



## ADVISORY BULLETIN 2006-AB-02

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*Federal Housing Finance Board  
Office of Supervision*

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**To:** Federal Home Loan Bank Chairs, Presidents, Chief Financial Officers, Chief Risk Officers, Community Investment Officers, and Directors of Internal Audit  
Managing Director of the Office of Finance

**From:** Stephen M. Cross  
Director, Office of Supervision

**Subject:** Model Documentation and Validation

**Background:**

Quantitative financial models are used by the Federal Home Loan Banks (FHLBanks) and the Office of Finance (OF) in a variety of areas including financial instrument valuation, risk measurement and control, and financial forecasting. While models are essential in managing large, complex institutions, reliance on inaccurate or inappropriate models may lead to poor or costly decisions. To mitigate model risk, each FHLBank and the OF should implement policies and procedures to ensure that quantitative models are appropriately documented and validated.

Validation is the process of determining that a model's results accurately reflect the intended use of the model. Model validation typically includes an independent review of the model's logical and conceptual soundness, a comparison of it against other competing models, and a comparison of model predictions against subsequent real-world events. Validation procedures may include the review of computer code, and/or the construction of a parallel model to replicate the model being tested. The level of documentation and frequency of validation should be commensurate with the relative importance of a model to an institution's decision-making or risk management processes. Model validation should be conducted while keeping in mind the business purpose(s) served by the model, recognizing there may be differences between market value and economic value due to factors such as bid-ask spreads, pricing conventions, and other factors.

"Mission critical" models, including trading models, hedging models, and market risk models, and those used in preparing public financial disclosures should be documented thoroughly and validated on an annual basis.<sup>1</sup> Less critical models should be documented adequately and validated in a manner that is consistent with formal policies established by FHLBank and OF management.

## **Guidance:**

Each FHLBank and the OF should have policies and procedures to ensure that its financial models are documented and validated. The level of documentation and frequency of model validation should be consistent with the importance and significance of the model to the organization's decision-making or risk management processes.

Each FHLBank and the OF should conduct an independent validation of significant financial models. All models and changes to models should be validated and approved by management before they are put into production. *Existing models that have not been validated and approved by management should be validated and approved as soon as practicable in accordance with a schedule determined by executive management.*<sup>2</sup>

Model validation should be carried out by qualified personnel who demonstrate the knowledge, skills, and experience necessary to successfully conduct the elements of a sound model validation program, as discussed below, and who are independent of the personnel who constructed the model and independent of those who operate and use the model. Validation of an internal market risk model or internal cash flow model should be performed on an annual basis or more frequently if required by the Finance Board.

Models may be validated by internal staff, external consultants, or a combination of both. More complex models and mission critical models may warrant the engagement of third-party experts to supplement internal validations. Qualified experts can bring a fresh perspective to the modeling process. When internal staff validates a model, management should ensure that the staff is qualified and independent of the staff responsible for operating or using the model. To the extent that external consultants are used in the validation process, management should consider their rotation (e.g., every three or four years) to ensure client-consultant independence.

Model validation reports should be provided to, and reviewed by, senior management and the board of directors (or to an appropriate committee of the board). The reports should be available to examiners and other Finance Board staff upon request.

### *Formal Policies*

Policies should require that model documentation be sufficient to facilitate model validation, replication, and training, *i.e.*, staff training on the model's purpose, underlying theory, mathematics, operation, and maintenance. Policies also should address the retention and safekeeping of model inputs, model documentation, model results, and validation reports.

Before a model can enter production, it must be fully documented, validated, and approved by management. Policies should also require that model change-control procedures are in place for implementing significant changes and updates to a model. Policies should also identify those individuals responsible for ensuring adherence to procedures and processes governing documentation and validation.

## *Documentation*

Each FHLBank and the OF should maintain an up-to-date inventory of financial models in use by the organization. The documentation for each model should include:

1. A brief summary that provides a clear description of the purpose of the model and its major assumptions and limitations.
2. An operating manual or similar document that describes the model's inputs, assumptions, underlying theory, mathematics, output reports, and risk metrics. The manual should also describe the procedures used to operate, maintain, and update the model. The manual should be sufficiently detailed to enable a qualified third-party to independently operate and maintain the model.
3. Procedures for checking the accuracy, reliability, and reasonableness of the model's input, assumptions, and output.
4. For internally developed models, an annotated copy of the model's computer code.
5. Procedures for controlling access to the model and, where appropriate, access to the model's computer code. The documentation should contain a list of personnel responsible for operating and maintaining the model. The list should identify each person's responsibilities. For internally developed models, the procedures should identify those individuals who have responsibility for maintaining and changing the model's computer code and who have the authority to change the code. The documentation should also describe the procedures for changing the code. Change-control procedures should ensure that the code cannot be altered except by approved parties.
6. A change-control log that lists all changes to the model, when they were made, and who made, reviewed and approved each change. For vendor models, the log should identify the version number of the model in use as well as the latest version of the model that is available in the marketplace.
7. Policies and procedures for record retention that specify the retention requirements for data inputs, assumptions, output reports, and model changes.

Copies of the model documentation should be stored in a safe place, preferably off-site, to facilitate disaster recovery.

## *Elements of a Sound Validation Program*

A model validation program should apply the same principles to internally developed and vendor provided models. The program should include the validation of the following four elements:

1. Data and Assumptions. A model validation program should include a review of the data and assumptions used as inputs for a model. It should also include a review of the adequacy of the controls in place to ensure the accuracy, integrity, and appropriateness of the model

inputs. Each FHLBank and the OF should have a process to evaluate the accuracy, integrity, and appropriateness of data and assumptions used as model inputs. External data should be reviewed periodically and, where possible, market data and instrument pricing data should be checked against alternative sources. Each FHLBank and the OF should have well-defined procedures for updating and validating assumptions used as model inputs. Assumptions should be evaluated for their appropriateness and reasonableness in light of current business and market conditions and other factors. Care should be taken to ensure that assumptions are supportable and accurately estimate risk. Any evaluation of the reasonableness and appropriateness of assumptions should take into consideration the prevailing industry practice with regard to the selection of assumptions for similar purposes. Modelers should be able to provide a clear rationale for their assumptions and should be able to explain and justify significant departures from industry practice. Assumptions should be reviewed by senior management on a regular basis.

2. Model Theory. A model validation should include an assessment of the statistical, financial, and/or economic theory underpinning a model. Those responsible for validation should have access to model documentation that contains a clear description of the underlying theory and logic of the model. The validation should include an assessment of whether the theory and logic underlying the model are generally accepted and supportable. With respect to vendor models, the validation should include a review of any vendor information that describes the theory and logic supporting the model and an assessment of whether the theory and logic are generally accepted and supportable.
3. Model Code and Mathematics. A model validation should examine the model's computer code and mathematical formulae, including calculations performed during data preparation in spreadsheets or other applications external to the primary model, for potential flaws in logic or coding.
4. Model Reports. A model validation should include a review of the model's output reports. Output reports should be analyzed and compared over time to assess their reasonableness and accuracy. Where possible, the output results should also be compared against those of comparable models or other benchmarks. Where possible, model results should be compared periodically to actual results, a procedure referred to as "backtesting" or "out-of-sample testing."<sup>3</sup> A model validation should also include a review of the adequacy of the audit trail documenting and supporting output reports. This audit trail should provide information on the inputs (data and assumptions) used to generate output reports.

### *Market Value Reporting*

FHLBanks should ensure that market values for assets, liabilities and off-balance sheet accounts generated by internal market risk models are independently validated and based on accurate and reliable inputs and sound valuation procedures.

Marking to market is the valuation of positions at readily available closing prices that are sourced independently. Examples of readily available closing prices include exchange prices, screen prices, or quotes from independent brokers. Positions should be marked to market where possible.

Marking to model is an alternative to marking to market when market prices are not available. It is defined as any valuation which has to be benchmarked, extrapolated, or otherwise calculated from a market input:

- Senior management should know which balance sheet accounts (financial positions) are marked-to-model. With respect to accounts that are marked-to-model, senior management should be able to identify the accounts that are subject to a high degree of valuation uncertainty. In applying mark-to-model valuations, special care should be taken to ensure that such accounts are appropriately valued.
- The appropriateness of the market inputs for the valuation process should be validated regularly. This should include a review of yield curves, other market rates, volatility inputs, data feeds, and sources of information.
- The accuracy of financial position inputs should be validated. This should include a review of terms and conditions.
- A sample of financial positions should be selected and validated. The sample should include some complex financial instruments.
- Scenario selections, including stress test scenarios, should be reviewed and assessed for reasonableness and usefulness in identifying the exposures of the institution.
- Accepted valuation methodologies should be used for financial instruments. For financial instruments that are marked-to-model, each FHLBank should maintain documentation that describes in detail how the instrument is modeled. The documentation should include a description of the methodology used to value the instrument and a description of all model inputs used to value the instrument, *i.e.*, the terms and conditions, yield curve, and assumptions.
- An independent validation report for any model used to estimate market values should include a discussion of financial instruments or positions that are difficult to value or for which the FHLBank's valuation is particularly uncertain.
- Special attention should be given to the valuation of positions that are "less liquid" or relatively illiquid. When assigning valuations to less liquid items, consideration should be given to the average volatility of bid/offer spreads, the availability of market quotes (number and identity of market makers), trading volume, and the volatility of trading volume.
- For valuation models that frequently generate values for financial instruments that are significantly different from "dealer marks" of those instruments should be reviewed carefully to determine the cause of differences. Persistent differences may be an indication of model weakness.<sup>4</sup>
- A validation report should address any known weakness of the model and any concerns relating to the accuracy and appropriateness of model inputs and assumptions used to estimate market values.

## **Principal Finance Board Contacts:**

Comments and questions on this Advisory Bulletin are welcome and should be directed to:

Anthony G. Cornyn, Senior Advisor to the Director, 202-408-2522, cornyna@fhfb.gov.

William Segal, Associate Director, Risk Modeling, 202-408 2884, segalw@fhfb.gov.

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<sup>1</sup> Section 932.5(c) of the Federal Housing Finance Board (Finance Board) regulations states that each FHLBank, post implementation of its capital plan, shall conduct, at least annually, an independent validation of its internal market risk model. 12 C.F.R. § 932.5(c). Section 932.5(c) further states that the validation may be carried out either by a qualified outside party, or by FHLBank staff not reporting to the business line responsible for conducting business transactions for the FHLBank.

<sup>2</sup> Section 932.5(d) of the Finance Board regulations states that each FHLBank shall obtain Finance Board approval of an internal market risk model or internal cash flow model, including subsequent material adjustments to the model made by the Bank, prior to the use of any model. 12 C.F.R. § 932.5(d).

<sup>3</sup> See *Supervisory Framework for the Use of Backtesting in Conjunction with the Internal Models Approach to Market Risk Capital Requirements*, Basle Committee on Banking Supervision, January, 1996.

<sup>4</sup> Some FHLBanks delay or submit and revoke periodic call report information because they reconcile the value of financial instruments derived from internal models with “dealer marks.” An ongoing model validation process that includes comparing and reconciling internal model valuations against dealer or other independent valuation sources should reduce the incidence of delay or revocation and resubmission of call reports.