within the context and complexity of their activities. They should be able to flag any excessive exposures.

7.3.2 Measurement systems should:

- evaluate all significant IRRBB arising from the full range of an AI's assets, liabilities and OBS positions. If the same measurement systems and management methods are not used for all activities, an integrated view of IRRBB across products and business lines should be available to management;
- employ a variety of generally accepted financial models and ways of measuring risk, rather than relying on a single measure of risk;
- have accurate and timely data (in relation to rates, maturities, repricing, embedded options and other details) on current positions[14]. Data inputs should be automated as much as possible to reduce administrative errors;
- document the assumptions, parameters and limitations on which they are based. Material changes to assumptions should be documented, justified and approved by senior management. Systems should also be sufficiently flexible to

[14] Any manual adjustments to underlying data should be clearly documented and the nature and reasons for the adjustments should be clearly understood.

incorporate supervisory-imposed constraints on AIs' internal risk parameter estimates;

- cover all significant sources of IRRBB (e.g. gap, basis and option risks). While all of an AI's positions should be appropriately treated, its largest concentrations and positions should be assessed with special thoroughness, as should instruments which might have a material effect on an AI's overall position (notwithstanding that they are not major concentrations) and instruments with significant embedded or explicit options; and
- assess exposures in different currencies (subject to para. 7.3.6 below).

7.3.3 Techniques to measure IRRBB exposure from an earnings and economic value perspective comprise, in increasing degrees of complexity, simple calculations, static simulations using current holdings and highly sophisticated dynamic modelling techniques based on business forecasts and decisions. As a minimum, AIs should be able to use the standardised framework for measuring IRRBB exposure (see section 5). Where cash flows are slotted into different time bands (e.g. for gap analyses), the slotting criteria should be stable over time to allow for a meaningful comparison of risk figures over different periods.

7.3.4 AIs having complex risk profiles should employ more sophisticated IRRBB measurement techniques such as simulation-based approaches. The assumptions underlying a simulation model can sometimes make it difficult to determine how much a variable contributes to changes in the simulation results. It is therefore necessary to supplement the simulation model by additional in-depth analysis or other simulation models to isolate the risk of each variable inherent in the existing balance sheet.

7.3.5 When assessing its IRRBB exposures, an AI should make judgments and assumptions about how an instrument's actual maturity or repricing behaviour may vary from the instrument's contractual terms because of behavioural optionalities. The behavioural assumptions used should be conceptually sound and reasonable, and

consistent with historical experience (see Annex 2 for a list of possible considerations). Such assumptions should be rigorously tested and aligned with the AI's business strategies. The most significant assumptions should be documented, clearly understood by the Board or the relevant committee and subject to periodic review (at least annually).

7.3.6 AIs with positions in different currencies need to measure their exposure to IRRBB in each currency. They may do so for each currency separately, on the ground that yield curves for different currencies vary. AIs with material multi-currency exposures may, if they have the requisite skills and sophistication, decide to aggregate their exposures in certain currencies where there is assumed to be some correlation between interest rates for those currencies. Such AIs should review periodically whether these assumptions remain valid and assess their potential exposure if such correlations prove invalid.

7.3.7 Measurement outcomes of IRRBB and hedging strategies should be reported to the Board or the relevant committee on a regular basis (at least semiannually), at relevant levels of aggregation (by consolidation level and currency). The reports should include at least the following:

- summaries of the AI's aggregate IRRBB exposures, and explanatory text that highlights the assets, liabilities, cash flows, and strategies that are driving the level and direction of IRRBB;
- reports demonstrating the AI's compliance with policies and limits;
- key assumptions such as NMD characteristics and prepayments on fixed rate loans;
- results of stress tests, including assessment of sensitivity to key assumptions and parameters, as well as sensitivity to changes in market conditions, with particular reference to portfolios that may be subject to significant mark-to-market movements; and

- summaries of the reviews of IRRBB policies, procedures and adequacy of the measurement systems, including any findings of internal and external auditors and/or other equivalent external parties (such as consultants).

7.4 Stress-testing

7.4.1 AIs should measure their vulnerability to loss in stressed market conditions, including the breakdown of key assumptions, and consider those results when establishing and reviewing their policies and limits for IRRBB, as well as in the CAAP.

7.4.2 An AI's stress testing framework for IRRBB should be commensurate with its nature, size and complexity as well as business activities and overall risk profile. The framework should have clearly defined objectives, well-documented assumptions and sound methodologies, and should take into account the opinions of experts within the AI.

7.4.3 AIs' IRRBB management systems should be able to calculate, by currency, the impact on economic value and earnings of multiple scenarios, including the six standardised interest rate shock scenarios[15] set out in subsection 5.3, as well as internally selected interest rate shock scenarios addressing the AI's risk profile according to its CAAP. Possible stress scenarios include:

- historical scenarios such as the Asian Financial Crisis in the late 1990s;
- changes in the relationships between key market rates (i.e. basis risk), e.g. (i) a surge in term and savings deposit rates and HIBOR but no change in the prime rate, and (ii) a drop in the prime rate but no change in term and savings deposit rates and HIBOR[16];
- changes in interest rates in individual time bands to different relative levels (i.e. non-parallel gap risk);

[15] AIs are only required to calculate the impact of two standardised interest shock scenarios (parallel up and parallel down) on earnings (see para. 4.4.3).

[16] These scenarios for basis risk are incorporated in the IRRBB Return.

- changes in the liquidity of key financial markets or changes in the volatility of market rates; and
- changes in key business assumptions and parameters such as the correlation between Hong Kong dollar and US dollar interest rates. In particular, changes in assumptions used for illiquid instruments and instruments with uncertain contractual maturities help understanding of an AI's risk profile.

7.4.4 When developing interest rate shock scenarios, AIs should consider the following:

- the scenarios should be severe and plausible, and sufficiently wide-ranging to identify parallel and non-parallel gap, basis and option risks;
- special consideration should be given to instruments or markets where concentrations exist;
- AIs should assess the possible interaction of IRRBB with other risks, e.g. credit risk and liquidity risk;
- AIs should assess the effect of adverse changes in the spreads of new assets or liabilities replacing those positions maturing over the horizon of the forecast on their NII;
- AIs with significant option risk should include scenarios that capture the exercise of such options. For example, AIs that have products with sold caps or floors should include scenarios that assess how the risk positions would change should those caps or floors move into the money. AIs should also develop interest rate assumptions to measure their IRRBB exposures given changes in interest rate volatilities;
- AIs should specify the term structure of interest rates that will be incorporated and the basis relationship between yield curves when building interest rate shock scenarios;

- AIs should estimate how interest rates that are administered or managed by management might change;
- AIs should consider the time it would take to reduce or unwind unfavourable IRRBB exposures, and their capability or willingness to withstand accounting losses in order to reposition their risk profile;
- Forward-looking scenarios should incorporate changes in portfolio composition, new products, new market information and emerging risks; and
- AIs should perform qualitative and quantitative reverse stress tests to identify key vulnerabilities.

7.5 Limits

7.5.1 AIs should establish and enforce operating limits and other practices that maintain exposures within levels consistent with their internal policies and that accord with their approach to measuring IRRBB. Such limits should be approved by the Board or a committee such as the ALCO.

7.5.2 In particular, AIs should set a limit on the extent to which floating rate exposures are funded by fixed rate sources and vice versa to limit IRRBB. In floating rate lending, AIs should limit the extent to which they run any basis risk that may arise if lending and funding are not based on precisely the same market interest rate (e.g. HIBOR).

7.5.3 The limits should be consistent with AIs' underlying approach to IRRBB measurement and should be directed at how reported earnings and capital adequacy might be affected by changes in market interest rates. As regards earnings, AIs should consider limits on earnings volatility in both net income and net interest income under specified interest rate scenarios so as to quantify what portion of their IRRBB exposure arises from non-interest income.

7.5.4 The limits should be appropriate to the nature, size, complexity and capital adequacy of the AI, as well as its ability to measure and manage its risks. Depending on the nature of an AI's activities and business model, sub-limits may also be identified for individual business units,

portfolios, instrument types or specific instruments. AIs with significant exposures to gap risk, basis risk or positions with explicit or embedded options should establish appropriate risk tolerances for these risks.

7.5.5 Limits on IRRBB should be related to explicit scenarios of changes in market interest rates and/or term structures, e.g. movements up or down of specified ranges or a change in shape. These scenarios or changes should constitute genuine stress conditions and should be developed in the light of historic rate volatility and time needed to unwind, restructure or hedge an AI's IRRBB position. They can also reflect measures from the underlying statistical distribution of interest rates, e.g. earnings at risk or economic value at risk techniques. The scenarios should cover all possible sources of IRRBB, e.g. gap, basis and option risks, and not just parallel shifts in interest rates or other simple scenarios.

7.5.6 There should be systems in place to ensure that positions that exceed, or are likely to exceed, limits established by the AI should receive prompt management attention and be escalated without delay. There should be a clear policy on who will be informed, how the communication will take place and the actions which will be taken in response to an exception.

7.6 Internal controls and independent audits

7.6.1 As an integral part of the overall internal control system, AIs should have adequate internal controls over IRRBB. The effectiveness of such controls should be evaluated regularly by independent parties, e.g. internal or external auditors.

7.6.2 AIs should conduct periodic reviews of their risk management process for IRRBB to ensure its integrity, accuracy and reasonableness. AIs with more complex profiles and measurement systems should have their internal models or calculations audited or validated by an independent internal or external reviewer. Reports written by independent reviewers should be made available to the HKMA.

7.6.3 In such independent reviews, the factors to be considered include the quality of IRRBB management and the size of IRRBB, e.g.:

- the volume and price sensitivity of various products;
- how vulnerable earnings and economic value are to all forms of IRRBB, e.g. gap, basis and option risks;
- compliance with established policies and procedures and escalation procedures for any exceeded limits; and
- any significant changes that may affect the effectiveness of controls (including changes in market conditions, personnel, technology and structures of compliance with exposure limits).

Annex 1 : Basel principles for the management of IRRBB

1.1 Background

1.1.1 The Basel Committee issued the paper "Principles for the management and supervision of interest rate risk" ("IRRBB Principles") in July 2004, setting out supervisory expectations for banks' identification, measurement, monitoring and control of IRRBB as well as its supervision. In April 2016, the Basel Committee published standards for "Interest rate risk in the banking book" with revised IRRBB Principles for banks as summarised below.

1.2 Principles for banks

1.2.1 IRRBB is an important risk for all banks that must be specifically identified, measured, monitored and controlled. In addition, banks should monitor and assess credit spread risk in the banking book.

1.2.2 The governing body of each bank is responsible for oversight of the IRRBB management framework, and the bank's risk appetite for IRRBB. Monitoring and management of IRRBB may be delegated by the governing body to senior management, expert individuals or an asset and liability management committee (henceforth, its delegates). Banks must have an adequate IRRBB management framework, involving regular independent reviews and evaluations of the effectiveness of the system.

1.2.3 The banks' risk appetite for IRRBB should be articulated in terms of the risk to both economic value and earnings. Banks must implement policy limits that target maintaining IRRBB exposures consistent with their risk appetite.

1.2.4 Measurement of IRRBB should be based on outcomes of both economic value and earnings-based measures, arising from a wide and appropriate range of interest rate shock and stress scenarios.

1.2.5 In measuring IRRBB, key behavioural assumptions should be fully understood, conceptually sound and documented. Such assumptions should be rigorously tested and aligned with the bank's business strategies.

1.2.6 Measurement systems and models used for IRRBB should be based on accurate data, and subject to appropriate documentation, testing and controls to give assurance on the accuracy of calculations. Models used to measure IRRBB should be comprehensive and covered by governance processes for model risk management, including a validation function that is independent of the development process.

1.2.7 Measurement outcomes of IRRBB and hedging strategies should be reported to the governing body or its delegates on a regular basis, at relevant levels of aggregation (by consolidation level and currency).

1.2.8 Information on the level of IRRBB exposure and practices for measuring and controlling IRRBB must be disclosed to the public on a regular basis.

1.2.9 Capital adequacy for IRRBB must be specifically considered as part of the Internal Capital Adequacy Assessment Process (ICAAP) approved by the governing body, in line with the bank's risk appetite for IRRBB.

Annex 2 : Factors influencing behavioural optionality

Fixed rate loans subject to prepayment risk	Loan size, loan-to-value (LTV) ratio, borrower characteristics, contractual interest rates, seasoning, geographical location, original and remaining maturity, and other historical factors. Other macroeconomic variables such as stock indices, unemployment rates, GDP, inflation and housing price indices.
Fixed rate loan commitments	Borrower characteristics, geographical location (including competitive environment and local premium conventions), customers' relationship with the AI as evidenced by cross-products, remaining maturity of the commitment, seasoning and remaining term of the mortgage.
Term deposits subject to early redemption risk	Deposit size, depositor characteristics, funding channel (e.g. direct or brokered deposit), contractual interest rates, seasonal factors, geographical location and competitive environment, remaining maturity and other historical factors. Other macroeconomic variables such as stock indices, unemployment rates, GDP, inflation and housing price indices.
NMDs	Responsiveness of product rates to changes in market interest rates, current level of interest rates, spread between an AI's offer rate and market rate, competition from other firms, the AI's geographical location and demographic and other relevant characteristics of its customer base.

Appendix

The following document is the previous version of Supervisory Policy Manual IR-1 "Interest Rate Risk Management" dated 13 December 2002, which only serves as a reference for those overseas incorporated AIs that are exempted from the local IRRBB framework to report interest rate exposures through the "Interest Rate Risk Return – MA(BS)12" (see paragraph 4.1.3 of Supervisory Policy Manual IR-1 "Interest Rate Risk in the Banking Book" dated 14 December 2018).

Contents	Glossary	Home	Introduction

This module should be read in conjunction with the Introduction and with the Glossary, which contains an explanation of abbreviations and other terms used in this Manual. If reading on-line, click on blue underlined headings to activate hyperlinks to the relevant module.

Purpose

To set out the approach which the HKMA will adopt in the supervision of interest rate risk and in monitoring AIs' level of interest rate risk exposures

Classification

A non-statutory guideline issued by the MA as a guidance note

Previous guidelines superseded

This is a new guideline

Application

To all AIs

Structure

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1. Introduction

1.1 Terminology

1.1.1 In this module

- "interest rate risk" means the risk to an AI's financial condition resulting from adverse movements in interest rates; and

- "OBS" means off-balance sheet.

1.2 Background

1.2.1 AIs' normal activities of lending, taking deposits with differing maturities and interest rates and buying securities may expose them to interest rate risk.

1.2.2 Interest rate risk may apply to the banking book as well as the trading book.

1.2.3 While accepting some interest rate risk is inherent in banking business, excessive interest rate risk can pose a significant threat to AIs' earnings and capital adequacy. AIs should therefore have a process to identify, measure, monitor and manage interest rate risk in a timely and comprehensive fashion.

1.3 Scope

1.3.1 This module:

- provides guidance on the processes for effective interest rate risk management;
- aims to help AIs evaluate the adequacy and effectiveness of their interest rate risk management; and
- sets out how the HKMA monitors and supervises AIs' level and management of interest rate risk.

1.3.2 The main focus of this module is on the management and measurement of interest rate risk in the banking book, although the HKMA will also take into account an AI's exposures in the trading book in evaluating the overall complexity and level of its interest rate risk. Sound practices for the management and measurement of interest rate risk in the trading book are covered in TA-1 "Market Risk Management" and TA-3 "Management of Trading in Derivatives and Other Instruments"[1].

1.3.3 This module should be read in conjunction with IC-1 "General Risk Management Controls". The criteria and sound practices for general risk management contained therein are also applicable to effective interest rate risk management.

[1] Module under development.

2. Sources of interest rate risk

2.1 Summary

2.1.1 The following subsections describe the primary forms of interest rate risk faced by AIs. They can be divided into four broad categories:

- repricing (or maturity mismatch) risk;
- yield curve risk;
- basis risk; and
- option risk.

2.1.2 Repricing risk and basis risk, in particular, are the major sources of risk underlying the interest rate risk exposures of AIs that are active in retail banking activities.

2.2 Repricing (or maturity mismatch) risk

2.2.1 Repricing risk is caused by timing differences in rate changes and cash flows that occur in the repricing and maturity of fixed and floating rate assets, liabilities and OBS instruments. It is the most obvious source of interest rate risk for an AI.

2.2.2 Repricing risk is fundamental to banking business and some AIs may take on this risk in their balance sheet as part of their strategy to improve earnings. It can, however, affect the income and economic value of an AI as interest rates fluctuate.

2.2.3 For example, an AI that has funded a long-term fixed rate loan with a short-term deposit could face a decline in future income arising from the positions and their values if interest rates increase. This is because the cash flows from the loan are fixed while interest payable on replacement funding will be higher after the short-term deposit matures.

2.3 Yield curve risk

2.3.1 Repricing mismatches can expose an AI to changes in both the overall level of interest rates (parallel shifts in the yield curve) and the relative level of rates across the yield curve (non-parallel shifts in the yield curve, e.g. steepening or flattening yield curves). Yield curve risk materialises when unanticipated changes in the yield

curve have adverse effects on an AI's income or economic value.

2.3.2 As an example, the economic value of an AI's long position in ten-year government bonds hedged by a short position in five-year government bonds could decline sharply if the yield curve steepens, even if the position is hedged against parallel movements in the yield curve.

2.4 Basis risk

2.4.1 Basis risk arises from imperfect correlation between changes in the rates earned and paid on different instruments with otherwise similar repricing characteristics. As a result of these differences, the cash flows and earnings spread between assets, liabilities and OBS instruments of similar maturities or repricing frequencies will change.

2.4.2 For example, an AI may have mortgage loans priced at a different rate to that for its funding, e.g. priced at the prime rate and funded by HIBOR. HIBOR may rise while the prime rate remains unchanged. The AI has the option of increasing its prime rate but in practice its scope to do so may depend on whether other AIs will do the same.

2.4.3 This scenario affects the AI's current net interest margin through changes in the spread between earnings and payments on instruments that are being repriced. It will also affect future cash flows from these instruments, which will in turn affect the economic value of the AI.

2.5 Option risk

2.5.1 The options embedded in many AIs' assets, liabilities and OBS portfolios pose an additional and increasingly important source of interest rate risk. Options may be stand-alone instruments such as exchange-traded bond options and over-the-counter contracts such as caps and floors or they may be embedded within otherwise standard instruments.

2.5.2 Embedded options include various types of bonds and notes with call or put provisions, loans which give borrowers the right to prepay outstandings (e.g. in some syndicated lending) and various types of demand

deposits which give depositors the right to withdraw funds at any time, often without any penalty.

2.5.3 The early repayment of residential mortgage and commercial loans by customers is as if an AI had written an option to the customers. If the spread over the reference rate, or the mortgage rate offered by other AIs, is lower, customers may prepay a mortgage loan, notwithstanding any applicable penalties. Conversely, customers will leave their loans outstanding if the spread rises. Both scenarios will reduce AIs' potential future earnings.

2.5.4 On the deposit side, customers can generally withdraw early. Early withdrawal rights are equivalent to put options on deposits. If rates increase, the market value of customer deposits declines and customers may withdraw them and place them with the same AI, or a different one, at a higher rate.

3. Effects of interest rate risk

3.1 Summary

3.1.1 As described in section 2 above, changes in interest rates can have adverse effects both on an AI's earnings and economic value. Its interest rate risk exposure can therefore be assessed from two separate but complementary perspectives, i.e. earnings and economic value.

3.2 Earnings perspective

3.2.1 In this traditional approach to interest rate risk assessment, the analysis focuses on the impact of changes in interest rates on accruing or reported earnings. Reduced earnings or outright losses can threaten the financial stability of an AI by undermining its capital adequacy and by reducing market confidence in it.

3.2.2 The component of earnings that usually receives most attention is net interest income, i.e. the difference between total interest income and total interest expense. Net interest income is important for AIs' overall earnings and has a direct, obvious link to changes in interest rates. Net interest income will vary because of differences in the timing of accrual changes (repricing

risk), changing rate and yield curve relationships (basis and yield curve risks) and option positions.

3.2.3 Market interest rate changes can also have an impact on banking activities that generate fee-based and other non-interest income. Non-interest income arising from many activities such as loan servicing and asset securitisation programmes can be highly sensitive to market interest rates.

3.3 Economic value perspective

3.3.1 Variations in market interest rates can affect the economic value of an AI's assets, liabilities and OBS positions. The economic value of an instrument represents an assessment of the present value of its expected net cash flows, discounted to reflect market rates. As fluctuations in interest rates will affect an AI's earnings, they will also affect its net worth.

3.3.2 The economic value perspective reflects this sensitivity. It provides a more comprehensive view of the potential long-term effects of changes in interest rates than is offered by the earnings perspective. In contrast, changes in short-term earnings, the typical focus of the earnings perspective, may not provide an accurate indication of the impact of interest rate movements on an AI's overall positions.

3.4 Embedded losses

3.4.1 An AI should also consider the impact that past interest rates may have on future performance. Instruments that are not marked-to-market may already contain embedded gains or losses due to past rate movements. These gains or losses may be reflected over time in the AI's earnings. For example, a long-term fixed rate loan entered into when interest rates were low will result in an embedded loss when its funding is subsequently replaced by liabilities bearing higher interest rates over the remaining life of the loan. This embedded loss will be materialised over time until the loan is settled.

4. Supervisory approach to interest rate risk

4.1 Objectives and process

4.1.1 The HKMA adopts a risk-based supervisory approach which enables continuous supervision of AIs' interest

rate risk through a combination of on-site examinations, off-site reviews and prudential meetings. The objective is to assess the adequacy and effectiveness of an AI's interest rate risk management process, the level and trend of the AI's risk exposure and, in the case of a locally incorporated AI, the adequacy of its capital relative to the size of its exposure. See SA-1 "Risk-based Supervisory Approach" for details of the HKMA's risk-based supervisory methodology.

4.1.2 AIs are required to submit timely and comprehensive information on their interest rate risk exposures through the "Return of Interest Rate Risk Exposures - MA(BS)12" ("Interest Rate Risk Return") on a quarterly basis. The HKMA uses this Return to evaluate AIs' level of interest rate risk based on both the earnings approach and the economic value approach (see subsections 4.4 and 4.5 below for more details). The information collected takes appropriate account of the range of maturities and currencies in each AI's portfolio, including OBS items, as well as other relevant factors such as basis risk.

4.1.3 Locally incorporated AIs that are exempted from the market risk capital adequacy regime [2] and overseas incorporated AIs are required to report in the Interest Rate Risk Return the aggregate of their interest rate risk exposures in the trading book and banking book. Where necessary, the HKMA may request individual overseas incorporated AIs that have material trading positions to comply with additional reporting requirements in order to distinguish between their trading and non-trading activities for monitoring purposes.

4.1.4 Locally incorporated AIs that are subject to the market risk capital adequacy regime are only required to report their interest rate risk exposures in the banking book in the Interest Rate Risk Return as their trading positions in interest rate risk are monitored through the "Return of Market Risk Exposures - MA(BS)3A" ("Market Risk Return").

[2] Details of the market risk capital adequacy regime and the de minimis exemption criteria as well as the requirements relevant to exempted AIs are set out in CA-G-2 "Maintenance of Adequate Capital Against Market Risk".

4.1.5 The HKMA will discuss with an AI's management to identify the major sources of the AI's interest rate risk exposures and evaluate whether its measurement systems can identify and quantify adequately such risk exposures. The HKMA will also analyse the integrity and effectiveness of the AI's interest rate risk management process to ensure that its practices comply with the objectives and risk tolerance limits approved by the Board of Directors.

4.1.6 In considering whether an AI has appropriate systems for managing interest rate risk, the HKMA will have regard to the nature and complexity of the AI's interest rate risk exposures and its compliance with the standards and sound practices set out in IC-1 "General Risk Management Controls" and this module.

4.2 Basel Committee principles

4.2.1 The supervisory approach to interest rate risk set out in this module is based on the principles and practices expounded in the Basel Committee paper of September 1997, "Principles for the Management of Interest Rate Risk". Details of the principles are listed in Annex A.

4.3 Factors to be considered

4.3.1 In assessing the safety and soundness of an AI's interest rate risk management and exposures, the HKMA will consider:

- the complexity and level of risk posed by its assets, liabilities and OBS activities, including both trading and non-trading sources;
- the adequacy and effectiveness of Board and senior management oversight;
- management's knowledge and ability to identify and manage sources of interest rate risk;
- the adequacy of and compliance with risk management policies and procedures;
- the adequacy of internal measurement, monitoring and management information systems;
- the adequacy and effectiveness of risk limits on and controls over income and capital losses;

- the adequacy of the AI's internal review and audit of its interest rate risk management process;
- the adequacy and effectiveness of the AI's risk management practices and strategies, as evidenced from past and projected financial performance; and
- the appropriateness of the AI's level of interest rate risk in relation to its earnings, capital and risk management systems.

4.3.2 These topics are discussed further in sections 5 and 6 below.

4.4 Monitoring of interest rate risk (earnings approach)

4.4.1 The HKMA reviews the level and trend of AIs' interest rate risk exposures using the quarterly Interest Rate Risk Return. The Return collects information on the following:

- the repricing positions of interest bearing assets, interest bearing liabilities and OBS positions by different time bands and currencies (i.e. Hong Kong dollar, US dollar and any other major foreign currency that accounts for 5% or more of an AI's total on-balance sheet assets in all currencies);
- a breakdown of interest bearing assets and liabilities into fixed rate, variable rate and managed rate items [3] which have different repricing features and reference rates;
- the repricing positions of residential mortgage loans and deposits, which are the major components of AIs' interest bearing assets and liabilities respectively;
- the weighted average yield and interest costs of interest bearing assets and liabilities, which

[3] Fixed rate items are those assets and liabilities with interest rates fixed up to their final maturities. Variable rate items are those which will automatically be repriced at the next repricing date during the life of the items in accordance with movements in the relevant ""reference rates" (such as HIBOR) and include those items for which the interest rates can be varied at the discretion of the counterparty. Managed rate items are those variable rate items (e.g. mortgage loans and savings deposits) for which there are no fixed repricing dates and the interest rates can be adjusted at any time at the discretion of the reporting AI.

provide more information for analysing AIs' net interest income; and

- a breakdown of the major types of OBS positions (e.g. interest rate swaps, cross currency swaps and options).

4.4.2 AIs are allowed to use behavioural maturity for the purpose of reporting interest rate risks in the Interest Rate Risk Return if they can satisfy the minimum criteria set out in the Completion Instructions. The HKMA may request additional information on those positions where the behavioural maturity is different from the contractual maturity. It may also review AIs' internal processes and assumptions for determining the behavioural maturity of interest rate risk positions in their portfolios.

4.4.3 Based on the reported interest rate repricing positions in the Interest Rate Risk Return, the HKMA assesses the impact on an AI's earnings over the next 12 months if the interest rates change by 200 basis points. The HKMA will be particularly attentive to those AIs whose repricing risk leads to a significant decline in earnings having regard to the nature and complexity of their activities.

4.4.4 As basis risk is a major risk factor underlying AIs' interest rate risk exposures, the HKMA assesses the impact of changes in the relationships between key market rates on AIs' earnings using two hypothetical stress scenarios set out in the Interest Rate Risk Return. They are:

- all rates except for fixed and managed rates (e.g. the prime rate) on interest bearing assets rise by 200 basis points; and
- managed rates on interest bearing assets drop by 200 basis points while other rates remain unchanged.

The changes are assumed to last for one month, three months, six months and 12 months respectively. The HKMA will be particularly attentive to those AIs whose basis risk leads to a significant decline in earnings having regard to the nature and complexity of their activities.

4.4.5 Where an AI has significant exposures to repricing risk or basis risk, the HKMA may review information from the AI's internal management reports such as maturity/repricing gaps, earnings and economic value simulation estimates and the results of stress tests conducted. The HKMA will also discuss with the AI's management to evaluate its strategy for managing those exposures and assess its capacity to absorb the risk of loss. Depending on the circumstances of each case, the AI may be asked to strengthen its capital position or reduce its interest rate risk (through, for example, hedging or restructuring existing positions) if necessary.

4.5 Review of capital adequacy (economic value approach)

4.5.1 Capital has an important role to play in mitigating and absorbing the risk of loss from changes in interest rates. As part of sound management, AIs should incorporate the level of interest rate risk they undertake, whether arising from their trading or non-trading activities, into their overall evaluation of capital adequacy. Where AIs undertake significant interest rate risk in the course of their business, an appropriate amount of capital should be allocated specifically to support this risk.

4.5.2 The HKMA expects locally incorporated AIs to maintain adequate capital for the risks they undertake and to develop their own processes for internal assessment of capital adequacy. As regards interest rate risk in the trading book, they are required to provide capital in accordance with the methodology set out in the Market Risk Return[4].

4.5.3 While no capital charges are currently required for interest rate risk in the banking book[5], the HKMA will evaluate whether an AI has adequate capital to support its level of interest rate risk exposures and the risk those exposures may pose to its future financial performance.

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[4] Those AIs that fulfil the de minimis exemption criteria and other relevant requirements set out in CA-G-2 "Maintenance of Adequate Capital Against Market Risk" are exempted from the market risk capital adequacy regime. However, they are required to report their market risk exposures in the Market Risk Return annually for the HKMA's monitoring purposes.

[5] The Basel Committee on Banking Supervision has concluded that no explicit capital requirements should be set for interest rate risk in the banking book in the New Basel Capital Accord but supervisors will be required to take account of a bank's interest rate risk under Pillar 2 (supervisory review process).

4.5.4 To facilitate the monitoring of an AI's interest rate risk and its capital adequacy, the HKMA models a standardised 200-basis-point parallel rate shock to the AI's interest rate risk exposures as reported in the Interest Rate Risk Return and measures the economic value impact of the shock.

4.5.5 The HKMA will be particularly attentive to the capital sufficiency of "outlier AIs" – those whose interest rate risk leads to an economic value decline of more than 20% of their capital base as a result of applying the standardised interest rate shock to the banking book[6].

4.5.6 Where the HKMA is of the view that an AI's level of interest rate risk exposures is high in relation to its capital, the HKMA will discuss the concern with the AI's management. Depending on the circumstances of each case, the AI may be asked to strengthen its capital position or reduce its interest rate risk (through, for example, hedging or restructuring existing positions). The AI may also be subject to additional reporting requirements for its interest rate risk exposures.

4.5.7 While overseas incorporated AIs are not subject to the capital adequacy regime in Hong Kong, the HKMA uses the standardised interest rate shock to monitor their interest rate risk in terms of economic value. In view of the limitations of the earnings approach, the economic value approach provides supplementary information about the impact of interest rate movements on an AI's overall positions (see para. 3.3.2 above).

4.5.8 In monitoring the impact of the standardised interest rate shock on the economic value of overseas incorporated AIs, the HKMA will have regard to the capital base of their head office. Nevertheless, the 20% benchmark mentioned in para. 4.5.5 above will not apply.

4.6 Criteria for adequate internal systems

4.6.1 The HKMA will assess whether an AI's internal measurement system for interest rate risk is adequate for managing risk in a safe and sound manner and for

[6] For locally incorporated AIs which are exempted from the market risk capital adequacy regime, the HKMA will have regard to their positions in both the banking book and trading book.

evaluation of its capital adequacy[7] in the case of a locally incorporated AI.

4.6.2 An AI's interest rate risk management system should meet the criteria set out in subsection 6.3 below. The system should be integrated into the AI's daily risk management practices and its output should be used in reporting the level of interest rate risk to the Board of Directors and senior management and, where appropriate, individual business line managers. The system should be capable of measuring risk under the earnings approach. Depending on the scale and complexity of its activities, the AI may also need to measure risk based on the economic value approach.

4.6.3 The HKMA will require AIs to bring their internal measurement system up to standard if deficiencies are identified. Until the HKMA is satisfied that an AI's measurement system is adequate, it may require the AI concerned to increase the frequency of reporting, to supply additional information and to keep its exposures within more prudent limits.

5. Oversight by AIs

5.1 Responsibilities of Board and senior management

5.1.1 Effective oversight by an AI's Board of Directors and senior management is critical for sound interest rate risk management practices. See CG-1 "Corporate Governance of Locally Incorporated Authorized Institutions" and IC-1 "General Risk Management Controls" for details of their risk management responsibilities. Many of the requirements and practices cited have a general application.

5.2 Asset and Liability Management Committee

5.2.1 The Board of Directors may delegate responsibility for establishing interest rate risk policies and strategies to the Asset and Liability Committee ("ALCO"), which is a designated committee usually composed of senior staff. Larger or more complex AIs should have such committees, responsible for the design and administration of interest rate risk management.

[7] But it is the AI's responsibility to ensure that its capital is adequate.

5.2.2 The main role and functions of the ALCO are described in CG-1 "Corporate Governance of Locally Incorporated Authorized Institutions".

5.3 Independent risk management

5.3.1 The Board or senior management should assign responsibility for managing interest rate risk to individuals or units with appropriate experience and expertise. The responsible personnel should have an adequate understanding of all types of interest rate risk faced throughout the AI.

5.3.2 There should be adequate segregation of duties in key elements of the risk management process to avoid potential conflicts of interest. For example, the level of interest rate risk is determined by how a particular transaction is evaluated based on current market rates. Such evaluation is normally conducted by the risk management or operations department of an AI while the actual transaction is performed by a risk-taking unit or front office. This is to ensure independent risk assessment of the transactions.

6. Risk management policies, procedures and controls

6.1 Coverage

6.1.1 Whatever the methodology chosen, an AI's interest rate risk management procedures should be clearly defined and consistent with the nature and complexity of its activities.

6.1.2 The policies, procedures and limits (e.g. limits to fixed rate deals, use of interest rate swaps, etc.) should be properly documented, drawn up after careful consideration of interest rate risk associated with different types of lending, and reviewed and approved by management at the appropriate level.

6.1.3 There should also be an accurate, informative and timely management information system for interest rate risk. This is essential both to keep senior management and, where appropriate, individual business line managers in the picture and to facilitate compliance with Board policy.

6.1.4 AIs' policies and procedures for interest rate risk management should cover the general criteria set out in IC-1 "General Risk Management Controls" and other

criteria specific to interest rate risk as discussed in the following subsections.

6.2 New services and strategies

6.2.1 AIs should identify the interest rate risks inherent in new services and activities and ensure that these are subject to adequate procedures and controls before being introduced or undertaken. For example, an AI specialising in prime-based mortgage loans that then engages in HIBOR-based mortgage loans with interest rate caps for customers should be aware of the volatility of HIBOR and the embedded option features.

6.2.2 AIs may be exposed to additional interest rate risk if they develop products or services that enable greater access to customers who primarily seek the best rate. The introduction of e-banking services is an example of such services. This reinforces the need for AIs to react quickly to changing market conditions and to ensure that their pricing strategy has catered for an adequate interest spread to absorb any additional interest rate risk.

6.2.3 AIs should consider balancing cash flows and managing the interest rate risk arising from new services or strategies through hedging, e.g. using swaps or other derivative instruments. Major hedging or risk management initiatives should be approved in advance by the Board or a committee such as the ALCO.

6.3 Risk measurement, monitoring and control

6.3.1 AIs should have interest rate risk measurement systems that encompass all significant causes of such risk. The systems should evaluate the effect of rate changes on earnings or economic value meaningfully and accurately within the context and complexity of their activities. They should be able to flag any excessive exposures.

6.3.2 Measurement systems should:

- evaluate all significant interest rate risk arising from the full range of an AI's assets, liabilities and OBS positions, both trading and non-trading. If the same measurement systems and management methods are not used for all activities, an integrated view of interest rate risk

across products and business lines should be available to management;

- employ generally accepted financial models and ways of measuring risk;
- have accurate and timely data (in relation to rates, maturities, repricing, embedded options and other details) on current positions[8];
- document the assumptions, parameters and limitations on which they are based. Material changes to assumptions should be documented, justified and approved by senior management;
- cover all significant sources of interest rate risk (e.g. repricing, yield curve, basis and option). While all of an AI's positions should be appropriately treated, its largest concentrations and positions should be assessed with special thoroughness, as should instruments which might have a material effect on an AI's overall position (notwithstanding that they are not major concentrations) and instruments with significant embedded or explicit options; and
- assess exposures in different currencies (subject to para. 6.3.6 below).

6.3.3 Techniques to measure interest rate risk exposure from an earnings and economic value perspective comprise, in increasing degrees of complexity, simple calculations, static simulations using current holdings and highly sophisticated dynamic modelling techniques based on business forecasts and decisions. These are discussed in greater detail in Annex B. As a minimum AIs should be able to use the simpler techniques for measuring interest rate risk exposure, such as producing a maturity/repricing schedule and carrying out gap analysis (see section B2 of Annex B).

6.3.4 As gap analysis provides only a rough approximation of changes in net interest income due to its limitations (see para. B2.7 below), AIs having complex risk profiles should employ more sophisticated interest rate risk

[8] Any manual adjustments to underlying data should be clearly documented and the nature and reasons for the adjustments should be clearly understood.

measurement techniques such as the simulation approaches (see section B3 of Annex B and Annex C). The assumptions underlying a simulation model can sometimes make it difficult to determine how much a variable contributes to changes in the simulation results. It is therefore necessary to supplement the simulation model by additional in-depth analysis or other simulation models to isolate the risk of each variable inherent in the existing balance sheet.

6.3.5 Regarding positions where the behavioural maturities may differ from contractual maturities, these should be given assumed maturities or repricing frequencies based on past experience of the AI and with sound empirical analysis. Such positions include demand deposits which can be withdrawn without notice, but a portion of which tend to remain with the AI in practice (i.e. core deposits). Conversely, term deposits have contractual maturities but depositors generally have the option to make withdrawals at any time, subject to applicable penalties or charges. On the asset side, prepayment features of mortgages and mortgage-related instruments also introduce uncertainty about the timing of cash flows from these positions. The behavioural assumptions used should be subject to periodic review. The issues are discussed in more detail in section B4 of Annex B.

6.3.6 AIs with positions in different currencies need to measure their exposure to interest rate risk in each currency. They may do so for each currency separately, on the ground that yield curves for different currencies vary. AIs with material multi-currency exposures may, if they have the requisite skills and sophistication, decide to aggregate their exposures in certain currencies where there is assumed to be some correlation between interest rates for those currencies. Such AIs should review periodically whether these assumptions remain valid and assess their potential exposure if such correlations prove invalid.

6.4 Stress-testing

6.4.1 AIs should measure their vulnerability to loss in stressed market conditions, including the breakdown of key assumptions, and consider those results when establishing and reviewing their policies and limits for interest rate risk.

6.4.2 Possible stress scenarios include:

- historical scenarios such as the Asian Crisis in the late nineties;
- changes in the general level of interest rates, e.g. changes in yields of 200 basis points or more in one year[9];
- changes in the relationships between key market rates (i.e. basis risk), e.g. (i) a surge in term and savings deposit rates and HIBOR but no change in the prime rate, and (ii) a drop in the prime rate but no change in term and savings deposit rates and HIBOR[10];
- changes in interest rates in individual time bands to different relative levels (i.e. yield curve risk);
- changes in the liquidity of key financial markets or changes in the volatility of market rates; and
- changes in key business assumptions and parameters such as the correlation between Hong Kong dollar and US dollar interest rates. In particular, changes in assumptions used for illiquid instruments and instruments with uncertain contractual maturities help understanding of an AI's risk profile.

6.5 Limits

6.5.1 AIs should establish and enforce operating limits and other practices that maintain exposures within levels consistent with their internal policies and that accord with their approach to measuring interest rate risk.

6.5.2 In particular, AIs should set a limit on the extent to which floating rate exposures are funded by fixed rate sources and vice versa to limit interest rate risk. In floating rate lending, AIs should limit the extent to which they run any basis risk that may arise if lending and funding are not based on precisely the same market interest rate (e.g. HIBOR).

[9] This scenario is incorporated as the standardised 200-basis-point parallel rate shock in the Interest Rate Risk Return.

[10] These scenarios for basis risk are incorporated in the Interest Rate Risk Return.

6.5.3 The limits should be consistent with AIs' underlying approach to interest rate risk measurement and should be directed at how reported earnings and capital adequacy might be affected by changes in market interest rates. As regards earnings, AIs should consider limits on earnings volatility in both net income and net interest income under specified interest rate scenarios so as to quantify what portion of their interest rate risk exposure arises from non-interest income.

6.5.4 Limits on the effect of rates on an AI's earnings and economic value should reflect the size and complexity of its positions. Simple limits such as gap limits may be adequate for AIs undertaking mainly traditional banking activities and with few holdings of long-term instruments, options, instruments with embedded options or other instruments whose value may be substantially altered by changes in market rates. More complex AIs may need to use more sophisticated limits such as factor sensitivity limits. Examples of the various types of limits are given in sections B5 and B6 of Annex B.

6.5.5 Limits on interest rate risk should be related to explicit scenarios of changes in market interest rates, e.g. movements up or down of specified ranges. These ranges should constitute genuine stress conditions and should be developed in the light of historic rate volatility and time needed to unwind, restructure or hedge an AI's interest rate risk position. They can also reflect measures from the underlying statistical distribution of interest rates, e.g. earnings at risk or economic value at risk techniques. The scenarios should cover all possible sources of interest rate risk, e.g. mismatch, yield curve, basis and option risks, and not just parallel shifts in interest rates or other simple scenarios.

6.6 Internal controls and independent audits

6.6.1 As an integral part of the overall internal control system, AIs should have adequate internal controls over interest rate risk. The effectiveness of such controls should be evaluated regularly by independent parties, e.g. internal or external auditors.

6.6.2 AIs should conduct periodic reviews of their risk management process for interest rate risk to ensure its integrity, accuracy and reasonableness. AIs with more

complex profiles and measurement systems should have their internal models or calculations audited or validated by an independent internal or external reviewer.

6.6.3 In such independent reviews, the factors to be considered include the quality of interest rate risk management and the size of interest rate risk, e.g.:

- the volume and price sensitivity of various products;
- how vulnerable earnings and capital are to differing rate changes including yield curve changes; and
- the exposure of earnings and economic value to various other forms of interest rate risk, including basis and option risks.

Annex A : Basel principles for the management of interest rate risk

A1 Background

A1.1 The Basel Committee issued the paper "Principles for the Management of Interest Rate Risk" ("the paper") in September 1997. The paper sets out 11 principles covering, inter alia, the role of the Board and senior management, policies and procedures, measurement and monitoring systems, internal controls and information for supervisory authorities. These are summarised below.

A2 Board and senior management oversight

A2.1 In order to carry out its responsibilities, the Board of Directors of a bank should approve strategies and policies with respect to interest rate risk management and ensure that senior management takes the steps necessary to monitor and control these risks. The Board of Directors should be informed regularly of the interest rate risk exposure of the bank in order to assess the monitoring and controlling of such risk.

A2.2 Senior management should ensure that the structure of the bank's business and the level of interest rate risk it assumes are effectively managed, that appropriate policies and procedures are established to control and limit these risks and that resources are available for evaluating and controlling interest rate risk.

A2.3 Banks should clearly define the individuals or committees responsible for managing interest rate risk and should ensure that there is adequate segregation 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 senior management and the Board of Directors. 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.

A3 Adequate risk management policies and procedures

A3.1 It is essential that banks' interest rate risk policies and procedures are clearly defined and consistent with the nature and complexity of their activities. These policies should be applied on a consolidated basis and, as appropriate, at the level of individual affiliates, especially when recognising legal distinctions and possible obstacles to cash movements among affiliates.

A3.2 It is important that banks identify the risks inherent in new products and activities and ensure that these are subject to adequate procedures and controls before being introduced or undertaken. Major hedging or risk management initiatives should be approved in advance by the Board or its appropriate delegated committee.

A4 Risk measurement, monitoring and control functions

A4.1 It is essential that banks have interest rate risk measurement systems that capture all material sources of interest rate risk and that assess the effect of interest rate changes in ways that are consistent with the scope of their activities. The assumptions underlying the system should be clearly understood by risk managers and bank management.

A4.2 Banks should establish and enforce operating limits and other practices that maintain exposures within levels consistent with their internal policies.

A4.3 Banks should measure their vulnerability to loss under stressed market conditions, including the breakdown of key assumptions, and consider those results when establishing and reviewing their policies and limits for interest rate risk.

A4.4 Banks should have adequate information systems for measuring, monitoring, controlling and reporting interest rate exposures. Reports should be provided on a timely basis to the bank's Board of Directors, senior management and, where appropriate, individual business line managers.

A5 Internal controls

A5.1 Banks should have an adequate system of internal controls over their interest rate risk management process. A fundamental component of the internal control system involves regular independent reviews and

evaluations of the effectiveness of the system and, where necessary, ensuring that appropriate revisions or enhancements to internal controls are made. The results of such reviews should be available to the relevant supervisory authorities.

A6 Information for supervisory authorities

A6.1 Banks should provide sufficient and timely information to their supervisory authorities to enable them to evaluate their level of interest rate risk. This information should take appropriate account of the range of maturities and currencies in each bank's portfolio, including OBS items, as well as other relevant factors, such as the distinction between trading and non-trading activities.

Annex B : Interest rate risk measurement techniques

B1 Types, uses, strengths and limitations

B1.1 This section provides a brief overview of various techniques used by banks to measure the exposure of earnings and economic value to changes in interest rates and to set risk limits.

B1.2 The variety of the techniques ranges from calculations that rely on simple maturity and repricing tables, 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.

B1.3 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 simpler methods are intended primarily to capture the risks arising from maturity and repricing mismatches, while the more sophisticated methods can capture more easily the full range of risk exposures.

B1.4 The various measurement approaches described below have their strengths and weaknesses in terms of providing accurate and reasonable measures of interest rate risk exposure and setting risk limits. Ideally a bank's interest rate risk measurement system should take into account the specific characteristics of each individual interest sensitive position and capture in detail the full range of potential movements in interest rates. In practice, however, measurement systems embody simplifications that depart from this ideal.

B1.5 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.

B1.6 Finally, the various approaches differ in their ability to capture the optionality inherent in many positions and instruments.

B1.7 The following sections highlight the areas of simplification that characterise each of the major interest rate risk measurement techniques and risk limits.

B2 Repricing schedules

B2.1 The simplest technique for measuring a bank's interest rate risk exposure entails producing a maturity/repricing schedule and carrying out gap analysis.

B2.2 Interest sensitive assets, liabilities and OBS positions are allocated among a number of predefined time bands according to their maturity (if fixed rate) or time remaining to their next repricing (if floating rate). Assets and liabilities lacking definite repricing intervals (e.g. 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 judgement and past experience of the bank.

B2.3 Such simple maturity/repricing schedules can provide rough indications of how sensitive earnings and economic value are to changes in interest rates. Their use to evaluate the interest rate risk of current earnings is normally called gap analysis. The size of the gap between assets and liabilities for a given time band, plus OBS exposures that reprice or mature within that time band, indicates the bank's repricing risk exposure.

B2.4 To evaluate earnings exposure, interest rate sensitive liabilities in each time band are subtracted from the interest rate sensitive assets in that time band to produce a repricing gap for that time band. This gap can be multiplied by a hypothetical change in interest rates (e.g. 1%) 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 management.

B2.5 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.

B2.6 These simple gap calculations can be augmented by information on the average yield from 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 yield could be used to estimate 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.

B2.7 Although widely used, gap analysis has a number of shortcomings:

- it does not take account of variations in the characteristics of different positions within a time band. All positions within a given time band are assumed to mature or reprice simultaneously, a simplification that is likely to have a greater impact on the precision of the estimates as the degree of aggregation within a time band increases;
- gap analysis ignores differences in spreads between interest rates that could arise as the level of changes in market interest rates (basis risk). To measure the basis risk, banks may need to separate the interest rate positions that are subject to different interest rate movements (e.g. the prime rate and HIBOR) to estimate their level of basis risk;
- 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; and
- it usually fails to capture variability in non-interest revenue and expenses, a potentially important source of risk to current income.

B2.8 For these reasons, gap analysis provides only a rough approximation of changes in net interest income resulting from the assumed changes in interest rate movements.

B2.9 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. Such weights are usually based on estimates of the duration of the assets and liabilities that fall into each time band[11]. Duration reflects the timing and size of cash flows that occur before an instrument's contractual maturity. Generally the longer the maturity or next repricing 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 would have a larger impact on economic value.

B2.10 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. 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 coupon rates and maturities, for instance, one weight for assets and another for liabilities. Different interest rate changes are sometimes used also 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

[11] 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, 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. One important modification of simple duration is called modified duration. 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.

result from the assumed changes in interest rates.

B2.11 Alternatively a bank 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 or cash flows.

B2.12 Estimates derived from a standard duration approach may provide an acceptable approximation of exposure to changes in economic value for relatively non-complex banks. Such estimates generally focus, however, on just one form of interest rate risk exposure, i.e. repricing risk. As a result, they may not reflect interest rate risk arising, for instance, from changes in the relationship between 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 mean that the risk of options may not be captured fully.

B3 Simulation approaches

B3.1 Some banks, particularly those with complex risk profiles or which use complex financial instruments, use more sophisticated interest rate risk measurement systems. These entail comprehensive evaluations of the possible effects of interest rates changes on earnings and economic value by modelling the potential direction of interest rates and their effect on cash flow.

B3.2 Simulation techniques may be seen as an extension and refinement of simple analysis based on maturity/repricing schedules. They involve, however, 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.

B3.3 Simulation techniques can also 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.

B3.4 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. Usually 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.

B3.5 Dynamic simulation incorporates more comprehensive suppositions about future changes in interest rates and in a bank's business over a given period. For instance, the simulation could involve assumptions about a bank's strategy for changing administered interest rates (e.g. on savings deposits), about the behaviour of the bank's customers (e.g. withdrawals from savings deposits) or about the future stream of business (new loans or other transactions) that the bank will encounter (see Annex C for a sample simulation model). 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 techniques show dynamically the interaction between payment streams and interest rates and show the effect of embedded and explicit options.

B3.6 The usefulness of simulation-based and other interest rate risk measurement techniques depends on how accurate the underlying presumptions are about future interest rates and the behaviour of the bank and its customers and the accuracy of the basic methodology. The output should be assessed accordingly. Such simulations should not lead to undue confidence in the precision of the estimates.

B3.7 For risk management purposes, estimates of interest rate risk exposure and forecasts of future interest rate trends should incorporate sufficiently large changes to reflect the risks inherent in a bank's positions. Multiple scenarios should be considered, e.g. changes in the relationship between interest rates (i.e. yield curve and basis risk) and in the general level of rates. Statistical analysis can be used to analyse assumptions of correlation in basis and yield curve risk.

B3.8 Data on current positions should be comprehensive, accurate and timely for risk measurement purposes. All material positions and cash flows should be covered. Information on the yields or cash flows from associated instruments and contracts should be available. Manual changes to data should be documented, understood and justified. The documentation and underlying reasoning should be available for review.

B4 Repayments and optionality

B4.1 A difficult task when measuring interest rate risk is dealing with positions where behavioural maturity differs from contractual maturity or where there is no stated contractual maturity.

B4.2 On the asset side of the balance sheet, such positions may include mortgage loans and mortgage-related securities, which can be prepaid. Borrowers can generally prepay their mortgages with little or no penalty (although perhaps after a certain "lock-in" period). This renders the timing of the cash flows associated with these instruments uncertain. Although there is always some volatility in prepayments resulting from demographic factors (e.g. deaths, divorces or job transfers) and macroeconomic conditions, much of the uncertainty surrounding prepayments arises from the response of borrowers to movements in mortgage rates (or spreads over reference rates). In general, declines in mortgage rates result in increasing levels of prepayments, as borrowers refinance their loans at lower yields. In contrast, when mortgage rates rise, prepayment rates tend to slow, leaving the bank with a volume of mortgages paying below current market rates.

B4.3 On the liability side, such positions include non-maturing, open-ended deposits such as savings

deposits and current accounts, which can be withdrawn, often without penalty, at the discretion of the depositor. Their treatment is 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 practice banks administer the rates on the accounts to manage the volume of deposits retained in the light of the rates offered by competitors. They may often decide not to move the rates on these deposits in line with changes in other market rates. This makes it more difficult to measure interest rate risk exposure, since both the value of the positions and the timing of their attendant cash flows can change when interest rates change.

B4.4 The treatment of positions with embedded options is an area of special difficulty in measuring the exposure of both current earnings and economic value to interest rate changes. The issue arises across the full spectrum of approaches to interest rate measurement.

B4.5 In the maturity/repricing schedule framework, banks make assumptions about the likely timing of payments and withdrawals on these positions and allocate the balances across time bands accordingly. For instance, it might be assumed that certain percentages of a pool of 20-year mortgages prepay in given years during the life of the mortgages. In the simulation framework, more sophisticated behavioural assumptions could be employed to estimate better the timing and magnitude of cash flows in different interest rate environments. The simulations can also incorporate the bank's assumptions about its likely future treatment of administered interest rates on non-maturing deposits.

B4.6 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 usually 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-maturing 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, developed internally by the bank or purchased from outside parties, 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.

B5 Gap limits

B5.1 Gap (maturity or repricing) limits are designed to manage the potential exposure to a bank's earnings or capital from changes in interest rates. The limits control the volume or amount of repricing imbalances in a given time band and the overall gap position.

B5.2 These limits can be expressed by the ratio of rate sensitive assets ("RSA") to rate sensitive liabilities ("RSL") in a given time band. A ratio greater than one suggests that the bank is asset sensitive and has a greater value of assets than liabilities subject to repricing. All other factors being constant, the earnings of such a bank generally will be reduced by falling interest rates. An RSA/RSL ratio of less than one means that the bank is liability sensitive and that its earnings may be reduced by rising interest rates.

B5.3 Other gap limits that banks can use to control exposure include dollar limits on the net gap and gap to assets ratios.

B5.4 The use of gap limits may be a useful way to limit the volume of a bank's repricing exposures and is an adequate and effective method of communicating the bank's risk profile to senior management and the Board. Due to the limitations of gap analysis (see section B2 above), however, a bank that relies solely on gap measures to control its interest rate exposure should explain to its senior management and the Board the level of earnings and capital at risk that are implied by its gap exposures (imbalances).

B6 Factor sensitivity limits

B6.1 The factor sensitivity of a position is defined as the change in the present value of the position caused by a

unit shift in a given market factor. Thus a position has as many factor sensitivities as there are underlying market factors. A typical unit shift for interest rates is +1 basis point.

B6.2 The factor sensitivity of an interest rate position is calculated by valuing the position using the current market interest rate (R) and then using the current market interest rate increased by one basis point (R + 0.01%). The difference between these two valuations, obtained by subtracting the initial valuation from the final valuation, is the factor sensitivity. An alternative mathematical expression can be derived from an examination of the definition of factor sensitivity, namely:

$$\textit{factor sensitivity} = \textit{change in present value} \div \textit{change in interest rate}$$

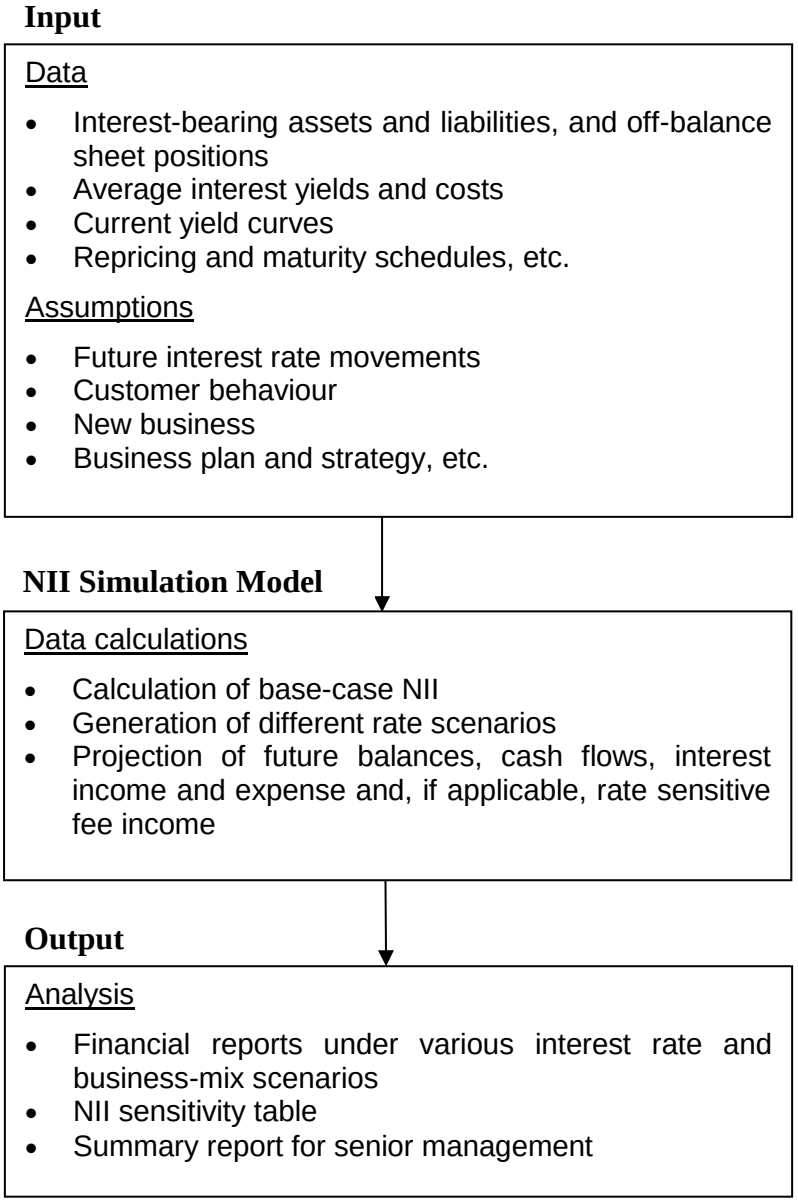
B6.3 The factor sensitivity limits are usually expressed in terms of present value per basis point ("PVBP"), which measures the change in portfolio present value due to a one-basis-point movement in the underlying interest rate. The limits can be set according to the one-basis-point movement applied to all time bands (i.e. parallel shift of interest rates) and to individual time bands. The limits can serve as safeguards in respect of the economic value of a bank's interest rate positions.

Annex C : A simulation model of net interest income

C1 Construction of an NII simulation model

C1.1 This annex presents a sample construction of a simulation model of net interest income ("NII") that AIs could use in evaluating the possible effects of interest rate risk.

C1.2 The main components of an NII simulation model are illustrated below:



C1.3 Data on an AI's current position for each product type in the model's chart of accounts are first obtained from the

AI's general ledger and transaction systems. This information is similar to that used for gap analysis. The products include all interest-bearing assets and liabilities, and off-balance sheet positions. The breakdown in products should be detailed enough to allow analysis of their interest rate sensitivity and behaviour under different interest rate scenarios. The chart of accounts includes current balances, rates, and repricing and maturity schedules.

C1.4 Managerial assumptions about future interest rate movements, customer behaviour, new business and business strategy (such as different loan growth, funding and reinvestment plans) are then input into the model to generate a range of interest rate and business-mix scenarios. The assumptions on interest rate movements may involve forecasts of their direction, the future shape of the yield curve and the relationship between various reference rates that the AI uses for pricing products. Other assumptions may be derived from historical trends, business plans or statistical models.

C1.5 Based on the above input of data and assumptions, the NII simulation model can estimate the AI's potential exposure by calculating how a change in interest rates may affect the balances, interest income and expenses, and hence NII of the AI's future financial positions.

C1.6 The output of a typical NII simulation model may consist of:

- projected balance sheet and income statements under a number of interest rate and business-mix scenarios;
- an analysis of the impact of the different scenarios on NII; and
- a summary report for senior management.

C1.7 The following table illustrates the type of summary report that may be generated by an NII simulation model. The report shows variation in NII for the next four quarters under different interest rate scenarios using a flat rate scenario as a base. Greater changes in NII under different interest rate scenarios imply greater interest rate risk. Rate scenarios often include rising, flat and declining rates. Similar reports may be developed to

show how NII might vary with alternative business mixes and strategies.

(Amount in HK$ millions)

For the next 4 quarters	Interest income	Interest expense	NII (base)	Rate change (basis points)			
				-200	-100	+100	+200
				% change in NII			
Q1	250	150	100	+5%	+3%	-3%	-5%
Q2	220	130	90	+6%	+3%	-3%	-6%
Q3	235	140	95	+16%	+8%	-6%	-11%
Q4	260	150	110	+14%	+7%	-5%	-9%
Total	**965**	**570**	**395**	**+10%**	**+5%**	**-4%**	**-8%**

C1.8 An AI should have guidelines and risk limits to restrict losses in its NII for a defined interest rate scenario over a certain period of time. For example, the AI in the table above might limit losses in annual NII from a 200-basis-point increase in rates to 8 percent of its base NII. Any projected losses over 8 percent of its base NII under the same scenario might trigger a more in-depth analysis of the causes of the projected losses. For example, the analysis should identify which products or business lines have led to the losses. Remedial actions such as unwinding, restructuring or hedging the AI's interest rate risk position should be taken if necessary.

C2 Advantages of an NII Simulation Model

C2.1 An NII simulation model addresses a number of deficiencies associated with a simpler gap analysis (see para. 6.3.4). For instance, gap analyses usually take a "snapshot" of the risk inherent in an AI's position at a particular point in time ignoring the dynamic nature of an AI's balance sheet, and assume a one-time shift in interest rates. They also make an improbable assumption that all current assets and liabilities run off and are reinvested overnight. The simulation model, on the other hand, evaluates risk exposures over a period of time and can handle varying interest rate paths, including variations in the shape of the yield curve. Particularly important is the fact that an NII simulation model can take into account projected changes in balance sheet structures, pricing, maturity relationships caused by a changing rate environment, as well as assumptions about new business.

C2.2 An NII simulation model can accommodate various business forecasts and allow flexibility in running

sensitivity analyses. For example, basis risk can be evaluated by including variations between the reference rates an AI uses to price its products in the rate scenarios.

C2.3 The simulation results, which reflect changes to NII under different rate scenarios, present risks and rewards that can be readily understood by the Board and senior management.

C3 Limitations of an NII Simulation Model

C3.1 Like other simulation models, an NII simulation model is not always objective despite offering greater versatility than gap analysis. An NII simulation might distort, underestimate or overestimate an AI's current interest rate risk position because it relies on management's assumptions about the AI's future business.

C3.2 The myriad assumptions underlying an NII simulation model can make it difficult to determine how much a variable contributes to changes in the value of NII. For this reason, it is necessary to supplement NII simulation measures by additional in-depth analysis and specific simulation results to isolate the risk of each variable inherent in the existing balance sheet and assess the specific impact on NII.

C3.3 It may be appropriate to limit the evaluation of risk exposures to the next two years in an NII simulation model because interest rate and business assumptions that project further would be unreliable. However, using the models with horizons of only one or two years will not fully capture long-term exposures. An AI that uses an NII simulation model to measure the risk solely to near-term earnings should supplement its model with gap analysis or economic value approach that measures the amount of long-term repricing exposures.