

## **GUIDELINES ON MARKET RISK MANAGEMENT**

### ***(Appendix to Sec. 144)***

#### I. Background

The globalization of financial markets, increased transaction volume and volatility, and the introduction of complex products and trading strategies have made market risk management take on a more important role in risk management. FIs now use a wide range of financial products and strategies, ranging from the most liquid fixed income securities to complex derivative instruments and structured products. The risk dimensions of these products and strategies must be fully understood, monitored, and controlled by an FI.

#### II. Statement of policy

For purposes of these guidelines, FIs refer to banks and NBFIs supervised by the Bangko Sentral and their respective financial subsidiaries.

The level of market risk assumed by an FI is not necessarily a concern, so long as the FI has the ability to effectively manage the risk. Therefore, the Bangko Sentral will not restrict the level of risk assumed by an FI, or the scope of its financial market activities, so long as the FI is authorized to engage in such activities and:

- Understands, measures, monitors and controls the risk assumed,
- Adopts risk management practices whose sophistication and effectiveness are commensurate to the risk being monitored and controlled, and
- Maintains capital commensurate with the risk exposure assumed.

If the Bangko Sentral determines that an FI's risk exposures are excessive relative to the FI's capital, or that the risk assumed is not well managed, the Bangko Sentral will direct the FI to reduce its exposure to an appropriate level and/or strengthen its risk management systems.

In evaluating the above parameters, the Bangko Sentral expects FIs to have sufficient knowledge, skills and appropriate system and technology necessary to understand and effectively manage their market risk exposures. The principles set forth in these guidelines shall be used in determining the adequacy and effectiveness of an FI's market risk management process, the level and trend of market risk exposure and adequacy of capital relative to exposure. The Bangko Sentral shall consider the following factors:

1. The major sources of market risk exposure and the complexity and level of risk posed by the

assets, liabilities, and off- balance-sheet activities of the FI;

2. The FI's actual and prospective level of market risk in relation to its earnings, capital, and risk management systems;
3. The adequacy and effectiveness of the FI's risk management practices and strategies as evidenced by:
  - The adequacy and effectiveness of Board and senior management oversight;
  - Management's knowledge and ability to identify and manage sources of market risk as measured by past and projected financial performance;
  - The adequacy of internal measurement, monitoring, and management information systems;
  - The adequacy and effectiveness of risk limits and controls that set tolerances on income and capital losses;
  - The adequacy and frequency of the FI's internal review and audit of its market risk management process.

Further, an FI's market risk management system shall be assessed under the FI's general risk management framework, consistent with the guidelines on supervision by risk as set forth under *Appendix 72*.

### III. Market risk management process

An FI's market risk management process should be consistent with its general risk management framework and should be commensurate with the level of risk assumed. Although there is no single market risk management system that works for all FIs, an FI's market risk management process should:

1. *Identify market risk*. Identifying current and prospective market risk exposures involves understanding the sources of market risk arising from an FI's existing or new business initiatives. An FI should have procedures in place to identify and address the risk posed by new products and activities prior to initiating the new products or activities.

Identifying market risk also includes identifying an FI's desired level of risk exposure based on its ability and willingness to assume market risk. An FI's ability to assume market risk depends on its capital base and the skills/capabilities of its management team. In any case, market risk identification should be a continuing process and should occur at both the transaction and portfolio level.

2. *Measure market risk*. Once the sources and desired level of market risk have been identified, market risk measurement models can be applied to quantify an FI's market risk exposures. However, market risk cannot be managed in isolation. Market risk measurement systems should

be integrated into an FI's general risk measurement system and results from models should be interpreted in coordination with other risk exposures. Further, the more complex an FI's financial market activities are, the more sophisticated the tools that measure market risk exposures arising from such complex activities should be.

3. *Control market risk.* Quantifying market risk exposures help an FI align existing exposures with the identified desired level of exposures. Controlling market risk usually involves establishing market risk limits that are consistent with an FI's market risk measurement methodologies. Limits may be applied through an outright prohibition on exposures above a pre-set threshold, by restraining activities or deploying strategies that alter the risk-return characteristics of on- and off- balance sheet positions. Appropriate pricing strategies may likewise be used to control market risk exposures.
4. *Monitor market risk.* Ensuring that market risk exposures are adequately controlled requires the timely review of market risk positions and exceptions. Monitoring reports should be frequent, timely and accurate. For large, complex FIs, consolidated monitoring should be employed to ensure that management's decisions are implemented for all geographies, products, and legal entities.

#### IV. Definition and sources of market risk

*Market risk* is the risk to earnings or capital arising from adverse movements in factors that affect the market value of instruments, products, and transactions in an institution's overall portfolio, both on or off-balance sheet. Market risk arises from market-making, dealing, and position-taking in interest rate, foreign exchange, equity and commodities markets.

*Interest rate risk* is the current and prospective risk to earnings or capital arising from movements in interest rates.

*Foreign exchange risk* refers to the risk to earnings or capital arising from adverse movements in foreign exchange rates.

*Equity risk* is the risk to earnings or capital arising from movements in the value of an institution's equity-related holdings.

*Commodity risk* is the risk to earnings or capital due to adverse changes in the value of an institution's commodity-related holdings.

While there are generally four sources of market risk, as defined herein, the focus of this Appendix

is interest rate risk and foreign exchange risk. Nevertheless, the principles set forth in the market risk management process and sound risk management practices are generally applicable to all sources of market risk.

a. Interest rate risk

*Interest rate risk* is the risk that changes in market interest rates will reduce current or future earnings and/or the economic value of an FI. Accepting interest rate risk is a normal part of financial intermediation and is a major source of profitability and shareholder value. Excessive or inadequately understood and controlled interest rate risk, however, can pose a significant threat to an FI's earnings and capital. Thus, an effective risk management process that maintains interest rate risk within prudent levels is essential to the safety and soundness of FIs.

1. Sources of interest rate risk

a. *Re-pricing risk*

This is the most common type of interest rate risk and arises from differences in the maturity (for fixed-rate instruments) and re-pricing (for floating-rate instruments) of an FI's assets, liabilities and off-balance sheet (OBS) positions. While such re-pricing mismatches are fundamental to the business of financial intermediation, they also expose an FI's earnings and underlying economic value to changes based on fluctuations in market interest rates.

b. *Basis risk*

Basis risk arises from imperfect correlations among the various interest rates earned and paid on financial instruments with otherwise similar re-pricing characteristics. A shift in the relationship between these rates or interest rates in different markets can give rise to unexpected changes in the cash flows and earnings spread between assets, liabilities and OBS instruments of similar maturities or re-pricing frequencies.

c. *Yield curve risk*

Yield curve risk is the risk that rates of different maturities may change by a different magnitude. It arises from variations in the movement of interest rates across the maturity spectrum of the same index or market. Yield curves can steepen, flatten or even invert. Unanticipated shifts of the yield curve may have adverse effects on an FI's earnings or underlying economic value.

d. *Option risk*

Option risk is the risk that the payment patterns of assets and liabilities will change when interest rates change. Formally, an option gives the option holder the right, but not the obligation to buy, sell, or in some manner alter the cash flow of an instrument or financial

contract. Options may be stand-alone instruments or may be embedded within otherwise standard instruments. Examples of instruments with embedded options include various types of bonds, notes, loans or even deposits which give a counterparty the right to prepay or even extend the maturity of an instrument or to change the rate paid. In some cases, the holder of an option can force a counterparty to pay additional notional, or to forfeit notional already paid.

The option holder's ability to choose to alter cash flows creates an asymmetric performance pattern. If not adequately managed, the asymmetrical payoff characteristics of instruments with optionality can pose significant risk particularly to those who sell the options, since the options held, both explicit and embedded, are generally exercised to the advantage of the holder and the disadvantage of the seller.

## 2. Measuring the effects of interest rate risk.

Changes in interest rates affect both earnings and the economic value of an FI. This has given rise to two separate, but complementary, perspectives for evaluating an FI's exposure to interest rate risk.

Exposure to earnings typically receives the most attention. Many FIs use a modified interest rate gap or earnings simulation model to forecast earnings over a running next twelve (12) month time horizon under a variety of interest rate scenarios. Given that a large portion of a typical FI's liabilities and even assets re-price in less than one (1) year, there is value in such a system. For example, earnings are a key measure in determining if the board of directors is creating value for the shareholders.

However, earnings over the next twelve (12) months do not present a complete picture of an FI's exposure to interest rate risk. Many FIs hold assets such as bonds and fixed rate loans with extended terms. The full effect of changes in interest rates on the value of these assets cannot be fully captured by a short-term earnings model. Thus, it is also important to consider a more comprehensive picture of the FI's exposure to interest rate risk through an assessment of the FI's economic value.

The Bangko Sentral will not consider market risk to be "well managed" unless the FI has fully implemented an effective risk measurement system whose sophistication is commensurate with the nature and complexity of the risk assumed. Smaller FIs with non-complex single currency balance sheets may be able to use a single non-complex measurement methodology, such as re-pricing gap analysis to manage their interest rate risk. However, large commercial or universal banks with complex, multi-currency balance sheets, or FIs that accept large exposures

of interest rate risk relative to capital will be expected to measure interest rate risk through a combination of earnings simulation and economic value. Trading activities should continue to be managed through the use of an effective, and independently validated Value-at-Risk (VaR) methodology.

*a. Earnings Perspective*

An FI should consider how changes in interest rates may affect future earnings. The focus of analysis under the earnings perspective is the impact of changes in interest rates on accrual or reported earnings. Volatility in earnings should be monitored and controlled because reduced earnings or outright losses can threaten the financial stability of an FI by undermining its capital adequacy. Further, unexpected volatility in earnings can undermine an FI's reputation and result in an erosion of public confidence.

Fluctuations in interest rates generally have the greatest impact on reported earnings through changes in net interest income (i.e., the difference between total interest income and total interest expense). Thus, the Bangko Sentral will expect FIs to adopt systems that are capable of estimating changes to net interest income under a variety of interest rate scenarios. For example, non-complex FIs with traditional business lines and balance sheets could potentially limit their simulations to a single + 100 basis point parallel rate shock. However, FIs that hold significant levels of derivatives and structured products relative to capital should incorporate more severe rate movements (e.g., + 100, 200 and 300 basis points) to determine what happens if strike prices are breached or "events" are triggered. Further, the Bangko Sentral will expect an FI to employ alternative scenarios such as changes to the shape of the yield curve if the FI is exposed to significant levels of yield curve or basis risk.

Changes in market interest rates may also affect the volume of activities that generate fee income and other non-interest income. Thus, FIs should incorporate a broader focus on overall net income - incorporating both interest and non-interest income and expenses - if the FI reports significant levels of interest rate sensitive non-interest income.

*b. Economic value perspective*

The economic value of an FI can be viewed as the present value of an FI's expected net cash flows, defined as the expected cash flows from assets minus the expected cash flows from liabilities plus the expected net cash flows on OBS positions. As such, it provides a more comprehensive view of the potential long-term effects of changes in interest rates than is offered by the earnings perspective.

While a variety of models are available, the Bangko Sentral expects that economic value

models will incorporate all significant classes of assets, liabilities and OBS. As with earnings at risk, the FI should incorporate a variety of interest rate scenarios to ensure that any strike prices, caps, limits, or “events” are breached in the simulation. Also, FIs with significant levels of basis or yield curve risk are expected to add scenarios such as alternative correlations between interest rates and/or a flatter or steeper yield curve.

*c. Managing earnings and economic exposures*

Management must make certain tradeoffs when immunizing earnings and economic value from interest rate risk. When earnings are immunized, economic value becomes more vulnerable, and vice versa. The economic value of equity, like that of other financial instruments, is a function of the discounted net cash flows it is expected to earn in the future. If an FI has immunized earnings, such that expected earnings remain constant for any change in interest rates, the discounted value of those earnings will be lower if interest rates rise. Hence, its economic value will fluctuate with rate changes. Conversely, if an FI fully immunizes its economic value, its periodic earnings must increase when rates rise and decline when interest rates fall.

*b. Foreign exchange risk*

Foreign exchange risk (FX risk) is the risk to earnings or capital arising from changes in foreign exchange rates.

In contracting to meet clients’ foreign currency needs or simply buying and selling foreign exchange for its own account, an FI undertakes a risk that exchange rates might change subsequent to the time the contract is consummated. Foreign exchange risk may also arise from maintaining an open foreign exchange (FX) position. Thus, managing FX risk includes monitoring an FI’s net FX position.

An FI has a net position in a foreign currency when its assets, including spot and future contracts to purchase, and its liabilities, including spot and future contracts to sell, in that currency are not equal. An excess of assets over liabilities is called a net “long” position and liabilities in excess of assets, a net “short” position.

It should be noted that when engaging in FX activities, FIs are also exposed to other risks including liquidity and credit risks, particularly related to the settlement of FX contracts. FIs should have an integrated approach to risk management in relation to its FX activities: FX risk should be reviewed together with other risks to determine the FI’s overall risk profile. Liquidity and settlement risks related to FX activities are outside the scope of these guidelines. Nevertheless, future guidelines may be issued on these risk areas.

## V. Sound market risk management practices

When assessing an FI's market risk management system, the Bangko Sentral expects an FI to address the four (4) basic elements of a sound risk management system:

1. Active and appropriate Board and senior management oversight;
2. Adequate risk management policies and procedures;
3. Appropriate risk measurement methodologies, limits structure, monitoring and management information systems; and
4. Comprehensive internal controls and independent audits.

The specific manner in which an FI applies these elements in managing its market risk will depend upon the complexity and nature of its activities, as well as the level of market risk exposure assumed. What constitutes adequate market risk management practices can therefore vary considerably. Regardless of the systems used, the Bangko Sentral will not consider market risk to be well managed unless all four of the above elements are deemed to be at least "satisfactory".

As with other risk factor categories, banking groups (banks and subsidiaries/ affiliates) should monitor and manage market risk exposures of the group on a consolidated and comprehensive basis. At the same time, however, FIs should fully recognize any legal distinctions and possible obstacles to cash flow movements among affiliates and adjust their risk management practices accordingly. While consolidation may provide a comprehensive measure in respect of market risk, it may also underestimate risk when positions in one affiliate are used to offset positions in another affiliate. This is because a conventional accounting consolidation may allow theoretical offsets between such positions from which an FI may not in practice be able to benefit because of legal or operational constraints.

### A. Active and appropriate board and senior management oversight<sup>1</sup>

Effective board and senior management oversight of an FI's market risk activities is critical to a sound market risk management process. It is important that these individuals are aware of their responsibilities with regard to market risk management and how market risk fits within the organization's overall risk management framework.

#### *Responsibilities of the board of directors*

The board of directors has the ultimate responsibility for understanding the nature and the level of market risk taken by the FI. In order to carry out its responsibilities, the Board should:

1. Establish and guide the FI's strategic direction and tolerance for market risk. While it is not



possible to provide a comprehensive list of documents to consider, the Bangko Sentral should see a clear and documented pattern whereby the Board reviews, discusses and approves strategies and policies with respect to market risk management. In addition, there should be evidence that the Board periodically reviews and discusses the overall objectives of the FI with respect to the level of market risk acceptable to the FI.

2. Identify senior management who has the authority and responsibility for managing market risk and ensure that senior management takes the necessary steps to monitor and control market risk consistent with the approved strategies and policies. The Bangko Sentral should be able to discern a clear hierarchal structure with a clear assignment of responsibility and authority.
3. Monitor the FI's performance and overall market risk profile, ensuring that the level of market risk is maintained within tolerance and at prudent levels supported by adequate capital. The Board should be regularly informed of the market risk exposure of the FI and any breaches to established limits for appropriate action. Reporting should be timely and clearly presented. In assessing an FI's capital adequacy for market risk, the Board should consider the FI's current and potential market risk exposure as well as other risks that may impair the FI's capital, such as credit, liquidity, operational, strategic, and reputation risks.
4. Ensure that the FI implements sound fundamental principles that facilitate the identification, measurement, monitoring and control of market risk. The board of directors should encourage discussions among its members and senior management - as well as between senior management and others in the FI - regarding the FI's market risk exposures and management process.
5. Ensure that adequate resources, both technical and human resources, are devoted to market risk management. While board members need not have detailed technical knowledge of complex financial instruments, legal issues or sophisticated risk management techniques, they have the responsibility to ensure that the FI has personnel available who have the necessary technical skills to evaluate and control market risk. This responsibility includes ensuring that there is continuous training of personnel on market risk management and providing competent technical staff for the internal audit function.

#### *Responsibilities of senior management*

Senior management is responsible for ensuring that market risk is adequately managed for both long-term and day-to-day basis. In managing the FI's activities, senior management should:

1. Develop and implement policies, procedures and practices that translate the board's goals, objectives and risk tolerances into operating standards that are well understood by personnel and that are consistent with the board's intent. Senior management should also periodically review the organization's market risk management policies and procedures to ensure that they remain appropriate and sound.
2. Ensure adherence to the lines of authority and responsibility that the board has established for measuring, managing, and reporting market risk exposures.
3. Maintain appropriate limits structure, adequate systems for measuring market risk, and standards for measuring performance.
4. Oversee the implementation and maintenance of management information and other systems to identify, measure, monitor, and control the FI's market risk.
5. Establish effective internal controls over the market risk management process.
6. Ensure that adequate resources are available for evaluating and controlling market risk. Senior management of FIs, including branches of foreign banks, should ensure that analysis and market risk management activities are conducted by competent staff with technical knowledge and experience consistent with the nature and scope of the FI's activities. There should be sufficient depth in staff resources to manage these activities and to accommodate the temporary absence of key personnel and normal succession.

In evaluating the quality of oversight, the Bangko Sentral shall evaluate how the board and senior management carry out the above functions/ responsibilities. Further, sound management oversight is highly related to the quality of other areas/elements of an FI's risk management system. Thus, even if board and senior management exhibit active oversight, the FI's policies, procedures, measurement methodologies, limits structure, monitoring and information systems, controls and audit must be considered adequate before quality of board and senior management can be considered at least "satisfactory".

#### *Lines of responsibility and authority*

FIs should clearly define the individuals and/or committees responsible for managing market risk and should ensure that there is adequate separation of duties in key elements of the risk management process to avoid potential conflicts of interest.

Management should ensure that sufficient safeguards exist to minimize the potential that

individuals initiating risk-taking positions may inappropriately influence key control functions of the market risk management process. FIs should therefore have risk measurement, monitoring, and control functions with clearly defined duties that are sufficiently independent from position-taking functions of the FI and which report risk exposures directly to the board of directors.

The nature and scope of safeguards to minimize potential conflicts of interest should be in accordance with the size and structure of an FI. Larger or more complex FIs should have a designated independent unit responsible for the design and administration of the FI's market risk measurement, monitoring and control functions.

#### B. Adequate risk management policies and procedures

An FI's market risk policies and procedures should be clearly defined, documented and duly approved by the board of directors. Policies and procedures should be consistent with the nature and complexity of the FI's activities. When reviewing banking groups, the Bangko Sentral will assess whether adequate and effective policies and procedures have been adopted and implemented across all levels of the organization.

Policies and procedures should delineate lines of responsibility and accountability and should clearly define authorized instruments, hedging strategies, position-taking opportunities, and the market risk models used to quantify market risk. Market risk policies should also identify quantitative parameters that define the acceptable level of market risk for the FI. Where appropriate, limits should be further specified for certain types of instruments, portfolios, and activities. All market risk policies should be reviewed periodically and revised as needed. Management should define the specific procedures to be used for identifying, reporting and approving exceptions to policies, limits, and authorizations.

It is important that FIs identify market risk, as well as other risks, inherent in new products and activities and ensure these are subject to adequate procedures and controls before the new products and activities are introduced or undertaken. Specifically, new products and activities should undergo a careful pre-acquisition review to ensure that the FI understands their market risk characteristics and can incorporate them into its risk management process. Major hedging or risk management initiatives should be approved in advance by the board or its appropriate delegated committee.

Proposals and the subsequent new product/activity review should be formal and written. For purposes of managing market risk inherent in new products, proposals should, at a minimum, contain the following features:

1. Description of the relevant product or strategy;
2. Use/purpose of the new product/ activity;
3. Identification of the resources required and unit/s responsible for establishing sound and effective market risk management of the product or activity;
4. Analysis of the reasonableness of the proposed activities in relation to the FI's overall financial condition and capital levels; and
5. Procedures to be used to measure, monitor, and control the risks of the proposed product or activity.

C. Appropriate risk measurement methodologies, limits structure, monitoring, and management information system

*Market risk measurement models/ methodologies*

It is essential that FIs have market risk measurement systems that capture all material sources of market risk and that assess the effect of changes in market risk factors in ways that are consistent with the scope of their activities. Depending upon the size, complexity, and nature of activities that give rise to market risk, the ability to capture all material sources of market risk in a timely manner may require an FI's market risk measurement system to be interfaced with other systems, such as the treasury system or loan system. The assumptions underlying the measurement system should be clearly understood by risk managers and senior management.

Market risk measurement systems should:

1. Assess all material market risk associated with an FI's assets, liabilities, and OBS positions;
2. Utilize generally accepted financial concepts and risk measurement techniques; and
3. Have well-documented assumptions and parameters.

There are a number of methods/ techniques for measuring market risks. Complexity ranges from simple marking-to-market or valuation techniques to more advanced static simulations using current holdings to highly sophisticated dynamic modeling techniques that reflect potential future business activities. In designing market risk measurement systems, FIs should ensure that the degree of detail regarding the nature of their positions is commensurate with the complexity and risk inherent in those positions.

At a minimum, smaller non-complex FIs should have the ability to mark-to-market or revalue their investment portfolio and construct a simple re-pricing gap. When using gap analysis, the precision of interest rate risk measurement depends in part on the number of time bands into which positions are aggregated. Clearly, aggregation of positions/cash flows into broad time bands implies

some loss of precision. In addition, the use of reasonable and valid assumptions is important for a measurement system to be precise. In practice, the FI must assess the significance of the potential loss of precision in determining the extent of aggregation and simplification to be built into the measurement approach. Assumptions and limitations of the measurement approach, such as the loss of precision, should be documented.

On the other hand, banks holding an expanded derivatives license and FIs engaging in options or structured products with embedded options cannot capture all material sources of market risk by using static models such as the re-pricing gap. These FIs should have interest rate risk measurement systems that assess the effects of rate changes on both earnings and economic value. These systems should provide meaningful measures of an FI's current levels of interest rate risk exposure, and should be capable of identifying any excessive exposures that might arise. Pricing models and simulation techniques will probably be required.

There is also a question on the extent to which market risk should be viewed on a whole institution basis or whether the trading book, which is marked to market, and the accrual book, which is often not, should be treated separately. As a general rule, it is desirable for any measurement system to incorporate market risk exposures arising from the full scope of an FI's activities, including both trading and non-trading sources. A single measurement system can facilitate analysis of market risk exposure. However, this does not preclude different measurement systems and risk management approaches being used for similar or different activities. For example, a bank with expanded derivatives license will use pricing models as basic tools in valuing position from its derivatives activities and structured products. In addition, the bank should use simulation models to assess the potential effects of changes in market risk factors by simulating the future path of market risk factors and their impact on cash flows from these activities.

Different methodologies may also be applied to the trading and accrual books. Regardless of the number of models or measurement systems used, management should have an integrated view of market risk across products and business lines.

Regardless of the measurement system used, the Bangko Sentral will expect the FI to ensure that input data are timely and correct, assumptions can be supported and are valid, the methodologies used produce accurate results, and the results can be easily understood by senior management and the board.

- (1) *Model input.* All market risk measurement methodologies require various types of inputs, including hard data, readily observable parameters such as asset prices, and both quantitatively and qualitatively-derived assumptions. This applies equally to simple gap as well as complex simulation models.

The integrity and timeliness of data is a key component of the market risk measurement process. The Bangko Sentral expects that adequate controls will be established to ensure that all material positions and cash flows from on- and off- balance sheet positions are incorporated into the measurement system on a consistent and timely basis. Inputs should be verified through a process that validates data integrity. Assumptions and inputs should be subject to control and oversight review. Any manual adjustments to underlying data should be documented, and the nature and reasons for the adjustments should also be clearly understood.

Critical to model accuracy is the validity of underlying assumptions. Assumptions regarding maturity of deposits, for example, are critical in measuring interest rate risk. The treatment of positions where behavioral maturity is different from contractual maturity requires the use of assumptions and may complicate the measurement of interest rate risk exposure, particularly when using the economic value approach. The validity of correlation assumptions to aggregate market risk exposures is likewise important as breakdowns in correlations may significantly affect the validity of model results. Key assumptions should therefore be subject to rigorous documentation and review. Any significant changes should be approved in advance by the board of directors.

- (2) *Model risk.* While accuracy is key to an effective market risk measurement system, methodologies cannot be expected to flawlessly predict potential losses arising from market risk. The use of models introduces the potential for model risk. Thus, model risk is the risk of loss arising from inaccurate or incorrect quantification of market risk exposures due to weaknesses in market risk methodologies. It may arise from relying on assumptions that are inconsistent with market realities, from employing input parameters that are unreliable, or from calibrating, applying and implementing models incorrectly.

Model risk is more likely to arise for instruments that have non-standard or option-like features. The use of proprietary models that employ unconventional techniques that are not widely agreed upon by market participants is likewise more sensitive to model risk. Even the use of standard models may lead to errors if the financial tools are not appropriate for a given instrument.

The Bangko Sentral expects FIs to implement effective policies and procedures to manage model risk. The scope of policies and procedures will depend upon the type and complexity of models developed or purchased. However, FIs holding an expanded license or significant levels of complex investments including structured products, should at a minimum implement the following controls:

- a. Model development/acquisition, implementation and revisions. The Bangko Sentral expects larger, complex FIs to adopt policies governing development/acquisition, implementation and revision of market risk models. These policies should clearly define the responsibilities of staff involved in the development/acquisition process. FIs should ensure that modeling techniques and assumptions are consistent with widely accepted financial theories and market practices. Policies and procedures should be duly approved by the board of directors and properly documented. An inventory of the models in use should be maintained along with documentation explaining how they operate.

The Bangko Sentral also expects that revisions to models will be performed in a controlled environment by authorized personnel and changes should be made or verified by a control function. Written policies should specify when changes to models are acceptable and how those revisions should be accomplished.

- b. *Model validation*. Before models are authorized for use, they should be validated by individuals who are neither directly involved in the development process nor responsible for providing inputs to the model. Independent model validation is a key control in the model development process and should be specifically addressed in an FI's policies. Further, the Bangko Sentral expects that the staff validating the models will have the necessary technical expertise.

A sound validation process should rigorously and comprehensively evaluate the sensitivity of the model to material sources of model risk and includes the following:

1. Tests of internal logic and mathematical accuracy;
2. Development of empirical support for the model's assumptions;
3. Back-testing. The Bangko Sentral expects FIs to conduct backtesting of model results. Back-testing is a method of periodically evaluating the accuracy and predictive capability of an FI's market risk measurement system by monitoring and comparing actual movements in market prices or market risk factors with projections produced by the model. To be more effective, back-testing should be conducted by parties independent of those developing or using the model. Policies should address the scope of the back-testing process, frequency of back-testing, documentation requirements, and management responses. Complex models should be back-tested continually while simple models can be back-tested periodically. Significant discrepancies should prompt a model review.

4. Periodic review of methodologies and assumptions. The Bangko Sentral expects that FIs will periodically review or reassess their modeling methodologies and assumptions. Again, the frequency of review will depend on the model but complex models should be reviewed at least once a year, when changes are made, or when a new product or activity is introduced. Model review could also be prompted when there is a need for the model to be updated to reflect changes in the FI or market. The review process should be performed by an independent group as it is considered to be part of the risk control and audit function.

The use of vendor models can present special challenges, as vendors often claim proprietary privilege to avoid disclosing information about their models. Thus, FIs may be constrained from performing validation procedures related to internal logic, mathematical accuracy and model assumptions. However, vendors should provide adequate information on how the models were constructed and validated so that FIs have reasonable assurances that the model works as intended.

- c. *Stress testing*. The underlying statistical models used to measure market risk summarize the exposures that reflect the most probable market conditions. Regardless of size and complexity of activities, the Bangko Sentral expects FIs to supplement their market risk measurement models with stress tests. Stress testing are simulations that show how a portfolio or balance sheet might perform during extreme events or highly volatile markets.

Stress testing should be designed to provide information on the kinds of conditions under which the FI's strategies or positions would be most vulnerable. Thus stress tests must be tailored to the risk characteristics of the FI. Possible stress scenarios might include abrupt changes in the general level of interest rates, changes in the relationships among key market rates (i.e., basis risk), changes in the slope and the shape of the yield curve (i.e., yield curve risk), changes in the liquidity of key financial markets, or changes in the volatility of market rates.

In addition, stress scenarios should include conditions under which key business assumptions and parameters break down. The stress testing of assumptions used for illiquid instruments and instruments with uncertain contractual maturities are particularly critical to achieving an understanding of the FI's risk profile. When conducting stress tests, special consideration should be given to instruments or markets where concentrations exist. FIs should consider also "worst case" scenarios in addition to more probable events.

Further, the Bangko Sentral will expect FIs with material market risk exposure, particularly from derivatives and/or structured products to supplement their stress testing



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

Guidelines for performing stress testing should be detailed in the risk management policy statement. Management and the board of directors should periodically review the design, major assumptions, and the results of such stress tests to ensure that appropriate contingency plans are in place.

- (3) *Model output.* Reports should be provided to senior management and the board as a basis for making decisions. Report content should be clear and straightforward, indicating the purpose of the model, significant limitations, the quantitative level of risk estimated by the simulation, a comparison to Board approved limits and a qualitative discussion regarding the appropriateness of the FI’s current exposures. Sophisticated simulations should be used carefully so that they do not become “black boxes” producing numbers that have the appearance of precision but may not be very accurate when their specific assumptions and parameters are revealed.

#### *Market limits structure*

The FI’s board of directors should set the institution’s tolerance for market risk and communicate that tolerance to senior management. Based on these tolerances, senior management should establish appropriate risk limits, duly approved by the Board, to maintain the FI’s exposure within the set tolerances over a range of possible changes in market risk factors such as interest rates.

Limits represent the FI’s actual willingness and ability to accept real losses. In setting risk limits, the board and senior management should consider the nature of the FI’s strategies and activities, past performance, and management skills. Most importantly, the board and senior management should consider the level of the FI’s earnings and capital and ensure that both are sufficient to absorb losses equal to the proposed limits. Limits should be approved by the board of directors. Furthermore, limits should be flexible to changes in conditions or risk tolerances and should be reviewed periodically.

An FI’s limits should be consistent with its overall approach to measuring market risk. At a

minimum, FIs using simple gap should establish limits on mismatches in each time bucket on a stand-alone and cumulative basis. In addition, limits should be adopted to control potential losses in the investment portfolio to a pre-set percentage of capital.

Larger, more complex FIs should establish limits on the potential impact of changes in market risk factors on reported earnings or/and the FI's economic value of equity. Market risk limits may include limits on net and gross positions, volume limits, stop-loss limits, value-at-risk limits, re-pricing gap limits, earnings-at-risk limits and other limits that capture either notional or (un)expected loss exposures. In assigning interest rate risk limits under the earnings perspective, FIs should explore limits on the variability of net income as well as net interest income in order to fully assess the contribution of non-interest income to the interest rate risk exposure of the FI. Such limits usually specify acceptable levels of earnings volatility under specified interest rate scenarios.

For example, interest rate risk limits may be keyed to specific scenarios of movements in market interest rates such as an increase or decrease of a particular magnitude. The rate movements used in developing these limits should represent meaningful stress situations taking into account historic rate volatility and the time required for management to address exposures. Limits may also be based on measures derived from the underlying statistical distribution of interest rates, such as earnings at risk or economic value-at-risk techniques. Moreover, specified scenarios should take account of the full range of possible sources of interest rate risk to the FI including re-pricing, yield curve, basis, and option risks. Simple scenarios using parallel shifts in interest rates may be insufficient to identify such risks. This is particularly important for FIs with significant exposures to these sources of market risk.

The form of limits for addressing the effect of rates on an FI's economic value of equity should be appropriate for the size and complexity of its underlying positions. For FIs engaged in traditional banking activities, relatively simple limits may suffice. However, for FIs with significant holdings of long-term instruments, options, instruments with embedded options, or other structured instruments, more detailed limit systems may be required.

Depending on the nature of an FI's holdings and its general sophistication, limits can also be identified for individual business units, portfolios, instrument types, or specific instruments. The level of detail of risk limits should reflect the characteristics of the FI's holdings including the various sources of market risk the FI is exposed to.

The Bangko Sentral also expects that the limits system will ensure that positions that exceed predetermined levels receive prompt management attention. Limit exceptions should be communicated to appropriate senior management without delay. Policies should include how senior management will be informed and what action should be taken by management in such cases.

Particularly important is whether limits are absolute in the sense that they should never be exceeded or whether, under specific circumstances, breaches of limits can be tolerated for a short period of time. The circumstances leading to a tolerance of breaches should be clearly described.

#### *Market risk monitoring and reporting*

An accurate, informative, and timely management information system is essential for managing market risk exposures both to inform management and to support compliance with board policy. Reporting of risk measures should be done regularly and should clearly compare current exposure to policy limits. In addition, past forecasts or risk estimates should be compared with actual results to identify any modeling shortcomings.

Reports detailing the market risk exposure of the FI should be reviewed by the board on a regular basis. While the types of reports prepared for the board and for various levels of management will vary based on the FI's market risk profile, they should at a minimum include the following:

1. Summaries of the FI's aggregate exposures;
2. Reports demonstrating the FI's compliance with policies and limits;
3. Summary of key assumptions, for example, non-maturity deposit behavior, prepayment information, and correlation assumptions;
4. Results of stress tests, including those assessing breakdowns in key assumptions and parameters; and
5. Summaries of the findings of reviews of market risk policies, procedures, and the adequacy of the market risk measurement systems, including any findings of internal and external auditors and retained consultants.

#### D. Risk controls and audit

Adequate internal controls ensure the integrity of an FI's market risk management process. These internal controls should be an integral part of the institution's overall system of internal control and should promote effective and efficient operations, reliable financial and regulatory reporting, and compliance with relevant laws, regulations, and institutional policies. An effective system of internal control for market risk includes:

1. A strong control environment;
2. An adequate process for identifying and evaluating risk;
3. The establishment of control activities such as policies, procedures, and methodologies;
4. Adequate information systems;

5. Continual review of adherence to established policies and procedures; and
6. An effective internal audit and independent validation process.

Policies and procedures should specify the approval processes, exposure limits, reconciliations, reviews, and other control mechanisms designed to provide a reasonable assurance that the institution's market risk management objectives are achieved. Many attributes of a sound risk management process, including risk measurement, monitoring, and control functions, are actually key aspects of an effective system of internal control. FIs should ensure that all aspects of the internal control system are effective, including those aspects that are not directly part of the risk management process.

An important element of an FI's internal control system is regular evaluation and review. The Banko Sentral expects that FIs will establish a process to ensure that its personnel are following established policies and procedures, and that its procedures are actually accomplishing their intended objectives. Such reviews and evaluations should also address any significant change that may impact the effectiveness of controls, and that appropriate follow-up action was implemented when limits were breached. Management should ensure that all such reviews and evaluations are conducted regularly by individuals who are independent of the function they are assigned to review. When revisions or enhancements to internal controls are warranted, there should be a mechanism in place to ensure that these are implemented in a timely manner.

Independent reviews of the market risk measurement system should also include assessments of the assumptions, parameters, and methodologies used. Such reviews should seek to understand, test, and document the current measurement process, evaluate the system's accuracy, and recommend solutions to any identified weaknesses. If the measurement system incorporates one or more subsidiary systems or processes, the review should include testing aimed at ensuring that the subsidiary systems are well-integrated and consistent with each other in all critical respects. The results of this review, along with any recommendations for improvement, should be reported to senior management and/or the board.

The Banko Sentral expects that FIs with complex risk exposures should have their measurement, monitoring, and control functions reviewed on a regular basis by an independent party (such as an internal or external auditor). In such cases, reports written by external auditors or other outside parties should be available to the Banko Sentral. It is essential that any independent reviewer ensures that the FI's risk measurement system is sufficient to capture all material elements of market risk, whether arising from on- or off-balance-sheet activities. Among the items that an audit should review and validate are:

1. The appropriateness of the FI's risk measurement system(s) given the nature, scope, and

complexity of its activities.

2. The accuracy and completeness of the data inputs – This includes verifying that balances and contractual terms are correctly specified and that all major instruments, portfolios, and business units are captured in the model. The review should also investigate whether data extracts and model inputs have been reconciled with transactions and general ledger systems.<sup>2</sup>
3. The reasonableness and validity of scenarios and assumptions – This includes a review of the appropriateness of the interest rate scenarios as well as customer behaviors and pricing/volume relationships to ensure that these assumptions are reasonable and internally consistent.<sup>3</sup>
4. The validity of the risk measurement calculations – The scope and formality of the measurement validation will depend on the size and complexity of the FI. At large FIs, internal and external auditors may have their own models against which the FI's model is tested. FIs with more complex risk profiles and measurement systems should have the model or calculations audited or validated by an independent source. At smaller and less complex FIs, periodic comparisons of actual performance with forecasts may be sufficient.<sup>4</sup>
5. The frequency and extent to which an FI should re-evaluate its risk measurement methodologies and models depend, in part, on the particular market risk exposures created by holdings and activities, the pace and nature of market rate changes, and the pace and complexity of innovation with respect to measuring and managing market risk.

## VI. Capital adequacy

In addition to adequate risk management systems and controls, capital has an important role to play in mitigating and supporting market risk. FIs must hold capital commensurate with the level of market risk they undertake. As part of sound market risk management, FIs must translate the level of market risk they undertake whether as part of their trading or non-trading activities, into their overall evaluation of capital adequacy. Where market risk is undertaken as part of an FI's trading activities, existing capital adequacy ratio requirements shall prevail.

The Bangko Sentral will periodically evaluate the market risk measurement system for the accrual book to determine if the FI's capital is adequate to support its exposure to market risk and whether the internal measurement systems of the FI are adequate. In performing this assessment, the Bangko Sentral may require information regarding the market risk exposure of the FI, including re-pricing gaps, earnings and economic value simulation estimates, and the results of stress tests.

This information will typically be found in internal management reports.

If an FI's internal measurement system does not adequately capture the level of market risk, the Bangko Sentral may require an FI to improve its system. In cases where an FI accepts significant market risk in its accrual book, the Bangko Sentral expects that a portion of capital will be allocated to cover this risk.

When performing these evaluations, the Bangko Sentral will determine if:

- (a) All material market risk associated with an institution's assets, liabilities, and OBS positions in the accrual book are captured by the risk management systems;
- (b) Generally accepted financial concepts and risk measurement techniques are utilized. For larger, complex FIs, internal systems must be capable of measuring risk using both an earnings and economic value approach;
- (c) Data inputs are adequately specified (commensurate with the nature and complexity of an FI's holdings) with regard to rates, maturities, re-pricing, embedded options, and other details;
- (d) The system's assumptions (used to transform positions into cash flows) are reasonable, properly documented, and stable over time;<sup>5</sup> and
- (e) Market risk measurement systems are integrated into the institution's daily risk management practices. The output of the systems should be used in characterizing the level of market risk to senior management and board of directors.

#### Footnotes

1. This Section refers to a management structure composed of a board of directors and senior management. The Bangko Sentral is aware that there may be differences in some FIs as regards the organizational framework and functions of the board of directors and senior management. For instance, branches of foreign banks have board of directors located outside of the Philippines and are overseeing multiple branches in various countries. In this case, "board-equivalent" committees are appointed. Owing to these differences, the notions of the board of directors and the senior management are used in these guidelines not to identify legal constructs but rather to label two decision-making functions within a FI.
2. It is acceptable for parts of the reconciliation to be automated; e.g., routines may be programmed to investigate whether the balances being extracted from various transaction systems match the balances recorded on the FI's general ledger. Similarly, the model itself often contains various audit checks to ensure, for example, that maturing balances do not exceed original balances.
3. Key areas of review include the statistical methods that were used to generate scenarios and assumptions (if applicable), and whether senior management reviewed and approved key assumptions. The review should also compare actual pricing spreads and balance sheet behavior to model assumptions. For some instruments, estimates of value changes can be compared with market value changes. Unfavorable results may lead the FI to revise model relationships.

4. The validity of the model calculations is often tested by comparing actual with forecasted results. When doing so, FIs can compare projected net income results with actual earnings. Reconciling the results of economic valuation systems can be more difficult because market prices for all instruments are not always readily available, and the FI does not routinely mark all of its balance sheet to market. For instruments or portfolios with market prices, these prices are often used to benchmark or check model assumptions.
5. This is especially important for assets and liabilities whose behavior differs markedly from contractual maturity or re-pricing, and for new products. Material changes to assumptions should be documented, justified, and approved by management.