Comptroller's Handbook

# Safety and Soundness

Capital Adequacy (C) | Asset Quality (A) | Management (M) | Earnings (E) | Liquidity (L) | **Sensitivity to Market Risk (S)** | Other Activities (O)

# Interest Rate Risk

Version 1.0, March 2020

**References to reputation risk have been removed from this booklet as of March 20, 2025. Removal of reputation risk references is identified by a strikethrough. Refer to OCC Bulletin 2025-4.**

Office of the Comptroller of the Currency

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# Introduction

The Office of the Comptroller of the Currency's (OCC) *Comptroller's Handbook* booklet, "Interest Rate Risk," is prepared for use by OCC examiners in connection with their examination and supervision of national banks, federal savings associations, and federal branches and agencies of foreign banking organizations (collectively, banks). Each bank is different and may present specific issues. Accordingly, examiners should apply the information in this booklet consistent with each bank's individual circumstances. When it is necessary to distinguish between them, national banks, federal savings associations (FSA), and covered savings associations are referred to separately.[1]

This booklet addresses interest rate risk (IRR) and other risks associated with IRR and provides examiners with information for evaluating a bank's IRR management. The examination procedures and other reference material in this booklet supplement the core assessment in the "Community Bank Supervision," "Federal Branches and Agencies Supervision," and "Large Bank Supervision" booklets of the *Comptroller's Handbook.* This booklet includes expanded examination procedures for examiners to use when review beyond completion of the core assessment is necessary.

## Overview

To meet the demands of their customers and communities—and to execute business strategies—banks make loans, purchase securities, take deposits, and borrow funds with different maturities, interest rates, and repricing characteristics. IRR is the risk to the bank's current or projected financial condition[2] and resilience[3] arising from movements in interest rates. IRR results from differences between the timing of rate changes and the timing of cash flows (repricing risk); from changing rate relationships among different yield curves affecting bank activities (basis risk); from changing rate relationships across the spectrum of maturities (yield curve risk); and from interest-related options embedded in bank products (options risk).

The movement of interest rates affects the bank's earnings and capital by changing net interest income (NII), the market value of fair valued instruments (trading and available-for-

[1] Generally, references to "national banks" throughout this booklet also apply to federal branches and agencies of foreign banking organizations unless otherwise specified. Refer to the "Federal Branches and Agencies Supervision" booklet of the *Comptroller's Handbook* for more information regarding applicability of laws, regulations, and guidance to federal branches and agencies. Certain federal savings associations may make an election to operate as a covered savings association. For more information, refer to OCC Bulletin 2019-31, "Covered Savings Associations Implementation: Covered Savings Associations" and 12 CFR 101, "Covered Savings Associations."

[2] Financial condition includes impacts from diminished capital and liquidity. Capital in this context includes potential impacts from losses, reduced earnings, and market value of equity.

[3] Resilience recognizes the bank's ability to withstand periods of stress.

sale), and other interest-sensitive income and expenses, such as mortgage servicing income. Therefore, sound IRR management should address risk from two perspectives:

- **Earnings perspective:** The projected effect on the bank's accrual earnings. This is also referred to as the accounting perspective.
- **Economic perspective:** The projected effect on the bank's economic value of assets, liabilities, and off-balance-sheet positions.

In some banks, IRR is included in the broader category of market risk, which also includes price risk. In contrast with price risk, which focuses on portfolios accounted for primarily on a mark-to-market basis (e.g., trading accounts, other real estate owned), IRR focuses on the value implications for non-trading portfolios (e.g., held-to-maturity and available-for-sale accounts).

IRR is inherent in banking. Excessive or poorly managed IRR can threaten a bank's earnings and capital. Banks should have sound risk management practices to identify, measure, monitor, and control IRR.[4] A bank's IRR management should be appropriate for the level of IRR and the nature, mix, and complexity of a bank's products and activities.

[4] Changes to the capital rule revised the definition of "internationally active" banks from assets equal to greater than $250 billion to any bank with total assets equal to or over $700 billion or cross-jurisdictional activity equal to or greater than $75 billion. Refer to the "Developing Stress Scenarios" section of this booklet for more information.

# Risk Management

Each bank should identify, measure, monitor, and control risk by implementing an effective risk management system appropriate for the size and complexity of the bank's operations. When examiners assess the effectiveness of a bank's risk management system, they consider the bank's policies, processes, personnel, and control systems. Refer to the "Corporate and Risk Governance" booklet of the *Comptroller's Handbook* for an expanded discussion of risk management.

Risk management systems should provide accurate, timely, and complete information to identify, measure, monitor, and control IRR. Management should incorporate IRR management into the bank-wide risk management system to promote the consideration of IRR and its interrelationship with other risks.[5]

## Board of Directors and Senior Management Oversight

Effective board and senior management oversight is the cornerstone of effective IRR management. The board and senior management are responsible for understanding the nature, level, and trend of the bank's IRR and how the risk fits within the bank's overall business strategy and risk appetite.

### Board Responsibilities

The board plays a critical role in the oversight of IRR management. Boards or designated board committees should oversee the establishment, approval, implementation, and periodic review of IRR management strategies, policies, processes, and limits (or risk tolerances). The board should understand the implications of the IRR strategies management engages in, including the strategies' potential impact on other risk areas.

The board should

- establish a risk appetite that guides the strategic direction for IRR.
- approve key policies, relevant risk limits, independent review program.
- identify senior managers who have the authority and responsibility for managing IRR risk.
- review reports provided by senior management to
  - monitor the bank's performance.
  - monitor compliance with established risk limits.
  - assess the bank's overall IRR profile.
  - verify that the level of IRR is within the bank's risk appetite and is supported by adequate capital and liquidity levels.
- provide credible challenge and hold management accountable for implementing sound principles that facilitate the identification, measurement, monitoring, and control of IRR.

[5] Refer to OCC Bulletin 2010-1, "Interest Rate Risk: Interagency Advisory on Interest Rate Risk Management."

- confirm that the bank has an appropriate IRR management system in place.

## Senior Management Responsibilities

Senior management is responsible for the execution of board-approved IRR management strategies and policies and holding applicable bank personnel accountable. These responsibilities include the following:

- Develop and implement strategies, policies, and processes that translate the board's goals, objectives, and risk appetite into operating standards that are well understood by bank personnel.
- Oversee lines of authority, responsibilities, reporting, and staffing.
- Oversee implementation and maintenance of management information and other systems used in IRR management.
- Implement effective internal controls and review processes over the IRR management process.

## Oversight Structure

The organizational structure used to manage IRR varies depending on the size, scope, and complexity of the bank's activities. The board usually delegates responsibility for establishing specific IRR policies and processes to a committee of senior managers. Smaller banks often operate with one oversight group, typically an asset-liability management committee (ALCO). Larger or more complex banks may operate with multiple oversight groups spread out over major affiliates and business lines, in addition to an ALCO, while other banks may operate with centralized structures. Structures that centralize oversight in a lead bank or a holding company do not absolve the directors of each affiliate bank of their responsibilities for IRR oversight. Regardless of the bank's size or oversight structure, the board and management should clearly understand the bank's IRR profile.

Banks typically operate with an ALCO that is responsible for monitoring the balance sheet and the bank's IRR. The ALCO is often responsible for providing the oversight to confirm that measurement systems adequately reflect the bank's exposure and that reporting systems effectively communicate relevant information concerning the level and sources of IRR. Effective ALCOs meet regularly and include representatives from a variety of business lines to promote awareness; for instance, marketing representatives can be included to promote marketing efforts consistent with the ALCO's view on the structure of the bank's business. ALCO members should be senior managers with clear lines of authority over the units responsible for establishing and executing interest rate positions and should be a communication channel to their units.

The ALCO ordinarily delegates day-to-day operating responsibilities to another balance-sheet management unit, often to the treasury unit. In the absence of a centralized IRR management unit, the ALCO or board might delegate the daily operating responsibilities to an investment officer or chief financial officer. The ALCO should establish specific policies and processes, including limits, for treasury and balance-sheet-management operations

before delegating authority.[6] Treasury or other balance-sheet management/investment personnel are typically responsible for managing the bank's discretionary portfolios (such as securities, Eurocurrency, time deposits, domestic wholesale liabilities, and off-balance-sheet interest rate contracts).

The treasury unit (or investment officer) can influence the level of IRR. For example, the unit could be responsible for implementing the directives of the ALCO on short- and long-term positions. Regardless of specific delegations, treasury or other units should monitor the bank's risk positions and prepare and provide reports on the bank's current risk to the ALCO, as well as appropriate members of any independent risk oversight functions, in a timely fashion.

Some banks implement a funds transfer pricing (FTP) system to centralize the management of IRR in the aforementioned single unit. FTP allows the bank to transfer the impact of changing interest rates from individual business lines to the central unit. Centralizing risk can allow the bank to take advantage of natural offsets, use comprehensive hedging activities, and have a broader view of the bank. Refer to appendix B, "Funds Transfer Pricing," of this booklet for more information.

## Interest Rate Risk Policies

Operating with appropriate IRR policies is fundamental to effective risk management.[7] Policies should be aligned with the board's risk appetite and designed to help ensure that the IRR implications of significant new strategies or new activities[8] are integrated into the bank's risk management system. IRR policies should typically include the following:

- IRR appetite and risk management objectives, including approved strategies and activities for managing IRR. Policies can also include prohibited strategies or products. For example, senior management or the board might choose to prohibit the use of hedges without prior board approval.
- Responsibility and authority for IRR management.
- Standards for measuring and monitoring IRR, including
  - the types of IRR measurement systems that the bank will use.
  - the frequency of IRR measurement.
  - how the bank will assess the quality of IRR management.
  - limits on IRR exposures. Refer to the "Risk Limits" section of this booklet for more information.
  - procedures to monitor, escalate, and address limit breaches.

[6] Refer to OCC Bulletin 2010-1.

[7] 12 CFR 163.176, "Interest Rate Risk Management Procedures," requires FSAs to have IRR policies.

[8] The term "new activities" is used collectively to include new, modified, or expanded products or services. Refer to OCC Bulletin 2017-43, "New, Modified, or Expanded Bank Products and Services: Risk Management Principles."

  - reporting standards, including the types of reports senior management and the board will use to monitor the bank's IRR.
- Model validation and back-testing requirements. Refer to the "Model Risk Management" section of this booklet for more information.

# Risk Identification

## Repricing Risk

Repricing risk is often the most apparent source of a bank's IRR. Repricing risk results from differences in the timing of rate changes and cash flows because of repricing of a bank's assets, liabilities, and off-balance-sheet instruments (e.g., maturity or repricing mismatches). For example, a bank makes a five-year, fixed-rate loan that is funded by a six-month certificate of deposit (CD). The bank is subject to repricing risk every six months when the CD renews. Repricing risk is often measured by comparing the volume of the bank's assets and liabilities that mature or reprice over a given time frame. Most banks' balance sheets are either asset-sensitive or liability-sensitive:

- **Asset-sensitive:** Banks with assets repricing quicker than liabilities are considered asset-sensitive. An asset-sensitive bank's earnings generally increase when rates rise and decrease when rates fall.
- **Liability-sensitive:** Banks with liabilities repricing quicker than assets are considered liability-sensitive. A liability-sensitive bank's earnings generally increase when rates fall and decrease when rates rise.

Some banks are neutrally positioned and have assets and liabilities repricing in unison and are therefore neither asset- nor liability-sensitive.

Repricing risk is not always reflected in banks' current earnings performance. Some banks intentionally take on repricing risk in an attempt to improve earnings. Because the yield curve is typically upward sloping (long-term rates are higher than short-term rates), banks often earn a positive spread by funding longer-term assets with shorter-term liabilities. Although this may increase short-term earnings, rising rates force management to protect liquidity by raising funding costs even though asset yields stay the same. This results in the gradual depreciation in value of long-term assets and compressing net interest margins. Failure to measure and manage material long-term repricing risk can leave banks' future earnings and capital vulnerable to IRR.

## Basis Risk

Basis risk arises from a shift in the relationship of the rates in different financial markets or on different financial instruments. Basis risk occurs when market rates for different financial instruments or the indexes used to price assets and liabilities change at different times or by different amounts. For example, if the funding for an asset position is tied to the one-year U.S. Treasury (UST) rate and the asset is tied to the prime rate, basis risk occurs when the spread between the one-year UST rate and the prime rate changes. This change affects the

bank's net interest margin (NIM) through widening or narrowing of spreads between interest earned and interest paid. The change also affects the anticipated future cash flows from such instruments, which in turn affect the bank's underlying net economic value.

Basis risk can also include changes in the relationship between rates established by the bank (i.e., managed rates) and external rates. For example, basis risk may arise because of differences in the prime rate and the bank's offering rates on its products.

Because consumer deposit rates tend to lag behind increases in market interest rates, banks often experience an initial improvement in their NIM when rates are rising. As rates stabilize, this benefit could be offset by repricing imbalances and unfavorable spreads in other key market rate relationships; deposit rates gradually catch up to the market. Management should understand the implications of this pricing behavior on the bank's IRR exposure.

## Yield-Curve Risk

Yield-curve risk arises from variations in the movement of interest rates across the maturity spectrum. This risk involves changes in the relationship among interest rates of different maturities of the same index or market (e.g., the three-month UST rate versus the five-year UST rate). The relationships change when the slope and shape of the yield curve for a given market flattens, steepens, or becomes negatively sloped (inverted) during an interest rate cycle. Yield-curve variations can accentuate the bank's IRR by amplifying the effect of maturity mismatches. For example, a bank that funds long-term assets with short-term liabilities will generally experience a greater decline in the NIM in a flattening yield curve environment versus a parallel shift in the yield curve. In a flattening rate environment, there is usually little benefit in holding a longer-term security as the bank does not gain any excess compensation for the risks associated with holding longer-term assets.

Certain types of structured notes can be particularly vulnerable to changes in the shape of the yield curve. For example, the performance of certain types of structured note products, such as dual index notes, is directly linked to basis and yield-curve relationships. These notes have coupon rates that are determined by the difference between market indexes. A dual index note usually has a fixed rate for a brief period, followed by a longer period of variable rates. For example, the coupon might start out as a fixed rate of 8 percent for two years, then switch to a variable rate calculated as index A plus 300 basis points minus index B. Because the coupon on this note adjusts as interest rates change, the bank may incorrectly assume that it always benefits if interest rates increase. If, however, the increase in index B exceeds the increase in index A, the coupon on this note will fall, even if both indexes are increasing. Performance of structured notes should be evaluated under different yield curve shapes.

## Options Risk

Options risk arises when a bank or its customer has the right (not the obligation) to alter the level and timing of the cash flows of an asset, liability, or off-balance-sheet instrument. An option gives the holder the right to buy (call option) or sell (put option) a financial instrument at a specified price (strike price) over a specified period. For the seller (or writer) of an

option, there is an obligation to perform if the option holder exercises the option. Some banks buy and sell options on a stand-alone basis; each of these options has an explicit price at which it is bought or sold and can be linked with another bank product. The bank does not, however, have to buy and sell options on a stand-alone basis to incur options risk. Almost all banks incur options risk from options that are embedded in instruments (loans and deposits) on both sides of the balance sheet (i.e., embedded options).

The option holder's ability to choose whether to exercise the option creates an asymmetry in an option's performance. Generally, option holders exercise their right only when it is to their benefit. The option holder faces limited downside risk (the premium or amount paid for the option) and unlimited upside reward. The option seller faces unlimited downside risk (an option is usually exercised at a disadvantageous time for the option seller) and limited upside reward (if the holder does not exercise the option and the seller retains the premium).
If the bank has written (sold) options to its customers, the bank may have more downside exposure than upside reward, as the amount of earnings or capital value lost from an unfavorable movement in interest rates may exceed the amount gained if rates move in a favorable direction. Written options positions leave many banks exposed to losses from both rising and falling interest rates.

## Prepayment Options and Convexity

On the asset side of the balance sheet, prepayment options are the most prevalent embedded option. Mortgage prepayments are an option given to homeowners as part of their mortgages at no cost. This contractual right allows homeowners to pay more principal than the scheduled amortized amount (i.e., a curtailment) or to pay off the remaining principal balance entirely (i.e., a prepayment). Curtailments are usually voluntary. Prepayments can be either voluntary (e.g., refinancing an existing mortgage for a better rate or paying off a mortgage upon sale of the home) or involuntary (e.g., full or partial charge-off due to a credit event).

Prepayment speed estimates significantly affect the expected cash flows of a mortgage loan portfolio or mortgage-backed security. Prepayment speeds change in different rate environments, which results in different expected cash flows. Understanding prepayments and their impact on duration, or the measure of the price sensitivity of a fixed-income investment to a change in interest rates, is essential to understanding the earnings and price volatility of mortgage loans and related instruments.

Convexity is a key risk factor related to the price sensitivity of mortgage loans and related securities. Convexity reflects a significant characteristic of optionality and is an important component of IRR. It reflects the change in a security's duration as interest rates and prepayment speeds change. Typically, as market rates increase, prepayment speeds generally slow down and the expected cash flow stream slows down, resulting in a longer time period to return principal, and thus a longer duration. As market rates fall, prepayments increase and the expected cash flow stream increases as more principal is returned sooner, shortening the duration of the asset.

For example, the duration of a five-year instrument (e.g., a mortgage-backed security) at purchase could decline to a two- to three-year duration in the falling rate scenario but increase to an eight- to 10-year duration in the rising rate scenarios. In both falling rate and rising rate markets, the bank experiences adverse change to the mortgage duration. If rates decrease, duration shortens so that the mortgages appreciate less than they would without convexity. If rates rise, duration extends so that the bonds depreciate more than they would without convexity. The bank experiences negative convexity in both cases because prices increase less than expected in the falling rate scenario and the price declines more than expected in the rising rate scenario.

## Interest Rate Caps and Floors

Bank loans that contain interest rate caps or floors are other sources of options risk. Such products may have a significant effect on banks' IRR exposure. The cap or floor rate of interest is the strike price. When market interest rates exceed the cap rate, the borrower's option moves "in the money" because the borrower is paying interest at a rate lower than market. When market interest rates decline below the floor, the bank's option moves "in the money" because the rate paid on the loan is higher than the market rate.

Floating rate loans that do not have an explicit cap may have an implicit one at the highest rate that the borrower can afford to pay. In high-rate environments, the bank may have to cap the rate on the loan, renegotiate the loan to a lower rate, or face a default on the loan. The bank's non-maturity deposits (NMD) also may have implicit caps and floors on the rates of interest that the bank is willing to pay or depositors are willing to accept.

## Early Withdrawal Rights and Deposit Pricing

The liability side of the balance sheet also has significant embedded options. For deposits, the most prevalent option given to customers is the right of early withdrawal. Early withdrawal rights are like "put" options on deposits. When rates increase, the market value of customers' deposits declines, and customers have the right to "put" the deposits back to the bank. For example, if a customer has a 2 year CD with early withdrawal rights, and rates increased at year one, the market value of that CD from the customer's perspective has declined. The customer has the right to "put" (or exercise) the early withdrawal so that he or she can reinvest the funds at market rates. This option is to the depositor's advantage. Management's discretion in pricing retail products such as NMDs can be viewed as a type of option. This option usually works in the bank's favor. For example, the bank might peg its deposits at rates that lag market rates when interest rates are increasing and that lead market rates when market rates are decreasing. The deposit pricing in such cases is a balancing act. If management lags rates by too much (in a rising rate environment), customers will withdraw funds. If management increases deposit rates too much, the bank could pay more than needed to retain the deposits.

### Federal Home Loan Bank Borrowings

Many banks fund assets using borrowings with explicit options. The Federal Home Loan Bank (FHLB) may offer advances that have the option to convert from a fixed rate to a variable rate or to be called by the FHLB. The options are generally held by the FHLB but may be held by the bank. Such borrowings can be very complex and should be analyzed like complex investments. FHLB borrowings can also carry steep prepayment penalties, leaving banks vulnerable to protracted mismatches in a falling rate environment.

## Risk Measurement

Accurate and timely IRR measurement is necessary for monitoring IRR effectively. Risk measurement systems should be appropriate for the bank's size, complexity, and risk profile, and should identify and quantify the major sources and types of IRR. Measurement systems should be commensurate with the nature, mix, and complexity of the bank's balance sheet, products, and activities. IRR measurement that is conducted quarterly, and more frequently as necessary based on the bank's size, complexity, risk profile, and volatility of the interest rate environment, supports effective IRR monitoring.

### Types of Interest Rate Risk Measurement Systems

The most common IRR measurement systems are earnings simulation models, economic value models, and gap reports. Table 1 summarizes the types of IRR exposures that these measurement systems address. Every risk measurement system has limitations. Systems vary in the degree to which they identify and quantify the components of IRR. Well-managed banks use a variety of measurement systems to estimate the bank's IRR exposure.

**Table 1: IRR Measurement Systems**

| Types of risk | Earnings simulation model* | Economic value model** | Gap report |
|---|---|---|---|
| Short-term earnings exposure | Yes | No | Yes |
| Long-term exposure | Limited*** | Yes | Yes |
| Repricing risk | Yes | Yes | Yes |
| Basis risk | Yes | Limited*** | No |
| Yield-curve risk | Yes | Yes | No |
| Options risk | Limited*** | Yes | No |

* Earnings simulation models are also commonly referred to as earnings-at-risk (EAR) models

** Economic value models are sometimes referred to as economic value of equity (EVE), net present value (NPV), or duration of equity models.

*** The ability of these measurement systems to capture this type of risk varies with the measurement system's sophistication and the manner in which management uses it.

Regardless of the measurement system used, the system should be sufficiently robust to capture all material on- and off-balance-sheet positions and incorporate a stress-testing

process to identify and quantify the bank's IRR exposure and potential problem areas. Stress testing, which includes both scenario and sensitivity analysis, is an integral component of IRR management. In general, scenario analysis uses a model to predict a possible future outcome given an event or series of events.[9] The "Risk Measurement" section of this booklet focuses on scenario analysis, and the "Risk Control" section addresses sensitivity analysis.

When measuring risk, management should give special consideration to concentrations in instruments or markets. Positions may be more difficult to liquidate or offset in stressful situations, and concentrations can amplify this risk.

## Earnings Simulation Models

Earnings simulation models, also referred to as earnings-at-risk (EAR) models, use data on the bank's current financial position combined with managerial assumptions to forecast future earnings under differing scenarios. EAR models measure short-term IRR, as they typically focus on the risk to earnings over the next one or two years.

EAR models forecast changes to one or more major earnings perspectives, such as NII or net income (NI). The appropriate earnings perspective for a bank generally depends on the nature and sources of the bank's earnings. For banks with earnings volatility occurring primarily in the NIM, NII could be an appropriate earnings perspective. Banks with significant noninterest income and expense items that are sensitive to changes in interest rates should consider a more bottom-line-oriented earnings perspective, such as NI. For example, a bank with significant mortgage banking activity generally experiences lower origination fees when rates rise because the volume of residential mortgage originations declines.

A key aspect of earnings simulation involves the selection of an appropriate time horizon(s) over which to assess IRR exposures. When using EAR models, IRR exposures are best projected over a two-year period. Using a two-year time frame better captures the true impact of important transactions, tactics, and strategies taken to increase revenues which can be hidden by viewing projected results within shorter time horizons.[10]

The output of a typical EAR model generally includes the following under a number of scenarios:[11]

- Future financial statements (balance sheets and income statements).
- An analysis of the impact of different scenarios on the earnings perspective (NI or NII).
- Graphical representations of the analysis (often useful to communicate the results to the board and senior management).

[9] Refer to OCC Bulletin 2010-1 and Basel Committee on Banking Supervision's *Principles for Sound Stress Testing Practices and Supervision*.

[10] Refer to OCC Bulletin 2010-1.

[11] Refer to the "Developing Scenarios" section of this booklet for more information.

EAR models can be either static or dynamic. Static models are based on the bank's current exposures and assume no growth. In contrast, dynamic models rely on detailed assumptions regarding changes in existing business lines, new business, and changes in management and customer behavior. Both techniques are capable of incorporating assumptions about the future path of interest rates using simple deterministic scenario analysis, more sophisticated stochastic-path techniques, or Monte Carlo simulations.[12]

Dynamic EAR models can be useful for business planning and budgeting purposes. Dynamic simulation is highly dependent on key variables and assumptions that are extremely difficult to project with accuracy over an extended period. Furthermore, model assumptions can potentially hide certain key underlying risk exposures. As such, when performing dynamic simulations, management should also run static simulations to provide a comprehensive view of the bank's IRR exposure.

## Economic Value Models

Economic value models[13] measure the degree to which the economic values of a bank's positions change under different interest rate scenarios. Economic value models focus on a long-term time horizon by capturing future cash flows expected from existing assets, liabilities, and off-balance-sheet items. In contrast with EAR models, economic value models are generally more effective in considering embedded options and identifying risk arising from long-term repricing or maturity gaps.

Economic value models are beneficial in measuring IRR, as they incorporate the complexity of many loan, investment, and deposit products. The two most common measures produced by economic value models are economic value of equity (EVE) and net present value (NPV). The financial performance of many instruments is linked to pricing and cash flow options embedded within those instruments. The impact of some of these options, such as interest rate caps on adjustable rate mortgages, withdrawal options on deposits, and prepayment options on fixed-rate mortgages, is often difficult to accurately predict, particularly if the impact of interest rate changes is evaluated only over a short-term horizon. Therefore, it is important for banks with options risk exposure to focus on both short-term (e.g., EAR) and long-term (i.e., economic value) measures.

Economic value models begin by calculating the net present dollar value of rate-sensitive assets, liabilities, and off-balance-sheet positions. For the purposes of this booklet, economic value can be thought of as the value of an instrument derived from its ability to generate income. In an efficient market, this would be the instrument's observable market value (e.g., Bloomberg option-adjusted spread mortgage prices and FHLB provided advance values).

Some instruments have limited observable market value, and management should generally use a methodology such as discounted cash flow to value these instruments. Reliance solely

[12] Refer to the "Measurement Processes" section of this booklet for more information about the types of scenario analysis and modeling techniques.

[13] Economic value models are sometimes referred to as EVE, NPV, or duration of equity models.

on discounted cash flow models, however, is typically not appropriate for complex banks with significant options risk. In such instances, a more sophisticated method, such as multi-path modeling[14] or option-adjusted pricing, to model positions with significant options risk exposure is appropriate. These positions can be valued outside of the larger economic value model and the results then combined with the rest of the bank's positions and put into the larger economic value model. If portfolios with substantial options risk are significant, examiners should consider whether the entire balance sheet should be modeled using a more sophisticated method/model.

After calculating economic values for all interest-bearing instruments, these values are then netted to arrive at a base EVE or NPV dollar amount. The model then estimates changes in the value of the bank's instruments under different rate scenarios. Because of the difficulty of estimating market values for every product, many economic value models estimate the relative change or sensitivity of EVE or NPV rather than the absolute change in value (e.g., a 5 percent decline in EVE).

## Gap Reports

The gap report was one of the first models used to measure IRR and remains one of the simplest IRR measurement systems. A gap report can be a useful tool to determine a bank's asset or liability sensitivity. Gap reports typically include ratios of rate-sensitive assets (RSA) to rate-sensitive liabilities (RSL) in given time periods. Within a given time band, a bank may have a positive, negative, or neutral gap.

- **Positive gap:** A bank with a positive gap is asset sensitive for the given time band because more assets than liabilities are subject to repricing. An RSA to RSL ratio greater than one suggests that the bank is asset sensitive.
- **Negative gap:** A bank with a negative gap is liability sensitive for the given time band because more liabilities than assets are subject to repricing. An RSA to RSL ratio less than one suggests that the bank is liability sensitive.
- **Neutral gap:** A bank with a neutral gap is neither asset nor liability sensitive for the given time band. An RSA to RSL equal to one equates to a neutral gap.

Gap reports are simple assessment tools and often do not provide an adequate perspective of the bank's overall IRR exposure because they only capture repricing mismatches. Therefore, many banks use a gap report in conjunction with EAR or economic value models. Few

[14] Multi-path modeling is generally referred to as Monte Carlo modeling. Management generates a large number of interest rate paths (generally 500 to 1,000) and models the instruments over all of the rate paths. The cash flows are discounted back to get an estimate value. Another common form of multi-path modeling is option adjusted spread analysis. An option-adjusted spread is the measurement of the spread of a fixed-income security rate and the risk-free rate of return, which is adjusted to take into account an embedded option. Typically, the UST securities yield is used for the risk-free rate. The spread is added to the fixed-income security price to make the risk-free bond price the same as the bond. This analysis generally uses a Monte Carlo process and discounts the cash flows back to determine a spread over a benchmark rate. This analysis is useful to compare similar instruments (e.g., a 4 percent Fannie Mae mortgage-backed security with a 3.5 percent Freddie Mac mortgage-backed security) just as an annual percentage rate is used to compare rates and terms on mortgage loans.

banks' balance sheets are simplistic enough to warrant using only a gap report. A gap report could be appropriate for banks with IRR resulting almost entirely from repricing risk. A bank with a basic balance sheet may use a gap report when complex measurement systems are more burdensome than beneficial. If bank management elects to use only a gap report to measure IRR, it should document or, at a minimum, be able to clearly explain the rationale supporting why using a gap report is adequate based on the circumstances.

## Measurement Processes

To properly measure a bank's IRR, management should gather and input position data, apply assumptions, and compute and quantify risk exposures under various rate scenarios. It is important for management to use accurate and complete data and bank-specific assumptions, or the model's output could be unreliable. Examiners should review and evaluate each phase of the measurement process when assessing the adequacy of the bank's risk measurement system.

Some banks encounter the following challenges or weaknesses in risk measurement processes:

- **Changing products:** The model no longer captures all material sources of the bank's IRR exposure. Banks that have not updated risk measurement techniques for changes in business strategies and products or acquisition and merger activities can experience this problem.
- **Inadequate understanding:** Management does not understand the model's methods and assumptions. Banks that purchase a third-party model and fail to obtain current user guides and source documents that describe the model's implied assumptions and calculation methods may misinterpret model results or have difficulties with the measurement system.
- **Key person risk:** One person in the bank is able to run and maintain the risk measurement system. Should that person leave the bank, the bank may not be able to generate timely and accurate estimates of its risk exposure. Having more than one person in the bank with detailed knowledge of the measurement system can help mitigate key person risk.

### Data Gathering and Aggregation

Every measurement system, whether it is a simple gap report or a complex model, needs information on the bank's current balance sheet composition (sometimes referred to as "providing current position inputs or the chart of accounts"). Management should document the data sources used in the bank's risk measurement system.[15] Data inputs should be accurate and complete for the risk measurement system to produce reliable results. Banks can gain efficiencies by aggregating data, but using data that are not granular enough can produce unreliable model results.

[15] Refer to OCC Bulletin 2011-12, "Sound Practices for Model Risk Management: Supervisory Guidance on Model Risk Management."

The following are common data-related problems in IRR measurement:

- Incomplete data on the bank's operations, portfolios, or branches.
- Data that do not map to a product within the chart of accounts.
- Data that are mapped to an incorrect product within the chart of accounts.
- Lack of information on off-balance-sheet positions.
- Lack of information on caps and floors for loan and deposit products.
- Inappropriate levels of data aggregation.
- Inadequate documentation of the data sources.

Data used in IRR measurement typically includes the following:

- Current balances and contractual interest rates associated with instruments and portfolios.
- Loan type, coupon bands, original maturity, and prepayment characteristics for homogenous whole-loan, fixed-rate portfolios.
- Index, reset periods, margin, caps or floors, and prepayment characteristics for adjustable rate loans.
- Information about material off-balance-sheet positions and rate-sensitive noninterest income sources.
- Specific information about certain products if a more complete picture of the bank's IRR exposure is needed. For example, the age (or vintage) of certain loans, such as mortgages, can affect their prepayment speeds. Consequently, it may be appropriate for management to obtain the origination dates and interest rates of the instruments. The geographic location of the loans or deposits can also help bank management evaluate prepayment or withdrawal speeds. Complex or structured investments should be modeled individually because of their complexity.

Depending on the bank's circumstances and complexity, management may have to obtain information from a variety of systems, including commercial and consumer loan, investment, and deposit systems (collectively, transaction systems). General ledgers may be used to check the integrity of information pulled from transaction systems. Information from the general ledger system by itself generally does not contain sufficient detail on the maturity and repricing characteristics of the bank's instruments.

Automation of data inputs, to the extent possible, can help reduce the possibility of errors. The bank should have sufficient management information systems (MIS) to allow management to retrieve accurate data in a timely manner. Data mapping, an application or process that creates links between bank data source systems and the model, reduces the possibility of errors. Because data mapping issues can arise, however, data mapping should be reviewed and tested as appropriate.

**Data Aggregation**

Management typically performs preliminary data aggregation before putting the data into the bank's IRR models for ease of use and computing efficiency. The extent of data aggregation varies from bank to bank and from portfolio to portfolio within a bank. Data should be

appropriately aggregated or stratified such that material holdings of instruments with similar risk characteristics are grouped together or instruments are modeled individually when appropriate.

Significant holdings of adjustable rate mortgages should be differentiated by, for example, balances by periodic and lifetime caps, the reset frequency of mortgages, and the market index used for rate resets. Significant holdings of fixed-rate mortgages should be stratified by, for example, balances by coupon levels to reflect differences in prepayment behaviors. Some banks use a tiered pricing structure for interest-bearing NMDs. Such tiered pricing is generally based on the size of deposit balances. The differentiated pricing results in differentiated runoff and price sensitivity characteristics of various tiers.

Some banks input each instrument for certain portfolios. For example, the cash flow characteristics of certain complex collateralized mortgage obligations or structured notes should generally be at the instrument level so they can be modeled separately.

## Developing Stress Scenarios

A bank's risk measurement systems should measure IRR exposure in various conditions through stress tests.[16] IRR exposure is a function of the sensitivity of the bank's instruments to a given change in interest rates and the magnitude and direction of the change in interest rates. Therefore, the scenarios management develops are usually shaped by these two variables.

Some common problems in this step of the risk management process include the following:

- Failing to assess the potential risk exposures over a sufficiently wide range of interest rate movements to identify vulnerabilities and stress points.
- Failing to consider the bank's strategic or growth plans.
- If the bank uses a dynamic model, failing to also run a static model.

Scenarios should cover a range of outcomes that are sufficiently meaningful to fully identify repricing, basis, yield curve, and options risks. In many cases, static interest rate shocks consisting of parallel shifts in the yield curve of plus or minus 200 basis points may not be sufficient to adequately assess IRR exposure. Because of this, management should regularly assess IRR exposures beyond typical industry conventions, including changes in rates of significant magnitude (e.g. up and down 300 and 400 basis points) across different tenors to reflect changing slopes and twists of the yield curve.[17] Scenarios should be severe but plausible in light of the current level of interest rates and the interest rate cycle. For example, in low-rate environments, scenarios involving significant declines in market rates can generally be deemphasized in favor of increasing the number and size of alternative rising-rate scenarios.

[16] Refer to OCC Bulletin 2010-1.

[17] Ibid.

Depending on the bank's risk profile, stress scenarios should typically include the following:

- Instantaneous shocks and significant changes in the level of interest rates.
- Substantial changes in rates over time (i.e., prolonged rate shocks).
- No changes in rates over time (i.e., prolonged static rate environment).
- Changes in the relationship between key market rates (i.e., basis risk).
- Changes in the slope and shape of the yield curve (e.g., flattening, steepening, non-parallel shifts, or inversion).
- Negative interest rate scenarios (in low-interest rate environments).
- Short rate shocks both up and down.

Changes to the capital rule revised the definition of "internationally active" banks from assets equal to or greater than $250 billion to any bank with total assets equal to or over $700 billion or cross-jurisdictional activity equal to or greater than $75 billion. For these banks, management should run, at a minimum, the six prescribed scenarios (parallel up, parallel down, short rates up, short rates down, flattener shock [short rates up and long rates down], and steepener shock [short rates down and long rates up]) for EVE and parallel up and down for NII instituted by the Basel Pillar 2 approach for IRR in the banking book. Refer to annex 2 of the Basel Committee on Banking Supervision's *Interest Rate Risk in the Banking Book* (April 2016) for the six scenarios.

Banks with significant options risk should include scenarios that capture the exercise of such options. For example, banks that have material exposure to products with caps or floors should include scenarios that assess how the bank's risk profile would change if those caps or floors become binding. Because the market value of options fluctuates with changes in the volatility of rates as well as with changes in the level of rates, such banks should also measure their exposure to changes in rate volatility.

Non-complex banks (e.g., banks with limited embedded options or structured products on their balance sheet) may be able to justify running fewer or less intricate scenarios, depending on their IRR profile. Interest rate shocks of sufficient magnitude should be run, regardless of the bank's size or complexity.

Administered rates (rates that are set by management and not market-driven), which often move more slowly than market rates, include rates such as the bank's prime rate and rates it pays on consumer deposits. Therefore, when developing scenarios, it is important to estimate how administered rates might change. Management should document support for how these estimates are determined.[18]

Banks generally use one of the following methods to develop interest rate scenarios:

- **Deterministic approach:** Using this common approach, management specifies the amount and timing of the rate changes to be evaluated. Banks using this approach typically establish standard scenarios for their risk analysis and reporting, based on

[18] Ibid.

estimates of the likelihood of interest rate movements. Banks may include an analysis of the exposure under a "most likely" or flat-rate scenario for comparative purposes. These standard rate scenarios are then supplemented periodically with stress-test scenarios.
- **Stochastic approach:** Developed out of options and mortgage-pricing applications, this approach employs a simulator model to randomly generate interest rate scenarios. Typically, numerous interest rate scenarios or paths are evaluated. Models using this approach generate a distribution of outcomes or exposures. Banks use these distributions to estimate the probabilities of a certain range of outcomes. For example, management might determine that it wants to have 95 percent confidence that NI over the next 12 months will not decline by more than a certain amount.

In building a rate scenario, management should specify the

- term structure of interest rates that is incorporated in its rate scenario.
- "basis" relationships between yield curves and rate indexes (e.g., the spreads among UST rate and CD rates).

## Developing Behavioral and Pricing Assumptions

IRR measurement systems use assumptions about how an instrument's actual maturity or repricing behavior could vary from its contractual terms. Assumptions have a significant impact on the measurement of earnings and economic value at risk. Management should document, monitor, and regularly update key assumptions. Assumptions should be indicative of the bank's balance sheet and likely customer behavior.[19]

Model assumptions should be consistent, reasonable for each scenario, and aligned with the bank's experience. For example, assumptions about mortgage prepayments should vary with the scenario and reflect customers' economic incentives to prepay the mortgage in that interest rate environment.

Typical information sources used to help formulate assumptions include

- a historical trend analysis of portfolio and individual account behavior (i.e., deposit studies).
- bank- or third party-developed prepayment models.
- dealer or third-party estimates.
- managerial and business unit input about business and pricing strategies.

Some common problems in developing assumptions include the following:

- Failing to modify or vary assumptions for products with embedded options to be consistent with individual rate scenarios.

[19] Ibid.

- Basing assumptions solely on past customer behavior and performance without considering actual or potential changes in the bank's competitive market and customer base.
- Using third party-supplied or industry assumptions without determining the reasonableness for the bank.
- Failing to periodically reassess the reasonableness and accuracy of assumptions.

Assumptions are especially important for products that have unspecified maturity or repricing dates, such as NMDs, credit card loans, and some credit lines. Management should estimate the date on which these balances will likely reprice, migrate to other bank products, or run off. In doing so, management should consider relevant factors, including the current level of interest rates, the spread between the bank's offering rates and market rates, the bank's competition, and the characteristics of the bank's customer base.

Documentation is necessary to understand how a model is built and to validate that assumptions are properly designed. Such documentation, which usually describes the types of analyses used in developing the assumptions, facilitates the periodic review of assumptions. Documentation also helps to ensure that more than one person in the bank understands how assumptions were derived. The volume and detail of documentation should be consistent with the significance of the risk and the complexity of the analysis. For non-complex banks, documentation typically includes an analysis of historical account behavior and comments about pricing strategies, competitor considerations, and relevant economic factors. Complex banks often use more rigorous and statistically based analyses. The board or an appropriate board committee should review the bank's key assumptions and their impact on the bank's models at least annually.

Refer to OCC Bulletin 2010-1,"Interest Rate Risk: Interagency Advisory on Interest Rate Risk," and OCC Bulletin 2011-12, "Sound Practices for Model Risk Management: Supervisory Guidance on Model Risk Management," for guidance regarding model assumptions.

**Non-Maturity Deposit Assumptions**

NMD assumptions are one of the most vital assumptions in an IRR model because NMDs usually represent a large portion of the bank's funding base and depositors' behavior can vary considerably. NMD assumptions are particularly critical in market environments in which customer behaviors may not reflect long-term economic fundamentals or in which banks are subject to heightened competition for such deposits.

Key NMD assumptions generally include deposit price sensitivity assumptions (e.g., betas) and runoff assumptions (e.g., decay rates). Betas are estimates of the change in an instrument's pricing versus the change in market rates. For example, if market rates increase 100 basis points and the rate on a bank's money market accounts increases 80 basis points, this would equal a beta of 80 percent. Decay rates represent the level of deposit runoff over a given time period.

Examiners should not expect every bank to treat NMDs the same, as their characteristics can vary based on the bank's competitive market, its position in that market, and the nature of its customer base. Examiners should determine whether management has analyzed the bank's deposit base and formulated and documented reasonable assumptions given the bank's performance and its current marketing, funding, and pricing strategies.

Management should identify stable and nonstable deposits when developing NMD assumptions. Data used to develop assumptions should be captured over a reasonable time frame, and management should consider changes in dollar volumes as well as changes in the number of accounts when determining decay rates.[20] NMD assumptions are typically based on one or a combination of the following:

- Historical trend analysis of bank data.
- Industry or third-party sourced analysis that includes data from multiple firms.
- Line of business assumptions for betas, decay rates, and truncation points (i.e., where data are cut off because they are not statistically relevant).
- Line of business analysis supported by behavioral data and pricing methodologies.

Generally, rate-sensitive and higher-cost deposits, such as brokered and internet deposits, would reflect higher decay rates than other types of deposits. Also, banks with current or projected capital levels that trigger brokered and high interest rate deposit restrictions should adjust deposit assumptions accordingly.[21]

**Prepayment Assumptions**

Loan prepayment assumptions are also a critical component of IRR models. Prepayment assumptions reflect the expected rate of loan prepayments (i.e., prepayment speeds). These primarily affect mortgage loans and mortgage-related securities. Whether valuing a pool of loans or a security backed by a pool of loans, prepayment assumptions affect the cash flow projections and consequently, the value estimate of the mortgage-related instruments.

A prepayment speed is expressed as a percentage of the outstanding principal balance. These are the three most common prepayment speed metrics:

- **Constant or conditional prepayment rate (CPR):** The annualized percentage of a mortgage pool that is expected to be prepaid in one year. This assumes a constant rate for prepayment (i.e., after every coupon, a constant percentage of the mortgages is prepaid.)

[20] Ibid.

[21] Deposit rate restrictions prevent a bank that is not "well capitalized" as defined in 12 CFR 6, "Prompt Corrective Action," from circumventing the prohibition on brokered deposits by offering rates significantly above market in order to attract a large volume of deposits quickly. As a general rule, a bank that is not well capitalized may not offer deposit rates more than 75 basis points above average national rates for deposits of similar size and maturity. Refer to Federal Deposit Insurance Corporation FIL-42-2016, "Frequently Asked Questions on Identifying, Accepting and Reporting Brokered Deposits," for more information. Refer also to 12 USC 1831f, "Brokered Deposits"; 12 CFR 303.243, "Brokered Deposit Waivers"; and 12 CFR 337.6, "Brokered Deposits."

- **Single month mortality rate:** The monthly rate of CPR.
- **100 percent Public Securities Association (PSA) model:** Developed by the former PSA, the PSA model assumes increasing prepayment rates for the first 30 months of the instrument's lifetime and constant rates thereafter. The standard model (also called "the 100 percent PSA model") starts with an annualized prepayment rate of 0 percent in month 0, the rate then increases by 0.2 percent each month until it peaks at 6 percent after 30 months. From the 30th month forward, the model assumes an annual conditional prepayment rate of 6 percent. A PSA prepayment speed of 100 is equal to 6 percent CPR.

Prepayment speed assumptions significantly affect the expected cash flows of a mortgage loan portfolio or mortgage-backed security. Prepayment speeds change in different rate environments, which results in different expected cash flows. Understanding prepayments and their impact on duration (measure of the price sensitivity of a fixed-income investment to a change in interest rates) is essential to understanding the earnings and price volatility of mortgage loans and related instruments.

Prepayment speeds should change based on the scenario being applied. When reviewing prepayment assumptions, examiners should remember that it is not possible to accurately predict all prepayments. Typically, a low rate environment motivates borrowers to refinance their loans, producing higher prepayment speeds; however, actual prepayments do not adhere to steady patterns like those embodied in models. Instead, prepayments can be erratic and volatile. Management should understand the nature of prepayment risk for the bank's portfolio, make reasonable estimates of expected prepayments, and properly document those assumptions.[22]

## Assumption Governance

Management should evaluate key assumptions for reasonableness at least annually and more frequently during rapidly changing market conditions or when other material changes occur. Market conditions, competitive environments, and strategies change over time, which can cause assumptions to lose their validity. For example, if the bank's competitive market has changed such that customers face lower transaction costs for refinancing their residential mortgages, prepayments could be triggered by smaller reductions in interest rates than in the past. Similarly, as bank products go through their life cycles, management's business and pricing strategies for the product may change.

Management's review of key assumptions should include an assessment of the impact of those assumptions on model outputs. This type of assessment can be done by performing sensitivity analyses that examine what the bank's exposure would be under a different set of assumptions. By conducting such analyses, management can determine which assumptions are most critical and warrant more frequent monitoring or more rigorous methods to assess their reasonableness. Additionally, sensitivity analysis can be used to determine the conditions under which key assumptions and model parameters break down or when IRR may be exacerbated by other risks or earnings pressures. Sensitivity testing of assumptions

[22] Refer to OCC Bulletin 2010-1.

for illiquid instruments and instruments with uncertain maturities (e.g., NMDs) is particularly critical to understanding the bank's risk profile.

For guidance on assumption governance, refer to OCC Bulletin 2010-1 and OCC Bulletin 2011-12.

## Computing Risk Levels

The last step in the risk measurement process is calculating the bank's risk exposures. The data inputs are used in conjunction with management's assumptions to generate expected maturities, cash flows, or earnings estimates, under different interest rate scenarios. The manner in which risk is quantified depends on the methods of measuring risk. Management should be able to explain the difference between the current balance sheet, base case, and the scenario results.

### Calculating Risk to Earnings

When measuring risk to earnings, a model focuses on NII or NI, which would include inputs for rate sensitive fee income. When calculating for NII, the model is similar to a budget or forecasting model. The model multiplies projected average rates by projected average balances. The projected average rates and balances are derived from the bank's current positions and its assumptions about future interest rates, maturities and repricing of existing positions, and growth assumptions.

Rate sensitive fee income or the risk to earnings arising from interest sensitive fee income or operating expenses are also often included in model outputs. Examples include mortgage servicing fees and income arising from credit card securitization.

EAR models also calculate marked-to-market gains or losses on trading or dealing positions. These calculations are often performed in a separate market valuation or subsystem of the model and projects all expected future cash flows. It discounts those cash flows back to a present value and calculates NPVs under different rate scenarios.

### Calculating Risk to Capital

Banks should calculate their exposures to the effect of interest rate changes on their economic value. Economic value is generally more sensitive to changes in interest rates for banks with longer-term positions and positions with embedded options. The appropriate method for assessing a bank's long-term exposures depends on the maturity and complexity of the bank's assets, liabilities, and off-balance-sheet activities.

Banks can measure the volatility of long-term IRR exposures using a variety of methods. To quantify its EVE exposure, a bank generally either uses duration-based models (where duration is a proxy for market value sensitivity) or market (economic) valuation models. These models are essentially a collection of present value calculations that discount the cash flows derived from the current position and assumptions for a specified interest rate scenario.

Static discounted cash flow models are associated with deterministic models. In deterministic models, the user designates an interest rate scenario, and the model generates an exposure estimate for the scenario. Stochastic models use rate scenarios that are randomly generated. Exposure estimates are then generated for each scenario, and an estimate of expected value can be calculated from the distribution of estimates (common forms of stochastic models are Monte Carlo and binomial interest rate trees).

Although stochastic models require more expertise and computing power than deterministic models, they produce more comprehensive estimates for options and products with embedded options. The value of most options increases continually as interest rates approach the option's strike price and the probability of the option going "into the money," or being exercised, likewise increases continually. Stochastic models capture this effect because they calculate an expected value of future cash flows derived from a distribution of rate paths. Deterministic models, in contrast, view an option unrealistically as riskless until the predetermined rate path rises above the strike price, at which point the exposure estimate suddenly becomes very large. Stochastic models, because they are path dependent, capture the impact of option exercise. Deterministic models may not capture this at all depending on the assumptions chosen and could mask material IRR.

# Risk Monitoring

Risk monitoring is a vital component of IRR oversight. Monitoring is the process for management and the board to confirm consistency with the bank's risk appetite. Senior management and the board should have reporting systems that enable them to monitor current and potential risk exposure and to determine whether those levels are consistent with established risk tolerances. Bank management should periodically review and evaluate the bank's strategies for appropriateness and consistency with the bank's risk appetite.

## Interest Rate Risk Reporting

Banks should have an adequate system for reporting risk exposures. Senior management and the board (or a board committee) should receive reports on the bank's IRR profile at least quarterly, or more frequently, depending on the level and direction of risk.[23] Reports should allow senior management and the board to do the following:

- Evaluate the level and trends of aggregate IRR exposure.
- Assess the consistency of management's strategies with the established risk appetite, including verifying compliance with established risk tolerance levels and limits.
- Identify policy exceptions.
- Evaluate the sensitivity of key assumptions.
- Determine whether the bank holds sufficient capital for the level of IRR being taken.
- Evaluate the trade-offs between risk levels and performance. When management considers major interest rate strategies (including no action), it should assess the impact

[23] Refer to OCC Bulletin 2010-1.

of potential risk (an adverse rate movement) against that of the potential reward (a favorable rate movement).

Reports provided to the board and senior management should be clear, concise, and timely and provide the information needed for decision making. The board should receive reports on the bank's risk management and control activities, such as audit reports, independent risk management reports, independent valuations of products used for IRR management (e.g., derivatives and investment securities), and model validation results.

## Risk Limits

The board sets the bank's risk appetite, which drives IRR tolerance and corresponding risk limits. Senior management should establish risk limits over a range of possible changes in interest rates to help determine that the bank's IRR remains within the established risk appetite. Limits should be consistent with the bank's approach to measuring IRR, risk appetite, and the bank's size, complexity, earnings performance, and capital adequacy. Banks should have limits for both EAR and EVE/NPV. The bank should have procedures for positions that exceed limits. If positions exceed limits, they should receive prompt management attention and be escalated to senior management or the board depending on severity.

Examiners should identify and evaluate the types of limits used to control IRR. In particular, examiners should determine whether the bank's limits are effective methods for both controlling the bank's exposure and maintaining IRR exposure with the board's expressed risk appetite. Examiners also should assess the appropriateness of the level of risk allowed under the bank's risk limits in view of the bank's financial condition, risk profile, capital base, and the quality of its risk management practices and managerial expertise.

In general, limits should be reasonable (e.g., not so high that they will likely never be breached nor so rigid that they are routinely exceeded). If risk limits seem high or are breached frequently, management should have strong support for the appropriateness of the limits. For example, refer to table 2, which shows that bank C's risk limits are the most appropriate, whereas bank A's are too lax and bank B's are often breached. For both bank A and bank B, management should be able to provide strong support for the appropriateness of the established limits. In bank A's case, management should be able to demonstrate why the limits are consistent with the board's risk appetite given that actual IRR exposure is consistently significantly less than set limits. In bank B's case, management should be able to show what caused the breaches and any plans to bring exposures back within limits. Management should be able to clearly articulate why exposures exceed limits and why management and the board are comfortable with these risk limits given the bank's IRR exposures and earnings and capital support.

**Table 2: Example of Earnings-at-Risk IRR Exposures and Risk Exposure Limits (in Percentages)**

| Which risk limit is more appropriate? | | | | | | |
|---|---|---|---|---|---|---|
| | Bank A | | Bank B | | Bank C | |
| Year | IRR exposure | Risk limit | IRR exposure | Risk limit | IRR exposure | Risk limit |
| 1 | 2.4 | 15 | 14.1 | 10 | 10.2 | 12 |
| 2 | 2.9 | 15 | 12.2 | 10 | 11.3 | 12 |
| 3 | 2.5 | 15 | 13.7 | 10 | 8.5 | 12 |
| 4 | 1.9 | 15 | 11.6 | 10 | 13.6 | 12 |
| 5 | 1.8 | 15 | 9.4 | 10 | 10.4 | 12 |
| 6 | 2.1 | 15 | 10.6 | 10 | 9.6 | 12 |

Source: OCC

Many banks use a combination of limits to control IRR exposures. These include primary limits on the level of reported EAR and economic value at risk (for example, the amount by which NI and economic value may change for a given interest rate scenario) as well as secondary limits. Secondary limits often include volume limits for maturities, coupons, markets, or instruments. Typically, larger banks use both primary and secondary limits while smaller banks have only primary limits.

The process for identifying, reporting, escalating, and correcting/accepting limit breaches is important and helps shed light on the bank's risk management approach. The bank should have appropriate processes, including documentation of expectations and the designation of parties responsible for identifying, reporting, escalating, and correcting/accepting limit breaches.

## Earnings-at-Risk Limits

EAR limits are designed to control the risk to the bank's earnings in specified rate scenarios. Limits are usually expressed as a change in projected earnings (in dollars or percent) over a specified time horizon and rate scenario. Management typically computes EAR limits relative to NII and/or NI.

## Equity-at-Risk Limits

Equity-at-risk limits should reflect the size and complexity of the bank's underlying positions. For banks with few holdings of complex instruments and low-risk profiles, limits on permissible holdings or allowable repricing mismatches in intermediate- and long-term instruments may be adequate. At more complex banks, or banks with higher risk profiles, more extensive limit structures may be necessary. Banks that have significant intermediate- and long-term mismatches or complex options positions should establish limits to restrict possible losses of economic value or capital. Limits should identify the equity ratios under the various scenarios. Limits are often expressed in terms of the relative change or sensitivity of EVE or NPV (e.g., percent decline in EVE) rather than the absolute change in value.

### Gap Limits

Gap limits are designed to control the volume or amount of maturity or repricing imbalances in a given time period. Gap limits are typically expressed as the ratio of RSA to RSL in a given time period. Other gap limits that banks might use to control exposure include gap-to-assets ratios, gap-to-equity ratios, and dollar limits on the net gap.

Although gap limits can be a useful way to limit the bank's repricing risk, they are not an effective method of controlling a bank's overall IRR except for the least complex banks. If a bank relies solely on gap measures, management should explain the level of earnings and capital at risk that are implied by the bank's gap exposures.

## Evaluating and Implementing Strategies

In well managed banks, management looks not only at the risk arising from the bank's existing businesses but also at exposures that could arise from expected business growth or asset-liability management strategies. The bank's risk management and strategic planning personnel should communicate regularly to facilitate evaluations of risks arising from future business.[24]

EAR analyses can include assumptions about the type and mix of activities and businesses as well as the volume, pricing, and maturities of future businesses. Typically, strategic plans, marketing strategies, budgets, and historical trend analyses help management to formulate these assumptions. Some banks include new business assumptions in analyzing the risk to the banks' economic value. To do so, management first quantifies the sensitivity of the bank's EVE to the risks posed by its current positions. Then, management recomputes EVE sensitivity as of a future date, under a projected or pro forma balance sheet.

Although growth assumptions introduce yet another subjective factor to the risk measurement process, they help management to anticipate future risk exposures. When incorporating assumptions about new and changing business mix, management should assess whether the assumptions are realistic for the rate scenario being evaluated and whether they are attainable given the bank's competition and overall business strategies. In particular, overly optimistic assumptions that could mask the bank's IRR from its existing balance sheet should be avoided. For example, to improve the bank's earnings in a rising rate scenario, management might increase the volume of the bank's floating rate loans and decrease fixed-rate loans. Such a restructuring, however, can take considerable time and effort, given the bank's overall lending strategies, customer base, and customer preferences. Therefore, management should run both static and dynamic simulations to fully capture the range of the bank's IRR exposures.[25]

Larger, more complex banks typically develop specific strategies to actively manage the bank's risk exposures. These strategies can include decisions to buy or sell specific

[24] Refer to OCC Bulletin 2010-1.

[25] Ibid.

instruments or from certain portfolios, strategic decisions for business lines, maturity or pricing strategies, and hedging or risk transformation strategies using derivative instruments. The bank's IRR model may be used to test or evaluate strategies before implementation. Special subsystems or models may be employed to analyze specific instruments or strategies, such as derivative transactions or acquisitions of banks with products that could have a significant impact on the IRR profile of the acquiring bank. The results from these models may be entered into the overall IRR model. Hedging strategies should be designed to limit downside earnings exposure or to manage income volatility.

Examiners should review and discuss with management the bank's process for evaluating potential IRR exposures of new products or future business plans. Examiners should assess whether the bank's assumptions about new activities are realistic and attainable. In addition, examiners should review the bank's IRR strategies to determine whether they are consistent with the stated goals and objectives of senior management and the board.

### Trade-Offs in Managing Earnings and Economic Value Exposures

Management makes certain trade-offs in managing the bank's earnings and economic value at risk. When management focuses on preserving short-term earnings, economic value generally becomes more vulnerable, and vice versa. The net economic value of the bank's balance sheet, like that of other financial instruments, is a function of the discounted net cash flows that the bank is expected to earn in the future. If the bank has managed its short-term earnings such that earnings are expected to remain constant for any change in interest rates, the discounted value of those earnings from an economic perspective will generally be lower if interest rates rise. Conversely, if the bank fully manages its economic value, its short-term earnings would typically increase when rates rise and decline when interest rates fall. Many banks that limit the sensitivity of their economic value do not set a zero-risk tolerance (i.e., try to maintain current economic value at all costs) but rather set limits around a range of possible outcomes.

Appendix A of this booklet further illustrates the distinctions between the earnings and economic perspectives.

## Control Systems

Control systems are the functions (such as internal and external audits, risk review, quality control, and quality assurance) and information systems that bank managers use to measure performance, make decisions about risk, and assess the effectiveness of processes and personnel. Management or staff responsible for control functions should be independent from the line units or individuals who take or create IRR.

Each step of the IRR measurement process should be reviewed and validated for integrity and reasonableness. This is often performed by a number of different units in the bank, including the ALCO or treasury staff (regularly and routinely), and a risk control unit that has oversight responsibility for IRR modeling. Internal and external auditors also can

periodically review the bank's process. At smaller banks, outsourced internal auditors or consultants often conduct independent reviews and validations.

Examiners should identify the units or individuals responsible for validating or auditing important steps in the IRR measurement process. Examiners should review recent audit reports and work papers and model validation reports to assess the sufficiency of reviews and their coverage.[26]

## Model Risk Management

This section of this booklet addresses model risk management specifically related to IRR modeling. The effectiveness of IRR management is highly dependent on the validity of model(s) used to measure IRR. OCC Bulletin 2011-12 describes a model in the following way:

> … [t]he term *model* refers to a quantitative method, system, or approach that applies statistical, economic, financial, or mathematical theories, techniques, and assumptions to process input data into quantitative estimates. A *model* consists of three components: an information input component, which delivers assumptions and data to the model; a processing component, which transforms inputs into estimates; and a reporting component, which translates the estimates into useful business information. Models meeting this definition might be used for analyzing business strategies, informing business decisions, identifying and measuring risks, valuing exposures, instruments or positions, conducting stress testing, assessing adequacy of capital, managing client assets, measuring compliance with internal limits, maintaining the formal control apparatus of the institution, or meeting financial or regulatory reporting requirements and issuing public disclosures. The definition of *model* also covers quantitative approaches whose inputs are partially or wholly qualitative or based on expert judgment, provided that the output is quantitative in nature.

The use of models invariably presents model risk, which is the potential for adverse consequences from decisions based on incorrect or misused model outputs and reports. Model risk occurs primarily for two reasons:

- The model may have fundamental errors and may produce inaccurate outputs. Errors can occur at any point in the modeling process, from design through implementation. Additionally, the quality of model outputs depends on the quality of input data and assumptions—errors in inputs or incorrect assumptions can result in inaccurate outputs. Data or assumption errors can be caused by human error and system issues.

[26] Refer to the "Internal and External Audits" booklet of the *Comptroller's Handbook* and OCC Bulletin 2011-12.

- The model may be used incorrectly or inappropriately. Decision makers should understand the limitations of the models to avoid using models inconsistent with the original intent.

Model risk management programs should promote the accuracy of the measurement system. Sound model risk management includes robust processes for model development, implementation, and use; a sound model validation process; and governance, policies, and controls.

Model risk management should be included in bank policies; this may be in the bank's IRR policy or a stand-alone model risk management policy. Such policies should be reviewed and approved by the appropriate board function at least annually. The policy should address staffing needs and who is responsible for model oversight, evaluating results, and development of the validation procedures. The policy should address the expected validation and independent review activities and set the frequency and extent of the reviews.

Internal audit should include model reviews in the audit risk assessment and audit plans. Internal audit should not necessarily duplicate model risk management processes but should determine whether the bank's model risk management is effective.

## Third-Party Model Considerations

Many banks use third-party IRR models. Management should conduct appropriate due diligence when selecting a third-party model. Management should have sufficient knowledge concerning the model's processes, operations, and outputs. Management should also develop contingency plans in the event that third-party models become unavailable.[27]

Third-party models are typically designed to provide a range of capabilities and generally need some level of customization for each bank. Management should document and justify the customization decisions. If a third-party provides behavioral and pricing assumptions, management should have a process to determine whether these assumptions are reasonable for the bank and customize the assumptions when necessary. Refer to the "Developing Behavioral and Pricing Assumptions" and "Assumption Governance" sections of this booklet for more information.

While banks are generally not expected to test the mechanics and mathematics of third-party IRR models, the bank should review documentation from the third party that a credible independent party has performed such a validation (often referred to as a model certification). Banks should not rely solely on the model certification provided by the third party and should also validate their use of the model as discussed in the "Model Validation and Back-Testing" section of this booklet.[28]

[27] Refer to OCC Bulletin 2013-29, "Third-Party Relationships: Risk Management Guidance," and OCC Bulletin 2017-21, "Third-Party Relationships: Frequently Asked Questions to Supplement OCC Bulletin 2013-29."

[28] Refer also to OCC Bulletin 2010-1 and OCC Bulletin 2012-5, "Interest Rate Risk Management: FAQs on 2010 Interagency Advisory on Interest Rate Risk Management."

## Model Validation and Ongoing Monitoring

IRR model validation and ongoing monitoring should be sufficiently robust to confirm that the model is reliable, functioning as intended, and appropriate for the bank's risk profile. Validation and ongoing monitoring should include the following:[29]

- **Process verification to confirm that data inputs are accurate, complete, and consistent with model purpose and design.** This includes verifying that balances and terms are correctly specified and that all major instruments, portfolios, and business units are captured in the model. The review should investigate whether data extracts and model inputs have been reconciled with transactions and general ledger systems. It is acceptable for parts of the reconcilement to be automated; for example, routines may be programmed to investigate whether the balances being extracted from various transaction systems match the balances recorded on the bank's general ledger. Similarly, models often contain audit checks to confirm, for example, that maturing balances do not exceed original balances. More detailed, periodic reviews or audit testing of specific portfolios may be performed by the ALCO, independent risk management, or the bank's auditors.
- **Reasonableness of scenarios and assumptions.** Reviews should assess the appropriateness of the interest scenarios and assumptions as well as the adequacy of the process management uses to select the scenarios and assumptions. Reviews should include the statistical methods that were used to generate scenarios and assumptions (if applicable) and whether senior management reviewed and approved key assumptions.
- **Ongoing monitoring and outcomes analysis to evaluate model performance, confirm that the model is appropriately implemented, and confirm the model is being used and functioning as intended (i.e., back-testing).** Back-testing is often conducted by comparing actual results with the model's projections. For EAR models, management typically compares projected and actual NI, NII, or earnings per share (EPS). Performing back-testing of an economic value model can be more difficult because market prices for all instruments are not always readily available, and the bank does not routinely mark its entire balance sheet to market. For instruments or portfolios with readily observable market prices, these prices are often used to benchmark or check model assumptions. Management can use back-testing results to determine whether differences between forecasted and actual results stem from errors in model setup, model assumptions, or other factors such as market changes. Management should evaluate whether changes in such variables as products, activities, or market conditions warrant adjusting or replacing the model.

The scope and formality of model validation depend on the bank's size, complexity, and risk profile as well as the nature and complexity of the model. At large banks, internal and external validation functions or auditors may have their own models against which the banks' models are tested. Large or complex banks, and banks with complex measurement systems, should have the model or calculations audited or validated by an independent party such as independent risk management, auditors, or consultants. At small and less complex banks,

[29] Refer to OCC Bulletin 2011-12, OCC Bulletin 2010-1, and OCC Bulletin 2012-5.

periodic comparisons of actual performance with forecast may be sufficient but should be performed at least annually.

# Supervisory Review of Interest Rate Risk

In forming conclusions about the effectiveness of IRR management and risk resulting from IRR exposures, examiners should consider

- the complexity and level of risk posed by the assets, liabilities, and off-balance-sheet activities.
- the adequacy and effectiveness of board and senior management oversight.
- management's knowledge and ability to identify and manage sources of IRR.
- the adequacy of measurement systems, monitoring, and reporting.
- the adequacy of risk limits.
- the adequacy and frequency of the bank's internal review and audit of its IRR management process, including independent model validation.
- the effectiveness of risk management practices and strategies as evidenced in past and projected financial performance.
- the appropriateness of the level of IRR in relation to the earnings, capital, and risk management systems.
- for banks that have $700 billion or more in total assets or cross-jurisdictional activity equal to or greater than $75 billion, EVE reduction in any rate shock scenarios that exceed 15 percent of the bank's tier 1 capital should be highlighted as these would be considered outlier banks according to the Basel Committee on Banking Supervision's *Interest Rate Risk in the Banking Book.*[30]

Examiners should evaluate whether the bank has an earnings stream and capital base that are commensurate with the level of short- and long-term IRR exposures and the risk those exposures pose to the bank's future condition, including financial performance and risk profile. Management should have in place contingency plans for reducing excessive IRR exposures, which could include changing the balance-sheet mix, raising additional capital, or other strategies to reduce risk. Examiners should consider the following factors:

- **Strength and stability of the bank's earnings stream and level of income the bank needs to generate to support normal business operations.** High IRR exposure could, under a reasonable range of interest rate scenarios, result in the bank reporting losses or curtailing normal dividends and business operations. In such cases, management should demonstrate that the bank has adequate capital and liquidity to withstand the possible adverse impact of such events until it can implement corrective action, such as reducing IRR exposures or increasing capital.
- **Current and potential depreciation in the bank's underlying economic value due to changes in interest rates.** When the bank has significant unrealized losses in its assets because of interest rate changes (e.g., depreciation in its investment or loan portfolios), examiners should evaluate the impact that such depreciation, if recognized, could have on the bank's capital. In making this determination, examiners should consider the degree to which the bank's liabilities or off-balance-sheet positions could offset the asset

[30] Refer to the Basel Committee on Banking Supervision's *Interest Rate Risk in the Banking Book*, Principle 12.

depreciation. Such offsets could include NMDs that management can demonstrate represent a stable source of fixed-rate funding. Alternatively, the bank may have entered into an interest rate swap contract enabling the bank to pay a fixed rate of interest and receive a floating rate of interest. This type of swap contract essentially transforms the bank's floating rate liabilities into a fixed-rate source of funds. A bank with moderate or high IRR exposure should consider such exposure when developing scenarios analysis as part of its capital planning process.[31]

- **Exposure to other risks that could impair the bank's capital.** Examiners should consider the entire risk profile of the bank relative to its capital. The OCC expects all banks to maintain adequate capital for the risks they undertake. Banks typically maintain capital above regulatory minimum requirements[32] to align capital with their risk profiles. Examiners should not automatically assume that a bank that is "well-capitalized" under 12 CFR 6 has sufficient capital in relation to its risks. For example, if a bank is experiencing a credit quality deterioration (e.g., a high level of nonperforming loans), the bank's capital could provide little to no support for IRR exposures.[33]

[31] Refer to the "Capital Planning" section of the "Capital and Dividends" booklet of the *Comptroller's Handbook* for more information.

[32] Refer to 12 CFR 3.10, "Minimum Capital Ratios."

[33] Refer to the "Capital and Dividends" booklet of the *Comptroller's Handbook* for more information.

# Examination Procedures

This booklet contains expanded procedures for examining specialized activities or specific products or services that warrant extra attention beyond the core assessment contained in the "Community Bank Supervision," "Federal Branches and Agencies Supervision," and "Large Bank Supervision" booklets of the *Comptroller's Handbook*. Examiners determine which expanded procedures to use, if any, during examination planning or after drawing preliminary conclusions during the core assessment.

## Scope

These procedures are designed to help examiners tailor the examination to each bank and determine the scope of the IRR examination. This determination should consider work performed by internal and external auditors and other independent risk control functions and by other examiners on related areas. Examiners need to perform only those objectives and steps that are relevant to the scope of the examination as determined by the following objectives. Seldom will every objective or step of the expanded procedures be necessary.

**Objective**: To determine the scope of the examination of IRR and identify examination objectives and activities necessary to meet the needs of the supervisory strategy for the bank.

1. Review the following sources of information and note any previously identified problems related to IRR that require follow-up:

   - Supervisory strategy.
   - Examiner-in-charge's (EIC) scope memorandum.
   - Previous reports of examination and work papers.
   - The OCC's supervisory information systems.
   - Internal and external audit reports and work papers.
   - Bank management's responses to previous reports of examination and audit reports.
   - Open matters requiring attention or enforcement actions related to IRR, if applicable.

2. Obtain and review the following information to form an initial understanding of the bank's IRR exposure and determine whether any material changes have occurred in the structure of the bank's balance sheet or the nature of off-balance-sheet activities since the prior examination:

   - Uniform bank performance report and applicable OCC reports and analytical tools.
   - Balance sheet and income statement. (Balance-sheet accounts most likely to hold significant amounts of embedded options include mortgage loans and mortgage-related securities, callable securities, structured notes, deposit liabilities, and FHLB advances.)
   - Investment trial balance and a list of investment purchases and sales since the last examination.
   - Budget and variance reports.

- Most recent board and ALCO package(s) or reports from the bank's equivalent function.
- Minutes of the ALCO and any related committee meetings since the last examination.

3. Using the information obtained in procedure 2,

   - analyze trends in the bank's quarterly NIM since the last examination and annual NIM over at least the previous two years. Perform this analysis taking into account the context of the interest rate environments of the corresponding time periods.
   - analyze trends in the bank's volume, rate, and mix variances to determine whether there have been significant changes in the bank's portfolio composition or in its earnings performance that could signal a change in the bank's current or potential IRR profile.
   - evaluate the bank's funding stability and usage of contingent funding sources.

4. Obtain and review policies, procedures, and reports bank management uses to supervise IRR, such as

   - IRR and asset/liability management policies.
   - IRR measurement reports, such as EAR, EVE, NPV, duration of equity, or gap reports. (Because of its simplicity, gap analysis has very limited use and may be appropriate only for a few non-complex banks. These banks would have basic balance sheets with minimal optionality and mainly repricing risk.)
   - internal risk assessments.
   - investment portfolio market value calculations.
   - model validation reports.
   - back-testing results.
   - stress testing and sensitivity analysis reports or documentation.

5. During early discussions with management, determine the following:

   - Whether there have been any changes in IRR policies or risk measurement processes.
   - Whether there have been changes to the oversight structure and responsibilities for IRR.
   - Whether there have been changes to the staffing and organization of the ALCO, or the treasury, investment, and funds management units of the bank.
   - Whether there have been significant changes in the bank's IRR strategies, exposures, or measurement, or if any such changes are planned.
   - Reasons for any significant changes in balance-sheet structure.
   - Reasons for any significant changes in IRR exposures.
   - Reasons for limit breaches and management's actual or planned actions in response to such breaches.

6. If the bank is part of a multi-bank company, determine whether the bank's risk management system captures risks to the bank from its subsidiaries or affiliates. If IRR

management is centralized at a holding company or lead bank, determine whether IRR management reports provide bank management and the board with sufficient information to manage and oversee the bank's IRR, respectively.

7. Consider management's comfort in discussing how the bank's IRR management approach and how that risk oversight fits in with similar, bank- or company-wide risk oversight. Document any identified gaps in the reporting chain, management knowledge, management or board reports, or other weaknesses.

8. Based on an analysis of information obtained in the previous steps, as well as input from the EIC, determine the scope and objectives of the IRR examination. Select from among the following procedures the steps necessary to meet the examination objectives and the supervisory strategy. It will seldom be necessary to perform all of the steps in an examination.

# Quantity of Risk

## Conclusion: The quantity of interest rate risk is (low, moderate, or high).

**Objective:** To identify the bank's primary sources of IRR.

1. Review and analyze the bank's balance-sheet structure, off-balance-sheet activities, and trends in the balance-sheet composition to identify the major sources of IRR exposures. Assess and discuss with management the bank's exposure to repricing, basis, yield-curve, and options risks. Consider the following:

   - Maturity and repricing structures of the bank's loans, investments, liabilities, and off-balance-sheet items.
   - Whether the bank has substantial holdings of products with explicit or embedded options, such as prepayment options, caps and floors, or products with rates that considerably lag market interest rates.
   - The reliance on non-stable, less stable, or rate-sensitive sources of funding.
   - various indexes used by the bank to price its variable rate products (e.g., prime and UST) and the level or mix of products tied to these indexes.
   - The use and nature of derivative products.
   - Interest rate-sensitive non-interest income sources, such as mortgage servicing portfolios.
   - Other off-balance-sheet items (e.g., letters of credit and loan commitments).

**Objective:** Determine the level of IRR in the bank's loan portfolio.

1. If the bank has substantial volumes of loans with unspecified maturities, such as credit card loans, ascertain the repricing dates for those loans and assess the potential IRR exposure.

2. If the bank has substantial volumes of medium- or longer-term, fixed-rate loans, assess how appreciation or depreciation of these loans could affect the bank's earnings and economic value of equity.

3. If the bank has substantial volumes of loans with explicit (e.g., convert to fixed or floating) or embedded (e.g., prepayment) options, evaluate the effect those could have on the bank's future earnings and at what level of interest rates these options might be exercised.

4. If the bank has substantial volumes of adjustable-rate mortgage products or other loans with explicit caps and floors, evaluate the effect on the bank's future earnings and at what level of interest rates those caps and floors would come into effect.

5. If the bank uses prepayment penalties on medium- or longer-term, fixed-rate loans, assess the effect of penalties on optionality of these loans. Determine if penalties are enforced.

**Objective:** Determine the level of IRR in the bank's investment portfolio.

1. Review the investment trial balance and list of investment purchases to determine the nature and maturity/repricing composition of the bank's investment portfolio. Determine if investment decisions are in line with the bank's IRR management strategy.

2. If the bank has substantial volumes of medium- or longer-term, fixed-rate investments, determine the actual and potential appreciation or depreciation of such investments. Assess how appreciation or depreciation could affect the bank's earnings and capital.

3. If the bank has substantial volumes of investments with explicit or embedded options, evaluate the effect those investments could have on the bank's future earnings and at what level of interest rates these options might be exercised.

**Objective:** Determine the level of IRR in the bank's deposit accounts.

1. Analyze trends in deposit accounts. Consider

   - the stability of deposit balances.
   - the nature and composition of the deposit base.
   - the stability of offering rates.
   - the use of promotional rates
   - increasing or declining balances.
   - large depositor concentrations.
   - seasonal and cyclical variations in deposit balances.
   - channels used to raise deposits (e.g. internet, reciprocal programs, brokered).
   - reliance on non-stable sources.

2. Assess how the bank's deposits might react in different rate environments. Consider management's assumptions for

   - implicit or explicit floors or ceilings on deposit rates.
   - rate sensitivity (beta coefficient), average life (decay), and truncation (final maturity) of the bank's deposit base and deposit products.
   - rate sensitivity of CDs given early withdrawal penalties.

3. Determine the reasonableness of the bank's assumptions about the effective maturity of the bank's deposits and evaluate to what extent the bank's deposit base could offset declines in asset value under various interest rate scenarios (deposit premium).

**Objective:** Determine the level of IRR in the bank's borrowed funds.

1. Assess the level and trend of borrowings (e.g., FHLB advances and repurchase agreements). Identify the source(s) of borrowings.

2. For banks with considerable usage or increasing levels of borrowings, assess how such usage fits into management's overall IRR management strategy.

3. Assess the terms and structure of borrowings and the potential impact on IRR.

4. Assess the stability of the borrowings in relation to the original and remaining term in light of the rate environment. Analyze the impact of any FHLB puttable advances.

5. Consider the impact to the bank, including liquidity risk, if a funding provider were to demand repayment or repurchase of debt.

**Objective:** Determine the level of IRR in the bank's off-balance-sheet derivatives. Coordinate the following steps with the examiner assigned to review derivatives activities, as applicable. For more information, refer to the "Risk Management of Derivatives" booklet of the *Comptroller's Handbook* (national banks) and *Office of Thrift Supervision Examination Handbook* section 660, "Derivative Instruments and Hedging" (FSAs).

1. Determine the types of derivatives that management uses to manage the bank's IRR exposure (e.g., interest rate contracts, futures, options, floors, and caps).

2. Determine the reason(s) management uses derivatives. Consider the following:

   - Risk reduction activities that use derivatives to reduce the volatility of earnings or to stabilize the economic value of a particular asset, liability, or business.
   - Positioning activities that use derivatives as investment substitutes or specifically to alter the bank's IRR profile.

3. Review the bank's derivatives activities to determine whether such activities are consistent with board-approved IRR strategies and policies. Determine whether the use of such derivatives allows the bank to achieve those strategies effectively and whether usage is consistent with bank policies.

**Objective:** Determine the level of IRR from other sources.

1. If the bank has other sources of IRR (such as asset management activities, mortgage banking activities, mortgage servicing, credit card servicing, and other loan servicing assets), determine the sensitivity of these sources to changes in interest rates and the potential impact on earnings and capital.

# Quality of Risk Management

## Conclusion: The quality of risk management is (strong, satisfactory, insufficient, or weak).

The conclusion on risk management considers all risks associated with interest rate risk.

## Policies

Policies are statements of actions adopted by a bank to pursue certain objectives. Policies guide decisions, often set standards (on risk limits, for example), and should be consistent with the bank's underlying mission, risk appetite, and core values. Policies should be reviewed periodically for effectiveness and approved by the board of directors or designated board committee.

**Objective**: To determine whether the board has adopted effective policies that are consistent with safe and sound banking practices and appropriate for the bank's size, complexity, and risk profile.

1. Evaluate relevant policies to determine whether they provide appropriate guidance for managing the bank's IRR and are consistent with the bank's mission, values, and principles. Consider whether the bank's policies

   - define the IRR appetite and identify IRR management objectives, including approved strategies and activities for managing IRR.
   - include any prohibited strategies or products for managing IRR.
   - establish responsibility and authority for IRR management.
   - establish standards for measuring and monitoring IRR, including
     - the types of IRR measurement systems that the bank will use.
     - the frequency of IRR measurement.
     - how the bank will assess the quality of IRR management.
   - establish reporting standards, including the types of reports senior management and the board will use to monitor IRR.
   - incorporate the bank's model validation and back-testing requirements. These may be included in the bank's IRR policy, model risk management policy, or both.
   - are appropriate for the nature and complexity of the bank's IRR exposure.

2. Determine whether policies establish appropriate risk limits. Consider the following:

   - Whether limits have been established for gap, earnings-at-risk, and economic value exposures.
   - Whether limits have been established for an appropriate range of scenarios.
   - The appropriateness of limits in light of the bank's
     - earnings performance.

  - capital levels.
  - overall risk profile, and areas of significant risk.
- The potential impact on the bank's condition if actual exposures reached limits.
- The consistency of limits with the established risk appetite.
- For banks with $700 billion or more in total assets or cross-jurisdictional activity equal to or greater than $75 billion, whether management considered the 15 percent outlier threshold in the Basel Pillar 2 approach when establishing the bank's limits.

3. Determine whether the bank's IRR policies delineate prudent actions to be taken if limits are exceeded. Consider whether policies include the following:

   - Standards for documenting limit breaches.
   - Reporting and escalation requirements.
   - Prudent actions to be taken if limits are breached. Such actions could include developing action plans to bring exposures into compliance or accepting the risk in accordance with the bank's overall risk management program.

4. Verify that the board, or a designated board committee, periodically reviews and approves the bank's IRR policies.

## Processes

Processes are the procedures, programs, and practices that impose order on a bank's pursuit of its objectives. Processes define how activities are carried out and help manage risk. Effective processes are consistent with the underlying policies and are governed by appropriate checks and balances (such as internal controls).

**Objective**: To determine if the bank's IRR measurement systems are appropriate for the nature and complexity of the bank's activities.

1. Determine the type of IRR measurement systems used by the bank and evaluate the adequacy of those systems. Do the risk measurement systems

   - measure EAR?
   - measure economic value at risk?
   - identify and quantify the major sources of IRR exposure?
   - capture material on- and off-balance-sheet positions?
   - provide estimates of the bank's exposures in a timely and comprehensive manner?
   - evaluate assets and liabilities with embedded options?
   - measure risk over appropriate time horizons?
   - forecast changes to the appropriate earnings measures (NI, NII, or EPS)? If the bank has material reliance on rate-sensitive noninterest income sources, the bank should include measurements of risk to NI.
   - appropriately account for the risk characteristics of the bank's business lines and products?

- measure the impact of non-interest income and expenses, if appropriate?

2. Determine whether the bank uses static or dynamic models and whether usage is appropriate. If management runs dynamic simulations (e.g., simulations that incorporate growth assumptions), does management also run static simulations to estimate the bank's IRR should growth forecasts not materialize? Are growth assumptions used in dynamic simulations reasonable?

3. Assess the adequacy of the interest rate scenarios the bank uses to measure IRR and whether such scenarios cover a range of outcomes that are sufficiently meaningful to fully identify basis, yield curve, options, and repricing risks. Consider whether stress scenarios include the following:

   - Instantaneous shocks and significant changes in the level of interest rates.
   - Substantial changes in rates over time (i.e., prolonged rate shocks).
   - No changes in rates over time (i.e., prolonged static rate environment).
   - Changes in the relationship between key market rates (i.e., basis risk).
   - Changes in the slope and shape of the yield curve (e.g., flattening, steepening, non-parallel shifts, or inversion).
   - For banks that have $250 billion or more in total consolidated assets or $10 billion or more in on-balance-sheet foreign exposure,
     - the six prescribed scenarios for EVE instituted by the Basel Pillar 2 approach for IRR in the banking book:
       - parallel up, parallel down, short rates up, short rates down
       - flattener shock (short rates up and long rates down)
       - steepener shock (short rates down and long rates up).
     - two of the six prescribed scenarios for NII.

**Objective**: To evaluate the adequacy of the bank's processes for data inputs.

1. Determine whether management has appropriately documented the model's data sources.

2. Assess the adequacy of controls relative to the types of data inputs used (manual, automated, or a combination). Consider the following:

   - The percentage of data downloaded directly into the model from systems versus data entered manually.
   - Whether management reconciles balances and rates reconciled to the data source.
   - Whether access to the model's data inputs or changes to the model is restricted to appropriate personnel.
   - Whether data are entered into the model in a timely manner.

**Objective:** To assess the appropriateness of data aggregation processes. Consider whether data are appropriately aggregated or stratified such that material holdings of instruments with similar risk characteristics are grouped together. Some instruments may warrant individual modeling (i.e., should not be aggregated).

1. Assess the adequacy of the bank's processes for aggregating loan portfolio data. Consider the following:

   - If the bank has significant holdings of fixed-rate residential mortgage-related products, determine if coupon data are captured in sufficient detail to reasonably assess prepayment and extension risks.
   - If the bank has significant holdings of adjustable-rate residential mortgages or other loans with explicit caps or floors, determine whether
     – data on periodic and lifetime caps or floors are captured in sufficient detail.
     – the effect of teaser rates, margins, and rate indexes used (current versus lagging) has been factored into the bank's risk measurement system.
     – data are adequate to permit the bank to monitor the prepayment, default, and extension risks of the products.
   - If the bank has a substantial volume of loans with unspecified maturities, such as credit card loans, discuss with management the assumptions and methods used to assess the effective maturities or repricing dates for those loans.
   - If the bank uses prepayment penalties, determine whether assumptions for prepayment penalties are consistent with the bank's usage and historical experience.

2. Assess the adequacy of the bank's processes for aggregating investment portfolio data. Determine if the investment portfolio is modeled in the IRR model or if the price sensitivity is input from another source. Consider the following:

   - If modeled internally, does the bank have a significant portfolio of complex investments? If so, determine if the model is capable of measuring complexity.
   - If input from another source, determine if management has determined that the price sensitivity is reasonable. Generally, investments are analyzed at a security-level basis. If not, determine why and if the grouped analysis is reasonable.

3. Assess the adequacy of the bank's processes for aggregating deposit data. Consider whether

   - NMDs are divided into appropriate groupings with similar characteristics such as
     – the materiality of balances using tiered pricing structures.
     – the stability of different types of accounts.
   - CDs are divided into appropriate groupings to distinguish major characteristics, such as terms, types, early-withdrawal penalties, rate resets, or other characteristics.
   - public funds, brokered deposits, or internet deposits are appropriately segregated from other deposit balances.

4. Assess the adequacy of the bank's process for aggregating borrowed funds data. Consider the following:

   - Whether borrowed funds are divided into appropriate groups based on similar risk characteristics, such as fixed vs. floating rate and maturity date.

- If the bank has FHLB advances, determine the characteristics and whether management has grouped them accordingly. Advances can be fixed or floating, amortizing or fixed term, or structured. Consider the following, as applicable:
  - Does the bank model such advances individually?
  - What factors does management consider when modeling the behavior of puttable advances? Assess the appropriates of these factors.

5. Determine whether management obtains or develops reliable and independent estimates for the value and sensitivity of its off-balance-sheet derivatives. Are the estimates calculated over a range of potential interest rate movements? Do the rate changes reflect the same scenarios run for on-balance-sheet holdings and reflect other applicable changes?

6. Determine the adequacy of the bank's method of aggregating data sources of IRR not covered in procedures 2 through 5. Consider the following:

   - If other assets that have IRR exposure are included in the analysis and how the price sensitivity is determined. Generally, the most common are mortgage-servicing assets. Due to limitations in most models, servicing is generally valued outside of the IRR model and the price sensitivity added.
   - The rate environments impact on noninterest sources of funding, especially if they account for a considerable portion of the bank's income stream.

**Objective**: To determine if assumptions used in the IRR measurement system are reasonable and well-supported.

1. Assess the adequacy of processes to develop model assumptions. Consider the following:

   - The type of information used in formulating assumptions, such as
     - Deposit studies.
     - Bank-developed prepayment models.
     - Third-party-developed prepayment models.
     - Managerial and business unit input about business and pricing strategies.
   - How management determines the appropriateness of the assumptions for the bank.
   - How often management reviews assumptions for reasonableness.
   - Whether management understands the impact of third-party assumptions on the bank's model.
   - Whether major assumption changes are reported and tested before implementation.

2. Review documentation of key loan assumptions. Determine whether the assumptions are reasonable in light of the bank's product mix, business strategy, historical experience, and competitive market. Consider the following:

   - How prepayment speeds are calculated for various loan types.
     - Is the source for prepayment data reliable and updated for each period?

  - Are prepayment speeds based on the type of the loan combined with the underlying rate and age?
  - Are the prepayment speeds tied to the appropriate driver rate?
  - Are prepayment speeds adjusted based on different rate scenarios?
  - Does the bank regularly back-test the assumptions against actual performance?
  - If provided by a third-party, how does management determine that the prepayment speeds are appropriate for the bank's products?
- How other loan-related assumptions are developed, including assumptions for
  - credit spreads, and how management handles changes in spreads (credit declines generally require a higher discount rate).
  - maturity or repricing assumptions for loans with unspecified maturities.
  - interest rate caps and floors.
- Whether new volumes are priced differently (i.e., spread to curve) based on the point on the yield curve (or whether they are priced the same regardless of the point on the curve).

3. Review documentation of key investment portfolio assumptions. Determine whether the assumptions are reasonable. Consider the following:

   - The percentage of the investment portfolio that is callable and how securities are modeled in the different rate scenarios.
   - What yield curves are used to calculate market values and why?
   - How many reinvestment rates are used for the cash flows?

4. Review documentation of key deposit assumptions. Determine whether the assumptions are reasonable in light of the bank's product mix, business strategy, historical experience, and competitive market. Consider the following:

   - Whether management performs any analysis on the bank's deposit base to support the NMD assumptions (for both earnings and economic value).
   - Whether the decay rates and repricing assumptions for NMDs are reasonable given the bank's past performance and its current market, funding, and pricing strategy.

5. Determine whether there are significant differences in assumptions used in EAR modeling and economic value modeling, and assess the reasonableness of such differences. Some differences could be appropriate given the models being used.

6. Determine whether management performs a sensitivity analysis on deposit and prepayment assumptions. In particular, determine whether management analyzes how its interest rate exposure may change if those assumptions change or prove to be incorrect and what action, if any, would be taken.

**Objective**: To determine the adequacy of reports used to monitor IRR.

1. Determine whether information is available for all the bank's material portfolios, lines of business, and operating units. Consider whether the bank's MIS adequately capture

- current outstanding balances, rates and coupons, and repricing indexes.
- contractual maturities or repricing dates.
- contractual caps or floors on interest rates.
- call options in both securities (callable/puttable bonds) and borrowings (FHLB and repos).
- scheduled amortizations and repayments.
- introductory "teaser" rates.

2. Determine whether the bank's reports provide sufficient historical, trend, and customer information to help bank personnel formulate and evaluate assumptions regarding customer behavior. When appropriate, consider

   - loan or mortgage-backed security prepayments.
   - early deposit withdrawals.
   - spreads between administered rate products, such as prime-based loans and NMD accounts, and market rates.
   - account behavior for NMDs in different rate environments. This may include tracking accounts opened in certain periods and how they have acted (vintage analysis); tracking accounts added during published promotions and how they behaved after the promotions ended; deposit marketing strategies; changing demographics; and any other major characteristics that may affect decay or beta estimates.

## Personnel

Personnel are the bank staff and managers who execute or oversee processes. Personnel should be qualified and competent, have clearly defined responsibilities, and be held accountable for their actions. They should understand the bank's mission, risk appetite, core values, policies, and processes. Banks should design compensation programs to attract and retain personnel, align with strategy, and appropriately balance risk-taking and reward.

**Objective**: To determine the adequacy of management and board oversight of IRR.

1. Given the scope and complexity of the bank's IRR, assess the bank's oversight structure and staffing. Consider

   - management's expertise and training.
   - the expertise, training, and number of staff.
   - whether reporting lines encourage open communication and limit the chances of conflicts of interest.
   - the level of staff turnover.
   - the use of third parties.
   - management's ability and willingness to address identified deficiencies.
   - management's responsiveness to regulatory, accounting, industry, and technological changes.

2. Review the ALCO, board, and other relevant committee minutes for IRR-related information. Assess the adequacy of information reviewed by the committees.

3. Assess performance management and compensation programs. Consider whether these programs measure and reward performance that aligns with the bank's strategic objectives and risk tolerance.

   If the bank offers incentive compensation programs, determine whether the programs (1) provide employees with incentives that appropriately balance risk and reward; (2) are compatible with effective controls and risk management; and (3) are supported by strong corporate governance, including active and effective board oversight. Refer to OCC Bulletin 2010-24, "Incentive Compensation: Interagency Guidance on Sound Incentive Compensation Policies," for more information.

**Objective**: To determine if management is active or passive in managing IRR.

1. Determine if management prepares before and after analysis on major strategy changes and significant transactions. Has the board set guidelines on what is a significant transaction and the required analysis? Is the board briefed on products or initiatives that could have a significant impact on the bank?

2. Determine if the bank's level of IRR was by intention or a byproduct of other decisions (e.g., the types of lending and deposits obtained).

3. Determine if management has thought through potential responses to significant adverse model scenarios to assess balance-sheet flexibility and tools to manage IRR.

## Control Systems

Control systems are the functions (such as internal and external audits and quality assurance) and information systems that bank managers use to measure performance, make decisions about risk, and assess the effectiveness of processes and personnel. Control functions should have clear reporting lines, sufficient resources, and appropriate access and authority. MIS should provide timely, accurate, and relevant feedback.

**Objective**: To determine the adequacy of audit and independent risk management reviews related to IRR.

1. Verify that the bank has an effective process in place to periodically evaluate internal controls. (Examiners may need to conduct additional testing such as completing the Internal Control Questionnaire, if the bank does not have an effective process.)

2. Assess the scope, frequency, effectiveness, and independence of audits of the treasury area and IRR management processes. Consider whether the audit includes the following:

- Periodic assessment of the adequacy of the IRR management process, including limits and controls.
- Appropriateness of the bank's risk measurement system or systems given the nature, scope, and complexity of the system's or systems' activities.
- Independent verification of the accuracy of IRR measurement systems (including gap reports, earnings, and economic value simulation models).
- Reasonableness of interest rate scenarios and assumptions used in the risk measurement systems.
- Independent verification of the accuracy and completeness of the data used in the risk measurement systems.

3. Assess the effectiveness of independent risk management's role in IRR management.

**Objective**: To assess the adequacy of IRR model risk managment. For more information, refer to OCC Bulletin 2011-12 and the "Model Risk Management" section of this booklet.

1. Determine whether the bank periodically conducts independent validation of the model's conceptual soundness. If a third-party model is used, the bank may rely partially on independent validations commissioned by the third party, as long as the bank reviews the validation to verify it meets the bank's internal policies and requirements. Partial reliance on the validations commissioned by the third party is, however, only one component of model validation.

2. Determine whether the bank periodically conducts independent reviews of internal controls over data input and assumptions for models used to measure IRR.

3. Determine the adequacy of processes for maintaining model integrity.

   For third-party models, consider whether

   - models are upgraded and kept current.
   - bank staff understand the model's key methods.
   - bank staff have received sufficient training and have sufficient documentation on the model so that bank staff can successfully use and interpret model results.
   - management has assessed whether the third-party can continue to provide ongoing support and documentation of the model and its methods.
   - data feeds sourcing the model are integrated appropriately.

   For internally developed models, consider whether

   - sufficient documentation for the model's methods, operating code, and data sources exists so that the model's operation is not solely dependent on one or two key employees.
   - the model is kept current.
   - a source independent of the persons or units that developed and maintain the model has tested and validated the model's calculations and methods.

4. Determine whether the management regularly conducts back-testing by comparing model output and exposure estimates against actual results to reveal potential material weaknesses in the models or assumptions.

5. Determine if individuals conducting the review or audit have the appropriate background to conduct such a review.

6. Verify that the individual(s) performing the model review is independent of the model owner.

7. Determine whether the board and senior management have established clear lines of authority and responsibility for monitoring compliance with policies, procedures, and limits.

**Objective:** To determine the adequacy of management's actions in response to weaknesses identified by audit, model validation, and other independent risk management reviews.

1. Determine whether audit findings, and management responses to those findings, are fully documented and tracked for adequate follow-up.

2. Determine whether management gives identified material weaknesses appropriate and timely attention.

3. Determine whether management's actions taken in response to material weaknesses have been verified and reviewed by senior management and the board.

# Conclusions

Conclusion: The aggregate level of interest rate risk is (low, moderate, or high).
The direction of interest rate risk is (increasing, stable, or decreasing).

**Objective**: To determine, document, and communicate overall findings and conclusions regarding the examination of IRR.

1. Determine preliminary examination findings and conclusions and discuss with the EIC, including

   - the quantity of IRR, including the quantity of price, options, basis, and yield curve risks.
   - the quality of IRR management.
   - the aggregate level and direction of IRR.
   - violations or deficient practices.

   Refer to the "Community Bank Supervision" or "Large Bank Supervision" booklet of the *Comptroller's Handbook* for risk assessment system information.

2. Evaluate how IRR, including IRR management practices, affects other risks. Communicate relevant findings to the EIC or examiners responsible for other functional areas, as appropriate.

3. Based on the quantity of IRR and quality of IRR management, evaluate the adequacy of the bank's capital to support the level of IRR taken. Consider

   - whether there is significant depreciation in the bank's current balance-sheet positions from past interest rate movements.
   - the potential adverse exposure to earnings and capital from future interest rate movements.
   - the adequacy and effectiveness of the bank's IRR management and measurement processes, including its ability to identify adverse risk exposures in a timely manner and to take prompt remedial action.
   - the strength and stability of the bank's earnings stream.

4. Determine the component rating for sensitivity to market risk. Refer to the "Bank Supervision Process" booklet of the *Comptroller's Handbook*.

5. If substantive safety and soundness concerns remain unresolved that may have a material adverse effect on the bank, further expand the scope of the examination by completing verification procedures.

6. Discuss examination findings with management, including violations, deficient practices, and conclusions about risks and risk management practices. If necessary, obtain commitments for corrective action.

7. Compose conclusion comments, highlighting any issues that should be included in the report of examination or supervisory letter. If necessary, compose matters requiring attention or violation write-ups.

8. Update the OCC's supervisory information systems and any applicable report of examination schedules or tables. For midsize and community banks, this includes completion of the IRR survey in Examiner View.

9. Document recommendations for the supervisory strategy (e.g., what the OCC should do in the future to effectively supervise IRR in the bank, including time periods, staffing, and workdays required.

10. Update, organize, and reference work papers in accordance with OCC policy.

11. Appropriately dispose of or secure any paper or electronic media that contain sensitive bank or customer information.

# Internal Control Questionnaires

An internal control questionnaire (ICQ) helps an examiner assess a bank's internal controls for an area. ICQs typically address standard controls that provide day-to-day protection of bank assets and financial records. The examiner decides the extent to which it is necessary to complete or update ICQs during examination planning or after reviewing the findings and conclusions of the core assessment.

This section provides separate ICQs for asset-liability management, IRR, IRR model risk management, and FTP.

**Asset-Liability Management**
**Internal Control Questionnaire**

1. Has the board, consistent with its duties and responsibilities, adopted a funds management policy? Does the funds management policy include

   - lines of authority and responsibility for funds management decisions?
   - a formal mechanism to coordinate asset and liability decisions?
   - a method to identify liquidity needs and the means to meet those needs?
   - requirements for the level of liquid assets and other sources of funds in relationship to anticipated and potential funding needs?
   - guidelines for the level of rate-sensitive assets and rate-sensitive liabilities and the relationship between them?
   - limits on the risk to earnings arising from historic cost accounts and instruments carried on a market valuation basis?

2. Does the planning and budgeting function consider liquidity and IRR?

3. Does the bank have internal management reports that are an adequate basis for funds management decisions and for monitoring the results of those decisions?

   - Are reports prepared concerning liquidity needs and sources of funds to meet those needs?
   - Do the board and senior management review reports concerning liquidity needs and sources of funds?
   - Are reports prepared on the bank's IRR?
   - Is historical information regarding asset yields, cost of funds, and NIM readily available?
   - Are variations in the interest margin, both from the prior reporting period and from the budget, regularly monitored?
   - Is sufficient information available to permit an analysis of the cause of NIM variations?

4. Is the foregoing information an adequate basis for evaluating internal control in that there are no significant additional internal auditing procedures, accounting controls, administrative controls, or other circumstances that impair any controls or mitigate any weaknesses indicated previously (explain negative answers briefly, and indicate conclusions as to their effect on specific examination procedures)?

**Based on a composite evaluation (as evidenced by answers to the foregoing questions), internal control of asset-liability management is considered (strong, satisfactory, insufficient, or weak).**

## Interest Rate Risk
## Internal Control Questionnaire

### Management and Board Supervision

1. Has the board communicated to management the board's IRR appetite?

2. Is the IRR appetite consistent with the board's overall risk appetite?

3. Has management formulated sound controls and provided monitoring systems for the bank's IRR decisions? Do these controls

   - establish lines of authority and responsibility for interest rate decisions?
   - establish a risk measurement system that captures and quantifies risk in a timely and comprehensive manner?
   - specify appropriate limits for earnings and economic value at risk?
   - measure, monitor, and control the potential adverse exposure to future earnings and capital from significant medium- and long-term positions?

4. Do senior management and the board review IRR principles and controls at least annually to determine whether they remain adequate?

5. Has management provided the board with sufficient information for the board to have an adequate understanding of the current and potential impact that IRR may have on the bank's condition?

6. Do the planning, budgeting, and new activity functions consider IRR?

7. Does management use reports that serve as an adequate basis for IRR management decisions and for monitoring the results of those decisions?

8. Are management, committee, and board reports timely?

9. Are reports sufficiently detailed to allow management, ALCO, and the board, as appropriate, to

   - identify the major sources of IRR exposure?
   - determine the level of IRR in the consolidated bank and the major legal entities?
   - assess the risk of long-term mismatches?
   - determine compliance with the bank's policies?
   - evaluate the results of past strategies?
   - assess the potential risks and returns of proposed strategies?

10. Do management, committee, and board reports describe the causes of excessive exposures?

11. Does management identify and document strategies to address excessive exposures?

12. Does the audit function review IRR management?

**Net Interest Margin**

1. Are variations in the NIM, both from the previous reporting period and from the budget, monitored with appropriate frequency?

2. Are significant variances investigated and explained?

3. Is sufficient information available to allow an analysis of the cause of significant NIM variations?

**Based on a composite evaluation (as evidenced by answers to the foregoing questions), internal control of IRR is considered (strong, satisfactory, insufficient, or weak).**

## IRR Modeling
## Internal Control Questionnaire

### General Modeling Questions

1. Does the bank measure both short-term (EAR) and long-term (EVE or NPV) exposure?

2. Is the bank or third party using the most current release of the model?

3. Is the staff that supports the model trained?

4. Is there sufficient cross-training of bank staff so that operation of the bank's models is not dependent on one employee?

5. Is there adequate documentation of the model's methodology?

### Chart of Accounts

1. Are all balance-sheet and off-balance-sheet items captured in the model?

2. Is the chart of accounts segregated into enough detail so that accounts with unique repricing or cash flow characteristics are appropriately segmented (e.g., consider fixed versus variable, different repricing dates, different repricing indexes, various prepayment, and callable options)?

3. Are off-balance-sheet activities, such as options, futures, swaps, caps, and floors, adequately incorporated into the risk measurement system?

### Data Input

1. Does management or bank staff reconcile balances and rates to the data source?

2. Are the data entered into the model in a timely manner?

3. Has management established controls that restrict access for making changes to the model, data inputs, or assumptions to only those personnel who need such access?

### Assumptions

1. Is the support for the assumptions documented?

2. Are significant model assumptions reviewed and approved by the board and ALCO at least annually?

3. Has management established processes for reviewing and approving changes to the model's assumptions?

4. Is there an assumption logging report that shows the history of assumption revisions?

5. Are the assumptions used for the measurement systems, pricing, and volume relationships consistent with the interest rate scenarios used in the risk measurement process?

6. Are differences between the assumptions used in the EAR model and the EVE model reasonable?

7. Are prepayment speeds based on the type of the loan combined with the underlying rate and vintage?

8. Are loan prepayments considered on all loan types?

9. Does the model incorporate caps and floors?

10. Are assumptions (including rates, spreads, drivers, prepayments, yield curves, and discount rates) updated for each run or quarterly at a minimum? If not updated quarterly, are assumptions reviewed quarterly to verify that the assumptions remain current?

11. Do the models consider the impact of non-interest income and expenses?

12. Does management perform any analysis on the bank's deposit base to support the NMD assumptions (for both EAR and EVE)?

13. For NMD accounts, do rates move at 100 percent of the driver rate?

14. Does the model appropriately capture pricing of tiered deposit accounts?

15. Are NMD assumptions reasonable given the bank's past performance and its current market, funding, and pricing strategy?

16. Does the bank run alternative NMD scenarios to determine the impact on EAR and EVE?

**Scenarios**

1. Do scenarios include the following:

   - Instantaneous shocks and significant changes in the level of interest rates.
   - Substantial changes in rates over time (i.e., prolonged rate shocks).
   - No changes in rates over time (i.e., prolonged static rate environment).
   - Changes in the relationship between key market rates (i.e., basis risk).
   - Changes in the slope and shape of the yield curve (e.g., flattening, steepening, non-parallel shifts, or inversion).

2. Does the model include scenarios beyond typical industry conventions (± 200 basis points)?

3. Are growth assumptions for dynamic simulations reasonable?

4. Are different rate relationships used for increasing and decreasing rate scenarios?

5. Does the bank periodically use stress tests that explore the bank's vulnerabilities under more unusual or extreme events?

**Model Risk Management**

1. Are large variances tracked and explained from one run to the next?

2. Does the audit function check the accuracy of financial information used to measure IRR? Does it verify

   - the accuracy and completeness of data input?
   - that all major instruments, portfolios, and business units are captured in the model?

3. Does the audit function independently verify the accuracy of IRR measurement systems (including gap reports and earnings and economic value simulation models)?

4. If the bank uses a model designed by a third party,

   - are the models upgraded and kept current?
   - does the bank's staff understand the key assumptions used by the model?
   - has the bank's staff received sufficient training and documentation on the model?
   - has management assessed whether the third party can continue to provide ongoing support and documentation of the model and its methods?
   - does model validation assess the bank's usage of the model (i.e., validation does *not* consist solely of the model certification provided by the third party)?

5. If the bank uses an internally developed model, determine whether

   - sufficient documentation for the model's methods, operating code, and data sources exists so that its operation does not depend on one or two key employees.
   - all major instruments, portfolios, and business units are captured in the interest rate measurement system.
   - the model is kept current.

6. Does the bank perform sensitivity testing?

7. Has the model been independently validated?

8. Is back-testing (model output is compared against subsequent financial results) performed?

9. Does the bank maintain documentation of validation and back-testing?

10. Has management addressed concerns identified during validation or back-testing activities?

11. Has management addressed IRR-related audit findings?

**Based on a composite evaluation (as evidenced by answers to the foregoing questions), internal control of model risk is considered (strong, satisfactory, insufficient, or weak).**

## Funds Transfer Pricing
## Internal Control Questionnaire

### Funds Transfer Pricing Program Objectives

1. What are the primary objectives of the FTP system?

### System Structure and Design

1. Who has primary responsibility for implementing and maintaining the FTP system?
2. How many full-time support staff are devoted to the FTP system?
3. What software does the FTP system run on?
4. What are the basic design features of the FTP system?
5. What is the source of the FTP funding curve?
6. Is the FTP funding curve adjusted to reflect the bank's true borrowing costs?
7. Are FTP charges and credits adjusted for embedded option (prepayment) risk?
8. Are breakage fees charged for loans that prepay early?
9. Are FTP charges and credits adjusted for caps and floors?
10. Are FTP loan charges adjusted for basis risk?
11. Are FTP charges assigned to floating and adjustable rate loans adjusted for liquidity risk (i.e., liquidity risk of funding longer-term floating and adjustable rate loans with short-term funds)?
12. Are FTP charges and credits adjusted for collateral considerations (i.e., assets that can be used as collateral for borrowings receive a reduced cost of funds; liabilities that require collateral receive a lower crediting rate)?
13. Is the entire balance-sheet transfer priced?
14. How are transfer prices determined for fixed-rate amortizing products?
15. How are transfer prices determined for fixed-rate, bullet maturity products?
16. How are transfer prices determined for adjustable rate (i.e., the rate is subject to adjustment at stated repricing intervals) amortizing and bullet maturity products?

17. How are transfer prices determined for floating rate (i.e., the rate is adjusted whenever the index changes) amortizing and bullet maturity products?

18. How are transfer prices determined for non-specific maturity deposits?

19. Are FTP assumptions consistent with the assumptions used in the IRR model?

**FTP Reporting Process**

1. Are mirror offsetting entries for assigned FTP charges and credits captured in a central funding or offset center?

2. Are FTP charges and credits incorporated into internal profitability reports?

3. Are FTP charges and credits incorporated into the annual budgeting process?

4. Is FTP output integrated into other internal profit or risk measurement platforms, such as cost accounting systems, capital allocation or risk adjusted return models, and product pricing models?

**Internal Control Environment**

1. Are FTP goals and objectives formally stated in writing?

2. Has the bank developed written FTP policies and control procedures that address the following areas:

    - A general description of the FTP system?
    - Who is formally responsible for approving initial FTP methodologies, key assumptions, and any changes made thereafter?
    - Documentation standards for supporting key assumptions?
    - Periodically reviewing and validating key assumptions?

3. Has the FTP system been reviewed by internal or external auditors?

4. Has the FTP system been subjected to a model validation review? (Refer to OCC Bulletin 2011-12.)

5. Are FTP inputs and outputs regularly reconciled to general ledger and other subsidiary accounts?

**Based on a composite evaluation (as evidenced by answers to the foregoing questions), internal control of FTP is considered (strong, satisfactory, insufficient, or weak).**

# Verification Procedures

Verification procedures are used to verify the existence of assets and liabilities or test the reliability of financial records. Examiners generally do not perform verification procedures as part of a typical examination. Rather, verification procedures are performed when substantive safety and soundness concerns are identified that are not mitigated by the bank's risk management systems and internal controls.

1. Test a sample of accounts from the chart of accounts to determine if the balances in the IRR model reconcile to the general ledger (a recent audit or validation of the model can be used to supplement this review if performed by an independent and competent source). Refer to the "Sampling Methodologies" booklet of the *Comptroller's Handbook.*

2. Test a sample of accounts from various balance-sheet categories to determine whether the following attributes in the bank's model are set up appropriately. Ask management for information they have prepared to support these attributes:

   - Driver and key rate (e.g., prime rate and Treasury curve).
   - Assess the risk of long-term mismatches.
   - Spread to driver.
   - Yield curve.
   - Discount rate.
   - Prepayment speed.
   - Floors and ceilings (periodic and lifetime).

   Refer to the "Sampling Methodologies" booklet of the *Comptroller's Handbook.*

# Appendixes

## Appendix A: Earnings Versus Economic Perspectives — Numerical Examples

A bank's IRR should not be viewed solely in terms of its effects on either economic value or earnings. The earnings and economic perspectives are complementary, and both are necessary to capture IRR comprehensively.

The economic perspective focuses on the value of the bank in today's interest rate environment and the sensitivity of that value to changes in interest rates. The economic perspective also captures future exposure by evaluating the impact of potential rate changes on market values of the bank's assets, liabilities, and off-balance-sheet instruments.

The earnings perspective, which captures the timing of income effects, helps risk managers determine what action to take to offset or hedge the exposure. In the example in this appendix, the earnings perspective indicates that earnings problems will not develop until the second year in which the assets and liabilities are on the bank's balance sheet.

The bank in the following example is exposed to IRR arising from the repricing gap between a four-year asset and a one-year liability. Both instruments are accounted for on a historic cost basis.

The example uses the following simplifying assumptions:

- The bank has equity capital of $200 million.
- The bank has a four-year, fixed-rate note carrying an 8 percent coupon. The face amount is $1.2 million, and the current market value is par. The note pays interest annually.
- The bank funds the note with a one-year CD with a face amount of $1 million. The current rate on the CD is 6 percent and interest is paid annually.
- The bank pays all of its income to shareholders as dividends and pays no taxes. It has no other income or operating expenses.
- At the end of the fourth year, the bank plans to liquidate and distribute any residual equity to shareholders.

Table 3 illustrates the expected annual income and cash flows for this bank, assuming that interest rates remain at their current levels. Under this scenario, the bank expects to earn $36,000 each year on the spread between its asset and liability. Shareholders would receive $36,000 in dividends in each year. At the end of the fourth year, the bank would receive $1.2 million in cash from the note but must pay out $1 million in cash to the CD customer. Because all of the bank's NI was distributed as dividends, the equity available to shareholders equals the original equity of $200,000.

**Table 3: Example of Expected Cash Flows and Income, Stable Interest Rates (in Millions of Dollars)**

| | Initial cash outlay and book values | Cash flows | | | |
|---|---|---|---|---|---|
| | | Year 1 | Year 2 | Year 3 | Year 4 |
| Note | –$1,200 | $96 | $96 | $96 | $1,296 |
| CD | $1,000 | –$60 | –$60 | –$60 | –$1,060 |
| NI | | $36 | $36 | $36 | $36 |
| Dividends | | –$36 | –$36 | –$36 | –$36 |
| Equity | $200 | | | | –$200 |

Source: OCC

Table 4 shows the present value of the asset, liability, dividends, and equity cash flows, assuming that interest rates do not change. The note's cash flows are discounted at 8 percent and the CD cash flows are discounted at 6 percent. The present values for dividends (NI) and equity reflect the differences in the present value of the note and CD cash flows. These residual cash flows imply an internal rate of return on the bank's equity of 18 percent. Note that if interest rates stay at their current level, the present value of the expected cash flows equals the par value of the instruments.

**Table 4: Example of Present Value of Expected Cash Flows and Income, Stable Interest Rates (in Thousands of Dollars)**

| | NPVs | Present value of cash flows | | | |
|---|---|---|---|---|---|
| | | Year 1 | Year 2 | Year 3 | Year 4 |
| Notes | $1,200 | $88.9 | $82.3 | $76.2 | $952.6 |
| CDs | –$1,000 | –$56.6 | –$53.4 | –$50.4 | –$839.6 |
| Dividends and equity | –$200 | –$32.3 | –$28.9 | –$25.8 | –$113.0 |

Source: OCC

Because this bank is funding a four-year asset with a one-year liability, the bank is adversely exposed to rising interest rates. Table 5 illustrates what happens to the bank's cash flows and NI if interest rates were to immediately rise by 200 basis points. The bank's reported earnings in year one remain unchanged because the bank has locked in its funding rates for the first year. After year one, however, the CD reprices by 200 basis points to a new rate of 8 percent. As a result, the bank's NI for the remaining three years will decline by $20,000 per year as shown in table 5 The bank's cumulative NI and the corresponding dividends paid to shareholders over the four-year period declines from $144,000 to $84,000.

**Table 5: Example of Expected Cash Flows and Income, 200-Basis-Point Rise (in Thousands of Dollars)**

| | Cash flows | | | |
|---|---|---|---|---|
| | Year 1 | Year 2 | Year 3 | Year 4 |
| Note | $96 | $96 | $96 | $1,296 |
| CD | –$60 | –$80 | –$80 | –$1,080 |
| NI | $36 | $16 | $16 | $16 |
| Dividends and equity | –$36 | –$16 | –$16 | –$216 |
| Change in NI vs. stable rate scenario | $0 | –$20 | –$20 | –$20 |

Source: OCC

Table 6 illustrates the present value of the bank's expected cash flows under the new rate scenario. Note that the present value of both the note and the CD decline. The decline in the present value of the note reflects the fact that, although the cash flows from the note remain constant, those cash flows are now discounted at a higher rate (10 percent). In essence, the bank has forgone more profitable investment opportunities and now holds a note that offers below-market returns that is funded by a CD paying a market rate.

As in table 4, the present value of NI, dividends, and equity represents the difference between the present values of the note and CD cash flows. Table 6 shows that the net economic value of the bank declines by $57.6 million in comparison with net economic value in the stable rate scenario. This decline in net economic value represents the decline in the present value of the bank's future cash flows.

**Table 6: Example of Present Value of Expected Cash Flows and Income, 200-Basis-Point Rise (in Thousands of Dollars)**

| | | Present value of cash flows | | | |
|---|---|---|---|---|---|
| | NPVs | Year 1 | Year 2 | Year 3 | Year 4 |
| Note | $1,123.9 | $87.3 | $79.3 | $72.1 | $885.2 |
| CD | –$981.5 | –$55.6 | –$68.6 | –$63.5 | –$793.8 |
| Dividends and equity | –$142.4 | –$31.7 | –$10.7 | –$8.6 | –$91.4 |
| Change in equity vs. stable rate scenario | –$57.6 | | | | |

Source: OCC

These examples illustrate that if the bank evaluates its earnings exposure over only a short time horizon, it may incorrectly assume that it has little or no exposure. This bank shows no earnings exposure for the first 12 months. Yet, as table 5 illustrates, the bank's earnings in future periods may decline significantly if interest rates increase. The change in the EVE (as measured by the change in the present value of the bank's assets less the present value of its liabilities) can be a leading indicator of the expected decline in future earnings and capital.

# Appendix B: Funds Transfer Pricing

Some banks centralize the management of IRR in a single unit, often the treasury unit, using an FTP system. FTP allows the bank to transfer the impact of changing interest rates from individual business lines to the central unit that can take advantage of natural offsets, centralized hedging activities, and a broader view of the firm. The earnings of the business lines can then be traced more directly to the business decisions of line managers. FTP also motivates line managers to make pricing decisions that are consistent with the IRR management objectives of the ALCO and the treasury unit. Because line managers are making pricing decisions in the FTP process, management can use the FTP process to evaluate and enhance the performance of business units. Failure to consistently and effectively apply FTP, however, can misalign the risk-taking incentives of individual business lines with the bank's risk appetite.

As an example, under an FTP system, profits and losses arising from interest rate mismatches are transferred to a central unit, which is responsible for funding loans. The IRR management unit may either match-fund the loans or maintain the repricing mismatch. If loans are matched-funded, no IRR is assumed by either the lending units or treasury unit. If the treasury unit decides to maintain the mismatch, the unit would earn the difference between its actual funding costs and what it has charged the lending units. For example, if the treasury unit charges the lending units 10 percent for five-year funds and raises one-year funds at 9 percent, the unit would earn a 1 percent spread and the unit would assume IRR. If rates were to rise, the spread earned could decline or even become negative.

FTP allows businesses to manage their portfolios by transferring risk to a centralized treasury unit and should be governed by an appropriate methodology to transfer the risk. There are several methodologies to do this. Here are two examples:

- **Gap approach:** Assign a transfer rate based on aggregating portfolios of assets and liabilities based on the maturity and repricing characteristics.
- **Cost/earnings rate:** Determine a cost to fund certain types of assets or businesses. For example, the treasury unit assigns a cost of funds to the commercial lending units for loans. A fixed-rate, five-year loan might be assigned a cost of funds equivalent to the rate paid by the bank to borrow five-year funds. The treasury unit assigns an earnings credit to the deposit or retail unit for the funds raised.

While meant to transfer risk, an FTP system essentially makes the central unit an intermediary between the lending and deposit gathering units, which places responsibility of IRR management on the lines of business. OCC Bulletin 2016-7, "Funds Transfer Pricing: Interagency Guidance," provides more information on FTP principles.

# Appendix C: Accounting

Banks should account for their investments and hedging instruments used to manage IRR consistent with generally accepted accounting principles and Instructions for the Consolidated Report of Condition and Income (i.e., call report). Investments in debt securities should be categorized as trading, available-for-sale, or held-to-maturity consistent with Accounting Standards Codification (ASC) Topic 320, "Investments—Debt Securities." Management should periodically reassess its security categorization decisions to confirm that they remain appropriate.

Equity securities (except those accounted for under the equity method of accounting or those that result in consolidation of the investee) with readily determinable fair values should generally be measured at fair value, with changes in fair value recognized through NI consistent with ASC Topic 321, "Investments—Equity Securities." If an equity security does not have a readily determinable fair value, a bank may generally elect to carry the equity security at cost minus impairment, if any, plus or minus observable price changes in orderly transactions for the identical or similar investment of the same issuer.

Debt securities intended to be held principally for the purpose of selling them in the near term should be classified as trading assets. Trading activity includes active and frequent buying and selling of debt securities for the purpose of generating profits on short-term fluctuations in price. Debt securities held for trading purposes should be reported at fair value, with unrealized gains and losses recognized in current earnings and regulatory capital. Banks may elect to report debt securities within the scope of ASC Topic 320 at fair value in accordance with ASC Subtopic 825-10, "Financial Instruments—Overall." Debt securities for which the fair value option is elected should be classified as trading assets with unrealized gains and losses recognized in current earnings and regulatory capital. In general, the fair value option may be elected for an individual security only when it is first recognized and the election is irrevocable.

Held-to-maturity debt securities are investments that the bank has the positive intent and ability to hold to maturity. Held-to-maturity debt securities are generally reported at amortized cost. Debt securities not categorized as trading or held-to-maturity should be reported as available-for-sale. Banks should report available-for-sale debt securities at fair value on the balance sheet, but unrealized gains and losses are excluded from earnings and reported in a separate component of equity capital (accumulated other comprehensive income).

Hedging strategies used to manage IRR should be accounted for in accordance with ASC Topic 815, "Derivatives and Hedging." ASC Topic 815 requires all derivatives to be recognized on the balance sheet as either assets or liabilities at their fair value. The accounting for changes in the fair value (that is, gains and losses) of a derivative depends on whether it has been designated and qualifies as part of a hedging relationship and, if so, on the reason for holding it. The gain or loss on a derivative instrument not designated as a hedging instrument in a qualifying hedge for accounting purposes, including derivatives held for trading purposes, is recognized in earnings.

To qualify for hedge accounting, the risk being hedged must represent an exposure to an institution's earnings. Qualifying accounting hedges must meet specific documentation requirements and be highly effective in achieving offsetting changes in fair value or offsetting cash flows attributable to the hedged risk. Additionally, initial and ongoing hedge effectiveness testing (quantitative or qualitative) is required on a regular basis to validate the hedge as highly effective.

ASC Topic 815 requires a qualifying accounting hedge to be designated as a fair value hedge, cash flow hedge, or net investment hedge. A fair value hedge reduces the exposure to changes in the fair value of a recognized asset or liability or a firm commitment. The gain or loss on the derivative as well as the offsetting loss or gain on the hedged item attributable to the risk being hedged should be recognized in earnings. A cash flow hedge reduces the exposure to variable cash flows of an existing recognized asset or liability or a forecasted transaction. The gain or loss on the derivative should be reported outside of earnings as a component of other comprehensive income and subsequently reclassified into earnings in the same period or periods during which the hedged transaction affects earnings. A net investment hedge reduces the foreign currency exposure of a net investment in a foreign operation. The gain or loss is reported outside of earnings in other comprehensive income as part of the cumulative translation adjustment.

Valuation measurements for investments and hedging instruments should be consistent with ASC Topic 820, "Fair Value Measurements and Disclosures." Fair value is defined as the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants in the asset's or liability's principal (or most advantageous) market at the measurement date. This value is often referred to as an "exit" price. ASC Topic 820 establishes a three-level fair value hierarchy that prioritizes inputs used to measure fair value based on significance and observability. The highest priority is given to level 1 (observable, unadjusted) and the lowest priority to level 3 (unobservable). During periods of market stress, the fair values of some financial instruments and nonfinancial assets may be difficult to determine. Banks are reminded that, under such conditions, fair value measurement should be determined consistent with the objective of fair value set forth in ASC Topic 820.

# Appendix D: Relationship With Other Risks

This appendix summarizes how IRR can relate to other risk areas. Refer to the "Bank Supervision Process" booklet of the *Comptroller's Handbook* for an expanded discussion of banking risks and their definitions.

**Credit Risk**

Credit risk is the risk to current or projected financial condition and resilience arising from an obligor's failure to meet the terms of any contract with the bank or otherwise perform as agreed. Credit risk exists any time bank funds are extended, committed, invested, or otherwise exposed through actual or implied contractual agreements, whether reflected on or off the balance sheet. Credit risk, however, encompasses more than the traditional definition associated with lending activities. It arises in conjunction with a broad range of bank activities, including selecting investment portfolio products, derivatives trading partners, or foreign exchange counterparties. It also arises due to country or sovereign exposure, as well as indirectly through guarantor performance.

An increase in interest rates can expose banks with a significant concentration of adjustable rate loans to credit risk if borrowers are unable to afford higher loan payments due to an increase in rates. For banks that are predominantly funded with short-term liabilities, a rise in rates can decrease NII at the same time that credit quality problems are increasing.

**Liquidity Risk**

Liquidity risk is the risk to current or projected financial condition and resilience arising from an inability to meet obligations when they come due. Liquidity risk includes the inability to access funding sources or manage fluctuations in funding levels. Liquidity risk results from a bank's failure to recognize or address changes in market conditions that affect its ability to liquidate assets quickly and with minimal loss in value.

IRR is interrelated with liquidity risk because of pricing on investments, deposits, and borrowings. Banks' pricing decisions drive customer behavior relative to deposit withdrawals. As interest rates increase, bond prices generally fall, which causes depreciation in the investment portfolio and diminishes the amount of readily available liquidity from the investment portfolio. Conversely, increasing rates generally cause interest-bearing deposits to reprice to keep up with competition and constrain outflows. Additionally, a bank's borrowings can contain call features that result in liquidity risk. For example, if rates rise, the bank's counterparty could call the borrowings, resulting in either the bank needing to repay or obtain new borrowings at a higher rate.

**Price Risk**

Price risk is the risk to current or projected financial condition arising from changes in the value of either trading portfolios or other obligations that are entered into as part of distributing risk. These portfolios typically are subject to daily price movements and are

accounted for primarily on a mark-to-market basis. This risk occurs most significantly from market-making, dealing, and position-taking in interest rate, foreign exchange, equity, commodities, and credit markets. Price risk arises from bank activities for which value changes are reflected in the income statement, such as assets and liabilities accounted for under the fair value option, lending pipelines, and mortgage servicing rights. Banks that maintain trading portfolios or otherwise hold assets classified as "held-for-trading" have exposure to price risk that arises from changes in interest rates.

For more guidance, examiners should refer to the "Risk Management of Financial Derivatives" booklet of the *Comptroller's Handbook* (national banks) and *Office of Thrift Supervision Examination Handbook* section 660, "Derivative Instruments and Hedging" (FSAs).

**Operational Risk**

Operational risk is the risk to current or projected financial condition and resilience arising from inadequate or failed internal processes or systems, human errors or misconduct, or adverse external events. Operational losses may result from internal fraud; external fraud; inadequate or inappropriate employment practices and workplace safety; failure to meet professional obligations involving clients, products, and business practices; damage to physical assets; business disruption and systems failures; and failures in execution, delivery, and process management. Internal controls, effective challenge, and internal audit play a critical role in preventing and detecting operational errors. Model risk and third-party risk management weaknesses are two key operational risk factors related to IRR.

**Model risk:** Most banks use models to measure IRR exposures. Model risk is the potential for adverse consequences from decisions based on incorrect or misused model outputs and reports.[34] Model risk can lead to financial loss, poor business and strategic decision making, ~~or damage to a bank's reputation~~. Management should subject IRR models to sound model risk governance, including periodic validation. Refer to the "Model Risk Management" section of this booklet for more information.

**Third-party risk management weaknesses:** Many banks use third-party models to measure IRR. Third-party relationships can increase a bank's exposure to operational risk because the bank does not have direct control of the activity performed by the third party. Management should understand the underlying analytics, assumptions, and methodologies of third-party models. Banks should have contingency plans to address lapses in third-party support for critical models.[35]

[34] For more information, refer to OCC Bulletin 2011-12.

[35] Refer to the "Model Risk Management" section of this booklet. Also refer to OCC Bulletin 2013-29, OCC Bulletin 2017-21, OCC Bulletin 2010-1, and OCC Bulletin 2012-5.

### Strategic Risk

Strategic risk is the risk to current or projected financial condition and resilience arising from adverse business decisions, poor implementation of business decisions, or lack of responsiveness to changes in the banking industry and operating environment. This risk is a function of a bank's strategic goals, business strategies, resources, and quality of implementation.

Management and the board should consider the bank's IRR profile when developing the bank's strategic plan. A bank that has significant long-term IRR exposures (such as long-term, fixed-rate assets funded by short-term liabilities) may have limited new business opportunities based on the rate environment.

### ~~Reputation Risk~~

~~Reputation risk is the risk to current or projected financial condition and resilience arising from negative public opinion. This risk may impair a bank's competitiveness by affecting its ability to establish new relationships or services or continue servicing existing relationships. Reputation risk is inherent in all bank activities.~~

### Compliance Risk

Compliance risk is the risk to current or projected financial condition and resilience arising from violations of laws or regulations, or from nonconformance with prescribed practices, internal bank policies and procedures, or ethical standards. Compliance risk is not limited to risk from failure to comply with consumer protection laws; it encompasses the risk of noncompliance with *all* laws and regulations, as well as prudent ethical standards and contractual obligations. It also includes the exposure to litigation (known as legal risk) from all aspects of banking, traditional and nontraditional. Compliance risk can result when bank employees fail to follow internal bank policies and procedures. Decisions to change interest rates for specific products or services can also expose the bank to compliance risk, particularly if bank management fails to consider potential fair lending or other consumer protection implications.

# Appendix E: Sample Request Letter

This appendix is provided as a guide and should be modified as needed depending on the scope of the supervisory activity and the bank's activities and risk profile. The EIC is responsible for obtaining the information and managing the examination to avoid duplicate requests to the bank.

The following verbiage should be included in the request letter:

> The OCC retains all work papers in digital form. When possible, we ask that you provide all requested items digitally and securely through the large file transfer tool, which can be accessed by going to www.banknet.gov, or OCC secure mail. **Where prompted to select an upload folder in the large file transfer tool, please choose the "Supervision – Exam – Capital Markets" folder when submitting the requested information.** Please contact the designated examiner-in-charge if digital submission via OCC secure mail or large file transfer is not feasible.
>
> Please label the file to correspond to the numbers on the request letter. All information requested should be as of (examination date). We will also review the (most current month-end date) information if available during our examination for any material changes.

**Board and Management Supervision**

1. A current organizational chart that includes the names of personnel responsible for IRR management. Describe each person's primary responsibilities and experience level. Provide résumés of any key ALCO and audit-related personnel joining the management team since (prior examination date).

2. A copy of the board of directors' package containing information as of (examination date). Also, please provide a copy of any special presentations to the board or ALCO regarding IRR in (prior year) and year to date (current year). *Information included in the provided board package that is requested in this request letter need not be duplicated.*

3. All ALCO packages since the prior examination. *Information included in these packages that is requested in this request letter need not be duplicated.*

4. Copies of all ALCO meeting minutes since the prior examination, unless already provided in the ALCO package. If related committees (for example, investment, funds management, or balance-sheet management) also are responsible for overseeing IRR, please make available the meeting minutes and information packages since the last examination.

5. The most recent reports used by the board and senior management to monitor and manage the bank's level of IRR (e.g., gap planning, EAR and EVE model results, and duration analysis), if not provided as part of the ALCO or board package. If not included

in these reports, please provide trend reports that track earnings (EAR) and capital (EVE) at risk since the prior examination.

6. The most current board-approved IRR, asset/liability management, derivatives, and model validation policies and procedures. Please also provide any draft versions of these documents that are in the process of revision. Also, if these policies and procedures do not address IRR related to the investment portfolio, please provide the policies and procedures where that is addressed.

7. A copy of the most recent internal and external audit report(s) pertaining to IRR and asset/liability management since the prior examination. Make available the audit work papers. Please provide the name of the employee examiners should contact to obtain the work papers.

**Financial Reports**

8. A copy of the general ledger as of the examination date.

9. Make available call report work papers. Please provide the name of the employee examiners should contact to obtain the work papers.

10. The bank's budget for the current and prior year.

11. Budget variance reports for the prior year-end and year-to-date (exam year).

**Investment Portfolio**

12. Investment portfolio trial balance.

13. Investment portfolio price sensitivity reports.

14. A list of structured notes reported on the most recent call report, the investment prospectus, and any market value stress testing performed to measure price sensitivity.

15. Listing of investment purchases and sales since the prior examination.

16. Make available all pre-purchase analyses of investment portfolio transactions since the last examination.

**Derivatives**

17. A list of balance-sheet derivatives, including a description of the transaction, current valuations, and identification of counterparties.

18. A list of customer derivatives.

19. A copy of risk management or hedging reports used by the board and senior management to show the effectiveness of derivatives or hedging strategies.

**IRR Models**

20. A summary of the assumptions used in the IRR model, including but not limited to non-maturity deposit decay rates and repricing betas, loan prepayments, key rate drivers, discount rates, and reinvestment allocations. Also provide all documentation and analyses (including any back-testing or sensitivity analysis) that support the reasonableness of these assumptions.

    For example, supporting documentation and analysis for non-maturity deposit assumptions typically includes a historical trend analysis, a decay vintage analysis, driver rate sensitivity (beta), a segmentation analysis, a regression analysis, demographic analysis, seasonality, and market competition.

21. A summary of significant changes to IRR modeling since the last examination. Include new software or software upgrades, new or revised assumptions, new documentation associated with prior assumptions, added detail to the chart of accounts, added recognition of optionality, and additional interest rate scenarios analyzed.

22. Please make available the following model-related information:

    - A chart of accounts listing.
    - A narrative describing the process by which the bank's accounting records are input into the model. Please note any manual processes necessary to upload assets and liabilities.
    - A copy of the model's user manual.
    - A detailed overview of scenarios analyzed, including parallel ramps, immediate parallel shocks, yield-curve twists, basis risk, and special ad hoc scenarios.

23. A copy of the most recent model validation and back-testing analysis (e.g., EAR and EVE) performed. Please include management responses to any model validation findings, along with the project plan for corrective action.

**Please note that examiners may request additional information to assist in evaluating this area during the review.**

# Appendix F: Glossary

**Accounting perspective:** See earnings perspective.

**Asset-sensitive:** Banks with assets repricing quicker than liabilities are considered asset-sensitive. An asset-sensitive bank's earnings generally increase when rates rise and decrease when rates fall.

**Basis risk:** Basis risk arises from a shift in the relationship of the rates in different financial markets or on different financial instruments. Basis risk occurs when market rates for different financial instruments or the indexes used to price assets and liabilities change at different times or by different amounts.

**Bear flattener:** Scenario in which short-term interest rates are increasing at a faster rate than long-term interest rates. This causes the yield curve to flatten as short-term and long-term rates start to converge.

**Bear steepener:** Scenario in which the widening of the yield curve is caused by long-term rates increasing at a faster rate than short-term rates. This causes a larger spread between the two rates as the longer-term rates move further away from the short-term rates.

**Beta:** The rate at which a bank's deposit rates change given a change in market rates.

**Bull flattener:** Scenario in which long-term rates are decreasing at a rate faster than short-term rates. This causes the yield curve to flatten as the short-term and long-term rates start to converge.

**Bull steepener:** Scenario in which short-term rates fall faster than long-term rates, resulting in a higher spread between the two rates.

**Convexity**: The rate at which duration changes with respect to changes in rates.

**Decay rate:** The rate at which deposits run off the balance sheet.

**Earnings perspective:** The projected effect on the bank's accrual earnings. This is also referred to as the accounting perspective.

**Economic perspective:** The projected effect on the bank's economic value of assets, liabilities, and off-balance-sheet positions.

**Effective duration:** Measures the percentage change in price given a 100-basis-point change in rates. Effective duration takes into account the way in which changes in yield affect the expected cash flows. It also takes into account both the discounting that occurs at different interest rates as well as changes in cash flows. This is an appropriate measure for any bond with an option embedded in it.

**Investment portfolio duration:** Weighted average duration of the bonds within a portfolio.

**Liability-sensitive:** Banks with liabilities repricing quicker than assets are considered liability-sensitive. A liability-sensitive bank's earnings generally increase when rates fall and decrease when rates rise.

**Macaulay duration:** Weighted average time until cash flows are received. Macaulay duration is measured in years. It is a shortcut for measuring modified duration because modified duration does not incorporate the change in cash flows due to an embedded option. Macaulay durations also do not incorporate these changes.

**Managed rates:** Rates established by the bank.

**Modified duration:** Approximate percentage change in a bond's price for a 100 basis point change in yield, assuming that the bond's expected cash flow does not change when the yield changes. This works for option-free bonds such as UST securities though not with option-embedded bonds because the cash flows may change because of a call or prepayment.

**Monte Carlo simulation:** A method of measuring a dependent variable, which involves running specified independent variables through a model thousands of times. Each run randomizes the independent variables, typically based on a probability distribution of expected values. The output is a probability distribution of expected values of the dependent variable.

**Options risk:** Options risk arises when a bank or its customer has the right (not the obligation) to alter the level and timing of the cash flows of an asset, liability, or off-balance-sheet instrument.

**Prepayment speed:** The estimated rate at which mortgage assets pay ahead of schedule.

**Repricing risk:** Repricing risk results from differences in the timing of rate changes and the timing of rate changes and cash flows because of repricing of the bank's assets, liabilities, and off-balance-sheet instruments (e.g., maturity or repricing mismatches).

**Strike price:** The price at which a call or put option can be exercised.

**Truncation point:** A manual adjustment to a cash flow that assumes that the cash flows are not statistically important after a certain point.

**Yield-curve risk:** Yield-curve risk arises from variations in the movement of interest rates across the maturity spectrum. This risk involves changes in the relationship among interest rates of different maturities of the same index or market (e.g., the three-month UST rate versus the five-year UST rate). The relationships change when the slope and shape of the yield curve for a given market flattens, steepens, or becomes negatively sloped (inverted) during an interest rate cycle.

# Appendix G: Abbreviations

| | |
|---|---|
| ALCO | asset-liability management committee |
| ASC | Accounting Standards Codification |
| CD | certificate of deposit |
| CFR | Code of Federal Regulations |
| CPR | constant or conditional prepayment rate |
| EAR | earnings at risk |
| EIC | examiner-in-charge |
| EPS | earnings per share |
| EVE | economic value of equity |
| FHLB | Federal Home Loan Bank |
| FIL | Financial Institution Letter |
| FSA | federal savings association |
| FTP | funds transfer pricing |
| ICQ | internal control questionnaire |
| IRR | interest rate risk |
| MIS | management information systems |
| NI | net income |
| NII | net interest income |
| NIM | net interest margin |
| NMD | non-maturity deposit |
| NPV | net present value |
| OCC | Office of the Comptroller of the Currency |
| PSA | Public Securities Association |
| RSA | rate sensitive assets |
| RSL | rate sensitive liabilities |
| USC | U.S. Code |
| UST | U.S. Treasury |

# References

Listed references apply to both national banks and FSAs unless otherwise noted.

## Laws

12 USC 1831f, "Brokered Deposits"

## Regulations

12 CFR 3, "Capital Adequacy Standards"
12 CFR 6, "Prompt Corrective Action"
12 CFR 101, "Covered Savings Associations" (covered savings associations)
12 CFR 163.176, "Interest Rate Risk Management Procedures" (FSAs)
12 CFR 303.243, "Brokered Deposit Waivers"
12 CFR 337.6, "Brokered Deposits"

## Comptroller's Handbook

"Bank Supervision Process"
"Capital and Dividends"
"Community Bank Supervision"
"Corporate and Risk Governance"
"Federal Branches and Agencies Supervision"
"Internal and External Audits"
"Large Bank Supervision"
"Risk Management of Financial Derivatives" (national banks)
"Sampling Methodologies"

## Office of Thrift Supervision Examination Handbook (FSAs)

Section 660, "Derivative Instruments and Hedging"

## OCC Issuances

OCC Bulletin 2010-1, "Interest Rate Risk: Interagency Advisory on Interest Rate Risk Management"
OCC Bulletin 2010-24, "Incentive Compensation: Interagency Guidance on Sound Incentive Compensation Policies"
OCC Bulletin 2011-12, "Sound Practices for Model Risk Management: Supervisory Guidance on Model Risk Management"
OCC Bulletin 2012-5, "Interest Rate Risk Management: FAQs on 2010 Interagency Advisory on Interest Rate Risk Management"
OCC Bulletin 2013-29, "Third-Party Relationships: Risk Management Guidance"
OCC Bulletin 2016-7, "Funds Transfer Pricing: Interagency Guidance"

OCC Bulletin 2017-21, "Third-Party Relationships: Frequently Asked Questions to Supplement OCC Bulletin 2013-29"
OCC Bulletin 2017-43, "New, Modified, or Expanded Bank Products and Services: Risk Management Principles"
OCC Bulletin 2019-31, "Covered Savings Associations Implementation: Covered Savings Associations"

## Other

ASC Topic 320, "Investments–Debt and Equity Securities"
ASC Topic 321, "Investments–Equity Securities"
ASC Topic 815, "Derivatives and Hedging"
ASC Topic 820, "Fair Value Measurements and Disclosures"
ASC Subtopic 825-10, "Financial Instruments–Overall"
Federal Deposit Insurance Corporation, FIL-42-2016, "Frequently Asked Questions on Identifying, Accepting and Reporting Brokered Deposits"
Basel Committee on Banking Supervision, *Interest Rate Risk in the Banking Book* (April 2016)
Basel Committee on Banking Supervision, *Stress Testing Principles* (October 2018)