National Bank of the Republic of Macedonia
Supervisory Policy Manual

Title: **MR-3** Price Risk

Date: **FINAL**

Purpose: To set out the approach which the NBRM will adopt in the supervision of licensed institutions' price risk, and to provide guidance to licensed institutions on the key elements of effective price risk management.

Issue Type: Supervisory Guidance

Supersedes Previous Issue: None

Application: All licensed institutions and supervision personnel

Contents:

1. Introduction

1.1. ***Price risk*** is the current or prospective risk to earnings and capital arising from adverse movements in bond, security and commodity prices, and foreign exchange rates in the *trading book*. This risk arises from market making, dealing, and position taking in debt and equity securities, currencies, commodities, and derivatives (bonds, securities, currencies, and commodities). Price risk focuses on the changes in market factors (e.g., interest rates, market liquidity, and volatilities) that affect the value of traded instruments. The primary accounts affected by price risk are those which are revalued for financial presentation (e.g., trading accounts for securities, derivatives, and foreign exchange products).

1.2. Institutions engaged in trading and/or derivatives activities are exposed to price risk to the degree they have unhedged exposures relating to customer trades or proprietary positions. The degree of price risk depends on the price sensitivity of the trading asset and the time it takes to liquidate or offset (close out) the position. Price sensitivity is generally greater for instruments with leverage, longer maturities, or option features. See Appendix A for definitions of trading and derivatives.

1.3. Many institutions use the term price risk interchangeably with market risk. This is because price risk focuses on the changes in market factors that affect bonds, securities, currencies, commodities and spot, forward and other derivative transactions. This guidance focuses on trading activities, while those that address the management of structural risk (banking book) are focused on activities that typically do not directly involve market transactions (such as traditional lending).

1.4. Since the risk of loss resulting from a mismatch is a function of the possibility of adverse changes in prices or rates, one person might conclude that a particular exposure belongs under the heading of structural risk while another could perceive it as being a matter of price risk (trading book). Ultimately, all significant risks facing an institution should be subjected to effective risk management. No significant risk that arises either directly or indirectly from exposure to the movement of prices or rates should escape attention because there may not be a consensus on how it should be labeled for purposes of discussion.

1.5. In general, the trading book consists only of positions in financial instruments and commodities held either with trading intent or in order to hedge other elements of the trading book. Positions held with trading intent are those held intentionally for short-term resale and/or with the intent of benefiting from actual or expected short-term price movements or to lock in arbitrage profits. This definition is consistent with the Basel Committee on Banking Supervision's "International Convergence of Capital Measurement and Capital Standards." See Appendix A for further discussion on the definition of trading book and differences between the Basal Committee's and generally accepted account standards definitions of trading book.

1.6. While this guidance focuses on price risk as it pertains to the trading book, the concepts discussed here are very much applicable to those banking book activities that contain

price risk. Many institutions will experience price risk in their banking book through normal investment activities and derivatives used to hedge banking book positions.

2. Supervisory Board and Board of Directors Oversight

2.1. Effective Supervisory Board (Board) and Board of Directors (Directors) oversight of an institution's price risk activities is the foundation of an effective risk management process. It is the responsibility of the Board and Directors to understand the nature and level of price risk being taken by the institution and how that risk fits within the its overall business strategies and the mechanisms used to manage that risk. Effective risk management requires an informed Board, capable management, and appropriate staffing.

2.2. The Board must:

- Establish and guide the institution's strategic direction and tolerance for price risk and identify the senior managers who have the authority and responsibility for managing this risk.
- Monitor the institution's performance and overall price risk profile, ensuring that price risk is maintained at prudent levels and is supported by adequate capital. In assessing the institution's capital adequacy for price risk, the Board should consider the current and potential price risk exposure as well as other risks that may impair capital.
- Ensure that Directors implement sound fundamental principles that facilitate the identification, measurement, monitoring, and control of price risk.
- Ensure that adequate resources are devoted to price risk management. Effective risk management requires both technical and human resources.

2.3. Directors must:

- Develop and implement procedures and practices that translate the Board's goals, objectives, and risk tolerances into operating standards that are well understood by all personnel and that are consistent with the Board's intent.
- Ensure adherence to the lines of authority and responsibility that the Board has established for measuring, managing, and reporting price risk exposures.
- Oversee the implementation and maintenance of management information and other systems that identify, measure, monitor, and control price risk.
- Establish effective internal controls (including audit) over the price risk management process.

3. Effective Risk Management Process

3.1. Effective management of price risk involves managing the risk/reward relationship and market exposures across a variety of dimensions, such as quality, volatility, concentration, diversification and maturity. The objective of price risk management need not be the elimination of exposure to price or rate changes. Rather, it should be to manage the risk of adverse impact of changes within self-imposed limits after careful consideration of a range of possible market scenarios.

3.2. It is sound risk management for an institution that is exposed to significant price risk to have appropriate and prudent policies on the types of financial instruments and other

investments, both on- and off-balance sheet, in which the institution is willing to trade or take positions. Additionally, such a risk management process establishes exposure limits that take into account all other risks, both on- and off-balance sheet, for:

- A single issuer,
- Groups of associated issuers,
- Types of financial instruments and other investments or assets,
- Industries or economic sectors,
- Geographic regions, and
- Market exposures warranting aggregation.

3.3. Furthermore, sound risk management processes directed toward price risk have procedures and controls that include:

- Defined and prudent levels of decision-making authority for approving market exposures;
- Fixed quality and return expectations for market exposures;
- Suitably qualified securities dealers and other counterparties with whom the institution is willing to deal;
- Reliable data and effective techniques, such as stress testing and shock testing, for assessing the nature, quality and value of the institution's market exposures and for evaluating the extent of price risk to which the institution is or will be exposed under current and reasonably foreseeable scenarios;
- Effective techniques for back-testing the above assessments and evaluations against actual results; and
- Effective methodology for identifying, estimating, providing for and recording market impairments.

3.4. Establishing quality and return objectives for market risk facilitates obtaining assurance that exposures are acceptable in terms of the risk of the issuer as well as return expectations given the level of risk. Quality and return objectives may relate to individual exposures as well as the overall portfolio. Certain investment or trading instruments that do not meet individual risk/return criteria may yield an appropriate overall return when combined with other instruments.

3.5. An institution's Board and Directors can readily approve policies delineating permissible trading and derivative activities and risk tolerances. However, the volume and complexity of activities at many institutions make it impractical for Board members and senior managers to oversee the day-to-day management of trading activities. Consequently, they rely on strong risk control and audit functions to ensure compliance with policies.

3.6. The risk control and audit functions should possess the independence, authority, and corporate stature to be unimpeded in identifying and reporting their findings. It is equally important to employ individuals with sufficient experience and technical expertise to be credible to the business line they monitor and senior executives to whom

they report. Evaluations of these employees and their compensation should be independent of the businesses they monitor and audit.

3.7. ***Risk Control Function.*** The role and structure of the risk control function should be commensurate with the extent and complexity of trading and derivative activities. Because measuring and controlling the risk of some activities can be more complex than doing so for traditional products, a strong risk control function is a key element in assisting the Board and Directors in fulfilling their oversight responsibilities.

3.8. Risk control units regularly evaluate risk-taking activities by assessing risk levels and the adequacy of risk management processes. These units also monitor the development and implementation of control policies and risk measurement systems. Risk control personnel staff should periodically communicate their observations to senior management and the Board.

3.9. Depending on the nature and extent of an institution's activities, the risk control function can be structured in various ways. At institutions with significant trading and derivative activities, the risk control function should be a separate unit reporting directly to the Board or a Board committee. Institutions with smaller and less complex trading and derivative activities may not find it economically feasible to establish a separate risk control unit. Often the most practical solution for such institutions is the use of independent risk management or treasury support units, or qualified outside auditors or consultants. Regardless of the size, complexity and structure, the risk control unit should report on risk-taking and management issues to the Board or a committee, such as an Asset Liability Management Committee or Risk Management Committee. The selected approach should be structured to ensure sufficient stature and expertise in the oversight role.

3.10. ***Audit Function.*** Internal audits are to be conducted by qualified professionals who are independent of the business line being audited. Internal audits supplement, and are not a substitute for, a risk control function. The level of auditor expertise should also be consistent with the level and complexity of activities and degree of risk assumed. In many cases, institutions choose to out-source audit coverage to ensure that the professionals performing the work possess sufficient knowledge and experience.

3.11. The scope of audit coverage is commensurate with the level of risk and volume of activity. The audit includes:

- Appraising the adequacy of operations, compliance, and accounting systems and the effectiveness of internal controls;
- Testing compliance with policies, including limits;
- Evaluating the reliability and timeliness of information reported to senior management and the Board;
- Tracing and verifying information provided on risk exposure reports to the underlying data sources;
- Appraising the effectiveness and independence of the risk management process;
- Ensuring that risk measurement models, including algorithms, are properly validated;

- Evaluating the adequacy of the valuation process and ensuring that it is performed by parties independent of risk-taking activities;
- Testing valuation reports for accuracy; and
- Reviewing (for hedge transactions) the appropriateness of accounting treatment and test for compliance with accounting policies.

3.12. The audit function must have the support of management and the Board in order to be effective. Management should respond promptly to audit findings by investigating identified system and internal control weaknesses and implementing corrective action. Thereafter, management should periodically monitor newly implemented systems and controls to ensure they are working appropriately. The Board, or designated committee, should receive reports tracking management's actions to address identified deficiencies.

4. Organizational Structures for Managing Price Risk

4.1. Institutions involved in trading and/or derivatives activities must establish an effective process for managing price risk. The level of structure and formality associated with this process should be commensurate with the level of risk in the institution's activities.

4.2. Defined levels of approval authority help ensure that an institution's price risk activities are undertaken appropriately and that exposures do not exceed the limits established under its Board and management policies.

4.3. The degree of delegation will depend on a number of variables, including:

- The extent and quality of the institution's control environment related to price risk management;
- The size, nature and complexity of price risks assumed;
- The degree of market responsiveness required; and
- The experience and abilities of the individuals responsible for carrying out trading and derivative activities.

5. Supervisory Review of Price Risk Management

5.1. Supervisors determine the adequacy and effectiveness of an institution's price risk management process, the level and trend of risk exposure, and the adequacy of capital relative to its exposure and risk management process.

5.2. Supervisors determine the major sources of price risk exposure and evaluate whether the institution's measurement systems provide a sufficient basis for identifying and quantifying the exposure. They also analyze the integrity and effectiveness of price risk control and management processes to ensure that practices comply with the stated objectives and risk tolerances of the Board and Directors.

5.3. When evaluating capital adequacy, supervisors consider the effect of changes in market rates and prices on the economic value of the institution by evaluating any unrealized losses in an institution's investment, trading and derivative positions. This evaluation should assess the ability of the institution to hold its positions and function as a going

concern if recognition of unrealized losses would significantly affect the institution's capital ratios.

5.4. In forming conclusions about the safety and soundness of the institution's price risk management and exposures, supervisors:

- Determine whether the institution's trading activities are conducted in a safe and sound manner.
- Determine the adequacy of Board and Directors supervision of the institution's trading activities.
- Determine the adequacy of policies, procedures, practices, and management information systems.
- Determine whether the Board and Directors have established an effective risk management process.
- Determine compliance with laws, regulations, regulatory guidelines, and established policies and procedures.
- Determine the level of risk undertaken in trading activity and whether it is appropriately considered in the context of the institution's overall risk management framework.
- Evaluate trading-related profitability.
- Determine whether the overall strategy for trading activities is reasonable in light of past, present, and projected earnings performance, risk appetite, systems, control infrastructure, and market conditions.
- Effect corrective action when policies, practices, procedures, or internal controls are deficient or when violations of law or regulation or noncompliance with regulatory guidelines have been noted.

6. Types of Price Risk

6.1. The primary factors that affect the price of trading book holdings are interest rates, foreign exchange rates, equity prices, and commodity prices. In addition to the absolute changes in these factors, the volatility of those changes can influence the prices of trading book holdings that have option or leverage features.

6.2. When evaluating the sensitivity of a trading book holding to a change in price risk factors, the terms, maturity, and timing and amount of future cash flows are considered. When evaluating the potential impact on all or a portfolio within the trading book, the extent to which holdings may complement or offset one another is also considered. Price risk factors and pertinent aspects of options and leveraged products are discussed below.

6.3. ***Interest Rate Risk.*** The magnitude of the exposure from an adverse change in interest rates depends on the sensitivity of the instrument to changes in interest rates as well as the absolute change in interest rates. In general, values of long-term instruments are more sensitive to interest rate changes than the values of short-term instruments. See MR-1 Interest Rate Risk for a more thorough discussion of interest rate risk.

6.4. ***Foreign Exchange Risk.*** The exposure from an adverse change in foreign exchange rates is a function of spot foreign exchange rates and domestic and foreign interest rates. Any forward premium or discount in the value of a foreign currency relative to the domestic currency is determined largely by relative interest rates. See MR-2 Foreign Exchange Risk for a more thorough discussion of foreign exchange risk.

6.5. ***Equity Risk.*** Equity risk is the risk to earnings and capital arising from changes in the price of equities. Exposures associated with equities are often classified as either systematic or unsystematic (unique or specific) risks. Unsystematic risk is the price risk that is specific to the equity of a particular company. This risk is independent of market-wide price fluctuations and can be reduced by portfolio diversification. By assembling a portfolio with a sufficiently large number of different equities, unsystematic risk can be greatly reduced or eliminated, because the unique fluctuations in the price of any single equity will tend to be cancelled out by fluctuations in the opposite direction of prices of other equities. Moreover, in a well-diversified portfolio, any one asset represents a small fraction of the total portfolio and, consequently, an insignificant portion of total portfolio variance.

6.6. Systematic risk arises from an event (of any magnitude) that affects all equities simultaneously. For example, when the economy is growing, all equities will likely be affected either in a cyclical or counter-cyclical fashion. Systematic risk cannot be reduced by diversification, because a market move will affect all security prices in a similar way (albeit to varying degrees).

6.7. Institutions should reframe from trading equities that are not actively traded either over-the-counter or on an organized exchange. [Note: Many licensed institutions in Macedonia invest in equities (banking book) that are not actively traded. Since market quotes for these equities are difficult to obtain, neither systematic nor unsystematic risk may have a major affect on an institution's equities portfolio. Hence, institutions must value equities (that do not have market quotes) more from a credit risk stand point by evaluating a company's assets and liabilities and earnings performance to arrive at a reasonable equity value. This requires substantial financial information on companies whose shares are held by the institution. If an institution cannot reasonably value an equity investment held in its portfolio, the NBRM requires that a 100% reserve be formed offsetting the value of the equity investment.]

6.8. ***Commodity Risk.*** Commodity risk is the risk to earnings and capital arising from adverse changes in commodity prices. Institutions in Macedonia may experience commodity risk if they participate directly in commodity markets or possess derivatives whose values are directly tied to commodity products. [Note: commodity risk may also be present if an institution holds large volumes (banking book) of securities or equities whose values may be indirectly or directly affected by price movements of commodities. Additionally, institutions with a large volume of loans secured by commodities may experience unacceptable credit risk if commodity prices decline.]

6.9. Price risks associated with commodities differ considerably from interest rate and foreign exchange rate risk and require careful monitoring and management. Most commodities are traded in markets whose price volatility is associated with uncertainties about supply and demand and the concentration of market participants in the underlying cash markets. Because of these market characteristics, commodity markets are generally much less liquid than the interest rate and foreign exchange markets and fluctuations in market liquidity often accompany price volatility. An evaluation of commodity price risk should be performed on a market-by-market basis. Depending on the level and nature of commodity exposure, this evaluation may include an analysis of historical price behavior and an assessment of the structure of market supply and demand to evaluate the potential for unusually large price movements.

6.10. ***Basis Risk***. Basis risk is the risk that the correlation between two prices may change. (Correlation is the relationship between mathematical or statistical variables.) For example, if an institution uses an interest rate swap priced off of LIBOR to hedge its loan portfolio, it is exposed to basis risk because changes in loan rates and LIBOR will most likely not move exactly in tandem with each other.

6.11. Similarly, changes in the values of certain foreign currencies can be correlated under normal market conditions but these correlations can be unstable during volatile market periods. For example, if an institution uses a derivative denominated in one foreign currency to hedge an asset denominated in another foreign currency, it exposes itself to basis risk even when those currencies have been historically closely correlated.

6.12. ***Options Risk.*** The value of an option is the function of several variables, including the current spot price of the underlying asset, the volatility of the price of the underlying asset, interest rates, time to expiration, and the option's exercise price.

6.13. The potential exposure from options is measured by evaluating the sensitivity of options prices to changes in price risk factors. Sensitivity or exposure can be measured in aggregate (i.e., the total value of the option) or in components. These components are referred to as "the Greeks," because most of them are designated by letters of the Greek alphabet.

6.14. The primary component measures of options sensitivity are (See Appendix F for more information on "the Greeks" and how they are used for risk management purposes.):

- delta – the sensitivity of an option's value to changes in the price of the underlying instrument.
- gamma – the amount delta would change in response to a change in the price of the underlying instrument.
- vega (also known as kappa) – the sensitivity of an option's price to changes in the volatility of the underlying instrument.
- theta – the amount an option's price would be expected to change to reflect the passage of time (also called time decay).
- rho – the amount an option's price would change for an incremental move (generally one basis point) in short-term interest rates.

6.15. Because options give the purchaser the right, but not the obligation, to engage in a specified transaction, the payoff from options is asymmetric. Purchasers would only exercise an option to experience a gain. Should markets move adversely, holders of options would not experience a loss over time (other than the loss of the premium paid). Such a risk-reward profile, potentially unlimited upside gain with limited downside cost (the premium paid), creates an asymmetric payoff for options. The reverse would hold true of sellers (writers) of options contracts, who would benefit from limited revenue (the premium received for the option) and be exposed to potentially unlimited downside loss.

6.16. ***Effect of Leverage on Derivative Contracts.*** The price sensitivity of a derivative contract is magnified by the effects of leverage. By definition, derivative contracts are leveraged because for a relatively small performance bond (e.g., margin) or premium, a counterparty can enter into a transaction that possesses the risk/return tradeoff of a much larger Denar volume of the underlying cash instrument. Small changes in the underlying price factor can produce a large change in the value of the derivative. Leverage can be intensified when the cash flow of a contract is based on some multiple of the performance of the underlying cash instrument. The price sensitivity of contracts containing leverage factors can be extremely high.

7. Price Risk Measurement

7.1. Managing price risk requires an understanding of the nature and characteristics of market exposures. Continuous and prospective evaluations of market exposures provide an effective means of ensuring that portfolio performance and quality meets the institution's price risk management policies and objectives, and that the portfolio(s) is not unduly concentrated. Back-testing is an effective way of evaluating the robustness of a forecasting tool or model.

7.2. ***Pricing and Revaluation Systems.*** The institution's traders need pricing and revaluation systems to effectively manage exposure to price risk factors. These systems (and price risk measurement systems discussed below) require similar input data that describe the trading book asset's terms, maturity, and expected cash flow. These systems may be the same, integrated, or separate.

7.3. Pricing system(s) are used to determine reliable prices for traded products being purchased and sold. Such pricing systems allow dealers to evaluate prices offered in the market, identify profits and losses on positions, and identify potential risks in the portfolio. A pricing system should be maintained by an independent party and subject to a rigorous validation process.

7.4. Revaluation systems provide mark-to-market information for reporting positions and recording profits and losses. It is imperative that the input used for determining the fair value of positions and profits/losses be independent of risk-taking personnel. See Appendix G for more information on segregation of duties and Transaction Risk.

7.5. Institutions should regularly review their pricing and revaluation models to ensure they provide a reasonable estimate of value. In addition, institutions should continually monitor acceptance of the pricing model's results in the marketplace. If the model's results are inconsistent with the market, institutions must decide whether to continue using the model.

7.6. ***Measuring Price Risk.*** There are a variety of ways to measure price risk, some of which are far more sophisticated than others. The degree of sophistication in price risk measurement should be related to (1) the type and amount of price risk, (2) the ability of management to understand the nature, limitations, and meaning of the measurement and (3) the nature of trading activities. The less sophisticated methods are only appropriate when an institution uses conservative strategies, the level of price risk is low relative to earnings and capital, or price risk is linear (no option exposure). For instance, institutions with largely matched positions would not be expected to have sophisticated risk measurement systems. Institutions with large or complex derivative activities or large open positions need the more sophisticated measurement methods that rely on mathematical models to replicate price behavior.

7.7. Value-at-risk (VAR) is one of the most common methods used by institutions to measure aggregate price risk. VAR is an estimate of the potential loss within a specified confidence interval in a portfolio's value over a defined holding period. In trading portfolios that are marked-to-market daily, VAR is usually translated into a potential reduction in the institution's future earnings. VAR is most valuable as a high-level management information tool because it reduces an institution's multiple price risks to a single number or to a small number of key statistics. The trading desks will manage their individual exposures using more detailed information. See section 7.11 "Evaluating Price Risk Measurement" for more information on VAR.

7.8. Although generally believed to reflect risk more precisely, the more sophisticated price risk measurement systems (as well as pricing and revaluation systems) can introduce the added risk that: (1) the algorithms and assumptions underlying the models are not valid; (2) the models are inappropriately applied; (3) the models are not well understood within the organization; and (4) the model's results are inconsistent with the market (applicable to pricing systems). This is sometimes termed model risk. Institutions should regularly re-evaluate risk measurement models and assumptions to ensure they provide reasonable estimates of risks. Management should ensure that the models are used for their intended purpose and not as a proxy because the institution lacks a more appropriate model. See appendix C - Evaluating Price Risk Measurement Systems for more information on evaluating statistical models.

7.9. There are six fundamental issues that must be addressed when formulating risk measurement systems. These are: (1) purpose of the measure; (2) position description; (3) holding period; (4) confidence interval (probability threshold); (5) historical time period of the data series; and (6) aggregation. These issues are further discussed in Appendix B – Price Risk Measurement Systems.

7.10. Accurately measuring an institution's price risk requires timely information about the current carrying and market values of its trading and derivative holdings. Accordingly, institutions should have price-risk measurement systems commensurate with the size and nature of these holdings. Institutions with significant holdings of highly complex instruments should ensure that they have independent means to value their positions. Institutions using internal models to measure risk should have adequate procedures to validate the models and periodically review all elements of the modeling process, including its assumptions and risk measurement techniques. Institutions relying on third parties for price risk measurement systems and analyses should fully understand the assumptions and techniques used by the third party.

7.11. ***Evaluating Price Risk Measurement.*** Institutions should regularly re-evaluate risk measurement models to ensure that they provide a reasonable estimate of risk. Management should ensure that the models are used for their intended purpose and that material limitations of the models are well understood at appropriate levels within the organization.

7.12. Although VAR is the most common method of measuring price risk, it is important that management and the Board understand the system's limitations. VAR is appealing to users because it reduces multiple price risks into a single value-at-risk number or a small number of key statistics. However, VAR results are highly dependent upon assumptions, algorithms, and methods. VAR does not provide assurance that the potential loss will fall within a certain confidence interval (e.g., 99 percent); rather, it estimates the potential loss based on a specific set of assumptions.

7.13. Another limitation of VAR is that it may not accurately estimate the impact of large market moves. To address these limitations, institutions need to supplement their VAR scenarios with stress testing. Stress testing helps mitigate weaknesses in VAR by focusing on worst case scenarios that may be outside the confidence interval. Stress testing is further discussed in Appendix D.

7.14. Institutions with high price risk should supplement stress testing with an analysis of their exposure to interconnected risks. While stress testing typically considers the movement of single market factors (e.g., interest rates), interconnected risks considers the linkages between markets (e.g., interest rates and foreign exchange rates) and between the types of risk (e.g., price, credit, and liquidity risk). More information on interconnected risk can be found in Appendix E.

7.15. Most institutions use a combination of independent validation, calibration, back-testing, stress testing, and reserves to mitigate potential weaknesses in price risk measurement models.

8. Price Risk Limits

8.1. The price risk limit structure should be consistent with the Board's risk appetite and the capabilities of the risk measurement system. Institutions should use a variety of limits to adequately capture the range of price risks or to address risks that the measurement

system does not capture. A single type of limit is generally not sufficient on its own to control price risk. However, many types of limits tend to complement each other. For instance, aggregate VAR limits are a mechanism to control risk on an institution or entity-wide level. Traders will need supplemental limits (e.g., stop-loss limits) to control risk at the trading desk or portfolio level. Standard limits used to control price risks are described below.

8.2. ***Value-at-Risk Limits.*** These sensitivity limits are designed to restrict potential loss to an amount equal to a Board-approved percentage of projected earnings or capital. All institutions with largely matched positions should use VAR limits.

8.3. VAR limits are useful for controlling price risk. However, as discussed above in "Evaluating Price Risk Measurement," one limitation of VAR is that the results produced are highly dependent upon the algorithms, assumptions, and methodology used by the model. Changes in any of these elements can produce widely different VAR results. In addition, VAR may be less useful for predicting the effect of large market moves. To address these weaknesses, institutions should complement VAR limits with other types of limits such as notional and loss control limits.

8.4. ***Loss Control Limits.*** Loss control limits require a specific management action if the defined level of loss is approached or breached. If such limits are exceeded, policy should require that a position be closed out or that a higher level of management is contacted for approval of maintaining the exposure. In many cases, the limits are established to foster communication, rather than limit management's ability to maintain a position. For instance, a position that currently exhibits unrealized losses may continue, in management's estimation, to make economic sense over the time horizon it is expected to be held.

8.5. Loss control limits complement other limits. However, they are generally not sufficient by themselves, because they are based on unrealized losses to date and do not measure potential loss exposure. When establishing loss control limits, consideration must be given to the starting point (e.g., date transaction is booked) for measuring the loss and period of time (e.g., day, week, month) over which the cumulative loss is measured.

8.6. ***Tenor or Gap Limits.*** Tenor (maturity) or gap (re-pricing) limits are designed to reduce price risk by limiting the maturity and/or controlling the volume of transactions that matures or re-prices in a given time period. Such limits can be used to reduce the volatility of revenue or expenses by staggering the maturity and/or re-pricing, thereby smoothing the effect of changes in market factors affecting price.

8.7. Tenor limits can also be useful for liquidity risk control. Generally these limits are expressed in terms of volume and/or amount per measurable time period (e.g., day, week, monthly).

8.8. Like loss control limits, tenor or gap limits can be used to supplement other limits, but are not sufficient in isolation. They are not anticipatory and do not provide a reasonable proxy for price risk.

8.9. ***Notional[1] or Volume Limits.*** Notional or volume limits are most effective for controlling operational capacity and, in some cases, liquidity risk. Specifically, in the case of exchange-traded futures and options, volume limits on open interest may be advisable in less liquid contracts. Limits on concentrations by strike price and expiration date can facilitate portfolio diversification in large books. In the case of over-the-counter options, these limits should be set in the context of the institution's ability to settle a large number of trades if the options are exercised. Notional limits may be very useful for highly illiquid instruments, such as emerging market issues for which the frequency and volatility of price changes render VAR less useful. Because notional amount and volume of contracts do not provide a reasonable proxy for price (or credit) risk, these limits are not acceptable on a stand-alone basis.

8.10. ***Options Limits.*** Limits specific to option exposure should be established for any institution with sizable option positions. Such limits should consider the sensitivity of positions to changes in delta, gamma, vega, theta, and rho. Generally, this type of analysis requires the modeling capabilities addressed in the previous discussion of VAR limits.

8.11. ***Product Concentration Limits.*** Product concentration limits may be useful to ensure that a concentration in any one product does not significantly increase the price risk of the portfolio as a whole.

8.12. Market-risk limits should be established for both the acquisition and ongoing management of an institution’s trading and derivative holdings and, as appropriate, should address exposures for individual instruments, instrument types, and portfolios. These limits should be integrated fully with limits established for the entire institution. At the institutional level, the Board should approve price-risk exposure limits that specify percentage changes in the economic value of capital and, when applicable, in the projected earnings of the institution under various market scenarios. Similar and complementary limits on the volatility of prices or fair value should be established at the appropriate instrument, product-type, and portfolio levels, based on the institution’s willingness to accept price risk. Limits on the variability of effective maturities may also be desirable for certain types of instruments or portfolios.

[1] Notional amount - The principal amount or face value of a derivative. Defined by the Financial Accounting Standards Board (FASB) in FAS 133 as the number of currency units, shares, bushels, pounds or other units specified in a derivatives contract. The notional amount is used to calculate the payments that are exchanged by the counterparties in the transaction. Market participants refer to notional principal because, unlike bonds or other conventional credit instruments, these types of derivatives do not involve an exchange of principal. Rather, the parties state the principal amount only as a basis for calculating the sizes of the interest related payments that they exchange. In this application, principal is only a reference point or idea - hence the term. Also called the notional principal balance.

9. Management Information Systems

9.1. Institutions should evaluate the market-risk exposures of their securities, trading and derivative positions and report this information to their Boards regularly, not less frequently than each quarter. These evaluations should assess trends in aggregate market-risk exposure and the performance of portfolios relative to their established objectives and risk constraints. They also should identify compliance with Board-approved limits and identify any exceptions to established standards.

9.2. Supervisors should ensure that institutions have mechanisms to detect and adequately address exceptions to limits and guidelines. Supervisors should also determine that management reporting on price risk appropriately addresses potential exposures to interest rate risk, foreign exchange risk, basis risk, etc. and other factors pertinent to the institution's holdings. In this connection, supervisors should assess an institution's compliance with broader guidance for managing price risk in a consolidated organization.

9.3. As mentioned earlier, risk measurement and assessment should be conducted on an aggregate basis. The Board and management should evaluate price risks for the institution as a whole, in addition to consideration of other risks.

9.4. At least annually, institutions that assume material price risk should summarize current risk measurement and reporting techniques and management practices. This summary should explicitly identify and report not only the advantages of the given models/systems of choice but also the limitations or weaknesses inherent to the given process (for instance, a duration-based model will not incorporate an instrument's convexity or recognize correlations). Also, significant revisions to models should be disclosed and the impact on risk levels quantified.

9.5. The following list includes the types of reports that institutions with material price risk should generate to properly communicate risk. The formality and frequency of reporting should be directly related to the level of trading activities and risk. The recipients of these reports may also vary depending on the institution's organizational structure.

9.6. Board and/or appropriate committee:

- Trends in aggregate price risk.
- Compliance with Board-approved policies and risk limits.
- Summary of performance relative to objectives that articulates risk-adjusted return.
- Results of stress testing.
- Summary of current risk measurement techniques and management practices (annually).

9.7. Risk Management Committee or other executive management committee responsible for the supervision of price risk:

- Trends in exposure to applicable price risk factors (e.g., interest rates, volatilities, etc).
- Compliance with policies and aggregate limits by major business/region.

- Summary of performance relative to objectives that articulates risk-adjusted return.
- Major new product developments or business initiatives.
- Results of stress testing including major assumptions.
- Summary of current risk measurement techniques and management practices, including results of validation and back-testing exercises (annually).

9.8. Management will need the following reports, as applicable:

- Business head/region:
  - Detailed profit and loss statement by trading desk.
  - Summary of major exposures.
  - Compliance with policies and procedures, including limits.
  - Detail exceptions to policies, procedures and limits, including frequency and trends.
  - Aggregate exposure versus limits.
  - Summary of performance relative to objectives that articulates risk-adjusted return.
  - Valuation reserve summary.
  - Major new product developments or business initiatives.
  - Results of stress testing including major assumptions.
  - Periodic reports on price risk model development, including independent certifications and periodic validation and back-testing of models.
- Trading Room:
  - Detailed profit and loss statement, by trading desk.
  - Sensitivity modeling of significant exposures, e.g., position reports. (These can be selected by management or the risk control group, and should include a sensitivity matrix indicating the vulnerability of the position to various changes in the variables affecting price.)
  - Compliance with limits.
  - Summary of performance versus objectives that articulates risk-adjusted return.
  - New product developments or business initiatives.
- Trading desk:
  - Detailed breakdown of all positions, including cash flows.
  - Detailed profit and loss statements by portfolio and trader.
  - Sensitivity modeling of all positions. (This should include a sensitivity matrix indicating the vulnerability of the position to various changes in the variables affecting price.)
  - Compliance with limits.
  - Product specific detail, such as contracts maturing or expiring, pertinent concentration information, etc.

National Bank of the Republic of Macedonia
Supervisory Policy Manual

Appendix A – Definitions of Trading/Trading Book and Derivatives

Trading/Trading Book

Trading is:
(1) The activity of buying and selling financial instruments or commodities for profit. Individuals or entities may engage in trading either strictly on their own behalf or for current or future transactions with customers. Trading profits may come from market price changes but may also come from the spreads between bid and asked prices or from customer markups. Trading is distinct from investing, although trading activities are not always easy to distinguish from investing activities. In trading, the profit goal is almost always short term. Unlike trading, investing is generally longer term and may even include the intent to hold the instrument to maturity. A common misconception is that trading activities are speculative while investing activities are not. Trading may indeed include highly speculative transactions. However, trading may also include relatively low-risk transactions such as matched trading or arbitrage. Like investing, trading may involve either cash or derivative instruments. Trading transactions may also involve cash and/or futures positions.

(2) One of three defined categories established in FAS 115 for the classification of financial instruments held as assets on the books of an investor. Trading securities are those owned by investors engaged in trading activities including short-term speculation. Under FAS 115, trading assets must be reported at their market values. FAS 115 also includes provisions that restrict investors' ability to transfer assets from the trading category to available-for-sale (AFS) or held-to-maturity (HTM).

Excerpt from:
Statement of Financial Accounting Standards (FAS) No. 115
Trading securities. Securities that are bought and held principally for the purpose of selling them in the near term (thus held for only a short period of time) shall be classified as *trading securities.*

Excerpts from:
Basel Committee on Banking Supervision
International Convergence of Capital Measurement and Capital Standards
A Revised Framework: Comprehensive Version
June 2006

Part 2: The First Pillar – Minimum Capital Requirements
VI. Market Risk
A. The risk measurement framework

685. A trading book consists of positions in financial instruments and commodities held either with trading intent or in order to hedge other elements of the trading book. To be eligible for trading book capital treatment, financial instruments must either be free of any restrictive covenants on their tradability or able to be hedged completely. In addition, positions should be frequently and accurately valued, and the portfolio should be actively managed.

686. 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 both 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 the contractual right to exchange financial assets on potentially favorable terms, or an equity instrument. A financial liability is the contractual obligation to deliver cash or another financial asset or to exchange financial liabilities under conditions that are potentially unfavorable.

687. Positions held with trading intent are those held intentionally for short-term resale and/or with the intent of benefiting from actual or expected short-term price movements or to lock in arbitrage profits, and may include for example proprietary positions, positions arising from client servicing (e.g., matched principal brokering) and market making.

687(i). Banks must have clearly defined policies and procedures for determining which exposures to include in, and to exclude from, the trading book for purposes of calculating their regulatory capital, to ensure compliance with the criteria for trading book set forth in this Section and taking into account the bank's risk management capabilities and practices. Compliance with these policies and procedures must be fully documented and subject to periodic internal audit.

687(ii). These policies and procedures should, at a minimum, address the general considerations listed below. The list below is not intended to provide a series of tests that a product or group of related products must pass to be eligible for inclusion in the trading book. Rather, the list provides a minimum set of key points that must be addressed by the policies and procedures for overall management of a firm's trading book:

- The activities the bank considers to be trading and as constituting part of the trading book for regulatory capital purposes;
- The extent to which an exposure can be marked-to-market daily by reference to an active, liquid two-way market;
- For exposures that are marked-to-model, the extent to which the bank can:
  (i) Identify the material risks of the exposure;
  (ii) Hedge the material risks of the exposure and the extent to which hedging instruments would have an active, liquid two-way market;
  (iii) Derive reliable estimates for the key assumptions and parameters used in the model.
- The extent to which the bank can and is required to generate valuations for the exposure that can be validated externally in a consistent manner;
- The extent to which legal restrictions or other operational requirements would impede the bank's ability to effect an immediate liquidation of the exposure;
- The extent to which the bank is required to, and can, actively risk manage the exposure within its trading operations; and
- The extent to which the bank may transfer risk or exposures between the banking and the trading books and criteria for such transfers.

688. The following will be the basic requirements for positions eligible to receive trading book capital treatment.

- Clearly documented trading strategy for the position/instrument or portfolios, approved by senior management (which would include expected holding horizon).

- Clearly defined policies and procedures for the active management of the position, which must include:
  - positions are managed on a trading desk;
  - position limits are set and monitored for appropriateness;
  - dealers have the autonomy to enter into/manage the position within agreed limits and according to the agreed strategy;
  - positions are marked-to-market at least daily and when marking-to-model the parameters must be assessed on a daily basis;
  - positions are reported to senior management as an integral part of the institution's risk management process; and
  - positions are actively monitored with reference to market information sources (assessment should be made of the market liquidity or the ability to hedge positions or the portfolio risk profiles). This would include assessing the quality and availability of market inputs to the valuation process, level of market turnover, sizes of positions traded in the market, etc.
- Clearly defined policy and procedures to monitor the positions against the bank's trading strategy including the monitoring of turnover and stale positions in the bank's trading book.

689. (deleted)
689(i). When a bank hedges a banking book credit risk exposure using a credit derivative booked in its trading book (i.e., using an internal hedge), the banking book exposure is not deemed to be hedged for capital purposes unless the bank purchases from an eligible third party protection provider a credit derivative meeting the requirements of paragraph 191 vis-à-vis the banking book exposure. Where such third party protection is purchased and is recognized as a hedge of a banking book exposure for regulatory capital purposes, neither the internal nor external credit derivative hedge would be included in the trading book for regulatory capital purposes.

689(ii). Positions in the bank's own eligible regulatory capital instruments are deducted from capital. Positions in other banks', securities firms', and other financial entities' eligible regulatory capital instruments, as well as intangible assets, will receive the same treatment as that set down by the national supervisor for such assets held in the banking book, which in many cases is deduction from capital. Where a bank demonstrates that it is an active market maker then a national supervisor may establish a dealer exception for holdings of other banks', securities firms', and other financial entities' capital instruments in the trading book. In order to qualify for the dealer exception, the bank must have adequate systems and controls surrounding the trading of financial institutions' eligible regulatory capital instruments.

689(iii). Term trading-related repo-style transactions that a bank accounts for in its banking book may be included in the bank's trading book for regulatory capital purposes so long as all such repo-style transactions are included. For this purpose, trading-related repo-style transactions are defined as only those that meet the requirements of paragraphs 687 and 688 and both legs are in the form of either cash or securities includable in the trading book. Regardless of where they are booked, all repo-style transactions are subject to a banking book counterparty credit risk charge.

National Bank of the Republic of Macedonia
Supervisory Policy Manual

Excerpt from:
Basel Committee on Banking Supervision
The Application of Basel II to Trading Activities and the Treatment of Double Default Effects
July 2005

III. Minimum capital requirements under Pillar 1
A. Capital charges related to the trading book/banking book boundary

269. The Revised Framework defines the trading book for regulatory capital purposes as consisting only of positions in financial instruments and commodities held either with trading intent or in order to hedge other elements of the trading book. The definition also makes clear that positions held with trading intent are those held intentionally for short-term resale and/or with the intent of benefiting from actual or expected short-term price movements or to lock in arbitrage profits. This definition normally prevents any positions that are neither financial instruments nor commodities from being booked in the trading book. Moreover, a position that has the nature of an exposure that is other than short-term or that constitutes a hedge for regulatory capital purposes of a banking book credit risk exposure, should not be included in the trading book. Accordingly, an institution is precluded from using a hedge booked in the trading book to obtain both a reduced risk weight for a banking book item and an offset of a long trading book position. Furthermore, positions in the firm's own eligible regulatory capital, or in other firms' eligible regulatory capital, should follow the treatment set forth in the BCBS's definition of eligible regulatory capital. Finally clarifications are made on the treatment of term trading-related repo-style transactions in the trading book. These various clarifications imply that the definition of the trading book for regulatory capital purposes outlined above may be more restrictive than the definition used for accounting purposes.

Derivatives
A derivative is a financial contract whose value is determined from publicly traded securities, interest rates, currency exchange rates, or market indexes. Derivatives-literally, *derivative contracts*, are often used to protect assets against changes in value.

Derivatives cover a wide assortment of financial contracts, including forwards contracts, futures, options, and swaps. *Exchange–traded* derivatives are traded on the floor of an organized exchange and usually require a good faith deposit, or margin, when buying or selling a contract. Examples are interest rate futures and options on futures contracts.

Over-the-counter derivatives, such as currency swaps and interest rate swaps, are privately negotiated bilateral agreements, and are transacted off the organized exchanges. In the currency markets, forward delivery contracts allow traders to lock in current prices when buying or selling baskets of currencies for futures delivery.

Derivative securities are bond-like securities created when pools of loans and mortgages are packaged and sold to investors and are another type of derivative widely used.

In the hands of knowledgeable users, derivative contracts have many applications in today's floating interest environment: managing currency and interest rate risk, or locking in financing costs by swapping floating rate debt for fixed-rate.

Appendix B – Price Risk Measurement Systems

There are six fundamental issues that must be addressed when formulating price risk measurement systems. These are: (1) purpose of the measure; (2) position description; (3) holding period; (4) confidence interval (probability threshold); (5) historical time period of the data series; and (6) aggregation.

Purpose of the Measure

For most institutions, the price risk measurement system is designed to provide a sense of the overnight exposure to potential adverse changes in the major factors affecting the value of the institution's positions. Thus, the systems generally reflect exposure in what is considered a normal market environment. However, institutions may modify the price risk measurement models for capital allocation purposes. For example, an institution may use a longer holding period for capital allocation purposes than to manage daily risk because capital is generally intended to be a cushion against unexpected losses. Therefore, institutions may use more conservative assumptions, reflecting extreme market movements, when estimating price risk for their capital allocation models.

Position Description

A critical step in developing a price risk measurement system is establishing the framework by which positions will be described. There must be agreement on a standard method of describing risk across businesses. For example, a forward foreign exchange component can be described in two ways:

- As a specific product; or
- As a combination of price risk factors — in this case, spot foreign exchange rates and interest rates.

The more sophisticated systems attempt to break instruments into their component parts using price risk factors. These systems attempt to estimate the institution's exposure to the principal factors affecting the value of their positions. This approach has important advantages. First, it enables the institution to aggregate its exposure to a specific factor, such as interest rates, across all products. Second, it can generally capture new products or structures more easily. This is a clear advantage for institutions that engage in structured over-the-counter derivatives for which specific prices are not readily available.

The risk measurement process frequently requires that a firm's positions be mapped onto a grid. This mapping is done both by tenor and by long (asset) position or short (liability) position class. Care must be taken to ensure that exposures are sufficiently similar to merit their inclusion in the same class. The greater the mapping detail, the greater the accuracy of the measure. However, greater detail increases the time it takes to perform the necessary calculations. Once the descriptive mechanism is in place, risk measurement systems extract the information they need from the systems used by traders to price and manage their positions. [Note: This mapping process may also be done by the trading system.]

Holding Period
Typically, institutions measure the risk of loss using the change in market value over a one-day holding period. For many traded instruments, the position exposure can be eliminated in a matter of hours (perhaps minutes). However, for some less-liquid instruments, several days or weeks may be needed for an orderly reduction in position exposure.

Most models are relatively sensitive to the holding period assumption. In order to convert the system to a cost to close or other measure, a number of assumptions must be made regarding market behavior, acceptable offsets and their likelihood of being executed, and trader capabilities. These assumptions are relatively less empirical than those derived from historical observation or simulation. The one-day holding period provides a starting point for discussion. When establishing limits, institutions using a one-day holding period will need to incorporate judgments about liquidity and other events and make any adjustments deemed necessary.

An important exception should be made for sectors in which there are significant concerns regarding event or liquidity risk, or in which historical data are unreliable. This exception occurs most notably in emerging markets debt. Here, considerations regarding the magnitude of event risk, as well as uncertainty regarding market depth, tend to argue for longer holding periods. Additionally, activities involving relatively illiquid instruments, or instruments for which good data may not be available, may need additional limits tailored to the specific attributes of that business.

Ultimately, the length of a holding period depends on the purpose of the system and its place in the overall risk management process. Most institutions clearly state that the measurement system is designed to be an indicator of what can be expected under normal conditions. It is only one of several tools used to monitor exposure on an ongoing basis. It becomes the starting point for further discussion.

Confidence Interval
The confidence interval, also referred to as the probability threshold, specifies how frequently the estimate provided by the model will likely be surpassed. Specifying a confidence interval of 99 percent is more conservative than an interval of 95 percent. With the 99 percent interval, actual results will likely surpass the model's measured amount roughly once every 100 days. With the 95 percent threshold, the results will surpass the model's estimate roughly five times every 100 days (or once every 20 days, at least once a month). Confidence intervals are frequently expressed in terms of standard deviations. (E.g., actual results will likely exceed the model’s estimate if rates move in excess of two standard deviations, which is approximately a 95 percent interval.) The confidence interval is critical to interpreting both the level of exposure and size of risk limits. Ultimately, the choice of a confidence interval should be consistent with the purpose of the measure and the limit structure. For example, institutions choosing to lower the confidence interval would also be expected to lower their risk limits, assuming their risk tolerance had not changed.

Data Series
When using risk measurement models, institutions must select the data series that will be the basis for market volatility and correlation assumptions. Among the many issues to consider

when selecting the data series are the source, time horizon, frequency of updating, and time-of-day.

The data series can be obtained by using historical data or data implied by current market rates. Although each source has its advantages depending on market conditions, historical data are most commonly used. The length of the time horizon over which to collect the data should depend upon the relevance of past periods to the current market conditions and to what extent recent market events will be incorporated. During volatile markets, using a longer time horizon may understate risk because the risk measure will be slower to adjust. A shorter time horizon will make the risk measure adjust more quickly to changing market conditions. Another issue to consider when selecting a data series is whether to exclude certain data points, such as those depicting extreme low-probability events. Inclusion of outliers may overstate risk during stable market conditions. On the other hand, failure to include past data that reflects unusual or higher than normal price volatility may lead to understated risk estimates.

The frequency with which data are sampled must also be determined. The frequency should be high enough to produce a statistically valid sample. The time of day that data are collected should also be considered (e.g., end of day, intraday, high/low).

In selecting the parameters for the data series it is important to understand that there is no single right answer. The meaningfulness of results will vary with market conditions.

Aggregation

A number of issues should be addressed when aggregating exposures to produce a consolidated measure. One of the most important issues is determining the extent to which exposures within markets (e.g., currency markets) and across markets (e.g., currency and interest rate markets) move together or are correlated. The correlation coefficient, which changes in relation to the strength of the relationship between movements in two price risk variables, represents the likelihood of the two variables moving together. The coefficient ranges from -1 to 1. The stronger the relationship between the two variables, the closer the coefficient is to 1 or -1. Correlation coefficients can be based on historical data or implied from current market conditions.

The extent to which institutions use correlations in risk measurement systems varies widely. Therefore, the risk measurement results for similar portfolios can be very different depending on correlation assumptions. Most commonly, correlations are used within markets. It is less common, because of systems limitations, for correlations to be used across markets. One complication of correlating exposures is that correlations may be unstable in volatile markets. Generally, the use of lower correlations will reflect reduced portfolio risk. However, by using lower correlations, the model may underestimate risk during volatile markets. If an institution chooses to use correlations when aggregating risks, the analysis should be empirically derived and updated regularly.

When consolidating institutional exposure, the assumption will frequently be made that exposures are not correlated. When assumptions are made that exposures are not correlated, they

are generally aggregated using the square root of the sum of the squares method, which is a widely used statistical approach to aggregating portfolio value.

Institutions may also aggregate exposure using a combination of risk measurement methods based on a characteristic of the underlying instrument. For example, the interest rate risk from fixed income positions based on a variance/covariance model may be aggregated with the interest rate risk from option positions based on a simulation model. The feature that makes the measures comparable is the defined confidence interval.

In developing a consolidated risk measure, institutions will make a number of trade-offs. Trade-offs are most significant at institutions that have decentralized trading environments, are active in several countries and time zones, or operate (often because of mergers) using a variety of computer systems. Given a clear definition of the system's purpose, however, the problems are not insurmountable. The main consideration is time. Because of the complexity of some products and the number of calculations required, compromises and approximations are required in order to obtain a timely estimate of aggregate risk. Institutions must continually evaluate assumptions and simplified position descriptions. Data requirements should be incorporated in longer-term technology plans.

Appendix C - Evaluating Price Risk Measurement Systems

Most institutions use a combination of independent validation, calibration, back-testing, and reserves to manage potential weaknesses in price risk measurement models. These processes are described below.

Validation

Validation is the process through which 1) the internal logic of the model is evaluated (includes verification of mathematical accuracy), 2) model predictions are compared with subsequent events, and 3) the model is compared with other existing models, internal and external (when available). New models both internally developed and purchased from vendors should receive initial validation reviews. Internally developed models may require more intensive evaluation because they may not have been market-tested by external parties. Thereafter, the frequency and extent to which models are validated depends on changes that affect pricing or risk presentation and on the existing control environment. Changes in market conditions that affect pricing and risk conventions, and therefore model performance, should trigger additional validation review.

Risk management policies should clearly address the scope of the validation process, frequency of validations, documentation requirements, and management responses. At a minimum, policies should require the evaluation of significant underlying algorithms and assumptions before the model is put in regular use, and as market conditions warrant thereafter. Such internal evaluations should be conducted by parties who are independent of the business using or developing the model, where practicable. The evaluation may, if necessary, be conducted or supplemented with reviews by qualified outside parties, such as experts in highly technical models and risk management techniques.

Calibration

One calibrates a model in two steps. First, one ensures that the model is internally consistent – that is, that the internal logic is sound. Second, one observes market prices to adjust the model parameters. For example, if the model prices are below market prices for caps and floors, it is likely that the model's assumed volatility is below that of the market. Repeatedly adjusting the volatility of other model parameters until model prices match market prices is called convergence to market.

Back-Testing

Back-testing is a method of periodically evaluating the accuracy and predictive capability of an institution's risk measurement system. There is no widely agreed-upon process for back-testing and techniques are continuing to evolve. Back-testing usually involves an *ex post* comparison of an institution's profits and losses for a particular day against the risk measure projected by the model for the same day.

When evaluating back-testing results, it is important to understand the complexities of comparing risk measures and daily profit and loss. For institutions using VAR models, one significant issue to consider is that VAR assumes a static trading portfolio that is not adjusted during the trading day, while actual profit and loss incorporates results of intraday trading. Thus, comparisons of VAR to actual profit and loss need to address the effect of intraday trading and

risk management activities, customer mark-up, and net interest income. Because of the limitations of using actual profit and loss, some institutions have elected to use hypothetical profit and loss that excludes customer mark-up, intraday trading profits and losses, and net interest income.

There are other issues to consider when reconciling risk measurement results with daily profit and loss. Exceptions may occur because of sudden changes in volatilities or correlations caused by large shifts in the market. Operational issues such as incorrect data entry, subsequent profit and loss adjustments, and timing differences can also give rise to differences between risk measures and daily profit and loss results.

Risk management policies should address the scope of the back-testing process, frequency of back-testing, documentation requirements, and management responses. To be most effective, back-testing should be conducted regularly by parties independent of those developing or using the model. Results of back-testing should be part of risk management reporting to senior management.

Reserves for Model Risk

Institutions should consider establishing reserves for model risk. These reserves may be appropriate for models measuring the price risk of complex instruments or models using unconventional valuation techniques that are not widely accepted in the market. These reserves are normally established through adjustments to mid-market valuations. If the institution elects to establish reserves for model risk, policies should require documentation of rationale, require periodic review of assumptions, and provide for proper accounting treatment.

Appendix D - Stress Testing

Institutions with large positions relative to earnings and capital should regularly supplement their daily risk management information with stress testing or simulations that show how the portfolio might perform during certain extreme events or highly volatile markets. To perform stress testing, an institution's risk measurement system must be flexible enough to facilitate running various scenarios. Assumptions used in the stress scenario should be carefully constructed to test the portfolio's vulnerabilities. It is common for institutions to model stress tests around large historical market moves. However, large market moves do not always produce the greatest losses or expose a portfolio's vulnerabilities. For example, for some option portfolios, the worst scenario could result from a very small change in the price of the underlying assets.

The more sophisticated risk management systems will identify potential scenarios that would produce the most undesirable results and estimate the probability of their occurrence. Depending on the severity of the outcomes and the likelihood of occurrence, management should take appropriate initiatives to reduce risk. Stress testing should involve both the risk control unit and the trading desk, as their perspectives will be complimentary. Traders' input is valuable to the process as they are generally the most knowledgeable about the portfolio's vulnerabilities. The participation of risk control provides independent oversight and an objective viewpoint to assure the integrity of the process.

The framework for stress testing should be detailed in the risk management policy. Results of stress testing scenarios along with major assumptions should be provided to the Board and Directors on a periodic basis. This information should include an assessment of the institution's ability to effectively respond to the event and assumptions underlying this assessment.

Appendix E - Interconnected Risk

Institutions with high price risk should supplement stress testing with an analysis of their exposure to interconnected risk. While stress testing typically considers the movement of a single market factor (e.g., interest rates), interconnected risk considers the linkages across markets (e.g., interest rates and foreign exchange rates) and across the various categories of risk (e.g., price, credit, and liquidity risk). For example, stress from one market may transmit shocks to other markets and give rise to otherwise dormant risks. Evaluating interconnected risk involves assessing the total or aggregate impact of singular events.

Management must understand how risks are connected in order to avoid disasters like those encountered in the 1980s in the United States. During that decade, many Texas institutions failed to see the correlation between real estate prices and the profitability of the oil industry. Similarly, institutions lending to less-developed countries (LDC) failed to see the link between world commodity prices and the LDC debt repayment capacity.

To understand interconnected risk, institutions should regularly evaluate alternative market situations using scenario or what-if analyses. For example, a scenario analysis might assess the results of various twists and shifts of the yield curve, as well as changes in the relationships among yield curves for various interest rates. Questions that should be addressed include:

- What happens to the value of financial instruments?
- Given what you know about counterparty activities, how might the counterparty's credit quality be affected?
- What might happen to market liquidity if the change indicated by the scenario occurred suddenly rather than more gradually?
- What possible condition of the macro economy might also accompany the shift and/or twist used in a particular scenario (e.g., an inverted yield curve sometimes signals an oncoming economic downturn)?
- The volatility of prospective earnings and capital.

Issues for review might include:

- The extent to which net funding requirements become concentrated around certain dates.
- Potential extensions of holding and settlement periods.
- Impact of credit reserves, and potential changes for administrative and close-out costs.

Sophisticated institutions should be developing and evaluating methods to identify, measure, monitor, and control exposures from activities that are interconnected. Senior management and the Board should consider interconnected risk when evaluating the institution's overall risk profile, setting limits, and overseeing day-to-day activity.

Appendix F - The Greeks

The "Greeks" that follow are the primary measures of options sensitivity.

delta
Delta reflects the sensitivity of an option's value to small changes in the price of the underlying asset. The delta of a call option is always a number between zero and one, and the delta of a put option is always a number between zero and minus one (some leveraged options may be exceptions to this rule). For example, consider a call option on a corporate bond. If the delta value for the call option were 0.5, the price of the option would be expected to increase by €.5 if the price of the bond increased by €1. Likewise, a decrease of €1 in the price of the bond would be expected to cause a decrease of €.5 in the price of the option.

Delta helps traders to hedge portfolios of financial instruments. The delta value indicates the amount of hedging required to neutralize the price risk arising from spot movements. Using the previous example, the €1 increase in the price of the corporate bond is equal to the price change for two call options (i.e., 2 times €.5). Consequently, if a trader's portfolio were long one bond and hedged with two call options, it would not be affected by changes in the price of the bond. The ratio of the number of options of the same type (e.g., call options) to the number of underlying financial instruments is called the hedge ratio. In this example, the hedge ratio is 2:1, which is the inverse of the delta value for the option. A fully hedged portfolio, such as that described above, is called a delta-neutral portfolio. For such a portfolio, the change in the value of the options will be approximately offset by the change in the value of the underlying bond, as long as the change in the price of the underlying bond is small.

When the price of the underlying instrument changes by a small amount, the resulting change in the value of the option is reliably predicted by delta. When the value of the underlying instrument changes considerably, however, the delta itself will nearly always change. The size of the change in delta is predicted by gamma (described below). Thus, the manager of a delta-neutral portfolio must constantly adjust the portfolio to reflect the changes in delta. This change in delta exposes options users to gamma risk.

gamma
Gamma is a measure of the amount delta would change in response to a change in the price of the underlying instrument. Gamma thus provides a measure of the sensitivity of a delta-neutral portfolio. A gamma other than zero indicates that the delta would change when the price of the underlying instrument changes, implying that the number of options in the portfolio relative to the number of underlying instruments would need to be adjusted. As gamma increases, so does delta, and the more significant will be the portfolio adjustments required.

Gamma is the most important options measure for hedged options portfolios. Gamma tends to be lowest when a standard option is deep in the money or deep out of the money. Gamma tends to be highest when a standard option is at-the-money and near or at expiration; a small change in the spot price can make the difference between exercising an in-the-money option and letting an out-of-the-money option expire.

Because gamma is highest for at-the-money options, an options book is most apt to become unhedged if it contains near-the-money options, all else being equal. As the time to maturity decreases, the gamma of an at-the-money option approaches infinity. Therefore, at-the-money options are the most difficult options to hedge. Supervisors should seek to understand how gamma is reported and managed by the financial institution, how it is used in the institution's hedging strategies, and how it is used to evaluate income from options trading (e.g., the frequency of the hedging interval and the use of dynamic hedging strategies).

vega
Vega, also known as kappa, is a measure of the sensitivity of an option's price to changes in the volatility of the price of the underlying instrument.

The value of an option largely depends on the likelihood that the price of the underlying instrument will keep or move the option in the money before the option matures. For example, the value of a call option is based on the likelihood that the price of the underlying instrument will surpass the strike price before the option expires. The more volatile the price of the underlying instrument, the greater the potential for its price movement. Because purchased options have asymmetric risk (i.e., potentially unlimited upside gain with limited downside cost), greater potential movement in the underlying instrument can benefit only options buyers. As a result, standard options, such as calls and puts, always increase in value with increases in the volatility of the underlying instrument.

theta
Theta is a measure of the amount an option's price would be expected to change to reflect the passage of time (also called time decay). The value of an option depends on the likelihood that the price of the underlying instrument will change in the desired manner. The likelihood of a favorable event occurring decreases as time to expiration decreases. Consequently, the value of an option generally declines with the passage of time (which is advantageous to the writer but not to the holder of the option).

rho
Rho is a measure of the amount an option's price would change for an incremental move (generally one basis point) in short-term interest rates. Rho is usually small compared with the other option price components, because interest rates rarely move enough to have an appreciable effect on option prices. The impact of rho is more significant for longer-term options or in-the-money options.

Appendix G - Transaction Risk

Transaction risk is the risk to earnings or capital arising from problems with service or product delivery. This risk is a function of internal controls, information systems, employee integrity, and operating processes. Transaction risk exists in all products and services. Trading and derivative activities can pose challenging operational risks because of their complexity and continual evolution. The operations function, which is discussed in a later section, refers to the product support systems and related processes.

As part of their fiduciary responsibility, the Board and Directors must institute a sound internal control framework to prevent losses caused by fraud and human error. Fundamental to this framework is the segregation of the operations and risk-taking functions. Many well publicized financial mishaps (e.g., the Barings Bank, Daiwa Bank, and Sumitomo Corporation) have illustrated the peril of failing to segregate key risk-taking and operational functions.

Adequate systems and sufficient operational capacity are essential to support trading and derivative activities. This is especially true for dealers and active position-takers who process large volumes of transactions daily. Just as trading systems have evolved, operational systems must keep pace with the rapid growth in both the volume and complexity of trading and derivatives products. In today's fast-paced environment, trades must be processed quickly not only to service the counterparty but also to update position management and credit line monitoring systems.

Skilled and experienced staff are integral to the efficient operation of back office systems. This is especially true for trading and derivatives activities because of their complex nature. Management should regularly determine whether the staff members processing trading and derivatives transactions have the knowledge and skills necessary for the job and whether their numbers are sufficient.

Institutions should not participate in trading and derivative activities if their systems, operations, personnel, or internal controls are not sufficient to support the management of transaction risk.

Transaction Risk Management

In order to effectively manage transaction risk, senior managers must fully understand the processing cycle and must change processes and technology when necessary. They should identify areas of transaction risk and estimate the loss an institution could suffer from a given exposure.

To minimize transaction risk and ensure efficient processing, all personnel involved in trading and derivatives activities should understand the differing roles played by sales, trading, risk control, credit, operations, and accounting. Operations personnel cannot adequately support a business activity they do not understand. Insufficient knowledge of trading and derivatives prevents an understanding of the risks involved and may prevent effective internal controls from being implemented. The operations unit needs to evolve

from a clerical processing room into a professional, value-adding division that is competent in trading and derivative products. The staff must be self-reliant, knowledgeable of trading and derivative products, and have technical abilities that enable them to communicate and work effectively with front office traders. Accordingly, an institution should provide back-office personnel with appropriate continuing education.

The degree of sophistication in an operations system should be commensurate with the level of risk. For trading and derivative dealers and active position-takers, a system with extensive capabilities is generally needed to efficiently process, confirm, and record transaction details. Limited end-users may use a personal computer with spreadsheets or other devices to record transaction data. Regardless of the type of support system used, certain fundamental requirements for the processing and control functions remain the same. These requirements are discussed later in this appendix.

Weak operational processes increase the possibility of loss from human error, fraud, or systems failure. Operational errors may affect the accuracy of management reports and risk measurement systems, thus jeopardizing the quality of management decisions. For example, losses can occur not only from settlement errors but also from managing incorrect positions or misstating credit exposure because trade data was input incorrectly. Further, operational errors and inefficiencies can harm an institution's reputation and cause a loss of business.

A properly controlled transaction risk management function should include:

- Effective Board and Directors supervision.
- Policies and procedures.
- Segregation of risk-taking and operational duties.
- Skilled and experienced operations personnel.
- Timely financial, exposure, and risk reporting (as applicable).
- Operational performance measures.
- Technology commensurate with the level and complexity of activity.

Transaction Risk Measurement

The level of transaction risk associated with an institution's trading and derivative activities is related to (1) the volume and complexity of transactions and (2) the efficiency and integrity of the operations department. The better the institution's ability to prevent losses from human error, fraud, and weak operational systems, the lower will be the level of transaction risk.

One way to measure transaction risk is to monitor the quality and efficiency of operations vis-à-vis quantifiable performance measures. This is particularly important for dealers transacting large volumes of trades. Examples of operating performance measures include the number of transactions processed per employee and overtime hours worked. Other examples of performance measures include: the volume of disputed, unconfirmed, or failed trades; reconciling items; and documentation exceptions. Timeframes for resolving discrepancies should be documented, evaluated, and regularly reported to senior management.

Role of Operations

The function of an operations department is to process transactions, record contracts, and reconcile transactions and databases. A properly functioning operations department will help ensure the integrity of financial information and minimize operations, settlement, and legal risks. The operations area should provide the necessary checks to detect unauthorized trades.

Typically, the dealing/risk-taking and sales functions are referred to as the front office and the processing and recording/reporting areas are referred to as the back office. In some institutions, a middle office helps reconcile systems, monitor positions and revenues, and perform related activities. Institutions create middle offices to be able to calculate and verify profits and losses, as well as position risk, in a more timely fashion. Like the back office, the middle office should operate independently of the risk-taking environment.

At institutions for which establishing a separate risk control unit is not economical, the back office will generally be responsible for much of the risk control. This may include exposure/position reporting, monitoring of credit and price limits, and profit and loss reporting.

Transaction risk is very difficult to quantify. The ability to control this risk depends on accurate transaction updates to all systems (e.g., trading, settlement, credit, and general ledger). Back-office personnel, who are responsible for accounting records, confirmations, reconciliation and settlement, must maintain a reporting line independent of front-office personnel. On-line credit systems should calculate aggregate exposure globally with credit exposure and credit usage information updated as soon as deals are transacted. Procedures should be established to segregate duties among persons responsible for: making investment and credit decisions; confirmations; recordkeeping; reconciliations; and disbursing and receiving funds.

Policies and Procedures

Policies and procedures are the framework for managing transaction risk. Institutions should insure that operating policies and procedures are developed and regularly updated. Procedures manuals can take different forms, but their detail should be commensurate with the nature of trading and derivative activities. Policies and procedures for trading and derivatives activities need not be stand-alone documents, but rather can be incorporated into other applicable policies such as operations guidance on interest rate risk, investment securities, and dealing activities. The documents should guide employees through the range of tasks performed and should contain guidance on relevant areas of trade processing, account valuations, reconciliations, and documentation.

The following issues should be addressed in policies and procedures.

Trade Capture

In the front office, the risk-taker transacts a deal directly over a recorded phone line, through a broker, or through an electronic matching system. After the deal is executed, the risk-taker or operations staff should immediately input trade data into the trading system (or write a ticket to be entered into a institution's operations system). Information on deals transacted over electronic dealing systems can flow electronically to update relevant reports and databases. All trades should be entered promptly so that all systems can be updated (e.g., credit, intra-day profit and loss statements, risk positions, confirmation processing, settlement, and general ledger).

Trade information captured includes trade date, time of trade, settlement date, counterparty, financial instrument traded and amount transacted, price or rate, and netting instructions. Settlement instructions sometimes accompany this information. The trading system uses this information to update position and profit and loss reports or on-line systems. Deal information captured by trading system may also flow into the credit system so that settlement and pre-settlement exposures can be updated.

Ideally, the front-office system should have one-time data capture for transactions to maximize operational efficiency. That is, after the trade is executed, the system should automatically generate accounting entries, confirmations, update trader positions, credit risk exposure reports, and other relevant databases. One-time data capture can significantly minimize the possibility of subsequent data entry errors at the manual level.

Confirmation Process

The purpose of the confirmation process is to verify that each trade and derivative counterparty agrees to the terms of the trade. For each trade, a confirmation is issued by the institution, and the counterparty either issues its own confirmation or affirms the institution's confirmation. To reduce the likelihood of fraud or human error, this confirmation process must be conducted independently of the risk-taking unit.

To minimize risk, an institution should make every effort to send confirmations within one to three hours after deals are executed and no later than the end of the business day. Inefficient confirmation issuance and receipt make it difficult to detect errors that may lead to problems in profit and loss reconciliation and position valuation.

The method of confirmation varies depending on the type of counterparty, asset or derivative traded, and the method of settlement. Ideally, confirmations are exchanged electronically with the counterparty via the Society for Worldwide Interbank Financial Telecommunications (SWIFT) or an electronic matching service.

Although phone confirmations can help to reduce the number and size of trade discrepancies, they are no substitute for physical confirmations. Except when contracts have very short maturities, it is poor practice to rely solely on telephone verifications.

Errors may be made in interpreting terminology used over the phone. In addition, certain jurisdictions only recognize physical confirmations for litigation purposes.

Unconfirmed and Disputed Trades

All incoming confirmations should be sent to the attention of a department that is independent of the risk-taking unit. Incoming information should be compared with the outgoing confirmation, and any disputes should be carefully researched. Disputes or unconfirmed trades should be brought immediately to the attention of the operations manager. All disputes and unconfirmed trades should be regularly reported to a senior operations officer.

An institution should adopt standard procedures for addressing disputes and unconfirmed deals. Documentation should include the key financial terms of the transaction, indicate the disputed item, and summarize the resolution. The counterparty should receive notice of the final disposition of the trade and an adequate audit trail of the notice should be on file in the back office. Risk-taking and sales personnel should be notified of disputed or unconfirmed deals.

Netting

Netting is an agreement between counterparties to offset positions or obligations. Payment (or settlement) netting is a bilateral (two-party) agreement intended to reduce settlement risk. Payment netting is a mechanism in which parties agree to net payments payable between them on any date, in the same currency, under the same transaction or a specified group of transactions. Payment netting goes on continually during the life of a master agreement. Payment netting reduces credit and transaction risk by allowing the institution to make one payment instead of settling multiple transactions individually. However, an institution should not perform payment netting without first ensuring that netting agreements are properly documented and legally enforceable. Institutions often use standardized master agreements such as the International Swaps and Derivatives Association (ISDA) agreement, Foreign Exchange and Options Agreement (FEOMA), and International Currency Options Market (ICOM) agreement to document netting arrangements. The credit and compliance risk aspects of netting are discussed in their respective sections.

Despite the obvious advantages of netting, it presents operational complexities and its use is mainly confined to the largest institutions and counterparties. Institutions cite costs and lack of operational capacity, as well as legal uncertainties, as barriers to the greater use of netting arrangements. Institutions performing netting should ensure that they have the systems to accurately and quickly calculate net payments. Correct calculations of netted payments are important to preserve counterparty relationships and avoid costly errors. Some institutions use payment netting services such as FXNET, SWIFT, and VALUNET to calculate net payments. These on-line systems allow counterparties to communicate directly with each other and avoid costly discrepancies. Some pairs of institutions have set up bilateral netting arrangements on their own using standardized netting contracts.

Institutions can reduce credit and transaction exposure by using multilateral netting arrangements. Multilateral netting is designed to extend the benefits of bilateral netting to cover contracts with a group of counterparties. Often, under a multilateral netting arrangement, a clearinghouse interposes itself as the legal counterparty for covered contracts transacted between its members. The most familiar form of multilateral netting is in the clearing and settlement of contracts on futures and options exchanges.

Management should confirm that operational procedures ensure that netting is carried out as contractually obligated between an institution and its counterparties. Operations should ensure that netted trades are reflected in trade capture systems and credit systems so that netting is successfully executed. The operational procedures should include any necessary cut-off times, settlement instructions, and the method of confirmation/affirmation and should be supported by the documentation of the counterparty.

Close-Out Netting. Close-out (or default) netting is a bilateral agreement intended to reduce pre-settlement credit risk in the event that a counterparty becomes insolvent before the settlement date. Upon default, the non-defaulting party nets gains and losses with the defaulting counterparty to a single payment for all covered transactions.

Settlement Netting. Settlement (or payment) netting is a bilateral agreement intended to reduce settlement risk. Settlement netting is a mechanism in which parties agree to net payments payable between them on any date in the same currency under the same transaction or a specified group of transactions. Unlike close-out netting, payment netting is continual during the life of a master agreement.

Multilateral Netting. Multilateral netting is designed to extend the benefits of bilateral netting to cover contracts with a group of counterparties. Commonly, under a multilateral netting arrangement, a clearinghouse interposes itself as the legal counterparty for covered contracts transacted between its members. Multilateral netting is used in the clearing and settlement of contracts on futures exchanges.

Settlement Process

Settlement refers to the process through which trades are cleared by the payment/receipt of currency, securities, or cash flows on periodic payment dates and the date of final settlement. The settlement of trading and derivative transactions can involve the use of various international and domestic payment system networks.

By separating the duties of operations staff members, an institution asserts vital control over the settlement process. Like other operations functions, the settlement process should be controlled through procedures directing the payment/receipt of funds.

Specifically, operations procedures should address regular terms of settlement, exception processes, and the reporting of stale-dated or unusually large unsettled transactions. The person(s) responsible for the release of funds should be independent of the confirmation process as well as areas of transaction processing that could allow access to the payment

process. Such sensitive areas include, for instance, access to standardized settlement instructions.

Because failed trades or unsettled items increase settlement risk and cause inaccuracies in profit and loss, position, and credit reporting, they should be identified and resolved as soon as possible. Anything more than a routine situation should be brought to the attention of risk-taking management and the senior operations officer.

Reconciliations
To ensure that data has been accurately captured, critical data points and reports should be promptly reconciled. The person who reconciles accounts must be independent of the person who initiates the transaction or inputs transaction data. The general ledger should be reconciled with front and back systems each day. Front and back office profit and loss statements and position reports should also be reconciled each day. Regulatory reports should be periodically reconciled to the general ledger. Reconcilement discrepancies should be investigated and resolved as soon as possible. Significant discrepancies should be brought to the attention of senior management.

Broker's Commissions and Fees
The back office should review brokers' statements, reconcile charges to the general ledger, check commissions, and initiate payment. Brokers should be approved independently of the risk-takers. The back office should monitor brokerage activity to ensure that it is conducted with only approved brokers and that trades are distributed to a reasonable number of brokers. Unusual trends or charges should be brought to the attention of back office management and reviewed with the appropriate personnel.

Documentation and Record-Keeping
Transaction documentation for trading and derivative instruments often requires written confirmation of trades, contract terms, legal authorities, etc. Typically, many of the terms under which the instruments are transacted are stipulated in master agreements and other legal documents. Maintaining proper documentation and ensuring proper completion and receipt is often the responsibility of the operations or credit functions. Institutions should establish processes (checklists, tickler files, etc.) to ensure that trading and derivative transactions, like all other risk-taking transactions, are properly documented. These processes should monitor and control receipt of documents. Institutions should establish thresholds limiting future business with counterparties failing to provide required documentation. Proper control over trading and derivative documentation requires a process that quickly identifies and resolves documentation exceptions.

Revaluation Approaches and Reserves
Both the risk control and audit functions should ensure that position valuations are generated from independent sources. Accurate values are key to the generation of reliable reports on risk levels, profitability, and trends. Ideally, much of the valuation process employs valuation model algorithms or electronic data feeds from wire services, with little manual intervention. When reliable revaluation models or data feeds are not available, as is the case with some illiquid or highly customized products, operations

personnel or other independent personnel should obtain values from other dealers or use approved mathematical techniques to derive values.

The process through which positions are marked-to-market should be specified in policies and procedures. Controls should be implemented that ensure proper segregation of duties between risk-takers and control personnel, including the independent input and verification of market rates. In addition, controls should provide for consistent use of pricing methods and assumptions about pricing factors (e.g., volatility) to ensure accurate financial reporting and consistent evaluations of price risk.

The approach institutions use to value their trading and derivative portfolios will depend on a variety of factors including the liquidity and complexity of the contracts and the sophistication of their valuation and accounting systems. The most conservative approach is using the bid for long positions and the offer for short positions. Some dealers will take a conservative approach with illiquid or highly structured trading and derivative portfolios by valuing them at the lower of cost or market (LOCOM).

Dealers and more sophisticated end-users typically value transactions at mid-market less adjustments (usually through the use of reserves) for future costs. The most common types of adjustments are those made to reflect credit risk and future administrative costs. Other types of adjustments may be made to reflect close-out costs, investing and funding costs, and costs associated with valuation model errors. At a minimum, institutions using mid-market valuations should make adjustments for credit risk and administrative costs. If an institution elects not to use adjustments for close-out costs, investment and funding costs, and model errors, its rationale should be documented.

Regardless of the valuation method used, management should ensure that policies and procedures are established that support their valuation. If mid-market less adjustments is used, policies and procedures should specify required valuation adjustments, documentation of valuation rationale, periodic review of assumptions, and appropriate accounting treatment.

Dealers should mark positions to market at least daily (intraday marks may be necessary in some market environments) and on an official, independent basis, no less frequently than once a month. For risk management purposes, active position-takers should independently revalue trading and derivative positions at least once a month and should possess the ability to obtain reliable market values daily if warranted by market conditions. Limited end-users should establish a timeframe for revaluations that is consistent with other risk measurements. At a minimum, revaluations should be conducted by end-users at least quarterly.

Although independent revaluation of exchange-traded instruments is readily accomplished through published contract prices, the valuation of less actively transacted instruments, particularly the less liquid and more exotic OTC products and derivatives, is more difficult. Certain volatility rates and other parameters can be difficult to generate without input from the risk-taker. However, if an institution wishes to deal in or use

these products, it must have a mechanism to independently and consistently derive needed market rates from similar markets or other dealers.

In obtaining external valuations, the requirements of the valuation should be specified (e.g., mid, bid, offer, indicative, firm, etc.). In addition, when external valuations are received they should be considered in light of the relationship with the party supplying them and, in particular, whether they include factors that may make them inappropriate (e.g., obtaining valuations from the originating dealer).

The revaluation process should include a review of trades executed at off-market rates. These trades may result from human error or undesirable trader or counterparty activity. A daily procedure should be followed that provides for an independent review, whether manual or automated, of trade prices relative to prevailing market rates. Any deals conducted at off-market rates should be reported to the senior operations and risk-taking management and risk control.

Procedures for documenting and resolving discrepancies between front office inputs and back office inputs should be firmly established. Documentation containing the reason for the discrepancy, the profit and loss impact, and the final resolution of the discrepancy should be maintained. Significant discrepancies should be reported to senior operations and risk-taking management. Independence in establishing revaluation information should not be compromised.

Information Technology
Although systems and modeling technology supports a trading or derivatives business, technology can also pose significant risks.

The degree of sophistication of systems technology should be commensurate with the character and complexity of the trading and derivatives business. In assessing risk, management and the Board should consider how well the management information system functions, rather than its technical specifications. The system should serve the needs of applicable users, including senior management, risk control units, front office, back office, financial reporting, and internal audit. For large systems, the institution should have flow charts or other documentation that show data flow from input through reporting.

An important aspect in the evaluation of information technology is how well different systems interface. (Interface is usually accomplished using emulators that communicate from one application to another.) Institutions relying on a single database may have stronger controls on data integrity than those with multiple databases and operating systems. However, it is rare to find a single automated system that handles data entry and all processing and control functions relevant to over-the-counter and exchange-traded instruments. The systems used may be a combination of systems purchased from vendors, applications developed in-house, and legacy systems.

Incompatible systems can result in logistical obstacles because deal capture, data entry, and report generation will require multiple keying of data. Accordingly, controls and reconciliations that minimize the potential for corrupting data should be used when consolidating data obtained from multiple sources. If independent databases are used to support subsidiary systems, reconciliation controls should be in place at each point that data files come together. Regardless of how an institution combines automated systems and manual processes, management should ensure that appropriate validation processes ensure data integrity.

Periodic planning. Operations and support systems should receive periodic reviews to ensure that capacity, staffing, and the internal control environment support current and planned trading and derivative activity. These reviews can be performed as a part of the annual budgeting and planning process, but should also be conducted as activity and plans change throughout the year.

Contingency planning. Plans should be in place to provide contingency systems and operations support in case of a natural disaster or systems failure. Contingency back-up plans should be comprehensive and include all critical support functions. The objective of the plan should be to restore business continuity as quickly and seamlessly as possible. Plans should be tested periodically. The overall contingency planning process should be reviewed and updated for market, product, and systems changes at least once a year.