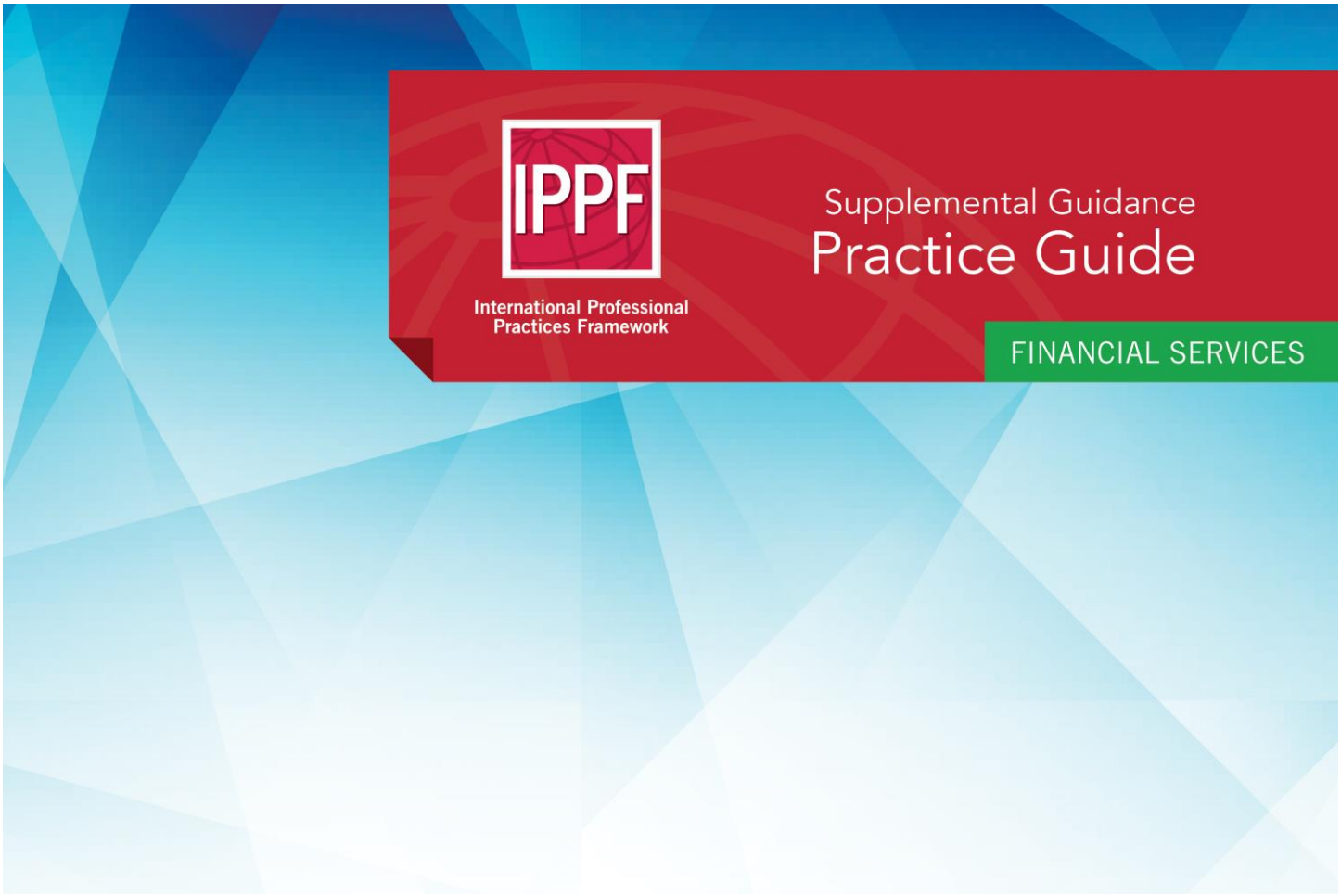
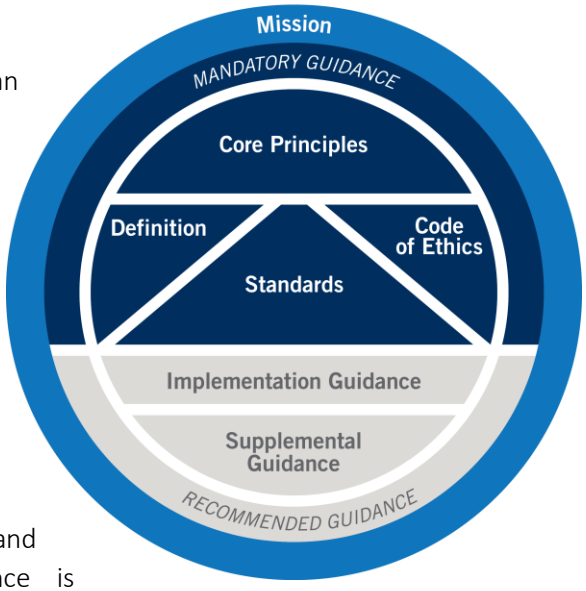


Auditing Market Risk in Financial Institutions

The Institute of Internal Auditors | Global

About the IPPF

The International Professional Practices Framework® (IPPF®) is the conceptual framework that organizes authoritative guidance promulgated by The IIA for internal audit professionals worldwide.



Mandatory Guidance is developed following an established due diligence process, which includes a period of public exposure for stakeholder input. The mandatory elements of the IPPF are:

- Core Principles for the Professional Practice of Internal Auditing.
- Definition of Internal Auditing.
- Code of Ethics.
- *International Standards for the Professional Practice of Internal Auditing*.

Recommended Guidance includes Implementation and Supplemental Guidance. Implementation Guidance is designed to help internal auditors understand how to apply and conform with the requirements of Mandatory Guidance.

About Supplemental Guidance

Supplemental Guidance provides additional information, advice, and best practices for providing internal audit services. It supports the *Standards* by addressing topical areas and sector-specific issues in more detail than Implementation Guidance and is endorsed by The IIA through formal review and approval processes.

Practice Guides

Practice Guides, a type of Supplemental Guidance, provide detailed approaches, step-by-step processes, and examples intended to support all internal auditors. Select Practice Guides focus on:

- Financial Services.
- Public Sector.
- Information Technology (GTAG®).

For an overview of authoritative guidance materials provided by The IIA, please visit www.globaliia.org/standards-guidance.

Table of Contents

Executive Summary

Market risk has always been considered a key risk for financial services organizations. Regulators and supervisors have increasingly focused on this risk, emphasizing the necessity of having accurate models that can measure the capital impact of market activities on the financial viability of an institution.

These requirements and supervisors' expanded expectations are giving internal audit a more relevant and active role in the assessment of market risk. In addition, an organization's board of directors has direct responsibility on the market risk oversight and governance, so internal audit should give independent assurance per the elements laid out in The IIA's International Professional Practices Framework, 2017 edition, including the Mission of Internal Audit, Core Principles for the Professional Practice of Internal Auditing, and the *International Standards for the Professional Practice of Internal Auditing* to the appropriate governance body.

This guidance may serve as a resource for internal auditors in the banking, insurance, and asset management industries as well as any companies and organizations that have financial investments and deal with market risk. It will equip internal auditors with the tools to audit those investments, make judgments about organizational levels of risk exposure, and communicate with stakeholders.

In addition, this guidance explores the background of market risk, offering definitions and scenarios with the intention of informing and educating internal auditors who may be newer to the financial services industry or who lack a deep background in finance. The second half of the guide offers assistance in auditing market risk.

Introduction

The purpose of this guidance is to support financial services internal auditors in auditing investments within financial instruments in relation to market risks. Market risk is an essential **risk** category of the financial services sector that is also in the focus of regulators across the globe.

Note: Terms in bold are defined in the glossary in Appendix B.

This guide covers the following topics from a high-level perspective:

- Definition and components of market risk.
- Regulatory landscape.
- **Risk governance** and management process.
- Auditing market risk.

This guidance is not intended to provide in-depth knowledge in any of these key topical areas. This practice guide is intended to provide internal audit activities and key stakeholders with an overview of market risk. Major global regulatory standards and principles are reviewed at a high level with acknowledgements to local standards where it is known they differ.

After reading this guidance, internal auditors should be able to understand:

- The importance of market risk in a financial services context.
- The regulatory environment and requirements related to market risk.
- The risk governance and risk management processes surrounding market risk.
- How to articulate the key components of market risk including interest rate risk, equity risk, and foreign exchange risk.
- How to apply IPPF and risk-based internal audit techniques to assess and audit market risk in their organizations.

This guide is the latest in a series of practice guides specifically for internal auditors in the financial sector. The IIA has published several guides for financial services professionals:

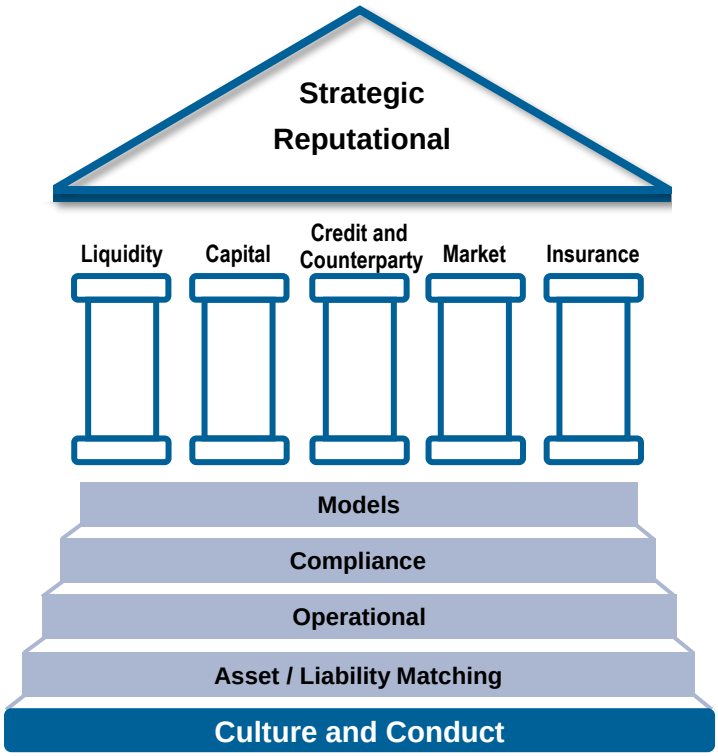
- Auditing Capital Adequacy and Stress Testing for Banks.
- Auditing Credit Risk Management.
- Auditing Liquidity: An Overview.
- Auditing Model Risk Management.
- Foundations of Internal Auditing in Financial Services Firms.

The term "bank" is used frequently in this guide and is intended to encompass all types of financial services organizations.

Definition of Market Risk

To properly manage the risks facing their organization, employees must understand the terminology associated with risk management, compliance, and internal auditing. One tool to communicate risk information across organizations is a risk framework. The IIA's Financial Services Guidance Committee has developed a comprehensive risk framework specifically for financial services organizations. This risk framework, depicted in Figure 1, considers the major areas of risk applicable to financial services organizations.

Figure 1: The IIA's Financial Services Risk Framework



Source: The Institute of Internal Auditors.

The IIA's Financial Services Risk Framework defines *market risk* as the "potential for losses in on- and off-balance sheet (OBS) positions arising from adverse movements in market prices. Includes pricing and interest rate risks."[1]

More broadly, market risk arises from changes in these components:

- Interest rates.
- Equity pricing.
- Foreign exchange.
- Commodity pricing.

All of these components can change the value of the underlying reference security or collateral thus affecting the value of a portfolio. Market risk can also be affected by flawed data aggregation as the prices of instruments are recorded, portfolio performance is modeled, and trades are made.

1. "Market risk," Regulation and policy, European Banking Authority, accessed November 17, 2020, https://www.eba.europa.eu/regulation-and-policy/market-risk.

Regulatory Requirements

There are qualitative standards promulgated by various supervisors that banks must implement or accomplish to use various market risk management and monitoring techniques. For example, according to the Basel Committee on Banking Supervision (BCBS or Basel), banks must have an independent risk control unit that should produce and analyze daily reports on the output of the bank´s risk measurement model, and must conduct regular back testing and profit and loss attribution programs, among others.

Regulators have made an effort to implement stricter criteria for assigning instruments to trading books. They also changed methodologies used to calculate the amount of capital banks must hold against the market risk in their portfolios, including more risk-sensitive standardized methodologies.

A key component of market risk is pricing. Banks divide their portfolios into two categories: the trading book and the banking book. The trading book consists of instruments the bank intends to actively trade. The banking book consists of instruments the bank intends to hold until maturity. Instruments in the trading book are marked to market on a daily basis. Instruments in the banking book are recorded either at amortized cost or fair value through other comprehensive income as required by IFRS 9.

The European Central Bank (ECB) made extensive changes to its fundamental review of the trading book (FRTB), which was finalized in 2019:

> The FRTB introduces significant changes to the internal models approach (IMA), including a new market risk metric, greater sensitivity to market illiquidity and model approval at the trading desk level. These changes are so fundamental that banks will have to apply for a new approval of their internal models approach. The ECB has set up a working group

Economic Capital

Internal auditors should know that market risk is part of a much bigger risk framework in their institution. Per the Basel rules, banks must still calculate how much capital they must allocate internally to their business lines and products to execute their strategy and obtain their desired yields from their activities while remaining solvent. This would account for all types of risk including market risk. To do this, banks use internal capital models and the concept of economic capital (eCap), which is the amount of risk capital that a bank estimates it needs to remain solvent at a given confidence level and time horizon.

In a practical sense, banks use eCap to identify deals that may appear to generate large profits but have more than a commensurate capital charge. It also draws attention to businesses that offer high risk-adjusted returns despite low gross returns. This information assists the bank in making decisions regarding how to manage their portfolios with their need for profitability in balance with requirements for regulatory capital.

with representatives from the ECB and the national competent authorities to develop the FRTB IMA application and approval process and, more broadly, to coordinate the implementation of the new market risk rules from the perspective of the banking supervisor.[2]

Market risk regulations may change rapidly so internal auditors should confirm their institutions are making the required adjustments, even though they may be expensive and cause significant disruption to their operations.

Market Risk Governance

All financial services organizations should have a defined market risk management framework. The **board** is responsible for monitoring the market risk management framework and the **governance** structures that surround that framework. Standard 2120 – Risk Management states, "The internal audit activity must evaluate the effectiveness and contribute to the improvement of risk management processes." It is important for internal auditors to understand their organization's governance structures and processes associated with market risk management.

Market risk strategy or strategies, policies, procedures, and documented practices for determining which instruments to include or exclude from the trading book for the purposes of calculating their regulatory capital, ensuring compliance with the criteria set forth in this section, and taking into account the bank's risk management capabilities and practices should be reviewed by the board annually at a minimum. In larger organizations, the market risk policies may be tailored for different regions and/or business units.

Financial services organizations may also have an asset/liability committee (ALCO). This may be a board-level committee with a business-level counterpart or the board may delegate the responsibility completely to the business-level ALCO and receive reports from it on a regular basis. In general, the ALCO should review the capital plan, monitor conformance to the institution's stated **risk appetite**, and oversee decision-making related to managing assets and liabilities. This oversight includes evaluating and reacting to changing market conditions and ensuring the adequacy of **liquidity** and capital resources. Related to market risk, the ALCO should:

- Establish and guide the bank's asset liability strategies, rate risk appetites, and limits.
- Review liquidity and interest rate risk reports and understand key assumptions.
- Monitor the bank's performance and overall liquidity position and interest rate risk profile and compliance with policies, strategies, limits, and regulations.

2. "Market risk: implementing new rules for internal models," European Central Bank, Banking Supervision, February 12, 2020. https://www.bankingsupervision.europa.eu/press/publications/newsletter/2020/html/ssm.nl200212_2.en.html.

- Verify that asset liability strategies remain prudent and supported by adequate capital and liquidity levels.
- Identify senior managers who have authority and responsibility for managing these risks and verify that adequate resources are devoted to asset liability management.[3]
- Discuss and assess the yield curve for global currencies, particularly in countries more closely related to the organization's business environment.

In smaller financial services organizations such as local banks or credit unions, these duties may be covered by a credit committee made up of senior lending officials, the chief loan officer, the CEO, CFO, and others as appropriate. Alternatively, the senior executive team in total may perform these duties. In both cases, the committees/teams are monitored by the audit committee (known as the supervisory committee in credit unions).

Risk management (the second line) plays a key role in managing market risk.[4] For larger corporations, each line of business (i.e., retail, commercial) may have their own risk management committees that meet regularly to discuss all types of risk including market risk. Some regulators require the creation of a second-line function referred to as "market risk management." This function sets groupwide value at risk (VaR), economic capital, and portfolio stress testing limits for market risk in the trading book. Market risk management would also allocate the overall market risk appetite to the corporate divisions and individual business units within them based on established and agreed business plans. There may also be business unit personnel aligned with market risk management who establish business limits, by allocating the limit down to individual portfolios, geographical regions, and types of market risk. Limits are also set on sensitivity and concentration/liquidity, exposure, business level stress testing, and even risk scenarios, taking into consideration business plans and the risk versus return investment strategy.

Audit Consideration

Internal auditors should verify there is a clear exception process for violations of market or interest rate risk limits, review if there is enough information on exceptions performance, and verify that the organization uses that information to take corrective actions.

Further, the ALCO, another second line function, or other relevant personnel, should regularly review exception reports and communicate significant exceptions to executive management and the board as necessary.

Internal auditors should verify if the exception process for violations of market risk limits is clear, monitored, and communicated.

Also see Standards 2210.A2 and 2320.

3. Office of the Comptroller of the Currency (US), *Comptroller's Handbook: Corporate and Risk Governance, Version 2.0* (Washington, D.C.: Office of the Comptroller of the Currency, July 2019). https://www.occ.treas.gov/publications-and-resources/publications/comptrollers-handbook/files/corporate-risk-governance/pub-ch-corporate-risk.pdf.

4. The Institute of Internal Auditors. The IIA's Position Paper, "The IIA's Three Lines Model: An Update of the Three Lines of Defense" (Lake Mary, FL: The Institute of Internal Auditors, July 2020). https://na.theiia.org/about-ia/PublicDocuments/Three-Lines-Model-Updated.pdf.

Market risk managers also may have external considerations when setting limits including but not limited to:

- Limits from the bank or regulator(s) related to their capital requirements.
- Limits on exposure to certain instruments as indicated in the risk appetite statement.

Market risk managers identify market risks through active portfolio analysis and engagement with the business areas. This means conducting an ongoing evaluation of instruments both in and out of the trading book to assess whether its instruments are being properly designated initially as trading or nontrading instruments in the context of the bank's trading activities. Compliance with policies and procedures should be fully documented and subject to periodic (at least yearly) internal audit, and the results should be available for supervisory review.

Market Risk Identification, Measurement, and Monitoring Processes

To determine how much capital to hold against the market risks presented by their trading and banking books, banks weight the risks of such assets and must allocate capital as a percentage of risk weighted assets (RWA) to ensure they are able to meet any losses arising due to movements in market prices. Capital requirements for market risks can be measured through either the internal models approach (IMA) or the **standardized approach**, reviewed later in this guide.[5]

IFRS 9 Rules for Classification of Investments

IFRS 9, which replaced IAS 39 as of January 2018, requires an organization to recognize an instrument when the contract is finalized, at its fair value, and classify assets by their cash flow characteristics including these listed from the IFRS Standards:

> Amortized cost if the asset is held within a business model whose objective is to hold assets to collect contractual cash flows, and the contractual terms of the financial asset produce cash flows on specified dates that are solely payments of principal and interest on the principal amount outstanding.

- Fair value through other comprehensive income if the asset is held in a business model whose objective is achieved by both collecting contractual cash flows and selling financial assets.

5. Basel Committee on Banking Supervision. *STANDARDS: Minimum capital requirements for market risk* (Basel, Switzerland: Bank for International Settlements, January 2016). https://www.bis.org/bcbs/publ/d352.pdf.

- Fair value through profit or loss if the asset is not held in a business model consistent with one of the first two categories.[6]
- Similar to securities accounting rules in which securities are held either to maturity or as "available for sale," assets must be reclassified if the entity changes its business model for managing that asset.

Revised Boundary between the Trading Book and Banking Book

Prior to 2008, BCBS's definition of securities that should be held in a bank's trading book was ambiguous. It was based on whether or not the bank intended to trade the security. In 2016, BCBS revised this definition to clarify the boundary between the banking book (instruments held to maturity) and the trading book with the objective of restricting arbitrage opportunities between the capital requirements for market risk and credit risk. In 2019, BCBS further clarified regulatory book assignment requirements with better articulated precedence and clarification for certain exposures.[7] Properly classifying securities in the trading book (subject to market risk capital requirements) and banking book (subject to credit risk capital requirements) is critical.

BCBS's regulatory requirements for market risk are more prescriptive than other regulations that can be found in the publication "Minimum capital requirements for market risk."[8]

Any instrument a bank holds for one or more of the following purposes must, when it is first recognized on its books, be designated as a trading book instrument: (1) short-term resale; (2) profiting from short-term price movements; (3) locking in arbitrage profits; or (4) hedging risks that arise from instruments meeting (1), (2), or (3) above.

According to BCBS, the scope of the trading book is as follows:

> Instruments comprise financial instruments, foreign exchange (FX), and commodities. A financial instrument is any contract that gives rise to both a financial asset of one entity and a financial liability or equity instrument of another entity. Financial instruments include primary financial instruments (or cash instruments) and derivative financial instruments. A financial asset is any asset that is cash, the right to receive cash or another financial asset or a commodity, or an equity instrument. A financial liability is the contractual obligation to deliver cash or another financial asset or a commodity. Commodities also include nontangible (i.e., nonphysical) goods such as electric power.

6. IFRS 9 Financial Instruments, accessed November 17, 2020. https://www.ifrs.org/issued-standards/list-of-standards/ifrs-9-financial-instruments/.

7. Basel Committee on Banking Supervision. *Minimum capital requirements for market risk* (Basel, Switzerland: Bank for International Settlements, February 2019). https://www.bis.org/bcbs/publ/d457.pdf.

8. Ibid.

1. Banks may only include a financial instrument, instruments on FX, or commodity in the trading book when there is no legal impediment against selling or fully hedging it.
2. Banks must fair value daily any trading book instrument and recognize any valuation change in the profit and loss (P&L) account.[9]

BCBS describes the banking book as containing the following instruments:

- Unlisted equities.
- Instruments designated for securitization warehousing.
- Real estate holdings, where in the context of assigning instrument to the trading book, real estate holdings relate only to direct holdings of real estate as well as derivatives on direct holdings.
- Retail and small- or medium-sized enterprise (SME) credit.
- Equity investments in a fund, unless the bank meets at least one of the following conditions:
  a. The bank is able to look through the fund to its individual components and there is sufficient and frequent information, verified by an independent third party, provided to the bank regarding the fund's composition; or
  b. The bank obtains daily price quotes for the fund and it has access to the information contained in the fund's mandate or in the national regulations governing such investment funds.
- Hedge funds.
- Derivative instruments and funds that have the above instrument types as underlying assets.
- Instruments held for the purpose of hedging a particular risk of a position in the types of instruments above.[10]

Switching instruments from the trading book to the banking book or vice versa comes with its own set of regulatory requirements including: If the capital charge on an instrument or portfolio is reduced as a result of switching (in the rare instances where this is allowed), the differences in charges (measured at the point of the switch) is imposed on the bank as a fixed, additional disclosed Pillar 1 capital charge.[11]

Restrictions on Moving Instruments between the Regulatory Books

In general terms, there is a strict limit on the ability of banks to move instruments between the trading book and the banking book by their own discretion after initial designation. Switching

9. Ibid., RBC25.3.

10. Ibid., RBC25.8.

11. Ibid., RBC25.15.

instruments for regulatory arbitrage is strictly prohibited. In practice, switching should be rare and will be allowed by supervisors only in extraordinary circumstances. Examples are a major publicly announced event, such as a bank restructuring that results in the permanent closure of trading desks, requiring termination of the business activity applicable to the instrument or portfolio, or a change in accounting standards that allows an item to be fair-valued through P&L. Market events, changes in the liquidity of a financial instrument, or a change of trading intent alone are not valid reasons for reassigning an instrument to a different book.[12]

Internal Models Approach

The internal models approach is one of two methods banks can use to calculate market risk capital requirements under BCBS rules. BCBS has determined that use of the IMA will depend on the approval of the bank's supervisory authority. Home and host country supervisors are expected to work together to ensure consistency in the criteria used to approve or disallow a bank's use of IMA.

This approval is based on the supervisor's assessment of the bank's overall risk management program, the skill of its staff, and its history in measuring risk exposures accurately. Approval to use the IMA approach is granted on a trading desk by trading desk basis with BCBS's revised IMA approach including more consistent identification and capitalization of material risk factors across banks. This is in addition to the constraints on the capital-reducing effects of hedging and diversification.

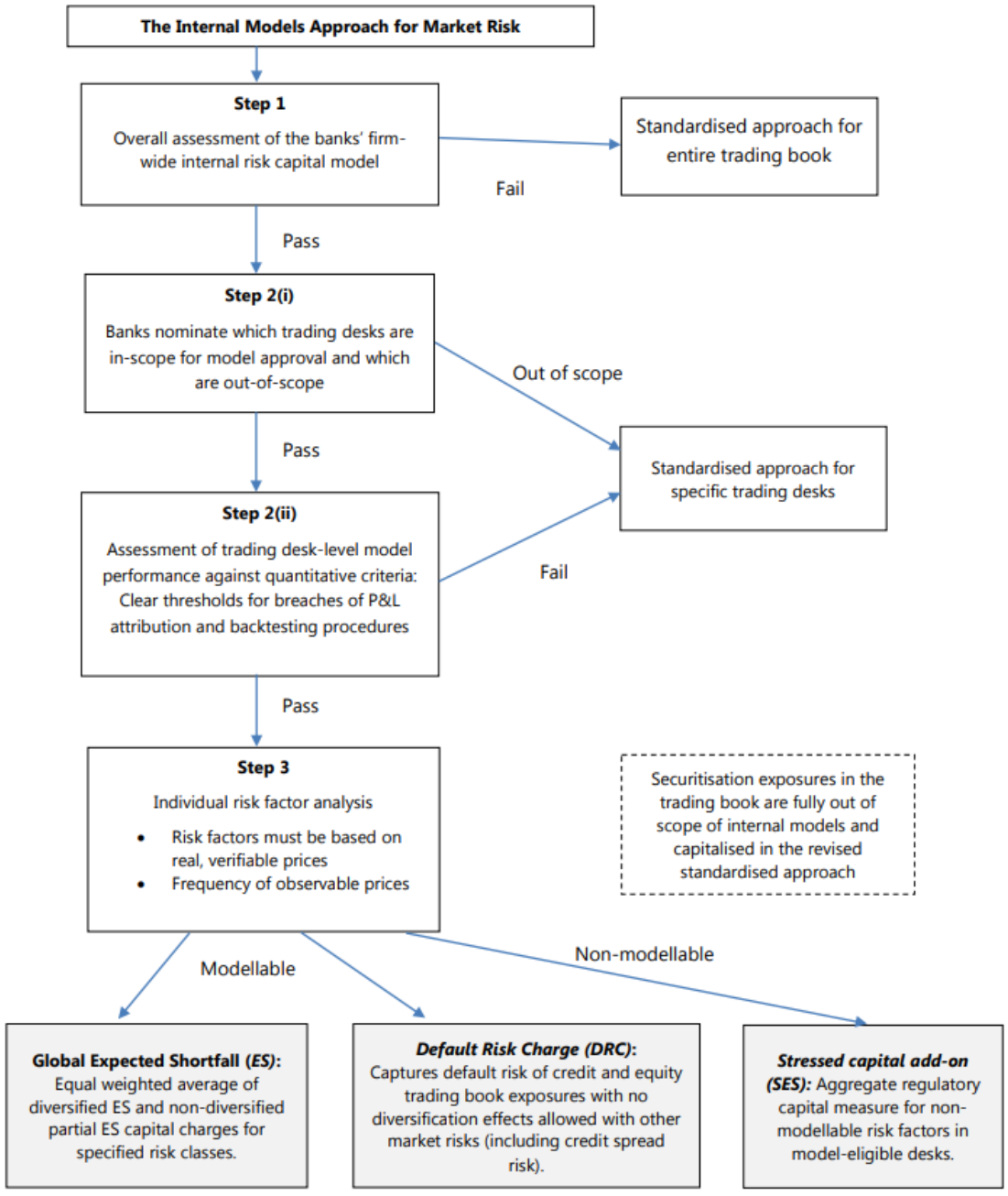
The total IMA capital requirement is the aggregation of three components including:

- Global expected shortfall (ES).
- Default risk charge (DRC).
- Stressed capital add-on for nonmodelable risks (SES).

The process for choosing which trading desks are eligible for IMA is depicted in Figure 2.

12. Ibid., RBC25.14.

Figure 2: Illustration of the Process and Policy Design of the IMA



Source: BCBS, *STANDARDS: Minimum capital requirements for market risk* (Basel, Switzerland: Bank for International Settlements, January 2016), p. 6. https://www.bis.org/bcbs/publ/d352.pdf.

Value at Risk (IMA Requirements)

The expected shortfall is the conditional expectation of loss given that the loss is beyond the VaR level.[13]

Expected shortfall is computed on a daily basis for each trading desk included in the IMA. In calculating the ES, a 97.5th percentile, one-tailed confidence level is to be used. The ES is adjusted using liquidity horizons unique to the instruments held in the portfolio. There are five liquidity horizons:

1. 10 days.
2. 20 days.
3. 40 days.
4. 60 days.
5. 120 days.

The liquidity horizons are shorter for liquid instruments (i.e., large capitalization stocks) and longer for illiquid instruments (i.e., noninvestment grade corporate bonds). The effect is that models are built with overlapping time periods. For example, a shock equal to the change in price between day 0 and 10 may be calculated for a large capitalization stock while a shock equal to the change between day 0 and 250 might be calculated for the credit spread on a noninvestment grade corporate bond. The data for these shocks would need to closely resemble an ES charge that the bank's current portfolio would experience in times of stress.

Value at Risk

Until 2016, value at risk (VaR) was the most popular singular parameter used to calculate market risk, and VaR is still used in many countries. VaR estimates how much a set of investments might lose given normal market conditions over a set time period.

VaR can be calculated by taking past performance of a given investment and projecting it into the future. At its core, VaR relies on past values and a normal distribution which assumes there will be no extreme events, so it should not be used as a definitive measure of risk exposure under stress conditions. Other related measures used to model market risks are stressed VaR (sVaR) and conditional VaR (cVaR).

See BCBS publication, "*STANDARDS: Minimum capital requirements for market risk*" for more information. https://www.bis.org/bcbs/publ/d352.pdf

BCBS also requires that data sets be updated monthly and when market prices are subject to material changes. Supervisors also have the authority to ask the bank to rerun the models for shorter periods of time if they have reason to believe the ES would be significantly different. Further, for stressed scenarios, banks must identify the 12-month period in which the portfolio experienced the most stress, and these time periods must, at a minimum, go back to and include 2007.[14]

13. For further comparison, see *Comparative analyses of expected shortfall and value-at-risk under market stress*. https://www.bis.org/cgfs/conf/mar02p.pdf.

14. Basel Committee on Banking Supervision. *STANDARDS: Minimum capital requirements for market risk* (Basel, Switzerland, Bank for International Settlements, January 2016). https://www.bis.org/bcbs/publ/d352.pdf.

As mentioned, the other two components of the IMA are the default risk charge (DRC) and the stressed capital add-on (SES). The DRC captures default risk of credit and equity trading book exposures with no diversification effects allowed with other market risks. The SES is an aggregate regulatory capital measure for risk factors that cannot be modeled in model-eligible trading desks.

The total IMA capital requirement is an aggregation of ES, DRC, and SES. Securitization exposures in the trading book are not eligible for the IMA approach and must be capitalized using the standardized approach.

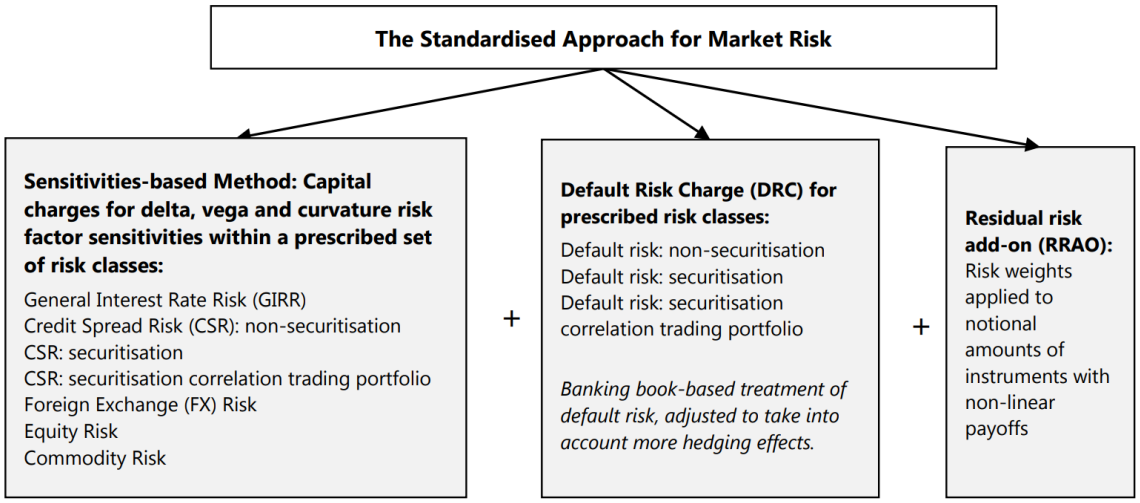
Standardized Approach

BCBS has revised the standardized approach to make it more risk-sensitive and better able to gauge IMA results while still suited to banks that do not need to use the IMA approach for market risk. The standardized approach, as shown in Figure 3, consists of three elements:

Sensitivities-based method + default risk charge + residual risk add-on (RRAO).

Unlike the IMA, the standardized approach applies to both securitization and nonsecuritization exposures in the trading book. The results from this approach must be communicated to bank supervisors on a monthly basis.

Figure 3: The Standardized Approach for Market Risk



Source: Basel Committee on Banking Supervision. *STANDARDS: Minimum capital requirements for market risk* (Basel, Switzerland: Bank for International Settlements, January 2016), https://www.bis.org/bcbs/publ/d352.pdf.

Sensitivity Analysis

The sensitivities-based method extends the elements of the former standardized measurement method for market risk, which allows for the use of sensitivities in some risk treatments within a risk class (e.g., duration for interest rate risk) and for certain instruments (e.g., the delta plus method for options). The advantage of the sensitivities-based method is it creates a consistent risk-based framework that can be applied across a wide spectrum of banks in different jurisdictions.

The risk charge is calculated by aggregating these common risk measures used at trading desks: delta, vega, and curvature. These risk sensitivity measures are to be used as inputs into the aggregation formula described by BCBS. The bank must determine delta and vega sensitivity and curvature scenarios based on instrument prices or pricing models that an independent risk control unit within the bank uses to report risk exposures to senior management.

Here are brief definitions of each risk sensitivity measure:

- *Delta* measures the sensitivity of a portfolio to a small increase in the value of the variable (risk factor) and the resulting change in the value of the portfolio.
- *Vega* is present in derivatives trading because it is a measure of the rate of change to the portfolio's value regarding the volatility of the underlying asset price.
- *Curvature* involves calculating two shock scenarios (one up and one down) with the delta effect removed. Both scenarios are shocked by risk weights, and the worst loss is used as an input into the aggregation formula provided by BCBS, which delivers the capital charge.

Additional Resources

A full description of "buckets" and their risks weight for asset classes is described in *Minimum capital requirements for market risk*, BCBS, February 2019.

A Note on Pricing Models

A key assumption of the standardized approach for market risk is that a bank's pricing models used in actual profit and loss reporting provide an appropriate basis for the determination of regulatory capital requirements for all market risks. To ensure such adequacy, banks must at a minimum establish a framework for prudent valuation practices.

Depending on the asset size of a financial services firm, many regulators may require a routine and rigorous program of stress testing. The results of stress testing should be:

- Reviewed at least monthly by senior management.
- Used in the bank's internal assessment of **capital adequacy**.
- Reflected in the policies and limits set by the bank's management and its board of directors.

See Appendix G for more information on modeling price volatility with VaR.

Positions are broken down by risk class and grouped into categories or "buckets." Three risk charge figures must be calculated for each risk class based on three individual scenarios. These scenarios use specified values for the parameter representing correlation between risk factors in a bucket and the parameter representing correlation across buckets within a risk class. No diversification benefit is permitted.

The second component of the standardized approach (SA) is the DRC. In this context, the DRC is used to capture jump-to-default risk (JTD). BCBS prescribes a step-by-step approach to capture JTD:

- Compute the JTD risk of each instrument separately. The JTD risk is a function of notional amount (or face value) and market value of the instruments and prescribed loss given default (LGD).
- Offsetting rules are specified that enable the derivation of net JTD risk positions.
- Net JTD risk positions are then allocated to buckets and weighted by prescribed risk weights. Note there are different treatments for positions held in the banking book versus those held in the trading book.[15]

The third component of the standardized approach is the residual risk add-on (RRAO), which is to be calculated for all positions bearing residual risk separately and in addition to other components of the capital requirement. RRAO is intended to capture risk exposures not measured by the other components of the standardized approach in cases such as exotic underlying assets with exposures to longevity risk, weather, and natural disasters, among others.

The RRAO is the simple sum of gross notional amounts of the instruments bearing residual risks, multiplied by a risk weight of 1.0% for instruments with an exotic underlying asset and risk weights of 0.1% for instruments bearing other residual risks.[16]

LIBOR Replacement

A fundamental review and reform of major interest rate benchmarks is being undertaken globally. There is uncertainty as to the timing and the methods of transition for replacing the existing benchmark London Inter-bank Offered Rates (LIBOR) with alternative rates. Internal auditors should be aware of this impending change and observe how their organizations are monitoring and preparing to address this major change in interest rates. See Appendix F for more information.

15. Ibid., pp.22-23.

16. Ibid., p. 23.

Role of Internal Audit

According to BCBS, a bank's internal audit and validation functions must conduct an independent review of the market risk governance, management, and measurement systems at least annually. The scope of the independent review must include both the activities of the business trading units and the activities of the independent risk control unit. The independent review must be sufficiently detailed to determine which trading desks are impacted by any failings.[17] Further, Standard 2120.A1 states, "The internal audit activity must evaluate risk exposures relating to the organization's governance, operations, and information system."

Planning and Performing the Engagement

Gather Information

The **chief audit executive**, or internal auditors assigned by the CAE, should be involved in various meetings throughout the organization regarding strategic planning, capital planning, and other types of risk. Internal auditors attending these meetings should be conscious of the information that pertains to market risk. This information will also help internal auditors identify where market or interest rate-related risk information is retained in the organization.

Standard 2010 – Planning states, "The chief audit executive must establish a risk-based plan to determine the priorities of the internal audit activity, consistent with the organization's goals." Once internal auditors have identified the departments, functions, and roles in the organization that are relevant to managing market risk, they should gather relevant documentation to support the preliminary risk assessment and plan the audit engagement.

Audit Consideration

When planning an engagements, auditors should consider The IIA's Code of Ethics principles of Integrity and Competency.

The following elements can help internal auditors understand the level of market risk the institution is willing to accept in the pursuit of its stated objectives:

- Charters, policies, risk appetite statement (RAS), and other mandate information for the governance entities responsible for establishing the market risk management strategy, policies, and procedures including the ALCO and any market risk management group or individuals.

17. Basel Committee on Banking Supervision. *Minimum capital requirements for market risk* (Basel, Switzerland: Bank for International Settlements, February 2019). https://www.bis.org/bcbs/publ/d457.pdf.

- Results of modeling and other analysis for market risks.
- Reports containing the results of stress testing various shocks to the bank's portfolios.
- Evolution of capital allocation for market risk management.
- Recommendations from regulators, particularly from eCap assessments.

Internal auditors should also ask for related escalation protocols to understand what happens when a trade or position is approved outside of typical parameters or as an exception to policy.

Risk Assessment

Among the many types of risk financial institutions encounter, three key risks include credit risk, operational risk, and market risk. In general terms, an institution may manage its credit risk by reducing its portfolio and/or changing the risk profile of its clients. Operational risk can be contained, but not eliminated, using technology and clear processes. When dealing with market risks, variables may arise that are outside the institution´s control. They may move in different ways and at different speeds, thereby increasing the risk exposure and reducing the economic value of the institution. Greater volatility in the economic value of the firm, publicly disclosed in financial statements, affects share prices making them more volatile as well. If a financial services firm does not turn a profit, it will affect stock prices that can impact other risks such as customer growth and retention, reputation, and, ultimately, liquidity.

Market risks include but are not limited to:

- *Interest rate risk* – the risk of loss resulting from changes in interest rates. As a result of a mismatch of interest rates on its assets and liabilities and/or timing differences in the maturity thereof, a financial institution may suffer a loss or a decline in profit due to changes in interest rates.
- *Foreign exchange risk* – the risk of loss resulting from the difference between assumed and actual foreign exchange rates in the case where a financial institution has a long position or short position on a net basis with regard to its assets and liabilities denominated in foreign currencies.
- *Price change risk* – the risk of loss resulting from a decline in the value of assets due to changes in the prices of securities or other devaluing situations.

The key controls to consider for market risks are the established risk limits categorized as hard limits and soft limits. Hard limits trigger compulsory reduction of risks and positions when they are exceeded, while soft limits do not necessarily trigger such reduction but require that the board of directors or a group equivalent to a board of directors discuss and decide what measures to take. Usually, hard limits are established in the trading account and soft limits are established in the banking account.

Any risk assessment for market risk should include a detailed examination of the risk appetite, risk limits, policies, and procedures against the actual instruments that exist in the trading and banking portfolios as those items comprise the control environment.

Types of Market Risk

Interest Rate Risk

Interest rate risk is a significant contributor to overall market risk exposure. Interest rate risk occurs due to movements in global interest rates and is most significant in the banking book. A fundamental objective in banking is to borrow funds at a lower rate and lend them at a higher rate, thereby profiting on the interest rate spread. However, an increase in interest rates puts pressure on customers that may result in default, so a balance is desirable.

Accordingly, the net interest income (NII) or net interest margin (NIM) is dependent on the movements of interest rates. Variations in the NIM of banks occur when there are mismatches in cash flows or repricing dates. Interest rate risk refers to the potential impact on the NII, the NIM, or the market value of equity that occurs due to unexpected changes in market interest rates.

BCBS recognizes two broad categories of interest rate risk:

Regulatory Note

Mortgage-backed securities and mortgage derivative products carry significant prepayment risk. Accordingly, BCBS does not require common treatment for these securities but leaves the treatment decisions to national regulators.

1. *Specific risk* – applies to each security, whether it is a short or a long position.
2. *General market risk* – applies to situations where long and short positions in different securities or instruments can be offset.[18]

This practice guide's focus is limited on interest rate risk by first reviewing the major forms of that risk followed by a brief overview of common techniques for measuring interest rate risk.

Major Forms of Interest Rate Risk

Gap or Mismatch Risk

A gap or mismatch risk arises from holding assets, liabilities, and off-balance sheet items with different principal amounts, maturity dates, or repricing dates, thereby creating exposure to unexpected changes in the level of market interest rates. This risk arises when there is a time-based discrepancy between maturity and new price determination.

18. Basel Committee on Banking Supervision. *Minimum capital requirements for market risk* (Basel, Switzerland: Bank for International Settlements, February 2019). https://www.bis.org/bcbs/publ/d457.pdf.

Basis risk

The risk that the interest rate of different assets, liabilities, and OBS items may change in different magnitudes is termed a basis risk. The degree of basis risk is fairly high in banks that create composite assets out of composite liabilities. Basis risk is the result of different reference interest rates in interest-sensitive positions, with similar characteristics regarding maturity or repricing.

Embedded option risk

Embedded option risk results from significant changes in market interest rates that affect a bank's profitability by encouraging prepayment of cash credit/demand loans/term loans. Thus, optionality risk arises from contract provisions regarding interest-sensitive positions, such as loans with early repayment options and deposits with early withdrawal options. The exercise of call/put options on bonds/debentures also leads to optionality risk. Banks should estimate embedded options and then adjust the gap statements to estimate risk profiles. Banks must also periodically conduct stress tests to measure the impact of changes in interest rates.

Yield curve risk

This risk arises from changes in the shape of the yield curve. Banks base their assets and liabilities prices on different benchmarks, including Treasury bill rates, fixed deposits, and call money market rates. When banks use two instruments that mature at different times for pricing their assets and liabilities, any nonparallel movements in the yield curves will affect the net interest margin. The fluctuations in the yield curve are more frequent when the economy moves through business cycles. Banks should examine the impact of yield curve fluctuations on the portfolio value and operating income. These risks cover adverse effects on a bank's income or underlying economic value resulting from unanticipated shifts in the yield curve.

Price risk

The scenario of price risk arises when assets are sold before their stipulated maturity period. In financial terminology, bond prices and yields are inversely related. Price risk occurs when assets are sold before their stated maturities. Price risk is closely associated with short-term movements in interest rates. Hence, banks that have active trading books must focus on formulating policies to restrict portfolio size, holding period, duration, stop-loss limits, and marking to market.

Reinvestment risk

Reinvestment risk is uncertainty as to the interest rates at which the future cash flows could be reinvested.

Net interest position risk

One of the significant factors contributing to the profitability of banks is the size of nonpaying liabilities. When interest rates are in a downward trend, the interest rate risk is higher for banks that have more earning assets than paying liabilities. In other words, banks with positive net

interest positions will experience reductions in net interest income as the market interest rate declines and increases when the interest rate rises.

Interest Rate Risk Measurement and Management

Maturity gap analysis

Maturity gap analysis is one of the simplest analytical techniques for managing interest rate risk exposure. Gap analysis distributes interest rate-sensitive assets (RSAs), liabilities, and off-balance sheet positions into a certain number of predefined time bands, according to their maturity (fixed rate) or the time remaining for their next repricing, which is based on a floating rate. Assets and liabilities that lack definite repricing intervals, such as bank savings, cash credit, overdraft, loans, and export finance, are assigned time bands according to the bank's judgment and past experience. Time bands are also assigned when actual maturities vary from contractual maturities, such as an embedded option in bonds with put/call options, loans, cash credit/overdraft, time deposits, and so on.

Banks with large exposures in the short term should test the sensitivity of their assets and liabilities at short intervals. To evaluate earnings exposure, interest RSAs in each time band are netted with the interest rate-sensitive liabilities (RSLs) to produce a repricing gap for that time band. A positive gap indicates that banks have more RSAs than RSLs. A positive or asset-sensitive gap means that an increase in market interest rates would cause an increase in NII. A negative or liability-sensitive gap implies that a bank's NII would decline as a result of the increase in market interest rates.

The gap is used as a measure of interest rate sensitivity. The positive or negative gap is multiplied by the assumed interest rate changes to derive the earnings at risk (EaR). The EaR method estimates the potential impact on earnings if interest rates are adversely affected. Changes in interest rates can be estimated based on past trends, forecasting of interest rates, or other criteria. The periodic gap analysis indicates the interest rate risk exposure of banks over distinct maturities. It also suggests the magnitude of portfolio changes necessary to change the risk profile of banks.

Limitations of gap analysis

The gap analysis quantifies the time difference between repricing dates of assets and liabilities but fails to measure the impact of the basis and embedded option risks. The gap report will be unable to measure the entire impact of a change in interest rates within a stated time band. Note that all assets and liabilities are matured or repriced simultaneously in a gap analysis.

Gap analysis also fails to measure the effect of changes in interest rates on the economic or market value of assets, liabilities, and OBS positions. It does not take into account any differences in the timings of payments that might occur resulting from changes in an interest rate environment. In a practical situation, the assumption of a parallel shift in the yield curves is not valid. As such, gap analysis fails to capture the variability in noninterest revenues and expenses.

Duration gap analysis

Duration gap analysis is an effective way to protect the economic values of banks from exposure to interest rate risk. The duration of a fixed income instrument is a weighted average of the times that payments (cash flows) are made. In duration gap analysis, the duration of assets and liabilities are matched instead of matching the maturity or repricing dates. The duration gap model considers the change in the market values of assets, liabilities, and OBS items. In other words, the economic value changes to market interest rates are estimated by calculating the duration of each asset, liability, and OBS position, and assigning weights to arrive at the weighted duration of assets, liabilities, and OBS. Based on the weighted duration of assets and liabilities, a duration gap is worked out mathematically. When weighted assets and liabilities are matched, the market interest rate movements have almost the same impact on assets, liabilities, and OBS items.

Duration is defined as the measure of the percentage change in the economic value of a position given a small deviation in the level of interest rates. The duration gap measure is used to estimate the expected change in the market value of equity (MVE) for a given change in the market interest rate. Banks' net duration is the difference between the duration of assets (DA) and the duration of liabilities (DL). If the net duration is positive (DA > DL), a decrease in market interest rates will increase the market value of equity of a bank. When the duration gap is negative (DL > DA), the MVE increases when the interest increases. Duration analysis provides a comprehensive measure of interest rate risk for the total portfolio. Duration analysis considers the time value of money and is additive in nature, thereby enabling banks to match their total assets and liabilities rather than matching individual accounts. Duration gap analysis fails to identify basis risk because the parallel shifts in the yield curve assumption is made in this case.

Simulation analysis

Many international banks use balance sheet simulation models to gauge the effect of market interest rate variations on reported earnings/economic values over different time zones. Simulation analysis overcomes the limitations of gap and duration analysis. Computer-based simulation techniques model a bank's interest rate sensitivity. Monte Carlo simulation makes assumptions about the future path of interest rates, the shape of a yield curve, pricing, and hedging strategies. In simulation analysis, the detailed assessment of potential effects of changes in interest rates on earnings and economic values could be done. The simulation model is an effective tool for understanding the risk exposure in a variety of interest rate/balance sheet scenarios. Simulation models are useful for evaluating the effect of alternative business strategies on risk exposures.

Equity Risk

Banks can accept equity as collateral for loans and purchase ownership stakes in other companies as investments with their free or investable cash. These instruments create risk due to the current value (or periodic profit) of assets and liabilities (including OBS assets and liabilities) being affected by changes in stock prices, stock index prices, and other scenarios. This list offers examples of items that present equity risk:

- Stocks.
- Corporate bonds with equity-purchase warrants.
- Stock derivatives (e.g., forward contracts, futures, swaps, options).
- Assets and liabilities whose cash flow (e.g., redemption value, coupon rate) is determined in reference to stock prices, stock index prices, and other scenarios.

Equity Risk Measurement

Common methods employed to measure equity risk include standard deviation, beta, and VaR. Because VaR already has been covered in this guide, this section will focus on standard deviation and beta.

Standard Deviation

Standard deviation measures the variance of data from its expected value. The standard deviation is used in making an investment decision to measure the amount of historical volatility associated with an investment relative to its annual rate of return. It indicates how much the current return is deviating from its expected historical normal returns. For example, a stock that has high standard deviation experiences higher volatility, and therefore, a higher level of risk is associated with the stock.

Beta

Beta is another common measure of risk that considers the amount of systematic risk an individual security or an industrial sector has relative to the whole stock market. The market has a beta of 1, and it can be used to gauge the risk of a security. If a security's beta is equal to 1, the security's price moves in step with the market. A security with a beta greater than 1 indicates that it is more volatile than the market.

Conversely, if a security's beta is less than 1, it indicates that the security is less volatile than the market. For example, if a security's beta is 1.5, in theory, the security is 50% more volatile than the market.

Foreign Exchange Risk

There are three main types of foreign exchange risk:

1. *Transaction Risk* – may occur when a bank has to convert a cash flow or other instrument from one currency to another. As the value of the two currencies fluctuates, a bank may make or lose money on the transaction. Banks can hedge FX risk depending on their positions, strategies, and the timing of deals and transactions. FX risk may also occur between the signing of a contract or a purchase of a monetary instrument and the finalization of the transaction.
2. *Translation Risk* – may occur as large multinational organizations consolidate their financial results onto their balance sheets, thereby converting multiple foreign currencies

into the institution's home currency. Depending on the amounts involved, even small fluctuations in currency values can generate large risk exposures and/or events. These fluctuations and the ability to monitor them becomes even more important when the transaction crosses a financial reporting boundary such as a quarter-end or a year-end.

3. *Economic Risk* (also known as strategic or operational risk) – may occur as the institution collects interest income or other revenue and pays operating expenses in multiple currencies. Unfavorable currency fluctuations could generate a reduction in the present value of future operating cash flows.

Audit Consideration

Financial institutions may have many entities auditing various aspects of market risk. Internal audit, regulators, market risk review functions, compliance, and others may be constantly asking for the same information.

Internal audit should attempt to coordinate as much as possible with other entities to avoid audit fatigue.

For information on coordinating with others during an audit, see IIA Practice Guide "Coordination and Reliance: Developing an Assurance Map."

Also see Standard 2050 – Coordination and Reliance.

Foreign Exchange Risk Measurement

The most common technique used to measure and monitor FX risk is VaR. Since the VaR model does not define the maximum loss with 100% confidence, firms often set operational limits, such as nominal amounts or stop loss orders, in addition to VaR limits, to reach the highest possible coverage of their risk exposure.

Commodity Pricing

Commodity risk is not covered in this guide because it is not particularly relevant to most financial institutions. Institutions that trade commodity futures or operates in a business environment with indirect links between commodity markets (e.g., oil) and financial markets may refer to Appendix H for additional reading.

Planning the Engagement

To satisfy Standard 2210 – Engagement Objectives and Standard 2220 – Engagement Scope, some approaches the CAE may consider are:

Market risk governance audits – Since market risk is generated by real-time movements in the markets, internal auditors may want to consider auditing the functioning of the governance structures that deal with market risk.

Market risk management process audits – Internal audit may choose to design an audit engagement that would cover market risk management processes for a selection of portfolios depending on the nature of the investments in and risk exposure presented by those portfolios

(e.g., fixed income portfolios, portfolios invested in individual securities, and portfolios holding investments in hedge funds would each have different characteristics and risk exposure levels.)

Market risk model audits – Internal auditors may decide to conduct a review of the models used to identify, measure, and monitor market risk. This may include a review of model governance, policies and controls, an assessment of model validation activities, or audits structured around model development, implementation, and use.

To accurately and completely examine market risk in an organization, internal auditors should ensure they are independent (Standard 1100 – Independence and Objectivity) and that the appropriate technical skill sets are employed (Standard 1200 – Proficiency and Due Professional Care). The most common way internal auditors or second line personnel, as defined in The IIA's position paper, "The IIA's Three Lines Model: An Update of the Three Lines of Defense," may have their independence impaired regarding market risk is if they are involved with the development of a trading strategy, new portfolio of investments, or the development, implementation, or validation of any relevant models.[19]

Auditing Risk Management Frameworks

While market risk may be a more technical risk, the process of auditing a risk management framework that supports and enables an organization's risk governance structures remain constant.

Appendices D and E provide general recommendations for the assessment of an organization's risk management frameworks regardless of which risk the internal audit engagement is focused.

For more information, see IIA Practice Guide "Assessing the Risk Management Process."

Internal auditors may also have their independence compromised by being part of a team developing a new product if their duties cross over from being an observer to participating in product design. If this occurs, auditors should refrain from participating on the audit team if their team participation occurred within the past year. Standard 1120 – Individual Objectivity states, "Internal auditors must have an impartial, unbiased attitude and avoid any conflict of interest." The interpretation of the standard says a conflict of interest can create an appearance of impropriety that can undermine confidence in the auditor, the internal audit activity, and the profession.

Standard 1130 – Impairment to Independence or Objectivity states, "If independence or objectivity is impaired in fact or appearance, the details of the impairment must be disclosed to appropriate parties. The nature of the disclosure will depend upon the impairment." The interpretation of this standard outlines further parameters that must considered when assigning auditors to an audit or consulting project.

19. The Institute of Internal Auditors. The IIA's Position Paper, "The IIA's Three Lines Model: An Update of the Three Lines of Defense" (Lake Mary, FL: The Institute of Internal Auditors, July 2020). https://na.theiia.org/about-ia/PublicDocuments/Three-Lines-Model-Updated.pdf.

In conformance with Standard 2230 – Engagement Resource Allocation, the interpretation indicates the CAE should assess the skills of internal audit team members periodically to ensure that the internal audit activity has the appropriate skills to evaluate the area under review.

Some organizations may cosource or hire external vendors to execute and/or evaluate their market risk management programs. If so, the CAE must decide if that work can be relied upon. If the CAE chooses to or is required to rely on other service providers, as noted in Standard 2050 – Coordination and Reliance, they should carefully consider the competency, objectivity, and due professional care of the other providers, as well as clearly understand the scope, objectives, and results of their work. Ultimately, the CAE retains the responsibility for ensuring adequate support exists for the conclusions and opinions reached by the internal audit activity, even if that includes work contributed by others. (For information on coordinating with others during an audit, see IIA Practice Guide "Coordination and Reliance: Developing an Assurance Map.")

During planning, internal auditors document information in engagement workpapers as mandated by Standard 2330 – Documenting Information. This information becomes part of the engagement work program that must be established to achieve the engagement objectives, as required by Standard 2240 – Engagement Work Program.

The process of establishing the engagement objectives and scope may produce any or all of the following workpapers:

- Process maps.
- Summary of interviews.
- Preliminary risk assessment (e.g., risk and control matrix and heat map).
- Rationale for decisions regarding risks included in the engagement.
- Criteria used to evaluate the area or process under review including criteria to evaluate management's self-assessment results (required for assurance engagements, according to Standard 2210.A3).

Evaluating Market Risk Governance

Generally, the greatest responsibility of market risk management would be the responsibility of the first line of a three-line model, while monitoring is usually conducted by the second line. However, this does not exempt the first line from carrying out process controls that allow it to correct deviations with risk budgets and meet the entity's risk appetite. A comprehensive work program for market risk audit engagements should focus on both the first line and the second line as well as the higher market risk governance committees mentioned in the Market Risk Governance section of this document.

Some important considerations should be confirmed as part of Standard 2240 – Engagement Work Program:

- Committees responsible for monitoring market risk, whose activities must be documented, will be of particular relevance to demonstrate the second line is appropriately supervising the first line.
- Market risk decisions are taken within individual and committee mandates, as prescribed by the authorities delegated to them from the organization's board. Those responsible for making risk decisions (individuals and committees) should be provided with relevant and updated information from any appropriate risk assessments. Material risk decisions may be subject to challenge by the second line.
- Committee structures may vary. Depending on the size of the financial institution, it may be necessary to create different committees with varying levels of approval power. There may also be cases in which the board itself participates in the decision approval involving the most or highest risk.
- There should be evidence that committees are executing their oversight functions of market risk policies and monitoring portfolios by effectively challenging actions taken by the first line as appropriate. This requires them to monitor the portfolio's performance to identify deviations that may require action.
- Internal auditors should examine information flows from a bottom-up perspective in the organization. For example, a walk-through of the escalation protocols from the trader, to the risk manager, to business unit management, to the ALCO and, ultimately, to the board would be beneficial.
- Board members should assess if the management risk committee is effectively monitoring whether strategic goals are being met within the risk appetite of the organization.
- Evaluating the organization of the risk control (market risk management) unit:
  - An examination of segregation of duties.
  - The competency and qualifications of the market risk manager(s) to provide effective challenge.
  - Reasonable expectations of independence among second-line employees involved in measuring and monitoring market risk.
- Internal auditors should confirm the sufficiency of capital allocated for market risk.

Auditing the Market Risk Identification, Measurement, and Monitoring Process

Market risk management is heavily based on financial modeling. However, models are mathematical reductions of real-world events and may not reflect the actual risk in a portfolio. Thus traders, management, risk managers, and internal auditors should apply their judgment and experience in knowing how to use the models appropriately, and to appreciate the strengths and weaknesses of their models, including when to supplement or substitute one model with another model or approach.

Markets operate continuously, so there is a constant data flow related to market risk. Experienced traders and risk managers should blend this historical data with their own forward-looking judgment. It is important for internal auditors to be able to audit the models involved in managing market risk but also to possess the skill sets and knowledge required to analyze the judgmental aspects of market risk management.

Market risk information for the portfolio(s) in scope of the audit should be compared to the institutions' stated risk appetite and risk limits. Internal auditors should perform walk-throughs or tests to verify that limit breaches are brought to the attention of senior management promptly and that they are resolved within the institution's stated policies and procedures.

Evaluating the market risk management process also may include the following activities:[20]

- Assessing the adequacy of the documentation of the risk management models and processes.
  - Market Risk Management (MRM) policies should contain statements regarding:
    a. The roles and responsibilities of the director in charge and the board of directors or a group equivalent to a board of directors with regard to market risk management.
    b. The policy on organizational framework, such as establishment of a division concerning market risk management, the office division (trading, banking), and the division that conducts back office business concerning market transactions and the authority assigned to it.
    c. The policy regarding the establishing of market risk limits.
    d. The policy on identification, assessment, monitoring, control, and mitigation of market risks.[21]
  - Policies and procedures governing models are typically drafted by senior management and approved by the board and should meet the following criteria:
    a. Cover the entire MRM process.
    b. Be written in detail to reduce the need for interpretation and increase uniform execution throughout the organization.
    c. Establish documentation standards for all key activities in the three model risk management areas of activity.
    d. Define MRM roles and responsibilities across the organization.
    e. Define the model risk assessment framework and process.
    f. Establish control standards for models.
    g. Require the creation and maintenance of an organizationwide model inventory.

20. Adapted from Basel Committee on Banking Supervision's *Minimum capital requirements for market risk* (Basel, Switzerland: Bank for International Settlements, February 2019). https://www.bis.org/bcbs/publ/d457.pdf.

21. Financial Services Agency, "Checklist for Marketing Risk Management." Accessed November 17, 2020. https://www.fsa.go.jp/en/refer/manual/yokin_e/y09.pdf.

- Assessing the effectiveness of the approval process for risk pricing models and valuation systems used by a bank's front- and back-office personnel.
- Validating the scope of market risks reflected in trading desk risk management models.
- Validating the integrity of the management information system.

Auditing Models Used in Market Risk Management

Model risk occurs for two primary reasons: fundamental errors in model data, rationale, hypothesis, and methodologies may produce inaccurate outputs when viewed against the design objective and intended business uses, and/or the model or its results may be used incorrectly or inappropriately. Further, **aggregate model risk** refers to interrelated risk among models caused by shared inputs and/or assumptions or one model's output being another model's input.[22]

Resource

For more information on auditing models, see IIA Practice Guide "Auditing Model Risk Management."

The scope of an independent review of the models used to identify, measure and monitor market risk may include the following activities:

- Obtaining or validating the inventory of market risk-associated models.
- Assessing the accuracy and appropriateness of market risk management models (including any significant changes).
- Verifying of the consistency, timeliness, and reliability of data sources used to run internal models, including the independence of such data sources.
- Assessing the accuracy and completeness of position data.
- Verifying the accuracy and appropriateness of volatility and correlation assumptions.
- Verifying the accuracy of valuation and risk transformation calculations.
- Verifying the trading desk risk management model accuracy through frequent backtesting and profit and loss attribution (PLA) assessments.
- Examining the general alignment between the models to determine market risk capital requirements.

Reporting

Standard 2400 – Communicating Results is self-explanatory in that results of an engagement must be communicated. According to the interpretation of Standard 2410 – Criteria for Communicating, "Opinions at the engagement level may be ratings, conclusions, or other descriptions of the results. Such an engagement may be in relation to controls around a specific process, risk, or business unit.

22. Ibid.

The formulation of such opinions requires consideration of the engagement results and their significance."

CAEs should be aware that the *Standards* do not require a specific reporting format. Not all internal audit reports must be written or include ratings. Alternatives to a traditional report may be considered.

Appendix A. Relevant Standards and Guidance

The following IIA resources were referenced throughout this practice guide. For more information about applying the *International Standards for the Professional Practice of Internal Auditing*, please refer to The IIA's Implementation Guides.

Code of Ethics
Principle 1: Integrity
Principle 4: Competency
Standards
Standard 1100 – Independence and Objectivity
Standard 1120 – Individual Objectivity
Standard 1130 – Impairment to Independence and Objectivity
Standard 1200 – Performance and Due Professional Care
Standard 2010 – Planning
Standard 2120 – Risk Management
Standard 2050 – Coordination and Reliance
Standard 2210 – Engagement Objectives
Standard 2220 – Engagement Scope
Standard 2230 – Engagement Resource Allocation
Standard 2240 – Engagement Work Program
Standard 2330 – Documenting Information
Standard 2400 – Communicating Results
Standard 2410 – Criteria for Communicating
Related IIA Resources
Practice Guide "Assessing the Risk Management Process," 2019.
Practice Guide "Auditing Model Risk Management," 2018.
Practice Guide "Coordination and Reliance: Developing an Assurance Map," 2018.
Position Paper "The IIA's Three Lines Model: An Update of the Three Lines of Defense," 2020.

Appendix B. Glossary

Terms identified with an asterisk (*) are taken from The IIA's *International Professional Practices Framework* "Glossary," 2017 edition.

aggregate model risk – interrelated model risk caused by shared inputs and assumptions or one model's output being another model's input.

board* – the highest level governing body (e.g., a board of directors, a supervisory board, or a board of governors or trustees) charged with *the* responsibility to direct and/or oversee the organization's activities and hold senior management accountable. Although governance arrangements vary among jurisdictions and sectors, typically the board includes members who are not part of management. If a board does not exist, the word "board" in the Standards refers to a group or person charged with governance of the organization. Furthermore, "board" in the Standards may refer to a committee or another body to which the governing body has delegated certain functions (e.g., an audit committee).

capital adequacy – enough capital to run an institution's business while still absorbing the risk and volatility of its credit, market, and operational threats.

chief audit executive* – describes the role of a person in a senior position responsible for effectively managing the internal audit activity in accordance with the internal audit charter and the mandatory elements of the International Professional Practices Framework. The chief audit executive or others reporting to the chief audit executive will have appropriate professional certifications and qualifications. The specific job title and/or responsibilities of the chief audit executive may vary across organizations.

compliance* – adherence to policies, plans, procedures, laws, regulations, contracts, or other requirements.

control* – any action taken by management, the board, and other parties to manage risk and increase the likelihood that established objectives and goals will be achieved. Management plans, organizes, and directs the performance of sufficient action to provide reasonable assurance that objectives and goals will be achieved.

governance* – the combination of processes and structures implemented by the board to inform, direct, manage, and monitor the activities of the organization toward the achievement of its objectives.

internal audit activity* – a department, division, team of consultants, or other practitioner(s) that provides independent, objective assurance and consulting services designed to add value and improve an organization's operations. The internal audit activity helps an organization accomplish its objectives by bringing a systematic, disciplined approach to evaluate and improve the effectiveness of governance, risk management, and control processes.

liquidity – the ability of a bank to fund increases in assets and meet obligations as they come due, without incurring unacceptable losses.

risk* – the possibility of an event occurring that will have an impact on the achievement of objectives. Risk is measured in terms of impact and likelihood

risk appetite* – the level of risk that an organization is willing to accept.

risk governance – participation in the risk management process throughout the entire organization by personnel that are knowledgeable, skilled, and competent in risk management.

risk management* – a process to identify, assess, manage, and control potential events or situations to provide reasonable assurance regarding the achievement of the organization's objectives.

Appendix C. Acronym Guide

Acronym	Expansion
ALCO	Asset/liability committee
BCBS	Basel Committee on Banking Supervision (or Basel)
CAE	Chief audit executive
CEO	Chief executive officer
CFO	Chief financial officer
CSR	Credit spread risk
DA	Duration of assets
DL	Duration of liabilities
DRC	Default risk charge
EaR	Earnings at risk
EC/eCap	Economic capital
ECB	European Central Bank
ES	Expected shortfall
FRTB	Fundamental review of trading book
FX	Foreign exchange
GIRR	General interest rate risk
IFRS	International Financial Reporting Standard
IMA	Internal models approach
JTD	Jump-to-default risk
LGD	Loss given default
LIBOR	London Inter-bank Offered Rate
MRM	Market risk management or Model risk management
NII	Net interest income
NIM	Net interest margin
OBS	Off-balance sheet
P&L	Profit and loss
PLA	Profit and loss attribution
RAS	Risk appetite statement
RRAO	Residual risk add-on
RSA	Rate-sensitive asset
RSL	Risk-sensitive liability
RWA	Risk weighted assets
SA	Standardized approach
SES	Stressed capital add-on
SME	Small- and medium-sized enterprises
VaR	Value at Risk

Appendix D. Risk Management Framework Audit Approaches

While not customized for a market risk management governance framework, the approaches depicted here contain the elements common to designing an audit work program for any risk management framework.

Top-down Approach	
Most effective information-gathering method(s)	■ Interviews. ■ Document reviews.
Typical participants	■ Board members (e.g., audit committee and/or risk committee chairs). ■ Senior management. ■ Group/division management.
Limitations	■ Level of detail gathered is low. ■ The assessment may take on a governance focus as a function of the participant group. ■ The views of the board and senior management may not represent those of the rest of the organization.
Bottom-up Approach	
Most effective information-gathering method(s)	■ Interviews. ■ Surveys. ■ Document reviews. ■ Walk-throughs.
Typical participants	■ Line managers. ■ Supervisors.
Limitations	■ Surveys may generate confusion if they lack a common risk language or process. ■ Feedback may be inconsistently distributed across participants. ■ Many line managers and supervisors may be unable to participate due to time/resource restrictions (which may be indicative of the priority given to the risk management process).
Combination Approach	
Most effective information-gathering method(s)	■ Interviews (higher level personnel). ■ Surveys (lower level personnel). ■ Document reviews.
Typical participants	■ Board members (e.g., audit committee and/or risk committee chairs). ■ Senior management. ■ Group/division management. ■ Line managers.
Limitations	■ While this approach should provide a more comprehensive view, any of the previously mentioned limitations may still apply.

Appendix E. Assessing the Risk Management Process

At a general level, these tables describe activities that internal auditors may perform as part of an assessment of an organization's risk management process. As stated in Appendix D, while not customized to market risk management governance, these activities may be adapted to that context with the addition of rigorous audits of the models used to monitor market risk.

These activities do not constitute a complete work program for such an assessment. Internal auditors may need to create more detailed analyses and test steps tailored to the policies and procedures that are unique to the organization.

Risk Management Culture

Risk reporting

- Gather documentation including:
  - Charters, policies, and other mandated information for the governance entities responsible for establishing and overseeing the risk management process.
  - Documentation of all phases of the risk reporting process.
- Gain an understanding of the key risks identified as related to the organization's objectives.
- Determine whether risk reporting accurately communicates the status of risk exposure in the organization (e.g., is it too complicated, or is it too simple?).
- Rate risks in accordance with the organization's established risk assessment methodology.
- Review information obtained in the preliminary risk assessment to assess the impact and likelihood of risks related to risk culture.

Communication

- Follow risk reporting in various areas to ascertain whether risk information is communicated fluidly at all levels throughout the organization.
- Examine risk-related ethics and compliance investigations to determine whether retaliation for communicating risk information is a problem.
- Use surveys, interviews, or other methods to ascertain employees' participation in communication programs and their level of understanding of the organization's risk management objectives.

Accountability

- Confirm risk owners are held accountable for risk exposures in their sphere of authority.
- Confirm the board and senior management are held accountable for requesting and using risk information in decision-making.

Risk Management Governance

Risk reporting

- Use reported risk information to assess culture and examine for appropriateness in terms of distribution, monitoring, and data retention.
- Review information obtained in the preliminary risk assessment to assess the impact and likelihood of risks related to risk management governance.

Board reporting

- Review risk-related reports that were prepared for the board. Ensure the reports contain all pertinent information needed by the board to make informed decisions.
- Review reports from senior management about the status of risk exposures in relation to strategies and risk appetite.

Risk appetite

- Review the organization's risk appetite profile for completeness and adequacy, including:
  - Risk capacity: The maximum level of risk the organization can assume given its current obligations and constraints and its level of available resources.
  - Risk limits: The allocation of aggregate risk appetite limits to business lines, legal entities, specific risk categories, and other relevant granular levels.
  - Risk tolerance: The amount of variance the organization will accept around revenue and expenses, etc., given the parameters set for risk capacity and their associated risk limits.
- Review plans and processes to communicate the risk appetite to all employees.
- Ensure the plan covers the entire organization and is executed regularly.
- Use surveys, interviews, or other methods to ascertain both employees' participation in communication programs and their level of understanding regarding the organization's risk appetite.

Risk Management Process

Policies and procedures

- Verify that the policies and procedures are current and updated timely when procedural changes occur.
- Confirm that updates requested by the board during the annual review have been properly implemented.
- Ensure the policies and procedures cover the entire risk management process in detail. Specific areas of importance include:
  - Relationship to strategies and risk appetite.
  - Governance overview.
  - Risk limits and tolerances with their associated triggers and escalation protocols (walk through the process from the identification of a breach to its resolution).
  - Roles and responsibilities.
  - Data considerations.
- Regulatory requirements.

Risk assessment process

- Identify where and how often risk assessments are conducted across the organization.
- Examine whether processes for risk identification, assessment, treatment, monitoring, and reporting are consistent.
- Review information obtained in the preliminary risk assessment to assess the impact and likelihood of risks related to risk management processes throughout the organization.

First line procedures

- Check whether daily automatic reconciliations are carried out correctly between the operating and accounting balances of the portfolios of the trading portfolio.
- Carry out an independent recalculation of the cash equity requirement for market risk.
- Verify if there is a monthly validation procedure for the correct compensation between short and long positions in national and foreign currency of the financial instruments that make up the trading portfolio used to calculate the cash equity requirement for market risk.
- Check if the interest rate and exchange rate risks are obtained correctly both for general risk and for specific risk.
- Check if there is an adequate process for sending regulatory reports.
- Verify if the applications used in the process comply with the security mechanisms established by the institution to ensure the confidentiality, integrity, and availability of the information related to the calculations of key performance indicators and key risk indicators related to market risk.

Appendix F. LIBOR Replacement

The London Inter-bank Offered Rate (LIBOR) has a long history, but came into global use in the 1980s as an interest-rate tool when derivative contracts began using it to hedge interest rates. Scandals have undermined LIBOR's credibility and as a result, replacements are being sought.

LIBOR is a set of benchmark interest rates that provide an indication of the average rates at which panel banks could borrow wholesale, unsecured funds for set periods in particular currencies. It is calculated and published daily by the Intercontinental Exchange (ICE) Benchmark Administrator (IBA) based on submissions from a panel of banks. It is published across a range of currencies (GBP, USD, EUR, JPY, and CHF) and maturities (overnight, one week, one month, two months, three months, six months, and one year).

As of 2017, it was estimated that LIBOR underpinned approximately $300 trillion of financial contracts including derivatives, bonds, and loans globally.[23]

LIBOR is being replaced for two reasons:

1. A series of price fixing scandals associated with LIBOR undermined market confidence in the validity of the rate.
2. The underlying market that LIBOR is derived from is no longer used in any significant volume. Therefore, the submissions made by banks to sustain the LIBOR rate are often based (at least in part) on expert judgment rather than actual transactions.

There is a global effort underway to replace LIBOR, and the Financial Stability Board (FSB) and the International Organization of Securities Commissions (IOSCO) have decided the key principle is that the benchmark rates should be based on observable arms-length transactions rather than estimates.

Sterling Overnight Index Average

The UK's Financial Conduct Authority (FCA) has concluded that the way in which LIBOR is calculated in practice means that it no longer complies with internationally accepted principles for robust interest rate benchmarks. As such, FCA announced in 2017 its intention to stop compelling banks to submit the rates required to calculate LIBOR after the end of 2021.

Since the FCA's announcement, the UK authorities (the FCA, the Prudential Regulation Authority [PRA] and the Bank of England) have encouraged a transition from LIBOR to alternative interest rates before the end of 2021, calling this transition "critical."

23. "The replacement of LIBOR," Santander, accessed November 17, 2020. https://www.santander.com/en/landing-pages/banco-santander-london-branch/the-replacement-of-libor.

In the UK, the Working Group on Sterling Risk-Free Reference Rates (the RFR Working Group) has been established to develop alternative rates to replace GBP LIBOR and oversee transition.

In April 2017, the RFR Working Group recommended SONIA (the Sterling Overnight Index Average) as its preferred alternative reference interest rate for sterling transactions (although it is possible to transition to others rates as well). Since then, the RFR Working Group has been focused on how to implement a transition across sterling markets.[24]

Secured Overnight Financing Rate

In 2014 the United States Federal Reserve convened the Alternative Reference Rates Committee (ARRC) to plan the transition away from U.S. dollar LIBOR. The ARRC decided the criteria for the new benchmark rate would include:

1. Methodological quality.
2. Accountability.
3. Governance.
4. Ease of implementation.

Along with the Treasury Department's Office of Financial Research, the New York Fed proposed a new rate called the Secured Overnight Financing Rate (SOFR). The New York Fed has published SOFR every day since early April of 2018. According to a speech made by Michael Held, Executive Vice President and General Counsel of the Federal Reserve Bank of New York (New York Fed):

> The SOFR measures the cost of overnight borrowings through repo transactions collateralized with U.S. Treasury securities, which is the deepest and most liquid money market in the US. It is based on actual transactions and takes in more transactions than any other Treasury repo rate available, recently around a trillion dollars each day. SOFR is relevant to the cost of borrowing for a wide array of market participants, was constructed to meet the best practices for benchmarks set out by IOSCO and is built to accommodate future market evolution.[25]

Similar initiatives are underway globally for euro, Swiss franc, and yen IBORs.

24. Ibid.

25. Michael Held, "SOFR and the Transition from LIBOR (speech, Remarks at the SIFMA C&L Society February Luncheon, New York City, NY, February 26, 2019).
https://www.newyorkfed.org/newsevents/speeches/2019/hel190226#footnote10.

Appendix G. Modeling Methods Required to Capture Significant Price Risks Within VaR

Banking organizations should map or reference each covered-position type to appropriate and sufficiently granular historical data series to ensure proper estimation of potential price volatilities and correlations with other positions. Proxy time series utilized in VaR modeling should reflect all significant sources of price risk, including potential price moves driven by changes in market liquidity. Proxy choices should be supported by documented analysis and reassessed periodically for continued appropriateness.

Banking organizations can reduce VaR-model complexity and the number of time-series drivers by establishing formal prohibitions or strict limits on certain position types or risk exposures. For example, a documented and well-enforced program of trader, desk, and business limits that prohibits certain potential covered-position exposures naturally reduces the exposure types that need to be reflected within the regulatory VaR model.

When a banking organization plans to assume certain significant risk(s) within a covered-position portfolio but is unable to robustly reflect such risk(s) through an internal VaR model due to modeling or data limitations, or other circumstances, management should consult with the Federal Reserve prior to initiating the activity. In such cases, adjustments to internal models may be required to appropriately reflect risks within the market-risk capital measure. A banking organization's failure to appropriately capture significant price risks within its internal VaR model may result in required restatements of reported regulatory capital ratios.

Source: Board of Governors of the Federal Reserve System. Division of Banking Supervision and Regulation. "Application of the Market Risk Rule in Bank Holding Companies and State Member Banks, SR 09-1." January 14, 2009. https://www.federalreserve.gov/boarddocs/srletters/2009/SR0901.htm#Footref2.

Appendix H. References and Additional Reading

References

Basel Committee on Banking Supervision. *Minimum capital requirements for market risk* (Basel, Switzerland: Bank for International Settlements, 2019). https://www.bis.org/bcbs/publ/d457.pdf.

Basel Committee on Banking Supervision. *STANDARDS: Minimum capital requirements for market risk* (Basel, Switzerland: Bank for International Settlements, 2016). https://www.bis.org/bcbs/publ/d352.pdf.

Basel Committee on Banking Supervision. *The market risk framework: in brief.* (Basel, Switzerland: Bank for International Settlements, 2019). https://www.bis.org/bcbs/publ/d457_inbrief.pdf.

Board of Governors of the Federal Reserve System. Division of Banking Supervision and Regulation. "Application of the Market Risk Rule in Bank Holding Companies and State Member Banks, SR 09-1." January 14, 2009. https://www.federalreserve.gov/boarddocs/srletters/2009/SR0901.htm#Footref2

European Banking Authority. "Regulation and policy: Market Risk." Accessed November 17, 2020. https://www.eba.europa.eu/regulation-and-policy/market-risk.

European Central Bank, Banking Supervision. *Market risk: implementing new rules for internal models*. February 12, 2020. https://www.bankingsupervision.europa.eu/press/publications/newsletter/2020/html/ssm.nl200212_2.en.html.

Financial Services Agency. *Checklist for Marketing Risk Management*. Accessed November 17, 2020. https://www.fsa.go.jp/en/refer/manual/yokin_e/y09.pdf.

Held, Michael. "SOFR and the Transition from LIBOR." Remarks at the SIFMA C&L Society February Luncheon, New York City, NY. February 26, 2019. https://www.newyorkfed.org/newsevents/speeches/2019/hel190226.

International Financial Reporting Standards Foundation. "IFRS 9 Financial Instruments." Accessed November 17, 2020. https://www.ifrs.org/issued-standards/list-of-standards/ifrs-9-financial-instruments/.

Office of the Comptroller of the Currency (US). Comptroller's Handbook: Corporate and Risk Governance, Version 2.0, July 2019. https://www.occ.treas.gov/publications-and-resources/publications/comptrollers-handbook/files/corporate-risk-governance/pub-ch-corporate-risk.pdf.

Santander. "The replacement of LIBOR." Accessed November 17, 2020. https://www.santander.com/en/landing-pages/banco-santander-london-branch/the-replacement-of-libor.

Yamai, Yasuhiro and Toshinao Yoshiba. Bank of Japan. "Comparative analyses of expected shortfall and value-at-risk under market stress." Accessed November 17, 2020. https://www.bis.org/cgfs/conf/mar02p.pdf.

Additional Reading

Commodity Price Risk Management. Deloitte Touche Tohmatsu India and MCX Metal and Energy, 2018. https://www2.deloitte.com/content/dam/Deloitte/in/Documents/risk/in-risk-overview-of-commodity-noexp.PDF.

Hull, John C. *Risk Management and Financial Institutions, 5th Edition*. Hoboken, NJ: John Wiley & Sons Inc., 2018. https://www.wiley.com/en-us/Risk+Management+and+Financial+Institutions%2C+5th+Edition-p-9781119448112.

Kowalski, Chuck. "The Risk of Commodities." *The Balance*. October 4, 2019. https://www.thebalance.com/commodities-and-risk-809167.

Measuring and Managing Market Risk. 2021 Curriculum, CFA Institute. https://www.cfainstitute.org/en/membership/professional-development/refresher-readings/measuring-managing-market-risk.

Morris, James R. and John P. Daley. *Introduction to Financial Models for Management and Planning, 2nd Edition.* New York: Chapman and Hall, 2017. https://www.routledge.com/Introduction-to-Financial-Models-for-Management-and-Planning/Morris-Daley/p/book/9781498765039.

Acknowledgements

Guidance Development Team

Jose Esposito, CIA, CRMA, Peru (Chairman)

Ara Chalabyan, CIA, CRMA, Armenia (Project Lead)

Michael O'Bryan, CIA, Canada

Hazem Keshk, CIA, CRMA, Egypt

IIA Global Standards and Guidance

Jeanette York, CCSA, FS Director (Project Lead)

Jim Pelletier, CIA, CGAP, Vice President

Harold Silverman, CIA, QIAL, CRMA, Managing Director

Anne Mercer, CIA, CFSA, Director

Tammy Wyche, Director

Shelli Browning, Technical Editor

Lauressa Nelson, Technical Editor

Geoffrey Nordhoff, Content Developer, Technical Writer

Christine Janesko, Content Developer, Technical Writer

The IIA would like to thank the following oversight bodies for their support: Financial Services Guidance Committee, Professional Guidance Advisory Council, International Internal Audit Standards Board, Professional Responsibility and Ethics Committee, and International Professional Practices Framework Oversight Council.

About The IIA

The Institute of Internal Auditors (IIA) is the internal audit profession's most widely recognized advocate, educator, and provider of standards, guidance, and certifications. Established in 1941, The IIA today serves more than 200,000 members from more than 170 countries and territories. The association's global headquarters is in Lake Mary, Fla., USA. For more information, visit www.globaliia.org.

Disclaimer

Copyright

December 2020

Global Headquarters
The Institute of Internal Auditors
1035 Greenwood Blvd., Suite 401
Lake Mary, FL 32746, USA
Phone: +1-407-937-1111
Fax: +1-407-937-1101
www.theiia.org