

## **Management of Interest Rate Risk**

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## **Chapter 1 – General**

### **Foreword**

1. Interest rate risk is an integral part of banking business, and may even be a source of profit. Nevertheless, abnormal levels of interest rate risk may expose banking corporations to losses and even pose a threat to their capital. The management of interest rate risk is therefore critical to the stability of any banking corporation.
2. It is essential that banking corporations have a comprehensive risk management process in place that effectively identifies, measures, monitors and controls interest rate risk exposures, and that is subject to appropriate board and senior management oversight.
3. The instructions in this directive should be used in the management of interest rate risk management per se, irrespective of whether the positions are part of the trading book or the banking book. Nevertheless, in view of the importance of interest rate risk in the banking book, this directive specifically includes instructions that address interest rate risk in the banking book.
4. The requirement imposed on all banking corporations to allocate adequate capital against all the risks in their business, including interest rate risk, is dealt with in Proper Conduct of Banking Business Directive 211, “Capital Adequacy Assessment”.

### **Scope**

5. This directive applies to banking corporations, as they are defined in the Banking (Licensing) Law, 5741–1981, except for a joint service company, and to auxiliary companies that are credit card companies (these two groups will be denoted below as “banking corporation”).

**Definitions**

6. New product – as defined in the Proper Conduct of Banking Business Directive 310 – “Risk Management”.
7. Trading book – according to its meaning in Proper Conduct of Banking Business Directive 208, sections 685-689(iii).
8. Banking book – all financial instruments, on and off balance sheet, excluding those that are part of the trading book.
9. Standardized interest rate shock – as defined in Addendum 2 of this Directive.

**Interest rate risk and sources of interest rate risk**

10. Interest rate risk is the risk to income or capital arising from fluctuating interest rates. Changes in interest rates affect a banking corporation’s earnings by changing its net interest income and the level of other income (including changes in non-interest revenues/expenses). Changes in interest rates also affect the underlying value of the banking corporation’s assets, liabilities and off-balance sheet (OBS) financial instruments because the present value of future cash flows (and in some cases, the cash flows themselves) change when interest rates change.

**Sources of interest rate risk**

11. Banking corporations encounter interest rate risk in several ways, including repricing risk, yield curve risk, basis risk (also known as spread risk), and optionality risk.
12. Repricing risk: The primary and most discussed form of interest rate risk arises from timing differences in the maturity (for fixed-rate) and repricing (for floating rate) of banking corporation assets, liabilities and OBS positions. Such repricing

mismatches may expose a bank's income and economic value to unanticipated fluctuations as interest rates vary.

13. Yield curve risk: Yield curve risk arises when unanticipated shifts of the yield curve have adverse effects on a banking corporation's income or economic value. The yield curve may shift due to changing relationships between interest rates for different maturities of the same index or market. These changes will be evident in the slope (steeper or flatter) or shape (bend) of the curve.
14. Basis risk: A risk arising from imperfect correlation in the changes of interest rates in different financial markets or on different instruments with otherwise similar repricing characteristics. Differences in interest rate changes can give rise to unexpected changes in the cash flows and earnings spread between assets, liabilities and OBS instruments of similar maturities or repricing frequencies.
15. Optionality risk: An additional source of interest rate risk arises from a change in the timing or scope of a financial instrument's cash flows due to changing market interest rates. This risk arises from the options embedded in many banking corporation assets, liabilities and OBS portfolios. These options provide the holder the right, but not the obligation, to buy, sell or in some manner alter the cash flow of the financial instrument. While banking corporations use exchange-traded and OTC options in both trading and non-trading accounts, instruments with embedded options are generally more important in non-trading activities. Examples of instruments with embedded options include various types of bonds and notes with call or put provisions, loans which give borrowers the right to prepay balances, and various types of non-maturity deposit instruments which give depositors the right to withdraw funds at any time, often without penalties.

**Principles for the management of interest rate risk**

- (A) The board of directors in a banking corporation 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 consistent with the approved strategies and policies. The board of directors should be informed regularly of the interest rate exposure of the banking corporation in order to assess the monitoring and controlling of such risk against the board’s guidance on risk appetite.**
- (B) Senior management must ensure that the structure of the banking corporation’s business and 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.**
- (C) Banking corporations should clearly define the individuals and/or committees responsible for managing interest rate risk and should ensure that there is adequate separation of duties in key elements of the risk management process to avoid potential conflicts of interest. The banking corporations should have control functions in their business units and an independent interest rate risk management function, with clearly defined duties that are consistent with the requirements of Proper Conduct of Banking Business Directive 310, “Risk Management” and Proper Conduct of Banking Business Directive 339, “Market Risk Management”, paragraph 10.**
- (D) Banking corporations’ interest rate risk policies and procedures should be 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 overseas branches and subsidiaries,**

especially when recognizing legal distinctions and possible obstacles to cash movements among entities of the banking group.

- (E) Banking corporations should identify the risks inherent in new products and activities and ensure 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 of directors.
- (F) Banking corporations should have interest rate risk management 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.
- (G) Banking corporations must establish and enforce limits on activity and implement other practices to maintain exposures within levels consistent with their internal policies.
- (H) Banking corporations should measure their vulnerability to loss under stressful market conditions – including the breakdown of key assumptions – and consider those results when reviewing and updating their policies and limits for interest rate risk.
- (I) Banking corporations must have adequate information systems for measuring, monitoring, controlling and reporting interest rate exposures in general and interest rate exposures separately in the banking book and the trading book. Reports must be provided on a timely basis to the banking corporation’s board of directors, senior management, and where appropriate, to individual business line managers.
- (J) Banking corporations must have an adequate system of internal controls over their interest rate risk management process. A fundamental

**component of the internal control systems 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 Supervisor of Banks upon request.**

## **Chapter 2 General Framework for Interest Rate Risk Management**

### **I. Sound interest rate risk management practices**

16. Sound interest rate risk management involves the application of four basic elements in the management of assets, liabilities and OBS instruments:
  - (a) Appropriate board and senior management oversight;
  - (b) Adequate risk management policies and procedures;
  - (c) Appropriate risk measurement, monitoring, and control functions; and
  - (d) Comprehensive internal controls and independent audits.
17. The specific manner in which a banking corporation applies these elements in managing its interest rate risk will depend on the complexity and nature of its holdings and activities, as well as on the level of interest rate risk exposure. For example, more complex interest rate risk management processes require adequate internal controls that include audits or other appropriate oversight mechanisms to ensure the integrity of the information used by senior officials in overseeing compliance with policies and limits.
18. The duties of the individuals involved in the risk measurement, monitoring and control functions must be sufficiently separate and as relevant, independent from the business decision makers and position takers to ensure the avoidance of conflicts of interests.
19. Banking corporations should monitor the interest rate risk on a consolidated basis. At the same time, however, banking corporations that parent a banking group must fully recognize any legal distinctions and possible obstacles to cash flow movements among affiliates and adjust their risk management process accordingly. While a consolidated basis may provide a comprehensive measure in respect of interest rate risk, it may also underestimate risk, for example when positions in one affiliate are used to offset positions in another affiliate. This is

because a conventional accounting consolidation may allow theoretical offsets between such positions from which a banking corporation may not in practice be able to benefit because of legal or operational constraints. Banking corporations that parent a banking group should therefore also monitor the interest rate risks of their affiliates that are exposed to significant interest rate risk and/or are involved in complex activity, separately.

## II. Board and senior management oversight of interest rate risk

20. Effective oversight by the board of directors and senior management is critical to a sound interest rate risk management process. It is essential that these individuals are aware of their responsibilities with regard to overseeing and managing interest rate risk.

### **The board of directors**

21. The board of directors has the ultimate responsibility for understanding the nature and the level of interest rate risk taken by the banking corporation.
- (a) The board should approve business strategies that establish or influence the interest rate risk, the risk appetite, and risk management policy of the banking corporation.
  - (b) At least once a year, the board or its risk management committee, as appropriate, should re-evaluate the interest rate risk management policies as well as the business strategies that influence its exposure to interest rate risk.
  - (c) At least once a year the board or its risk management committee should review the key assumptions used in interest rate risk management and the results of their sensitivity tests.
  - (d) At least once a year the board should review the design of stress tests, and at least once a quarter it should review their results.

- (e) The board should approve policies that define the lines of responsibility and authority for managing the exposure to interest rate risk.
- (f) The board should examine and approve new products before launching, as specified in Proper Conduct of Banking Business Directive 310, “Risk Management”.
- (g) The board should ensure that management takes the necessary steps to identify, measure, monitor and control the interest rate risk. At least once a quarter, the board or its risk management committee, as appropriate, should review information that is sufficient in detail and timeliness to allow it to understand and assess the performance of senior management in monitoring and controlling these risks in compliance with the banking corporation’s board-approved policies. Such reviews should be conducted regularly and with greater frequency where the banking corporation holds significant positions in complex instruments.
- (h) The board should ensure that senior management understands the risks to which the banking corporation is exposed and that the banking corporation has personnel available who have the necessary technical skills to evaluate and control these risks.

**Senior management**

- 22. Senior management is responsible for ensuring that the banking corporation has adequate policies and procedures for managing interest rate risk on both a long-term and day-to-day basis. At least once a year, senior management must review the interest rate risk management policies and procedures to ensure that they remain sound and appropriate.
- 23. Management is also responsible for implementing:
  - (a) Appropriate limits on risk taking;

- (b) Adequate systems and standards for measuring risk;
- (c) Standards for valuing positions and measuring performance;
- (d) A comprehensive interest rate risk reporting and interest rate risk management review process; and
- (e) Effective internal controls.

**Organizational infrastructure for managing interest rate risk**

- 24. Senior management is responsible for ensuring that the banking corporation has clear lines of authority and responsibility for the management and control of interest rate risk, including clearly identifying the individuals and/or committees responsible for implementing the various elements of interest risk management.
- 25. Senior management should ensure that analyses and risk management activities related to interest rate risk are conducted by competent staff with technical knowledge and experience, consistent with the nature and scope of the banking corporation's activities. There should be sufficient depth in staff resources to manage these activities and to accommodate the temporary absence of key personnel.
- 26. Senior management should ensure that there is adequate separation of duties in key elements of the risk management process to avoid potential conflicts of interest. Management should ensure that sufficient safeguards exist to minimize the potential that individuals initiating risk-taking positions may inappropriately influence key control functions. The nature and scope of such safeguards should be in accordance with the size and structure of the banking corporation and they should also be commensurate with the volume and complexity of interest rate risk incurred by the banking corporation.
- 27. In addition to the business unit control function, the banking corporation must also have an independent interest rate risk management function, as specified in

Proper Conduct of Banking Business Directive 339, “Market Risk Management”, paragraph 10.

### III. Adequate risk management policies and procedures

#### **Policies and procedures**

28. Banking corporations should have clearly defined policies and procedures for limiting and controlling interest rate risk.
- (a) These policies should be applied on a consolidated basis and, as appropriate, at specific subsidiaries or other units of the banking corporation.
  - (b) Such policies and procedures should delineate lines of responsibility and accountability over interest rate risk management decisions.
  - (c) Such policies should clearly define authorized instruments (specifically or by type), hedging strategies, and position-taking opportunities, including the reasons for using them and while using quantitative parameters to define exposure limits. Where appropriate, limits should be further specified for certain types of instruments, portfolios and activities.
  - (d) Procedures for acquiring specific instruments, managing portfolios, and controlling the aggregate interest rate risk exposure should be established.
  - (e) The interest rate risk management policy should be reviewed at least once a year, and revised as needed.
  - (f) The specific procedures and approvals necessary in case of exceptions to policies, limits and authorizations must be defined.

#### **New products**

29. Banking corporations shall establish policies and approve new products as specified in Section 16 of the Proper Conduct of Banking Business Directive 310, "Risk Management". When analyzing whether or not a product or activity introduces a new element of interest rate risk exposure, the banking corporation should be aware that changes in the instrument's maturity, repricing or repayment terms can materially affect the product's interest rate risk characteristics.

**Hedging activities**

30. Banking corporations use derivative instruments for investment and/or to manage earnings or capital exposures. Although derivative instruments may hedge the exposure to interest rate risk, they expose the banking corporation to basis risk. Improper application of the hedging strategy may cause the banking corporation unexpected results, including losses. When derivative instruments are used to reduce exposure to interest rate risk, banking corporations must therefore comply with the following requirements:
- (a) They should have commensurate professional knowledge and experience.
  - (b) They should examine the implications of the derivative activity for other risks, such as liquidity risk and the cost of hedging.
  - (c) Hedging activity should be engaged in only when the board and senior management fully understand the hedging strategy, including its potential risks and benefits.

IV. Risk measurement, monitoring and control functions

**Interest rate risk measurement**

**A. General**

31. Depending on the complexity and range of activities of the individual banking corporation, banking corporations should have interest rate risk measurement systems that assess the effects of interest rate changes on both earnings and economic value.
32. At the very least, these measurement systems should:
  - (a) Assess all material interest rate risk associated with a banking corporation's assets, liabilities and off balance sheet positions;
  - (b) Provide measurements of the banking corporation's current exposure levels to interest rate risk;
  - (c) Make it possible to find any deviant exposure;
  - (d) Utilize generally accepted financial concepts and risk measurement techniques; and
  - (e) Have well-documented assumptions and parameters.
33. Measurement systems should incorporate all interest rate exposures arising from the full scope of a banking corporation's activities, including trading and non-trading sources. This does not preclude different measurement systems and risk management approaches being used for different activities, however management should have an integrated view of interest rate risk across products and business lines. The interest rate risk in the banking book should be measured separately, in part to ensure compliance with Proper Conduct of Banking Business Directive 211, "Capital Adequacy Assessment".

34. A banking corporation's interest rate risk measurement system should address all material sources of interest rate risk including repricing, yield curve, basis, and optionality risk exposures.
35. Measurement systems should evaluate concentrations of the banking corporation's largest holdings with particular rigor and should also provide rigorous treatment of those instruments which might significantly affect a banking corporation's aggregate position, even if they do not represent a major concentration, such as instruments with significant embedded or explicit option characteristics.

**B. Interest rate risk effects**

36. Exposure to interest rate risk may affect both earnings and economic value and is represented by two separate but complementary measurement techniques. A number of techniques are available for measuring the risk and their complexity ranges from simple calculations to static simulations using current holdings to highly sophisticated dynamic modeling techniques that reflect potential future business activities.
  - Earnings approach: An analysis of the effect of changes in interest rates on earnings which are measured according to the Reporting to the Public Directives. In the past the analysis focused on net interest income, but nowadays an examination of whether income from other sources should be included is to be conducted, depending on the existence of an identifiable connection with changing market interest rates. For example, when a banking corporation provides operating services for a fee that is based on the volume of assets that it operates and which in turn can be associated with changes in the market interest rates.
  - Economic value approach: An analysis of the effect of changes in interest rates on the economic value of a banking corporation's assets, liabilities, and

OBS positions. The banking corporation's economic value is the present value of its net future cash flows, defined as future cash flows from assets net of future cash flows from liabilities, plus net future cash flows from OBS positions. Given that the economic value approach is mindful of the potential effect of changes in interest rates on the present value of all future cash flows, it provides a more comprehensive view of the possible long-term effects of changing interest rates than the earnings approach. This broad view is important as short-term changes in earnings – the focus of the earnings approach – may not provide an accurate indication of the effect of interest rate changes on the banking corporation's overall positions.

Banking corporations should use both approaches to estimate their risk exposure.

37. Embedded losses: The earnings approach and the economic value approach both focus on the question of how future changes in interest rates may affect banking corporations' financial performance. When banking corporations assess the level of interest rate risk they are willing and able to assume, they must also consider the effects of historical interest rates on future performance. Specifically, instruments that are not marked to market may already contain embedded gains or losses due to past rate fluctuations. These gains or losses may be reflected over time in the bank's earnings. For example, a long-term, fixed-rate loan entered into when interest rates were low and refunded more recently with liabilities bearing a higher rate of interest will, over its remaining life, represent a drain on the banking corporation's resources.

#### **Interest rate risk measurement techniques**

38. Maturity/repricing schedule—interest-sensitive assets, liabilities and OBS positions can be distributed into “time bands” according to their maturity (if fixed-rate) or time remaining to their next repricing (if floating-rate). These schedules can be used to generate simple indicators of the interest rate risk sensitivity of both earnings and economic value to changing interest rates,

typically known as gap analysis. The size of the gap for a given time band - that is, assets minus liabilities plus OBS exposures that reprice or mature within that time band, gives an indication of the banking corporation's repricing risk exposure. A maturity/repricing schedule can also be used to evaluate the effects of changing interest rates on a banking corporation's economic value by applying sensitivity weights considerations to each time band.

39. Simulation techniques—detailed assessments of the potential effects of changes in interest rates on earnings and economic value by simulating the future path of interest rates and their impact on cash flows. In static simulations, the cash flows arising solely from the banking corporation's current on- and off-balance sheet positions are assessed. In a dynamic simulation approach, the simulation builds in more detailed assumptions about the future course of interest rates and expected changes in a bank's activity over that time.
40. Banking corporations may use a variety of measurement techniques to evaluate their interest rate risk profile, provided that the techniques incorporate simulations.
41. Where the measurement techniques used by a banking corporation to assess the impact of interest rate risk on economic value produce results that differ significantly from those in the Reporting to the Public Directives, "Management's Review", Addendum D – "Banking corporation's exposure to changes in interest rates", the banking corporation should analyze the principal causes of the differences and document the analysis and its conclusions.

Measurement techniques are described in more detail in **Addendum 1**.

#### **Guidelines for the design of measurement systems**

42. Degree of detail and accuracy: Banking corporations should ensure that the degree of detail about the nature of their interest sensitive positions in their interest rate risk measurement systems is commensurate with the complexity and

risk inherent in those positions. The banking corporation must assess the significance of the potential loss of precision in determining the extent of aggregation and simplification to be built into the measurement approach.

43. Integrity and timeliness of data:

- (a) A banking corporation should ensure that all material positions and cash flows, whether stemming from on- or off-balance sheet positions, are incorporated into the measurement system on a timely basis.
- (b) Where applicable, these data should include information on the coupon rates or cash flows of associated instruments and contracts.
- (c) Any manual adjustments to underlying data should be clearly documented, and the nature and reasons for the adjustments should be clearly understood. In particular, any adjustments to expected cash flows for expected prepayments or early redemptions should be well reasoned and such adjustments should be available for review.

44. Assumptions:

- (a) Banking corporations should employ a change in interest rates that is large enough to encompass the risks attendant to their holdings. Banks should use multiple scenarios, including the potential effects of changes in the relationships among interest rates (i.e. yield curve risk and basis risk) as well as changes in the general level of interest rates. For determining probable changes in interest rates, simulation techniques could be used. Statistical analysis can also play an important role in evaluating correlation assumptions with respect to basis or yield curve risk.
- (b) In assessing the results of interest rate measurement systems, it is important that the assumptions underlying the system are clearly understood by risk managers and banking corporation management, in particular when sophisticated simulations are used.

- (c) Key assumptions should be recognized by senior management and risk managers and should be re-evaluated at least once a year. These assumptions should also be clearly documented to enable their meaning to be understood.
  - (d) Assumptions used in assessing the interest rate sensitivity of complex instruments and instruments with uncertain maturities should be subject to particularly rigorous documentation and review.
  - (e) Reviews of key assumptions should incorporate an assessment of their effect on measurement of the banking corporation's exposure. Such assessment will be conducted by employing a sensitivity analysis that examines the degree of exposure under a different set of assumptions. Management will use this analysis to determine which are the most important assumptions and require frequent monitoring or the use of more rigorous techniques to ensure their reasonability.
  - (f) When measuring interest rate risk exposure, two further aspects merit close attention: the treatment of those positions where behavioral maturity differs from contractual maturity and the treatment of positions denominated in different currencies.
45. Positions such as savings and sight deposits may have contractual maturities or may be open-ended, but in either case, depositors generally have the option to make withdrawals at any time. In addition, banks often choose not to move rates paid on these deposits in line with changes in market rates. These factors complicate the measurement of interest rate risk exposure, since not only the value of the positions but also the timing of their cash flows can change when interest rates vary. With respect to banking corporation' assets, prepayment features of mortgages and mortgage-related instruments also introduce uncertainty about the timing of cash flows on these positions.

46. Banking corporations with positions denominated in different currencies can expose themselves to interest rate risk in each of these currencies. Since yield curves vary from currency to currency, banking corporations generally need to assess exposures in each. Banks with the necessary skills and sophistication, and with material multi-currency exposures, may choose to include in their risk measurement process methods to aggregate their exposures in different currencies using assumptions about the correlation between interest rates in different currencies. A banking corporation that uses correlation assumptions to aggregate its risk exposures should, at least once a year, review the stability and validity of those assumptions. The banking corporation also should evaluate what its potential risk exposure would be in the event that such correlations break down. Likewise, the banking corporation should also evaluate the risk in respect of indexed and unindexed shekel positions.

### **Limits**

47. The goal of interest rate risk limits and risk-taking guidelines is to maintain a banking corporation's interest rate risk exposure within self-imposed parameters over a range of possible changes in interest rates.
- (a) Limits should be consistent with the size and complexity of the banking corporation's activity, capital adequacy and its ability to measure and manage its risks.
  - (b) Limit systems should address interest rate risk in its entirety, but make a distinction between interest rate risk in the banking book and interest rate risk in the trading book. The level of detail of risk limits should reflect the nature of the banking corporation's holdings and its complexity, including the various sources of interest rate risk to which the banking corporation is exposed. Limits should also be identified, if relevant, for individual business units, portfolios, instrument types or specific instruments.

- (c) A banking corporation's limits should be consistent with its overall approach to measuring interest rate risk and should address the potential impact of changes in market interest rates on reported earnings and the bank's economic value of equity.
- Limits on the variability of net income and net interest income should specify acceptable levels of earnings volatility under specified interest rate scenarios.
  - Limits on the impact of changing rates on a banking corporation's economic value of equity should be appropriate for the size and complexity of its underlying positions. For a banking corporation engaged in 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 given changes in market rates, relatively simple limits on the extent of such holdings may suffice. For more complex banking corporations, however, more detailed limit systems on acceptable changes in the estimated economic value of equity may be needed.
- (d) Interest rate risk limits may refer to specific scenarios of movements in market interest rates such as an increase or decrease of a particular magnitude. The rate movements used in developing these limits should represent meaningful stress situations taking into account historic rate volatility and the time required for management to address exposures. Limits may also be based on measures derived from the underlying statistical distribution of interest rates, such as earnings at risk (EaR) or economic value-at-risk (VaR) techniques. Moreover, specified scenarios should take account of the full range of possible sources of interest rate risk to the banking corporation including mismatch, yield curve, basis, and optionality

risks. Simple scenarios using parallel shifts in interest rates may be insufficient to identify such risks.

- (e) An appropriate limit system should enable management to control interest rate risk exposures, initiate discussion about opportunities and risks, and monitor actual risk taking against predetermined risk appetite.
- (f) There should be a clear policy as to how the board of directors and senior management will be informed of limit exceptions and what action should be taken by management in such cases. Particularly important is whether limits are absolute in the sense that they should never be exceeded or whether, under specific circumstances which should be clearly described, breaches of limits can be tolerated for a short period of time. In that context, the relative conservatism of the chosen limits may be an important factor.
- (g) Aggregate limits on interest rate risk should be reviewed at least once a year.

### **Stress testing**

#### **A. General**

48. Risk measurement systems should also support a meaningful evaluation of the effect of stressful market conditions on the banking corporation. Stress testing should incorporate scenario analyses – forecasting possible future outcomes of an event or series of events, as well as sensitivity analyses – changes in the model parameters that are not associated with a specific event. Stress testing should also be designed to provide information on the kinds of conditions under which the banking corporation’s strategies or positions would be most vulnerable, in accordance with the risk characteristics of the banking corporation.

#### **B. Stress test scenarios**

49. Banking corporations are expected to consider multiple scenarios in evaluating their interest rate risk as appropriate to their risk profile and current economic conditions. For example, in a low interest rate environment, less emphasis may be placed on scenarios involving a significant drop in interest rates at the expense of an increase in the quantity and magnitude of rising interest rate scenarios.
- (a) Possible stress scenarios might include abrupt changes in the general level of interest rates, including estimates of exposure to interest rate risk beyond frequent characteristics, such as changes in interest rates of a greater magnitude, for example an upward or downward 300 or 400 basis point shock, changes in the relationships among key market rates (i.e. basis risk), changes in the slope and shape of the yield curve (i.e. yield curve risk), changes in the liquidity of key financial markets, or changes in the volatility of market rates. The stress scenarios should also incorporate standardized rate shock scenarios on the banking book, according to the guidelines in Addendum 2 to the Directive.

- (b) In addition, stress scenarios should include conditions under which key business assumptions and parameters break down. The stress testing of assumptions used for illiquid instruments and instruments with uncertain contractual maturities is particularly critical to achieving an understanding of the bank's risk profile. In conducting stress tests, special consideration should be given to instruments or markets where concentrations exist, as such positions may be more difficult to liquidate or offset in stressful situations.
- (c) Worst-case scenarios should also be considered.
- (d) Overall exposure to risk under stressful conditions should be tested, making a distinction between interest rate risk in the banking book and interest rate risk in the trading book.

**C. Management and use of stress scenarios**

50. Banking corporations should:

- (a) Review the design of such stress tests at least once a year and review their results with adequate frequency and in accordance with the portfolio type. As long as the stress test results are being reviewed at least once a quarter, although scenarios that indicate significant sensitivity to a particular type of interest rate risk should be incorporated in the routine monitoring of interest rate risk.
- (b) Establish limits for stress test results as a way of monitoring actual risk against defined risk appetite, controlling the exposure to interest rate risk, and initiating discussions about the risks and possible courses of action.
- (c) Report to the board or its risk management committee, as applicable, stress scenarios that demonstrate significant interest rate risk and/or risks that deviate from defined risk appetite indicators.

- (d) Ensure that appropriate action plans are in place for accommodating extraordinary and unexpected losses.

**Interest rate risk monitoring and reporting**

- 51. Banking corporations must have an accurate, informative, and timely management information system for managing interest rate risk exposure.
  - (a) Reporting of risk measures should be done regularly and should clearly compare current exposure to policy limits. In addition, past forecasts or risk estimates should be compared with actual results to identify any modelling shortcomings (back testing).
  - (b) Reports detailing the interest rate risk exposure of the banking corporation should be submitted to the board and to management. The frequency of these reports should be consistent with the risk level and potential for significant change, as long as they are presented to senior management at least once a month and to the board at least once a quarter.
  - (c) Reports to management should provide aggregate information together with sufficient supporting details so that management can evaluate the banking corporation's sensitivity to changes in market conditions and to other important risk factors.
  - (d) While types of reports prepared for the board and for various levels of management will vary based on the bank's interest rate risk profile, they should at a minimum include the following:
    - (1) Summaries of the banking corporation's aggregate exposures in terms of risk to economic value and earnings, including an evaluation of their levels and trends. These summaries must also reflect the distribution among the trading book and the banking book.

- (2) Reports demonstrating adherence to policies and limits that help identify any deviation from policy.
  - (3) Results of stress tests, including those assessing breakdowns in key assumptions and parameters, including standardized interest rate shock on the banking book.
  - (4) Key assumptions, for example non-maturity deposit behavior and prepayment information, including sensitivity test results.
  - (5) Summaries of the findings of reviews of interest rate risk policies, procedures and the adequacy of the interest rate risk measurement systems, including any findings of control functions and audit functions by internal and external auditors and retained consultants.
52. When a standardized interest rate shock applied to the banking book shows a decline in economic value of more than 20 percent of equity, the banking corporation must file an immediate report with the Supervisor.

## **V. Internal controls**

53. Banking corporations should have adequate internal controls to ensure the integrity of their interest rate management process. These internal controls should be an integral part of the bank's overall system of internal control and promote effective and efficient operations, reliable financial and regulatory reporting, and compliance with relevant laws, regulations and policies.

- (a) An effective system of internal control for interest rate risk includes:
  - (1) A strong control environment;
  - (2) An adequate process for identifying and evaluating risk;
  - (3) The establishment of control activities such as policies, procedures, and methodologies;
  - (4) Adequate information systems; and
  - (5) Continual review of adherence to established policies and procedures.
- (b) Attention should be given to appropriate approval processes, exposure limits, reconciliations, reviews and other mechanisms designed to provide a reasonable assurance that the banking corporation's interest rate management objectives are achieved. Banking corporations should ensure that all aspects of the internal control system are effective, including those that are not directly part of the risk management process.
- (c) An important element of a banking corporation's internal control system over its interest rate management process is regular evaluation and review. This is intended, among other things, to ensure that personnel are following established policies and procedures, as well as ensuring that the procedures that were established actually accomplish the intended objectives. Such reviews and evaluations should also address any significant change that may impact the effectiveness of controls, such as changes in market conditions,

personnel, technology, and compliance with interest rate exposure limits, and should ensure that appropriate management follow-up has occurred for any limits that were exceeded. Management should ensure that all such reviews and evaluations are conducted regularly by individuals who are independent of the function they are assigned to review. When revisions or enhancements to internal controls are warranted, there should be a mechanism in place to ensure that these are implemented in a timely manner.

54. The internal control system should incorporate an evaluation of the adequacy of the interest rate risk measurement process. The banking corporation must comply with the Supervisor's model validation guidance (dated October 17, 2010). The frequency and extent to which a banking corporation should re-evaluate its methodologies and models depend, in part, on the particular interest rate risk exposures created by holdings and activities, the pace and nature of market interest rate changes, and the pace and complexity of innovation with respect to measuring and managing interest rate risk.
55. The banking corporation's risk measurement, monitoring and control functions should be regularly reviewed by the internal auditors, in accordance with Proper Conduct of Banking Business Directive 307, "Internal Audit Function".

## **Addendum 1**

### **Examples of interest rate risk measurement techniques**

1. This addendum provides a brief overview of the various techniques used by banking corporations to measure the exposure of earnings and of economic value to changes in interest rates. The variety of techniques ranges from calculations that rely on simple maturity and repricing tables, to static simulations based on current on- and off-balance-sheet positions, to highly sophisticated dynamic modelling techniques that incorporate assumptions about the behavior of the banking corporation and its customers in response to changes in the interest rate environment. Some of these general approaches can be used to measure interest rate risk exposure from both an earnings and an economic value perspective, while others are more typically associated with only one of these two perspectives. In addition, the methods vary in their ability to capture the different forms of interest rate exposure: the simplest methods are intended primarily to capture the risks arising from maturity and repricing mismatches, while the more sophisticated methods can more easily capture the full range of risk exposures.
2. The different measurement techniques described below have their strengths and weaknesses in terms of providing accurate and reasonable measures of interest rate risk exposure. Ideally, a banking corporation's interest rate risk measurement system would take into account the specific characteristics of each individual interest-sensitive position, and would capture in detail the full range of potential movements in interest rates. In practice however, measurement systems embody simplifications that move away from this ideal. For instance, in some approaches, the positions may be aggregated into broad categories rather than modelled separately, introducing a degree of measurement error into the estimation of their interest rate sensitivity. Similarly, the nature of interest rate movements that each approach can incorporate may be limited: in some cases only a parallel shift of the yield curve may be assumed or less than perfect correlations between interest

rates may not be taken into account. Finally, the various approaches differ in their ability to capture the optionality inherent in many positions and instruments. The discussion in the following sections will highlight the areas of simplification that typically characterize each of the major interest rate measurement techniques.

**A. Repricing schedules**

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

**1. Gap analysis**

4. Simple maturity/repricing schedules can be used to generate simple indicators of the interest rate risk sensitivity of both earnings and economic value to changing interest rates. When this approach is used to assess the interest rate risk of current earnings, it is typically referred to as gap analysis. To evaluate earnings exposure, interest-sensitive liabilities in each time band are subtracted from the corresponding interest-sensitive assets to produce a repricing "gap" for that time band. This gap can be multiplied by an assumed change in interest rates to yield an approximation of the change in net interest income that would result from such an interest rate movement. The size of the interest rate movement used in the analysis can be based on a variety of factors, including historical experience,

simulation of potential future interest rate movements, and the judgment of the banking corporation management.

5. A negative or liability sensitive gap occurs when liabilities exceed assets (including OBS positions) in a given time band. This means that an increase in market interest rates could cause a decline in net interest income. Conversely, a positive or asset-sensitive gap implies that the banking corporation's net interest income could decline as a result of a decrease in market interest rates.
6. These simple gap calculations can be augmented by information on the average coupon on assets and liabilities in each time band. This information can be used to place the results of the gap calculations in context. For instance, information on the average coupon rate could be used to calculate estimates of the level of interest income arising from positions maturing or repricing within a given time band, which would then provide a "scale" to assess the changes in income implied by the gap analysis.
7. Gap analysis has a number of shortcomings. First, gap analysis does not take account of variation in the characteristics of different positions within a time band. In particular, all positions within a given time band are assumed to mature or reprice simultaneously, a simplification that is likely to have a greater impact on the precision of the estimates as the degree of aggregation within a time band increases. Moreover, gap analysis ignores differences in spreads between interest rates that could arise as the level of market interest rates changes (basis risk). In addition, it does not take into account any changes in the timing of payments that might occur as a result of changes in the interest rate environment. Thus, it fails to account for differences in the sensitivity of income that may arise from option-related positions. For these reasons, gap analysis provides only a rough approximation of the actual changes in net interest income which would result from the chosen change in the pattern of interest rates. Finally, most gap analyses

fail to capture variability in non-interest revenue and expenses, a potentially important source of risk to current income.

## **2. Duration**

8. A maturity/repricing schedule can also be used to evaluate the effects of changing interest rates on a banking corporation's economic value by applying sensitivity weights to each time band. Typically, such weights are based on estimates of the duration of the assets and liabilities that fall into each time band. Duration is a measure of the percentage change in the economic value of a position that will occur given a small change in the level of interest rates.<sup>1</sup> It reflects the timing and size of cash flows that occur before 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 will have a larger impact on economic value.
9. Duration based weights can be used in combination with a maturity/repricing schedule to provide a rough approximation of the change in a banking corporation's economic value that would occur given a particular change in the level of market interest rates. Specifically, an "average" duration is assumed for the positions that fall into each time band. The average durations are then multiplied by an assumed change in interest rates to construct a weight for each

<sup>1</sup> In its simplest form, duration measures changes in economic value resulting from a percentage change of interest rates under the simplifying assumptions that changes in value are proportional to changes in the level of interest rates and that the timing of payments is fixed. Two important modifications of simple duration are commonly used that relax one or both of these assumptions. The first case is so-called modified duration. Modified duration - which is standard duration divided by  $1 + r$ , where  $r$  is the level of market interest rate - is an elasticity. As such, it reflects the percentage change in the economic value of the instrument for a given percentage change in  $1 + r$ . As with simple duration, it assumes a linear relationship between percentage changes in value and percentage changes in interest rates. The second form of duration (called effective duration) relaxes this assumption, as well as the assumption that the timing of payments is fixed. Effective duration is the percentage change in the price of a specific instrument for a basis point change in yield.

time band. In some cases, different weights are used for different positions that fall within a time band, reflecting broad differences in the coupon rates and maturities (for instance, one weight for assets, and another for liabilities). In addition, different interest rate changes are sometimes used for different time bands, generally to reflect differences in the volatility of interest rates along the yield curve. The weighted gaps are aggregated across time bands to produce an estimate of the change in economic value of the banking corporation that would result from the assumed changes in interest rates.

10. Alternatively, a banking corporation 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 banking corporation based on these more accurate measures, rather than by applying an estimated average duration weight to all positions in a given time band. This would eliminate potential errors occurring when aggregating positions/cash flows. As another variation, risk weights could also be designed for each time band on the basis of actual percentage changes in market values of hypothetical instruments that would result from a specific scenario of changing market rates. That approach - which is sometimes referred to as effective duration - would better capture the non-linearity of price movements arising from significant changes in market interest rates and, thereby, would avoid an important limitation of duration.
11. Estimates derived from a standard duration approach may provide an acceptable approximation of a banking corporation's exposure to changes in economic value for relatively non-complex banks. Such estimates, however, generally focus on just one form of interest rate risk exposure - repricing risk. As a result, they may not reflect interest rate risk arising, for instance, from changes in the relationship among interest rates within a time band (basis risk). In addition, because such approaches typically use an average duration for each time band, the estimates will not reflect differences in the actual sensitivity of positions that can arise from

differences in coupon rates and the timing of payments. Finally, the simplifying assumptions that underlie the calculation of standard duration means that the risk of options may not be adequately captured.

## **B. Simulation approaches**

12. Many banks employ more sophisticated interest rate risk measurement systems than those based on simple maturity/repricing schedules. These simulation techniques typically involve detailed assessments of the potential effects of changes in interest rates on earnings and economic value by simulating the future path of interest rates and their impact on cash flows.
13. In some sense, simulation techniques can be seen as an extension and refinement of the simple analysis based on maturity/repricing schedules. However, simulation approaches typically involve a more detailed breakdown of various categories of on- and off balance-sheet positions, so that specific assumptions about the interest and principal payments and non-interest income and expense arising from each type of position can be incorporated. In addition, simulation techniques can incorporate more varied and refined changes in the interest rate environment, ranging from changes in the slope and shape of the yield curve to interest rate scenarios derived from Monte Carlo simulations.

### **1. Static simulation**

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

discounted back to their present values, an estimate of the change in the bank's economic value can be calculated.<sup>2</sup>

## **2. Dynamic simulation**

15. In a dynamic simulation approach, the simulation builds in more detailed assumptions about the future course of interest rates and the expected changes in a banking corporation's business activity over that time. For instance, the simulation could involve assumptions about a bank's strategy for changing administered interest rates (on savings deposits, for example), about the behavior of the bank's customers (e.g. withdrawals from sight and savings deposits), and/or about the future stream of business (new loans or other transactions) that the banking corporation will encounter. Such simulations use these assumptions about future activities and reinvestment strategies to project expected cash flows and estimate dynamic earnings and economic value outcomes. These more sophisticated techniques allow for dynamic interaction of payments streams and interest rates, and better capture the effect of embedded or explicit options.
16. As with other approaches, the usefulness of simulation-based interest rate risk measurement techniques depends on the validity of the underlying assumptions and the accuracy of the basic methodology. The output of sophisticated simulations must be assessed largely in the light of the validity of the simulation's assumptions about future interest rates and the behavior of the banking corporation and its customers. One of the primary concerns that arises is that such simulations will become “black boxes” that lead to false confidence in the precision of the estimates.

## **C. Additional issues**

<sup>2</sup> The duration analysis described in the previous section can be viewed as a very simple form of static simulation.

17. One of the most difficult tasks when measuring interest rate risk is how to deal with those positions where behavioral maturity differs from contractual maturity (or where there is no stated contractual maturity). On the asset side of the balance sheet, such positions may include mortgages where borrowers have the discretion to prepay their mortgages with little or no penalty, which creates uncertainty about the timing of the cash flows associated with these instruments. Although there is always some volatility in prepayments resulting from demographic factors (such as death, divorce, or job transfers) and macroeconomic conditions, most of the uncertainty surrounding prepayments arises from the response of borrowers to movements in interest rates. In general, declines in interest rates result in increasing levels of prepayments as borrowers refinance their loans at lower interest rates. In contrast, when interest rates rise unexpectedly, prepayment rates tend to slow, leaving the banking corporation with a larger than anticipated volume of mortgages paying below current market rates.
18. On the liability side, such positions include so-called non-maturity deposits such as sight deposits and deposits which can be withdrawn, often without penalty, at the discretion of the depositor. The treatment of such deposits is further complicated by the fact that the rates received by depositors tend not to move in close correlation with changes in the general level of market interest rates. In fact, banking corporations can and do administer the rates on the accounts with the specific intention of managing the volume of deposits retained.
19. The treatment of positions with embedded options is an issue of special concern in measuring the exposure of both current earnings and economic value to interest rate changes. In addition, the issue arises across the full spectrum of approaches to interest rate measurement, from simple gap analysis to the most sophisticated simulation techniques. In the maturity/repricing schedule framework, banking corporations typically make assumptions about the likely timing of payments and withdrawals on these positions and “spread” the balances

across time bands accordingly. For instance, it might be assumed that certain percentages of a pool of 30-year mortgages prepay in given years during the life of the mortgages. As a result, a large share of the mortgage balances that would have been assigned to the time band containing 30-year instruments would be spread among nearer-term time bands. In a simulation framework, more sophisticated behavioral assumptions could be employed, such as the use of option-adjusted pricing models to better estimate the timing and magnitude of cash flows under different interest rate environments. In addition, simulations can incorporate the bank's assumptions about its likely future treatment of administered interest rates on nonmaturity deposits.

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



## **Addendum 2**

### **Standardized interest rate shock**

1. This addendum gives the technical background to the selection of the standardized shock rate. In selecting the shock, the following guiding principles should be followed:

- (a) The rate shock should reflect a fairly uncommon and stressful rate environment;
- (b) The magnitude of the rate shock should be significant enough to capture the effects of embedded options and convexity within banking corporation assets and liabilities so that underlying risk may be revealed;
- (c) The rate shock should be straightforward and practical to implement, and should be able to accommodate the diverse approaches inherent in single-rate-path simulation models and statistically driven value-at-risk (VaR) models for banking book positions;
- (d) The methodology should provide relevant shocks for indexed and unindexed shekel-denominated exposures and for significant exposures in other currencies.

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

For exposures in G10 currencies and for linked and non-linked shekel exposures, either:

- (a) An upward and downward 200 basis point parallel rate shock; or
- (b) 1<sup>st</sup> and 99<sup>th</sup> percentile of observed interest rate changes using a one-year (240 working days) holding period and a minimum five years of observations.

For significant exposures in other currencies, either:

- (a) A parallel rate shock substantially consistent with 1st and 99<sup>th</sup> percentile of observed interest rate changes using a one-year (240 working days) holding period and a minimum five years of observations for the particular currency;  
or
  - (b) 1<sup>st</sup> and 99<sup>th</sup> percentile of observed interest rate changes using a one-year (240 working days) holding period and a minimum five years of observations.
3. Banking corporations that are exposed to interest rate risk in more than one currency should carry out an analysis for each currency accounting for 5% or more of their banking book assets or liabilities, using an interest rate shock calculated according to one of the methodologies set out above. To ensure complete coverage of the banking book, remaining exposures should be aggregated and subjected to a 200 basis point shock.

**Revisions**

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