Module: Finance
Section: Interest Rate Risk Measurement and Management
EM-425

Date Published: 10/99

Introduction

This section constitutes the Agency's guidance for conducting examinations of the interest rate risk (IRR) management and measurement practices of Farm Credit System (System) institutions. The guidance identifies sound IRR management principles and practices intended to serve as the evaluative criteria when assigning a component rating for Sensitivity to Market Risk, also referred to as the "S" rating. Criteria for assigning the "S" rating is also contained within Section EM-135, Financial Institution Rating System of the Examination Manual.

The guidance provided within this section is intended for examinations of System banks, direct lender associations, and if applicable, service corporations. When conducting an examination of the IRR measurement and management practices of these institutions, a three-tiered examination approach will be used. This section contains criteria for each tier that correlate to the nature and scope of IRR managed by institutions. Once examiners have identified the appropriate tier for an institution, workpaper procedures applicable to each tier should be used as a tool in determining scope and directing the examination effort. An IRR Evaluation Summary should also be used to assist examiners in assigning an "S" rating. The summary should be prepared upon completion of the examination procedures.

The framework provided by the three tiers allows examiners to tailor the examination scope to an institution's IRR profile. Examiner judgment will be needed to adjust the scope of the examination based on the specific conditions within the district and institution. The scope of the examination should ultimately reflect the size, complexity, and risk profile of each System institution.

Sources of IRR

IRR is inherent to the operations of most System institutions; however, the source, nature, and scope of this risk vary significantly. To establish appropriate risk management and measurement processes, management must have a sound understanding of the current and potential risks and the sources of these risks. In addition, management must measure the impact of risk exposures under various projected economic scenarios and resolve how these risks can be effectively managed.

To properly identify the various sources of IRR, management must comprehend the structure and nature of the institution's balance sheet and the business activities that create risk. For example, System banks directly engaged in funding, investment, derivative, and cash management activities will likely be exposed to multiple sources of IRR. Primary sources may include repricing or maturity mismatch risk, basis risk, yield curve risk, and options risk. System banks may centrally manage these risks on behalf of associations through the use of a funds-transfer pricing program. Under most funds-transfer pricing mechanisms, the impact of interest rate movements on association earnings (arising from the primary sources of IRR) is transferred to the district bank. In exchange for this risk centralization, the district bank normally charges fees to recover its cost of risk-hedging activities.

An effective funds-transfer pricing process used to fully match retail and wholesale loan attributes transfers the primary sources of IRR from associations to the district bank. Nonetheless, associations will continue to have some exposure to IRR. For example, the net interest income of associations will be exposed to changing rates via their impact on retail loan spreads. Also, associations may offer unique loan products or programs for which the district bank does not centrally manage the IRR.

Appendix A provides a more detailed discussion of the sources of IRR most common to System banks and associations.

Criteria and Guidance

The following criteria are provided to assist examiners in determining the appropriate scope and approach to be used when examining an institution's IRR measurement and management process. Since institutions may vary considerably in the amount and sources of IRR exposure, as well as the sophistication of risk management and measurement systems, examiner judgment will be needed when selecting the scope of the examination to ensure that appropriate coverage is provided.

Tier I

A Tier I "S" examination will apply to associations with very limited exposure to IRRs. At these institutions, the material sources of risk exposure are centrally managed by the district bank through a comprehensive transfer-pricing mechanism. However, these associations may still have some IRR in the form of potential compression of net interest income. This could arise from sources including, but not limited to, lag risk caused by failure to properly administer retail loan rates in response to changes in funding costs, adjustments in loan spreads, the impact of interest rate movements on an institution's loanable funds position, or other unique loan products where the IRR is managed locally.

Tier II

A Tier II "S" examination will apply to associations where, like Tier I associations, the material sources of risk are centrally managed by a district bank. However, in addition to the sources of risk associated with Tier I associations, Tier II associations may have moderate exposure to locally managed sources of IRR. This risk might arise from modest differences in the repricing attributes of assets and liabilities, limited options risk (e.g., cap or prepayment), and/or the limited use of off-balance-sheet derivatives, such as interest rate caps. The IRR exposure of a Tier II association would likely exceed that of a Tier I association, but would be considerably less than that of a Tier III institution.

Tier III

A Tier III "S" examination will apply to institutions responsible for the management of significant risk exposures. This Tier will include all System banks and, if applicable, service corporations, but could also include associations with significant risk exposures arising from the management of IRR, such as mismatch, basis, yield curve, and options risks, and/or the significant use of off-balance-sheet derivatives.

IRR Management Process

Financial institutions must understand and manage the sensitivity of their earnings and economic value to movements in interest rates. Interest rate movements can affect an institution's earnings by impacting net interest income and other interest-sensitive income and operating expenses. Interest rate movements can also affect the underlying market value of an institution's assets, liabilities, and off-balance-sheet items. This occurs because the present value of a financial instrument's future cash flows (and in many cases, the cash flows themselves) changes with movements in rates. The combined effects of the changes in the present values of all the institution's assets and liabilities reflect the change in the institution's underlying market value of equity.

While IRR is an inherent for financial institutions, it can become excessive and threaten an institution's earnings and capital unless properly managed. Accordingly, an effective risk management process that maintains IRR within prudent levels is essential to the safety and soundness of System institutions. The adequacy and effectiveness of IRR management are also important in determining whether the level of IRR exposure poses supervisory concerns or if additional capital may be required.

As mentioned earlier, FCA recognizes that for a variety of reasons, the IRR exposure of institutions may vary considerably; thus, it is important that each institution develop an IRR management process tailored to its own needs and circumstances. To address IRR management practices comprehensively, the guidance contained in this section of the Examination Manual first emphasizes the importance of

adequate board, senior management, and committee oversight and then highlights the fundamental elements of a comprehensive risk management process. The guidance serves as evaluative criteria to be used by examiners in evaluating the effectiveness of board and senior management oversight activities and adequacy of a System institution's IRR management process. While the guidance provides a useful framework for evaluating IRR management practices, examiner judgment in its application is required.

Board of Directors' Responsibilities

Effective board oversight of IRR activities is the cornerstone of a sound risk management process. Therefore boards of directors must fully understand the source, nature, and scope of IRR exposure and how this risk fits within the overall business strategies of the institution. More specifically, a board should fulfill the following responsibilities:

- **Approve policies and business strategies that govern IRR, adequately consider the institution's current financial capacity, and are sufficiently integrated with the strategic and financial planning processes.** Policies should clearly communicate the board's tolerance for IRR as well as criteria to determine compliance. Limits should be stated in terms of the impact of rate changes on net interest income and market value of equity, but may also include more specific direction regarding the risk profiles of proposed or existing programs, products, or services. The policies should also identify lines of authority and responsibility for managing IRR exposures. The board should annually reevaluate these policies and strategies to ensure they remain appropriate and that all applicable regulatory requirements are incorporated.

- **Ensure management implements a sound risk management process that facilitates the identification, measurement and projection, monitoring, and control of IRR.** The formality and sophistication of the risk management process should match the institution's overall level of risk. The use of technology to identify and measure risk should supplement the board and management's understanding of the institution's risk exposures.

- **Monitor the institution's performance and overall IRR profile to ensure risk is maintained at acceptable levels.** The board or delegated board committee should periodically review information sufficient in detail and timeliness to allow it to understand and assess the performance of senior management in monitoring and controlling IRR. The information should allow the board to independently assess whether risks are being managed within prescribed policies, in compliance with laws and regulations, and in a safe and sound manner.

- **Ensure adequate resources are devoted to IRR management.** The quality of management, level of technical expertise, adequacy of information systems, and scope of internal and external audit coverage should be considered when evaluating this aspect.

Senior Management's Responsibilities

Senior management is responsible for ensuring IRR is managed on both a long-range and day-to-day basis. This is accomplished by effectively managing the structure of the institution's balance sheet, establishing appropriate procedures to control and manage IRR, and ensuring resources are available for assessing IRR. In managing the institution's activities, senior management should:

- **Establish and maintain procedures that translate the board's policy goals, objectives, and risk limits into operating standards.** The procedures should be consistent with the board's tolerance for risk and be clearly communicated and well understood by personnel. To ensure aggregate risk is managed within board-approved parameters, it may be necessary for management to establish limits on specific sources of IRR. Senior management should annually review the institution's procedures for appropriateness.

- **Ensure adherence to the lines of authority and responsibility the board has approved for measuring and projecting, managing, and reporting IRR exposures.** Lines of authority should be clearly defined with appropriate separations maintained for individuals and/or committees responsible for developing strategies, implementing decisions, and conducting the risk measurement, monitoring, and control

functions. For example, individuals engaged in monitoring and controlling risk should be independent from the position-taking functions of an institution. Likewise, individuals initiating the risk-taking positions should not be in a position to inappropriately influence key control functions of the risk management process, including the development and enforcement of policies and procedures, the reporting of risks to senior management, and the conduct of back-office functions. Separations of duty should be appropriate to the amount and complexity of IRR being managed.

- **Oversee the implementation and maintenance of management information systems that identify, measure, monitor, and control the institution's IRR.** Management should ensure the appropriateness of the institution's risk measurement system in relation to the nature, scope, and complexity of its activities. The reasonableness and validity of scenarios used to project exposures and the mathematical methods used to measure risk exposures need to be periodically tested by qualified outside sources. Management information systems need to be periodically updated, verified, and reviewed to ensure they provide comprehensive, accurate, and timely information.

- **Establish a comprehensive reporting and review process over the IRR management process.** Institutions with complex risk exposures should have a designated independent unit responsible for the design and administration of its IRR measurement, monitoring, and control functions. Reports of IRR should provide aggregate information and sufficient supporting detail to enable the board and management to assess the sensitivity of the institution to changes in market conditions and other important risk factors.

- **Ensure sufficient personnel resources to effectively administer risk management and measurement activities.** Personnel involved in the IRR management process should possess the knowledge, skills, and abilities to successfully fulfill their assigned responsibilities. Employees should be provided with on going training to maintain their knowledge, skills, abilities, and security awareness. Staffing levels should provide adequate back up to accommodate unexpected absences of key personnel. Performance evaluations should be conducted regularly and be based on established standards and specific job responsibilities. Controls should be in place to ensure the institution has the ability to cope with staff absences and to detect improper activity.

Management Committees

At a minimum, all System banks should establish a management committee, such as an asset liability management committee (ALCO) comprised of senior managers, while associations with more significant risk exposures are encouraged to do so. The committee should serve as a critical control component within an institution's IRR management process. The committee should be actively involved in establishing plans, procedures, and controls that maintain IRR exposure within predetermined risk tolerances established by the board of directors. Since a committee would likely be involved in the strategic management of an institution's IRR, it is desirable that representatives be included from the major functional areas of the organization, such as senior managers of the treasury, credit, marketing, and business planning. Ideally, committee members should include senior managers with clear lines of authority over the units responsible for establishing and executing interest rate positions. Clear and sufficient communication should exist between the ALCO and department managers, senior management, and the board of directors to ensure a clear, consistent, and timely understanding of an institution's IRR profile.

While an ALCO may be sufficient in most instances, System institutions may have a need to utilize a risk management committee that takes a broader view of risk management than just IRR. These committees often integrate credit and IRR management processes and other similar risk management functions into one comprehensive risk profile. Such committees are in a unique position to evaluate risks to all business units, implement capital allocation methodologies, and ensure capital is sufficient for all risk taking activities.

Risk Management Process

Effective control of IRR requires a comprehensive process that embodies fundamental components including (but are not limited to) the following:

- **Policies and procedures designed to control the nature and amount of IRR the institution assumes.** The policies and procedures should specify board-approved risk limits and define lines of responsibilities and authorities for managing risk. The complexity of the institution's risk profile should be balanced with its earnings and capital, as well as resources available to control IRR.

- **A system for identifying and measuring IRR.** The institution should clearly understand the sources of its IRR (e.g., mismatch, basis, yield curve, and option risk) and have the capability to properly identify how earnings and, if appropriate, market value of equity change as interest rates change.

- **A system for monitoring and reporting IRR.** Monitoring systems should provide accurate and timely information to ensure that the board and management have sufficient information to monitor IRR.

- **A system of internal controls, reviews, and audits to ensure the integrity of the overall risk management process.** Internal controls should validate the reliability and integrity of the institution's risk management process.

The significance of these elements may vary considerably among System institutions depending upon the level and complexity of IRR. Associations with non-complex activities, relatively short-term balance sheet structures, and retail loan attributes that are matched to the wholesale loan attributes via funds-transfer pricing mechanisms may be able to rely on a relatively basic and less formal IRR management process. In all cases, association procedures for managing and controlling risks should be communicated clearly and be well understood by all applicable personnel.

System banks and associations with higher IRR exposures or holdings of complex instruments with significant interest rate-related option characteristics will require more elaborate and formal rate risk management processes. IRR management processes for these institutions should:

- Address the institution's broader, and typically more complex, range of financial activities;

- Provide senior managers with the information they need to monitor and direct day-to-day activities;

- Require adequate internal controls that include internal and/or external audits or other appropriate oversight mechanisms to ensure the integrity of the information used by the board and senior management in overseeing compliance with policies and limits; and

- Ensure an adequate separation of duties by individuals involved in the IRR management process.

Additional detail concerning components of a sound risk management process are provided below.

Risk Limits - A fundamental component of a risk management process are the policies containing risk limits that reflect the board's tolerance for risk. These risk limits are often expressed in terms of the impact of rate changes on net interest income and market value of equity. Risk limits should be board approved, clearly defined, ensure that exposures will not lead to an unsafe or unsound condition, and should be consistent with the nature and complexity of as institution's activities. To ensure an institution's exposure is kept within these limits, board and senior management should consider precautionary thresholds that when exceeded trigger prompt management attention. An appropriate system of IRR limits should permit management to control exposures by monitoring actual risk-taking against predetermined risk tolerances. The board and management should establish approvals and procedures needed to control exceptions to limits.

An institution's limits should be consistent with its overall approach to measuring IRR and should consider capital and earnings levels and the board's risk tolerance. The limits should be appropriate for the size, complexity, and capital adequacy of the institution, and address the potential impact of changes in market interest rates on both reported earnings and the market value of equity.

The board and management should ensure adequate operational procedures and risk control systems

are in place prior to introducing a new product, hedging, or a position-taking strategy. These controls should establish clear lines of authority and responsibility to identify permissible instruments or strategies, require that purposes and objectives be documented before positions are taken, and ensure related functions in the institutions are capable of fully understanding and processing the risk characteristics of new actions. It may be prudent for the board or an appropriate delegated committee to approve material hedging or risk management initiatives prior to their implementation to ensure the risk-reward trade-off and the IRR characteristics of the product or strategy are understood.

Policies, procedures, and other controls governing an institution's exposure to IRR should be reviewed at least annually to ensure they remain appropriate with consideration given to the institution's financial position and market conditions.

IRR Identification and Measurement - It is essential that institutions identify and measure IRR in an accurate and timely manner. The type and sophistication of the measurement system an institution needs to maintain depends upon the nature and mix of its business and the risk characteristics of its activities. Given the diversity of risk exposures within System institutions, measurement systems may vary from relatively noncomplex programs to more sophisticated computer simulation models that measure exposure to options risk.
Regardless of the type and level of complexity of the measurement system used, management should ensure the system provides a reliable estimation of IRR. The reliability of the measurement system depends heavily upon the quality of the data and various assumptions used in the model; therefore, close attention to these areas is needed. As a general rule, management should ensure that measurement systems:

- **Enable management to recognize and identify risks arising from the institution's existing activities and from new business activities in both a timely and accurate manner.** This implies that management and staff involved in the measurement process have a sufficient understanding of the institution's IRR, have the necessary skills, are properly trained, and have appropriate back up in the event of personnel absences.

- **Capture all material sources of IRR in ways consistent with the scope of the institution's risk profile and activities.** In particular, measurement systems should consider all relevant repricing, amortization, and maturity data, including current balances, contractual rates, principal payments, interest reset dates, maturities, indexed rates, and interest rate caps and floors.

- **Contain assumptions that are well established and clearly understood by risk managers and institution management.** Key assumptions should be well documented and understood by management. Assumptions of customer behavior and new business activity should be reasonable and consistent with each economic scenario evaluated.

- **Measure an institution's vulnerability to loss under stressful market conditions, including a breakdown of key assumptions.** The system should measure risk arising from multiple economic scenarios, changes in the level of rates, and risk arising from changes in the shape of the yield curve. In addition, measurement systems should be periodically back-tested to validate their reliability.

When assessing the scope of its exposure, an institution should consider risk from both an earnings and market value of equity measurement perspectives. More detailed guidance concerning risk measurement can be found in the IRR measurement section of this manual.

Monitoring and Reporting - Institutions should have adequate systems for monitoring and reporting IRR exposures. These systems should provide clear, concise, and timely reports that allow the board, committee (if any), and senior management to:

- Evaluate the level and trends of the institution's aggregated IRR exposure;

- Evaluate the sensitivity and reasonableness of key assumptions, such as those dealing with changes in the shape of the yield curve or the pace of anticipated loan prepayments;

- Verify compliance with the board's established risk tolerance levels and limits and identify any policy exceptions; and

- Determine whether the institution holds sufficient capital for the level of IRR exposure.

The frequency of reporting will depend upon the amount and complexity of an institution's exposure to IRR. For example, System institutions with complex risk exposures or off-balance-sheet items that change significantly from month to month would likely require monthly reporting of risk. Less frequent reporting may be sufficient for institutions with less moderate exposures or off-balance-sheet items that do not change significantly over time. Past forecasts of IRR should be compared with actual results to identify any measurement errors. Risk reports should provide sufficient information for the board and management to assess exposure without containing extraneous detail.

Internal Controls and Audit - Institutions should maintain an effective system of internal controls as part of their IRR management process. The internal controls should ensure the effective management of IRR, reliable financial and regulatory reporting, compliance with relevant laws and regulations, and adherence to bookletters and institution policies.

As with many other aspects of institution operations, the types of controls used will vary but will likely consist of policies, procedures, measurement methodologies, monitoring activities, separations of duties, reporting, audit, and management information systems. Controls should include a process for identifying and evaluating risk, establishing appropriate approval processes and exposure limits, and should require reconciliations, reviews, and other mechanisms designed to provide reasonable assurance that IRR is managed in a safe and sound manner. The controls should enforce official lines of authority and the appropriate separation of duties. Internal controls should ensure personnel are following established policies and procedures as well as ensuring that the procedures established actually accomplish intended objectives.

Institutions, particularly those with more complex IRR exposures, should have their IRR measurement, monitoring, and control functions reviewed on a regular basis. The reviews should be conducted by qualified individuals who are independent of the function they are assigned to review (such as an internal audit, external auditors, and consultants). Review results should be reported to the board, senior management, and the ALCO. Results should also identify key assumptions used in the risk measurement process and provide an assessment of the impact of those assumptions on measured exposure.

IRR MEASUREMENT

Financial institutions have utilized risk measurement techniques for many years to assess the impact that changes in interest rates have on earnings and market value of equity. The volatility of interest rates in the late 1970s and early 1980s, movement to a global economy, new and innovative lending programs, and increased use of complex financially-engineered instruments has increased the importance of risk measurement. Reliable risk measurement is critical to the establishment of exposure limits and for ensuring compliance with those limits. Dependable risk measurement is crucial for a board of directors to provide effective oversight of an institution's management of IRR.

Approaches to Evaluating IRR

Movements in interest rates can have adverse effects both on an institution's earnings and its market value of equity. Provided below is an explanation of these two separate, but complementary perspectives for assessing an institution's IRR exposure.

Earnings Perspective

A traditional approach to IRR management taken by many institutions is to concentrate on the impact that changing interest rates will have on projected earnings. Variation in earnings is important because losses or even reduced earnings can threaten the financial stability of an institution by undermining its capital adequacy. The component of earnings traditionally receiving the most attention is net interest income (NII). However, some institutions have expanded into activities that generate fee-based and other

non-interest income. In these cases, a broader focus on overall net income, incorporating both interest and non-interest income and expenses, may be more appropriate.

Market Value of Equity Perspective

This approach focuses on the impact of changes in interest rates on the market value of an institution's assets, liabilities, and off-balance-sheet items. The market value of a financial instrument represents the present value of its expected cash flows discounted to reflect market value. By extension, the market value of an institution can be viewed as the present value of the institution's expected net cash flows (defined as the expected cash flows on assets minus the expected cash flow on liabilities) adjusted by the net cash flows of off-balance-sheet items. This is often referred to as an institution's market value of equity (MVE).

A major advantage of the MVE perspective over the earnings perspective is that it provides a more comprehensive view of IRR. This occurs because the MVE perspective considers the potential impact of interest rate changes on the present value of all future cash flows, not just those cash flows occurring within the near term. Since the focus of the earnings perspective is on near-term earnings, it may not provide an accurate indication of the impact of interest rate movements on an institution's longer-term earnings.

Balancing the Earnings and MVE Perspective

When managing IRR, institutions must understand the impact changing rates will have on their operations, from both an earnings and MVE perspective. When earnings are protected from changes in interest rates (i.e., institution equity is used to fund long-term loans), MVE can become more volatile to changes in interest rates. Likewise, when MVE is protected from changes in interest rates (i.e., institution equity is used to fund short-term loans), earnings can become more volatile due to changes in rates. Institutions should generally balance both the earnings and MVE perspectives to ensure they are not overly exposed to IRR from any one perspective.

IRR Measurement Techniques

Risk measurement techniques vary in sophistication from simplistic too extremely complex. The nature and scope of risk an institution manages determines the risk measurement system needed. For example, an association may find it sufficient to rely on an annual analysis for measuring IRR exposure if a System bank is managing most of the risks for the association and has a minimal level of IRR. However, a bank or association offering loans with significant options or with risks embedded in their assets, liabilities, or off-balance-sheet instruments will require a more frequent and sophisticated analysis. This analysis should adequately measure the risks being managed and evaluate those risks over multiple economic scenarios.

Despite varying levels of sophistication, all measurement techniques rely upon verifiable cash flow data and realistic assumptions about how those cash flows may change over time. The risk measurement technique(s) used by the institution should identify the institution's overall exposure and the significant sources of IRR causing this exposure, project what the impact these exposures could be in the future, and if excessive, what can be done to reduce the exposure. Several commonly used risk analysis techniques that vary in complexity and precision are:

- Gap
- Duration
- Simulation (income and market value)

All techniques have limitations and provide only an estimate of IRR. The following table provides an overview of gap, duration, and simulation analysis and the IRRs that can generally be evaluated using these measurement techniques.

Comparison of IRR Measurement Techniques

Sources/Exposures	Gap Analysis	Duration Analysis	Income Simulation	Market Value Simulation
Short-Term (NII) Exposure	Yes	No**	Yes	No
Long-Term (MVE) Exposure	No	Yes	No	Yes
Repricing or Mismatch Risk	Yes	Yes	Yes	Yes
Basis Risk	Limited*	No	Yes	Limited*
Yield Curve Risk	Limited*	No	Yes	Yes
Option Risk	Limited*	Limited*	Limited*	Yes

* Depending on complexity of analysis and software, the ability of the system to evaluate these risks will vary.
** Does not distinguish between short-term (NII) exposure and long-term (MVE) exposure.

Appendix B provides a general overview of the principles underlying the above measurement techniques, as well as a discussion of their primary strengths and weaknesses.

Internal Controls Over Risk Measurement

The internal controls surrounding a risk measurement model should provide management assurance that the data is reliable, the assumptions are reasonable, and the model design is appropriate. Controls should ensure that identified problems are corrected and reported in a timely fashion. Controls should also allow access to only the appropriate individuals. A disaster recovery plan should be adopted to ensure the integrity of the measurement system can be restored in the event of data corruption or system failure. Weaknesses in data integrity, model design, or faulty assumptions can lead to poor reporting and/or improper decisions. In addition, institutions should periodically validate the risk measurement model through internal or external audits. To substantiate the integrity of the measurement systems, this validation process should be made by persons independent of the day-to-day measurement and reporting function.

Data Integrity

Every measurement system, regardless of complexity, requires reliable data. Since inaccurate and incomplete data can significantly impact the reliability of a risk measurement model, management information systems should have the necessary capacity to ensure that all relevant data are captured and entered into the system correctly. Institutions should extract the data from the applicable accounting or general ledger systems in an efficient and timely manner to reduce the risk of data input error. In addition, the institution should ensure the data is accurate for the financial instruments modeled. As part of the modeling process, the data entered into the model should be reconciled to the applicable accounting system or general ledger to verify that the data is complete and correct. Automated extracts or downloads of information from the institution's databases to the risk measurement model may employ "scrub" features, which routinely check the data for accuracy. Data that cannot be reconciled should be reviewed and tested for accuracy.

An important consideration in the gathering and extracting of data from the institution's information systems is the level of data aggregation. Most risk measurement models allow for data aggregation because some of the assets and liabilities are so similar the data can be aggregated into the model

without a significant loss of accuracy. However, other financial instruments must be modeled in more detail to ensure their unique repricing characteristics are captured. For example, mortgage-backed securities need to be modeled in greater detail because of the significant differences in periodic and lifetime interest rate caps and interest rate reset dates. In addition, borrower prepayment behaviors may differ significantly among mortgage-backed securities and may need to be modeled in greater detail.

Assumptions

The development of assumptions is a key component to an accurate risk measurement model. For a risk measurement model to be a reliable decision-making tool, the assumptions must be reasonable, given the current economic environment and historical experience, and consistent with financial plans and loan portfolio management strategies. The assumptions developed and loaded into most risk measurement models are numerous. Some of the more significant assumptions include the impact of changing interest rates on:

- Loan and investment prepayment speeds;
- Spreads on administered loan products; and
- Projected volume of assets and liabilities.

Given the importance of assumptions to a model's accuracy, major assumptions should be periodically validated to ensure they are appropriate. Some validation approaches include comparing the assumptions with actual performance and stress-testing the assumptions to determine their impact on model results. If major assumptions are changed, management should understand their impact on model results and report these assumption changes to the board, senior management, and the ALCO. Management should also document their rationale supporting the assumptions.

Back-Testing

Periodic back-testing of the risk measurement model output is needed to ensure the results are reliable, given all of the assumptions and data input needed to operate a simulation model. Back-testing normally involves periodic comparisons of the risk measurement forecast with the actual results to gauge the model's performance and predictive capability. Any significant difference between forecasted and actual results may reflect poor assumptions, data quality problems, or model design problems. However, differences may also be caused by uncontrollable items, such as loan volume or interest rate variances. In addition, if an institution is implementing a new risk measurement model, the new model should be operated parallel with the existing model for an interim period to ensure consistency and to validate the results of the new model

Auditing the Risk Measurement Model

Institutions should periodically perform an independent audit of their risk measurement models. While the scope of the review will vary among institutions, depending upon the complexity of the operations, the scope should be sufficient to ensure the model provides the board and management with a reliable assessment of IRR. Items that should be reviewed and validated include:

- The appropriateness of the institution's risk measurement system in relation to the nature, scope, and complexity of its activities;
- The accuracy and completeness of the data entered into the institution's risk measurement system;
- The reasonableness and validity of scenarios used in the risk measurement system;
- The completeness of documentation and adequacy of procedures;
- The reasonableness and support for major assumptions utilized in the risk measurement system; and
- The validity of the risk measurement calculations. Comparing actual versus forecasted results is a good test of the validity of the calculations.

Information System Security and Disaster Recovery

Institutions should have adequate internal controls to prevent unauthorized personnel from accessing the risk measurement model. Controls should ensure access violations are reviewed and reported to the

information security officer. In addition, given the significant databases associated with risk measurement systems, management should establish a disaster recovery plan for the risk measurement model to ensure that data can be restored in the event of data corruption or system failure.

Selecting an IRR Measurement Model

The selection of a risk measurement model is an important management decision and a formal plan should be developed for the selection process. The plan should be consistent with the institution's information technology plans and risk management objectives established by the board and management. The risk measurement model selected must meet the institution's needs and should be commensurate with the risks existing in its current and projected assets, liabilities, and off-balance-sheet items.

In selecting a risk measurement model, management must clearly understand the material sources of IRRs in the institution and select a model with the capability to evaluate these risks. While the selection process will vary among institutions, depending on the complexity of operations, there are several key steps that should be completed to ensure that the appropriate risk measurement model is chosen. Some key steps include:

- Identifying software vendors whose products meet most, if not all, of management's requirements;
- Soliciting from vendors a proposal describing their system and its ability to meet the institution's needs. Vendors should demonstrate their products and confirm their ability to meet the institution's requirements;
- Interviewing other financial institutions that currently utilize the system to discuss installation, operation, vendor reliability, and ongoing support; and
- Analyzing, prior to final selection, the stability of the vendor to assess whether they can meet existing obligations, provide the needed support, and have the financial stability to remain in existence for the useful life of the system.

SOURCES OF IRR

Mismatch Risk

Mismatch or repricing risk is a common source of IRR arising from timing differences in the maturity and repricing of an institution's assets, liabilities, and off-balance-sheet items. This risk exposure is identified by reviewing reports that show differences or gaps in the volume of an institution's assets that mature or reprice within a given time period with the volume of liabilities that reprice within a similar time period.

A typical example where a gap or repricing risk is created would be an institution funding a fixed-rate asset with a floating-rate liability. Because the yield curve is generally upward sloping during most of a business cycle (long-term rates are higher than short-term rates), institutions can often earn a positive spread by funding long-term assets with short-term liabilities. These institutions create a "liability-sensitive" position because the liabilities reprice more frequently than the assets being funded. The earnings of such institutions would be vulnerable to an increase in interest rates that increases its costs of funds. The opposite would be true for an "asset-sensitive" institution.

Mismatch risk is often reflected in an institution's near-term earnings performance. However, an institution may also have repricing imbalances that will not impact earnings until sometime in the future. An institution focusing only on short-term repricing imbalances may be induced to take on increased IRR by extending maturities to improve yield. When evaluating exposure to repricing risk, it is essential that the institution consider not only near-term imbalances, but also long-term mismatches as well. Failure to measure and manage material long-term repricing imbalances can significantly expose an institution's future earnings to changes in interest rates.

Yield Curve Risk

Yield curve risk arises from changes in the shape of the yield curve that are adverse in relation to an institution's asset/liability position. More specifically, yield curve risk is the result of unequal changes in the spread between two or more rates for different maturities for the same instrument. For example, when prevailing interest rates fall, the 90-day U.S. Treasury rate may fall by a larger amount than the 1-year Treasury rate. (This is not uncommon because short-term rates are often more volatile than longer-term rates.) In this case, if an institution linked its loan rates to 90-day Treasuries, yet funded them with debt linked to 1-year Treasuries, the institution would be subjected to yield curve risk.

The degree to which an institution is exposed to yield curve risk will depend on its asset-liability position, as well as the direction of interest rates. To reduce yield curve risk, management should understand the impact that changes in the shape of the yield curve will have on net interest income and utilize a matched gap strategy. A more aggressive gap strategy (e.g., managing for a positive or negative gap) would expose an institution to additional risk. Such a strategy should be authorized in the institution's policies with appropriate risk parameters and controls in place. Also, institutions that utilize a mismatched gap strategy as part of an IRR management program should have the financial capacity to withstand the added risk.

Basis Risk

Basis risk is most often associated with floating rate financial instruments and arises when loans are priced in reference to one index and are funded with debt that is priced in reference to a different index. A common example is pricing a loan based on an index such as a prime rate, London Interbank Offered Rate (LIBOR), or U.S. Treasuries and funding it with debt indexed to Farm Credit cost of funds. Although the instruments may reprice with the same frequency (e.g., monthly, quarterly, etc.), the use of different indexes has the potential for rates on each index to change differently and therefore create basis risk.

Options Risk

IRR also arises when the expected cash flows of assets, liabilities, and off-balance-sheet items are modified because of options. This occurs because the options associated with various financial instruments, such as loans, bonds, and swaps, give the option holder the right (but not the obligation) to

alter the level and timing of the instruments' cash flows. Financial assets with embedded options most common to System institutions include loans and investments that are prepayable, interest rate commitments, and loans and investments with periodic and lifetime caps and/or floors. With regard to liabilities, System banks issue bonds that are callable. The call feature is essentially a prepayment option because it allows for the early retirement of the bond after a specific call date.

Prepayment risk arises from a borrower's option to repay a loan or a portion of a loan before it is contractually due. Interest rates are the most significant factor affecting prepayments in System institutions. As rates decline, borrowers can refinance fixed-rate debt at a lower rate. Generally, prepayments increase as interest rates decline. The reverse is true when interest rates increase. Prepayments may also occur on collateralize investments (mortgage-backed securities) owned by a System institution. Prepayments on the underlying mortgages would reduce the balance of the investment, thereby impacting income and overall market value. Institutions should recover costs associated with prepayment risk on loans by charging up-front loan fees, penalties upon prepayment, or a premium on the interest rate charged on the loan. In addition, institutions should perform sufficient analyses to ensure that they understand and properly project the impact of prepayments on net interest income and market value of equity.

Many adjustable-rate loans have embedded caps that limit the loan's interest rate from increasing beyond a stated amount. This interest rate cap can apply during an interim period (periodic cap) as well as a maximum increase during the life of the loan (lifetime cap). It is not unusual for System institutions to make adjustable-rate loans that cannot increase by more than 2 percentage points over a specified period or more than 6 percent over the life of the loan. Increases in an institution's cost of funding beyond the maximum periodic or lifetime caps can adversely impact projected income and market value of equity. Some institutions may sell interest rate caps in conjunction with variable rate loans to limit increases in the borrowers' loan rates. The sale of these caps should generally be hedged by similar caps purchased from the district bank.

Another option that may be embedded in an institution's assets or liabilities is an interest rate floor. A floor is typically a contractual agreement that precludes an interest rate on a floating-rate instrument from declining below a specified amount. An institution's income or market value of equity may change if it has funded a floating-rate loan with floating-rate debt that contains a floor option.

Options often result in an asymmetrical risk/reward profile that can pose significant risk for a System institution. For example, a borrower with a fully prepayable mortgage loan (option buyer) faces limited downside risk (the premium or amount paid for the option) and unlimited upside reward (savings resulting from being able to refinance at a lower rate). In contrast, the institution holding the mortgage (option seller) faces unlimited downside risk (reinvestment of prepaid loan proceeds at lower rates) and limited upside reward (the premium collected for the sale of the option). If not adequately managed, the asymmetrical payoff characteristics of financial instruments with options can pose significant risk. This is especially true for those who sell them because options are generally exercised to the advantage of the buyer and the disadvantage of the seller. As a result, those institutions that sell or write options must understand this risk and be able to manage and measure the impact on earnings and market value of equity under various interest rate environments.

Additional Sources of Risk

The primary sources of IRR discussed above may be managed for associations by a district bank via funds-transfer pricing. However, additional sources of risk may also create exposure. These sources of IRR include, but are not limited to, the following:

Lag Risk

IRR can arise when interest rates on assets are administered or determined by management, rather than formally indexed to the associated cost of funds. Under these circumstances, it is not uncommon for changes in retail rates to lag changes in the cost of funds. This creates potential for compression of interest rate margins and is a potential source of IRR. The typical amount of time between a change in an institution's cost of funds and a change in its lending rates to borrowers should be considered when

measuring IRR. The direction interest rates are moving may influence this consideration because there is an inherent tendency for lenders to lower rates to borrowers more rapidly than increasing rates. The potential spread compression arising from this source should be controlled and periodically measured.

Loanable Funds

An institution's net interest income is subjected to movements in interest rates to the extent the institution uses loanable funds to fund assets. The amount of change in net interest income is dependent on the repricing characteristics of the assets funded by loanable funds. When funds transfer pricing mechanisms eliminate all other sources of IRR as discussed above, an institution's variation in net interest income due to changes in rates may be largely due to its loanable funds position. An institution's exposure to this source of risk should be periodically simulated and understood by the board and management. Simulations of this exposure in conjunction with the institution's business planning process would be appropriate.

Forward Funding and Conversions

Loan commitments and conversions offered by banks and associations are also sources of IRR. Loan commitments often allow the borrower the right to borrow in the future at a stated rate of interest. This exposes the institution to risk if the commitment is not immediately funded and funding costs subsequently increase. Likewise, risk may arise when the commitment is immediately funded and the borrower later cancels the commitment. A conversion option allows a borrower to "convert" existing loan terms to other loan terms at the borrower's discretion. Since this option may be exercised when it is to the borrower's advantage, the conversion activity that arises before maturity creates a form of prepayment risk to the institution. To control risk from these sources, institutions must monitor and control the level of commitment and conversion activity and seek compensation to cover the costs of managing this risk.

Teaser Rates

Institutions may offer borrowers a "teaser rate" or an option to buy-down an interest rate for a specific time period. These programs are commonly associated with adjustable-rate mortgages. IRR in the form of compression of net interest margin is created on these loans unless the institution's funding costs are "teased" in a manner similar to the retail loans. Before offering loan products with these features, institutions should understand the nature and potential impact of IRR arising from this source and establish appropriate controls to measure and limit exposure from these programs.

Changes in Wholesale Spreads

Even though a district bank may manage the primary sources of IRR for associations, associations have indirect exposure to the extent this risk is mismanaged by the bank. Generally, a bank charges associations for centrally managing IRR through higher spreads on loan products or charges embedded in the bank's wholesale spread. If a bank mismanages districtwide risk to the point additional earnings or capital may be required, associations could be asked to bear this cost. Associations relying upon district banks to centrally manage risk should therefore be mindful of the bank's overall financial condition and risk management practices. Associations should also periodically evaluate the impact of potential changes in bank spreads and equity distributions on the association earnings.

IRR MEASUREMENT TECHNIQUES

Gap Analysis

Gap analysis is an income-oriented risk measurement approach that allows institutions to analyze the approximate impact repricing mismatches have on projected income. Gap analysis segregates rate-sensitive assets, rate-sensitive liabilities, and off-balance-sheet items into time periods (sometimes called buckets) according to their repricing characteristics. The difference between the quantity of assets and liabilities repricing within a period is called the period gap. If more assets than liabilities reprice within a given period, the institution is positively gapped. If more liabilities reprice than assets, the institution is negatively gapped. The size of the gap is an indication of risk, the larger the gap the bigger the risk exposure.

Provided below is a simplified example of a gap report:

Gap Report

	Repricing Periods		
	Period 1	Period 2	Period 3
Assets: Investments and Loans	$150	$20	$10
Liabilities: Systemwide Notes	$50	$100	$10
Period Gap:	$100	($80)	$0
Cumulative Gap:	$100	$20	$20

As shown in the report above, the institution is reporting a positive gap in Period 1, a negative gap in Period 2, and a matched position in Period 3. The institution's cumulative gap at the end of Period 3 is $20. Given this positive cumulative gap, increases in interest rates will generally increase the institution's profits, and decreases in interest rates will generally lower the institution's profits over the three periods (the yield on the institution's loans and investments will increase or decrease at a faster rate than the cost of debt). If this institution was liability sensitive, or negatively gapped, increases in interest rates would generally lower profits and decreases in interest rates would generally increase profits.

Gap analysis provides a relatively simple analysis of an institution's IRR and has several advantages. It does not require sophisticated technology and the results are easily interpreted. However, gap analysis weaknesses often exceed its strengths especially for larger, more complex institutions. The shortcomings of gap analysis include:

- Basis risk is generally not considered as assets and liabilities within the same repricing period may be tied to different indices which may not move in tandem;
- Actual repricing within each time period may vary widely (the assets may reprice at the beginning of the period while the liabilities reprice at the end of the period);
- Embedded options, such as prepayments and interest rate caps, are usually not fully evaluated. These options, however, can significantly affect repricing characteristics; and
- Gap analysis does not measure an institution's market value of equity exposure.

Some variations of gap analysis attempt to minimize these weaknesses. These techniques attempt to capture basis, yield curve, and option risks through the use of multiple schedules and more sophisticated gap analysis. However, institutions with significant risk exposure or complex financial instruments should not rely solely on gap analysis for establishing IRR exposure limits or measuring exposure to those limits.

Duration Analysis

Duration analysis is used to estimate the price sensitivity of financial instruments to small changes in

interest rates. This concept was first developed by Frederick Macaulay in 1938. Duration is calculated by weighting the present value of an instrument's cash flows by the time to receipt of those cash flows, divided by the present value of the financial instrument. In general, the greater the duration of a financial instrument, the greater its price volatility to changes in interest rates.

Some general properties of duration include:

- Duration declines as the maturity date of an instrument approaches;
- Duration equals maturity for zero-coupon instruments;
- Duration is less than maturity for instruments with payments prior to maturity;
- Duration is lower for instruments with higher coupons; and
- Duration is lower for amortizing instruments.

The table below provides a sample calculation of duration for a $100,000, 2-year bond that pays interest semiannually, has an 8 percent coupon, and was purchased at par to yield 8 percent.

Period (T)	Cash Flow (CF)	Present Value (PV) of $1at 4 Percent	PV of CF	(T) x (PV of CF)
1	$4,000	.9615385	$3,846.15	$3,846.15
2	$4,000	.9245562	$3,698.22	$7,396.44
3	$4,000	.8889964	$3,555.99	$10,667.97
4	$104,000	.8548042	$88,899.64	$355,598.56
Total			$100,000.00	$377,509.12
Macaulay Duration: $377,509.12/$100,000=3.77 semiannual periods or 1.89 years				
Modified Duration: 1.89/[1+(8.0%/2)]=1.89/(1+.04)=1.82				
*A 4 percent coupon and discount rate is used because of semiannual payment of interest.				

Macaulay's duration calculation was later enhanced, reflecting the effects of interest compounding. This revised duration calculation is known as modified duration. As shown above, modified duration represents Macaulay duration divided by [1 + (market yield/the number of coupon payments per year)]. An instrument's duration serves as a proxy for a measurement of the instrument's IRR. Using modified duration, an instrument's sensitivity to interest rates is estimated as:

percent price change = -modified duration * yield change * 100

Given the above example, a 100 basis point increase in interest rates would translate into the following estimated percent change in the value of the bond:

percent price change = -1.82 * 1% * 100
percent price change = -1.82 %

In a manner similar to the example of a single bond shown above, duration can be used to estimate the IRR of an institution's entire portfolio. This is accomplished by calculating the duration of all assets, liabilities, and off-balance-sheet derivatives to derive the institution's duration of equity. An institution with long-term assets funded by short-term liabilities will generally have a positive duration of equity. The market value of equity for this institution will decline as interest rates increase. An institution with short-term assets funded with long-term liabilities will generally have a negative duration of equity. The market value of equity of this institution will increase as interest rates rise. The greater (positive or negative) the duration of equity for an institution, the more sensitive its market value of equity will be to changes in rates.

While duration can be a useful measurement tool, it has several weaknesses:

- The duration of financial instruments will change with the passage of time (duration drift). Therefore, in a portfolio hedged for duration, the effectiveness of the hedge will diminish over time and the hedge will need to be periodically reset to maintain effectiveness;

- Modified duration is expressed in terms of symmetrical changes in value when, in fact, the actual changes in value are not symmetrical. In other words, duration measures assume a linear price/yield relationship when this relationship is actually curvilinear.

- Modified duration does not adjust the expected cash flows of a bond to changes in interest rates. As a result, it is not accurate for instruments whose cash flows can change significantly because of changes in interest rates, such as financial instruments containing options.

To improve the usefulness of duration, convexity analysis can be incorporated into the calculation. Convexity is a measure of the sensitivity of duration to changes in interest rates. Convexity measures the stability of duration measurements over a range of interest rates. When convexity is low, the price/yield relationship is close to a linear relationship and duration measurements are stable for changes in yields. However, when convexity is high, meaning the price yield relationship is curved, duration measurements are unstable and will change (maybe significantly) for changes in interest rates. While convexity can be either positive or negative, depending on the price/yield relationship for a financial instrument, as convexity increases, the reliability of the duration measurement decreases.

Because of the weaknesses noted above, some financial institutions are calculating "effective duration." Effective duration, while also taking into account convexity, provides a better estimate of the price sensitivity than the methods previously described because it incorporates changes in cash flow that occur because of embedded options. However, the calculation of effective duration is complex and requires risk measurement models that contain option-pricing methodologies.

Simulation Analysis

Simulation analysis utilizes computers to measure IRR and the impact of different funding or business strategies under numerous interest rate scenarios. Simulation analysis combines an institution's current financial position with expected future events to quantify the impact that changing interest rates would have on projected earnings and market value of equity. The accuracy of the analysis depends on the validity of the data, underlying assumptions, and the model's capacity to value complex instruments. If the data or assumptions are incorrect or the model cannot accurately value complex instruments, the output from the model may result in inappropriate decisions by management.

There are two types of simulation analysis that may be performed to evaluate IRR: income simulation and market value of equity simulation. In addition, there are two approaches generally used to develop the interest rate scenarios that are an integral part of simulation analysis. These include the deterministic approach and the stochastic approach. Provided below is an explanation of these analysis techniques.

Income simulation is used to forecast how net interest income, as well as net income, changes in response to changes in interest rates. As the change in income from the "base case" scenario increases under different economic scenarios, IRR increases. Income simulation is a useful analysis technique because it is dynamic or forward-looking. This is a considerable enhancement over the "static" analysis of gap or duration techniques. However, as discussed below, there are key components examiners must review to ensure the modeling process is providing management a reliable assessment of risk.

One key component that should be analyzed when examining income simulations is the "base case" scenario the institution selected to benchmark its income simulation. The base case can be described as the institution's current position. The base case can be an income simulation that assumes no changes in prevailing interest rates or in products and holds all assets, liabilities, and off-balance-sheet items constant. However, some analysts have used a "most likely" base case scenario that takes into account historical and projected changes in assets and liabilities. Regardless of the base case utilized, it should not incorporate expected changes in interest rates.

Another component that should be considered in examining income simulations is the time frame used in the analysis. Usually, institutions analyze the variations in income over a 1-year time horizon. However, if an institution has significant volume of longer-term assets funded with shorter-term liabilities, the institution should consider analyzing exposure to income over a longer time horizon because of the potential longer-term mismatch risk.

Income simulation captures the dynamics of short-term IRR better than the other methods previously described. However, because modeling is data and assumption intensive, effective internal controls and testing of output is required to ensure the model provides the board and management a reliable estimate of risk.

Market value of equity simulation is the process of generating forecasts of future interest rate scenarios and applying these rates to generate estimated cash flows of assets, liabilities, and off-balance-sheet items. The estimated cash flows are then discounted using the forecasted rate scenarios. For the base case scenario, the institution's market value of equity equals the present value of expected cash flows from assets, minus the present value of expected cash flows from liabilities, adjusted for the present value of expected cash flows from the off-balance-sheet items. While we refer to this technique as market value of equity simulation, the assets and liabilities of many System institutions are not traded instruments and no quoted market prices exist for them. As a result, the focus of market value simulation should not only be on the calculated value of market value of equity, but more importantly on the change in the calculated market value of equity for the various economic scenarios analyzed.

Market value of equity simulation is especially important in large and complex institutions managing significant sources of IRR. Unlike gap or duration, market value simulation provides management a better long-term analysis of IRR. However, like income simulation, market value simulation encompasses many assumptions. Effective internal controls and testing of output is therefore needed to ensure that the model is providing the board and management a reliable estimate of risk.

Both income and market value of equity simulation are effective at answering "what if" questions. The number of economic scenarios analyzed and the model's sophistication should be consistent with the sources and types of IRR the institution is managing. Financial institutions will generally use one of two approaches to develop the interest rate scenarios for simulation modeling: the deterministic approach or the stochastic approach.

Deterministic Approach - Under a deterministic approach to simulation analysis, an institution specifies the amount and timing of the interest rate changes being evaluated. An institution determines in advance the range of potential interest rate changes to evaluate and typically establishes standard simulation scenarios for evaluating and reporting IRR. Multiple scenarios may be used, depending on the level and type of risk to be analyzed. For associations where the district bank is managing the material sources of IRR, the number of scenarios conducted and the sophistication of the model (or computer spreadsheet) will be limited. However, in institutions with moderate risk or complex IRR exposures, the number of scenarios analyzed and the sophistication of the risk measurement model should be commensurate with the level of IRR exposure. Some of the more common interest rate scenarios utilized include:

- Flat interest rate scenario, where interest rates remain unchanged;
- Most likely interest rate scenario (management's or an outside consultant's prediction of interest rates);
- Rising and falling interest rate scenarios (ramps);
- Parallel yield curve shifts upward or downward (shocks); and
- Inverted yield curves and nonparallel interest rate changes (yield curve twists).

Simulation models using the deterministic approach generate an estimate of IRR exposure for each economic scenario, allowing comparisons of the results to the base case to determine the level of exposure for each scenario.

Stochastic Approach - The stochastic approach to modeling interest rates was developed out of mortgage and options pricing. This method typically utilizes a model to randomly generate hundreds of interest rate paths in which the institution's assets, liabilities, and off-balance-sheet items are evaluated using option-adjusted valuation analysis. Interest rate models utilizing this approach generate a distribution of outcomes using assumptions concerning interest rate volatility. Management then uses this distribution of outcomes to estimate the probabilities of the results. This approach allows management to identify not only the IRR exposure, but also allows estimates on the likelihood an outcome will appear. The stochastic approach is also used to value and assess IRR arising from options embedded in an institution's balance sheet. Because of the data-intensive nature of modeling and the volatility assumptions that control the distribution of the interest rate paths, effective internal controls are needed to ensure that the model results are providing the board and management a reliable assessment of risk.

Value-at-Risk (VAR) Analysis

VAR analysis is a statistical tool used to measure the market risk of a portfolio of assets, liabilities, or off-balance-sheet items. VAR measures the value a portfolio could lose in a given time period with a certain probability based on the portfolio's current composition and recent market conditions. For example, if a portfolio's 1-week 95 percent VAR is $10 million, the portfolio would be expected to lose less than $10 million over 95 weeks out of 100. VAR evolved from traditional risk measures and attempts to provide a more straightforward risk measure for senior management and the board of directors. While the definition of VAR is broad and encompasses all sources of market risk for a portfolio, estimating VAR requires sophisticated risk management models, techniques, and expertise.

Option-Adjusted-Spread (OAS) Analysis

OAS analysis is a measure of relative yield used to value embedded options existing in financial instruments. Financial institutions use it because of the increasing complexity associated with today's financial instruments. It was first widely employed in the mortgage-backed securities market. At that time, investors wanted to know what portion of a financial instrument's yield was attributed to its embedded options and what the yield over U.S. Treasuries would be if the exact same instrument did not have any embedded options. The spread over Treasuries adjusted to exclude any spread due to embedded options, is an OAS. The OAS enables investors and managers to judge the degree to which they are being compensated for a particular instrument's credit risk, liquidity, or other factors. Option pricing is subjective because of the number of assumptions needed, especially interest rate volatility assumptions used in the calculation. The OAS calculated for an instrument will depend not only upon the characteristics of that particular instrument, but also upon the assumptions incorporated into the option-pricing model. OASs are calculated for a wide variety of instruments, including mortgage-backed securities, structured notes, and callable corporate bonds.