



FEDERAL HOUSING FINANCE AGENCY

ADVISORY BULLETIN

AB 2018-01

SCENARIO DETERMINATION FOR MARKET RISK MODELS USED FOR RISK-BASED CAPITAL

Purpose

This Advisory Bulletin (AB) provides Federal Housing Finance Agency (FHFA) guidance for Federal Home Loan Bank (Bank) determinations of market risk scenarios that are incorporated into the Banks' internal market risk models, as required under the market risk capital requirement of the risk-based capital regulation.¹ This guidance supersedes both Advisory Bulletin 03-10, Guidance on Value-at-Risk Modeling, October 06, 2003 (as modified on July 22, 2016), and Revised Technical Guidance for Calculation of Market Risk Capital Requirement, April 25, 2013, both of which are hereby rescinded, effective as of November 1, 2018.

The capital regulation requires that a Bank's internal model use market risk scenarios that meet certain minimum requirements. Such scenarios must be satisfactory to FHFA, be historically-based, and represent changes in market environments observed over 120 business-day periods that are drawn from the period that starts at the end of the previous month and that goes back to 1978. The shocks are to be applied to the current market environment. Prior guidance has authorized the Banks to apply the historically observed changes in market environments as either proportional (percentage) shocks or "haircut" shocks (as described in AB 03-10), and to exclude scenarios that draw upon pre-1992 data (as described in the Revised Technical Guidance).

In light of recent methodological developments by FHFA for determining market risk scenarios, FHFA has determined that the continued use of either proportional shocks or haircut shocks to the Banks' internal market risk models will no longer be deemed to be satisfactory to FHFA, as required by the regulation. Instead, FHFA will now consider as satisfactory the application of absolute shocks that are subject to appropriate constraints that are designed to ensure the plausibility of the scenarios. As described below, a Bank may choose from any of the following three options: (1) use the scenarios provided by FHFA that already incorporate such constraints; (2) use the methodology developed by FHFA to implement such constraints; or (3) develop and apply a Bank version of a methodology and constraints, which must be subject to FHFA review. Given that the scenarios must be representative of periods of the greatest market stress, and that

¹ See 12 CFR § 932.5 (b)(4). FHFA has issued a proposed rule which, if adopted as a final rule, would revise and relocate the market risk capital regulations to 12 CFR § 1277.5(b)(4).

the 2008 financial crisis represents those periods, the guidance also allows Banks to exclude scenarios that draw upon pre-1998 data.

Background

Overview

In January 2001, the Federal Housing Finance Board (Finance Board), adopted a regulation governing the Banks' risk-based capital requirements, which included a market risk requirement. The rule established criteria to which a Bank must adhere in generating historically-based market risk scenarios to incorporate into the Bank's internal market risk model.

The rule requires the Banks to generate scenarios that represent changes in market interest rates, interest rate volatility (volatility), and the shape of the yield curve equivalent to those observed over 120 business-day periods of market stress going back to 1978. To do so, the Banks must measure historical changes in rates (including volatility and curve shape), and apply them as shocks to the current rate environment. There are two basic approaches for doing this: either by converting the historical rate changes to proportional changes (shocks) and then imposing the proportional shocks on the current rates; or by applying the absolute measure of changes in historical rates as shocks to the current rates.

One advantage of the proportional shock approach is that it cannot result in scenarios with implausible negative rates, whereas absolute shocks could do so when current rates are lower than the scenario historical rates. Under those same circumstances, however, converting a historical shock to a proportional shock may mute the shock to an extent that it is not very stressful, and hence not meaningful in assessing risk. In a similar fashion, should current interest rates well exceed the scenario historical rates, converting the shock to a proportional shock may effectively amplify the shock to be unreasonably stressful. Scenarios based on historical absolute rate changes are not amplified or muted. Thus, absolute shocks are not a concern in a high current rate environment.

Finance Board Permissions

In 2001, the Finance Board lacked a robust method to address the disadvantages of both the proportional and absolute shock approaches. Because interest rates in 2001 were not excessively high or low by historical standards, the Finance Board allowed that the disadvantages of using proportional shocks would be minimal for some time and, therefore, permitted the Banks to apply that approach. In 2002, the Finance Board developed the haircut method, intending to address potential disadvantages of both the proportional and absolute shock approaches, and permitted the Banks to apply that approach as an alternative to the proportional shock approach.

Recent developments have given FHFA reason to revisit its previous determinations that the use of the proportional and haircut shock approaches would be satisfactory means of generating the scenarios that are needed to comply with the market risk regulation. Specifically, the extended period of very low current interest rates has made more apparent the disadvantages of using the proportional shock approach. Also, FHFA has reviewed updated estimates of the statistical relationships that underlie the haircut method, and found them to be only weakly significant at

best, suggesting that the haircut shock approach also may be deficient. Contemporaneously with these developments, FHFA has devised a new approach, based on parsimonious factorization (PF), to address the potential disadvantages, and hence the viability, of using the absolute shock approach. FHFA staff working papers on the PF approach are available on the FHFA website and published in peer reviewed professional journals, and provide the reasoned basis for the approach FHFA is taking in this guidance.²

Scope

This Advisory Bulletin applies only to the Banks.

Guidance

Interest Rate and Market Price Scenario Construction

FHFA is rescinding AB 03-10 and will no longer deem the use of proportional or haircut measures of historical interest rate shocks to be satisfactory methods of generating the scenarios needed to comply with the market risk capital requirement. Subsequent to November 1, 2018, FHFA will consider interest rate and market price scenarios that a Bank incorporates into its internal market risk model to be satisfactory if they meet the following criteria: (1) the scenarios are based on historical absolute interest rate changes, as applied to current interest rates; (2) the historical shocks represent changes in interest rates and market conditions observed over 120 business-day periods, and the methodology to apply those shocks to current interest rates incorporates the constraints described herein; (3) the scenarios encompass shocks to interest rate volatility that reflect the historical relationship between interest rates and volatility; and (4) for assets backed by residential mortgage loans,³ the scenarios include shocks to option-adjusted spreads (OAS).

Each calendar quarter, FHFA will generate scenarios using the PF method and will make those scenarios available to the Banks. In addition, FHFA will provide the associated computer code to any Bank upon request. Thus, a Bank may either use the FHFA generated scenarios, or may use the FHFA code to generate its own scenarios for its market risk model. Alternatively, a Bank may develop its own methodology to generate the scenarios, provided that the Bank first demonstrates to FHFA that its approach also is based on absolute measures of historical shocks and includes appropriate constraints to ensure that the resulting scenarios are plausible and maintain the integrity of the historical shock in a manner that is similar to shocks produced using

² See, Bogin, Alexander N. and Doerner, William M. "Generating Historically-Based Stress Scenarios Using Parsimonious Factorization." *Journal of Risk Finance*, 15(5), 591-611, 2014. Originally published as FHFA Working Paper 13-02. <http://www.emeraldinsight.com/doi/abs/10.1108/JRF-03-2014-0036> . See also, Bogin, Alexander N., Doerner, William M., and Polkovnichenko, Nataliya, "Overlooked Market Risk Shocks: Prepayment Uncertainty and Option-Adjusted Spreads." *Journal of Fixed Income*, 26(2), 5-15, 2016. Originally published as FHFA Working Paper 15-03. <http://www.ijournals.com/doi/abs/10.3905/jfi.2016.26.2.005> .

³ For these purposes, the term "residential mortgage loans" includes those secured by both single-family and multi-family properties. Mortgage related assets that should be subject to the OAS shocks include: (1) repos, if backed by TBAs, (2) AMA mortgage loans, (3) agency securities backed by MBS, CMO, DUS, and HECM loans, (4) State Housing Agency Bonds, and (5) private label mortgage-backed securities. The only other assets that should be subject to the OAS shocks are asset-backed securities representing interests in federally guaranteed student loans.

the PF method, and are therefore reasonable ways to implement the requirements of the regulation.

Constraints to Ensure Scenario Plausibility

Stress test scenarios must represent plausible market conditions if they are to be used to estimate meaningful risk-based capital requirements. Because any method used to generate absolute shocks could produce scenarios with implausible characteristics, such as negative nominal rates, negative forward rates, and unlikely spreads between government and non-government rates, such methods must include appropriate constraints on the generation of the absolute shocks to eliminate such implausible outcomes. Such constraints, however, also should be designed in such a manner that they do not undermine the integrity of the historical representation of the interest rate shock. The PF method achieves both of those objectives because it accommodates the imposition of such constraints with only minimal effects on the integrity of the historical representation of the shock. The PF method achieves this outcome because it embeds the constraints to be considered simultaneously to the generation of the shock, rather than imposing the constraints as follow-on corrections to the shock.

Relevant Historical Observations

The current capital regulation provides that “the relevant historical observations should be drawn” from a period that begins in 1978. In 2001, when the rule was written, it was necessary to go back that far to ensure that the periods of the greatest potential market stress were included in the market risk scenarios. In 2013, FHFA permitted the Banks to use historical observations that began in 1992, reasoning that, since the 2008 financial crisis, scenarios drawing from market events of the 1980s no longer represented periods of the greatest market stress. That action was consistent with the requirement in the capital regulation that both the number of historical observations and the specific observations shall be satisfactory to FHFA. More recently, FHFA has concluded that historical data prior to 1998 lacks some of the key elements currently used to generate stress scenarios. For example, information pertaining to interest rate caps and floors, which currently is used in calculating volatility shocks, is not widely available for time periods prior to 1998. Moreover, FHFA has determined that post-1997 data is sufficient to produce appropriately robust scenarios. Consequently, FHFA will consider as satisfactory any historical observations drawn from the period that starts at the end of the month preceding the calculation date and goes back to the beginning of 1998.

Scenario Sampling

FHFA is mindful of the operational burdens that may be associated with incorporating all of the scenarios from the relevant historical period into the market risk models, and believes that it would be possible for a Bank to use an appropriately selected sample of those scenarios without compromising the quality of the model’s results. Accordingly, this bulletin will allow the Banks the option of using a sampling of scenarios to be identified by FHFA in lieu of using all of the scenarios from the relevant historical period. Periodically, FHFA will identify at least 100 historical scenarios that FHFA believes represent the most stressful shocks to market conditions, and will provide that information by letter to the Banks. FHFA will consider any market risk

model that incorporates all of those historical scenarios to be satisfactory, for purposes of the market risk capital regulation. A Bank also may include scenarios of its choosing in addition to those identified by FHFA.

One Percent Probability of Loss

The current regulation states that the market risk capital requirement shall equal the estimate of the market value of the Bank's portfolio at risk, such that the probability of a loss occurring that would be greater than the estimated loss shall be no more than one percent.⁴ The Finance Board recognized that because the scenarios are historically based, the distribution of outcomes cannot be known with certainty, and thus there is no way for a Bank to mathematically identify a number representing any given percentile of the distribution. Consequently, the Finance Board allowed the Banks to use the outcome that was associated with the scenario that was closest to the 99th percent worst scenario, in terms of rank order, as a proxy for the one percent requirement. That approach, however, would become problematic if used in connection with scenario sampling, as described above. That approach also effectively ignores information on market risk that would be contained in the tail of the distribution of outcomes. To address those shortcomings, FHFA is replacing the existing method of calculating the proxy for the one percent requirement with a method that is based on an average of worst outcomes. Accordingly, FHFA will deem a Bank's stress scenarios to be satisfactory if a Bank sets its proxy requirement based on an average of the five worst (tail) outcomes, and will not consider the previous rank-order proxy approach to be a reasonable implementation of the regulation. Periodically, FHFA will inform the Banks by letter whether and what weights are reasonable to apply to the tail outcomes in determining the average.

Stability of Implementation Considerations

A Bank's market risk management is informed not only by estimates of potential losses, but also by the trend or movement in those estimates over time. Discerning such trends is made more difficult if key aspects of the methodology are adjusted frequently or significantly over time. Such key aspects of the methodology would include, for example, the size or composition of the sample scenarios to be identified by FHFA and the method used to set the one percent probability of loss requirement based on the scenario outcomes. Consequently, FHFA will endeavor to make such adjustments only infrequently and will notify the Banks at least one full calendar quarter prior to implementing any such adjustments, unless supervisory considerations require FHFA to implement the adjustments on shorter notice.

⁴ The estimated market value loss with a one percent probability is necessarily associated with a future time horizon over which the loss is expected to occur. Because the market risk shocks to be applied by the Banks are based on six-month changes in historical rates, six months is the appropriate time horizon for the Banks to use in the model validation process, especially back-testing. Back-testing value at risk models involves comparing estimated losses with the actual losses realized at the end of the specified time horizon. This comparison identifies periods where the model overestimates value at risk or where actual losses are greater than projected levels.

Advisory bulletins communicate guidance to FHFA supervision staff and the regulated entities on specific supervisory matters. For this Advisory Bulletin, contact your respective Examiner-in-Charge if you have questions or comments.