

Other Comprehensive Income Projection for the Investment Portfolio

(Model ID #2122)

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Purpose and Use

- A. **Purpose of Model:** As part of the supervisory and regulatory stress testing exercises CCAR and DFAST, the Federal Reserve requires BNY Mellon to project the future market value (FMV) of the investment securities portfolio and report the Other Comprehensive Income (OCI) under all requested scenarios.
- B. **Areas of Use:** Other Comprehensive Income (OCI) is the unrealized gain/loss due the marked-to-market change in value of the available-for-sale (AFS) securities and impaired Held-to-Maturity (HTM) securities in the investment portfolio.
- C. **Work Stream Category:** Securities
- D. **Limitations:** The model is a vendor product and built on QRM platform:
 - There are currently no dynamic behavioral cash-flow models for credit sensitive securities including ABS, CLO, non-agency CMBS and foreign MBS available for QRM OCI valuation framework. To remediate this model limitation, ALM-IRR inputs behavioral assumptions for ABS, non-agency CMBS, CLO and foreign RMBS driving the OTTI models into the OCI valuation engine.

Background

As part of the supervisory and regulatory stress testing exercises CCAR and DFAST, the Federal Reserve requires BNY Mellon to project the market value of the investment securities portfolio and report the Other Comprehensive Income (OCI) under the required supervisory and idiosyncratic scenarios. OCI is defined as unrealized gain/loss due the marked-to-market changes in the value of available-for-sale (AFS) securities. OCI is calculated only on the Available-for-Sale (AFS) securities (including hedges) and impaired Held-to Maturity (HTM) securities in the investment portfolio. HTM securities are the portion of loss related to non-credit loss factors in securities deemed to not be AFS.

BNY Mellon uses the QRM modeling software framework (QRM) to construct its models for the supervisory and regulatory stress testing exercises. Post-tax OCI does affect the capital forecast of the Bank.

This document describes the configuration of the market value in QRM and the steps taken to achieve a strong calculation of OCI. The implemented model will be periodically checked and updated to ensure its continued accuracy and usefulness.

The initial draft for Model Risk Management was validated in May of 2014. It was subsequently tested through 3Q14 and validated on December 30, 2014. This included analysis from QRM on the Constant Hazard Rate Model FMV fix in the 2Q14 release. In May of 2015, the model was further updated to enhance the granularity of the products to which credit spread shocks were applied in the model for DFAST 2015 submission. For 2016, the model is further updated to enhance the granularity of asset class segmentation for future market value projections.

Model Specification

A. Methodology

Approach:

The OCI forecasting model requires the determination of securities portfolio future market value at every future instance determined by forecasted changes in interest rates and additional macro-economic factors including exchange rates, shocks to credit spreads, mortgage rates and the housing price index (HPI).

BNY Mellon uses the QRM-FMV framework to project the market value of the investment securities portfolio and to report the OCI for supervisory testing. The FMV configuration in QRM enables the calculation of the market value of securities at future time steps through a full revaluation, which allows BNY Mellon to report the OCI and to apply a wide range of scenarios that result in strong projections and a rich valuation process.

The FMV is configured for quarterly calculations until horizon to comply with stress testing requirements. This requires the ability to adjust for both changes in the face amount due to shifts in the outstanding balance change and in securities valued at discount in stressed scenarios.

The current market valuation model¹ (the base case scenario) provides the foundation for the OCI valuation model. The QRM software framework performs the future valuation of securities using a Monte-Carlo² simulation. The number of paths used for Monte Carlo simulation is the same as the current valuation configuration. The market price of every individual security in the portfolio is calculated at every future instant using the interest rate and macroeconomic assumptions input to the model. The forecasted value of OCI at each future point in time is calculated based on the projected net pay downs³, net amortization/accretion and investment portfolio strategy (incremental purchases, reinvestment and sale of the securities) consistent with the Balance Sheet Model.

In the current market valuation, the market price is input to the valuation engine to calculate the Option Adjusted Spreads (OAS)/Mark-to-Market (MTM) spread using the current market configuration. During future valuation, the forecasted shock to the credit spread/OAS is input to the model and the market price is determined using the projected OAS/MTM spread along with the future market configuration (interest rate, exchange rate, mortgage rate and HPI assumptions). For existing positions, the QRM FMV framework uses the current market valuation OAS/MTM spreads along with the forecasted credit spread shocks to calculate the market value at future instances. Implied market price for new volumes results from the effective yield of the representative cusip driven by the by the macroeconomic variables. The QRM framework reports mark-to-market gain/loss for each AFS security while taking into account the effect of the outstanding principal in each period⁴. AOCI needs to be reported for impaired HTM securities and AFS hedges. The QRM framework default AFS gain-loss feature does not automatically report the mark-to-market gain/loss on the off-balance sheet hedges and impaired HTM securities; thus, the fair value change at end of each quarter is normalized for principal changes in each period.

See the section on formulation for the equations, and the section on input data for a more detailed description of these inputs.

New Volume Origination: QRM Implementation using Planning Trade tickets

Incremental growth and reinvestments is implemented in the QRM framework using planning trade tickets. The QRM framework will compute a future investment portfolio with these planning scenarios and behavioral assumptions as basic constraints. QRM uses representative CUSIPs for the current investment portfolios to hold the new volume. For each CUSIP, the book value of these new volumes will be available (from model #2502); the market value will be equal to book value at the time of purchase of the new volume. The market price will be calculated using the cash flows of the CUSIP and the discount yield. Using the market value and the market price, the face amount could be calculated.

¹ shifted lognormal with path generation using Brownian Bridge with Enhanced Path Uniformity

² Monte Carlo simulations will present a variety of possible outcomes to a situation and the probability of those outcomes by using a defined range of possible data inputs to then generate a random set of numbers across this data range and produce possible outcomes from iterations of these random inputs.

³ defined the outstanding beginning balance change resulting from scheduled and unscheduled principal payments

⁴ the default AFS Gain-Loss account in QRM is modeled to output gain/loss contributions by asset type and legal entity

The discount yield for the new volume at time i equals to the underlying yield curve (e.g. Swap curve, Government Curve or MUNI curve) at quarter $t=i$ plus the credit spread of the corresponding segment for the CUSIP at quarter $t=i$.

$$\text{Discount Curve } [i] = \text{Underlying Yield Curve } [i] + \text{OAS/Credit Spread } [i]$$

QRM projects all of this at the cusip level, using representative cusips from the current investment portfolio as proxies for the future portfolio. All calculations based on strategies and governed by the macroeconomic variables and growth assumptions will happen in these representative cusips. Contractual features such as original maturity, credit rating, origination coupon, currency, country of risk and underlying properties of the structured securities (example origination LTV, age, SATO, loan type, etc. of MBS) of the representative cusip are retained for the new volume origination.

The reinvestment cusips are identified from the existing book for each security type based on the recent purchases and target purchase/reinvestment attributes (maturity/coupon/currency/country/etc.). Since the implied market price of the new volume origination depends on the OAS/MTM spread, representative cusips are identified based on the segments used for modeling credit spread forecasts.

BNY Mellon Asset Liability Management-Interest Rate Risk (ALM-IRR) works with the portfolio management group to evaluate the investment strategy for the baseline scenario and the stress scenarios. Additional details on the investment strategy are provided in Section B. The Portfolio Management group provides guidance on the general contractual features (coupon, yield, currency, country of risk) of the securities forecasted to be purchased. For each security type expected for growth/reinvestment, ALM-IRR investigates the most recent trades and selects a cusip that most closely represents the properties of the expected growth.

As an example, we assume that as of 3/31/15 Portfolio Management group forecasts purchase of a FNMA 15Y 2.5s bond with an expected duration of approximately 4.0. ALM-IRR group will list the most recent trades of all FNMA 15Y coupons and identify the cusip with a coupon of 2.5s, current duration of 4 and maturity exceeding the forecast horizon and select as a representative cusip for incremental purchase and reinvestment of FNMA 15Y run-off. In the screenshot below, we list the recent purchases of FNMA 15Y bonds and identified cusip 31417FUK2 as an appropriate choice most closely representing the features of the expected purchase in terms of the coupon (2.5s) and duration (~4.0).

| BUY/SELL | Group/Type | Trade Date | Sec Desc | CUSIP (Addin ID) | Ticker/Coupon/Maturity | Duration |
|----------|------------|------------|----------------|------------------|---------------------------|----------|
| BUY | MBS/POOL | 03/27/2015 | FNMA GOLD 30YR | 31419JES3 | FNAE7344 3.500 11/01/2025 | 2.180 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 31416XEL0 | FNAE1938 3.500 12/01/2025 | 2.180 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 31418SU80 | FNAE1939 3.500 12/01/2025 | 2.180 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 3138AABD3 | FNAH8103 3.500 03/01/2026 | 2.169 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 3138AAE54 | FNAH1055 3.500 12/01/2025 | 2.180 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 3138A7GY8 | FNAH5614 3.500 02/01/2026 | 2.169 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 31419JTP3 | FNAE7757 3.500 11/01/2025 | 2.180 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 31416XLJ7 | FNAE2128 3.500 01/01/2026 | 2.180 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 3138ASHG0 | FNAH3830 3.500 02/01/2026 | 2.169 |
| BUY | MBS/POOL | 01/15/2015 | FNMA 15YR | 3138Y8AX8 | FNAX6321 3.000 12/01/2029 | 3.452 |
| BUY | MBS/POOL | 01/16/2015 | FNMA 15YR | 3138YDT90 | FNAY0575 3.000 01/01/2030 | 3.180 |
| BUY | MBS/POOL | 01/16/2015 | FNMA 15YR | 3138EN4K2 | FNAL6225 3.000 01/01/2030 | 3.083 |
| BUY | MBS/POOL | 01/16/2015 | FNMA 15YR | 31418BNE2 | FNMA2188 3.000 02/01/2030 | 3.270 |
| BUY | MBS/POOL | 01/21/2015 | FNMA 15YR | 3138Y76L1 | FNAX6274 3.000 01/01/2030 | 3.845 |
| BUY | MBS/POOL | 02/06/2015 | FNMA 15YR | 3138Y8CE0 | FNAX6368 3.000 01/01/2030 | 4.265 |
| BUY | MBS/POOL | 02/20/2015 | FNMA 15YR | 3138Y8CY4 | FNAX6386 3.000 02/01/2030 | 3.636 |
| BUY | MBS/POOL | 02/23/2015 | FNMA 15YR | 3138Y8CZ1 | FNAX6387 3.000 02/01/2030 | 4.203 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 3138YEGN1 | FNAY1104 3.000 03/01/2030 | 4.169 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 31417A3W7 | FNAY4412 2.500 02/01/2027 | 3.832 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 31417C3H0 | FNAB6199 3.000 09/01/2027 | 3.611 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 3138WBW92 | FNAS2471 3.500 05/01/2029 | 2.834 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 3138WTPY6 | FNAT5838 3.000 05/01/2028 | 4.024 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 3138MRPX3 | FNAQ9437 3.000 12/01/2027 | 3.848 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 31417FUK2 | FNAB5685 2.500 03/01/2026 | 3.145 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 3138XTBL8 | FNAW3642 3.500 06/01/2029 | 2.834 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 3138MLGZ1 | FNAB5110 3.500 01/01/2027 | 2.858 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 31417BWV9 | FNAQ5162 2.500 05/01/2027 | 3.842 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 31417GLF1 | FNAB9325 2.500 05/01/2026 | 4.282 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 3138EN4K2 | FNAL6225 3.000 01/01/2030 | 2.979 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 3138ENLZ0 | FNAL5743 3.500 10/01/2029 | 2.803 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 3138ENL23 | FNAL5744 3.500 09/01/2029 | 2.834 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 3138ENB65 | FNAL5460 3.500 07/01/2029 | 2.834 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 3138ENLZ0 | FNAL5743 3.500 10/01/2029 | 2.803 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 3138ENL23 | FNAL5744 3.500 09/01/2029 | 2.834 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 3138ELWA7 | FNAL4240 3.500 04/01/2028 | 2.169 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 3138MB8HT3 | FNAP4711 2.500 08/01/2027 | 4.005 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 3138EGHY3 | FNAL0246 3.500 03/01/2026 | 2.180 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 3138M2C79 | FNAO9993 3.000 07/01/2027 | 3.660 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 31417BYN1 | FNAB5216 3.000 05/01/2027 | 3.559 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 31417C3H0 | FNAB8619 3.000 09/01/2027 | 3.611 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 31417FUK2 | FNAB8885 2.500 03/01/2028 | 4.109 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 31417GLF1 | FNAB8325 2.500 05/01/2028 | 4.282 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 31417BWV9 | FNAB8535 2.500 05/01/2028 | 3.842 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 3138M2C61 | FNAO9993 3.000 07/01/2027 | 3.697 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 3138M2C79 | FNAO9993 3.000 07/01/2027 | 3.660 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 3138M2C79 | FNAO9993 3.000 07/01/2027 | 3.660 |
| BUY | MBS/POOL | 03/27/2015 | FNMA 15YR | 3138WTP23 | FNAT5839 3.000 05/01/2028 | 4.023 |

New origination book value is determined either by the purchase plan for incremental growth or by the run-off amount (contractual/paydowns) for reinvestments. For reinvestments, the planning trades in QRM can be configured using expressions to target the new origination book volume equal to the run-off amount. The coupon is determined by the representative cusip but the effective yield on the new volume results from the interest rates, OAS/MTM spread and FX rate at the future instance. The market value will be equal to book value at the time of purchase of the new volume. The market price is calculated using the cash flows of the CUSIP and the discount yield. Using the market value and the market price, the face amount is determined.

Appendix C details the QRM setup, implementation test and output validation for modeling new volume originations using planning trade tickets.

Assumptions:

The behavioral assumption models for QRM FMV framework are:

- Prepayment Model for Agency MBS, CMO and Whole Loan Mortgages (ADCo Prepayment) (Model #2433) to model behavioral cashflows for Agency MBS securities
- Behavior Model for Non-Agency MBS (ADCo LDM) (Model #2434) to model Non Agency RMBS securities
- Behavior Model for CMBS (Model #2402) to model Agency CMBS
- OTTI for US ABS, Foreign RMBS, and US CMBS (Moody's) (Model #2454,) to model ABS, non-agency CMBS and International RMBS portfolio.
- BNY Mellon internal model for OTTI for Collateralized Loan Obligations (#2130), to model CLO portfolio.

All assumptions for the above listed models hold true for the OCI model. Refer to the model specific documents for detailed assumptions.

Formulation:

To calculate the OCI, the QRM framework is first configured for the planning scenario that incorporates the projected market and macroeconomic data (interest rates, exchange rate, mortgage rates, HPI) for each scenario. This planning scenario defines the spot market rate for future time steps. The QRM framework then uses this spot market rate to generate an implied forward interest rate curve for each of nine quarters into the future. Relevant macro-economic factors are input into the planning scenarios and are included in the calculation of the future valuation.

Current Market Configuration

The Current Market Configuration (the base scenario) for the analysis date is the business as usual (BAU) setup derived from QRM market services and Bloomberg. For the current valuation, the framework is configured to generate the implied forward yield curve using the shifted lognormal methodology. Documentation outlining additional details on the formulation of the shifted lognormal methodology is attached in Section D.

In the current market valuation, the market price is input to the valuation engine to calculate the OAS/MTM spread using the current market configuration.

Market Price [0] = future cash flows discounted by the discount rate

Discount rate = spot yield curve + OAS/MTM Spread [0]

Interest Rate Forecasts

The interest rate forecasts are generated by Moody's Economic scenario data (Model # 2399). Please refer to the model documentation attached in Section D for formulation details.

MUNI Curve Forecasts

For business as usual, ALM-IRR uses the US Taxable AA Muni BVal Yield Curve sourced from Bloomberg to discount municipal bond securities. Bloomberg BVal data series is relatively new with limited historical data. It was not possible to build a statistical model with limited historical data to forecast the generic discounting municipal curve consistent with the BAU process.

ALM-IRR identified multiple segments within the Municipal bond portfolio representing the different risk profile to model credit spread shocks. The historical yield data for these segments was sourced from Bloomberg using the BFV valuation model that has sufficient history. None of these curves could be used as a generic curve for discounting municipal bonds as these are used to shock the credit spread on the municipal bonds and does not align with the BAU modeling process. Another challenge with using the municipal curve for discounting is that Moody's Analytics is forecasting municipal bond spreads as a spread to the treasury.

Given the above challenges and constraints, and the ability to appropriately capture the spread move for the municipal curve, ALM-IRR will continue using the BAU Municipal curve setup for discounting but

hold it constant during the forecast horizon. To account for the shock in the total discounting yield, the applied spread shock at every forecasted period equals the sum of shock to the municipal spread and the shock to the underlying benchmark treasury curve.

Discount Curve [i] = BAU Muni curve [0] + Shock to the Benchmark UST Curve [i] +
municipal_spread_shock [i] + MTM Spread [0]

Where,

Shock to the Benchmark UST Curve [i] = UST curve[i] - UST curve[0]
municipal_spread_shock [i] =municipal_spread[i] - municipal_spread [0]

Credit Spread and Option-Adjusted-Spread Shocks

Credit Spread and OAS forecasts are modeled by Moody's for the identified credit spread segments representative of the BNY Mellon portfolio exposure and risk profile. Statistical models for the identified credit spread segments forecast the OAS/Credit spread for all the supervisory scenarios. Please refer to the appendix for more details.

For existing positions, the QRM FMV framework holds the current market valuation Option Adjusted Spreads (OAS)/Mark-to-Market (MTM) spreads constant and adds a shock derived from the planning scenario forecasts.

To input the credit spreads into the QRM framework, we calculate the shock to the spread/OAS from the spot spread. The forecasted shocks are input into the QRM FMV framework using planning scenarios. A step by step guide to setting up the spread shocks in the framework is detailed in Appendix A.

OAS/credit_spread_shock [i] =OAS/credit_spread[i] - OAS/credit_spread [0]

Where, OAS/Credit_spread [0] is the spot.

Mortgage Rates

The Federal Reserve releases the 30 year mortgage rates with the supervisory scenario description. The mortgage rates forecast is input into the AD&Co prepayment models for each scenario. AD&Co provided guidance to derive the 15Y rates from 30Y rates based on the historical relationship.

As of DFAST 2015, the Linear function provided by AD&CO to derive 15Y rates from 30Y rates was:
 $pmtg_15[i] = 1.0637 * pmtg_30[i] - 0.9151$

$pmtg_15[i] = 1.0637 * pmtg_30[i] - 0.9151$

Where, pmtg_15 is the 15Y mortgage rate and pmtg_30 is the 30Y mortgage rate

ALM-IRR consults AD&Co prior to the stress testing exercise for any revisions to the above the regression equation.

Mortgage rates are not used for discounting; it drives the behavior models for agency MBS and non-agency MBS.

FMV Calculation

To calculate the future market value at a future instance, the projected cashflows are discounted using the net discount rate at that instant. The discount curve is derived from the projected yield curve (implied forward generated at every future instance) and the OAS/MTM spread.

The discount curve for each security at quarter $t=i$ is as follows:

$$\text{Discount Curve [i]} = \text{Underlying Yield Curve [i]} + \text{OAS/MTM Spread [i]}$$

Where,

- For existing positions: OAS/Credit Spread [i] is one component of the OAS/MTM spread; the other component is the idiosyncratic spread for each security at time=0.
- For new volume: OAS/Credit Spread [i] = OAS/MTM Spread [i]

OCI Calculation on AFS

QRM directly calculated the OCI for AFS securities, as the unrealized mark-to-market Gain/Loss, for each quarter.

$$\text{Pre - tax OCI}_t = \sum_K \text{OCI}_{t,\text{account } K}$$

Where,

$\text{OCI}_{t,\text{account } K}$ is output by the default AFS gain-loss account in QRM

$$\text{After - Tax OCI}_t = \sum_K (1 - \text{Tax Rate}_{\text{legal entity } k}) \times \text{Pre - tax OCI}_{t,\text{legal entity } k}$$

OCI on Hedges

The QRM framework default AFS gain-loss feature does not automatically report the mark-to-market gain/loss on the off-balance sheet hedges; thus, the fair value change at end of each quarter is normalized for principal changes and is calculated as

$$\text{OCI}_t = [\text{MarketValue}_t * \text{FaceAmount}_{t-1}/\text{FaceAmount}_t] - [\text{MarketValue}_{t-1}]$$

Where,

$$\begin{aligned}
EndingFaceAmount_t &= Beg.FaceAmount_t + New\ Volume\ (i.\ e.\ Growth\ and\ Reinvestment) \\
&\quad - Unscheduled\ Principal\ Payment\ (i.\ e.\ prepayment\ and\ default) \\
&\quad - Scheduled\ Principal\ Payment\ (i.\ e.\ amortization\ and\ maturity)
\end{aligned}$$

For a derivative designated as hedging the exposure to variable cash flows of a forecasted transaction (referred to as a cash flow hedge), the effective portion of the derivative's gain or loss is initially reported as a component of other comprehensive income (outside earnings) and subsequently reclassified into earnings when the forecasted transaction affects earnings. The ineffective portion of the gain or loss is reported in earnings immediately.

As of 3/31/15, approximately \$7 Billion of AFS portfolio securities was hedged and qualified for FAS 133 fair value hedge accounting. To determine the OCI on total AFS portfolio including hedges, we test for the effectiveness of hedges for bonds for each scenario. The testing guideline and procedure as defined by Corporate Accounting, is to regress the price changes of the bonds on the price changes of the associated hedge for rolling 30-month periods (current month plus history). If the resulting slope is between 0.8 and 1.2, the hedge is deemed effective. Net mismatch in market value changes in securities and associated hedges is recorded to NII. ALM-IRR intends to review the hedge effectiveness procedure and guidelines with Corporate Accounting prior to every stress testing exercise.

OCI on Impaired Held to Maturity portfolio

OCI is primarily reported for the AFS portfolio, because it has the potential to be sold. OTTI is applicable to all securities in the AFS and HTM portfolios, but not in the trading accounts. If an HTM asset becomes impaired, it must go to AFS and follow the same accounting treatment. Therefore, OCI is also reported on impaired securities in the HTM portfolio. The QRM framework does not automatically report the marked-to-market gain/loss on impaired HTM securities.

The OCI on impaired HTM securities (portion of loss related to non-credit loss factors) at end of each quarter is normalized for principal changes and is calculated as

$$OCI_t = [MarketValue_t * FaceAmount_{t-1}/FaceAmount_t] - [MarketValue_{t-1}]$$

Where,

$$\begin{aligned}
EndingFaceAmount_t &= Beg.FaceAmount_t + New\ Volume\ (i.\ e.\ Growth\ and\ Reinvestment) \\
&\quad - Unscheduled\ Principal\ Payment\ (i.\ e.\ prepayment\ and\ default) \\
&\quad - Scheduled\ Principal\ Payment\ (i.\ e.\ amortization\ and\ maturity)
\end{aligned}$$

If the BHC determines that a debt security is other-than-temporarily impaired, and it intends to sell the security before its anticipated recovery, then the total amount of OTTI is written down and recognized in earnings. If it's not likely to be sold, only the credit component of OTTI (the loss attributable to the issuer's inability or unwillingness to pay) is recognized in earnings. The non-credit component, which reflects losses caused by illiquidity, fluctuating interest rates or other factors, is recognized as other comprehensive income (OCI).

Incorporating Other-than-temporary-impairment (OTTI)

For assets that are projected to have OTTI, the effect of temporary impairment needs to be incorporated into OCI. The forecasted OTTI provided by the Credit Risk Modeling group is subtracted from the book value using trade tickets (sale at market price=0 to ensure no cash equivalent is generated by the sales). If the forecasts project OTTI on specific cusips, (as observed for RMBS, ABS, International MBS and CMBS) impairment using trade tickets is modeled at the security level (OTTI on security-by-security basis). The OTTI forecasts on the bond portfolio partially impair multiple bonds. Trade tickets in QRM prorate the total impairment for a security type across all cusips of the given type. Once the effect of OTTI is factored in the QRM framework, OCI is determined as the fair value change on the decreased book value.

B. Input Data and Data Assumptions

Input Data:

The FMV will be run on the planning strategy as provided by the Portfolio Management Group, including existing volumes and new volumes (resulting from growth and reinvestment). All securities forecasted to be purchased in the future will also be fully re-valued. The following inputs will be used to create the FMV calculations in QRM as mentioned above in the Formulation section.

- Current Market Configuration (base case scenario)
- Interest Rate Forecasts
- Foreign Exchange (FX) rate forecast
- Credit Spread Shocks
- Mortgage Rates
- Housing Price Index

Current Market Configuration

The Current Market Configuration is the business as usual setup, and is the foundation and starting point for the OCI valuation model. It includes spot yield curves, rate index assumptions (mortgage rate definition) and exchange rates. For the current valuation, the framework is configured to generate the implied forward yield curve using the shifted lognormal methodology.

Data sources

The Current Market Configuration (the base scenario) for the analysis date is the business as usual setup derived from QRM market services and Bloomberg. The approach is consistent with the QRM model.

- QRM Market Service spot rates and curves are downloaded monthly. The Municipal curve is not downloaded from QRM Market Services but from Bloomberg. QRM uses a monotonic cubic spline method for yield curve bootstrapping. ALM-IRR implemented

using only the Bloomberg supplied points and allows the QRM bootstrap method to interpolate points on the curve.

- Spot FX rates are downloaded from QRM Market Services or from Bloomberg.

Controls for Integrity

The Head of IRR or his/her designee and/or senior analysts approve the base interest rate scenario. Then, an IRR analyst inputs the base forecast into the QRM framework which then calculates the current market valuation.

An independent analyst on the IRR team validates the interest rate forecast. An independent analyst on the IRR team validates the QRM framework forecast to ensure that it agrees to the forecast approved for use and for input into the model. An applicable IRR team member(s) sign off and add notes if necessary⁵.

Interest Rate Forecasts

For the supervisory stress scenarios, Moody's provides forecasts for all yield curves based on the forecast from the Federal Reserve for the baseline and stress scenarios. Moody's also collaborates with BNY Mellon in the definition of a BHC scenario. QRM then bootstraps these yield curves to create forward rates at every quarter end as part of the FMV process.

Data Sources

The relevant underlying interest rate curves include Libor/Swap curves (USD, EUR and GBP), Government curve from different countries (UST, Gilts, German Sovereigns) and the USD Muni curve. They are all directly provided by Moody's for the CCAR scenarios.

Controls for Integrity

The Head of IRR or his/her designee and/or senior analysts approve the forward interest rate scenario. Then, an IRR analyst inputs the forward interest rate forecast into the QRM framework.

An independent analyst on the IRR team validates the interest rate forecast. An independent analyst on IRR team validates the QRM framework forecast to ensure that it agrees to the forecast approved for use and for input into the model. An Applicable IRR team member(s) sign off and add notes if necessary⁶.

Foreign Exchange (FX) Rate Forecast

The relevant foreign exchange forecasts are provided by the Federal Reserve and Moody's for all the scenarios. The FX rate forecast is put into QRM using the planning scenarios.

⁵ For more information, please see the document Control Processes IRR Dec2015 (Word Document)

⁶ For more information, please see the document Control Processes IRR Dec2015 (Word Document)

Data sources

The forecast for the Foreign Exchange (FX) Rate forecast for the CCAR scenarios comes from Moody's Data.

Controls for Integrity

An independent analyst from the IRR team validates the Bloomberg FX rates. An independent analyst from the IRR team performs a validation of the data series as it is input into the framework to ensure the input has been done correctly. The applicable IRR team member signs off on the input and validation and adds notes if necessary⁷.

Credit Spread Shocks

Credit Spreads forecasts are modeled by Moody's for the identified credit spread segments representative of the BNY Mellon portfolio exposure and risk profile. The segmentation of the portfolio within asset classes follows a four-step process to ensure granularity assesses risk appropriately, and that rational spread modeling has been applied, in order to focus resources on critical exposure that may affect capital.⁸

The shocks to the credit spread/OAS from the spot position are input into the QRM framework in the planning scenario. Granular segmentation is modeled in QRM using multiple credit spread trees tied to the respective discounting yield curves.

Refer to Appendix A for a step-by-step guide on QRM implementation, including model setup for credit spread shocks.

Data Sources

Credit Spread forecasts are modeled by Moody's for the identified credit spread segments representative of the BNY Mellon portfolio exposure and risk profile. The available-for sale securities portfolio is segmented within asset classes into cohorts following a four-step process⁹ to ensure granularity assesses risk appropriately and rational spread modeling is being applied, thereby focusing resources on critical, capital-impacting exposure.

Historical market data to build statistical models is sourced from four external vendors, Bloomberg, JP Morgan Markets, Interactive Data Corp and Barclay's Live. Vendor selection was based on reviews of available data. These reviews considered reporting frequency, continuity of time series, extensiveness and consistency within a product range and alignment with market and industry and economic expectations. Historical data collected for each segment was passed on to Moody's which uses these time series to forecast stressed projections of these same spreads given BHC and Federal Reserve forecasted scenarios. During model development, variables are selected to identify core drivers which best explain the dynamic behavior of each dependent

⁷ For a more detailed description please see the document "Validate interest Rate and FX input (Word Document)

⁸ Refer to the document "Calculation Models for the Investment Portfolio's Marked-to-Market Effect on Other Comprehensive Income", Section 4.1 for details on the segmentation

⁹ Please see Appendix D for a description of the four step segmentation process.

variable (e.g. the credit spreads or OAS). Variable selection is based on a combination of economic principle, regulatory assumptions and strong theoretical underpinnings. Model development combines expert judgment and statistical optimization. All combinations of variables are tested, including lag combinations up to two quarters, to ensure the most robust and predictive models can be produced from the tested variables.¹⁰.

The table below summarizes the segmentation cohorts developed for credit spread modeling driven by the identified risk segments and the corresponding historical data sources.

¹⁰ Please see document titled 'Calculation Models for the Investment Portfolio's Marked-to-Market Effect on Other Comprehensive Income', Section 4.2 for detailed documentation on the modeling of credit spread forecasts.

| Product | Spread Mnemonic | Tag | Data Source | Ticker / Mnemonic |
|------------------------|---|---|-------------------|---|
| MBS Agency Passthrough | FNMA 15 Yr CC:Liber OAS | Agency MBS 15Y FANNIE_MAE CC | Barclays Live | FNCL 15Yr CC CC:Liber OAS |
| MBS Agency Passthrough | FNMA 15 Yr 4.5 2005:Liber OAS | Agency MBS 15Y FANNIE_MAE 4.5 2005 | Barclays Live | FNCL 15Yr 4.5 2005:Liber OAS |
| MBS Agency Passthrough | FNMA 15 Yr 4.0 2011:Liber OAS | Agency MBS 15Y FANNIE_MAE 4.0 2011 | Barclays Live | FNCL 15Yr 4.0 2011:Liber OAS |
| MBS Agency Passthrough | FHLMC 15 Yr CC:Liber OAS | Agency MBS 15Y FREDDIE_MAC CC | Barclays Live | FGCI 15Y CC CC:Liber OAS |
| MBS Agency Passthrough | FHLMC 15 Yr 4.5 2005:Liber OAS | Agency MBS 15Y FREDDIE_MAC 4.5 2005 | Barclays Live | FGCI 15Yr 4.5 2005:Liber OAS |
| MBS Agency Passthrough | FHLMC 15 Yr 5.0 2005:Liber OAS | Agency MBS 15Y FREDDIE_MAC 5.0 2005 | Barclays Live | FGCI 15Yr 5.0 2005:Liber OAS |
| MBS Agency Passthrough | FHLMC 15 Yr 5.0 2008:Liber OAS | Agency MBS 15Y FREDDIE_MAC 5.0 2008 | Barclays Live | FGCI 15Yr 5.0 2008:Liber OAS |
| MBS Agency Passthrough | FHLMC 15 Yr 4.5 2009:Liber OAS | Agency MBS 15Y FREDDIE_MAC 4.5 2009 | Barclays Live | FGCI 15Yr 4.5 2009:Liber OAS |
| MBS Agency Passthrough | FHLMC 15 Yr 4.0 2010:Liber OAS | Agency MBS 15Y FREDDIE_MAC 4.0 2010 | Barclays Live | FGCI 15Yr 4.0 2010:Liber OAS |
| MBS Agency Passthrough | GNMA 15 Yr CC:Liber OAS | Agency MBS 15Y GINNIE_MAE CC | Barclays Live | GNJO 15Yr CC CC:Liber OAS |
| MBS Agency Passthrough | FNMA 30 Yr CC CC:Liber OAS | Agency MBS 30Y FANNIE_MAE CC | Barclays Live | FNCL 30Yr CC CC:Liber OAS |
| MBS Agency Passthrough | FNMA 30 Yr 4.5 2005:Liber OAS | Agency MBS 30Y FANNIE_MAE 4.5 2005 | Barclays Live | FNCL 30Yr 4.5 2005:Liber OAS |
| MBS Agency Passthrough | FNMA 30 Yr 5.5 2006:Liber OAS | Agency MBS 30Y FANNIE_MAE 5.5 2006 | Barclays Live | FNCL 30Yr 5.5 2006:Liber OAS |
| MBS Agency Passthrough | FHLMC 30 Yr CC:Liber OAS | Agency MBS 30Y FREDDIE_MAC CC | Barclays Live | FGLMC 30Y CC CC:Liber OAS |
| MBS Agency Passthrough | GNMA 30 Yr CC:Liber OAS | Agency MBS 30Y GINNIE_MAE CC | Barclays Live | GNSF 30Yr CC CC:Liber OAS |
| MBS Agency Hybrid ARMS | FNMA, 5/1, 3.0, | Agency MBS ARM HYBRID FANNIE_MAE 3 5/1 | Barclays Live | FNMA, 5/1, 3.0, Liber OAS |
| MBS Agency Hybrid ARMS | FHLM, 5/1, 3.0, | Agency MBS ARM HYBRID FREDDIE_MAC 3 5/1 | Barclays Live | FHLM, 5/1, 3.0, Liber OAS |
| MBS Agency CMO | CMO PAC - 2Yr WAL | Agency CMO PAC | JP Morgan Markets | CMO PAC - 2Yr WAL |
| MBS Agency CMO | CMO PAC - 10Yr WAL | Agency CMO PAC | JP Morgan Markets | CMO PAC - 10Yr WAL |
| MBS Agency CMO | CMO SEQ - 2 Yr WAL | Agency CMO Sequential | JP Morgan Markets | CMO SEQ - 2Yr WAL |
| MBS Agency CMO | CMO SEQ - 10 Yr WAL | Agency CMO Sequential | JP Morgan Markets | CMO SEQ - 10Yr WAL |
| MBS Agency CMO | CMO Floaters - FloaterS / CAPs 6.5 Cap DM | Agency CMO 6.5 Floaters | JP Morgan Markets | CMO Flt - DM / 6.5 Cap |
| MBS Agency CMO | CMO Floaters - FloaterS / CAPs 7.0 Cap DM | Agency CMO 7.0 Floaters | JP Morgan Markets | CMO Flt - DM / 7.0 Cap |
| MBS Agency CMO | CMO Floaters Strips - 6.5 Cap DM | Agency CMO 6.5 Cap Passthrough Strips | Barclays Live | Floaters Conventional Strips 6.5 Cap,:DM |
| MBS Agency CMO | CMO Floaters Strips - 7.0 Cap DM | Agency CMO 7.0 Cap Passthrough Strips | Barclays Live | Floaters Conventional Strips 7.0 Cap,:DM |
| Agency CMBS | FHLMC CMBS - A2 10yr | Agency CMBS FREDDIE_MAC A2 | JP Morgan Markets | FHLMC A2 10yr Spread |
| Agency CMBS | FNMA DUS 5-10yr Spread | Agency CMBS FANNIE_MAE | JP Morgan Markets | FNMA DUS 5-10yr Spread |
| Agency CMBS | GNMA CMBS - 3.5yr | Agency CMBS GINNIE_MAE | JP Morgan Markets | GNMA Project Loans 3.5Yr Spread |
| Agency CMBS | GNMA CMBS - 12yr | Agency CMBS GINNIE_MAE | JP Morgan Markets | GNMA Project Loans 12Yr Spread |
| Non-Agency CMBS | CMBS 2005 A | Non Agency CMBS IG Senior AAA | Barclays Live | CMBS 2005 A |
| Non-Agency CMBS | CMBS 2005 AM | Non Agency CMBS Mezz Mezz AAA | Barclays Live | CMBS 2005 AM |
| Non-Agency CMBS | CMBS 2005 AJ | Non Agency CMBS Mezz Sub AAA | Barclays Live | CMBS 2005 AJ |
| Non-Agency CMBS | CMBS 10yr Mezz AA (2011-Current) Spread | Non Agency CMBS Mezz Mezz AA | JP Morgan Markets | CMBS 10yr Mezz AA (2011-Current) Spread |
| Non-Agency CMBS | CMBS 10yr AJ AA (2011-Current) Spread | Non Agency CMBS Mezz Sub AA | JP Morgan Markets | CMBS AJ AA (2011-Current) Spread |
| Non-Agency CMBS | CMBS 10yr Mezz A (2011-Current) Spread | Non Agency CMBS Mezz Mezz A | JP Morgan Markets | CMBS 10yr Mezz A (2011-Current) Spread |
| Non-Agency CMBS | CMBS 10yr BBB+ (2012-Current) Spread (Junior) | Non Agency CMBS Mezz Sub A | JP Morgan Markets | CMBS 10yr BBB+ (2012-Current) Spread |
| Covered Bonds | iBoxx \$ Canada Covered | USD Covered Bonds Canada | JP Morgan Markets | iBoxx \$ Canada Covered |
| Covered Bonds | iBoxx EUR Canada | EUR Covered Bonds Canada | JP Morgan Markets | iBoxx EUR Canada |
| Covered Bonds | iBoxx EUR GB | EUR Covered Bonds United kingdom | JP Morgan Markets | iBoxx EUR GB |
| Covered Bonds | iBoxx EUR Netherlands | EUR Covered Bonds Netherlands | JP Morgan Markets | iBoxx EUR Netherlands |
| Covered Bonds | iBoxx EUR Scandinavia | EUR Covered Bonds Scandinavia | JP Morgan Markets | iBoxx EUR Scandi |
| Agency Debentures | Agency Debentures Short | Agency Debentures spread | IDC | Agency Debentures Short |
| Agency Debentures | Agency Debentures Intermediate | Agency Debentures spread | IDC | Agency Debentures Intermediate |
| Agency Debentures | Agency Debentures Long | Agency Debentures spread | IDC | Agency Debentures Long |
| CLO | Seasoned USD (04-05 vintage) - CLU AAA Spread to 3M Libor | CLO AAA | JP Morgan Markets | Seasoned USD (04-05 vintage) - CLO AAA Spread to 3M Libor |
| ABS | Auto Fixed AAA to Swap 1 Yr | Auto ABS | JP Morgan Markets | ABS Auto Fixed AAA 1Yr Spread |
| ABS | Auto Fixed AAA to Swap 3 Yr | Auto ABS | JP Morgan Markets | ABS Auto Fixed AAA 3Yr Spread |
| ABS | ABS Credit Card Floating AAA 3 Yr | Credit Card ABS | JP Morgan Markets | ABS CC Fixed AAA 3Yr Spread |
| ABS | ABS Credit Card Floating AAA 7 Yr | Credit Card ABS | JP Morgan Markets | ABS CC Fixed AAA 7Yr Spread |
| ABS | Student Floating AAA 1y Libor | Student ABS | JP Morgan Markets | ABS Student Loans AAA 1Yr DM |
| ABS | Student Floating AAA 5y Libor | Student ABS | JP Morgan Markets | ABS Student Loans AAA 5Yr DM |
| Non-Agency RMBS | Non Agency RMBS Prime AAA | Non Agency MBS NONAGENCY_PRIME AAA | IDC | Non Agency RMBS Prime AAA |
| Non-Agency RMBS | Non Agency RMBS Alt-A AA | Non Agency MBS NONAGENCY_OTHER AA | IDC | Non Agency RMBS Alt-A AA |
| Non-Agency RMBS | Non Agency RMBS Alt-A AAA | Non Agency MBS NONAGENCY_OTHER AAA | IDC | Non Agency RMBS Alt-A AAA |
| Non-Agency RMBS | Non Agency RMBS Subprime AAA | Non Agency MBS NONAGENCY_SUBPRIME AAA | IDC | Non Agency RMBS Subprime AAA |

| Product | Spread Mnemonic | Tag | Data Source | Ticker / Mnemonic |
|------------------|--|---|---------------|--|
| Int'l RMBS | EUR Floating Coupon: Dutch RMBS: AA::Spread | EUR MBS AA Netherlands | Barclays Live | EUR Floating Coupon: Dutch RMBS: AA::Spread |
| Int'l RMBS | EUR Floating Coupon: Dutch RMBS: AAA 5-10::Spread | EUR MBS AAA Netherlands | Barclays Live | EUR Floating Coupon: Dutch RMBS: AAA 5-10::Spread |
| Int'l RMBS | EUR Floating Coupon: Irish RMBS: BBB::Spread | EUR MBS BBB Ireland | Barclays Live | EUR Floating Coupon: Irish RMBS: BBB::Spread |
| Int'l RMBS | GBP Floating Coupon: UK Prime RMBS: AAA 0-3::Spread | GBP MBS | Barclays Live | GBP Floating Coupon: UK Prime RMBS: AAA 0-3::Spread |
| Int'l RMBS | GBP Floating Coupon: UK Prime RMBS: AAA 3-5::Spread | GBP MBS | Barclays Live | GBP Floating Coupon: UK Prime RMBS: AAA 3-5::Spread |
| Int'l RMBS | GBP Floating Coupon: UK Prime RMBS: AAA 5-10::Spread | GBP MBS | Barclays Live | GBP Floating Coupon: UK Prime RMBS: AAA 5-10::Spread |
| US Corporates | BFV USD Composite AAA 1 Year | USD Corporate Bonds AAA | Bloomberg | C8801Y Index |
| US Corporates | BFV USD Composite AAA 5 Year | USD Corporate Bonds AAA | Bloomberg | C8805y Index |
| US Corporates | BFV USD Composite AAA 10 Year | USD Corporate Bonds AAA | Bloomberg | C88010y Index |
| US Corporates | BFV USD Composite AA 1 Year | USD Corporate Bonds AA | Bloomberg | C8811Y Index |
| US Corporates | BFV USD Composite AA 5 Year | USD Corporate Bonds AA | Bloomberg | C8815y Index |
| US Corporates | BFV USD Composite AA 10 Year | USD Corporate Bonds AA | Bloomberg | C88110y Index |
| US Corporates | BFV USD Composite A 1 Year | USD Corporate Bonds A | Bloomberg | C8821Y Index |
| US Corporates | BFV USD Composite A 5 Year | USD Corporate Bonds A | Bloomberg | C8825y Index |
| US Corporates | BFV USD Composite A 10 Year | USD Corporate Bonds A | Bloomberg | C88210y Index |
| US Corporates | BFV USD Composite BBB 1 Year | USD Corporate Bonds BBB | Bloomberg | C8831Y Index |
| US Corporates | BFV USD Composite BBB 5 Year | USD Corporate Bonds BBB | Bloomberg | C8835y Index |
| US Corporates | BFV USD Composite BBB 10 Year | USD Corporate Bonds BBB | Bloomberg | C88310y Index |
| EUR Corporates | EUR Europe Corporate AA BFV Yield Curve 1 Year | EUR Corporate bonds AA | Bloomberg | C6671Y Index |
| EUR Corporates | EUR Europe Corporate AA BFV Yield Curve 5 Year | EUR Corporate bonds AA | Bloomberg | C6675y Index |
| EUR Corporates | EUR Europe Corporate AA BFV Yield Curve 10 Year | EUR Corporate bonds AA | Bloomberg | C66710y Index |
| EUR Corporates | EUR Europe Corporate A BFV Yield Curve 1 Year | EUR Corporate bonds A | Bloomberg | C6701Y Index |
| EUR Corporates | EUR Europe Corporate A BFV Yield Curve 5 Year | EUR Corporate bonds A | Bloomberg | C6705y Index |
| EUR Corporates | EUR Europe Corporate A BFV Yield Curve 10 Year | EUR Corporate bonds A | Bloomberg | C67010y Index |
| EUR Corporates | EUR Europe Corporate BBB BFV Yield Curve 1 Year | EUR Corporate bonds BBB | Bloomberg | C6731Y Index |
| EUR Corporates | EUR Europe Corporate BBB BFV Yield Curve 5 Year | EUR Corporate bonds BBB | Bloomberg | C6735y Index |
| EUR Corporates | EUR Europe Corporate BBB BFV Yield Curve 10 Year | EUR Corporate bonds BBB | Bloomberg | C67310y Index |
| GBP Corporates | GBP Financials BFV Yield Curve 1 Year | GBP Corporate bonds | Bloomberg | C4001Y Index |
| GBP Corporates | GBP Financials BFV Yield Curve 5 Year | GBP Corporate bonds | Bloomberg | C4005y Index |
| GBP Corporates | GBP Financials BFV Yield Curve 10 Year | GBP Corporate bonds | Bloomberg | C40010y Index |
| Sovereign | EUR Belgian Sovereign Curve | EUR Belgian Sovereign Curve 1 Year | Bloomberg | C9001Y Index |
| Sovereign | EUR Belgian Sovereign Curve | EUR Belgian Sovereign Curve 10 year | Bloomberg | C90010Y Index |
| Sovereign | EUR France Sovereign Curve | EUR France Sovereign Curve 1 Year | Bloomberg | C9151Y Index |
| Sovereign | EUR France Sovereign Curve | EUR France Sovereign Curve 10 Year | Bloomberg | C91510Y Index |
| Sovereign | EUR Ireland Sovereign Curve | EUR Ireland Sovereign Curve 1 Year | Bloomberg | C9181Y Index |
| Sovereign | EUR Ireland Sovereign Curve | EUR Ireland Sovereign Curve 10 Year | Bloomberg | C91810Y Index |
| Sovereign | EUR Italy Sovereign Curve | EUR Italy Sovereign Curve 1 Year | Bloomberg | C9051Y Index |
| Sovereign | EUR Italy Sovereign Curve | EUR Italy Sovereign Curve 10 Year | Bloomberg | C90510Y Index |
| Sovereign | EUR Netherlands Sovereign Curve | EUR Netherlands Sovereign Curve 1 Year | Bloomberg | C9201Y Index |
| Sovereign | EUR Netherlands Sovereign Curve | EUR Netherlands Sovereign Curve 10 Year | Bloomberg | C92010Y Index |
| Sovereign | EUR Spanish Sovereign Curve | EUR Spanish Sovereign Curve 1 Year | Bloomberg | C9021Y Index |
| Sovereign | EUR Spanish Sovereign Curve | EUR Spanish Sovereign Curve 10 Year | Bloomberg | C90210Y Index |
| Sovereign | SEK Sweden Sovereign Curve | SEK Sweden Sovereign Curve 1 Year | Bloomberg | GTSEK1Y Govt |
| Sovereign | SEK Sweden Sovereign Curve | SEK Sweden Sovereign Curve 10 Year | Bloomberg | GTSEK10Y Govt |
| Municipals | BFV Muni GO AA 1 Year | Municipal Bonds AA G/O | Bloomberg | 045M1Y Index |
| Municipals | BFV Muni GO AA 5 Year | Municipal Bonds AA G/O | Bloomberg | 045M5Y Index |
| Municipals | BFV Muni GO AA 10 Year | Municipal Bonds AA G/O | Bloomberg | 045M10Y Index |
| Municipals | BFV Muni Insured A GO 1 Year | Municipal Bonds A G/O | Bloomberg | 252M1Y Index |
| Municipals | BFV Muni Insured A GO 5 Year | Municipal Bonds A G/O | Bloomberg | 252M5Y Index |
| Municipals | BFV Muni Insured A GO 10 Year | Municipal Bonds A G/O | Bloomberg | 252M10Y Index |
| Municipals | BFV US Muni Transportation AA- 1 Year | Municipal Bonds AA Rev Transportation | Bloomberg | 466M1Y Index |
| Municipals | BFV US Muni Transportation AA- 5 Year | Municipal Bonds AA Rev Transportation | Bloomberg | 466M5Y Index |
| Municipals | BFV US Muni Transportation AA- 10 Year | Municipal Bonds AA Rev Transportation | Bloomberg | 466M10Y Index |
| Municipals | BFV US Muni Utility A- 1 Year | Municipal Bonds A Rev Utility | Bloomberg | 522M1Y Index |
| Municipals | BFV US Muni Utility A- 5 Year | Municipal Bonds A Rev Utility | Bloomberg | 522M5Y Index |
| Municipals | BFV US Muni Utility A- 10 Year | Municipal Bonds A Rev Utility | Bloomberg | 522M10Y Index |
| Municipals | BFV US Muni Utility AA 1 Year | Municipal Bonds AA Rev Utility | Bloomberg | 520M1Y Index |
| Municipals | BFV US Muni Utility AA 5 Year | Municipal Bonds AA Rev Utility | Bloomberg | 520M5Y Index |
| Municipals | BFV US Muni Utility AA 10 Year | Municipal Bonds AA Rev Utility | Bloomberg | 520M10Y Index |
| Municipals | BFV US Muni Education AA 1 Year | Municipal Bonds AA Rev Education | Bloomberg | 448M1Y Index |
| Municipals | BFV US Muni Education AA 5 Year | Municipal Bonds AA Rev Education | Bloomberg | 448M5Y Index |
| Municipals | BFV US Muni Education AA 10 Year | Municipal Bonds AA Rev Education | Bloomberg | 448M10Y Index |
| Municipals | US Revenue A Muni BFV Yield Curve 1 Year | Municipal Bonds A Rev | Bloomberg | 332M1Y Index |
| Municipals | US Revenue A Muni BFV Yield Curve 5 Year | Municipal Bonds A Rev | Bloomberg | 332M5Y Index |
| Municipals | US Revenue A Muni BFV Yield Curve 10 Year | Municipal Bonds A Rev | Bloomberg | 332M10Y Index |
| Commercial Paper | BACR/6M SENIOR/SPREAD/NYCLOSE | Commercial Paper (ABCP) | Barclays Live | BACR/6M SENIOR/SPREAD/NYCLOSE |

Controls for Integrity

The BNY Mellon ALM-IRR team has a defined process to review and challenge the credit spread forecasts received from Moody's and to further benchmark against the internal model projections. The credit spread models are also independently validated by the Market Risk Modeling Group¹¹.

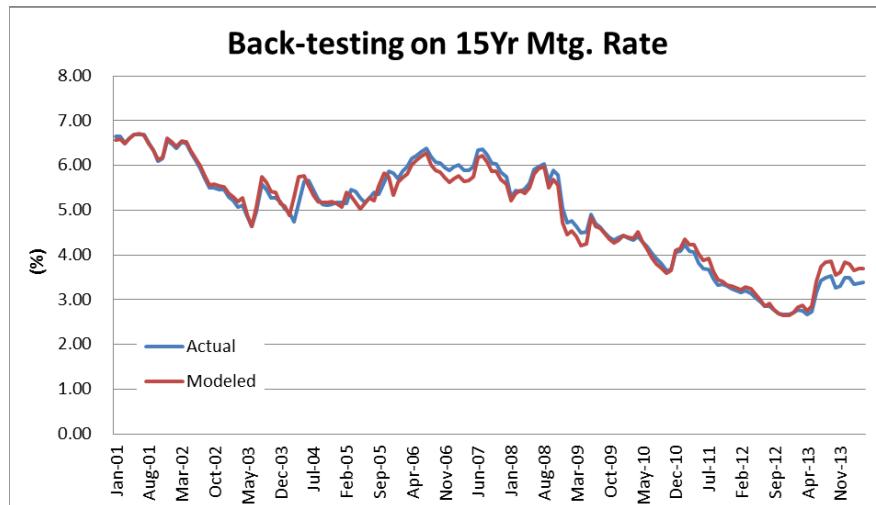
An independent analyst from the IRR team performs a validation of the credit spread shocks input into the QRM framework to ensure the input has been done correctly. The applicable IRR team member signs off on the input and validation and adds notes if necessary¹².

Mortgage Rates

Data Sources

For the Supervisory CCAR exercise, the Federal Reserve provides only the 30Y Mortgage Rate forecasts. AD&CO provided guidance on the custom currency forecast for the 15Y mortgage rate using 30Y mortgage rate (based on linear regression).

The 15Y and 30Y mortgage rates are directly fed as an input to the AD&CO prepayment models. The Model risk Management Group back-tested the mortgage rates against the Freddie Mac PMMS rate and approved the above.



Refer to [Appendix A](#) for the description on QRM implementation.

Controls for Data Integrity

An independent analyst from the IRR team performs a validation of the data series as it is input into the framework to ensure the input has been done correctly. The applicable IRR team member signs off on the input and validation and adds notes if necessary¹³.

¹¹ Details on the review and benchmark process are provided in the Section 6 of the document titled "Calculation Models for the Investment Portfolio's Marked-to-Market Effect on Other Comprehensive Income".

¹² For more information, please see the document Control Processes IRR Dec2015 (Word Document)

Housing Price Index

Data sources

The forecast for the Housing Price Index for the CCAR scenarios comes from Moody's Data. Refer to Appendix A for the description on QRM implementation.

Controls for Data Integrity

An independent analyst from the IRR team performs a validation of the data series as it is input into the framework to ensure the input has been done correctly. The applicable IRR team member signs off on the input and validation and adds notes if necessary¹⁴.

Assumptions Used as Inputs:

Investment Strategy

Data sources

The QRM OCI Valuation model forecasts have the investment portfolio strategy assumptions embedded for every scenario consistent with the BNY Mellon CCAR Balance Sheet forecasts. The projected portfolios include assumptions for the reinvestment of all asset classes as they roll off, in addition to incremental purchases of new securities and sales of existing positions. In order to incorporate reinvestments, growth and sales into the calculation for OCI, BNY Mellon ALM-IRR works with the portfolio management group to evaluate the bank operating plan for the coming year, the annual target for the portfolio, the group's assessment of coming market movements and the anticipated reactions to these movements under various scenarios. While the constraints for Liquidity Stress Testing are consulted, it is the portfolio management group that makes the final decision on the strategy, using its portfolio management policy as the guiding framework. This strategy depends on the deposit forecast dynamics under each scenario and generates the investment tactic for portfolio allocations. These investment strategies are entered into the QRM framework to inform the portfolio under all four scenarios for CCAR stress testing.

The Market Risk Oversight Group runs further OCI tests, stressing the credit spreads and yield curves under various scenarios to recalculate OCI relative to limits. If changes are suggested, BNY Mellon ALM-IRR consults again with the Portfolio Management Group and reviews the results.

Furthermore, when projections are made, Corporate Treasury first determines whether liquidity needs will affect the investment portfolio. Then, the portfolio is shocked to check the risk metrics. If OCI at the risk metrics has been breached, there may be steps taken to limit the breach. The tactics employed will vary depending on the scenarios, but if, for example, the strategy calls for a reduction, the first step could be to curb incremental growth. The second could be the change in

¹³ For more information, please see the document Control Processes IRR Dec2015 (Word Document)

¹⁴ For more information, please see the document Control Processes IRR Dec2015 (Word Document)

the reinvestment strategy. All of this would vary depending on the projected interest rates and macroeconomic environment. The portfolio management group has the final decision on potential changes to the strategies for future projections based on these stress tests.

These two above factors, deposit dynamics and OCI risk tests, are the main factors in the construction of the strategy for reinvestment, growth and sales within the investment portfolio.

Everything is entered in the QRM framework using planning trade tickets, whereby growth and reinvestments can be embedded in the forecasts. The QRM framework computes a future investment portfolio with these planning scenarios and behavioral assumptions as basic constraints. QRM calculates the future face value using the projected future market valuation to predict the price at which the security should be purchased (depending on the entered growth and reinvestment strategies). This forecasting is done monthly. The same is done for future forecasts of sales. QRM calculates the price at which the gain and loss will be realized (for NII based on accounting conventions). QRM projects all of this at the cusip level, using representative cusips from the current investment portfolio as proxies for the future portfolio. All calculations based on strategies and governed by the macroeconomic variables and growth assumptions are applied to these representative cusips.

Controls for Data Integrity

An independent analyst from the IRR team performs a validation of the data series as it is input into the framework to ensure the input has been done correctly. The applicable IRR team member signs off on the input and validation and adds notes if necessary¹⁵.

Tax Rates

Data sources

The projected AOCI by legal entity is dynamically determined by the existing positions and investment strategy under each stress scenario. To incorporate post-tax AOCI for calculating regulatory capital, the effect of tax rates is modeled with AOCI for each legal entity for each of the nine quarters to horizon. To account for these different taxation rates, the corporate taxation group provides the current tax rates for each legal entity. The projection calculates the taxation on OCI with an assumption that the tax rates are held constant for the nine quarters of forecasting, under all tested scenarios.

Controls for Data Integrity

An independent analyst from the IRR team performs a validation of the tax-rates to ensure the input has been done correctly. The applicable IRR team member signs off on the input and validation and adds notes if necessary¹⁶.

Behavioral Cash Flow Modeling

¹⁵ For more information, please see the document Control Processes IRR Dec2015 (Word Document)

¹⁶ For more information, please see the document Control Processes IRR Dec2015 (Word Document)

Data sources

Behavioral assumptions for the Agency RMBS (prepayment) and Non Agency RMBS (prepayment, default and severity) portfolio are modeled using AD&Co models. Agency CMBS is modeled using the QRM CHRM model.

Behavioral assumptions for other credit sensitive structured securities (ABS, International RMBS, CLO and CMBS) are derived from the corresponding OTTI forecasting (i.e. Model #2454 and #2130). These OTTI forecasting models are owned by the BNY Mellon Credit Risk Modeling team. Behavioral assumptions for ABS, International RMBS, CLO and CMBS are sourced from models for the OTTI framework and integrated into QRM-FMV framework for OCI calculation. The behavioral assumptions include the scenario specific prepayment, default and severity vectors from the OTTI models input into the framework at the collateral level using a custom integration DLL. The QRM sets up for the custom integration DLL to input the behavioral assumptions. Implementation test and output validation are detailed in Appendix B.

The Agency MBS portfolio is not tested for impairments, while the OCI model continues to use the AD&CO prepayment model (#2433) with the scenario specific inputs. The AD&Co loan dynamic model (#2434) is used for non-agency RMBS portfolio.

Controls for Data Integrity

Controls for integrity of the cashflows from Moody's model are performed by the credit risk modeling team.

C. Calculations

BNY Mellon ALM-IRR performed implementation testing for the enhanced QRM-FMV model prior to CCAR 2016. The OCI model in the latest test run primarily focused on testing the below enhancements

- Model credit spread forecasts based on the CCAR 2016 spread segmentation
- Incorporate behavioral cash flows (prepayment, default and recovery vectors) from the OTTI models for ABS, International MBS, CLO and CMBS.
- New volume origination under stress scenarios using planning trade tickets

The test run was conducted on the March 31, 2015 portfolio, AOCI forecasted for a baseline and a stress scenario. The interest rate forecasts used for the test run were consistent with the DFAST 2015 Baseline and Adverse Scenarios, while the credit spread forecasts were built on Moody's internal scenarios. For model development, Moody's forecasted credit spreads for the CCAR 2016 segments using an internal baseline and a "protracted slump" S4 scenario. This test run was to validate the QRM setup and the output results from the new model features.

OCI was calculated for the existing portfolio and for projected new volumes (forecasted incremental purchases and reinvestments per the DFAST 2015 strategy). The AFS securities of the investment

portfolio, represented approximately 69% of the total investment portfolio managed by BNY Mellon's Corporate Treasury and had a balance of \$88 Billion (as of March 31, 2015).

As of March 31, 2015 approximately \$7 Billion of AFS portfolio securities was hedged and qualified for FAS 133 fair value hedge accounting. The bonds/hedge effectiveness was tested for each scenario and the hedges were deemed effective. To test, price changes of the bonds were regressed on price changes of the hedge for rolling 30-month periods (current month plus history). If the resulting slope was between 0.8 and 1.2, the hedge was deemed effective. The net mismatch in market value changes in securities and associated hedges was recorded to NII. This methodology was consistent with the DFAST 2015 submission and the above listed enhancements do not affect the test for hedge effectiveness.

A brief summary of the US interest rate curve forecasts in the two scenarios is tabulated below

| (in percent) | 3/31/2015 | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 |
|-------------------------|-----------|------|------|------|------|------|------|------|------|------|
| Baseline | | | | | | | | | | |
| <i>USD Swap 2Y</i> | 0.81 | 0.70 | 0.83 | 1.06 | 1.60 | 1.98 | 2.40 | 2.94 | 3.34 | 3.65 |
| <i>USD Swap 5Y</i> | 1.53 | 1.73 | 1.93 | 2.15 | 2.51 | 2.89 | 3.11 | 3.42 | 4.01 | 4.22 |
| <i>USD Treasury 10Y</i> | 1.94 | 2.67 | 2.80 | 3.15 | 3.50 | 3.75 | 3.97 | 4.10 | 4.37 | 4.66 |
| Stress Scenario | | | | | | | | | | |
| <i>USD Swap 2Y</i> | 0.81 | 0.59 | 0.63 | 0.61 | 0.46 | 0.38 | 0.37 | 0.50 | 0.57 | 0.54 |
| <i>USD Swap 5Y</i> | 1.53 | 0.79 | 0.98 | 0.94 | 0.89 | 0.83 | 0.91 | 1.02 | 1.18 | 1.26 |
| <i>USD Treasury 10Y</i> | 1.94 | 0.66 | 1.16 | 1.21 | 1.37 | 1.53 | 1.50 | 1.67 | 1.85 | 1.93 |

Detailed credit spread shock forecasts during the nine quarter horizon for the credit spread segments is tabulated in Appendix E.

The table below exhibits the projected pre-tax OCI effect in the two test scenarios simulated.

| (in mm) | PQ1 | PQ2 | PQ3 | PQ4 | PQ5 | PQ6 | PQ7 | PQ8 | PQ9 | Total |
|------------------------|----------|------------|----------|----------|----------|---------|----------|---------|---------|------------|
| Baseline | \$ (591) | \$ (18) | \$ (264) | \$ (95) | \$ (86) | \$ (28) | \$ (167) | \$ (94) | \$ (97) | \$ (1,440) |
| Stress Scenario | \$ 58 | \$ (1,123) | \$ (684) | \$ (255) | \$ (147) | \$ 55 | \$ 228 | \$ 391 | \$ 386 | \$ (1,092) |

Baseline Scenario:

The Baseline Scenario of the test run is characterized as an ‘upward outlook’ scenario defined by rising rates and widening credit spreads. Changes in market value were mostly attributed to movements in the interest rates and credit spreads. The significant loss in PQ1 is partially influenced by the rise in rates and the widening of credit spreads of the credit sensitive asset classes. The losses forecasted in initial periods are partially muted in the subsequent periods by decline in the AFS portfolio balance driven by the strategy to run-off the securities portfolio by suspending all reinvestments.

Stress Scenario:

The Stress scenario credit spread forecasting is characterized by a ‘protracted slump’ resulting in a deep recession in the initial forecast period, while the interest rate forecasts are from the DFAST 2015 Adverse scenario. We observe a sharp decline in the interest rate levels in PQ1 (10Y UST declined ~132bps and 5Y US Swap rate was 74bps lower in PQ1), resulting in significant gains. The gains affected by interest rate are offset by the losses due to the credit spread widening. Beginning PQ6 the credit spreads stabilize and start to tighten. The increase in interest rates results in a projected marked-to-market gain in the portfolio.

Since the dry run was to primarily test the implementation of credit spread modeling, the below table summarizes the AOCI driven by credit spread shocks only holding all other macroeconomic inputs such as interest rates, foreign exchange, mortgage rates and HPI constant. .

| (in mm) | Test run AOCI driven by Credit Spread Shocks | | | | | | | | | Total |
|-----------------|--|------------|----------|----------|----------|---------|----------|---------|----------|------------|
| | PQ1 | PQ2 | PQ3 | PQ4 | PQ5 | PQ6 | PQ7 | PQ8 | PQ9 | |
| Baseline | \$ (402) | \$ (14) | \$ (272) | \$ (97) | \$ (81) | \$ (20) | \$ (160) | \$ (99) | \$ (103) | \$ (1,247) |
| Stress Scenario | \$ (546) | \$ (1,106) | \$ (670) | \$ (246) | \$ (134) | \$ 69 | \$ 243 | \$ 412 | \$ 406 | \$ (1,572) |

Testing the Model

A. Analysis of the Model

The future valuation model from BlackRock Advisory services serves as a benchmark model to the QRM-FMV model. ALM-IRR engaged BlackRock advisory services in 4Q15 to perform a dry run repeat of the DFAST 2015 OCI forecasting using the same input assumptions (rates, spreads, mortgage rates and HPI) as used for regulatory submission. The BlackRock valuation engine is run on the BNY Mellon provided portfolio positions and assumptions related to macroeconomic variables including rates, credit spreads/OAS and dynamic future composition. The BlackRock¹⁷ model uses its proprietary behavioral cash flow models and independent assumptions on discounting. The tables below briefly summarize the cash flow projections and rate curve assumptions per asset type for the BlackRock model.

| Asset Type / Methodology | Structured Products | | Direct Obligations | | | Agency RMBS |
|------------------------------|---------------------------------------|-----------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| | Fixed Rate | Floating Rate | Non Callable Non OTTI | Callable Non OTTI | TTI Direct Obligation | |
| Cashflow Projection | Deterministic | Deterministic | Contractual | Lattice | Deterministic using 100% PD | Stochastic |
| Rate Curve for CF Projection | NA | Curve implied by 3M forward rates | Full yield curve at each horizon date | Full yield curve at each horizon date | Curve implied by 3M forward rates | Full yield curve at each horizon date |
| Rate Curve for Discounting | Full yield curve at each horizon date | Curve implied by 3M forward rates | Full yield curve at each horizon date |

| Asset Class | QRM-FMV Model discounting curve | BlackRock Model discounting Curve |
|--------------------------------|---------------------------------|-----------------------------------|
| Corporate Bonds, Covered Bonds | GOVT | LIBOR |

¹⁷ The details of the BlackRock Valuation model and benchmarking are documented in Section 4.5 of the document titled “Calculation Models for the Investment Portfolio’s Marked-to-Market Effect on Other Comprehensive Income”.

| | | |
|--|-------|-------|
| Municipal Obligations | munI | GOVT |
| Govt. Obligations | GOVT | GOVT |
| Structured Products including Agency MBS | LIBOR | LIBOR |

ALM-IRR performed a benchmarking analysis of the DFAST 2015 submission to the BlackRock results and attributed the variances. QRM-FMV and BlackRock (BRS) modeling was compared for the existing positions using a bottom-up approach. BRS OCI data was aggregated at the product segmentation level, compared to QRM, and aggregated up to the total OCI. BRS also provided risk decomposition, and appropriate QRM decomposition was performed by rerunning the scenarios with only rate and only spread effects keeping all other macroeconomic factors constant. Hedges were analyzed separately because they were intertwined with hedged securities in regulatory OCI reporting, along with ineffectiveness testing where excess OCI potentially can be diverted to NII. The BlackRock model does not test for effectiveness of the FAS133 fair value hedges on securities and the net mismatch. The test was performed by ALM-IRR team using the same approach as for the QRM-FMV model. Additionally, the purpose of this model exercise is to benchmark and understand the OCI modeling for each relevant security type. Thus, the testing between the two approaches was performed at the product (unhedged) level.

Summarized below are the three DFAST 2015 scenarios and the projected OCI under these macroeconomic scenarios

Baseline Scenario: Changes in market value are mostly attributed to movements in the interest rates. The losses due to rising rates are partially muted by declines in the AFS portfolio balance because deposits run off aggressively in this rate environment and portfolio paydowns are not reinvested beginning 1Q16.

Adverse Scenario: Credit spread widening is the major cause of market value changes across all quarters. In the first quarter, the negative credit effect is largely muted by the sharp decrease in long term rates (10Y UST declined ~132bps and 5Y US Swap rate was 74bps lower in PQ1). Beginning PQ5 the credit spreads stabilize and start to tighten. The increase in interest rates results in a projected marked-to-market gain in the portfolio.

Severely Adverse Scenario: Credit spread widening dominates the significant marked-to-market changes in this recessionary scenario. Large OCI losses are projected in the first two planning quarters as credit spreads widen significantly while the forecasted interest rates do not decline as aggressively as the Adverse scenario. OCI gains are projected starting PQ5 as the credit spreads stabilize and start tightening. The charts below provide a comparison of the projected OCI between the QRM-FMV and the BlackRock models. The charts further compare the OCI due to the two primary drivers – interest rates and credit spreads.



The directional AOCI forecasts are consistent in both the models for all the three scenarios. However, the projected magnitude of loss is marginally more conservative in the BlackRock model. The differences occur at the product level and much can be attributed to the difference in behavioral modeling of securities (e.g., prepayments, defaults, amortization/accretion, discounting curves) between the two vendors.

Model Impact Analysis with the DFAST 2015 Model

BNY Mellon ALM-IRR performed impact analysis to compare the OCI projections with the DFAST 2015 submission. The DFAST 2015 asset specific credit shocks were not forecasted at the existing segmentation level; spread shocks were applied only at the asset class level and not at the same granularity as the revised segmentation for CCAR 2016.

The DFAST 2015 segmentation and spread forecast over the 9Q horizon is detailed in Appendix F. Appendix F also details the segment level variance in forecasted spread shocks between the test run and DFAST 2015 assumptions.

Baseline Scenario:

The test run baseline scenario forecasted by Moody's is a more upside scenario than the DFAST Baseline and projects a 'stronger near-term rebound'. In general, the forecasted spreads for the test run are wider than the DFAST 2015 forecasts, resulting in larger losses. As observed from the detailed variances tabulated in Appendix F Table 3, the average spread over the 9Q is substantially higher for CMO, CMBS, agency debentures and covered bonds. This portfolio represents a significant proportion of the market value and spread duration exposure of the AFS portfolio. The higher credit spread forecasts on the credit sensitive portfolio results in higher AOI in the test run in comparison to the DFAST forecast.

Stress Scenario:

The forecasted spread shocks in the stress scenario compared to the DFAST forecasts are narrower for a large proportion of the AFS portfolio, partially offset by the marginally wider spreads for agency MBS portfolio. As spreads start recovering starting PQ6, the narrower spreads drive lower gains. The net OCI effect in DFAST was muted because the losses in the first four quarters were majorly offset by the gain starting PQ5. In the test run, the losses driven by credit spreads continue until PQ5 followed by OCI gain in the remaining forecast quarters. The two stress scenarios are not directly comparable

- DFAST 2015 Adverse scenario is an idiosyncratic scenario resulting in deep recession with recovery forecasted starting PQ6.
- Moody's S4 scenario is a downside 4% scenario projecting a "protracted slump" resulting in a deep recession in the initial forecast period. This is not an idiosyncratic scenario

| (in mm) | AOI driven by Credit Spread Shocks | | | | | | | | | Total |
|------------------------|------------------------------------|------------|----------|----------|----------|---------|----------|---------|----------|------------|
| | PQ1 | PQ2 | PQ3 | PQ4 | PQ5 | PQ6 | PQ7 | PQ8 | PQ9 | |
| Baseline | | | | | | | | | | |
| Test Run | \$ (402) | \$ (14) | \$ (272) | \$ (97) | \$ (81) | \$ (20) | \$ (160) | \$ (99) | \$ (103) | \$ (1,247) |
| DFAST 2015 | \$ (105) | \$ (99) | \$ 91 | \$ (125) | \$ (125) | \$ (51) | \$ (25) | \$ (53) | \$ (90) | \$ (583) |
| Stress Scenario | | | | | | | | | | |
| Test Run | \$ (546) | \$ (1,106) | \$ (670) | \$ (246) | \$ (134) | \$ 69 | \$ 243 | \$ 412 | \$ 406 | \$ (1,572) |
| DFAST 2015 Adverse | \$ (866) | \$ (739) | \$ (433) | \$ (233) | \$ 339 | \$ 435 | \$ 424 | \$ 303 | \$ 209 | \$ (560) |

Assumption Validity

Not Applicable.

The assumptions made for OCI are all from the upper stream models; there is no additional assumption made in the future market value calculation.

Parameter Sensitivity

IRR performed an extended OCI sensitivity test to the risk factors for various latitudes as listed below:

- Credit Spread: Parallel shocks to all credit spreads by ± 100 bps
- Yield Curve: Parallel shift to all yield curves by ± 10 bps, ± 50 bps and ± 100 bps
- Mortgage Rate: Parallel shocks to all mortgage rate by $+50$ bps and $+100$ bps
- HPI: Change HPI relatively -5%, -10%

Sensitivity testing for credit spread was performed with the CCAR 2016 implementation test run conducted in 4Q15. Since the model enhancements do not have a material effect on the sensitivity to the other parameters (yield curves, mortgage rates and HPI), no additional sensitivity analysis was performed.

Credit Spread: Credit spread sensitivity test was conducted on the March 31, 2015 portfolio for the Baseline Scenario. The approximate 3/31/15 spread 01 for the AFS portfolio valued during the test run was ~17.5mm.

The market value change under the different scenarios of credit spread sensitivities were in line with the credit duration of the AFS portfolio. An additional shock of $+\/-100$ bps was applied to the credit sensitive securities. We observed higher OCI losses as the spreads widened and gains when the spreads tightened.

| CS Shock Analysis | | | | | |
|-------------------|---------|---------|-----------|------------|-----------|
| in mm's | PQ1 | Diff | Spot CS01 | bps Change | MV Change |
| Base | (394) | | | | |
| CS Dn 100bps | 1,239 | 1,634 | 17.57 | -100 | 1,757 |
| CS Up 100bps | (2,010) | (1,615) | 17.57 | 100 | (1,757) |

The sensitivity test for yield curve, mortgage rates and HPI was conducted on the CCAR 2014 Fed Baseline scenario during model development in 2014. The results for Baseline are summarized below and were deemed satisfactory.

Yield Curve: The 9/30/13 AFS portfolio (ex-CMBS) has a DV01 of ~17.66mm. The net OCI effect on the bps change in the yield curve was in line with the expected change¹⁸. The yield curve shocks affect the discount curve used for valuation. At the account level, the Market Value for fixed rate securities changed more than the face value (additional yield curve shocks do not affect amortization/prepayments) but the face amount delta was much more significant for floaters; prepayments react to yield curve shocks.

| OCI (\$ in mm) | 12/31/2013 | 3/31/2014 | 6/30/2014 | 9/30/2014 | 12/31/2014 | 3/31/2015 | 6/30/2015 | 9/30/2015 | 12/31/2015 |
|----------------|------------|-----------|-----------|-----------|------------|-----------|-----------|-----------|------------|
| Base | \$ (238) | \$ (301) | \$ (282) | \$ (159) | \$ (104) | \$ (321) | \$ (84) | \$ (230) | \$ (188) |
| YC Dn 100 | \$ 1,289 | \$ (331) | \$ (283) | \$ (125) | \$ (140) | \$ (209) | \$ (70) | \$ (163) | \$ (232) |
| YC Dn 50 | \$ 561 | \$ (328) | \$ (285) | \$ (140) | \$ (131) | \$ (274) | \$ (76) | \$ (198) | \$ (210) |
| YC Dn 10 | \$ (76) | \$ (306) | \$ (281) | \$ (157) | \$ (111) | \$ (313) | \$ (83) | \$ (224) | \$ (192) |
| YC Up 10 | \$ (403) | \$ (295) | \$ (282) | \$ (162) | \$ (98) | \$ (330) | \$ (84) | \$ (236) | \$ (182) |
| YC Up 50 | \$ (1,059) | \$ (274) | \$ (282) | \$ (169) | \$ (71) | \$ (362) | \$ (89) | \$ (260) | \$ (163) |
| YC Up 100 | \$ (1,878) | \$ (245) | \$ (272) | \$ (173) | \$ (37) | \$ (392) | \$ (91) | \$ (285) | \$ (142) |

¹⁸ Expected OCI Impact = (-DV01 * basis point shock) + ((0.5) * (convexity))

Below is the PQ1 market value change compared to the expected effect.

| PQ 1 Yield Curve Shock Analysis (ex CMBS) | | | | | | |
|---|------------|------------|----------|------------|---------------------|--|
| in mm's | 12/31/2013 | OCI Change | DV01 | bps Change | Expected OCI Change | |
| Base | \$ (238) | | | | | |
| YC Dn 100 | \$ 1,289 | \$ 1,527 | \$ 17.66 | -100 | \$ 1,766 | |
| YC Dn 50 | \$ 561 | \$ 799 | \$ 17.66 | -50 | \$ 883 | |
| YC Dn 10 | \$ (76) | \$ 162 | \$ 17.66 | -10 | \$ 177 | |
| YC Up 10 | \$ (403) | \$ (164) | \$ 17.66 | 10 | \$ (170) | |
| YC Up 50 | \$ (1,059) | \$ (821) | \$ 17.66 | 50 | \$ (848) | |
| YC Up 100 | \$ (1,878) | \$ (1,639) | \$ 17.66 | 100 | \$ (1,696) | |

Mortgage Rates: The mortgage rates only affect the prepayment speed of the mortgage securities and will affect the face amount. Shocking up mortgage rates slows down the prepayment speed and increases the outstanding balance. For OCI calculation, we normalize the Market Value for the face value and therefore do not observe much disturbance resulting from a shock to mortgage rates.

| OCI (\$ in mm) | 12/31/2013 | 3/31/2014 | 6/30/2014 | 9/30/2014 | 12/31/2014 | 3/31/2015 | 6/30/2015 | 9/30/2015 | 12/31/2015 |
|------------------|------------|-----------|-----------|-----------|------------|-----------|-----------|-----------|------------|
| Base | \$ (238) | \$ (301) | \$ (282) | \$ (159) | \$ (104) | \$ (321) | \$ (84) | \$ (230) | \$ (188) |
| MR Up 50 | \$ (228) | \$ (299) | \$ (281) | \$ (159) | \$ (105) | \$ (321) | \$ (85) | \$ (230) | \$ (189) |
| MR Up 100 | \$ (228) | \$ (299) | \$ (280) | \$ (159) | \$ (105) | \$ (321) | \$ (85) | \$ (230) | \$ (190) |

HPI: The HPI only affects the prepayment speed of the mortgage securities, which does affect the face amount. Shocking down HPI slows down the prepayment speed and increases the outstanding balance. For OCI calculation, we normalize the Market Value for face value, and therefore do not observe much effect on shocking HPI.

| OCI (\$ in mm) | 12/31/2013 | 3/31/2014 | 6/30/2014 | 9/30/2014 | 12/31/2014 | 3/31/2015 | 6/30/2015 | 9/30/2015 | 12/31/2015 |
|-------------------|------------|-----------|-----------|-----------|------------|-----------|-----------|-----------|------------|
| Base | \$ (238) | \$ (301) | \$ (282) | \$ (159) | \$ (104) | \$ (321) | \$ (84) | \$ (230) | \$ (188) |
| HPI Dn 10% | \$ (229) | \$ (301) | \$ (284) | \$ (162) | \$ (107) | \$ (324) | \$ (87) | \$ (232) | \$ (191) |
| HPI Dn 5% | \$ (229) | \$ (300) | \$ (282) | \$ (161) | \$ (106) | \$ (322) | \$ (85) | \$ (231) | \$ (189) |

Based on the sensitivity tests, it is observed that the yield curve and the credit spreads dominate the macroeconomic factors and more heavily figure in the explanation of the reactions of the OCI in the investment portfolio under stress scenarios.

Model Fidelity (Stability and Behavior)

Convergence Path Optimization

The ALM-IRR team performed tests to observe the convergence for FMV Monte Carlo Simulations during the initial phase of implementation. A sample portfolio of 14 cusips across security types (agency/non-agency MBS, agency CMO and CMBS, ABS, CDO, Municipal, International MBS) that represent the computationally intensive securities of AFS portfolio was used. The test was performed for 30, 60, 100, 200, 300 paths with 10 seeds for each path. The 300 simulations were used as the benchmark because it is used for the current valuation. The convergence was observed for BPV, Convexity and Option Cost, and the results show 100 paths as optimal for FMV Monte-Carlo simulations. *It was decided to use same number of path as current valuation (300 paths) in production until a new set of results are available.*

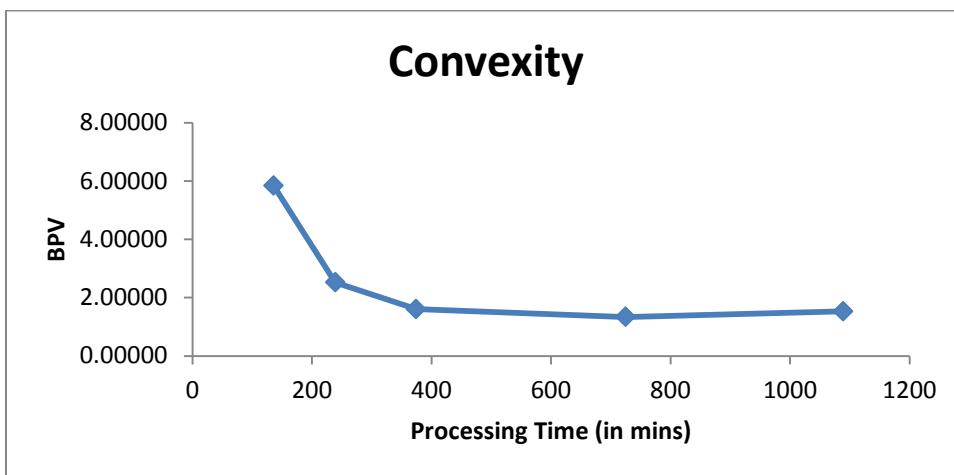
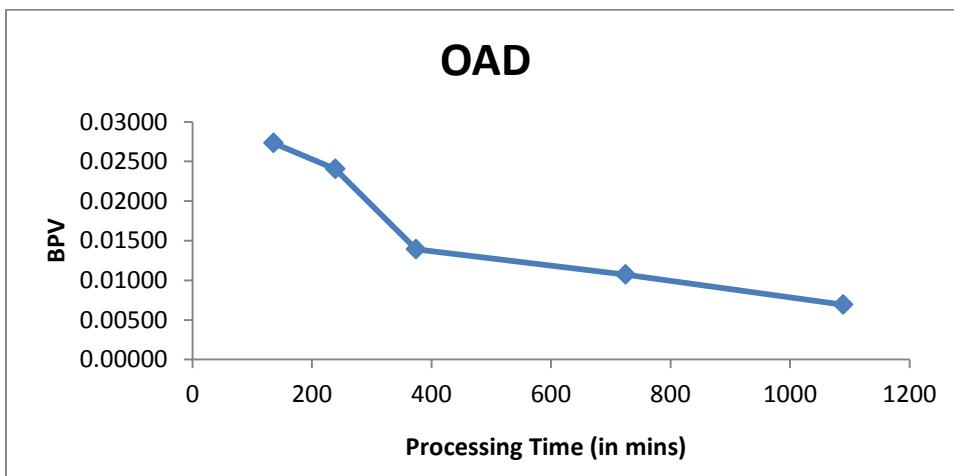
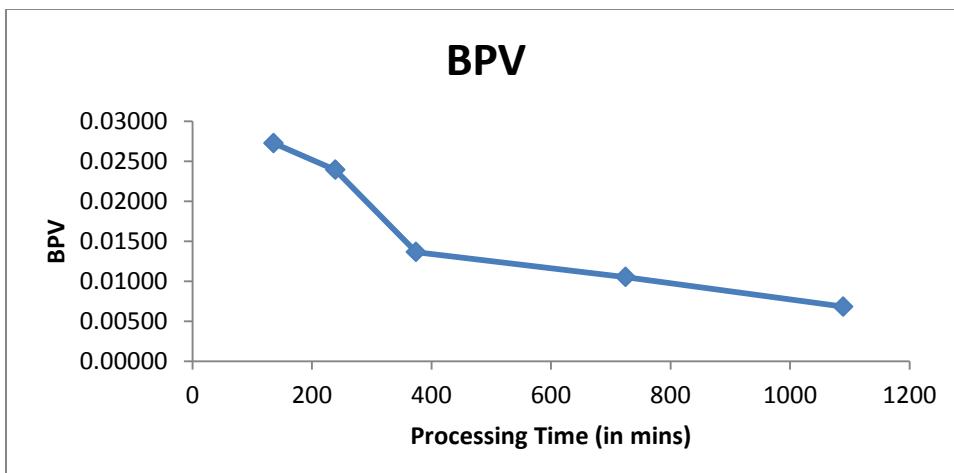
Sample Portfolio:

| CUSIP/ISIN | Account | Description |
|--------------|--------------------|-----------------------|
| 44921QAC0 | Auto ABS | HFMOT_13-1A-B |
| 3128S5TR5 | FHLMC Hybrid Fixed | FH 10/1 12M Libor ARM |
| 3138W2HQ1 | FNMA Hybrid Fixed | FN 7/1 12M Libor ARM |
| 3136AEX69 | Agency CMBS | FNMA 2.389 01/25/2023 |
| 3137B4GY6 | Agency CMBS | FHSM 3.31 05/25/2023 |
| 3128HX5D3 | CMO | FHSTR_277G-F6 |
| 31414EWD2 | FNMA ARM Float | FNMA 1Y TSY ARM |
| 3138LY4H7 | MBS | FNMA 30YR |
| 36176HP32 | MBS | GNMA2 30YR |
| 312940UL1 | MBS | FGOLD 30YR |
| 05952FAA1 | Prime MBS | BOAMS_07-2 A1 |
| 544495A95 | MUNI | 1/1/2025 expiry |
| XS0291723400 | INTL MBS | EUR |
| XS0843322594 | INTL MBS | GBP |

Below are the results for one of the sample cusips used for the test

CUSIP: 3137B4GY6

| Random Number Generator Seed | BPV | OAD | Convexity |
|------------------------------|-------------|-------------|-------------|
| 30 | 0.027257644 | 0.027330418 | 5.841284045 |
| 60 | 0.023924926 | 0.024049625 | 2.522362664 |
| 100 | 0.013639664 | 0.013910404 | 1.604968259 |
| 200 | 0.010523361 | 0.010733052 | 1.336041687 |
| 300 | 0.006817234 | 0.006923236 | 1.528145056 |



B. Analysis of Implementation

All implementation tests were performed in UAT and DEV and the test setup was available to the Model Risk Management Group for validation.

Details of the implementation test and validation of the output for the custom DLL configuration is documented in Appendix B, and for the new volume origination is documented in Appendix C.

Model Name: QRM Future Market Value/OCI

Model Owner: Randhir Ahluwalia

Model User: ALM IRR Team

Application Environment: QRM-CCAR

Vendor: Quantitative Research Management

Vendor Contact: Tyler Kirkwood (tyler.kirkwood@qrm.com)

Control Environment:

Model Implementation information from Vendor

C. Ongoing Performance Monitoring Plan

The IRR team aims to consistently monitor the model inputs, assumptions and the model outputs. The model will be deployed for the regulatory stress testing exercises semi-annually. The QRM OCI model builds on the QRM platform and uses the same behavioral¹⁹ and cash-flow models as the QRM Balance sheet model (NII Forecast & Balance Sheet Valuation #2359). The QRM balance sheet model is used for BAU processes and its outputs are subject to extensive ongoing monitoring and testing process²⁰.

For the OCI model, ALM-IRR intends to review the segmentation of OCI spread models on an annual basis to determine whether changes in portfolio composition necessitate the modeling of new portfolio segments.

BNY Mellon has benchmark models for both spread forecasting and future valuation- the internally developed models for spread forecasting and BlackRock Advisory Services' proprietary future valuation model for the QRM-FMV model. The documentation of the BlackRock model²¹ and benchmark to the QRM-FMV framework are included in the Section D.

BNY Mellon has also developed a well-defined review and challenge process to perform detailed outcome analysis and to understand the input assumptions²².

The scope for ongoing testing will include, but not limited to:

- Running the QRM-FMV configuration for the BAU process without the macroeconomic factor inputs.
- Perform sensitivity testing on the input assumptions
- Benchmark OCI spreads from Moody's models to Internal Spread models semi-annually
- Benchmark against the output of the BlackRock valuation model semi-annually.

¹⁹ For agency RMBS, non-agency RMBS and Agency CMBS

²⁰ The details of Ongoing Monitoring and testing processes for BAU process can be found in section C Ongoing Performance Monitoring Plan of document titled NII Forecast and Balance Sheet Valuation – documentation (#2359)

²¹ The details of the BlackRock model are documented in Section 4.5 of the document titled "Calculation Models for the Investment Portfolio's Marked-to-Market Effect on Other Comprehensive Income".

²² The details of the review and challenge process are documented in Section 6 of the document titled "Calculation Models for the Investment Portfolio's Marked-to-Market Effect on Other Comprehensive Income".

- Additional testing if significant variances are observed in the ongoing runs.

The Head of IRR will have his/her designee and/or senior analysts perform ongoing monitoring of the QRM-FMV framework. The results of the ongoing monitoring process will be analyzed and reviewed with the Head of IRR. Model Risk Management Group will be notified for any significant model enhancements or changes through the ‘Model change request form’ to gauge the materiality of the change. If the model changes are deemed material, model changes and output will be validated by the Model Risk Management Group.

ALM-IRR is currently working on building a more comprehensive ongoing and monitoring plan. The scope of the process would include

- Semi-annual back-testing on a given portfolio using market observed interest rates and credit spreads.
- Benchmark the OCI projections to the business-as-usual economic value of equity analysis on the available for sale investment portfolio.
- Develop thresholds for various testing parameters

The plan will be developed by the end of the year and is intended to be in production prior to CCAR 2017.

BNY Mellon ALM-IRR team has addressed all the model validation issues raised in the most recent validation report (dated 6/4/15).

D. References for Model Documentation

Reference model documents:

- AD&Co. Prepayment and Non Agency LoanDynamics Model (Model #2433 and #2434)
- QRM CHRM Model (Model #2402)
- Moody's Economic scenario data (Model # 2399)

Attached supporting documents

- Master OCI document – “Calculation Models for the Investment Portfolio’s Marked-to-Market Effect on Other Comprehensive Income”
- QRM Shifted Lognormal model (Attached)
- BlackRock OCI Modeling framework (Attached)

E. Change Log

| Date | Section | Description of Change | Validation of Change | Validation Date |
|---------|----------|--|----------------------|-----------------|
| 7/27/14 | Original | Initial Draft for Model Implementation | Full Scope | 5/30/2014 |

| | | | | |
|----------|----------------------|--|--|------------|
| 8/31/14 | Testing the Model | v2. Includes analysis from QRM Constant Hazard Rate Model fixed in Q2 2014 release | Review the CHRM model fix | 12/30/2014 |
| 10/31/14 | N.A | v3. Document updated with analysis on Municipal Curve | | 12/30/2014 |
| 5/19/15 | Model Specifications | v4. Model updated to describe the enhances credit spread shocking modeling, using the default AFS gain/loss account and output results from DFAST 2015 analysis. | Assess Credit spread appropriateness Review Impact Analysis Approval for enhanced implementation | 6/4/15 |
| 12/31/15 | All Sections | 1. Documentation updated with the new template compliant with the policy. 2. Updated credit spreads shocks methodology and output analyses 3. Included sections on OTTI, hedges, investment strategy and tax | Approval for enhanced credit spread modeling Review Net impact analysis | 3/25/2016 |
| 3/15/16 | Appendix G | Updated for CCAR 2016 credit spread forecasts | Approval for documentation | 3/25/2016 |

Access Controls

Akshat Mittal

Randhir Ahluwalia

F. Appendix A: Model Configuration in QRM²³

Follow these steps to calculate Future Market Value in the Framework.

1. Before logging into the Framework, navigate to the client folder associated with the database that this test will be run in. If there is an analysis.sys already in the client folder, please add the line below to the file. If an analysis.sys file does not exist, open a text file and insert the following line and save

²³ The configuration was directly provided by the vendor

the text file to the client folder (ensuring that a .sys file extension is used in place of a .txt file extension).

DISTRIBUTEDFUTUREMARKETVALUEPROCESSMULTIPLE = 40

This setting will trigger the Framework to distribute the FMV calculation to 40 processors. We will use the log file generated from this run to determine whether it is appropriate to use more of your CPUs or fewer for your production FMV runs.

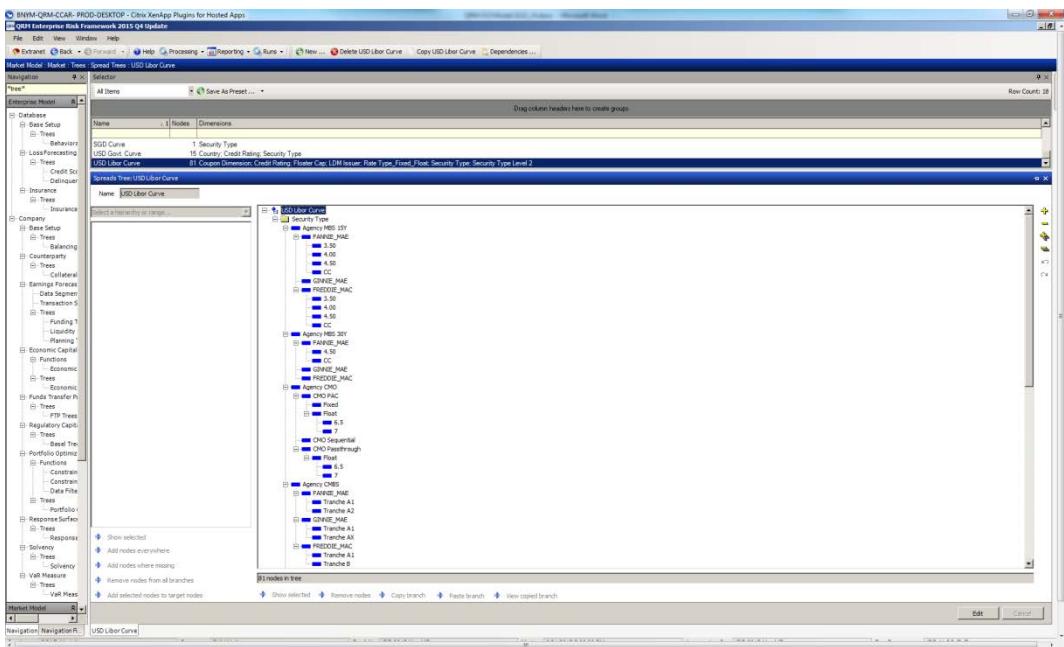
2. Verify that there is a strategy created in Enterprise Model/Portfolio/Earnings Forecasting/Strategies. This can be one of your regular production strategies.
3. Navigate to Properties/Analytics Options in the Strategy tree.
4. Click Edit.
5. Select calculate Future Market Values.
6. Navigate to Properties/Output Options/Balance Sheet and Income
7. Select Future Market Value to output Future Market Value results.
If this option is not selected, Future Market Value analysis will still take place (e.g. gain/losses will be accurately captured), but FMV results will not be output.
8. Click Save.
9. Navigate to Processing/Current Run Parameters/Modes of Analysis in the toolbar. Select Analytics Settings under Future Valuation.
10. Click Edit.
11. Specify the frequency of the future value calculation.

For Supervisory Stress Testing, the typical setting is “Quarterly until horizon.”

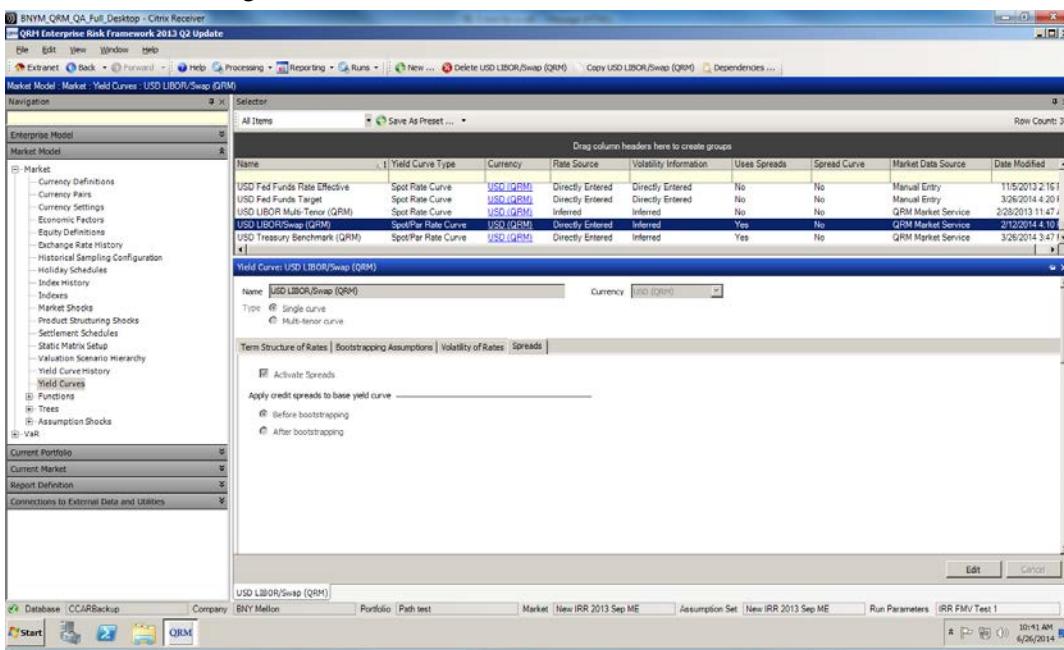


12. Click Save.
13. Navigate to Processing/Current Run Parameters/Yield Curve Models in the toolbar.
14. Select Future Valuation under Monte Carlo Settings for Pricing and Currency.
Verify that you've made the appropriate yield curve modeling selections. Select the number of Monte Carlo paths you wish to use for your analysis.
15. Navigate to Processing/Current Run Parameters/Modes of Analysis in the toolbar.
16. Select Scenario Selection under Future Valuation.
17. Click Edit.
18. Select the Market Shocks that you want to include in future market valuation. Click Save.

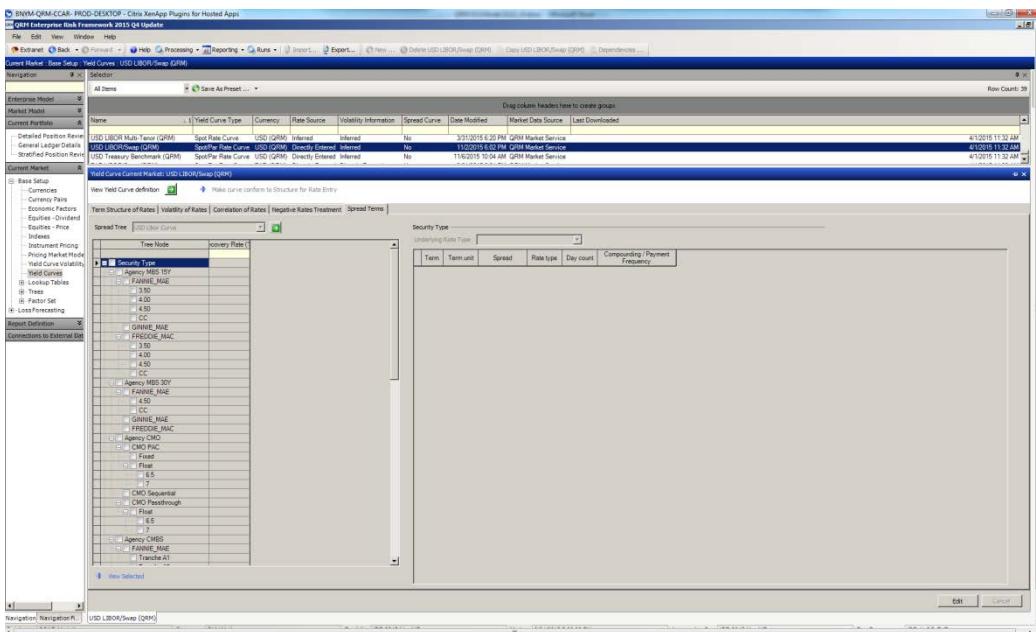
19. Navigate to Processing/Process Control Panel in the Toolbar to run the planning process.
 20. Verify that the strategy with Future Market Value activated is included in the run.
- For purposes of this test, please ensure to only select ONE strategy and scenario combination to process at first. This will provide us with our baseline memory usage.
21. Once analysis is completed, please send us the monitor log file from the run. You can also navigate to Reporting/Export Report Books and export the Planning/Future Market Value and Detailed Forecast Audit report (for the security type contributions to AFS Asset Gain/Loss account).
- I. Activating Credit Spread Shocks Configuration in QRM
- To apply credit spread shocks specific to the security type and its credit rating, multidimensional spread tree was created. Trees were created specific to the currency and attached to the corresponding currency yield curve.
1. Create Global Discrete Dimensions specific to the segmentation (security type, coupon dimension, country, rate_type_fixed_float, floater cap). Assign the hierarchy and members: Enterprise Model/Database/Base Configuration/Properties & Dimensions/ Global Discrete Dimensions
 2. Activate all the relevant dimension for all the required products (Enterprise Model/Database/Base Configuration/Product/ Products -> Instrument Parameters)
 3. Create Spread Trees using the relevant dimensions all required hierarchy members to represent the granular segmentation. Each spread tree is specific to the discounting yield curve.



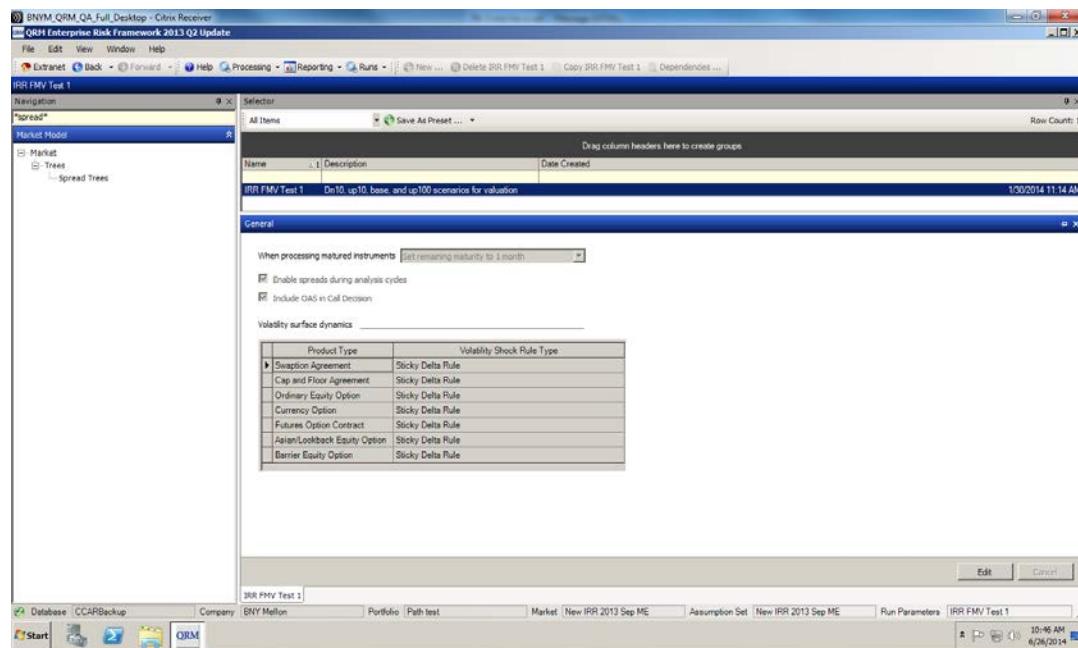
4. Activate Spreads for the appropriate yield curves (Market Model/Market/Yield Curves). Select the option for applying credit spread to base yield curve ‘Before bootstrapping’. This is QRM’s recommended setting.



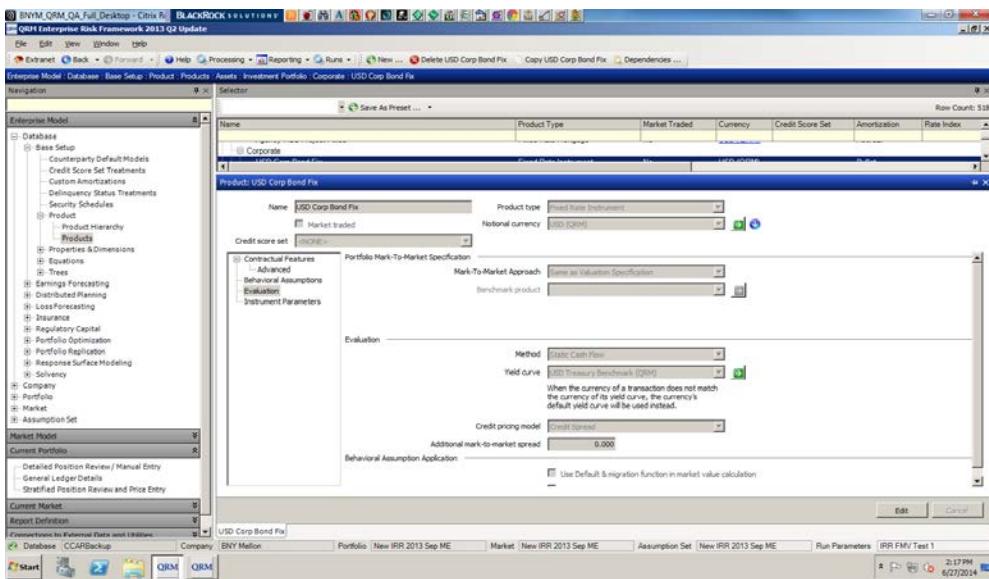
5. Select the Spread Tree (created in step 3) for the activated yield curve. (Current Market/Base Configuration/Yield Curves)



6. Enable Spreads during Analysis Cycle.(Processing/Current Run Parameters/Modes of Analysis)

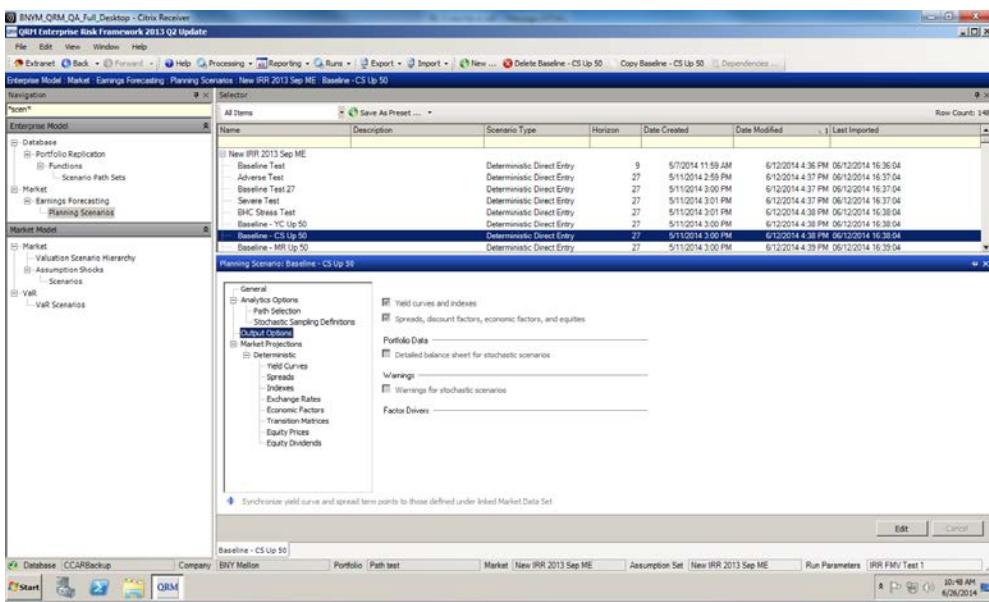


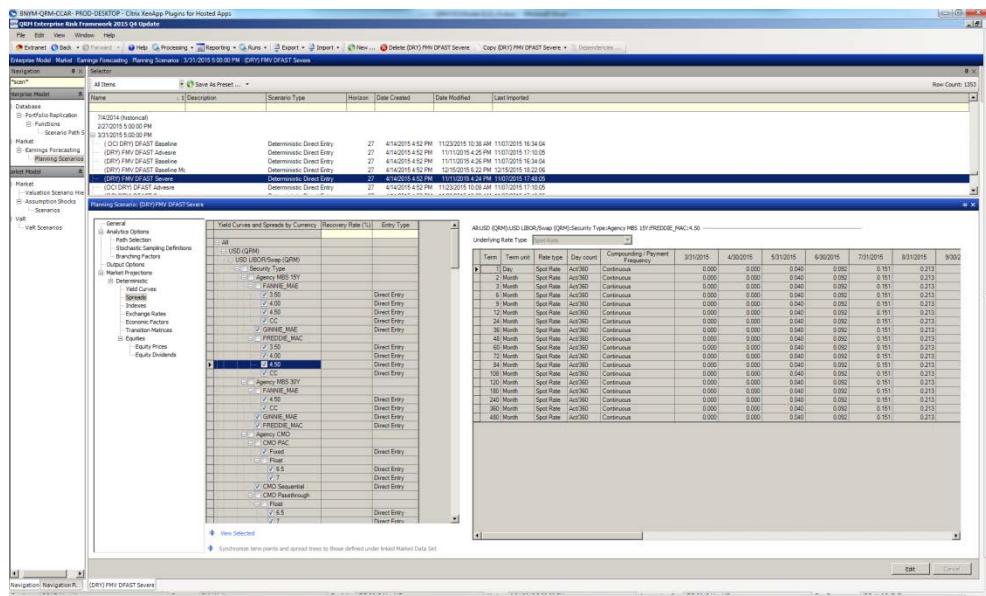
7. Activate the Credit Spread Pricing Model for all the required products (Enterprise Model/Database/Base Configuration/Products -> Evaluation)



8. Input the discounting credit spread shocks based on the spread trees activated for each of the yield curves. (Enterprise Model/Earning Forecast/Planning Scenarios).

Additionally activate the output options for spreads to enable reporting of credit spreads to discounting curves.





II. Setting Mortgage Rates in QRM

- Derive the 15Y and 20Y mortgage rates from the 30Y rates

For the Supervisory CCAR exercise, the Federal Reserve provides only the 30Y Mortgage Rate forecasts. AD&Co provided guidance on the custom CCY forecast for 15Y mortgage rate using 30Y mortgage rate (based on linear regression). The 20Y mortgage rates were derived by linear interpolation of the 15Y and 30Y mortgage rates.

Linear function provided by AD&Co to derive 15Y rates from 30Y rates

$$\text{pmtg_15 [i]} = 1.0637 * \text{pmtg_30 [i]} - 0.9151$$

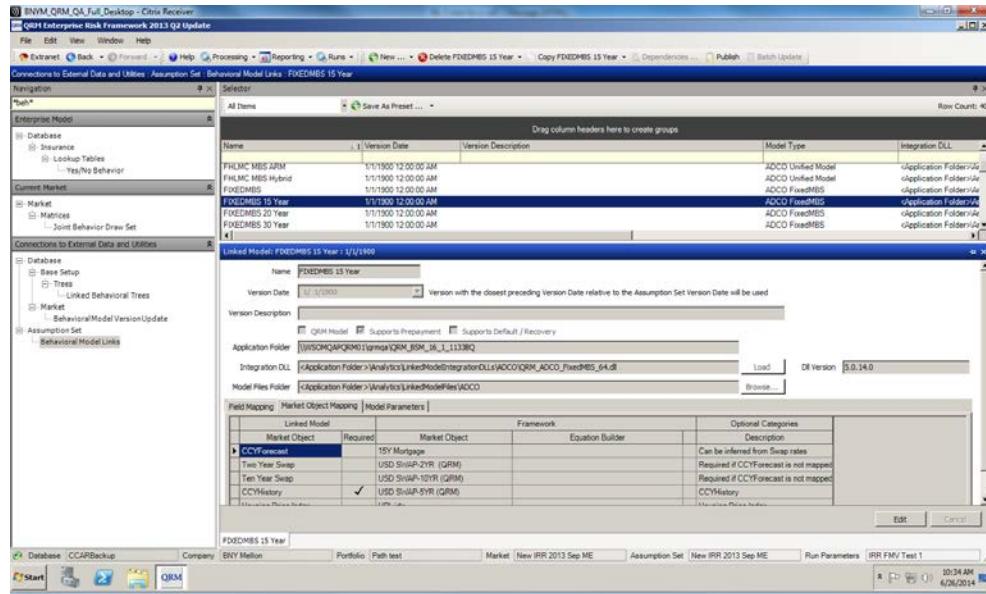
- Create mortgage rates Indexes in QRM (Market Model/Indexes) with Rate Index model type as Equation based referring to the lookup table. (Enterprise Model/Assumption Set/Base Configuration/Lookup Table/Parameterized Lookup tables)

The screenshot shows the Solvency II software interface with two main windows:

- Left Window (Navigation):** A tree view of the configuration structure. It includes sections for Scorecards (Credit and Market), Solvency (Lookup Tables for General and Rating), Assumption Set (Base Setup and Lookup Tables for Multidimensional and Parameterized), and Insurance (Lookup Tables for various products like Acquisition, Mortality, Commissions, Inflation, Benefits, Expenses, Mortality Additions, Mortality Multiples, Policy Loans, Premium Taxes, Withdrawals, and Skew Factors). Below these are Current Market and Base Setup.
- Right Window (Configuration):**
 - Top Panel:** A table titled "Drag column headers here to create groups" with columns: Name, Description, Model Type, Driver Curve, and Driver Index. It lists several rates:

| | | | |
|------------------------|-------------------------|------------------------------------|------------------------------|
| 10Y TREAS | | Relative to Yield Curve Term Point | USD Treasury Benchmark (QPM) |
| 15Y Mortgage | "CCAR Test" | Equation-Based | |
| 20Y Mortgage | "CCAR Test" | Equation-Based | |
| 30Y Mortgage | "CCAR Test" | Equation-Based | |
| 30Y TREAS | | Relative to Yield Curve Term Point | USD Treasury Benchmark (QPM) |
| 50% of EUR Target Rate | Dased on Jim's Forecast | Equation-Based | |
 - Bottom Panel (30Y Mortgage Configuration):**
 - Name:** 30Y Mortgage
 - Description:** "CCAR Test"
 - Currency:** USD (USM)
 - Modeling Assumptions:** (These options apply to assumption act "New [IR 2013 Sep ME]")
 - Rate index model type: Equation-Based
 - Equation preview: `Lookup([LUP:30Y Mortgage Rate], Date(1))`
 - Launch equation builder
 - Incidental Settings:**
 - Additional spread (%): 0.0000
 - Minimum rate step (%): 0.0000
 - Source of historical observation: Actual Rate Index History

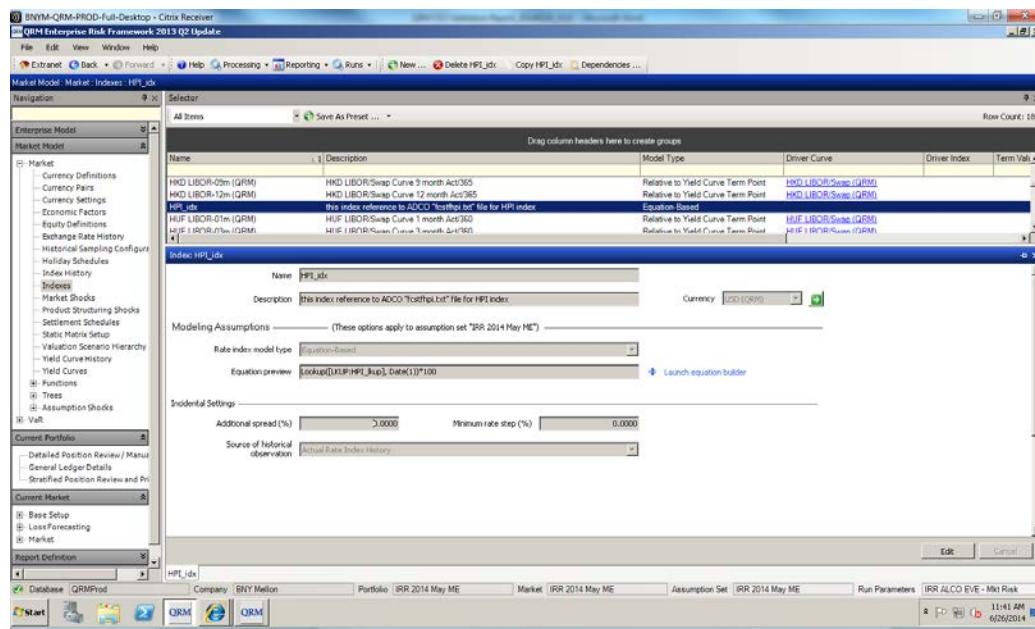
3. The mortgage rates are mapped to the CCY Forecast for the corresponding tenor FIXEDMBS model. The mortgage rate is quoted for coupon payments, and not included in discounting the mortgage related products. This was approved by the Model Risk Validation Group.



- The forecasted mortgage rates (calculated in step 1) are input to the corresponding planning scenarios. (Enterprise Model/Earning Forecast/Planning Scenarios)

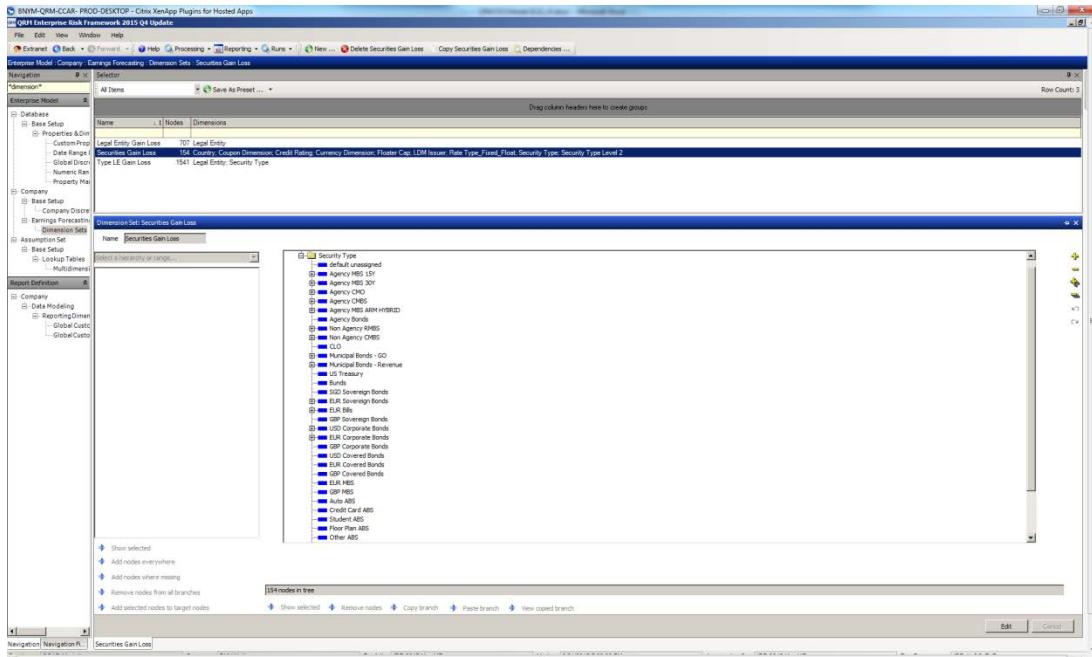
III. Setting House Price Index in QRM

HPI index configuration is similar to the mortgage rate Index configuration (Equation Based with lookup table).

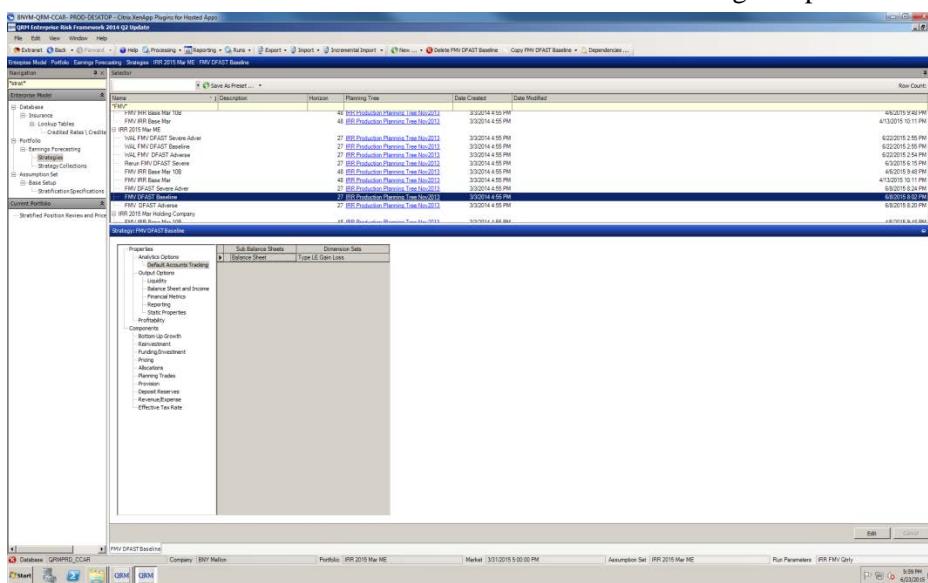


IV. Enabling tracking of Default AFS Gain/Loss Account

- Create a Dimension Set comprising the unique set of dimension combinations that you wish to view default contributions by.



2. Attach the Dimension Set to the Default Accounts tracking component in the strategy.



View contributions to the AFS Gain/Loss account by dimension combinations in the Detailed Forecast Audit.

G. Appendix B: QRM Implementation to integrate behavioral cashflows from OTTI model

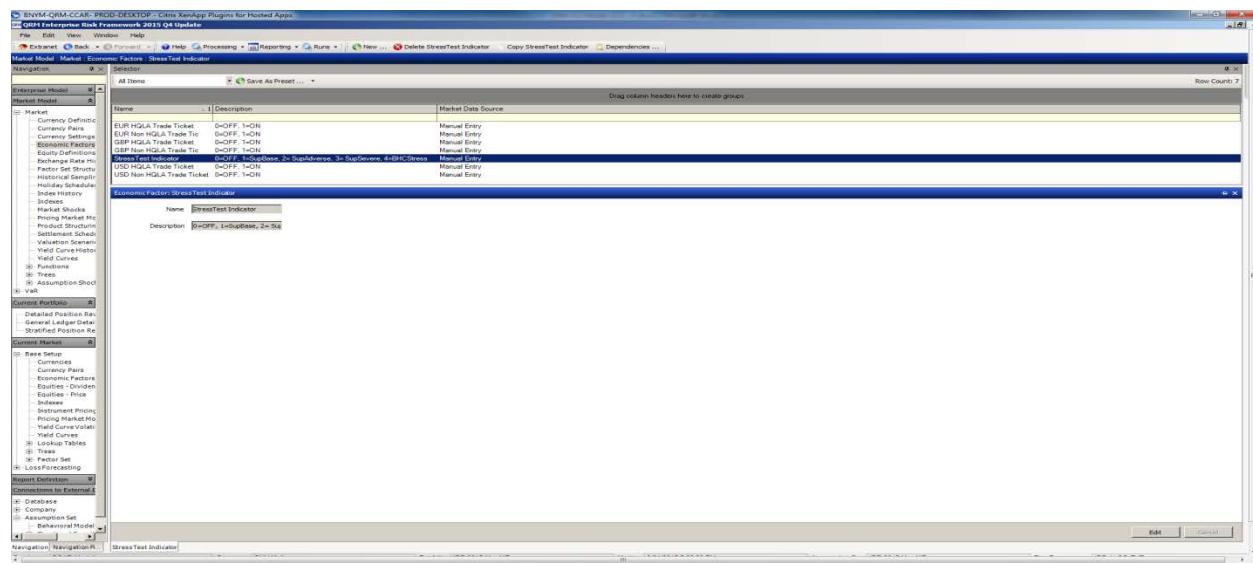
To synchronize the behavioral cashflows for the OCI-OTTI models, QRM has developed a custom DLL to integrate the behavioral cash flows generated by the credit risk model into the QRM-FMV framework used for OCI calculation. Behavioral cashflows for ABS, International RMBS and CMBS are sourced from models for the OTTI framework (Moody's analytics) and integrated into QRM.

The custom DLL permits the user to specify behavioral rates (SMM, MDR, and Loss Severity) for each cusip for multiple scenarios via text files in the model files folder. Note that the text files need to be in a certain format where the first three columns are the base SMM, MDR, and Recovery Rate for the baseline scenario, and the subsequent columns are the behavioral rates for the remaining scenarios. This lookup is controlled by a Scenario Identifier included in the Market Object tab of the DLL.

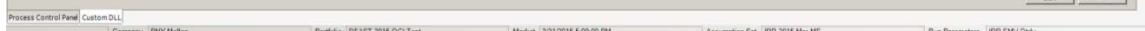
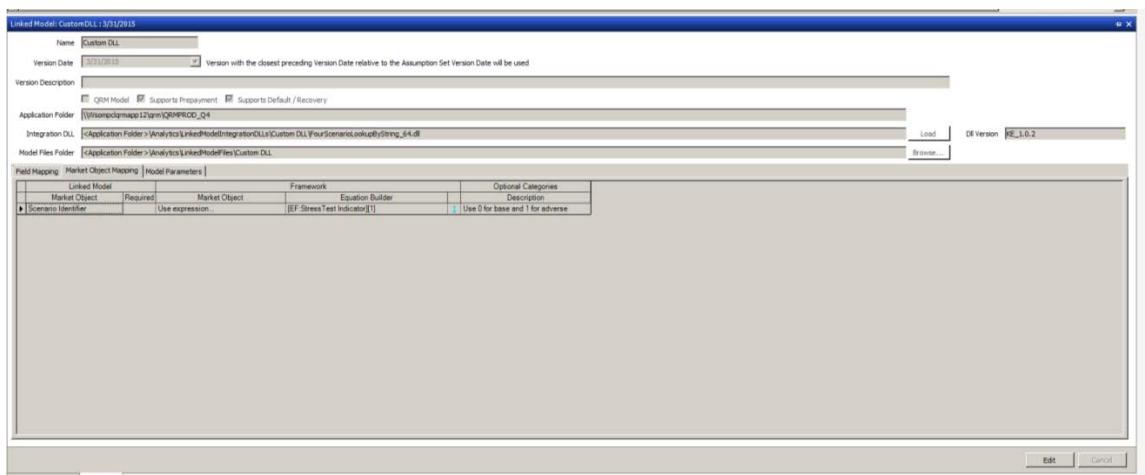
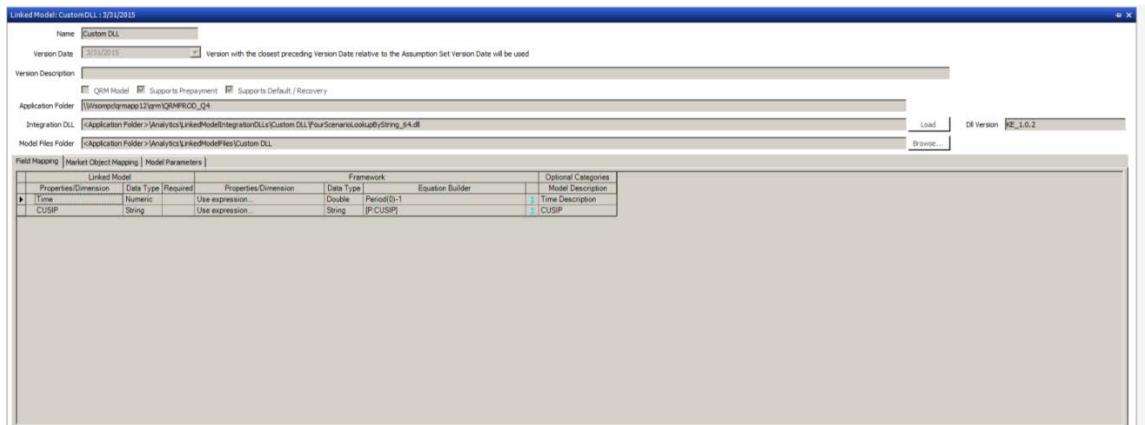
QRM Setup

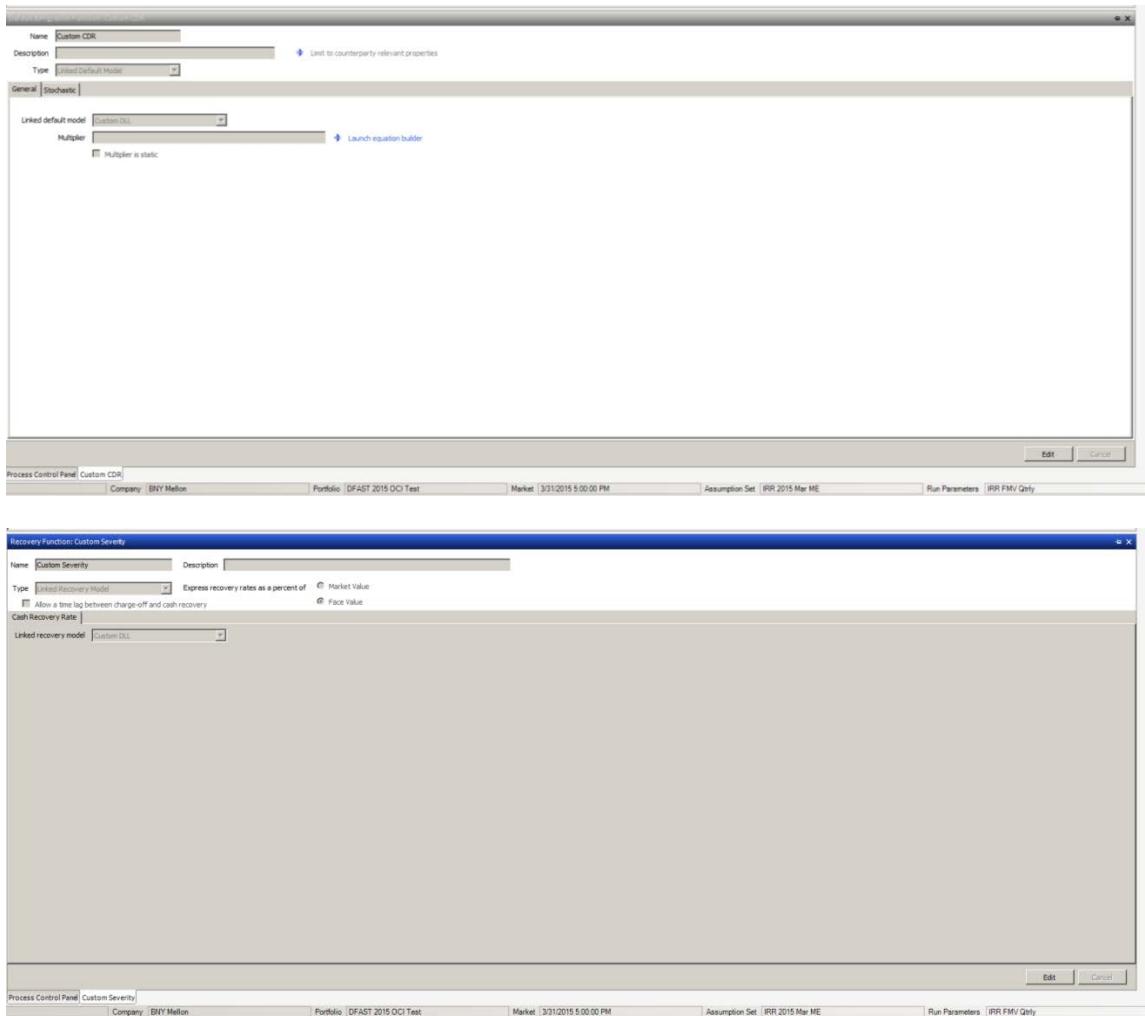
This section describes the step-by-step process for the configuration of the Linked Behavioral Model:

- Setup the economic scenario indicator (Market Model/Economic Factors) in the market object and assign value=-0 in the current market



- Setup the prepayment, default and recovery function for the Custom DLL. Also create a behavioral model for custom DLL and map the relevant objects





The scenario identifier accepts the values {0, 1, 2, and 3} based on the scenario.

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QRM Enterprise Risk Framework 2015 Q4 Update

File Edit View Window Help

Extract Back Forward Help Processing Reporting Runs Export New... Delete (DRY) FMV DFAST Severe Copy (DRY) FMV DFAST Severe Dependencies...

Enterprise Model Market Earnings Forecasting Planning Scenarios 3/21/2015 9:00:00 PM (DRY) FMV DFAST Severe

Navigation Selector

Planning

Enterprise Model

Database Distributed Planning

ACR Managers

Companies

Earnings Forecasting

- Planning Periodic
- Planning Tree
- Variables
- Planning Vertical
- Planning Trades
- Planning Data Sources
- Standard Trade

Portfolio Distributed Planning Pass

Market Earnings Forecasting Planning Scenarios

Connections to External Data

Company

- ETL
- Strategies
- Planning Tree II

General

Analytics Options

- Path Selection
- Statistical Sampling Definitions
- Economic Factors

Output Options

Market Projections

- Demographic
- Yield Curves
- Spreads
- Indexes
- Change Rates
- Economic Factors
- Transition Matrices

Equities

- Equity Prices
- Equity Dividends

All Items Save As Preset...

| Name | Description | Scenario Type | Horizon | Date Created | Date Modified | Last Imported |
|-----------------------------|----------------------------|---------------|-------------------|---------------------|---------------------|---------------|
| ZTR10201 (Historical) | | | | | | |
| TIA2014 (Historical) | | | | | | |
| 2/27/2015 5:00:00 PM | | | | | | |
| 3/1/2015 5:00:00 AM | | | | | | |
| (DRY) FMV DFAST Baseline | Deterministic Direct Entry | 27 | 4/14/2015 4:52 PM | 11/23/2015 10:38 AM | 11/07/2015 16:34:04 | |
| (DRY) FMV DFAST Baseline | Deterministic Direct Entry | 27 | 4/14/2015 4:52 PM | 11/11/2015 4:25 PM | 11/07/2015 17:10:05 | |
| (DRY) FMV DFAST Baseline | Deterministic Direct Entry | 27 | 4/14/2015 4:52 PM | 11/11/2015 4:25 PM | 11/07/2015 16:34:04 | |
| (DRY) FMV DFAST Baseline M1 | Deterministic Direct Entry | 27 | 4/14/2015 4:52 PM | 12/15/2015 6:24 PM | 12/15/2015 18:22:06 | |
| (DRY) FMV DFAST Severe | Deterministic Direct Entry | 27 | 4/14/2015 4:52 PM | 11/11/2015 4:24 PM | 11/07/2015 17:48:05 | |

Planning Scenarios (DRY) FMV DFAST Severe

Enter values, effective beginning of day for the date specified in the column header.

| Name | Entry Format | Current Value | 3/1/2015 | 4/20/2015 | 5/17/2015 | 6/30/2015 | 7/31/2015 | 8/31/2015 | 9/30/2015 | 10/31/2015 | 11/30/2015 | 12/31/2015 | 1/31/2016 | 2/29/2016 | 3/31/2016 | 4/30/2016 |
|----------------------|--------------|---------------|----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|------------|------------|-----------|-----------|-----------|-----------|
| Open Positions | Levels | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | |
| USD/HKD Trade Ticket | Levels | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| USD/NOK Trade Ticket | Levels | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| EUR/HKD Trade Ticket | Levels | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| EUR/NOK Trade Ticket | Levels | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| EUR/NOK Trade Tick | Levels | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| GBF/HKD Trade Ticket | Levels | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | | | | | | | | | | | | | | | | |

Synchronize economic factors to those defined under linked Market Data Set

Navigation Navigation R... (DRY) FMV DFAST Severe

Edit Cancel

- Map the appropriate deals in the deal mapping sections to the custom behavioral models. (Configuration to External Data and Utilities/Database/Base Setup/ Intex Setup – Collateral Pool Modeling)

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QRM Enterprise Risk Framework 2015 Q4 Update

File Edit View Window Help

Extract Back Forward Help Processing Reporting Runs Load Deal Data Import All Export All New... Delete Behavioral Functions Assignment - Deal Level Copy Behavioral Functions Assignment - Deal Level Dependencies...

Connections to External Data and Utilities Database Base Setup View Setup Collateral Pool Modeling Behavioral Functions Assignment - Deal Level

Navigation Selector

Prizes*

In External Data and Utilities

Intex Setup

Intex Setup - Collateral Pool

Intex Setup - Intex CMO Rep

Intex Setup - Rate Indexes

Behavioral Functions Assignment - Asset Level

Behavioral Functions Assignment - Deal Level

Level of Collateral Resolution

Collateral Pool Modeling

| Deal Name | CF Type | Prepayment Function | Prepayment Function 2 | Default Function | Recovery Function | Residual Value Adjustment Function |
|-----------|------------|---------------------|-----------------------|------------------|-------------------|------------------------------------|
| ACAR1102 | AUTO4YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1103 | AUTO5YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1102 | AUTO6YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1102 | AUTO7YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1103 | AUTO4YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1103 | AUTO5YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1103 | AUTO6YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1103 | AUTO7YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1102 | AUTO2YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1102 | AUTO3YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1102 | AUTO4YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1102 | AUTO5YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1102 | AUTO6YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1102 | AUTO7YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1103 | AUTO2YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1103 | AUTO3YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1103 | AUTO4YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1103 | AUTO5YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1103 | AUTO6YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1103 | AUTO7YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1104 | AUTO5YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1104 | AUTO6YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1105 | AUTO7YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1105 | AUTO2YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1105 | AUTO3YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1105 | AUTO4YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1105 | AUTO5YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1105 | AUTO6YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1105 | AUTO7YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1106 | AUTO2YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1106 | AUTO3YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1106 | AUTO4YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1106 | AUTO5YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1106 | AUTO6YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1106 | AUTO7YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1107 | CONSOL10YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1107 | CONSOL11YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1107 | CONSOL12YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1107 | CONSOL13YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |
| ACAR1107 | CONSOL14YR | Custom SMM | <None> | Custom CDR | Custom Severity | <None> |

Navigation Navigation R... (DRY) FMV DFAST Severe

Edit Cancel

Implementation testing and output validation

ALM-IRR tested the custom DLL using the DFAST 2015 behavioral model cashflows received from the Moody's OTTI model. We additionally tested specific cusips with the quarterly FMV run in addition to base valuation and planning and observed that the model operates as expected.

- Below is a screenshot of the text file labeled with cusip name and containing the behavioral rates we used for testing. The .txt cusip file is saved in the relevant `LinkedModelIntegrationDLLs` folder.

| 000759BY5.txt - Notepad | | | | | | |
|-------------------------|--------|--------|--------|--------|--------|--|
| File | Edit | Format | View | Help | | |
| 0.0185 | 0.0093 | 0.9590 | 0.0167 | 0.0102 | 0.9111 | |
| 0.0190 | 0.0105 | 0.9580 | 0.0171 | 0.0116 | 0.9101 | |
| 0.0195 | 0.0117 | 0.9570 | 0.0175 | 0.0120 | 0.9092 | |
| 0.0200 | 0.0123 | 0.9560 | 0.0180 | 0.0136 | 0.9082 | |
| 0.0205 | 0.0128 | 0.9550 | 0.0185 | 0.0143 | 0.9073 | |
| 0.0210 | 0.0130 | 0.9540 | 0.0189 | 0.0143 | 0.9063 | |
| 0.0215 | 0.0133 | 0.9530 | 0.0193 | 0.0148 | 0.9054 | |
| 0.0221 | 0.0123 | 0.9520 | 0.0199 | 0.0136 | 0.9044 | |
| 0.0226 | 0.0115 | 0.9510 | 0.0203 | 0.0127 | 0.9035 | |
| 0.0232 | 0.0105 | 0.9500 | 0.0209 | 0.0116 | 0.9025 | |
| 0.0238 | 0.0098 | 0.9490 | 0.0214 | 0.0106 | 0.9016 | |
| 0.0242 | 0.0090 | 0.9480 | 0.0164 | 0.0088 | 0.9006 | |
| 0.0183 | 0.0067 | 0.9470 | 0.0165 | 0.0074 | 0.8997 | |
| 0.0184 | 0.0062 | 0.9450 | 0.0166 | 0.0069 | 0.8987 | |
| 0.0184 | 0.0048 | 0.9440 | 0.0166 | 0.0049 | 0.8978 | |
| 0.0184 | 0.0037 | 0.9440 | 0.0166 | 0.0049 | 0.8968 | |
| 0.0185 | 0.0032 | 0.9430 | 0.0167 | 0.0035 | 0.8959 | |
| 0.0185 | 0.0029 | 0.9420 | 0.0167 | 0.0035 | 0.8949 | |
| 0.0186 | 0.0032 | 0.9410 | 0.0167 | 0.0035 | 0.8940 | |
| 0.0187 | 0.0037 | 0.9400 | 0.0168 | 0.0049 | 0.8930 | |
| 0.0188 | 0.0045 | 0.9390 | 0.0169 | 0.0049 | 0.8921 | |
| 0.0189 | 0.0052 | 0.9380 | 0.0170 | 0.0049 | 0.8911 | |
| 0.0189 | 0.0067 | 0.9370 | 0.0170 | 0.0074 | 0.8902 | |
| 0.0190 | 0.0088 | 0.9360 | 0.0171 | 0.0088 | 0.8892 | |
| 0.0191 | 0.0093 | 0.9350 | 0.0171 | 0.0088 | 0.8883 | |
| 0.0191 | 0.0105 | 0.9340 | 0.0173 | 0.0116 | 0.8873 | |
| 0.0193 | 0.0113 | 0.9330 | 0.0174 | 0.0127 | 0.8864 | |
| 0.0194 | 0.0123 | 0.9320 | 0.0175 | 0.0136 | 0.8854 | |
| 0.0195 | 0.0128 | 0.9310 | 0.0176 | 0.0145 | 0.8845 | |
| 0.0196 | 0.0130 | 0.9300 | 0.0176 | 0.0143 | 0.8835 | |
| 0.0198 | 0.0128 | 0.9290 | 0.0178 | 0.0141 | 0.8826 | |
| 0.0199 | 0.0123 | 0.9280 | 0.0179 | 0.0136 | 0.8816 | |
| 0.0200 | 0.0115 | 0.9270 | 0.0180 | 0.0107 | 0.8807 | |
| 0.0201 | 0.0105 | 0.9260 | 0.0181 | 0.0116 | 0.8797 | |
| 0.0203 | 0.0093 | 0.9250 | 0.0183 | 0.0102 | 0.8788 | |
| 0.0204 | 0.0080 | 0.9240 | 0.0184 | 0.0088 | 0.8778 | |
| 0.0204 | 0.0068 | 0.9230 | 0.0185 | 0.0069 | 0.8769 | |
| 0.0207 | 0.0055 | 0.9220 | 0.0186 | 0.0061 | 0.8759 | |
| 0.0209 | 0.0045 | 0.9210 | 0.0188 | 0.0049 | 0.8750 | |
| 0.0210 | 0.0040 | 0.9210 | 0.0188 | 0.0049 | 0.8740 | |
| 0.0212 | 0.0032 | 0.9200 | 0.0191 | 0.0035 | 0.8731 | |
| 0.0214 | 0.0032 | 0.9180 | 0.0193 | 0.0033 | 0.8721 | |
| 0.0216 | 0.0032 | 0.9170 | 0.0194 | 0.0035 | 0.8712 | |
| 0.0217 | 0.0032 | 0.9160 | 0.0194 | 0.0035 | 0.8702 | |
| 0.0219 | 0.0045 | 0.9150 | 0.0197 | 0.0049 | 0.8693 | |
| 0.0221 | 0.0055 | 0.9140 | 0.0199 | 0.0061 | 0.8683 | |
| 0.0223 | 0.0067 | 0.9130 | 0.0201 | 0.0074 | 0.8674 | |
| 0.0225 | 0.0080 | 0.9120 | 0.0203 | 0.0088 | 0.8664 | |
| 0.0228 | 0.0093 | 0.9110 | 0.0205 | 0.0102 | 0.8653 | |

- During testing, we activated log writing to the generic log file to conform the behavioral rates used during future valuation.
- The forecasted output was conformed in the output report. The screenshot below shows an example of validating the output behavioral rates using the Detailed Forecast Audit report.

H. Appendix C: QRM Implementation to use Planning Trade tickets for New Volume origination

Incremental growth and reinvestments is implemented in the QRM framework using planning trade tickets. The QRM framework will compute a future investment portfolio with these planning scenarios and behavioral assumptions as basic constraints.

QRM Setup

Below is an example of the setup for a purchase and sale trade ticket

(Enterprise Model/Company/Earnings Forecasting/Planning Trades/Standard Trades)

BNYM-QRM-CCAR - PROD-DESKTOP - Citrix Kendo-UI Plugins for Hosted Apps

Enterprise Model Company Earnings Forecasting Planning Trades Standard Trades ABS Student RO + G

Trade

Company Earnings Forecasting Planning Trades Standard Trades ABS Student RO + G

Navigation *Trade* Company Earnings Forecasting Planning Trades Standard Trades ABS Student RO + G

Standard Trades ABS Student RO + G

All Items Save As Preset ... Drag column headers here to create groups Row Count: 141

| Name | Description | Type | Portfolio | Planning Tree | Warnings |
|--------------------|-------------|------|--|---------------|----------|
| ABS Auto RO + G | | Buy | CCAR 2016 IRR Production Planning Tree | | |
| ABS CC RO + G | | Buy | CCAR 2016 IRR Production Planning Tree | | |
| ABS FP RO + G | | Buy | CCAR 2016 IRR Production Planning Tree | | |
| ABS Other RO + G | | Buy | CCAR 2016 IRR Production Planning Tree | | |
| ABS Student RO + G | | Buy | CCAR 2016 IRR Production Planning Tree | | |

Standard Trade: ABS Student RO + G

Name: ABS Student RO + G Planning tree: CCAR 2016 IRR Production Plan

Description: Portfolio link:

Trade type: Buy Sell Hedge

Node to buy: Balance Sheet / Assets / Investment Portfolio / Current

When to buy: Period: SFUSD Non HQA Trade Ticket[0]=1 Day:

Instrument attributes:

| Attribute | Value |
|---------------------|-----------|
| CUSIP | 78442IAE2 |
| Ref. Transaction ID | |
| Transaction ID | |
| Custom Defined 1 | |
| Custom Defined 2 | |

Price [% of par]: Calculate fair price on the trade date Use equation to determine price Book value

Size: Face/Notional amount Book value

2016 Student ABS (212141) Run#104 ABS Students

Navigation: Navigation.R Database: CCAR-Modeling Company: BNY Mellon Portfolio: IRR 2015 Mar ME Market: 1/31/2015 5:00:00 PM Assumption Set: IRR 2015 Mar ME Run Parameters: IRR ALCO E/E Edit Cancel 6:37 PM 12/2/2015

BNYM-QRM-CCAR - PROD-DESKTOP - Citrix Kendo-UI Plugins for Hosted Apps

Enterprise Model Company Earnings Forecasting Planning Trades Standard Trades Sale Agency MBS 15Y FNMA

Trade

Company Earnings Forecasting Planning Trades Standard Trades Sale Agency MBS 15Y FNMA

Navigation *Trade* Company Earnings Forecasting Planning Trades Standard Trades Sale Agency MBS 15Y FNMA

Standard Trades: Sale Agency MBS 15Y FNMA

All Items Save As Preset ... Drag column headers here to create groups Row Count: 141

| Name | Description | Type | Portfolio | Planning Tree | Warnings |
|---------------------------|-------------|------|--|---------------|----------|
| Sale Agency Hybrid GAMMA | | Sell | CCAR 2016 IRR Production Planning Tree | | |
| Sale Agency MBS 15Y FNMA | | Sell | CCAR 2016 IRR Production Planning Tree | | |
| Sale Agency MBS 15Y GAMMA | | Sell | CCAR 2016 IRR Production Planning Tree | | |
| Sale Agency MBS 30Y FNMA | | Sell | CCAR 2016 IRR Production Planning Tree | | |

Sale Agency MBS 15Y FNMA

Name: Sale Agency MBS 15Y FNMA Planning tree: CCAR 2016 IRR Production Plan

Description: Portfolio link:

Trade type: Buy Sell Hedge

Node to sell: Balance Sheet / Assets / Investment Portfolio / Current

When to sell: Period: [0]=2 Day:

Qualifying buckets: Use equation to determine qualifying buckets Select qualifying buckets

Order of sale: Sort by Then by Then by
 Pro-rate sale across all qualifying buckets Order Manually

Price [% of par]: Calculate fair price on the trade date Use equation to determine price Book value

Size: Face/Notional amount Book value

2016 FNMA MBS 15Y FNMA

Navigation: Navigation.R Database: CCAR-Modeling Company: BNY Mellon Portfolio: IRR 2015 Mar ME Market: 1/31/2015 5:00:00 PM Assumption Set: IRR 2015 Mar ME Run Parameters: IRR ALCO E/E Edit Cancel 6:58 PM 12/2/2015

Attach the trade ticket to the planning strategy.

Implementation testing and output validation

ALM-IRR performed validation of the calculated market price of the new volume origination. An example of the validation of 100% reinvestment of an existing cusip with and without additional credit spread shocks.

Existing position

| Portfolio - Stratified Position For Account: FNMA MBS 15yr Fixed | | | |
|--|----------------|---------------------------|-----------|
| Show | All Attributes | | |
| Total number of rows: 296 | | | |
| Bucket ID | Face Amount | Book Value | CUSIP |
| ► 1 | 6,097,352.48 | 6,394,551.27 | 3138E2N27 |
| Pricing Types | Pricing Input | Mark to Market Method | |
| | | | |
| Enter Price | 107.3860 | Price at 107.3860% of par | |

| 04/30/2015 | |
|--------------------------------------|-----------|
| Existing | |
| Beginning Balance | 6,097,352 |
| -Scheduled Principal | 36,572 |
| -Unscheduled Principal | 62,780 |
| +Purchases | - |
| =End Balance | 5,998,001 |
| Ending Book Balance | 6,290,358 |
| Market Value | 6,441,014 |
| AFS Gain | -2,206 |
| Existing Price (no FMV for existing) | 107.386 |

Projected Run-off

| 04/30/2015 | |
|------------------------|---------------|
| Existing | |
| Beginning Balance | 4,676,474,933 |
| -Scheduled Principal | 36,486,070 |
| -Unscheduled Principal | 52,012,098 |
| +Purchases | - |
| =End Balance | 4,587,976,764 |

| | |
|---------------------|---------------|
| Ending Book Balance | 4,775,430,496 |
| Market Value | 4,879,878,615 |
| AFS Gain | -1,959,454 |

Runoff from Existing 88,498,168

Reinvestment using a Trade Ticket with Credit Spread shocks =0

Standard Trade: Reinv Market AA Credit Rating

| Name | Reinv Market AA Credit Rating | Planning tree | IRR Production Planning Tree No: | | | | | | | | | | | | | | | | | | |
|----------------------------------|---|---|----------------------------------|-----------|-------|----------------------------------|--|--------------------|--|---------------------------------|--|----------------------------|--|---------------|------|-------|-----------|---------------------|--|----------------|--|
| Description | | Portfolio link | <Core> | | | | | | | | | | | | | | | | | | |
| Trade type | <input checked="" type="radio"/> Buy <input type="radio"/> Sell <input type="radio"/> Hedge | | | | | | | | | | | | | | | | | | | | |
| Node to buy | Balance Sheet / Assets / Investment Portfolio / Mana... | | | | | | | | | | | | | | | | | | | | |
| When to buy | Period | 1=1 | Launch equation builder Day EOM | | | | | | | | | | | | | | | | | | |
| Instrument attributes | <table border="1"> <thead> <tr> <th>Attribute</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>Recon_BNY Cap Mkts Holdings Cons</td> <td></td> </tr> <tr> <td>Recon_Dreyfus Corp</td> <td></td> </tr> <tr> <td>Recon_MBC Investments Corp Cons</td> <td></td> </tr> <tr> <td>Recon_BNY Holdings UK Cons</td> <td></td> </tr> <tr> <td>Credit Rating</td> <td>1388</td> </tr> <tr> <td>CUSIP</td> <td>3138E2N27</td> </tr> <tr> <td>Ref. Transaction ID</td> <td></td> </tr> <tr> <td>Transaction ID</td> <td></td> </tr> </tbody> </table> | | | Attribute | Value | Recon_BNY Cap Mkts Holdings Cons | | Recon_Dreyfus Corp | | Recon_MBC Investments Corp Cons | | Recon_BNY Holdings UK Cons | | Credit Rating | 1388 | CUSIP | 3138E2N27 | Ref. Transaction ID | | Transaction ID | |
| Attribute | Value | | | | | | | | | | | | | | | | | | | | |
| Recon_BNY Cap Mkts Holdings Cons | | | | | | | | | | | | | | | | | | | | | |
| Recon_Dreyfus Corp | | | | | | | | | | | | | | | | | | | | | |
| Recon_MBC Investments Corp Cons | | | | | | | | | | | | | | | | | | | | | |
| Recon_BNY Holdings UK Cons | | | | | | | | | | | | | | | | | | | | | |
| Credit Rating | 1388 | | | | | | | | | | | | | | | | | | | | |
| CUSIP | 3138E2N27 | | | | | | | | | | | | | | | | | | | | |
| Ref. Transaction ID | | | | | | | | | | | | | | | | | | | | | |
| Transaction ID | | | | | | | | | | | | | | | | | | | | | |
| Price (% of par) | <input checked="" type="radio"/> Calculate fair price on the trade date | MTM spread (%) | 0 | | | | | | | | | | | | | | | | | | |
| | <input type="radio"/> Use equation to determine price | | | | | | | | | | | | | | | | | | | | |
| Size | <input type="radio"/> Face/Notional amount <input checked="" type="radio"/> Book value | <input type="button" value="Launch equation builder"/> [BSN:FNMA MBS 15 yr Fixed (13218)][Runoff][0] | | | | | | | | | | | | | | | | | | | |

Yield Curves and Spreads by Currency Recovery

All:USD (QRM):USD LIBOR/Swap (QRM):Security Type:Agency MBS 15Y:AA

| Underlying Rate Type | | Spot/Par Coupon Rate | First per coupon month | 24 | | |
|----------------------|-----------|----------------------|------------------------|---------------------------------|-----------|-----------|
| Term | Term unit | Rate type | Day count | Compounding / Payment Frequency | 3/31/2015 | 4/30/2015 |
| 1 | Day | Spot Rate | Act/360 | Money Market | 0.010 | 0.000 |
| 1 | Week | Spot Rate | Act/360 | Money Market | 0.010 | 0.000 |
| 2 | Week | Spot Rate | Act/360 | Money Market | 0.010 | 0.000 |
| 1 | Month | Spot Rate | Act/360 | Money Market | 0.010 | 0.000 |
| 2 | Month | Spot Rate | Act/360 | Money Market | 0.010 | 0.000 |
| 3 | Month | Spot Rate | Act/360 | Money Market | 0.010 | 0.000 |
| 4 | Month | Spot Rate | Act/360 | Money Market | 0.010 | 0.000 |
| 5 | Month | Spot Rate | Act/360 | Money Market | 0.010 | 0.000 |
| 6 | Month | Spot Rate | Act/360 | Money Market | 0.010 | 0.000 |
| 7 | Month | Spot Rate | Act/360 | Money Market | 0.010 | 0.000 |
| 8 | Month | Spot Rate | Act/360 | Money Market | 0.010 | 0.000 |
| 9 | Month | Spot Rate | Act/360 | Money Market | 0.010 | 0.000 |
| 10 | Month | Spot Rate | Act/360 | Money Market | 0.010 | 0.000 |
| 11 | Month | Spot Rate | Act/360 | Money Market | 0.010 | 0.000 |
| 12 | Month | Spot Rate | Act/360 | Money Market | 0.010 | 0.000 |
| 13 | Month | Spot Rate | Act/360 | Money Market | 0.010 | 0.000 |
| 14 | Month | Spot Rate | Act/360 | Money Market | 0.010 | 0.000 |
| 15 | Month | Spot Rate | Act/360 | Money Market | 0.010 | 0.000 |
| 16 | Month | Spot Rate | Act/360 | Money Market | 0.010 | 0.000 |
| 17 | Month | Spot Rate | Act/360 | Money Market | 0.010 | 0.000 |
| 18 | Month | Spot Rate | Act/360 | Money Market | 0.010 | 0.000 |
| 19 | Month | Spot Rate | Act/360 | Money Market | 0.010 | 0.000 |
| 20 | Month | Spot Rate | Act/360 | Money Market | 0.010 | 0.000 |
| 21 | Month | Spot Rate | Act/360 | Money Market | 0.010 | 0.000 |
| 22 | Month | Spot Rate | Act/360 | Money Market | 0.010 | 0.000 |
| 23 | Month | Spot Rate | Act/360 | Money Market | 0.010 | 0.000 |
| 24 | Month | Par Coupon | 30/360 | Semiannual | 0.010 | 0.000 |
| 36 | Month | Par Coupon | 30/360 | Semiannual | 0.010 | 0.000 |
| 48 | Month | Par Coupon | 30/360 | Semiannual | 0.010 | 0.000 |
| 60 | Month | Par Coupon | 30/360 | Semiannual | 0.010 | 0.000 |
| 72 | Month | Par Coupon | 30/360 | Semiannual | 0.010 | 0.000 |
| 84 | Month | Par Coupon | 30/360 | Semiannual | 0.010 | 0.000 |
| 96 | Month | Par Coupon | 30/360 | Semiannual | 0.010 | 0.000 |
| 108 | Month | Par Coupon | 30/360 | Semiannual | 0.010 | 0.000 |
| 120 | Month | Par Coupon | 30/360 | Semiannual | 0.010 | 0.000 |
| 180 | Month | Par Coupon | 30/360 | Semiannual | 0.010 | 0.000 |
| 240 | Month | Par Coupon | 30/360 | Semiannual | 0.010 | 0.000 |
| 360 | Month | Par Coupon | 30/360 | Semiannual | 0.010 | 0.000 |
| 480 | Month | Par Coupon | 30/360 | Semiannual | 0.010 | 0.000 |

| 04/30/2015 | |
|------------------------|-------------------|
| New | |
| Beginning Balance | - |
| -Scheduled Principal | - |
| -Unscheduled Principal | - |
| +Purchases | 83,694,487 |
| =End Balance | 83,694,487 |
| Ending Book Balance | 88,498,168 |
| Market Value | 88,498,168 |
| AFS Gain | -235,972 |
| Implied Purchase Price | 105.739543 |

Reinvestment using a Trade Ticket with Credit Spread shocks

Standard Trade: Reinv Market NV Credit Rating

| Name | Reinv Market NV Credit Rating | Planning tree | IRR Production Planning Tree No: | | | | | | | | | | | | | | | | | | |
|---|---|--|--|-----------|-------|------------------|--|----------------------------------|--|--------------------|--|---------------------------------|--|----------------------------|--|---------------|------|-------|-----------|---------------------|--|
| Description | | Portfolio link | <Core> | | | | | | | | | | | | | | | | | | |
| Trade type | <input checked="" type="radio"/> Buy <input type="radio"/> Sell <input type="radio"/> Hedge | | | | | | | | | | | | | | | | | | | | |
| Node to buy | Balance Sheet / Assets / Investment Portfolio / Mana | | | | | | | | | | | | | | | | | | | | |
| When to buy | Period | 1=1 | <input type="button" value="Launch equation builder"/> Day EOM | | | | | | | | | | | | | | | | | | |
| Instrument attributes | <table border="1"> <thead> <tr> <th>Attribute</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>Recon_SA NV Cons</td> <td></td> </tr> <tr> <td>Recon_BNY Cap Mkts Holdings Cons</td> <td></td> </tr> <tr> <td>Recon_Dreyfus Corp</td> <td></td> </tr> <tr> <td>Recon_MBC Investments Corp Cons</td> <td></td> </tr> <tr> <td>Recon_BNY Holdings UK Cons</td> <td></td> </tr> <tr> <td>Credit Rating</td> <td>1512</td> </tr> <tr> <td>CUSIP</td> <td>3138E2N27</td> </tr> <tr> <td>Ref. Transaction ID</td> <td></td> </tr> </tbody> </table> | | | Attribute | Value | Recon_SA NV Cons | | Recon_BNY Cap Mkts Holdings Cons | | Recon_Dreyfus Corp | | Recon_MBC Investments Corp Cons | | Recon_BNY Holdings UK Cons | | Credit Rating | 1512 | CUSIP | 3138E2N27 | Ref. Transaction ID | |
| Attribute | Value | | | | | | | | | | | | | | | | | | | | |
| Recon_SA NV Cons | | | | | | | | | | | | | | | | | | | | | |
| Recon_BNY Cap Mkts Holdings Cons | | | | | | | | | | | | | | | | | | | | | |
| Recon_Dreyfus Corp | | | | | | | | | | | | | | | | | | | | | |
| Recon_MBC Investments Corp Cons | | | | | | | | | | | | | | | | | | | | | |
| Recon_BNY Holdings UK Cons | | | | | | | | | | | | | | | | | | | | | |
| Credit Rating | 1512 | | | | | | | | | | | | | | | | | | | | |
| CUSIP | 3138E2N27 | | | | | | | | | | | | | | | | | | | | |
| Ref. Transaction ID | | | | | | | | | | | | | | | | | | | | | |
| Price (% of par) | <input checked="" type="radio"/> Calculate fair price on the trade date | MTM spread (%) | 0 | | | | | | | | | | | | | | | | | | |
| | <input type="radio"/> Use equation to determine price | | | | | | | | | | | | | | | | | | | | |
| Size | <input type="radio"/> Face/Notional amount <input checked="" type="radio"/> Book value | | | | | | | | | | | | | | | | | | | | |
| <input type="text" value="BSN:FNMA MBS 15 yr Fixed (13218)][Runoff][0]"/> | | <input type="button" value="Launch equation builder"/> | | | | | | | | | | | | | | | | | | | |

| Yield Curves and Spreads by Currency | | Recovery | AllUSD (QRM)-USD LIBOR/Swap (QRM)-Security Type:Agency MBS 15Y/New Volumes | | | | | |
|--------------------------------------|-----------|-----------|--|-----------|---------------------------------|-----------|------------------------|----|
| | | | Underlying Rate Type | | Spot/Pic/Coupon Rate | | First par coupon month | 24 |
| | Term | Term unit | Rate type | Day count | Compounding / Payment Frequency | 3/31/2015 | 4/30/2015 | |
| | 1 Day | | Spot Rate | Act/360 | Money Market | -0.064 | -0.064 | |
| | 1 Week | | Spot Rate | Act/360 | Money Market | -0.064 | -0.064 | |
| | 2 Week | | Spot Rate | Act/360 | Money Market | -0.064 | -0.064 | |
| | 1 Month | | Spot Rate | Act/360 | Money Market | -0.064 | -0.064 | |
| | 2 Month | | Spot Rate | Act/360 | Money Market | -0.064 | -0.064 | |
| | 3 Month | | Spot Rate | Act/360 | Money Market | -0.064 | -0.064 | |
| | 4 Month | | Spot Rate | Act/360 | Money Market | -0.064 | -0.064 | |
| | 5 Month | | Spot Rate | Act/360 | Money Market | -0.064 | -0.064 | |
| | 6 Month | | Spot Rate | Act/360 | Money Market | -0.064 | -0.064 | |
| | 7 Month | | Spot Rate | Act/360 | Money Market | -0.064 | -0.064 | |
| | 8 Month | | Spot Rate | Act/360 | Money Market | -0.064 | -0.064 | |
| | 9 Month | | Spot Rate | Act/360 | Money Market | -0.064 | -0.064 | |
| | 10 Month | | Spot Rate | Act/360 | Money Market | -0.064 | -0.064 | |
| | 11 Month | | Spot Rate | Act/360 | Money Market | -0.064 | -0.064 | |
| | 12 Month | | Spot Rate | Act/360 | Money Market | -0.064 | -0.064 | |
| | 13 Month | | Spot Rate | Act/360 | Money Market | -0.064 | -0.064 | |
| | 14 Month | | Spot Rate | Act/360 | Money Market | -0.064 | -0.064 | |
| | 15 Month | | Spot Rate | Act/360 | Money Market | -0.064 | -0.064 | |
| | 16 Month | | Spot Rate | Act/360 | Money Market | -0.064 | -0.064 | |
| | 17 Month | | Spot Rate | Act/360 | Money Market | -0.064 | -0.064 | |
| | 18 Month | | Spot Rate | Act/360 | Money Market | -0.064 | -0.064 | |
| | 19 Month | | Spot Rate | Act/360 | Money Market | -0.064 | -0.064 | |
| | 20 Month | | Spot Rate | Act/360 | Money Market | -0.064 | -0.064 | |
| | 21 Month | | Spot Rate | Act/360 | Money Market | -0.064 | -0.064 | |
| | 22 Month | | Spot Rate | Act/360 | Money Market | -0.064 | -0.064 | |
| | 23 Month | | Spot Rate | Act/360 | Money Market | -0.064 | -0.064 | |
| | 24 Month | | Par Coupon | 30/360 | Semiannual | -0.064 | -0.064 | |
| | 36 Month | | Par Coupon | 30/360 | Semiannual | -0.064 | -0.064 | |
| | 48 Month | | Par Coupon | 30/360 | Semiannual | -0.064 | -0.064 | |
| | 60 Month | | Par Coupon | 30/360 | Semiannual | -0.064 | -0.064 | |
| | 72 Month | | Par Coupon | 30/360 | Semiannual | -0.064 | -0.064 | |
| | 84 Month | | Par Coupon | 30/360 | Semiannual | -0.064 | -0.064 | |
| | 96 Month | | Par Coupon | 30/360 | Semiannual | -0.064 | -0.064 | |
| | 108 Month | | Par Coupon | 30/360 | Semiannual | -0.064 | -0.064 | |
| | 120 Month | | Par Coupon | 30/360 | Semiannual | -0.064 | -0.064 | |
| | 180 Month | | Par Coupon | 30/360 | Semiannual | -0.064 | -0.064 | |
| | 240 Month | | Par Coupon | 30/360 | Semiannual | -0.064 | -0.064 | |
| | 360 Month | | Par Coupon | 30/360 | Semiannual | -0.064 | -0.064 | |
| | 480 Month | | Par Coupon | 30/360 | Semiannual | -0.064 | -0.064 | |

| 04/30/2015 | | |
|------------------------|--|-------------------|
| New | | |
| Beginning Balance | | - |
| -Scheduled Principal | | - |
| -Unscheduled Principal | | - |
| +Purchases | | 83,526,967 |
| =End Balance | | 83,526,967 |
| Ending Book Balance | | 88,498,168 |
| Market Value | | 88,498,168 |
| AFS Gain | | -235,500 |
| Implied Purchase Price | | 105.9516126 |

I. Appendix D: Segmentation of Risk for Credit Spread Modeling

When segmenting securities within asset classes, BNY Mellon applied its four step process to ensure granularity assesses risk appropriately and rational spread modeling was applied, thereby focusing resources on critical exposure that could affect capital. Risk that could not be modeled was a candidate for liquidation.

Step 1: GRANULARITY

Dodd Frank Act and CCAR Stress Testing require that the Investment Portfolio's risk profile is sufficiently detailed to support model development, baseline assumptions and documentation in accordance with supervisory expectations. Each asset class is thoroughly vetted to understand its inherent market and product risks. Individual risk positions are disaggregated by the following criteria (where appropriate):

Criteria for Disaggregating Risk at a Granular Level (Table 2.3A)

| | | |
|---------------|------------------------------------|---------------|
| Rating | Remaining life and/or Duration | Currency |
| Collateral | Valuation Base Rates | Domicile |
| Year of Issue | Level within the Capital Structure | Original Term |

Investment Portfolio transactions are recorded in the firm's trade and portfolio risk management system, Aladdin. Asset reference data, including credit ratings from S&P, Moody's and Fitch, are sourced independently from Blackrock.

Step 2: CONSOLIDATION BASED ON MATERIALITY

Ideally, asset spreads are modeled at their most detailed level. However, immaterial risk exposure and other idiosyncratic considerations may result in risk exposures being modeled at a consolidated level. In determining alignment between forecasted market rates to individual assets, BNY Mellon applies the following rules for materiality:

Materiality threshold:

Asset class represents <0.5% of *Available-for-Sale* portfolio by:
[Market Value] AND [DV01] AND [Spread DV01]

Step 3: DATA CONSTRAINTS

Limitations in historical market data may result in risk exposures being modeled at a consolidated level. Data gaps (missing dates), insufficient coverage (time-series only started recently and does not capture critical market events), deficient granularity by product type (coupon or tranche not available) and significant outliers mean time series may be unusable.

Step 4: GOVERNANCE PROCESS

Any consolidation is vetted and approved within the Governance Framework overseeing DFAST and CCAR Stress Testing. Rational for consolidation will be supported by empirical evidence and fully documented. Consolidated segments must have a similar risk profile to allow use of proxy time series. Product specific risks will be considered in their entirety to allow for consolidation.

For a detailed description of the segmentation within each asset class, refer to Section 4.1 of the Master OCI document – Calculation Models for the Investment Portfolio’s Marked-to-Market Effect on Other Comprehensive Income

J. Appendix E: Implementation Testing for CCAR 2016 Setup

Credit Spread shock forecast input for the two test scenarios – baseline and stress scenario. For the test run, no credit spread shocks were applied to US treasury, German sovereign bonds, UK sovereign bonds, Singapore Sovereign bonds, supranational bonds, money market funds and equities. Supranational bonds, money market funds and equities will be subjected to shocks in CCAR 2016 on security-by-security basis.

Credit Spread shock forecasts for the Baseline Scenario

| Asset Type | Segment | PQ1 | PQ2 | PQ3 | PQ4 | PQ5 | PQ6 | PQ7 | PQ8 | PQ9 |
|----------------------|------------------|------|------|------|------|-------|-------|-------|-------|-------|
| Agency MBS 15Y FNMA | FNMA15_CC | 0.07 | 0.09 | 0.16 | 0.16 | 0.14 | 0.13 | 0.15 | 0.15 | 0.16 |
| | FNMA15_4 | 0.06 | 0.05 | 0.08 | 0.05 | 0.01 | 0.00 | 0.01 | -0.02 | -0.05 |
| | FNMA15_4p5 | 0.11 | 0.10 | 0.15 | 0.10 | 0.05 | 0.04 | 0.07 | 0.04 | 0.00 |
| Agency MBS 15Y FHLMC | FHLMC15_CC | 0.10 | 0.11 | 0.13 | 0.12 | 0.13 | 0.16 | 0.21 | 0.22 | 0.22 |
| | FHLMC15_4 | 0.07 | 0.05 | 0.13 | 0.15 | 0.16 | 0.19 | 0.26 | 0.27 | 0.24 |
| | FHLMC15_4p5_2005 | 0.09 | 0.08 | 0.14 | 0.12 | 0.07 | 0.05 | 0.06 | 0.02 | -0.02 |
| | FHLMC15_4p5_2009 | 0.12 | 0.09 | 0.12 | 0.13 | 0.16 | 0.20 | 0.26 | 0.29 | 0.30 |
| | FHLMC15_5_2005 | 0.17 | 0.16 | 0.25 | 0.23 | 0.19 | 0.20 | 0.28 | 0.28 | 0.27 |
| | FHLMC15_5_2008 | 0.21 | 0.20 | 0.26 | 0.21 | 0.14 | 0.13 | 0.17 | 0.14 | 0.10 |
| Agency MBS 15Y GNMA | GNMA15_CC | 0.06 | 0.04 | 0.09 | 0.03 | -0.04 | -0.06 | -0.04 | -0.08 | -0.13 |
| Agency MBS 30Y FNMA | FNMA30_CC | 0.12 | 0.12 | 0.17 | 0.11 | 0.03 | -0.01 | 0.01 | -0.03 | -0.09 |
| | FNMA30_4p5 | 0.12 | 0.13 | 0.18 | 0.12 | 0.03 | 0.00 | 0.01 | -0.03 | -0.09 |
| | FNMA30_5p5 | 0.11 | 0.12 | 0.14 | 0.14 | 0.15 | 0.20 | 0.25 | 0.27 | 0.28 |
| Agency MBS 30Y FHLMC | FHLMC30_CC | 0.03 | 0.08 | 0.11 | 0.15 | 0.16 | 0.15 | 0.19 | 0.22 | 0.26 |
| Agency MBS 30Y GNMA | GNMA30_CC | 0.08 | 0.10 | 0.17 | 0.15 | 0.10 | 0.08 | 0.09 | 0.06 | 0.04 |
| Agency Hybrid | FNMA5_1_3 | 0.12 | 0.12 | 0.19 | 0.18 | 0.17 | 0.15 | 0.16 | 0.15 | 0.14 |
| | FHLM5_1_3 | 0.17 | 0.19 | 0.29 | 0.25 | 0.23 | 0.18 | 0.22 | 0.19 | 0.17 |
| Agency CMO | CMO_PAC_2WAL | 0.28 | 0.56 | 0.59 | 0.76 | 0.84 | 0.99 | 1.06 | 1.39 | 1.58 |
| | CMO_PAC_10WAL | 0.24 | 0.46 | 0.49 | 0.63 | 0.65 | 0.74 | 0.79 | 1.03 | 1.18 |
| | CMO_SEQ_2WAL | 0.23 | 0.43 | 0.43 | 0.56 | 0.59 | 0.71 | 0.73 | 1.00 | 1.16 |

| | | | | | | | | | | |
|----------------|------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | GBP_UK_RMBS_5to10Y_AAA | 0.75 | 0.63 | 1.24 | 1.33 | 1.34 | 1.21 | 1.24 | 1.15 | 1.05 |
| EUR Sovereigns | SOV_EUR_FRA_1Y | -0.01 | -0.01 | -0.01 | 0.01 | 0.02 | 0.02 | 0.02 | 0.03 | 0.01 |
| | SOV_EUR_FRA_5Y | -0.07 | -0.04 | -0.01 | 0.02 | 0.07 | 0.11 | 0.13 | 0.16 | 0.17 |
| | SOV_EUR_FRA_10Y | -0.32 | -0.57 | -0.48 | -0.49 | -0.46 | -0.44 | -0.42 | -0.39 | -0.37 |
| | SOV_EUR_NLD_1Y | -0.01 | -0.01 | -0.01 | 0.01 | 0.02 | 0.02 | 0.02 | 0.03 | 0.01 |
| | SOV_EUR_NLD_5Y | -0.08 | -0.04 | -0.01 | 0.03 | 0.07 | 0.12 | 0.14 | 0.17 | 0.18 |
| | SOV_EUR_NLD_10Y | -0.21 | -0.12 | -0.12 | -0.04 | 0.01 | 0.02 | 0.09 | 0.14 | 0.19 |
| | SOV_EUR_BEL_1Y | -0.01 | -0.01 | -0.01 | 0.01 | 0.02 | 0.02 | 0.02 | 0.03 | 0.01 |
| | SOV_EUR_BEL_5Y | 0.33 | 0.36 | 0.40 | 0.43 | 0.47 | 0.51 | 0.53 | 0.55 | 0.56 |
| | SOV_EUR_BEL_10Y | -0.23 | 0.01 | 0.28 | 0.42 | 0.52 | 0.64 | 0.75 | 0.83 | 0.89 |
| | SOV_EUR_ITA_1Y | -0.03 | -0.03 | -0.03 | -0.01 | 0.00 | 0.02 | 0.02 | 0.04 | 0.03 |
| | SOV_EUR_ITA_5Y | -0.22 | -0.25 | -0.19 | -0.15 | -0.06 | 0.02 | 0.10 | 0.18 | 0.26 |
| | SOV_EUR_ITA_10Y | -0.29 | -0.35 | -0.27 | -0.22 | -0.12 | -0.02 | 0.08 | 0.19 | 0.29 |
| | SOV_EUR_SPA_1Y | -0.02 | -0.03 | -0.02 | -0.01 | 0.02 | 0.03 | 0.04 | 0.07 | 0.06 |
| | SOV_EUR_SPA_5Y | -0.20 | -0.23 | -0.17 | -0.14 | -0.06 | 0.02 | 0.09 | 0.17 | 0.24 |
| | SOV_EUR_SPA_10Y | -0.18 | -0.41 | -0.27 | -0.12 | 0.01 | 0.14 | 0.25 | 0.30 | 0.39 |
| | SOV_EUR_IRL_1Y | -0.27 | 0.24 | 0.31 | 0.40 | 0.61 | 0.65 | 0.62 | 0.62 | 0.61 |
| | SOV_EUR_IRL_5Y | -0.35 | 0.35 | 0.52 | 0.60 | 0.84 | 0.92 | 0.92 | 0.94 | 0.93 |
| | SOV_EUR_IRL_10Y | -0.15 | 0.51 | 0.67 | 0.78 | 0.90 | 0.94 | 0.98 | 1.03 | 1.06 |
| | SOV_EUR_SWE_1Y | 0.01 | 0.12 | 0.09 | 0.12 | 0.17 | 0.20 | 0.28 | 0.34 | 0.46 |
| | SOV_EUR_SWE_5Y | -0.33 | 0.01 | -0.06 | 0.01 | 0.05 | 0.09 | 0.20 | 0.29 | 0.44 |
| | SOV_EUR_SWE_10Y | -0.11 | 0.54 | 0.42 | 0.51 | 0.51 | 0.53 | 0.62 | 0.75 | 0.81 |
| EUR Corporates | EUR_CORP_A_1Y | 0.42 | 0.41 | 0.68 | 0.52 | 0.31 | 0.28 | 0.39 | 0.35 | 0.29 |
| | EUR_CORP_A_5Y | 0.46 | 0.42 | 0.70 | 0.52 | 0.37 | 0.29 | 0.42 | 0.32 | 0.16 |
| | EUR_CORP_A_10Y | 0.49 | 0.43 | 0.72 | 0.52 | 0.42 | 0.30 | 0.44 | 0.26 | -0.03 |
| | EUR_CORP_AA_1Y | 0.41 | 0.40 | 0.67 | 0.51 | 0.31 | 0.28 | 0.39 | 0.34 | 0.29 |
| | EUR_CORP_AA_5Y | 0.44 | 0.40 | 0.67 | 0.50 | 0.35 | 0.28 | 0.40 | 0.30 | 0.16 |
| | EUR_CORP_AA_10Y | 0.47 | 0.41 | 0.68 | 0.49 | 0.40 | 0.29 | 0.42 | 0.25 | -0.03 |
| | EUR_CORP BBB_1Y | 0.52 | 0.53 | 0.70 | 0.59 | 0.45 | 0.40 | 0.50 | 0.46 | 0.35 |
| | EUR_CORP BBB_5Y | 0.56 | 0.55 | 0.77 | 0.62 | 0.50 | 0.42 | 0.54 | 0.44 | 0.27 |
| | EUR_CORP BBB_10Y | 0.59 | 0.57 | 0.83 | 0.64 | 0.55 | 0.42 | 0.57 | 0.41 | 0.14 |
| GBP Corporates | GBP_Corp_1Y | 0.29 | 0.29 | 0.48 | 0.36 | 0.22 | 0.19 | 0.28 | 0.24 | 0.19 |
| | GBP_Corp_5Y | 0.14 | 0.14 | 0.24 | 0.17 | 0.13 | 0.09 | 0.14 | 0.09 | 0.01 |
| | GBP_Corp_10Y | 0.11 | 0.10 | 0.16 | 0.11 | 0.11 | 0.07 | 0.11 | 0.05 | -0.03 |
| USD corporates | USD_Corp_A_1Y | 0.51 | 0.51 | 0.79 | 0.60 | 0.39 | 0.32 | 0.48 | 0.40 | 0.24 |
| | USD_Corp_A_5Y | 0.39 | 0.38 | 0.63 | 0.46 | 0.32 | 0.23 | 0.37 | 0.25 | 0.05 |
| | USD_Corp_A_10Y | 0.36 | 0.34 | 0.57 | 0.40 | 0.32 | 0.21 | 0.34 | 0.20 | -0.03 |
| | USD_Corp_AA_1Y | 0.18 | 0.18 | 0.30 | 0.22 | 0.14 | 0.11 | 0.17 | 0.14 | 0.08 |
| | USD_Corp_AA_5Y | 0.30 | 0.30 | 0.51 | 0.36 | 0.25 | 0.17 | 0.29 | 0.19 | 0.04 |
| | USD_Corp_AA_10Y | 0.33 | 0.30 | 0.53 | 0.37 | 0.29 | 0.19 | 0.31 | 0.17 | -0.03 |
| | USD_Corp AAA_1Y | 0.16 | 0.16 | 0.27 | 0.20 | 0.12 | 0.10 | 0.15 | 0.13 | 0.07 |

| | | | | | | | | | | |
|---------------------------------------|------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | USD_Corp_AAA_5Y | 0.18 | 0.17 | 0.30 | 0.21 | 0.15 | 0.10 | 0.17 | 0.11 | 0.02 |
| | USD_Corp_AAA_10Y | 0.17 | 0.16 | 0.28 | 0.19 | 0.15 | 0.10 | 0.16 | 0.09 | -0.01 |
| | USD_Corp_BBB_1Y | 0.49 | 0.50 | 0.76 | 0.59 | 0.38 | 0.31 | 0.46 | 0.39 | 0.23 |
| | USD_Corp_BBB_5Y | 0.39 | 0.39 | 0.64 | 0.46 | 0.33 | 0.23 | 0.37 | 0.25 | 0.05 |
| | USD_Corp_BBB_10Y | 0.39 | 0.37 | 0.62 | 0.44 | 0.35 | 0.23 | 0.37 | 0.22 | -0.04 |
| Municipal Bonds - General Obligations | MUNI_BFV_GO_A_1Y | 0.06 | 0.13 | 0.24 | 0.33 | 0.36 | 0.45 | 0.55 | 0.67 | 0.77 |
| | MUNI_BFV_GO_A_5Y | 0.00 | 0.01 | 0.05 | 0.10 | 0.13 | 0.20 | 0.34 | 0.38 | 0.44 |
| | MUNI_BFV_GO_A_10Y | 0.00 | 0.05 | 0.13 | 0.21 | 0.28 | 0.33 | 0.42 | 0.48 | 0.50 |
| | MUNI_BFV_GO_AA_1Y | 0.10 | 0.20 | 0.39 | 0.49 | 0.57 | 0.76 | 0.96 | 1.24 | 1.46 |
| | MUNI_BFV_GO_AA_5Y | -0.01 | 0.02 | 0.16 | 0.28 | 0.37 | 0.53 | 0.83 | 0.91 | 1.02 |
| | MUNI_BFV_GO_AA_10Y | 0.00 | 0.12 | 0.28 | 0.47 | 0.65 | 0.75 | 1.00 | 1.16 | 1.21 |
| Municipal Bonds - Revenue | MUNI_BFV_TR_AA_1Y | 0.05 | 0.10 | 0.21 | 0.30 | 0.34 | 0.45 | 0.58 | 0.77 | 0.94 |
| | MUNI_BFV_TR_AA_5Y | -0.01 | 0.02 | 0.14 | 0.25 | 0.33 | 0.48 | 0.75 | 0.83 | 0.93 |
| | MUNI_BFV_TR_AA_10Y | 0.00 | 0.12 | 0.29 | 0.48 | 0.67 | 0.77 | 1.03 | 1.19 | 1.25 |
| | MUNI_BFV_UT_A_1Y | 0.09 | 0.18 | 0.36 | 0.48 | 0.54 | 0.68 | 0.84 | 1.04 | 1.22 |
| | MUNI_BFV_UT_A_5Y | -0.01 | 0.02 | 0.15 | 0.27 | 0.36 | 0.51 | 0.78 | 0.86 | 0.95 |
| | MUNI_BFV_UT_A_10Y | 0.00 | 0.11 | 0.26 | 0.44 | 0.60 | 0.69 | 0.92 | 1.06 | 1.11 |
| | MUNI_BFV_UT_AA_1Y | 0.07 | 0.16 | 0.34 | 0.47 | 0.53 | 0.70 | 0.89 | 1.14 | 1.38 |
| | MUNI_BFV_UT_AA_5Y | -0.01 | 0.02 | 0.16 | 0.28 | 0.37 | 0.54 | 0.84 | 0.93 | 1.03 |
| | MUNI_BFV_UT_AA_10Y | 0.00 | 0.12 | 0.28 | 0.46 | 0.64 | 0.74 | 0.99 | 1.15 | 1.20 |
| | MUNI_BFV_ED_AA_1Y | 0.04 | 0.10 | 0.21 | 0.29 | 0.33 | 0.44 | 0.57 | 0.75 | 0.92 |
| | MUNI_BFV_ED_AA_5Y | -0.01 | 0.02 | 0.14 | 0.25 | 0.33 | 0.48 | 0.75 | 0.83 | 0.93 |
| | MUNI_BFV_ED_AA_10Y | 0.00 | 0.12 | 0.29 | 0.48 | 0.67 | 0.77 | 1.03 | 1.19 | 1.24 |
| | MUNI_BFV_REV_A_1Y | 0.07 | 0.15 | 0.28 | 0.38 | 0.42 | 0.54 | 0.66 | 0.81 | 0.94 |
| | MUNI_BFV_REV_A_5Y | -0.01 | 0.01 | 0.13 | 0.24 | 0.31 | 0.44 | 0.68 | 0.75 | 0.83 |
| | MUNI_BFV_REV_A_10Y | 0.00 | 0.06 | 0.14 | 0.22 | 0.30 | 0.35 | 0.45 | 0.52 | 0.54 |
| ABCP | ABCP | -0.03 | 0.15 | 0.23 | 0.31 | 0.29 | 0.31 | 0.39 | 0.41 | 0.44 |
| International Bonds | GBP Belgium 1Y | -0.11 | -0.33 | -0.51 | -0.63 | -0.80 | -0.99 | -1.22 | -1.47 | -1.66 |
| | GBP Belgium 5Y | 0.17 | -0.02 | -0.20 | -0.34 | -0.46 | -0.58 | -0.71 | -0.90 | -1.05 |
| | GBP Belgium 10Y | -0.51 | -0.48 | -0.48 | -0.56 | -0.60 | -0.60 | -0.57 | -0.66 | -0.75 |
| | USD International Sweden 1Y | -0.15 | -0.28 | -0.41 | -0.56 | -0.84 | -1.21 | -1.64 | -2.07 | -2.46 |
| | USD International Sweden 5Y | -0.38 | -0.28 | -0.58 | -0.67 | -0.96 | -1.52 | -1.59 | -1.73 | -1.69 |
| | USD International Sweden 10Y | -0.29 | 0.11 | -0.30 | -0.50 | -0.68 | -1.09 | -1.29 | -1.25 | -1.20 |

Credit Spread shock forecasts for the Stress Scenario

| Asset Type | Segment | PQ1 | PQ2 | PQ3 | PQ4 | PQ5 | PQ6 | PQ7 | PQ8 | PQ9 |
|----------------------|------------------|------|------|------|------|------|------|------|------|------|
| Agency MBS 15Y FNMA | FNMA15_CC | 0.11 | 0.38 | 0.69 | 0.83 | 0.88 | 0.83 | 0.67 | 0.47 | 0.30 |
| | FNMA15_4 | 0.09 | 0.26 | 0.41 | 0.45 | 0.44 | 0.38 | 0.28 | 0.18 | 0.12 |
| | FNMA15_4p5 | 0.16 | 0.46 | 0.74 | 0.80 | 0.76 | 0.66 | 0.49 | 0.30 | 0.21 |
| Agency MBS 15Y FHLMC | FHLMC15_CC | 0.13 | 0.35 | 0.59 | 0.49 | 0.39 | 0.30 | 0.19 | 0.09 | 0.06 |
| | FHLMC15_4 | 0.16 | 0.51 | 0.52 | 0.46 | 0.38 | 0.31 | 0.19 | 0.07 | 0.03 |
| | FHLMC15_4p5_2005 | 0.13 | 0.37 | 0.65 | 0.81 | 0.87 | 0.85 | 0.71 | 0.51 | 0.36 |

| | | | | | | | | | | |
|----------------------|-------------------|------|------|------|------|------|------|------|------|------|
| | FHLMC15_4p5_2009 | 0.12 | 0.46 | 0.70 | 0.56 | 0.42 | 0.32 | 0.21 | 0.11 | 0.08 |
| | FHLMC15_5_2005 | 0.25 | 0.66 | 0.91 | 0.93 | 0.86 | 0.75 | 0.55 | 0.34 | 0.24 |
| | FHLMC15_5_2008 | 0.28 | 0.61 | 0.88 | 0.95 | 0.91 | 0.81 | 0.62 | 0.41 | 0.31 |
| Agency MBS 15Y GNMA | GNMA15_CC | 0.11 | 0.39 | 0.64 | 0.71 | 0.69 | 0.60 | 0.43 | 0.25 | 0.16 |
| Agency MBS 30Y FNMA | FNMA30_CC | 0.18 | 0.52 | 0.85 | 0.97 | 0.96 | 0.86 | 0.65 | 0.41 | 0.28 |
| | FNMA30_4p5 | 0.17 | 0.51 | 0.85 | 1.00 | 0.99 | 0.89 | 0.68 | 0.44 | 0.30 |
| | FNMA30_5p5 | 0.15 | 0.39 | 0.65 | 0.54 | 0.42 | 0.32 | 0.20 | 0.09 | 0.06 |
| Agency MBS 30Y FHLMC | FHLMC30_CC | 0.03 | 0.34 | 0.80 | 1.12 | 1.33 | 1.41 | 1.16 | 0.87 | 0.61 |
| Agency MBS 30Y GNMA | GNMA30_CC | 0.13 | 0.41 | 0.72 | 0.88 | 0.95 | 0.92 | 0.76 | 0.53 | 0.37 |
| Agency Hybrid | FNMA5_1_3 | 0.12 | 0.32 | 0.53 | 0.65 | 0.70 | 0.69 | 0.62 | 0.46 | 0.36 |
| | FHLM5_1_3 | 0.20 | 0.56 | 0.92 | 1.10 | 1.14 | 1.11 | 0.99 | 0.73 | 0.58 |
| Agency CMO | CMO_PAC_2WAL | 0.34 | 0.85 | 1.72 | 1.55 | 1.55 | 1.43 | 1.24 | 1.09 | 0.98 |
| | CMO_PAC_10WAL | 0.23 | 0.51 | 1.16 | 1.02 | 0.98 | 0.93 | 0.79 | 0.66 | 0.62 |
| | CMO_SEQ_2WAL | 0.21 | 0.44 | 1.23 | 1.08 | 1.05 | 1.02 | 0.95 | 0.87 | 0.83 |
| | CMO_SEQ_10WAL | 0.20 | 0.44 | 1.34 | 1.04 | 0.96 | 0.92 | 0.84 | 0.77 | 0.76 |
| | CMO_FLTSTR_6p5 | 0.13 | 0.36 | 0.50 | 0.46 | 0.42 | 0.43 | 0.37 | 0.30 | 0.25 |
| | CMO_FLTSTR_7 | 0.12 | 0.34 | 0.46 | 0.43 | 0.40 | 0.41 | 0.35 | 0.29 | 0.24 |
| | CMO_FLTFLT_6p5 | 0.14 | 0.39 | 0.52 | 0.50 | 0.48 | 0.50 | 0.44 | 0.37 | 0.30 |
| | CMO_FLTFLT_7 | 0.12 | 0.37 | 0.44 | 0.40 | 0.36 | 0.37 | 0.32 | 0.27 | 0.22 |
| Agency CMBS | GNMA_CMBS_3p5Y | 0.07 | 0.14 | 0.25 | 0.33 | 0.35 | 0.33 | 0.26 | 0.19 | 0.13 |
| | GNMA_CMBS_12Y | 0.05 | 0.09 | 0.16 | 0.22 | 0.23 | 0.22 | 0.17 | 0.12 | 0.09 |
| | FNMA_DUS_5to10Y | 0.29 | 0.95 | 0.96 | 0.89 | 0.88 | 0.79 | 0.61 | 0.53 | 0.45 |
| | FHLMC_CMBS_A2_10Y | 0.30 | 0.85 | 0.90 | 0.95 | 0.96 | 0.90 | 0.80 | 0.63 | 0.52 |
| Non Agency CMBS | CMBS_2005_A | 1.10 | 3.19 | 5.47 | 6.81 | 7.52 | 7.26 | 6.52 | 5.04 | 4.00 |
| | CMBS_2005_AM | 2.14 | 5.71 | 11.2 | 14.2 | 15.8 | 16.4 | 15.6 | 12.4 | 10.0 |
| | CMBS_2005_AJ | 3.30 | 9.62 | 17.1 | 22.1 | 25.1 | 24.4 | 22.2 | 17.5 | 13.8 |
| | CMBS_10Y_MEZZ_AA | 1.32 | 4.61 | 6.97 | 8.49 | 9.60 | 9.32 | 7.97 | 6.08 | 4.31 |
| | CMBS_10Y_AJ_AA | 0.88 | 3.05 | 4.62 | 5.59 | 6.28 | 6.09 | 5.20 | 3.94 | 2.81 |
| | CMBS_10Y_MEZZ_A | 1.37 | 5.69 | 9.37 | 12.0 | 14.1 | 14.1 | 11.9 | 9.13 | 6.33 |
| | CMBS_10Y_BBB | 0.42 | 5.13 | 10.0 | 13.5 | 16.3 | 17.2 | 14.8 | 11.5 | 8.22 |
| Agency Bonds | AgencyDeb_Srt | 0.21 | 0.59 | 0.88 | 0.96 | 0.96 | 0.92 | 0.82 | 0.62 | 0.53 |
| | AgencyDeb_Int | 0.16 | 0.44 | 0.65 | 0.71 | 0.71 | 0.68 | 0.61 | 0.46 | 0.39 |
| | AgencyDeb_Lng | 0.05 | 0.18 | 0.28 | 0.29 | 0.29 | 0.28 | 0.25 | 0.20 | 0.16 |
| CLO | CLO AAA 3M | 0.66 | 2.00 | 3.57 | 4.81 | 5.52 | 5.24 | 4.67 | 3.61 | 2.62 |
| | CLO AA 3M | 2.05 | 5.54 | 9.44 | 12.0 | 13.2 | 12.4 | 11.1 | 8.46 | 6.43 |
| ABS | ABS_AT_AAA_1 | 0.46 | 1.61 | 2.37 | 2.70 | 2.78 | 2.58 | 2.23 | 1.64 | 1.33 |
| | ABS_AT_AAA_3 | 0.77 | 2.44 | 3.46 | 4.10 | 4.22 | 4.00 | 3.49 | 2.51 | 1.95 |
| | ABS_CC_AAA_3 | 0.63 | 1.90 | 2.88 | 3.36 | 3.52 | 3.21 | 2.73 | 2.00 | 1.57 |
| | ABS_CC_AAA_7 | 0.68 | 2.06 | 3.13 | 3.72 | 3.90 | 3.52 | 2.96 | 2.16 | 1.66 |
| | ABS_SL_AAA_1 | 0.39 | 1.35 | 1.86 | 2.01 | 2.03 | 1.94 | 1.73 | 1.27 | 1.09 |
| | ABS_SL_AAA_7 | 0.63 | 1.85 | 2.38 | 2.49 | 2.54 | 2.45 | 2.15 | 1.67 | 1.45 |
| | iBoxx_Canada_Cov | 0.24 | 0.71 | 1.40 | 1.89 | 2.12 | 2.16 | 1.91 | 1.51 | 1.15 |
| Covered Bonds | iBoxx_EUR_Canada | 0.15 | 0.45 | 0.87 | 1.17 | 1.30 | 1.32 | 1.18 | 0.94 | 0.71 |
| | iBoxx_EUR_GB | 0.52 | 1.44 | 2.70 | 3.48 | 3.68 | 3.62 | 3.33 | 2.74 | 2.18 |
| | iBoxx_EUR_Ntlnds | 0.07 | 0.43 | 0.98 | 1.29 | 1.37 | 1.37 | 1.30 | 1.13 | 0.92 |
| | iBoxx_EUR_Scandi | 0.13 | 0.41 | 0.82 | 1.05 | 1.11 | 1.10 | 1.04 | 0.88 | 0.71 |
| Non Agency RMBS | RMBS_Prime AAA | 0.62 | 3.08 | 5.34 | 7.23 | 8.96 | 10.1 | 9.56 | 8.14 | 6.16 |

| | | | | | | | | | | |
|----------------|------------------------|-----------|-------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| | RMBS_AltA AAA | 2.06 | 8.30 | 12.3 7 | 15.3 9 | 17.9 5 | 17.5 0 | 14.7 6 | 11.3 7 | 7.64 |
| | RMBS_AltA AA | 1.19 | 9.51 | 18.2 7 | 24.9 1 | 30.4 1 | 31.0 0 | 26.2 7 | 20.3 3 | 13.6 6 |
| | RMBS_SubPrime AAA | 0.72 | 3.51 | 7.43 3 | 11.5 5 | 15.1 5 | 17.6 9 | 17.2 5 | 14.7 7 | 11.1 3 |
| EUR MBS | EUR_DCH_RMBS_AA | 2.04 | 5.90 | 9.19 9 | 11.0 9 | 11.7 6 | 10.8 5 | 9.68 | 7.55 | 6.20 |
| | EUR_DCH_RMBS_5to10Y_AA | 0.57 | 1.92 | 2.95 9 | 3.62 4 | 3.89 3 | 3.52 9 | 3.07 0 | 2.44 0 | 1.96 1 |
| | EUR_IR_RMBS BBB | 3.47 | | 17.7 9 | 35.3 9 | 47.2 3 | 52.1 9 | 48.9 0 | 44.2 0 | 40.5 1 |
| | GBP_UK_RMBS_0to3Y AAA | - 0.69 | -0.69 | -0.69 -0.69 |
| GBP MBS | GBP_UK_RMBS_3to5Y AAA | - 0.64 | -0.64 | -0.64 -0.64 |
| | GBP_UK_RMBS_5to10Y AAA | 0.79 | 1.63 | 3.28 3.28 | 4.16 4.16 | 4.32 4.32 | 4.05 4.05 | 3.78 3.78 | 3.05 3.05 | 2.56 2.56 |
| | SOV_EUR_FRA_1Y | - 3.13 | -1.51 | -1.66 -1.66 | -1.20 -1.20 | -1.10 -1.10 | -0.82 -0.82 | -0.54 -0.54 | -0.26 -0.26 | 0.01 0.01 |
| EUR Sovereigns | SOV_EUR_FRA_5Y | - 3.19 | -1.78 | -1.99 -1.99 | -1.61 -1.61 | -1.51 -1.51 | -1.26 -1.26 | -1.05 -1.05 | -0.81 -0.81 | -0.62 -0.62 |
| | SOV_EUR_FRA_10Y | - 3.01 | -4.02 | -4.08 -4.08 | -4.14 -4.14 | -4.22 -4.22 | -4.28 -4.28 | -4.21 -4.21 | -4.22 -4.22 | -4.18 -4.18 |
| | SOV_EUR_NLD_1Y | - 3.14 | -1.53 | -1.68 -1.68 | -1.23 -1.23 | -1.13 -1.13 | -0.84 -0.84 | -0.57 -0.57 | -0.28 -0.28 | -0.02 -0.02 |
| | SOV_EUR_NLD_5Y | - 3.19 | -1.76 | -1.96 -1.96 | -1.58 -1.58 | -1.49 -1.49 | -1.23 -1.23 | -1.02 -1.02 | -0.78 -0.78 | -0.59 -0.59 |
| | SOV_EUR_NLD_10Y | - 2.87 | -3.47 | -3.71 -3.71 | -3.72 -3.72 | -3.81 -3.81 | -3.91 -3.91 | -3.80 -3.80 | -3.84 -3.84 | -3.80 -3.80 |
| | SOV_EUR_BEL_1Y | - 3.14 | -1.52 | -1.68 -1.68 | -1.22 -1.22 | -1.12 -1.12 | -0.83 -0.83 | -0.56 -0.56 | -0.27 -0.27 | -0.01 -0.01 |
| | SOV_EUR_BEL_5Y | - 2.79 | -1.40 | -1.61 -1.61 | -1.23 -1.23 | -1.13 -1.13 | -0.88 -0.88 | -0.67 -0.67 | -0.43 -0.43 | -0.24 -0.24 |
| | SOV_EUR_BEL_10Y | - 2.87 | -3.03 | -2.39 -2.39 | -2.23 -2.23 | -2.69 -2.69 | -2.95 -2.95 | -3.12 -3.12 | -3.27 -3.27 | -3.39 -3.39 |
| | SOV_EUR_ITA_1Y | - 3.21 | -1.91 | -1.99 -1.99 | -1.52 -1.52 | -1.50 -1.50 | -1.28 -1.28 | -1.06 -1.06 | -0.81 -0.81 | -0.56 -0.56 |
| | SOV_EUR_ITA_5Y | - 3.36 | -2.02 | -1.90 -1.90 | -1.44 -1.44 | -1.60 -1.60 | -1.50 -1.50 | -1.45 -1.45 | -1.31 -1.31 | -1.17 -1.17 |
| | SOV_EUR_ITA_10Y | - 2.93 | -3.36 | -2.97 -2.97 | -2.90 -2.90 | -3.33 -3.33 | -3.54 -3.54 | -3.68 -3.68 | -3.82 -3.82 | -3.88 -3.88 |
| | SOV_EUR_SPA_1Y | - 3.19 | -1.83 | -1.85 -1.85 | -1.31 -1.31 | -1.33 -1.33 | -1.14 -1.14 | -0.96 -0.96 | -0.73 -0.73 | -0.49 -0.49 |
| | SOV_EUR_SPA_5Y | - 3.35 | -2.04 | -1.94 -1.94 | -1.49 -1.49 | -1.63 -1.63 | -1.52 -1.52 | -1.46 -1.46 | -1.31 -1.31 | -1.17 -1.17 |
| | SOV_EUR_SPA_10Y | - 2.81 | -3.42 | -3.05 -3.05 | -2.94 -2.94 | -3.29 -3.29 | -3.49 -3.49 | -3.58 -3.58 | -3.76 -3.76 | -3.82 -3.82 |
| | SOV_EUR_IRL_1Y | - 3.16 | -0.16 | 0.48 0.48 | 0.45 0.45 | 0.78 0.78 | 1.09 1.09 | 1.37 1.37 | 1.64 1.64 | 1.93 1.93 |
| | SOV_EUR_IRL_5Y | - 3.10 | 0.46 | 1.69 1.69 | 1.40 1.40 | 1.68 1.68 | 1.92 1.92 | 2.11 2.11 | 2.29 2.29 | 2.51 2.51 |
| | SOV_EUR_IRL_10Y | - 2.43 | -0.78 | 0.64 0.64 | 0.18 0.18 | 0.20 0.20 | 0.06 0.06 | 0.07 0.07 | -0.05 -0.05 | -0.03 -0.03 |
| | SOV_EUR_SWE_1Y | - 3.26 | -2.09 | -2.32 -2.32 | -1.78 -1.78 | -1.54 -1.54 | -1.30 -1.30 | -1.02 -1.02 | -0.75 -0.75 | -0.49 -0.49 |
| | SOV_EUR_SWE_5Y | - 3.56 | -2.26 | -2.49 -2.49 | -1.98 -1.98 | -1.77 -1.77 | -1.58 -1.58 | -1.36 -1.36 | -1.13 -1.13 | -0.93 -0.93 |
| | SOV_EUR_SWE_10Y | - 2.85 | -3.13 | -3.33 -3.33 | -3.31 -3.31 | -3.38 -3.38 | -3.40 -3.40 | -3.27 -3.27 | -3.23 -3.23 | -3.16 -3.16 |
| EUR Corporates | EUR_CORP_A_1Y | - 2.62 | -0.23 | 0.65 0.65 | 1.35 1.35 | 1.38 1.38 | 1.01 1.01 | 0.34 0.34 | -0.05 -0.05 | -0.12 -0.12 |
| | EUR_CORP_A_5Y | - 2.44 | 0.04 | 0.66 0.66 | 1.19 1.19 | 1.21 1.21 | 0.91 0.91 | 0.26 0.26 | -0.15 -0.15 | -0.31 -0.31 |
| | EUR_CORP_A_10Y | - 1.78 | -0.86 | -0.44 -0.44 | -0.45 -0.45 | -0.59 -0.59 | -1.02 -1.02 | -1.65 -1.65 | -2.29 -2.29 | -2.62 -2.62 |
| | EUR_CORP_AA_1Y | - 2.62 | -0.26 | 0.61 0.61 | 1.30 1.30 | 1.33 1.33 | 0.98 0.98 | 0.32 0.32 | -0.07 -0.07 | -0.13 -0.13 |

| | | | | | | | | | | |
|---------------------------------------|--------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | EUR_Corp_AA_5Y | -2.47 | -0.05 | 0.53 | 1.05 | 1.08 | 0.80 | 0.19 | -0.20 | -0.34 |
| | EUR_Corp_AA_10Y | 1.82 | -0.98 | -0.59 | -0.60 | -0.74 | -1.15 | -1.75 | -2.36 | -2.67 |
| | EUR_Corp_BBB_1Y | 2.53 | -0.56 | -0.44 | 0.04 | 0.15 | 0.13 | -0.12 | -0.21 | -0.19 |
| | EUR_Corp_BBB_5Y | 2.36 | -0.14 | 0.01 | 0.41 | 0.48 | 0.39 | 0.01 | -0.22 | -0.31 |
| | EUR_Corp_BBB_10Y | 1.70 | -0.87 | -0.48 | -0.49 | -0.63 | -1.04 | -1.65 | -2.25 | -2.57 |
| GBP Corporates | GBP_Corp_1Y | 0.45 | 1.73 | 3.07 | 3.40 | 3.24 | 2.62 | 1.77 | 1.25 | 0.94 |
| | GBP_Corp_5Y | 0.10 | 0.74 | 1.59 | 1.91 | 1.86 | 1.67 | 1.30 | 1.02 | 0.84 |
| | GBP_Corp_10Y | 0.90 | -0.17 | 0.70 | 1.11 | 1.12 | 1.11 | 0.96 | 0.83 | 0.74 |
| | USD_Corp_A_1Y | 0.95 | 2.43 | 3.23 | 3.27 | 3.20 | 2.71 | 1.90 | 1.28 | 0.69 |
| USD corporates | USD_Corp_A_5Y | 0.35 | 2.49 | 3.45 | 3.66 | 3.51 | 2.90 | 2.36 | 1.77 | 1.36 |
| | USD_Corp_A_10Y | 0.11 | 2.47 | 3.48 | 3.60 | 3.53 | 3.16 | 2.49 | 1.89 | 1.42 |
| | USD_Corp_AA_1Y | 0.44 | 1.48 | 2.40 | 2.48 | 2.37 | 1.77 | 1.05 | 0.65 | 0.29 |
| | USD_Corp_AA_5Y | 0.23 | 2.62 | 3.92 | 4.19 | 3.99 | 3.12 | 2.31 | 1.65 | 1.24 |
| | USD_Corp_AA_10Y | 0.16 | 2.77 | 4.03 | 4.17 | 4.08 | 3.53 | 2.61 | 1.89 | 1.38 |
| | USD_Corp AAA_1Y | 0.42 | 1.36 | 2.20 | 2.28 | 2.18 | 1.63 | 0.97 | 0.62 | 0.27 |
| | USD_Corp AAA_5Y | 0.02 | 1.68 | 2.60 | 2.82 | 2.67 | 2.07 | 1.65 | 1.25 | 0.99 |
| | USD_Corp AAA_10Y | 0.47 | 1.63 | 2.55 | 2.67 | 2.60 | 2.29 | 1.76 | 1.34 | 1.01 |
| | USD_Corp BBB_1Y | 0.93 | 2.37 | 3.15 | 3.19 | 3.12 | 2.65 | 1.85 | 1.25 | 0.68 |
| | USD_Corp BBB_5Y | 0.36 | 2.52 | 3.48 | 3.70 | 3.54 | 2.93 | 2.38 | 1.79 | 1.37 |
| | USD_Corp BBB_10Y | 0.05 | 2.66 | 3.70 | 3.83 | 3.75 | 3.36 | 2.64 | 1.99 | 1.49 |
| Municipal Bonds - General Obligations | MUNI_BFV_GO_A_1Y | 0.08 | 0.03 | -0.02 | -0.15 | -0.17 | -0.13 | -0.14 | -0.13 | -0.15 |
| | MUNI_BFV_GO_A_5Y | 0.03 | 0.10 | -0.03 | -0.10 | -0.12 | -0.11 | -0.07 | -0.09 | -0.09 |
| | MUNI_BFV_GO_A_10Y | 0.10 | 0.32 | -0.02 | -0.22 | -0.25 | -0.24 | -0.21 | -0.18 | -0.15 |
| | MUNI_BFV_GO_AA_1Y | 0.12 | -0.02 | -0.05 | -0.23 | -0.15 | -0.16 | -0.16 | -0.16 | -0.17 |
| | MUNI_BFV_GO_AA_5Y | 0.09 | 0.29 | -0.12 | -0.37 | -0.47 | -0.40 | -0.26 | -0.35 | -0.32 |
| | MUNI_BFV_GO_AA_10Y | 0.22 | 0.73 | -0.03 | -0.44 | -0.50 | -0.47 | -0.43 | -0.37 | -0.30 |
| Municipal Bonds - Revenue | MUNI_BFV_TR_AA_1Y | 0.06 | 0.03 | -0.01 | -0.09 | -0.10 | -0.08 | -0.09 | -0.09 | -0.09 |
| | MUNI_BFV_TR_AA_5Y | 0.08 | 0.26 | -0.10 | -0.33 | -0.42 | -0.35 | -0.23 | -0.31 | -0.29 |
| | MUNI_BFV_TR_AA_10Y | 0.23 | 0.75 | -0.03 | -0.45 | -0.52 | -0.49 | -0.45 | -0.38 | -0.31 |
| | MUNI_BFV_UT_A_1Y | 0.12 | 0.05 | -0.03 | -0.21 | -0.23 | -0.18 | -0.20 | -0.18 | -0.21 |
| | MUNI_BFV_UT_A_5Y | 0.09 | 0.29 | -0.12 | -0.39 | -0.50 | -0.42 | -0.26 | -0.36 | -0.33 |
| | MUNI_BFV_UT_A_10Y | 0.20 | 0.68 | -0.03 | -0.42 | -0.48 | -0.45 | -0.41 | -0.35 | -0.28 |
| | MUNI_BFV_UT_AA_1Y | 0.10 | 0.04 | -0.02 | -0.16 | -0.18 | -0.14 | -0.16 | -0.15 | -0.16 |
| | MUNI_BFV_UT_AA_5Y | 0.09 | 0.30 | -0.12 | -0.38 | -0.48 | -0.41 | -0.26 | -0.35 | -0.33 |
| | MUNI_BFV_UT_AA_10Y | 0.22 | 0.72 | -0.03 | -0.43 | -0.50 | -0.47 | -0.43 | -0.37 | -0.30 |
| | MUNI_BFV_ED_AA_1Y | 0.06 | 0.02 | -0.01 | -0.09 | -0.10 | -0.08 | -0.09 | -0.08 | -0.09 |
| | MUNI_BFV_ED_AA_5Y | 0.08 | 0.26 | -0.10 | -0.33 | -0.42 | -0.35 | -0.23 | -0.31 | -0.29 |
| | MUNI_BFV_ED_AA_10Y | 0.22 | 0.75 | -0.03 | -0.45 | -0.52 | -0.49 | -0.45 | -0.38 | -0.31 |
| | MUNI_BFV_REV_A_1Y | 0.09 | 0.04 | -0.02 | -0.17 | -0.19 | -0.14 | -0.16 | -0.15 | -0.17 |
| | MUNI_BFV_REV_A_5Y | 0.08 | 0.25 | -0.10 | -0.33 | -0.43 | -0.36 | -0.23 | -0.31 | -0.29 |
| | MUNI_BFV_REV_A_10Y | 0.11 | 0.34 | -0.02 | -0.23 | -0.27 | -0.25 | -0.23 | -0.19 | -0.16 |
| ABCP | ABCP | 0.03 | 0.54 | 1.01 | 1.31 | 1.41 | 1.40 | 1.30 | 1.09 | 0.88 |
| International Bonds | GBP Belgium 1Y | 0.09 | 0.83 | 1.35 | 1.51 | 1.41 | 1.40 | 1.35 | 1.34 | 1.28 |
| | GBP Belgium 5Y | 0.04 | 0.63 | 1.26 | 1.56 | 1.52 | 1.56 | 1.52 | 1.48 | 1.42 |

| | | | | | | | | | |
|------------------------------|-------|-------|------|------|------|------|------|------|------|
| GBP Belgium 10Y | 1.30 | -0.40 | 1.15 | 1.78 | 1.43 | 1.27 | 1.02 | 0.90 | 0.73 |
| USD International Sweden 1Y | 0.12 | 0.30 | 0.49 | 0.56 | 0.65 | 0.60 | 0.60 | 0.56 | 0.37 |
| USD International Sweden 5Y | -0.23 | 0.12 | 0.30 | 0.41 | 0.52 | 0.47 | 0.49 | 0.46 | 0.29 |
| USD International Sweden 10Y | -0.03 | 0.51 | 0.53 | 0.55 | 0.60 | 0.62 | 0.69 | 0.73 | 0.60 |

K. Appendix F: DFAST 2015 Spread Modeling

No credit spread shocks were applied to US treasury, German sovereign bonds, UK sovereign bonds, Singapore Sovereign bonds, supranational bonds, agency debentures, money market funds and equities.

Table 1: DFAST 2015 Baseline credit spread shock forecasts

| Segment | | PQ1 | PQ2 | PQ3 | PQ4 | PQ5 | PQ6 | PQ7 | PQ8 | PQ9 |
|-------------------------------------|---------------|------|------|-------|------|------|------|-------|------|------|
| Non Agency CMBS | AAA | 0.10 | 0.12 | 0.08 | 0.07 | 0.04 | 0.03 | -0.01 | 0.01 | 0.01 |
| | AA | 0.36 | 0.40 | 0.07 | 0.03 | 0.19 | 0.24 | -0.41 | 0.46 | 0.47 |
| | A | 0.47 | 0.52 | 0.09 | 0.04 | 0.25 | 0.32 | 0.54 | 0.60 | 0.60 |
| | BBB | 0.78 | 0.85 | 0.15 | 0.07 | 0.41 | 0.52 | 0.88 | 0.98 | 0.99 |
| | BB | 1.25 | 1.37 | 0.25 | 0.11 | 0.66 | 0.84 | 1.42 | 1.58 | 1.60 |
| USD CLO | AAA | 0.16 | 0.34 | 0.47 | 0.58 | 0.64 | 0.65 | 0.58 | 0.60 | 0.61 |
| | AA | 0.39 | 0.81 | 1.07 | 1.31 | 1.40 | 1.40 | 1.19 | 1.22 | 1.23 |
| | A | 0.39 | 0.82 | 1.12 | 1.39 | 1.53 | 1.57 | 1.40 | 1.43 | 1.45 |
| | BBB | 0.79 | 1.65 | 2.25 | 2.80 | 3.08 | 3.16 | 2.80 | 2.88 | 2.92 |
| | BB | 0.55 | 1.15 | 1.57 | 1.95 | 2.15 | 2.21 | 1.96 | 2.01 | 2.04 |
| UK RMBS | AAA | 0.16 | 0.39 | 0.46 | 0.48 | 0.46 | 0.44 | 0.36 | 0.32 | 0.36 |
| | AA | 0.23 | 0.55 | 0.65 | 0.68 | 0.65 | 0.62 | 0.51 | 0.46 | 0.51 |
| | A | 0.32 | 0.75 | 0.89 | 0.93 | 0.89 | 0.85 | 0.69 | 0.63 | 0.69 |
| | BBB | 0.54 | 1.28 | 1.51 | 1.59 | 1.51 | 1.45 | 1.18 | 1.07 | 1.18 |
| USD Corporate Bonds Non-Agency RMBS | AAA | 0.00 | 0.01 | 0.01 | 0.03 | 0.04 | 0.06 | 0.07 | 0.10 | 0.13 |
| | AA | 0.00 | 0.02 | 0.02 | 0.05 | 0.08 | 0.10 | 0.12 | 0.18 | 0.24 |
| | A | 0.00 | 0.03 | 0.03 | 0.07 | 0.10 | 0.14 | 0.16 | 0.24 | 0.31 |
| | BBB | 0.00 | 0.06 | 0.05 | 0.12 | 0.18 | 0.24 | 0.29 | 0.42 | 0.55 |
| | BB | 0.00 | 0.11 | 0.09 | 0.23 | 0.36 | 0.47 | 0.57 | 0.83 | 1.08 |
| | B | 0.01 | 0.17 | 0.14 | 0.36 | 0.55 | 0.72 | 0.87 | 1.27 | 1.66 |
| Agency CMBS | CCC | 0.01 | 0.29 | 0.24 | 0.61 | 0.95 | 1.24 | 1.50 | 2.19 | 2.87 |
| | | 0.09 | 0.11 | 0.07 | 0.06 | 0.03 | 0.03 | -0.01 | 0.01 | 0.00 |
| | | | | | | | | | | |
| Agency MBS OAS | 30Y | 0.00 | 0.03 | -0.01 | 0.04 | 0.11 | 0.13 | 0.16 | 0.17 | 0.23 |
| | 15Y | 0.00 | 0.03 | -0.01 | 0.04 | 0.11 | 0.14 | 0.17 | 0.19 | 0.25 |
| | Hybrid | 0.00 | 0.03 | -0.01 | 0.04 | 0.11 | 0.14 | 0.17 | 0.19 | 0.25 |

| | CMO | 0.00 | 0.03 | -0.01 | 0.04 | 0.11 | 0.14 | 0.17 | 0.19 | 0.25 |
|--------------------------------|-------------------|-------|-------|-------|------|-------|------|------|------|------|
| EUR Sovereign Bonds | CORE | 0.03 | 0.04 | 0.07 | 0.08 | 0.09 | 0.10 | 0.12 | 0.13 | 0.15 |
| | PERIPHERAL | 0.18 | 0.38 | 0.50 | 0.62 | 0.68 | 0.73 | 0.77 | 0.81 | 0.89 |
| EUR BILLS | | 0.04 | 0.08 | 0.13 | 0.16 | 0.17 | 0.19 | 0.22 | 0.23 | 0.26 |
| USD COVERED BONDS | | -0.01 | 0.00 | 0.01 | 0.02 | 0.02 | 0.03 | 0.04 | 0.05 | 0.05 |
| EUR COVERED/ CORP BONDS | | -0.01 | -0.02 | -0.01 | 0.01 | 0.01 | 0.02 | 0.05 | 0.08 | 0.11 |
| EUR RMBS | AA | 0.33 | 0.63 | 0.76 | 0.76 | 0.76 | 0.72 | 0.68 | 0.58 | 0.63 |
| | A | 0.72 | 1.37 | 1.65 | 1.63 | 1.64 | 1.55 | 1.46 | 1.25 | 1.36 |
| | BBB | 1.22 | 2.30 | 2.76 | 2.72 | 2.73 | 2.59 | 2.45 | 2.09 | 2.27 |
| Auto ABS | AA | 0.11 | 0.27 | 0.34 | 0.46 | 0.51 | 0.54 | 0.49 | 0.53 | 0.55 |
| | A | 0.19 | 0.45 | 0.58 | 0.77 | 0.85 | 0.91 | 0.83 | 0.90 | 0.93 |
| | BBB | 0.28 | 0.67 | 0.86 | 1.15 | 1.27 | 1.36 | 1.24 | 1.34 | 1.38 |
| | BB | 0.45 | 1.08 | 1.38 | 1.85 | 2.05 | 2.18 | 1.99 | 2.15 | 2.22 |
| CREDIT CARD ABS | | 0.03 | 0.08 | 0.08 | 0.10 | 0.10 | 0.09 | 0.06 | 0.05 | 0.04 |
| STUDENT LOAN ABS | | 0.17 | 0.26 | 0.30 | 0.35 | 0.36 | 0.37 | 0.34 | 0.36 | 0.38 |
| TOTAL ABS | | 0.02 | 0.09 | 0.14 | 0.16 | 0.18 | 0.18 | 0.18 | 0.16 | 0.16 |
| Municipal Bonds AAA | 1Y | 0.05 | 0.07 | 0.12 | 0.30 | 0.43 | 0.56 | 0.62 | 0.84 | 1.13 |
| | 2Y | 0.07 | 0.09 | 0.15 | 0.37 | 0.52 | 0.66 | 0.72 | 0.95 | 1.25 |
| | 5Y | 0.11 | 0.15 | 0.22 | 0.49 | 0.65 | 0.79 | 0.85 | 1.07 | 1.34 |
| | 10Y | 0.14 | 0.17 | 0.23 | 0.45 | 0.55 | 0.66 | 0.69 | 0.84 | 1.02 |
| | 30Y | 0.10 | 0.12 | 0.12 | 0.18 | 0.19 | 0.22 | 0.22 | 0.27 | 0.33 |
| Municipal Bonds AA | 1Y | 0.07 | 0.10 | 0.16 | 0.43 | 0.62 | 0.80 | 0.88 | 1.20 | 1.60 |
| | 2Y | 0.08 | 0.12 | 0.19 | 0.48 | 0.66 | 0.84 | 0.91 | 1.21 | 1.57 |
| | 5Y | 0.12 | 0.16 | 0.24 | 0.51 | 0.67 | 0.81 | 0.87 | 1.09 | 1.36 |
| | 10Y | 0.14 | 0.18 | 0.22 | 0.43 | 0.52 | 0.62 | 0.64 | 0.79 | 0.96 |
| | 30Y | 0.10 | 0.11 | 0.10 | 0.13 | 0.12 | 0.14 | 0.13 | 0.16 | 0.20 |
| Municipal Bonds A | 1Y | 0.09 | 0.13 | 0.20 | 0.47 | 0.65 | 0.81 | 0.87 | 1.14 | 1.46 |
| | 2Y | 0.11 | 0.15 | 0.23 | 0.53 | 0.70 | 0.87 | 0.94 | 1.20 | 1.51 |
| | 5Y | 0.14 | 0.19 | 0.26 | 0.54 | 0.68 | 0.82 | 0.87 | 1.08 | 1.33 |
| | 10Y | 0.14 | 0.17 | 0.20 | 0.37 | 0.43 | 0.51 | 0.53 | 0.64 | 0.78 |
| | 30Y | 0.08 | 0.08 | 0.05 | 0.02 | -0.03 | 0.04 | 0.06 | 0.06 | 0.06 |
| Municipal Bonds BBB | 1Y | 0.12 | 0.17 | 0.26 | 0.59 | 0.79 | 0.98 | 1.05 | 1.35 | 1.70 |
| | 2Y | 0.17 | 0.22 | 0.33 | 0.73 | 0.96 | 1.17 | 1.26 | 1.59 | 2.00 |
| | 5Y | 0.20 | 0.25 | 0.33 | 0.65 | 0.80 | 0.96 | 1.01 | 1.25 | 1.53 |
| | 10Y | 0.19 | 0.22 | 0.24 | 0.40 | 0.45 | 0.53 | 0.54 | 0.66 | 0.80 |
| | 30Y | 0.15 | 0.14 | 0.06 | 0.05 | 0.16 | 0.19 | 0.24 | 0.28 | 0.29 |
| ABCP | | 0.01 | 0.29 | 0.24 | 0.61 | 0.95 | 1.24 | 1.50 | 2.19 | 2.87 |

Table 2: DFAST 2015 Adverse credit spread shock forecasts

| Segment | | PQ1 | PQ2 | PQ3 | PQ4 | PQ5 | PQ6 | PQ7 | PQ8 | PQ9 |
|-------------------------------------|-------------------|------|-------|-------|-------|-------|-------|-------|------|------|
| Non Agency CMBS | AAA | 0.44 | 0.55 | 0.53 | 0.50 | 0.37 | 0.28 | 0.21 | 0.14 | 0.09 |
| | AA | 2.01 | 3.21 | 2.62 | 2.51 | 1.76 | 1.38 | 1.09 | 0.75 | 0.53 |
| | A | 2.62 | 4.17 | 3.41 | 3.26 | 2.29 | 1.80 | 1.41 | 0.97 | 0.68 |
| | BBB | 4.30 | 6.86 | 5.61 | 5.37 | 3.76 | 2.95 | 2.32 | 1.60 | 1.13 |
| | BB | 6.93 | 11.04 | 9.03 | 8.64 | 6.05 | 4.75 | 3.74 | 2.58 | 1.81 |
| USD CLO | AAA | 0.75 | 1.58 | 2.58 | 3.28 | 3.31 | 2.95 | 2.36 | 1.76 | 1.22 |
| | AA | 1.84 | 3.98 | 6.58 | 8.19 | 7.75 | 6.39 | 4.72 | 3.25 | 2.06 |
| | A | 1.81 | 3.80 | 6.19 | 7.89 | 7.96 | 7.08 | 5.68 | 4.24 | 2.93 |
| | BBB | 3.63 | 7.64 | 12.43 | 15.84 | 15.99 | 14.22 | 11.40 | 8.51 | 5.88 |
| | BB | 2.54 | 5.33 | 8.67 | 11.06 | 11.15 | 9.92 | 7.96 | 5.94 | 4.10 |
| UK RMBS Bonds | AAA | 0.82 | 2.81 | 5.24 | 7.25 | 5.90 | 3.64 | 2.05 | 1.11 | 0.57 |
| | AA | 1.17 | 4.00 | 7.47 | 10.33 | 8.40 | 5.18 | 2.93 | 1.58 | 0.82 |
| | A | 1.60 | 5.46 | 10.20 | 14.10 | 11.47 | 7.07 | 4.00 | 2.16 | 1.12 |
| | BBB | 2.71 | 9.28 | 17.33 | 23.96 | 19.50 | 12.02 | 6.79 | 3.67 | 1.90 |
| USD Corporate Bonds Non-Agency RMBS | AAA | 0.19 | 0.49 | 0.77 | 0.95 | 0.90 | 0.57 | 0.37 | 0.24 | 0.14 |
| | AA | 0.35 | 0.90 | 1.41 | 1.74 | 1.66 | 1.05 | 0.68 | 0.43 | 0.26 |
| | A | 0.46 | 1.18 | 1.85 | 2.29 | 2.17 | 1.38 | 0.90 | 0.57 | 0.34 |
| | BBB | 0.81 | 2.09 | 3.28 | 4.07 | 3.86 | 2.46 | 1.59 | 1.01 | 0.60 |
| | BB | 1.58 | 4.08 | 6.41 | 7.95 | 7.54 | 4.80 | 3.11 | 1.97 | 1.17 |
| | B | 2.43 | 6.26 | 9.84 | 12.21 | 11.58 | 7.37 | 4.77 | 3.03 | 1.80 |
| Agency CMBS | CCC | 4.18 | 10.79 | 16.96 | 21.03 | 19.96 | 12.70 | 8.22 | 5.21 | 3.10 |
| | | 0.44 | 0.56 | 0.54 | 0.51 | 0.36 | 0.27 | 0.19 | 0.13 | 0.08 |
| Agency MBS OAS | 30Y | 0.14 | 0.29 | 0.43 | 0.53 | 0.50 | 0.41 | 0.32 | 0.24 | 0.19 |
| | 15Y | 0.15 | 0.31 | 0.46 | 0.57 | 0.53 | 0.44 | 0.34 | 0.26 | 0.21 |
| | Hybrid | 0.15 | 0.31 | 0.46 | 0.57 | 0.53 | 0.44 | 0.34 | 0.26 | 0.21 |
| | CMO | 0.15 | 0.31 | 0.46 | 0.57 | 0.53 | 0.44 | 0.34 | 0.26 | 0.21 |
| EUR Sovereign Bonds | CORE | 0.19 | 0.45 | 0.58 | 0.68 | 0.50 | 0.37 | 0.28 | 0.18 | 0.14 |
| | PERIPHERAL | 1.20 | 1.96 | 2.40 | 2.77 | 2.50 | 1.96 | 1.55 | 1.15 | 0.91 |
| EUR BILLS | | 0.27 | 0.64 | 0.84 | 1.01 | 0.80 | 0.58 | 0.43 | 0.27 | 0.19 |
| USD COVERED BONDS | | 2.48 | 2.85 | 2.41 | 2.28 | 1.37 | 1.08 | 0.90 | 0.74 | 0.58 |
| EUR COVERED/ CORP BONDS | | 1.17 | 2.94 | 4.47 | 5.14 | 2.86 | 1.49 | 0.81 | 0.45 | 0.27 |
| EUR RMBS | AA | 1.58 | 6.25 | 7.83 | 10.64 | 6.86 | 3.13 | 1.78 | 0.98 | 0.58 |
| | A | 3.46 | 13.52 | 17.04 | 23.14 | 14.81 | 6.71 | 3.78 | 2.06 | 1.21 |
| | BBB | 5.82 | 22.62 | 28.59 | 38.80 | 24.77 | 11.17 | 6.28 | 3.41 | 1.99 |
| Auto ABS | AA | 0.66 | 1.87 | 3.80 | 6.43 | 6.93 | 5.39 | 3.36 | 1.82 | 0.86 |
| | A | 1.12 | 3.16 | 6.43 | 10.87 | 11.72 | 9.11 | 5.68 | 3.07 | 1.45 |
| | BBB | 1.67 | 4.72 | 9.58 | 16.20 | 17.47 | 13.58 | 8.46 | 4.58 | 2.17 |
| | BB | 2.68 | 7.58 | 15.39 | 26.03 | 28.07 | 21.82 | 13.59 | 7.36 | 3.48 |
| CREDIT CARD ABS | | 0.17 | 0.58 | 1.01 | 1.28 | 1.40 | 1.25 | 0.92 | 0.62 | 0.28 |
| STUDENT LOAN ABS | | 0.59 | 0.93 | 1.22 | 1.38 | 1.28 | 1.08 | 0.83 | 0.57 | 0.34 |

| | | | | | | | | | | |
|----------------------------|------------|-------|-------|-------|-------|-------|-------|------|------|------|
| TOTAL ABS | | 0.16 | 0.27 | 0.48 | 0.66 | 0.60 | 0.52 | 0.39 | 0.22 | 0.12 |
| Municipal Bonds AAA | 1Y | 0.78 | 0.99 | 1.33 | 1.30 | 1.15 | 1.06 | 0.88 | 0.84 | 0.79 |
| | 2Y | 0.88 | 1.15 | 1.51 | 1.53 | 1.35 | 1.24 | 1.04 | 0.98 | 0.92 |
| | 5Y | 0.98 | 1.32 | 1.68 | 1.76 | 1.58 | 1.43 | 1.23 | 1.15 | 1.08 |
| | 10Y | 0.75 | 1.10 | 1.36 | 1.49 | 1.35 | 1.20 | 1.04 | 0.96 | 0.89 |
| | 30Y | 0.21 | 0.47 | 0.59 | 0.73 | 0.65 | 0.54 | 0.46 | 0.39 | 0.35 |
| Municipal Bonds AA | 1Y | 1.11 | 1.40 | 1.86 | 1.82 | 1.60 | 1.49 | 1.24 | 1.19 | 1.12 |
| | 2Y | 1.11 | 1.45 | 1.89 | 1.90 | 1.69 | 1.55 | 1.31 | 1.23 | 1.17 |
| | 5Y | 1.00 | 1.36 | 1.72 | 1.81 | 1.63 | 1.47 | 1.27 | 1.18 | 1.11 |
| | 10Y | 0.69 | 1.06 | 1.32 | 1.48 | 1.33 | 1.17 | 1.01 | 0.92 | 0.85 |
| | 30Y | 0.10 | 0.36 | 0.48 | 0.63 | 0.55 | 0.43 | 0.36 | 0.29 | 0.25 |
| Municipal Bonds A | 1Y | 1.05 | 1.37 | 1.76 | 1.79 | 1.60 | 1.47 | 1.25 | 1.18 | 1.11 |
| | 2Y | 1.11 | 1.45 | 1.84 | 1.90 | 1.70 | 1.55 | 1.33 | 1.25 | 1.19 |
| | 5Y | 0.98 | 1.37 | 1.70 | 1.82 | 1.64 | 1.48 | 1.28 | 1.19 | 1.12 |
| | 10Y | 0.55 | 0.92 | 1.14 | 1.31 | 1.18 | 1.02 | 0.88 | 0.79 | 0.72 |
| | 30Y | -0.12 | 0.13 | 0.21 | 0.38 | 0.32 | 0.20 | 0.15 | 0.08 | 0.04 |
| Municipal Bonds BBB | 1Y | 1.24 | 1.62 | 2.06 | 2.12 | 1.90 | 1.74 | 1.49 | 1.41 | 1.33 |
| | 2Y | 1.46 | 1.97 | 2.50 | 2.63 | 2.35 | 2.13 | 1.83 | 1.71 | 1.60 |
| | 5Y | 1.11 | 1.66 | 2.09 | 2.30 | 2.07 | 1.82 | 1.57 | 1.43 | 1.33 |
| | 10Y | 0.53 | 1.05 | 1.33 | 1.60 | 1.43 | 1.19 | 1.02 | 0.88 | 0.79 |
| | 30Y | -0.39 | 0.09 | 0.22 | 0.55 | 0.44 | 0.21 | 0.14 | 0.00 | 0.07 |
| ABCP | | 4.18 | 10.79 | 16.96 | 21.03 | 19.96 | 12.70 | 8.22 | 5.21 | 3.10 |

Table 3 - Baseline: Difference in forecasted spread shock Test run vs. DFAST 2015 assumptions

| Asset Type | Segment | Approx Exposure (\$mm) | PQ1 | PQ2 | PQ3 | PQ4 | PQ5 | PQ6 | PQ7 | PQ8 | PQ9 |
|----------------------|------------------|------------------------|------|------|------|-------|-------|-------|-------|-------|-------|
| Agency MBS 15Y FNMA | FNMA15_CC | \$ 3,477 | 0.07 | 0.06 | 0.17 | 0.12 | 0.03 | -0.01 | -0.02 | -0.04 | -0.09 |
| | FNMA15_4 | \$ 725 | 0.06 | 0.02 | 0.09 | 0.01 | -0.10 | -0.14 | -0.16 | -0.21 | -0.30 |
| | FNMA15_4p5 | \$ 773 | 0.11 | 0.07 | 0.16 | 0.06 | -0.06 | -0.10 | -0.10 | -0.15 | -0.25 |
| Agency MBS 15Y FHLMC | FHLMC15_CC | \$ 3,091 | 0.10 | 0.08 | 0.14 | 0.08 | 0.02 | 0.02 | 0.04 | 0.03 | -0.03 |
| | FHLMC15_4 | \$ 670 | 0.07 | 0.02 | 0.14 | 0.11 | 0.05 | 0.05 | 0.09 | 0.08 | -0.01 |
| | FHLMC15_4p5_2005 | \$ 126 | 0.09 | 0.05 | 0.15 | 0.08 | -0.04 | -0.09 | -0.11 | -0.17 | -0.27 |
| | FHLMC15_4p5_2009 | \$ 348 | 0.12 | 0.06 | 0.13 | 0.09 | 0.05 | 0.06 | 0.09 | 0.10 | 0.05 |
| | FHLMC15_5_2005 | \$ 59 | 0.17 | 0.13 | 0.26 | 0.19 | 0.08 | 0.06 | 0.11 | 0.09 | 0.02 |
| | FHLMC15_5_2008 | \$ 200 | 0.21 | 0.17 | 0.27 | 0.17 | 0.03 | -0.01 | 0.00 | -0.05 | -0.15 |
| Agency MBS 15Y GNMA | GNMA15_CC | \$ 1 | 0.06 | 0.01 | 0.10 | -0.01 | -0.15 | -0.20 | -0.21 | -0.27 | -0.38 |
| Agency MBS 30Y FNMA | FNMA30_CC | \$ 289 | 0.12 | 0.09 | 0.18 | 0.07 | -0.08 | -0.14 | -0.15 | -0.20 | -0.32 |
| | FNMA30_4p5 | \$ 111 | 0.12 | 0.10 | 0.19 | 0.08 | -0.08 | -0.13 | -0.15 | -0.20 | -0.32 |
| | FNMA30_5p5 | \$ 306 | 0.11 | 0.09 | 0.15 | 0.10 | 0.04 | 0.07 | 0.09 | 0.10 | 0.05 |

| | | | | | | | | | | | |
|----------------------|-------------------------|----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Agency MBS 30Y FHLMC | FHLMC30_CC | \$ 144 | 0.03 | 0.05 | 0.12 | 0.11 | 0.05 | 0.02 | 0.03 | 0.05 | 0.03 |
| Agency MBS 30Y GNMA | GNMA30_CC | \$ 117 | 0.08 | 0.07 | 0.18 | 0.11 | -0.01 | -0.05 | -0.07 | -0.11 | -0.19 |
| Agency Hybrid | FNMA5_1_3 | \$ 1,714 | 0.12 | 0.09 | 0.20 | 0.14 | 0.06 | 0.01 | -0.01 | -0.04 | -0.11 |
| | FHLM5_1_3 | \$ 621 | 0.17 | 0.16 | 0.30 | 0.21 | 0.12 | 0.04 | 0.05 | 0.00 | -0.08 |
| Agency CMO | CMO_PAC_2WAL | \$ 528 | 0.28 | 0.53 | 0.60 | 0.72 | 0.73 | 0.85 | 0.89 | 1.20 | 1.33 |
| | CMO_PAC_10WAL | | 0.24 | 0.43 | 0.50 | 0.59 | 0.54 | 0.60 | 0.62 | 0.84 | 0.93 |
| | CMO_SEQ_2WAL | \$ 885 | 0.23 | 0.40 | 0.44 | 0.52 | 0.48 | 0.57 | 0.56 | 0.81 | 0.91 |
| | CMO_SEQ_10WAL | | 0.23 | 0.45 | 0.50 | 0.57 | 0.57 | 0.67 | 0.68 | 0.96 | 1.09 |
| | CMO_FLTSTR_6p5 | \$ 4,913 | 0.09 | 0.10 | 0.16 | 0.21 | 0.20 | 0.24 | 0.29 | 0.37 | 0.38 |
| | CMO_FLTSTR_7 | \$ 3,964 | 0.08 | 0.09 | 0.14 | 0.19 | 0.17 | 0.21 | 0.25 | 0.32 | 0.31 |
| | CMO_FLTFLT_6p5 | \$ 971 | 0.09 | 0.11 | 0.17 | 0.24 | 0.23 | 0.27 | 0.33 | 0.41 | 0.41 |
| | CMO_FLTFLT_7 | \$ 860 | 0.08 | 0.08 | 0.14 | 0.19 | 0.18 | 0.21 | 0.25 | 0.32 | 0.31 |
| | GNMA_CMBS | \$ 163 | -0.03 | -0.03 | 0.02 | 0.05 | 0.05 | 0.05 | 0.09 | 0.09 | 0.08 |
| Agency CMBS | FNMA_DUS_5to10Y | \$ 3,245 | 0.03 | -0.03 | 0.11 | 0.14 | 0.25 | 0.20 | 0.25 | 0.30 | 0.29 |
| | FHLMC_CMBS_A2_10Y | \$ 478 | 0.09 | 0.05 | 0.17 | 0.18 | 0.22 | 0.14 | 0.24 | 0.21 | 0.13 |
| | CMBS_2005_A | \$ 1,180 | 0.96 | 0.92 | 1.46 | 1.24 | 1.17 | 0.97 | 1.20 | 1.06 | 0.96 |
| Non Agency CMBS | CMBS_2005_AM | \$ 295 | 1.86 | 1.89 | 3.21 | 3.36 | 3.58 | 3.10 | 3.63 | 3.51 | 3.27 |
| | CMBS_2005_AJ | \$ 188 | 2.83 | 2.54 | 4.70 | 4.43 | 4.47 | 3.99 | 4.77 | 4.57 | 4.24 |
| Agency Bonds | AgencyDeb_Srt | \$ 385 | 0.10 | 0.10 | 0.13 | 0.09 | 0.09 | 0.08 | 0.11 | 0.09 | 0.08 |
| CLO | CLO_AAA_3M | \$ 2,260 | 0.36 | 0.13 | 0.24 | 0.11 | 0.01 | -0.10 | -0.02 | -0.10 | -0.14 |
| | CLO_AA_3M | | 1.49 | 0.85 | 1.46 | 0.95 | 0.72 | 0.35 | 0.77 | 0.58 | 0.42 |
| ABS | ABS_AT_AAA | \$ 1,519 | 0.21 | 0.06 | 0.15 | -0.09 | -0.18 | -0.16 | 0.15 | -0.03 | -0.06 |
| | ABS_CC_AAA | \$ 1,093 | 0.35 | 0.27 | 0.43 | 0.22 | 0.16 | 0.11 | 0.29 | 0.19 | 0.15 |
| | ABS_SL_AAA | \$ 791 | 0.10 | -0.06 | 0.13 | -0.08 | -0.07 | -0.14 | 0.03 | -0.08 | -0.14 |
| Covered Bonds | iBoxx_Canada_Cov | \$ 1,165 | 0.20 | 0.32 | 0.38 | 0.38 | 0.33 | 0.25 | 0.24 | 0.24 | 0.20 |
| | iBoxx_EUR_Canada | \$ 117 | 0.13 | 0.23 | 0.27 | 0.29 | 0.22 | 0.18 | 0.14 | 0.12 | 0.07 |
| | iBoxx_EUR_GB | \$ 711 | 0.44 | 0.76 | 0.92 | 1.01 | 0.83 | 0.72 | 0.67 | 0.68 | 0.57 |
| | iBoxx_EUR_Ntlnds | \$ 215 | 0.10 | 0.31 | 0.30 | 0.40 | 0.29 | 0.25 | 0.16 | 0.20 | 0.12 |
| | iBoxx_EUR_Scandi | \$ 569 | 0.15 | 0.27 | 0.30 | 0.34 | 0.27 | 0.22 | 0.17 | 0.18 | 0.11 |
| Non Agency RMBS | RMBS_Prime_AAA | \$ 1,185 | 0.80 | -0.05 | 0.48 | 0.40 | 0.40 | -0.16 | -0.40 | -1.22 | -1.85 |
| | RMBS_Alta_AAA | \$ 1,608 | 0.83 | -0.16 | 1.08 | 0.92 | 0.49 | -0.12 | -0.38 | -1.13 | -1.62 |
| | RMBS_Alta_AA | \$ 31 | 1.50 | 0.91 | 2.39 | 2.54 | 1.88 | 0.93 | 0.54 | -0.29 | -0.73 |
| | RMBS_SubPrime_AAA | \$ 423 | 0.89 | 0.21 | 0.99 | 1.38 | 1.61 | 0.92 | 0.55 | -0.40 | -1.05 |
| EUR MBS | EUR_DCH_RMBS_AA | | 1.40 | 0.85 | 1.40 | 1.22 | 1.11 | 0.89 | 1.26 | 1.24 | 1.11 |
| | EUR_DCH_RMBS_5to10Y_AAA | \$ 249 | 0.06 | -0.31 | -0.33 | -0.34 | -0.37 | -0.37 | -0.25 | -0.17 | -0.22 |
| | EUR_IR_RMBS BBB | \$ 183 | 1.47 | 7.88 | 8.59 | 9.99 | 9.93 | 5.92 | 7.14 | 9.95 | 11.35 |
| GBP MBS | GBP_UK_RMBS_0to3Y_AAA | \$ 792 | -0.30 | -0.59 | -0.62 | -0.63 | -0.58 | -0.54 | -0.45 | -0.39 | -0.42 |
| EUR Sovereigns | SOV_EUR_FRA | \$ 4,248 | -0.13 | -0.09 | -0.12 | -0.08 | -0.06 | -0.05 | -0.04 | -0.02 | -0.03 |
| | SOV_EUR_NLD | \$ 1,236 | 0.00 | 0.08 | 0.15 | 0.20 | 0.24 | 0.29 | 0.31 | 0.34 | 0.33 |
| | SOV_EUR_BEL | \$ 946 | -0.21 | -0.25 | -0.23 | -0.21 | -0.15 | -0.09 | -0.06 | 0.00 | 0.04 |
| | SOV_EUR_ITA | \$ 1,154 | -0.31 | -0.61 | -0.65 | -0.71 | -0.69 | -0.67 | -0.64 | -0.63 | -0.66 |
| | SOV_EUR_SPA | \$ 1,815 | -0.43 | -0.02 | 0.00 | -0.02 | 0.10 | 0.11 | 0.07 | 0.05 | -0.02 |
| | SOV_EUR_IRL | \$ 801 | -0.32 | -0.16 | -0.35 | -0.40 | -0.44 | -0.46 | -0.40 | -0.35 | -0.32 |

| | | | | | | | | | | | |
|---------------------------------------|------------------------------|----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | SOV_EUR_SWE | | 0.28 | 0.04 | 0.20 | -0.10 | -0.32 | -0.44 | -0.35 | -0.50 | -0.75 |
| EUR Corporates | EUR_Corp_A | \$ 159 | 0.45 | 0.42 | 0.69 | 0.51 | 0.35 | 0.26 | 0.35 | 0.22 | 0.03 |
| | EUR_Corp_AA | \$ 84 | 0.57 | 0.57 | 0.78 | 0.62 | 0.49 | 0.39 | 0.49 | 0.36 | 0.14 |
| | EUR_Corp_BBB | \$ 117 | 0.19 | 0.19 | 0.31 | 0.22 | 0.15 | 0.09 | 0.13 | 0.05 | -0.05 |
| GBP Corporates | GBP_Corp | \$ 64 | 0.26 | 0.02 | 0.21 | 0.01 | -0.11 | -0.18 | 0.04 | -0.04 | -0.27 |
| USD corporates | USD_Corp_A | \$ 932 | 0.27 | 0.23 | 0.42 | 0.25 | 0.12 | 0.02 | 0.09 | -0.07 | -0.28 |
| | USD_Corp_AA | \$ 349 | 0.17 | 0.14 | 0.26 | 0.15 | 0.06 | 0.00 | 0.04 | -0.07 | -0.21 |
| | USD_Corp AAA | \$ 112 | 0.42 | 0.41 | 0.66 | 0.47 | 0.31 | 0.20 | 0.33 | 0.19 | -0.05 |
| | USD_Corp BBB | \$ 49 | 0.02 | 0.01 | 0.09 | 0.09 | 0.07 | 0.09 | 0.15 | 0.09 | 0.02 |
| Municipal Bonds - General Obligations | MUNI_BFV_GO_A_1Y | \$ 243 | -0.03 | 0.00 | 0.04 | -0.14 | -0.29 | -0.36 | -0.32 | -0.47 | -0.69 |
| | MUNI_BFV_GO_A_5Y | | -0.14 | -0.18 | -0.21 | -0.44 | -0.55 | -0.62 | -0.53 | -0.70 | -0.89 |
| | MUNI_BFV_GO_A_10Y | | -0.14 | -0.12 | -0.07 | -0.16 | -0.15 | -0.18 | -0.11 | -0.16 | -0.28 |
| | MUNI_BFV_GO_AA_1Y | \$ 1,410 | 0.03 | 0.10 | 0.23 | 0.06 | -0.05 | -0.04 | 0.08 | 0.04 | -0.14 |
| | MUNI_BFV_GO_AA_5Y | | -0.13 | -0.14 | -0.08 | -0.23 | -0.30 | -0.28 | -0.04 | -0.18 | -0.34 |
| | MUNI_BFV_GO_AA_10Y | | -0.14 | -0.06 | 0.06 | 0.04 | 0.13 | 0.13 | 0.36 | 0.37 | 0.25 |
| Municipal Bonds - Revenue | MUNI_BFV_TR_AA_1Y | \$ 650 | -0.02 | 0.00 | 0.05 | -0.13 | -0.28 | -0.35 | -0.30 | -0.43 | -0.66 |
| | MUNI_BFV_TR_AA_5Y | | -0.13 | -0.14 | -0.10 | -0.26 | -0.34 | -0.33 | -0.12 | -0.26 | -0.43 |
| | MUNI_BFV_TR_AA_10Y | | -0.14 | -0.06 | 0.07 | 0.05 | 0.15 | 0.15 | 0.39 | 0.40 | 0.29 |
| | MUNI_BFV_UT_A_1Y | \$ 10 | 0.00 | 0.05 | 0.16 | 0.01 | -0.11 | -0.13 | -0.03 | -0.10 | -0.24 |
| | MUNI_BFV_UT_A_5Y | | -0.15 | -0.17 | -0.11 | -0.27 | -0.32 | -0.31 | -0.09 | -0.22 | -0.38 |
| | MUNI_BFV_UT_A_10Y | | -0.14 | -0.06 | 0.06 | 0.07 | 0.17 | 0.18 | 0.39 | 0.42 | 0.33 |
| | MUNI_BFV_UT_AA_1Y | \$ 48 | 0.00 | 0.06 | 0.18 | 0.04 | -0.09 | -0.10 | 0.01 | -0.06 | -0.22 |
| | MUNI_BFV_UT_AA_5Y | | -0.13 | -0.14 | -0.08 | -0.23 | -0.30 | -0.27 | -0.03 | -0.16 | -0.33 |
| | MUNI_BFV_UT_AA_10Y | | -0.14 | -0.06 | 0.06 | 0.03 | 0.12 | 0.12 | 0.35 | 0.36 | 0.24 |
| | MUNI_BFV_ED_AA_1Y | \$ 500 | -0.03 | 0.00 | 0.05 | -0.14 | -0.29 | -0.36 | -0.31 | -0.45 | -0.68 |
| | MUNI_BFV_ED_AA_5Y | | -0.13 | -0.14 | -0.10 | -0.26 | -0.34 | -0.33 | -0.12 | -0.26 | -0.43 |
| | MUNI_BFV_ED_AA_10Y | | -0.14 | -0.06 | 0.07 | 0.05 | 0.15 | 0.15 | 0.39 | 0.40 | 0.28 |
| ABCP | MUNI_BFV_REV_A_1Y | \$ 2,089 | -0.02 | 0.02 | 0.08 | -0.09 | -0.23 | -0.27 | -0.21 | -0.33 | -0.52 |
| | MUNI_BFV_REV_A_5Y | | -0.15 | -0.18 | -0.13 | -0.30 | -0.37 | -0.38 | -0.19 | -0.33 | -0.50 |
| | MUNI_BFV_REV_A_10Y | | -0.14 | -0.11 | -0.06 | -0.15 | -0.13 | -0.16 | -0.08 | -0.12 | -0.24 |
| | ABCP | \$ 1,551 | -0.04 | -0.14 | -0.01 | -0.30 | -0.66 | -0.93 | -1.11 | -1.78 | -2.43 |
| International Bonds | GBP Belgium 1Y | \$ 111 | -0.11 | -0.33 | -0.51 | -0.63 | -0.80 | -0.99 | -1.22 | -1.47 | -1.66 |
| | GBP Belgium 5Y | | 0.17 | -0.02 | -0.20 | -0.34 | -0.46 | -0.58 | -0.71 | -0.90 | -1.05 |
| | GBP Belgium 10Y | | -0.51 | -0.48 | -0.48 | -0.56 | -0.60 | -0.60 | -0.57 | -0.66 | -0.75 |
| | USD International Sweden 1Y | \$ 85 | -0.15 | -0.28 | -0.41 | -0.56 | -0.84 | -1.21 | -1.64 | -2.07 | -2.46 |
| | USD International Sweden 5Y | | -0.38 | -0.28 | -0.58 | -0.67 | -0.96 | -1.52 | -1.59 | -1.73 | -1.69 |
| | USD International Sweden 10Y | | -0.29 | 0.11 | -0.30 | -0.50 | -0.68 | -1.09 | -1.29 | -1.25 | -1.20 |

Table 4 – Stress scenario: Difference in forecasted spread shock Test run vs. DFAST 2015 assumptions

| Asset Type | Segment | Approx Exposure (\$mm) | PQ1 | PQ2 | PQ3 | PQ4 | PQ5 | PQ6 | PQ7 | PQ8 | PQ9 |
|---------------------|-----------|------------------------|-------|------|------|------|------|------|------|------|------|
| Agency MBS 15Y FNMA | FNMA15_CC | \$ 3,477 | -0.04 | 0.07 | 0.23 | 0.26 | 0.35 | 0.39 | 0.33 | 0.21 | 0.00 |

| | | \$ | 725 | -0.06 | -0.05 | -0.05 | -0.12 | -0.09 | -0.06 | -0.06 | -0.08 | -0.08 | -0.08 |
|----------------------|-------------------|----|-------|-------|-------|--------|-------|-------|-------|-------|-------|-------|-------|
| | FNMA15_4 | \$ | 725 | -0.06 | -0.05 | -0.05 | -0.12 | -0.09 | -0.06 | -0.06 | -0.08 | -0.08 | -0.08 |
| | FNMA15_4p5 | \$ | 773 | 0.01 | 0.15 | 0.28 | 0.23 | 0.23 | 0.22 | 0.15 | 0.04 | 0.04 | 0 |
| Agency MBS 15Y FHLMC | FHLMC15_CC | \$ | 3,091 | -0.02 | 0.04 | 0.13 | -0.08 | -0.14 | -0.14 | -0.15 | -0.15 | -0.17 | -0.17 |
| | FHLMC15_4 | \$ | 670 | 0.01 | 0.2 | 0.06 | -0.11 | -0.15 | -0.13 | -0.15 | -0.19 | -0.19 | -0.19 |
| | FHLMC15_4p5_2005 | \$ | 126 | -0.02 | 0.06 | 0.19 | 0.24 | 0.34 | 0.41 | 0.37 | 0.25 | 0.1 | 0.1 |
| | FHLMC15_4p5_2009 | \$ | 348 | -0.03 | 0.15 | 0.24 | -0.01 | -0.11 | -0.12 | -0.13 | -0.15 | -0.15 | -0.15 |
| | FHLMC15_5_2005 | \$ | 59 | 0.1 | 0.35 | 0.45 | 0.36 | 0.33 | 0.31 | 0.21 | 0.08 | 0.08 | 0.08 |
| | FHLMC15_5_2008 | \$ | 200 | 0.13 | 0.3 | 0.42 | 0.38 | 0.38 | 0.37 | 0.28 | 0.15 | 0.15 | 0.15 |
| Agency MBS 15Y GNMA | GNMA15_CC | \$ | 1 | -0.04 | 0.08 | 0.18 | 0.14 | 0.16 | 0.16 | 0.09 | -0.01 | -0.01 | -0.01 |
| Agency MBS 30Y FNMA | FNMA30_CC | \$ | 289 | 0.04 | 0.23 | 0.42 | 0.44 | 0.46 | 0.45 | 0.33 | 0.17 | 0.0 | 0.0 |
| | FNMA30_4p5 | \$ | 111 | 0.03 | 0.22 | 0.42 | 0.47 | 0.49 | 0.48 | 0.36 | 0.2 | 0.1 | 0.1 |
| | FNMA30_5p5 | \$ | 306 | 0.01 | 0.1 | 0.22 | 0.01 | -0.08 | -0.09 | -0.12 | -0.15 | -0.15 | -0.15 |
| Agency MBS 30Y FHLMC | FHLMC30_CC | \$ | 144 | -0.11 | 0.05 | 0.37 | 0.59 | 0.83 | 1 | 0.84 | 0.63 | 0.4 | 0.4 |
| Agency MBS 30Y GNMA | GNMA30_CC | \$ | 117 | -0.01 | 0.12 | 0.29 | 0.35 | 0.45 | 0.51 | 0.44 | 0.29 | 0.1 | 0.1 |
| Agency Hybrid | FNMA5_1_3 | \$ | 1,714 | -0.03 | 0.01 | 0.07 | 0.08 | 0.17 | 0.25 | 0.28 | 0.2 | 0.1 | 0.1 |
| | FHL5_1_3 | \$ | 621 | 0.05 | 0.25 | 0.46 | 0.53 | 0.61 | 0.67 | 0.65 | 0.47 | 0.3 | 0.3 |
| Agency CMO | CMO_PAC_2WAL | \$ | 528 | 0.19 | 0.54 | 1.26 | 0.98 | 1.02 | 0.99 | 0.9 | 0.83 | 0.7 | 0.7 |
| | CMO_PAC_10WAL | | | 0.08 | 0.2 | 0.7 | 0.45 | 0.45 | 0.49 | 0.45 | 0.4 | 0.4 | 0.4 |
| | CMO_SEQ_2WAL | \$ | 885 | 0.06 | 0.13 | 0.77 | 0.51 | 0.52 | 0.58 | 0.61 | 0.61 | 0.61 | 0.61 |
| | CMO_SEQ_10WAL | | | 0.05 | 0.13 | 0.88 | 0.47 | 0.43 | 0.48 | 0.5 | 0.51 | 0.51 | 0.51 |
| | CMO_FLTSTR_6p5 | \$ | 4,913 | -0.02 | 0.05 | 0.04 | -0.11 | -0.11 | -0.01 | 0.03 | 0.04 | 0.04 | 0.04 |
| | CMO_FLTSTR_7 | \$ | 3,964 | -0.03 | 0.03 | 0 | -0.14 | -0.13 | -0.03 | 0.01 | 0.03 | 0.03 | 0.03 |
| | CMO_FLTFLT_6p5 | \$ | 971 | -0.01 | 0.08 | 0.06 | -0.07 | -0.05 | 0.06 | 0.1 | 0.11 | 0.11 | 0.11 |
| | CMO_FLTFLT_7 | \$ | 860 | -0.03 | 0.06 | -0.02 | -0.17 | -0.17 | -0.07 | -0.02 | 0.01 | 0.01 | 0.01 |
| Agency CMBS | GNMA_CMBS | \$ | 163 | -0.03 | 0 | 0.14 | 0.21 | 0.26 | 0.25 | 0.23 | 0.17 | 0.1 | 0.1 |
| | FNMA_DUS_5to10Y | \$ | 3,245 | 0.2 | 0.84 | 0.89 | 0.83 | 0.85 | 0.76 | 0.62 | 0.54 | 0.4 | 0.4 |
| | FHLMC_CMBS_A2_10Y | \$ | 478 | 0.21 | 0.74 | 0.83 | 0.89 | 0.93 | 0.87 | 0.81 | 0.64 | 0.5 | 0.5 |
| Non Agency CMBS | CMBS_2005_A | \$ | 1,180 | 0.66 | 2.64 | 4.94 | 6.31 | 7.15 | 6.98 | 6.31 | 4.9 | 3.9 | 3.9 |
| | CMBS_2005_AM | \$ | 295 | -0.48 | 1.54 | 7.86 | 11.02 | 13.52 | 14.65 | 14.24 | 11.45 | 9.3 | 9.3 |
| | CMBS_2005_AJ | \$ | 188 | -1 | 2.76 | 11.52 | 16.79 | 21.41 | 21.45 | 19.95 | 15.95 | 12 | 12 |
| Agency Bonds | AgencyDeb_Srt | \$ | 385 | 0.14 | 0.4 | 0.6 | 0.65 | 0.65 | 0.63 | 0.56 | 0.43 | 0.3 | 0.3 |
| CLO | CLO AAA_3M | \$ | 2,260 | -0.09 | 0.42 | 0.99 | 1.53 | 2.21 | 2.29 | 2.31 | 1.85 | 1.4 | 1.4 |
| | CLO AA_3M | | | 0.21 | 1.56 | 2.86 | 3.85 | 5.51 | 6.07 | 6.41 | 5.21 | 4.3 | 4.3 |
| ABS | ABS_AT AAA | \$ | 1,519 | -0.05 | 0.15 | -0.89 | -3.03 | -3.43 | -2.1 | -0.5 | 0.26 | 0.26 | 0.26 |
| | ABS_CC AAA | \$ | 1,093 | 0.48 | 1.4 | 2 | 2.26 | 2.31 | 2.12 | 1.92 | 1.46 | 1.3 | 1.3 |
| | ABS_SL AAA | \$ | 791 | -0.08 | 0.67 | 0.9 | 0.87 | 1 | 1.11 | 1.11 | 0.9 | 0.9 | 0.9 |
| Covered Bonds | iBoxx_Canada_Cov | \$ | 1,165 | -2.24 | -2.14 | -1.01 | -0.39 | 0.75 | 1.08 | 1.01 | 0.77 | 0.5 | 0.5 |
| | iBoxx_EUR_Canada | \$ | 117 | -1.02 | -2.49 | -3.6 | -3.97 | -1.56 | -0.17 | 0.37 | 0.49 | 0.4 | 0.4 |
| | iBoxx_EUR_GB | \$ | 711 | -0.65 | -1.5 | -1.77 | -1.66 | 0.82 | 2.13 | 2.52 | 2.29 | 1.9 | 1.9 |
| | iBoxx_EUR_Ntlnds | \$ | 215 | -1.1 | -2.51 | -3.49 | -3.85 | -1.49 | -0.12 | 0.49 | 0.68 | 0.6 | 0.6 |
| | iBoxx_EUR_Scandi | \$ | 569 | -1.04 | -2.53 | -3.65 | -4.09 | -1.75 | -0.39 | 0.23 | 0.43 | 0.4 | 0.4 |
| Non Agency RMBS | RMBS_Prime AAA | \$ | 1,185 | -3.56 | -7.71 | -11.62 | -13.8 | -11 | -2.58 | 1.34 | 2.93 | 3.0 | 3.0 |
| | RMBS_Alta AAA | \$ | 1,608 | -2.12 | -2.49 | -4.59 | -5.64 | -2.01 | 4.8 | 6.54 | 6.16 | 4.5 | 4.5 |

| | | | | | | | | | | | |
|---------------------------------------|-------------------------|----------|-------|--------|--------|--------|--------|-------|-------|-------|-----|
| | RMBS_AltA_AA | \$ 31 | -2.99 | -1.28 | 1.31 | 3.88 | 10.45 | 18.3 | 18.05 | 15.12 | 10. |
| | RMBS_SubPrime AAA | \$ 423 | -3.46 | -7.28 | -9.53 | -9.5 | -4.81 | 4.99 | 9.03 | 9.56 | 8.0 |
| EUR MBS | EUR_DCH_RMBS_AA | | 0.46 | -0.35 | 1.36 | 0.45 | 4.9 | 7.72 | 7.9 | 6.57 | 5.6 |
| | EUR_DCH_RMBS_5to10Y AAA | \$ 249 | -1.01 | -4.33 | -4.88 | -7.02 | -2.97 | 0.39 | 1.29 | 1.46 | 1.3 |
| | EUR_IR_RMBS_BBB | \$ 183 | -2.35 | -4.83 | 6.8 | 8.44 | 27.36 | 37.82 | 37.92 | 37.09 | 35 |
| GBP MBS | GBP_UK_RMBS_0to3Y AAA | \$ 792 | -3.93 | -5.25 | -7.82 | -9.57 | -8.18 | -5.76 | -3.99 | -2.87 | -2. |
| EUR Sovereigns | SOV_EUR_FRA | \$ 4,248 | -3.26 | -2.7 | -3.03 | -2.86 | -2.65 | -2.37 | -2.08 | -1.82 | -1. |
| | SOV_EUR_NLD | \$ 1,236 | -3.13 | -2.43 | -2.47 | -2.24 | -2.15 | -1.93 | -1.73 | -1.51 | -1. |
| | SOV_EUR_BEL | \$ 946 | -3.36 | -2.88 | -2.86 | -2.64 | -2.65 | -2.48 | -2.35 | -2.16 | -2. |
| | SOV_EUR_ITA | \$ 1,154 | -4.31 | -4.39 | -4.68 | -4.68 | -4.58 | -4.01 | -3.55 | -3.08 | -2. |
| | SOV_EUR_SPA | \$ 1,815 | -4.09 | -2.12 | -1.46 | -2.09 | -1.61 | -0.93 | -0.37 | 0.15 | 0.5 |
| | SOV_EUR_IRL | \$ 801 | -4.42 | -4.46 | -5.11 | -5.12 | -4.73 | -4.05 | -3.44 | -2.85 | -2. |
| | SOV_EUR_SWE | | -3.48 | -2.31 | -2.11 | -2.07 | -1.83 | -1.66 | -1.9 | -1.98 | -1. |
| EUR Corporates | EUR_CORP_A | \$ 159 | -3.47 | -3.37 | -4.29 | -4.55 | -2.31 | -1.28 | -1.22 | -1.33 | -1. |
| | EUR_CORP_AA | \$ 84 | -3.36 | -3.47 | -4.78 | -5.15 | -2.86 | -1.67 | -1.39 | -1.35 | -1. |
| | EUR_CORP BBB | \$ 117 | -1.35 | -2.18 | -2.69 | -3 | -0.79 | 0.31 | 0.54 | 0.58 | 0.5 |
| GBP Corporates | GBP_Corp | \$ 64 | -1.19 | -3.79 | -4.44 | -7.13 | -3.44 | -0.21 | 0.47 | 0.67 | 0.5 |
| USD corporates | USD_CORP_A | \$ 932 | -0.29 | 1.11 | 1.6 | 1.32 | 1.31 | 1.42 | 1.09 | 0.83 | 0.6 |
| | USD_CORP_AA | \$ 349 | -0.37 | 0.66 | 1.04 | 0.85 | 0.83 | 0.94 | 0.78 | 0.64 | 0.5 |
| | USD_CORP AAA | \$ 112 | 0.22 | 2.03 | 2.68 | 2.62 | 2.57 | 2.41 | 1.92 | 1.44 | 1.0 |
| | USD_CORP BBB | \$ 49 | -0.74 | -1.94 | -3.3 | -4.23 | -4.04 | -2.62 | -1.73 | -1.14 | -0. |
| Municipal Bonds - General Obligations | MUNI_BFV_GO_A_1Y | \$ 243 | -0.97 | -1.34 | -1.78 | -1.94 | -1.77 | -1.6 | -1.39 | -1.31 | -1. |
| | MUNI_BFV_GO_A_5Y | | -0.95 | -1.27 | -1.73 | -1.92 | -1.76 | -1.59 | -1.35 | -1.28 | -1. |
| | MUNI_BFV_GO_A_10Y | | -0.45 | -0.6 | -1.16 | -1.53 | -1.43 | -1.26 | -1.09 | -0.97 | -0. |
| | MUNI_BFV_GO_AA_1Y | \$ 1,410 | -0.99 | -1.42 | -1.91 | -2.05 | -1.75 | -1.65 | -1.4 | -1.35 | -1. |
| | MUNI_BFV_GO_AA_5Y | | -0.91 | -1.07 | -1.84 | -2.18 | -2.1 | -1.87 | -1.53 | -1.53 | -1. |
| | MUNI_BFV_GO_AA_10Y | | -0.47 | -0.33 | -1.35 | -1.92 | -1.83 | -1.64 | -1.44 | -1.29 | -1. |
| Municipal Bonds - Revenue | MUNI_BFV_TR_AA_1Y | \$ 650 | -1.05 | -1.37 | -1.87 | -1.91 | -1.7 | -1.57 | -1.33 | -1.28 | -1. |
| | MUNI_BFV_TR_AA_5Y | | -0.92 | -1.1 | -1.82 | -2.14 | -2.05 | -1.82 | -1.5 | -1.49 | -1. |
| | MUNI_BFV_TR_AA_10Y | | -0.46 | -0.31 | -1.35 | -1.93 | -1.85 | -1.66 | -1.46 | -1.3 | -1. |
| | MUNI_BFV_UT_A_1Y | \$ 10 | -0.93 | -1.32 | -1.79 | -2 | -1.83 | -1.65 | -1.45 | -1.36 | -1. |
| | MUNI_BFV_UT_A_5Y | | -0.89 | -1.08 | -1.82 | -2.21 | -2.14 | -1.9 | -1.54 | -1.55 | -1. |
| | MUNI_BFV_UT_A_10Y | | -0.35 | -0.24 | -1.17 | -1.73 | -1.66 | -1.47 | -1.29 | -1.14 | -1. |
| | MUNI_BFV_UT_AA_1Y | \$ 48 | -1.01 | -1.36 | -1.88 | -1.98 | -1.78 | -1.63 | -1.4 | -1.34 | -1. |
| | MUNI_BFV_UT_AA_5Y | | -0.91 | -1.06 | -1.84 | -2.19 | -2.11 | -1.88 | -1.53 | -1.53 | -1. |
| | MUNI_BFV_UT_AA_10Y | | -0.47 | -0.34 | -1.35 | -1.91 | -1.83 | -1.64 | -1.44 | -1.29 | -1. |
| | MUNI_BFV_ED_AA_1Y | \$ 500 | -1.05 | -1.38 | -1.87 | -1.91 | -1.7 | -1.57 | -1.33 | -1.27 | -1. |
| | MUNI_BFV_ED_AA_5Y | | -0.92 | -1.1 | -1.82 | -2.14 | -2.05 | -1.82 | -1.5 | -1.49 | -1. |
| | MUNI_BFV_ED_AA_10Y | | -0.47 | -0.31 | -1.35 | -1.93 | -1.85 | -1.66 | -1.46 | -1.3 | -1. |
| | MUNI_BFV_REV_A_1Y | \$ 2,089 | -0.96 | -1.33 | -1.78 | -1.96 | -1.79 | -1.61 | -1.41 | -1.33 | -1. |
| | MUNI_BFV_REV_A_5Y | | -0.9 | -1.12 | -1.8 | -2.15 | -2.07 | -1.84 | -1.51 | -1.5 | -1. |
| | MUNI_BFV_REV_A_10Y | | -0.44 | -0.58 | -1.16 | -1.54 | -1.45 | -1.27 | -1.11 | -0.98 | -0. |
| ABCP | ABCP | \$ 1,551 | -4.15 | -10.25 | -15.95 | -19.72 | -18.55 | -11.3 | -6.92 | -4.12 | -2. |

| | | | | | | | | | | | |
|---------------------|------------------------------|--------|--------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------|
| International Bonds | GBP international 1Y | \$ 111 | 0.09 | 0.83 | 1.35 | 1.51 | 1.41 | 1.4 | 1.35 | 1.34 | 1.2 |
| | GBP international 5Y | | 0.04 | 0.63 | 1.26 | 1.56 | 1.52 | 1.56 | 1.52 | 1.48 | 1.4 |
| | GBP international 10Y | | -1.3 | -0.4 | 1.15 | 1.78 | 1.43 | 1.27 | 1.02 | 0.9 | 0.7 |
| | USD International Sweden 1Y | \$ 85 | 0.12 | 0.3 | 0.49 | 0.56 | 0.65 | 0.6 | 0.6 | 0.56 | 0.3 |
| | USD International Sweden 5Y | | -0.23 | 0.12 | 0.3 | 0.41 | 0.52 | 0.47 | 0.49 | 0.46 | 0.2 |
| | USD International Sweden 10Y | | -0.03 | 0.51 | 0.53 | 0.55 | 0.6 | 0.62 | 0.69 | 0.73 | 0.6 |

L. Appendix G: CCAR 2016 Credit Spread Shock assumptions

Credit Spread shock forecasts for the Baseline Scenario

| Asset Type | Segment | Market Value (12/31/2015) | PQ1 | PQ2 | PQ3 | PQ4 | PQ5 | PQ6 | PQ7 | PQ8 | PQ9 |
|----------------------|-------------------|------------------------------|-------------|-------|-------|-------|-------|-------|-------|-------|-------|
| Agency MBS 15Y FNMA | FNMA15_CC | 3,145,288,581 | -0.02 | -0.03 | -0.06 | -0.06 | -0.06 | -0.07 | -0.07 | -0.08 | -0.09 |
| | FNMA15_4 | 602,376,199 | 0.04 | -0.01 | -0.05 | -0.06 | -0.06 | -0.08 | -0.09 | -0.11 | -0.12 |
| | FNMA15_4p5 | 585,028,346 | 0.04 | -0.01 | -0.06 | -0.06 | -0.07 | -0.09 | -0.11 | -0.12 | -0.13 |
| Agency MBS 15Y FHLMC | FHLMC15_CC | 3,400,054,997 | -0.01 | -0.03 | -0.05 | -0.06 | -0.06 | -0.07 | -0.07 | -0.07 | -0.08 |
| | FHLMC15_4 | 512,209,539 | 0.05 | 0.00 | -0.07 | -0.09 | -0.10 | -0.12 | -0.13 | -0.15 | -0.16 |
| | FHLMC15_4p5_2005 | 86,166,708 | 0.04 | -0.01 | -0.06 | -0.07 | -0.08 | -0.10 | -0.11 | -0.13 | -0.14 |
| | FHLMC15_4p5_2009 | 257,257,166 | 0.04 | -0.01 | -0.05 | -0.06 | -0.07 | -0.09 | -0.11 | -0.12 | -0.13 |
| | FHLMC15_5_2005 | 53,480,053 | 0.06 | 0.03 | -0.04 | -0.06 | -0.07 | -0.09 | -0.11 | -0.13 | -0.15 |
| | FHLMC15_5_2008 | 142,595,171 | -0.02 | -0.06 | -0.12 | -0.15 | -0.16 | -0.18 | -0.20 | -0.22 | -0.24 |
| Agency MBS 15Y GNMA | GNMA15_CC | 926,671 | 0.02 | 0.07 | 0.03 | -0.02 | -0.01 | -0.01 | -0.02 | -0.03 | -0.03 |
| Agency MBS 30Y FNMA | FNMA30_CC | 307,778,093 | 0.05 | 0.04 | 0.02 | 0.01 | 0.01 | 0.00 | 0.00 | -0.01 | -0.02 |
| | FNMA30_4p5 | 56,663,874 | 0.05 | 0.03 | 0.00 | 0.00 | -0.01 | -0.02 | -0.02 | -0.03 | -0.04 |
| Agency MBS 30Y FHLMC | FHLMC30_CC | 110,600,739 | -0.03 | -0.04 | -0.06 | -0.07 | -0.08 | -0.09 | -0.10 | -0.11 | -0.11 |
| | GNMA30_CC | 254,272,445 | 0.05 | 0.04 | 0.01 | 0.01 | 0.01 | 0.00 | -0.01 | -0.01 | -0.02 |
| Agency Hybrid | FNMS5_1_3 | 1,504,447,899 | 0.15 | 0.11 | 0.06 | 0.05 | 0.03 | 0.02 | 0.00 | 0.00 | -0.01 |
| | FHMS5_1_3 | 777,392,592 | 0.01 | -0.02 | -0.07 | -0.08 | -0.10 | -0.11 | -0.12 | -0.13 | -0.13 |
| Agency CMO | CMO_PAC_2WAL | 396,701,003 | 0.04 | 0.15 | 0.01 | 0.03 | 0.10 | 0.12 | 0.16 | 0.25 | 0.30 |
| | CMO_PAC_10WAL | | 0.06 | 0.16 | 0.04 | 0.07 | 0.14 | 0.16 | 0.21 | 0.30 | 0.36 |
| | CMO_SED_2WAL | | -0.10 | -0.04 | -0.14 | -0.17 | -0.14 | -0.14 | -0.14 | -0.10 | -0.08 |
| | CMO_SEQ_10WAL | 449,757,792 | 0.08 | 0.20 | 0.06 | 0.13 | 0.22 | 0.24 | 0.32 | 0.43 | 0.51 |
| | CMO_FLTSTR_6p5 | 5,129,103,946 | -0.01 | 0.06 | 0.08 | 0.12 | 0.16 | 0.20 | 0.27 | 0.33 | 0.40 |
| | CMO_FLTSTR_7 | 3,083,655,324 | 0.01 | 0.04 | 0.06 | 0.09 | 0.11 | 0.15 | 0.20 | 0.24 | 0.29 |
| Agency CMBS | CMO_FLTFLT_6p5 | 1,295,453,859 | 0.01 | 0.04 | 0.06 | 0.09 | 0.12 | 0.13 | 0.19 | 0.22 | 0.28 |
| | CMO_FLTFLT_7 | 1,113,080,247 | 0.00 | 0.03 | 0.04 | 0.06 | 0.07 | 0.10 | 0.14 | 0.17 | 0.22 |
| Non Agency CMBS | GNMA_CMBS_3p5Y | | 0.05 | 0.02 | -0.04 | -0.04 | -0.07 | -0.08 | -0.10 | -0.12 | -0.14 |
| | GNMA_CMBS_12Y | 141,091,676 | 0.04 | 0.02 | -0.03 | -0.03 | -0.05 | -0.06 | -0.07 | -0.08 | -0.09 |
| | FNMA_DUS_5to10Y | 2,195,272,360 | 0.07 | 0.03 | -0.04 | -0.04 | -0.05 | -0.08 | -0.11 | -0.14 | -0.16 |
| | FHLMC_CMBS_A2_10Y | 1,683,635,964 | 0.04 | 0.02 | -0.03 | -0.03 | -0.05 | -0.07 | -0.08 | -0.09 | -0.11 |
| Non Agency CMBS | CMBS_2005_A | 1,295,421,981 | 0.04 | 0.15 | 0.05 | 0.00 | -0.14 | -0.11 | -0.18 | -0.22 | -0.24 |
| | CMBS_2005_AJ | 96,578,019 | 0.64 | 1.36 | 1.29 | 1.01 | 0.40 | 0.63 | 0.33 | 0.09 | 0.05 |
| Agency Bonds | AgencyDeb_Srt | | 0.07 | 0.05 | 0.02 | 0.01 | 0.00 | 0.00 | -0.01 | -0.01 | -0.01 |
| | AgencyDeb_Int | 371,000,000 | 0.03 | 0.00 | -0.03 | -0.03 | -0.03 | -0.04 | -0.05 | -0.05 | -0.05 |
| | AgencyDeb_Lng | | 0.02 | -0.01 | -0.02 | -0.02 | -0.02 | -0.02 | -0.03 | -0.04 | -0.04 |
| CLO | CLO AAA_3M | 2,351,000,000 | 0.14 | 0.24 | 0.26 | 0.30 | 0.27 | 0.31 | 0.32 | 0.33 | 0.33 |
| ABS | ABS_AT AAA_2 | | 0.11 | 0.03 | -0.03 | -0.06 | -0.04 | -0.09 | -0.16 | -0.15 | -0.15 |
| | ABS_AT AAA_3 | 1,097,056,098 | 0.48 | 0.37 | 0.33 | 0.33 | 0.27 | 0.27 | 0.20 | 0.08 | 0.11 |
| | ABS_CC AAA_3 | | 0.07 | 0.03 | -0.03 | -0.04 | -0.04 | -0.06 | -0.06 | -0.05 | -0.05 |
| | ABS_CC AAA_7 | 1,185,171,903 | 0.04 | 0.03 | -0.05 | -0.06 | -0.05 | -0.08 | -0.08 | -0.08 | -0.09 |
| | ABS_SL AAA_1 | | 0.05 | 0.01 | -0.04 | -0.07 | -0.07 | -0.10 | -0.16 | -0.16 | -0.16 |
| | ABS_SL AAA_7 | 610,771,999 | 0.05 | -0.02 | -0.07 | -0.11 | -0.14 | -0.17 | -0.21 | -0.21 | -0.23 |
| Covered Bonds | iBoxx_Canada_Cov | 897,392,867 | -0.21 | -0.20 | -0.25 | -0.32 | -0.31 | -0.31 | -0.32 | -0.32 | -0.31 |
| | iBoxx_EUR_Canada | 117,512,503 | -0.13 | -0.11 | -0.14 | -0.18 | -0.17 | -0.17 | -0.18 | -0.18 | -0.18 |
| | iBoxx_EUR_GB | 362,873,078 | -0.15 | -0.15 | -0.15 | -0.15 | -0.15 | -0.15 | -0.15 | -0.15 | -0.15 |
| | iBoxx_EUR_Ntndis | 239,608,102 | -0.14 | -0.14 | -0.14 | -0.14 | -0.14 | -0.14 | -0.14 | -0.14 | -0.14 |
| | iBoxx_EUR_Scandi | 554,326,635 | -0.11 | -0.10 | -0.14 | -0.17 | -0.22 | -0.22 | -0.22 | -0.22 | -0.22 |
| Non Agency RMBS | RMBS_Prime AAA | 820,556,218 | -0.24 | -0.26 | 0.06 | -0.20 | -0.27 | -0.20 | -0.55 | -0.60 | -0.72 |
| | RMBS_AltA AAA | 1,332,122,987 | 1.01 | 1.41 | 1.38 | 0.74 | 1.07 | 0.78 | 0.28 | 0.21 | -0.08 |
| | RMBS_AltA AA | 284,290,870 | 1.34 | 1.88 | 2.16 | 1.26 | 1.67 | 1.65 | 1.17 | 1.11 | 0.78 |
| | RMBS_SubPrime AAA | 100,548,288 | -0.15 | 0.10 | 0.77 | 0.60 | 0.42 | 0.61 | 0.29 | 0.23 | 0.12 |
| EUR MBS | EUR_DCH_AA | | 147,278,146 | 1.75 | 1.78 | 1.50 | 1.58 | 1.47 | 1.51 | 1.49 | 1.51 |
| | EUR_DCH_5t10 AAA | 214,533,408 | 0.74 | 0.78 | 0.70 | 0.73 | 0.72 | 0.73 | 0.74 | 0.74 | 0.74 |
| | EUR_IR BBB | 119,329,995 | -0.58 | 3.77 | 4.87 | 6.26 | 6.96 | 6.75 | 7.30 | 7.85 | 7.83 |
| GBP MBS | GBP_UK_0t3 AAA | | | 0.55 | 0.69 | 0.56 | 0.63 | 0.52 | 0.56 | 0.52 | 0.42 |
| | GBP_UK_3t5 AAA | 623,340,088 | 0.28 | 0.35 | 0.37 | 0.40 | 0.36 | 0.37 | 0.37 | 0.35 | 0.32 |
| | GBP_UK_5t10 AAA | | 0.45 | 0.71 | 0.83 | 0.90 | 0.83 | 0.86 | 0.88 | 0.82 | 0.74 |
| EUR Sovereigns | SOV_EUR_FRA_1Y | | 0.11 | 0.11 | 0.11 | 0.11 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| | SOV_EUR_FRA_5Y | 1,978,377,538 | -0.09 | -0.15 | -0.20 | -0.27 | -0.29 | -0.33 | -0.40 | -0.43 | -0.47 |
| | SOV_EUR_FRA_10Y | | -0.09 | -0.15 | -0.20 | -0.27 | -0.29 | -0.33 | -0.40 | -0.43 | -0.47 |
| | SOV_EUR_NLD_1Y | | 0.11 | 0.11 | 0.11 | 0.11 | 0.11 | 0.11 | 0.11 | 0.11 | 0.11 |
| | SOV_EUR_NLD_5Y | 1,039,888,729 | 0.30 | 0.19 | 0.18 | 0.07 | 0.06 | 0.00 | -0.05 | 0.01 | -0.02 |
| EUR Sovereigns | SOV_EUR_NLD_10Y | | 0.30 | 0.19 | 0.18 | 0.07 | 0.06 | 0.00 | -0.05 | 0.01 | -0.02 |

Credit Spread shock forecasts for the Baseline Scenario

| Asset Type | Segment | Market Value (12/31/2015) | PQ1 | PQ2 | PQ3 | PQ4 | PQ5 | PQ6 | PQ7 | PQ8 | PQ9 |
|---------------------------------------|-------------------------------|------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| EUR Sovereigns | SOV_EUR_BEL_1Y | 1,004,810,141 | 0.11 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.09 |
| | SOV_EUR_BEL_5Y | | 0.30 | 0.21 | 0.21 | 0.18 | 0.17 | 0.16 | 0.15 | 0.15 | 0.14 |
| | SOV_EUR_BEL_10Y | | 0.30 | 0.21 | 0.21 | 0.18 | 0.17 | 0.16 | 0.15 | 0.15 | 0.14 |
| | SOV_EUR_ITA_1Y | 1,377,253,640 | 0.18 | 0.18 | 0.18 | 0.20 | 0.18 | 0.22 | 0.24 | 0.24 | 0.27 |
| | SOV_EUR_ITA_5Y | | 0.01 | -0.06 | -0.13 | -0.20 | -0.24 | -0.25 | -0.26 | -0.27 | -0.26 |
| | SOV_EUR_ITA_10Y | | 0.01 | -0.06 | -0.13 | -0.20 | -0.24 | -0.25 | -0.26 | -0.27 | -0.26 |
| | SOV_EUR_SPA_1Y | 1,926,954,727 | 0.26 | 0.23 | 0.25 | 0.27 | 0.26 | 0.29 | 0.32 | 0.33 | 0.36 |
| | SOV_EUR_SPA_5Y | | 0.38 | 0.18 | 0.17 | 0.09 | 0.09 | 0.06 | 0.05 | 0.09 | 0.10 |
| | SOV_EUR_SPA_10Y | | 0.38 | 0.18 | 0.17 | 0.09 | 0.09 | 0.06 | 0.05 | 0.09 | 0.10 |
| | SOV_EUR_IRL_1Y | 760,978,042 | 0.01 | -0.01 | 0.00 | 0.05 | 0.05 | 0.10 | 0.12 | 0.12 | 0.16 |
| | SOV_EUR_IRL_5Y | | 0.02 | -0.02 | -0.04 | -0.05 | -0.06 | -0.07 | -0.08 | -0.08 | -0.08 |
| | SOV_EUR_IRL_10Y | | 0.02 | -0.02 | -0.04 | -0.05 | -0.06 | -0.07 | -0.08 | -0.08 | -0.08 |
| | SOV_EUR_SWE_1Y | 137,820,783 | 0.20 | 0.18 | 0.17 | 0.19 | 0.20 | 0.25 | 0.27 | 0.26 | 0.34 |
| | SOV_EUR_SWE_5Y | | -0.13 | -0.22 | -0.31 | -0.38 | -0.34 | -0.29 | -0.34 | -0.31 | -0.30 |
| | SOV_EUR_SWE_10Y | | -0.13 | -0.22 | -0.31 | -0.38 | -0.34 | -0.29 | -0.34 | -0.31 | -0.30 |
| EUR Corporates | EUR_CORP_A_1Y | 179,100,994 | 0.13 | 0.09 | -0.07 | -0.08 | -0.07 | -0.08 | -0.07 | -0.06 | -0.05 |
| | EUR_CORP_A_5Y | | 0.11 | 0.08 | -0.06 | -0.08 | -0.07 | -0.07 | -0.07 | -0.05 | -0.05 |
| | EUR_CORP_A_10Y | | 0.09 | 0.08 | -0.06 | -0.08 | -0.07 | -0.07 | -0.06 | -0.05 | -0.04 |
| | EUR_CORP_AA_1Y | 88,778,804 | 0.10 | 0.07 | -0.05 | -0.06 | -0.05 | -0.06 | -0.06 | -0.06 | -0.04 |
| | EUR_CORP_AA_5Y | | -0.01 | -0.04 | -0.15 | -0.17 | -0.16 | -0.16 | -0.16 | -0.14 | -0.14 |
| | EUR_CORP_AA_10Y | | -0.13 | -0.15 | -0.25 | -0.27 | -0.26 | -0.26 | -0.25 | -0.24 | -0.24 |
| | EUR_CORP_BBB_1Y | 154,025,687 | 0.15 | 0.10 | -0.07 | -0.09 | -0.08 | -0.08 | -0.08 | -0.06 | -0.06 |
| | EUR_CORP_BBB_5Y | | 0.14 | 0.10 | -0.08 | -0.10 | -0.09 | -0.09 | -0.08 | -0.06 | -0.06 |
| | EUR_CORP_BBB_10Y | | 0.13 | 0.11 | -0.09 | -0.11 | -0.10 | -0.10 | -0.09 | -0.07 | -0.06 |
| USD corporates | USD_CORP_A_1Y | 1,039,884,594 | -0.49 | -0.37 | -0.17 | -0.32 | -0.23 | -0.19 | -0.21 | -0.16 | -0.12 |
| | USD_CORP_A_5Y | | -0.40 | -0.34 | -0.24 | -0.37 | -0.32 | -0.30 | -0.36 | -0.34 | -0.32 |
| | USD_CORP_A_10Y | | -0.32 | -0.31 | -0.29 | -0.39 | -0.38 | -0.38 | -0.47 | -0.47 | -0.46 |
| | USD_CORP_AA_1Y | 213,487,413 | -0.52 | -0.38 | -0.14 | -0.31 | -0.20 | -0.16 | -0.17 | -0.11 | -0.07 |
| | USD_CORP_AA_5Y | | -0.44 | -0.35 | -0.20 | -0.34 | -0.27 | -0.25 | -0.28 | -0.25 | -0.22 |
| | USD_CORP_AA_10Y | | -0.43 | -0.34 | -0.21 | -0.35 | -0.28 | -0.26 | -0.30 | -0.27 | -0.25 |
| | USD_CORP_AAA_1Y | 37,678,400 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | USD_CORP_AAA_5Y | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | USD_CORP_AAA_10Y | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | USD_CORP BBB_1Y | 83,949,592 | -0.45 | -0.35 | -0.20 | -0.34 | -0.27 | -0.24 | -0.28 | -0.24 | -0.21 |
| | USD_CORP BBB_5Y | | -0.39 | -0.33 | -0.24 | -0.36 | -0.32 | -0.30 | -0.36 | -0.34 | -0.32 |
| | USD_CORP BBB_10Y | | -0.30 | -0.30 | -0.30 | -0.40 | -0.40 | -0.40 | -0.50 | -0.50 | -0.50 |
| Municipal Bonds - General Obligations | BFV_GO_A_1Y | 205,923,179 | -0.06 | -0.08 | -0.15 | -0.17 | -0.25 | -0.30 | -0.44 | -0.51 | -0.53 |
| | BFV_GO_A_5Y | | -0.06 | -0.15 | -0.14 | -0.19 | -0.21 | -0.20 | -0.27 | -0.31 | -0.33 |
| | BFV_GO_A_10Y | | 0.04 | -0.17 | -0.18 | -0.20 | -0.30 | -0.27 | -0.34 | -0.45 | -0.46 |
| | BFV_GO_AA_1Y | 989,356,949 | -0.06 | -0.09 | -0.15 | -0.18 | -0.24 | -0.32 | -0.45 | -0.48 | -0.51 |
| | BFV_GO_AA_5Y | | -0.05 | -0.13 | -0.12 | -0.16 | -0.18 | -0.17 | -0.23 | -0.27 | -0.28 |
| | BFV_GO_AA_10Y | | -0.05 | -0.13 | -0.12 | -0.16 | -0.18 | -0.17 | -0.23 | -0.27 | -0.28 |
| Municipal Bonds - Revenue | BFV_TR_AA_1Y | 448,531,337 | -0.05 | -0.08 | -0.13 | -0.17 | -0.23 | -0.30 | -0.42 | -0.46 | -0.48 |
| | BFV_TR_AA_5Y | | -0.05 | -0.12 | -0.11 | -0.15 | -0.17 | -0.16 | -0.22 | -0.25 | -0.27 |
| | BFV_TR_AA_10Y | | -0.05 | -0.13 | -0.11 | -0.16 | -0.18 | -0.17 | -0.23 | -0.26 | -0.28 |
| | BFV_UT_A_1Y | 105,869,857 | -0.07 | -0.10 | -0.16 | -0.20 | -0.26 | -0.34 | -0.47 | -0.51 | -0.53 |
| | BFV_UT_A_5Y | | -0.10 | -0.20 | -0.20 | -0.26 | -0.29 | -0.28 | -0.35 | -0.40 | -0.42 |
| | BFV_UT_A_10Y | | -0.06 | -0.16 | -0.15 | -0.20 | -0.23 | -0.21 | -0.29 | -0.33 | -0.35 |
| | BFV_UT_AA_1Y | 686,570,476 | -0.06 | -0.09 | -0.15 | -0.18 | -0.24 | -0.31 | -0.43 | -0.47 | -0.49 |
| | BFV_UT_AA_5Y | | -0.04 | -0.13 | -0.11 | -0.15 | -0.17 | -0.16 | -0.22 | -0.25 | -0.27 |
| | BFV_UT_AA_10Y | | -0.05 | -0.13 | -0.12 | -0.16 | -0.18 | -0.17 | -0.23 | -0.26 | -0.28 |
| | BFV_ED_AA_1Y | 375,426,826 | -0.06 | -0.08 | -0.14 | -0.17 | -0.23 | -0.30 | -0.42 | -0.46 | -0.48 |
| | BFV_ED_AA_5Y | | -0.04 | -0.11 | -0.10 | -0.13 | -0.15 | -0.14 | -0.20 | -0.23 | -0.25 |
| | BFV_ED_AA_10Y | | -0.05 | -0.13 | -0.11 | -0.16 | -0.18 | -0.17 | -0.23 | -0.26 | -0.28 |
| | BFV_REV_A_1Y | 1,233,321,375 | -0.12 | -0.15 | -0.20 | -0.24 | -0.29 | -0.36 | -0.47 | -0.50 | -0.52 |
| | BFV_REV_A_5Y | | -0.11 | -0.21 | -0.20 | -0.27 | -0.30 | -0.30 | -0.37 | -0.42 | -0.43 |
| | BFV_REV_A_10Y | | 0.03 | -0.14 | -0.15 | -0.16 | -0.24 | -0.22 | -0.27 | -0.36 | -0.38 |
| ABCP | ABCP | 1,903,605,887 | -0.02 | -0.03 | -0.06 | -0.08 | -0.04 | -0.06 | -0.06 | -0.06 | -0.04 |
| International Bonds | USD INTERNATIONAL FINLAND 1Y | 14,083,738 | 0.52 | 0.60 | 0.70 | 0.75 | 0.65 | 0.63 | 0.54 | 0.45 | 0.37 |
| | USD INTERNATIONAL FINLAND 5Y | | 1.56 | 1.80 | 1.60 | 1.49 | 1.37 | 1.21 | 1.07 | 0.97 | 0.85 |
| | USD INTERNATIONAL FINLAND 10Y | | 1.56 | 1.80 | 1.60 | 1.49 | 1.37 | 1.21 | 1.07 | 0.97 | 0.85 |
| | GBP INTERNATIONAL BELGIUM 1Y | 88,399,041 | 2.07 | 2.26 | 1.91 | 1.71 | 1.36 | 1.06 | 0.76 | 0.48 | 0.19 |
| | GBP INTERNATIONAL BELGIUM 5Y | | 2.13 | 2.38 | 2.64 | 2.31 | 2.10 | 1.78 | 1.46 | 1.27 | 1.10 |
| | GBP INTERNATIONAL BELGIUM 10Y | | 2.13 | 2.38 | 2.64 | 2.31 | 2.10 | 1.78 | 1.46 | 1.27 | 1.10 |
| | EUR INTERNATIONAL SWEDEN 1Y | 140,187,876 | 0.52 | 0.60 | 0.70 | 0.75 | 0.65 | 0.63 | 0.54 | 0.45 | 0.37 |
| | EUR INTERNATIONAL SWEDEN 5Y | | 1.56 | 1.80 | 1.60 | 1.49 | 1.37 | 1.21 | 1.07 | 0.97 | 0.85 |
| | EUR INTERNATIONAL SWEDEN 10Y | | 1.56 | 1.80 | 1.60 | 1.49 | 1.37 | 1.21 | 1.07 | 0.97 | 0.85 |
| | USD INTERNATIONAL SWEDEN 1Y | | 0.52 | 0.60 | 0.70 | 0.75 | 0.65 | 0.63 | 0.54 | 0.45 | 0.37 |
| | USD INTERNATIONAL SWEDEN 5Y | | 1.56 | 1.80 | 1.60 | 1.49 | 1.37 | 1.21 | 1.07 | 0.97 | 0.85 |
| | USD INTERNATIONAL SWEDEN 10Y | | 1.56 | 1.80 | 1.60 | 1.49 | 1.37 | 1.21 | 1.07 | 0.97 | 0.85 |

Credit Spread shock forecasts for the Adverse Scenario

| Asset Type | Segment | Market Value (12/31/2015) | PQ1 | PQ2 | PQ3 | PQ4 | PQ5 | PQ6 | PQ7 | PQ8 | PQ9 |
|----------------------|-------------------|------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Agency MBS 15Y FNMA | FNMA15_CC | 3,145,288,581 | 0.13 | 0.14 | 0.20 | 0.21 | 0.19 | 0.16 | 0.14 | 0.11 | 0.08 |
| | FNMA15_4 | 602,376,199 | 0.16 | 0.11 | 0.12 | 0.10 | 0.07 | 0.03 | 0.00 | -0.02 | -0.03 |
| | FNMA15_4p5 | 585,028,346 | 0.19 | 0.13 | 0.14 | 0.12 | 0.08 | 0.03 | 0.00 | -0.02 | -0.04 |
| Agency MBS 15Y FHLMC | FHLMC15_CC | 3,400,054,997 | 0.13 | 0.13 | 0.16 | 0.17 | 0.15 | 0.12 | 0.09 | 0.06 | 0.04 |
| | FHLMC15_4 | 512,209,539 | 0.24 | 0.21 | 0.23 | 0.21 | 0.15 | 0.07 | 0.01 | -0.04 | -0.06 |
| | FHLMC15_4p5_2005 | 86,166,708 | 0.21 | 0.18 | 0.20 | 0.19 | 0.14 | 0.07 | 0.03 | -0.02 | -0.04 |
| | FHLMC15_4p5_2009 | 257,257,166 | 0.18 | 0.13 | 0.14 | 0.11 | 0.08 | 0.03 | 0.00 | -0.02 | -0.04 |
| | FHLMC15_5_2005 | 53,480,053 | 0.21 | 0.21 | 0.20 | 0.18 | 0.14 | 0.08 | 0.03 | 0.00 | -0.02 |
| | FHLMC15_5_2008 | 142,595,171 | 0.12 | 0.13 | 0.12 | 0.10 | 0.06 | -0.01 | -0.05 | -0.09 | -0.11 |
| Agency MBS 15Y GNMA | GNMA15_CC | 926,671 | 0.10 | 0.33 | 0.30 | 0.32 | 0.28 | 0.23 | 0.16 | 0.11 | 0.07 |
| Agency MBS 30Y FNMA | FNMA30_CC | 307,778,093 | 0.14 | 0.14 | 0.17 | 0.18 | 0.17 | 0.15 | 0.14 | 0.12 | 0.11 |
| | FNMA30_4p5 | 56,663,874 | 0.14 | 0.14 | 0.16 | 0.16 | 0.15 | 0.12 | 0.11 | 0.09 | 0.07 |
| | FNMA30_5p5 | 249,708,756 | 0.20 | 0.22 | 0.28 | 0.30 | 0.30 | 0.27 | 0.25 | 0.23 | 0.21 |
| Agency MBS 30Y FHLMC | FHLMC30_CC | 110,600,739 | 0.06 | 0.06 | 0.07 | 0.07 | 0.05 | 0.03 | 0.00 | -0.02 | -0.03 |
| Agency MBS 30Y GNMA | GNMA30_CC | 254,272,445 | 0.19 | 0.20 | 0.25 | 0.26 | 0.24 | 0.21 | 0.19 | 0.16 | 0.14 |
| Agency Hybrid | FNMAS_1_3 | 1,504,447,899 | 0.37 | 0.34 | 0.35 | 0.32 | 0.26 | 0.18 | 0.12 | 0.08 | 0.05 |
| | FHLMs_1_3 | 777,392,592 | 0.23 | 0.18 | 0.20 | 0.18 | 0.11 | 0.04 | -0.02 | -0.06 | -0.09 |
| Agency CMO | CMD_PAC_2WAL | 396,701,003 | 0.39 | 0.39 | 0.58 | 0.64 | 0.58 | 0.39 | 0.23 | 0.18 | 0.16 |
| | CMD_PAC_10WAL | | 0.31 | 0.29 | 0.45 | 0.51 | 0.48 | 0.32 | 0.20 | 0.17 | 0.17 |
| | CMD_SEQ_2WAL | | 0.24 | 0.31 | 0.39 | 0.41 | 0.35 | 0.21 | 0.06 | 0.00 | -0.03 |
| | CMD_SEQ_10WAL | 449,757,792 | 0.30 | 0.29 | 0.49 | 0.56 | 0.55 | 0.38 | 0.27 | 0.25 | 0.28 |
| | CMO_FLTSTR_6p5 | 5,129,103,946 | -0.06 | 0.16 | 0.29 | 0.41 | 0.38 | 0.31 | 0.29 | 0.28 | 0.27 |
| | CMO_FLTSTR_7 | 3,083,655,324 | -0.06 | 0.19 | 0.28 | 0.38 | 0.34 | 0.27 | 0.25 | 0.22 | 0.20 |
| | CMO_FLTFLT_6p5 | 1,295,453,859 | -0.09 | 0.16 | 0.28 | 0.39 | 0.41 | 0.31 | 0.28 | 0.24 | 0.21 |
| | CMO_FLTFLT_7 | 1,113,080,247 | -0.04 | 0.21 | 0.29 | 0.38 | 0.33 | 0.26 | 0.23 | 0.18 | 0.16 |
| Agency CMBS | GNMA_CMBS_3p5Y | | 0.36 | 0.30 | 0.34 | 0.32 | 0.27 | 0.18 | 0.12 | 0.07 | 0.03 |
| | GNMA_CMBS_12Y | 141,091,676 | 0.25 | 0.21 | 0.23 | 0.22 | 0.19 | 0.12 | 0.08 | 0.05 | 0.02 |
| | FNMA_DUS_5to10Y | 2,195,272,360 | 0.31 | 0.26 | 0.28 | 0.28 | 0.24 | 0.15 | 0.10 | 0.05 | 0.03 |
| Non Agency CMBS | FHLMC_CMBS_A2_10Y | 1,683,635,964 | 0.29 | 0.24 | 0.27 | 0.25 | 0.22 | 0.14 | 0.09 | 0.05 | 0.03 |
| | CMBS_2005_A | 1,295,423,981 | 0.84 | 1.65 | 2.00 | 2.16 | 2.23 | 1.84 | 1.42 | 1.04 | 0.79 |
| Agency Bonds | CMBS_2005_AJ | 96,578,019 | 2.50 | 6.59 | 7.97 | 8.88 | 9.50 | 8.35 | 6.83 | 5.46 | 4.50 |
| | AgencyDeb_Srt | | 0.24 | 0.25 | 0.26 | 0.24 | 0.20 | 0.14 | 0.08 | 0.04 | 0.02 |
| | AgencyDeb_Int | 371,000,000 | 0.19 | 0.15 | 0.16 | 0.15 | 0.12 | 0.07 | 0.03 | 0.01 | -0.01 |
| CLO | AgencyDeb_Lng | | 0.06 | 0.08 | 0.08 | 0.07 | 0.08 | 0.05 | 0.04 | 0.02 | 0.01 |
| | CLO AAA_3M | 2,351,000,000 | 1.01 | 1.84 | 2.52 | 3.07 | 2.78 | 2.35 | 2.01 | 1.67 | 1.34 |
| ABS | ABS_AT_AAA_1 | 1,097,056,098 | 0.54 | 0.33 | 0.42 | 0.35 | 0.29 | 0.20 | 0.15 | 0.10 | 0.08 |
| | ABS_AT_AAA_3 | | 1.12 | 1.20 | 1.48 | 1.45 | 1.04 | 0.77 | 0.51 | 0.30 | 0.16 |
| | ABS_CC_AAA_3 | 1,185,171,903 | 0.91 | 0.91 | 1.17 | 1.16 | 0.86 | 0.60 | 0.38 | 0.18 | 0.04 |
| | ABS_CC_AAA_7 | | 0.95 | 1.01 | 1.27 | 1.27 | 0.92 | 0.62 | 0.37 | 0.15 | -0.01 |
| | ABS_SL_AAA_1 | 610,771,999 | 0.39 | 0.25 | 0.31 | 0.29 | 0.22 | 0.16 | 0.12 | 0.08 | 0.06 |
| | ABS_SL_AAA_7 | | 0.82 | 0.52 | 0.64 | 0.51 | 0.35 | 0.24 | 0.15 | 0.08 | 0.02 |
| Covered Bonds | iBoxx_Canada_Cov | 897,392,867 | -0.05 | 0.32 | 0.43 | 0.52 | 0.53 | 0.29 | 0.08 | -0.09 | -0.23 |
| | iBoxx_EUR_Canada | 117,512,503 | -0.06 | 0.14 | 0.17 | 0.20 | 0.20 | 0.09 | -0.01 | -0.08 | -0.14 |
| | iBoxx_EUR_GB | 362,873,078 | -0.03 | 0.49 | 0.48 | 0.49 | 0.38 | 0.18 | -0.02 | -0.15 | -0.15 |
| | iBoxx_EUR_Ntinds | 239,608,102 | -0.04 | 0.30 | 0.30 | 0.34 | 0.28 | 0.21 | 0.12 | 0.05 | -0.01 |
| | iBoxx_EUR_Scandi | 554,326,635 | -0.03 | 0.17 | 0.16 | 0.18 | 0.14 | 0.08 | 0.02 | -0.03 | -0.07 |
| Non Agency RMBS | RMBS_Prime_AAA | 820,556,218 | 1.20 | 2.86 | 3.66 | 5.19 | 5.68 | 5.06 | 4.31 | 3.89 | 3.32 |
| | RMBS_Alta_AAA | 1,332,122,987 | 6.05 | 8.11 | 9.85 | 12.03 | 11.19 | 9.97 | 8.47 | 7.50 | 6.42 |
| | RMBS_Alta_AA | 284,290,870 | 6.28 | 11.28 | 14.55 | 18.22 | 18.25 | 16.54 | 14.06 | 11.96 | 9.95 |
| | RMBS_SubPrime_AAA | 100,548,288 | 1.28 | 4.25 | 6.16 | 8.63 | 9.86 | 9.14 | 8.42 | 7.82 | 6.87 |
| EUR MBS | EUR_DCH_AA | 147,278,146 | 3.63 | 4.12 | 4.72 | 5.06 | 4.12 | 3.29 | 2.55 | 1.92 | 1.51 |
| | EUR_DCH_5t10_AAA | 214,533,408 | 1.34 | 1.65 | 1.90 | 2.08 | 1.73 | 1.42 | 1.15 | 0.90 | 0.74 |
| GBP MBS | GBP_UK_0t3_AAA | 119,329,995 | 4.11 | 10.83 | 15.75 | 18.11 | 18.84 | 14.54 | 12.15 | 9.96 | 8.36 |
| | GBP_UK_3t5_AAA | | 1.51 | 1.47 | 2.03 | 2.30 | 2.05 | 1.66 | 1.27 | 0.90 | 0.65 |
| | GBP_UK_5t10_AAA | 623,340,088 | 1.00 | 0.86 | 1.25 | 1.31 | 1.20 | 1.01 | 0.82 | 0.59 | 0.42 |
| EUR Sovereigns | SOV_EUR_FRA_1Y | | 0.57 | 0.47 | 0.46 | 0.37 | 0.27 | 0.18 | 0.08 | 0.03 | -0.02 |
| | SOV_EUR_FRA_5Y | 1,978,377,538 | -0.51 | -0.57 | -0.59 | -0.62 | -0.63 | -0.61 | -0.61 | -0.65 | -0.69 |
| | SOV_EUR_FRA_10Y | | -0.62 | -0.67 | -0.69 | -0.73 | -0.73 | -0.71 | -0.71 | -0.75 | -0.80 |
| | SOV_EUR_NLD_1Y | | 0.58 | 0.47 | 0.46 | 0.38 | 0.28 | 0.19 | 0.08 | 0.04 | -0.02 |
| | SOV_EUR_NLD_5Y | 1,039,888,729 | 0.57 | 0.35 | 0.36 | 0.17 | 0.10 | -0.04 | -0.19 | -0.21 | -0.31 |
| | SOV_EUR_NLD_10Y | | 0.66 | 0.44 | 0.46 | 0.26 | 0.19 | 0.05 | -0.09 | -0.12 | -0.22 |

Credit Spread shock forecasts for the Adverse Scenario

| Asset Type | Segment | Market Value (12/31/2015) | PQ1 | PQ2 | PQ3 | PQ4 | PQ5 | PQ6 | PQ7 | PQ8 | PQ9 |
|---------------------------------------|-------------------------------|------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| EUR Sovereigns | SOV_EUR_BEL_1Y | 1,004,810,141 | 0.56 | 0.46 | 0.45 | 0.36 | 0.27 | 0.18 | 0.08 | 0.03 | -0.02 |
| | SOV_EUR_BEL_5Y | | 0.61 | 0.39 | 0.43 | 0.31 | 0.22 | 0.12 | -0.01 | -0.12 | -0.20 |
| | SOV_EUR_BEL_10Y | | 0.71 | 0.49 | 0.53 | 0.41 | 0.32 | 0.23 | 0.09 | -0.01 | -0.10 |
| | SOV_EUR_ITA_1Y | 1,377,253,640 | 0.73 | 0.71 | 0.76 | 0.68 | 0.52 | 0.35 | 0.18 | 0.11 | 0.05 |
| | SOV_EUR_ITA_5Y | | 0.41 | 0.40 | 0.42 | 0.29 | 0.10 | -0.20 | -0.45 | -0.52 | -0.62 |
| | SOV_EUR_ITA_10Y | | 0.50 | 0.49 | 0.51 | 0.38 | 0.19 | -0.10 | -0.36 | -0.42 | -0.52 |
| | SOV_EUR_SPA_1Y | 1,926,954,727 | 0.86 | 0.93 | 0.93 | 0.83 | 0.65 | 0.46 | 0.28 | 0.21 | 0.14 |
| | SOV_EUR_SPA_5Y | | 1.01 | 1.52 | 1.17 | 0.88 | 0.64 | 0.37 | 0.16 | 0.07 | -0.06 |
| | SOV_EUR_SPA_10Y | | 1.01 | 1.53 | 1.18 | 0.89 | 0.64 | 0.38 | 0.17 | 0.08 | -0.05 |
| | SOV_EUR_IRL_1Y | 760,978,042 | 1.02 | 0.84 | 0.82 | 0.73 | 0.74 | 0.73 | 0.54 | 0.36 | 0.24 |
| | SOV_EUR_IRL_5Y | | 0.91 | 0.85 | 0.88 | 0.78 | 0.67 | 0.53 | 0.24 | 0.01 | -0.19 |
| | SOV_EUR_IRL_10Y | | 1.14 | 1.08 | 1.11 | 1.00 | 0.89 | 0.75 | 0.45 | 0.23 | 0.03 |
| | SOV_EUR_SWE_1Y | 137,820,783 | 0.27 | 0.32 | 0.37 | 0.32 | 0.26 | 0.24 | 0.16 | 0.07 | 0.00 |
| | SOV_EUR_SWE_5Y | | -0.32 | -0.40 | -0.49 | -0.56 | -0.55 | -0.52 | -0.58 | -0.56 | -0.56 |
| | SOV_EUR_SWE_10Y | | -0.37 | -0.45 | -0.54 | -0.61 | -0.60 | -0.57 | -0.63 | -0.61 | -0.61 |
| EUR Corporates | EUR_CORP_A_1Y | 179,100,994 | 0.63 | 0.67 | 0.75 | 0.75 | 0.56 | 0.31 | 0.12 | -0.04 | -0.10 |
| | EUR_CORP_A_5Y | | 0.53 | 0.60 | 0.68 | 0.69 | 0.51 | 0.29 | 0.11 | -0.04 | -0.09 |
| | EUR_CORP_A_10Y | | 0.46 | 0.56 | 0.63 | 0.65 | 0.49 | 0.28 | 0.10 | -0.04 | -0.09 |
| | EUR_CORP_AA_1Y | 88,778,804 | 0.49 | 0.52 | 0.58 | 0.58 | 0.43 | 0.24 | 0.09 | -0.03 | -0.08 |
| | EUR_CORP_AA_5Y | | 0.32 | 0.38 | 0.44 | 0.45 | 0.31 | 0.13 | -0.01 | -0.13 | -0.18 |
| | EUR_CORP_AA_10Y | | 0.16 | 0.24 | 0.30 | 0.31 | 0.18 | 0.02 | -0.12 | -0.24 | -0.28 |
| | EUR_CORP BBB_1Y | 154,025,687 | 0.68 | 0.72 | 0.81 | 0.80 | 0.60 | 0.34 | 0.13 | -0.04 | -0.11 |
| | EUR_CORP BBB_5Y | | 0.66 | 0.75 | 0.85 | 0.87 | 0.65 | 0.37 | 0.14 | -0.05 | -0.12 |
| | EUR_CORP BBB_10Y | | 0.64 | 0.78 | 0.88 | 0.91 | 0.68 | 0.39 | 0.15 | -0.05 | -0.13 |
| USD corporates | USD_CORP_A_1Y | 1,039,884,594 | 0.15 | 0.35 | 0.26 | 0.24 | 0.38 | 0.48 | 0.48 | 0.64 | 0.61 |
| | USD_CORP_A_5Y | | 0.44 | 0.73 | 0.74 | 0.78 | 0.80 | 0.75 | 0.64 | 0.67 | 0.60 |
| | USD_CORP_A_10Y | | 0.65 | 1.03 | 1.11 | 1.19 | 1.12 | 0.95 | 0.77 | 0.70 | 0.61 |
| | USD_CORP_AA_1Y | 213,487,413 | 0.14 | 0.27 | 0.15 | 0.09 | 0.27 | 0.44 | 0.48 | 0.68 | 0.64 |
| | USD_CORP_AA_5Y | | 0.34 | 0.57 | 0.53 | 0.52 | 0.60 | 0.64 | 0.59 | 0.69 | 0.63 |
| | USD_CORP_AA_10Y | | 0.40 | 0.62 | 0.60 | 0.59 | 0.65 | 0.68 | 0.63 | 0.71 | 0.64 |
| | USD_CORP BBB_1Y | 83,949,592 | 0.33 | 0.54 | 0.50 | 0.45 | 0.58 | 0.62 | 0.59 | 0.69 | 0.63 |
| | USD_CORP BBB_5Y | | 0.44 | 0.74 | 0.75 | 0.80 | 0.81 | 0.75 | 0.65 | 0.67 | 0.61 |
| | USD_CORP BBB_10Y | | 0.70 | 1.10 | 1.20 | 1.30 | 1.20 | 1.00 | 0.80 | 0.70 | 0.60 |
| Municipal Bonds - General Obligations | BFV_GO_A_1Y | 205,923,179 | -0.09 | 0.04 | 0.00 | 0.20 | 0.20 | 0.17 | 0.17 | 0.19 | 0.20 |
| | BFV_GO_A_5Y | | 0.15 | 0.31 | 0.23 | 0.33 | 0.36 | 0.29 | 0.17 | 0.12 | 0.10 |
| | BFV_GO_A_10Y | | 0.04 | 0.52 | 0.49 | 0.49 | 0.68 | 0.55 | 0.41 | 0.25 | 0.23 |
| | BFV_GO_AA_1Y | 989,356,949 | -0.05 | 0.03 | 0.06 | 0.22 | 0.17 | 0.16 | 0.17 | 0.18 | 0.20 |
| | BFV_GO_AA_5Y | | 0.13 | 0.26 | 0.20 | 0.28 | 0.31 | 0.25 | 0.15 | 0.10 | 0.08 |
| | BFV_GO_AA_10Y | | 0.13 | 0.27 | 0.20 | 0.29 | 0.31 | 0.25 | 0.15 | 0.10 | 0.08 |
| Municipal Bonds - Revenue | BFV_TR_AA_1Y | 448,531,337 | -0.03 | 0.04 | 0.06 | 0.22 | 0.17 | 0.16 | 0.17 | 0.18 | 0.20 |
| | BFV_TR_AA_5Y | | 0.12 | 0.25 | 0.19 | 0.27 | 0.29 | 0.23 | 0.14 | 0.09 | 0.08 |
| | BFV_TR_AA_10Y | | 0.12 | 0.26 | 0.20 | 0.28 | 0.30 | 0.24 | 0.14 | 0.10 | 0.08 |
| | BFV_UT_AA_1Y | 105,869,857 | 0.02 | 0.19 | 0.28 | 0.50 | 0.42 | 0.34 | 0.30 | 0.26 | 0.24 |
| | BFV_UT_AA_5Y | | 0.08 | 0.37 | 0.29 | 0.39 | 0.43 | 0.32 | 0.18 | 0.11 | 0.07 |
| | BFV_UT_AA_10Y | | 0.16 | 0.33 | 0.25 | 0.35 | 0.38 | 0.31 | 0.18 | 0.12 | 0.10 |
| | BFV_UT_AA_1Y | 686,570,476 | 0.01 | 0.12 | 0.17 | 0.35 | 0.27 | 0.23 | 0.22 | 0.20 | 0.20 |
| | BFV_UT_AA_5Y | | 0.14 | 0.29 | 0.24 | 0.33 | 0.36 | 0.28 | 0.17 | 0.12 | 0.10 |
| | BFV_UT_AA_10Y | | 0.12 | 0.26 | 0.20 | 0.28 | 0.30 | 0.24 | 0.14 | 0.10 | 0.08 |
| | BFV_ED_AA_1Y | 375,426,826 | -0.04 | 0.05 | 0.07 | 0.23 | 0.19 | 0.17 | 0.17 | 0.17 | 0.18 |
| | BFV_ED_AA_5Y | | 0.14 | 0.27 | 0.21 | 0.29 | 0.31 | 0.26 | 0.15 | 0.11 | 0.10 |
| | BFV_ED_AA_10Y | | 0.12 | 0.26 | 0.20 | 0.28 | 0.30 | 0.24 | 0.14 | 0.10 | 0.08 |
| | BFV_REV_A_1Y | 1,233,321,375 | 0.02 | 0.17 | 0.24 | 0.43 | 0.36 | 0.30 | 0.26 | 0.22 | 0.21 |
| | BFV_REV_A_5Y | | 0.09 | 0.39 | 0.30 | 0.41 | 0.45 | 0.34 | 0.19 | 0.11 | 0.07 |
| | BFV_REV_A_10Y | | 0.03 | 0.42 | 0.40 | 0.40 | 0.55 | 0.45 | 0.33 | 0.20 | 0.19 |
| ABCP | ABCP | 1,903,605,887 | 0.08 | 0.23 | 0.19 | 0.19 | 0.17 | 0.10 | 0.06 | 0.03 | 0.01 |
| International Bonds | USD INTERNATIONAL FINLAND 1Y | 14,083,738 | 0.52 | 0.60 | 0.70 | 0.75 | 0.65 | 0.63 | 0.54 | 0.45 | 0.37 |
| | USD INTERNATIONAL FINLAND 5Y | | 1.56 | 1.80 | 1.60 | 1.49 | 1.37 | 1.21 | 1.07 | 0.97 | 0.85 |
| | USD INTERNATIONAL FINLAND 10Y | | 1.56 | 1.80 | 1.60 | 1.49 | 1.37 | 1.21 | 1.07 | 0.97 | 0.85 |
| | GBP INTERNATIONAL BELGIUM 1Y | 88,399,041 | 2.07 | 2.26 | 1.91 | 1.71 | 1.36 | 1.06 | 0.76 | 0.48 | 0.19 |
| | GBP INTERNATIONAL BELGIUM 5Y | | 2.13 | 2.38 | 2.64 | 2.31 | 2.10 | 1.78 | 1.45 | 1.27 | 1.10 |
| | GBP INTERNATIONAL BELGIUM 10Y | | 2.13 | 2.38 | 2.64 | 2.31 | 2.10 | 1.78 | 1.45 | 1.27 | 1.10 |
| | EUR INTERNATIONAL SWEDEN 1Y | 140,187,876 | 0.52 | 0.60 | 0.70 | 0.75 | 0.65 | 0.63 | 0.54 | 0.45 | 0.37 |
| | EUR INTERNATIONAL SWEDEN 5Y | | 1.56 | 1.80 | 1.60 | 1.49 | 1.37 | 1.21 | 1.07 | 0.97 | 0.85 |
| | EUR INTERNATIONAL SWEDEN 10Y | | 1.56 | 1.80 | 1.60 | 1.49 | 1.37 | 1.21 | 1.07 | 0.97 | 0.85 |
| | USD INTERNATIONAL SWEDEN 1Y | | 0.52 | 0.60 | 0.70 | 0.75 | 0.65 | 0.63 | 0.54 | 0.45 | 0.37 |
| | USD INTERNATIONAL SWEDEN 5Y | | 1.56 | 1.80 | 1.60 | 1.49 | 1.37 | 1.21 | 1.07 | 0.97 | 0.85 |
| | USD INTERNATIONAL SWEDEN 10Y | | 1.56 | 1.80 | 1.60 | 1.49 | 1.37 | 1.21 | 1.07 | 0.97 | 0.85 |

Credit Spread shock forecasts for the Severely Adverse Scenario

| Asset Type | Segment | Market Value (12/31/2015) | PQ1 | PQ2 | PQ3 | PQ4 | PQ5 | PQ6 | PQ7 | PQ8 | PQ9 |
|----------------------|-------------------|------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Agency MBS 15Y FNMA | FNMA15_CC | 3,145,288,581 | 0.39 | 0.37 | 0.51 | 0.48 | 0.41 | 0.32 | 0.26 | 0.19 | 0.14 |
| | FNMA15_4 | 602,376,199 | 0.41 | 0.29 | 0.37 | 0.28 | 0.18 | 0.08 | 0.03 | -0.02 | -0.05 |
| | FNMA15_4p5 | 585,028,346 | 0.48 | 0.34 | 0.43 | 0.32 | 0.21 | 0.10 | 0.03 | -0.03 | -0.06 |
| Agency MBS 15Y FHLMC | FHLMC15_CC | 3,400,054,997 | 0.38 | 0.33 | 0.45 | 0.40 | 0.33 | 0.24 | 0.18 | 0.12 | 0.07 |
| | FHLMC15_4 | 512,209,539 | 0.62 | 0.50 | 0.62 | 0.51 | 0.35 | 0.16 | 0.03 | -0.09 | -0.13 |
| | FHLMC15_4p5_2005 | 86,166,708 | 0.52 | 0.43 | 0.54 | 0.46 | 0.32 | 0.17 | 0.08 | -0.01 | -0.06 |
| | FHLMC15_4p5_2009 | 257,257,166 | 0.47 | 0.34 | 0.42 | 0.32 | 0.21 | 0.09 | 0.03 | -0.03 | -0.06 |
| | FHLMC15_5_2005 | 53,480,053 | 0.50 | 0.50 | 0.55 | 0.47 | 0.33 | 0.18 | 0.08 | 0.00 | -0.04 |
| | FHLMC15_5_2008 | 142,595,171 | 0.42 | 0.44 | 0.48 | 0.41 | 0.26 | 0.11 | 0.00 | -0.08 | -0.13 |
| Agency MBS 15Y GNMA | GNMA15_CC | 926,671 | 0.24 | 0.79 | 0.70 | 0.78 | 0.61 | 0.43 | 0.26 | 0.15 | 0.06 |
| Agency MBS 30Y FNMA | FNMA30_CC | 307,778,093 | 0.29 | 0.28 | 0.36 | 0.35 | 0.30 | 0.25 | 0.22 | 0.18 | 0.14 |
| | FNMA30_4p5 | 56,663,874 | 0.32 | 0.28 | 0.36 | 0.33 | 0.28 | 0.21 | 0.17 | 0.13 | 0.10 |
| | FNMA30_5p5 | 249,708,756 | 0.43 | 0.41 | 0.56 | 0.56 | 0.52 | 0.44 | 0.39 | 0.33 | 0.29 |
| Agency MBS 30Y FHLMC | FHLMC30_CC | 110,600,739 | 0.23 | 0.21 | 0.27 | 0.25 | 0.18 | 0.11 | 0.05 | 0.01 | -0.02 |
| Agency MBS 30Y GNMA | GNMA30_CC | 254,272,445 | 0.43 | 0.41 | 0.54 | 0.51 | 0.44 | 0.36 | 0.30 | 0.24 | 0.19 |
| Agency Hybrid | FNMA5_1_3 | 1,504,447,899 | 0.83 | 0.72 | 0.81 | 0.70 | 0.49 | 0.30 | 0.15 | 0.05 | -0.01 |
| | FHL5_1_3 | 777,392,592 | 0.68 | 0.53 | 0.63 | 0.53 | 0.33 | 0.15 | 0.01 | -0.08 | -0.14 |
| Agency CMO | CMO_PAC_2WAL | 396,701,003 | 0.92 | 0.79 | 1.21 | 1.18 | 0.95 | 0.53 | 0.19 | -0.13 | -0.21 |
| | CMO_PAC_10WAL | | 0.78 | 0.62 | 0.99 | 0.93 | 0.74 | 0.36 | 0.06 | -0.22 | -0.26 |
| | CMO_SEQ_2WAL | | 0.69 | 0.81 | 0.99 | 0.98 | 0.78 | 0.47 | 0.19 | -0.04 | -0.12 |
| | CMO_SEQ_10WAL | 449,757,792 | 0.77 | 0.62 | 1.05 | 1.00 | 0.80 | 0.41 | 0.09 | -0.19 | -0.23 |
| | CMO_FLTSTR_6p5 | 5,129,103,946 | -0.09 | 0.30 | 0.47 | 0.65 | 0.59 | 0.44 | 0.31 | 0.20 | 0.10 |
| | CMO_FLTSTR_7 | 3,083,655,324 | -0.10 | 0.34 | 0.44 | 0.61 | 0.53 | 0.40 | 0.28 | 0.17 | 0.08 |
| | CMO_FLTFLT_6p5 | 1,295,453,859 | -0.15 | 0.30 | 0.45 | 0.63 | 0.64 | 0.49 | 0.36 | 0.23 | 0.13 |
| | CMO_FLTFLT_7 | 1,113,080,247 | -0.06 | 0.39 | 0.48 | 0.63 | 0.55 | 0.41 | 0.28 | 0.16 | 0.06 |
| Agency CMBS | GNMA_CMBS_3p5Y | 141,091,676 | 0.89 | 0.70 | 0.91 | 0.78 | 0.58 | 0.34 | 0.19 | 0.07 | 0.00 |
| | GNMA_CMBS_12Y | | 0.62 | 0.49 | 0.64 | 0.54 | 0.40 | 0.24 | 0.13 | 0.05 | 0.00 |
| | FNMA_DUS_5to10Y | 2,195,272,360 | 0.81 | 0.70 | 0.88 | 0.75 | 0.56 | 0.32 | 0.19 | 0.08 | 0.02 |
| | FHLMC_CMBS_A2_10Y | 1,683,635,964 | 0.71 | 0.57 | 0.74 | 0.63 | 0.47 | 0.27 | 0.15 | 0.06 | 0.00 |
| Non Agency CMBS | CMBS_2005_A | 1,295,421,981 | 2.47 | 3.85 | 4.73 | 4.99 | 4.58 | 3.66 | 2.81 | 2.09 | 1.49 |
| | CMBS_2005_AI | 96,578,019 | 6.58 | 13.97 | 16.96 | 19.22 | 18.58 | 15.81 | 12.81 | 10.31 | 8.01 |
| Agency Bonds | AgencyDeb_Srt | | 0.58 | 0.58 | 0.65 | 0.58 | 0.42 | 0.26 | 0.14 | 0.05 | -0.01 |
| | AgencyDeb_Int | 371,000,000 | 0.49 | 0.40 | 0.48 | 0.40 | 0.29 | 0.17 | 0.10 | 0.04 | 0.01 |
| | AgencyDeb_Lng | | 0.14 | 0.20 | 0.24 | 0.23 | 0.20 | 0.14 | 0.11 | 0.07 | 0.05 |
| CLO | CLO_AAA_3M | 2,351,000,000 | 1.62 | 2.79 | 4.12 | 5.09 | 4.85 | 4.23 | 3.53 | 2.79 | 2.16 |
| ABS | ABS_AT_AAA_1 | 1,097,056,098 | 1.69 | 1.30 | 1.73 | 1.28 | 0.93 | 0.65 | 0.47 | 0.36 | 0.27 |
| | ABS_AT_AAA_3 | | 3.04 | 2.51 | 3.21 | 2.83 | 2.02 | 1.43 | 0.90 | 0.47 | 0.17 |
| | ABS_CC_AAA_3 | | 2.13 | 1.84 | 2.50 | 2.27 | 1.74 | 1.27 | 0.82 | 0.43 | 0.13 |
| | ABS_CC_AAA_7 | 1,185,171,903 | 2.24 | 2.02 | 2.71 | 2.49 | 1.84 | 1.29 | 0.78 | 0.34 | 0.03 |
| | ABS_SL_AAA_1 | | 1.27 | 0.98 | 1.29 | 1.05 | 0.73 | 0.51 | 0.37 | 0.27 | 0.20 |
| | ABS_SL_AAA_7 | 610,771,999 | 2.17 | 1.49 | 1.94 | 1.44 | 0.98 | 0.73 | 0.49 | 0.31 | 0.16 |
| Covered Bonds | iBoxx_Canada_Cov | 897,392,867 | 0.28 | 1.03 | 1.18 | 1.34 | 1.22 | 0.79 | 0.38 | 0.05 | -0.23 |
| | iBoxx_EUR_Canada | 117,512,503 | 0.09 | 0.50 | 0.53 | 0.60 | 0.52 | 0.31 | 0.12 | -0.03 | -0.15 |
| | iBoxx_EUR_G8 | 362,873,078 | 0.54 | 1.76 | 1.64 | 1.66 | 1.20 | 0.66 | 0.19 | -0.15 | -0.15 |
| | iBoxx_EUR_Ntlnds | 239,608,102 | 0.16 | 0.84 | 0.76 | 0.84 | 0.67 | 0.47 | 0.26 | 0.09 | -0.05 |
| | iBoxx_EUR_Sandi | 554,326,635 | 0.15 | 0.56 | 0.52 | 0.55 | 0.41 | 0.25 | 0.10 | -0.02 | -0.11 |
| Non Agency RMBS | RMBS_Prime_AAA | 820,556,218 | 3.43 | 6.24 | 8.77 | 10.86 | 11.32 | 10.42 | 9.37 | 8.12 | 6.92 |
| | RMBS_AltA_AAA | 1,332,122,987 | 11.49 | 15.84 | 20.25 | 22.82 | 21.25 | 19.31 | 16.86 | 14.39 | 11.68 |
| | RMBS_AltA_AA | 284,290,870 | 10.86 | 19.36 | 26.58 | 32.52 | 32.76 | 29.97 | 26.31 | 21.93 | 17.66 |
| | RMBS_SubPrime_AAA | 100,548,288 | 3.49 | 8.16 | 12.60 | 16.32 | 18.11 | 17.22 | 15.99 | 14.29 | 12.44 |
| EUR MBS | EUR_DCH_AA | 147,278,146 | 6.09 | 6.42 | 7.93 | 8.19 | 6.47 | 4.79 | 3.31 | 2.08 | 1.26 |
| | EUR_DCH_St10_AAA | 214,533,408 | 1.90 | 2.33 | 2.87 | 3.14 | 2.59 | 2.02 | 1.49 | 1.02 | 0.71 |
| | EUR_IR_BBB | 119,329,995 | 13.65 | 18.06 | 27.19 | 28.43 | 28.73 | 22.82 | 17.78 | 13.32 | 9.30 |
| GBP MBS | GBP_UK_0t3_AAA | | 3.41 | 2.50 | 3.73 | 3.61 | 2.79 | 1.97 | 1.16 | 0.59 | 0.23 |
| | GBP_UK_3t5_AAA | 623,340,088 | 2.33 | 1.54 | 2.38 | 2.05 | 1.68 | 1.35 | 0.94 | 0.64 | 0.43 |
| | GBP_UK_5t10_AAA | | 1.73 | 1.23 | 2.50 | 2.84 | 2.76 | 2.50 | 1.91 | 1.47 | 1.18 |
| EUR Sovereigns | SOV_EUR_FRA_1Y | | 1.10 | 0.76 | 0.71 | 0.56 | 0.45 | 0.42 | 0.30 | 0.14 | 0.06 |
| | SOV_EUR_FRA_5Y | 1,978,377,538 | -0.80 | -0.72 | -0.73 | -0.78 | -0.82 | -0.85 | -0.90 | -0.93 | -1.01 |
| | SOV_EUR_FRA_10Y | | -1.00 | -0.91 | -0.93 | -0.97 | -1.01 | -1.04 | -1.09 | -1.12 | -1.21 |
| | SOV_EUR_NLD_1Y | | 1.12 | 0.77 | 0.72 | 0.57 | 0.46 | 0.42 | 0.31 | 0.15 | 0.07 |
| | SOV_EUR_NLD_5Y | 1,039,888,729 | 0.90 | 0.60 | 0.65 | 0.34 | 0.18 | -0.06 | -0.32 | -0.42 | -0.55 |
| | SOV_EUR_NLD_10Y | | 1.09 | 0.79 | 0.83 | 0.53 | 0.37 | 0.13 | -0.13 | -0.23 | -0.36 |

Credit Spread shock forecasts for the Severely Adverse Scenario

| Asset Type | Segment | Market Value (12/31/2015) | PQ1 | PQ2 | PQ3 | PQ4 | PQ5 | PQ6 | PQ7 | PQ8 | PQ9 |
|---------------------------------------|-------------------------------|------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| EUR Sovereigns | SOV_EUR_BEL_1Y | 1,004,810,141 | 1.08 | 0.74 | 0.69 | 0.55 | 0.44 | 0.41 | 0.29 | 0.14 | 0.06 |
| | SOV_EUR_BEL_5Y | | 0.98 | 0.68 | 0.75 | 0.53 | 0.33 | 0.11 | -0.16 | -0.36 | -0.48 |
| | SOV_EUR_BEL_10Y | | 1.20 | 0.89 | 0.96 | 0.74 | 0.54 | 0.32 | 0.05 | -0.15 | -0.27 |
| | SOV_EUR_ITA_1Y | 1,377,253,640 | 1.35 | 1.17 | 1.21 | 1.00 | 0.75 | 0.60 | 0.40 | 0.17 | 0.02 |
| | SOV_EUR_ITA_5Y | | 0.82 | 0.82 | 0.85 | 0.55 | 0.20 | -0.10 | -0.39 | -0.64 | -0.86 |
| | SOV_EUR_ITA_10Y | | 1.03 | 1.02 | 1.06 | 0.75 | 0.40 | 0.11 | -0.19 | -0.44 | -0.65 |
| | SOV_EUR_SPA_1Y | 1,926,954,727 | 1.63 | 1.49 | 1.51 | 1.29 | 1.01 | 0.83 | 0.59 | 0.34 | 0.17 |
| | SOV_EUR_SPA_5Y | | 2.01 | 2.03 | 1.88 | 1.58 | 1.28 | 0.88 | 0.49 | 0.16 | -0.10 |
| | SOV_EUR_SPA_10Y | | 2.37 | 2.38 | 2.24 | 1.93 | 1.63 | 1.23 | 0.84 | 0.51 | 0.26 |
| EUR Corporates | SOV_EUR_IRL_1Y | 760,978,042 | 3.58 | 3.34 | 2.49 | 2.08 | 1.86 | 1.71 | 1.63 | 1.48 | 1.42 |
| | SOV_EUR_IRL_5Y | | 3.21 | 3.24 | 2.40 | 2.03 | 1.67 | 1.32 | 1.09 | 0.87 | 0.70 |
| | SOV_EUR_IRL_10Y | | 3.89 | 3.92 | 3.08 | 2.72 | 2.35 | 2.01 | 1.77 | 1.55 | 1.38 |
| | SOV_EUR_SWE_1Y | 137,820,783 | 0.26 | 0.34 | 0.40 | 0.35 | 0.29 | 0.26 | 0.18 | 0.08 | 0.02 |
| | SOV_EUR_SWE_5Y | | -0.60 | -0.62 | -0.74 | -0.81 | -0.81 | -0.82 | -0.86 | -0.86 | -0.86 |
| | SOV_EUR_SWE_10Y | | -0.72 | -0.74 | -0.87 | -0.94 | -0.93 | -0.94 | -0.98 | -0.98 | -0.99 |
| | EUR_CORP_A_1Y | 179,100,994 | 1.43 | 1.34 | 1.64 | 1.47 | 1.05 | 0.54 | 0.14 | -0.23 | -0.36 |
| | EUR_CORP_A_5Y | | 1.17 | 1.17 | 1.44 | 1.33 | 0.96 | 0.51 | 0.13 | -0.22 | -0.34 |
| | EUR_CORP_A_10Y | | 1.00 | 1.06 | 1.30 | 1.24 | 0.90 | 0.48 | 0.12 | -0.22 | -0.33 |
| USD corporates | EUR_CORP_AA_1Y | 88,778,804 | 1.11 | 1.04 | 1.28 | 1.14 | 0.81 | 0.42 | 0.11 | -0.17 | -0.28 |
| | EUR_CORP_AA_5Y | | 0.85 | 0.84 | 1.05 | 0.96 | 0.66 | 0.30 | 0.00 | -0.28 | -0.37 |
| | EUR_CORP_AA_10Y | | 0.59 | 0.64 | 0.83 | 0.78 | 0.51 | 0.18 | -0.11 | -0.38 | -0.47 |
| | EUR_CORP BBB_1Y | 154,025,687 | 1.54 | 1.44 | 1.77 | 1.59 | 1.13 | 0.59 | 0.15 | -0.24 | -0.39 |
| | EUR_CORP BBB_5Y | | 1.45 | 1.46 | 1.79 | 1.67 | 1.21 | 0.64 | 0.16 | -0.28 | -0.43 |
| | EUR_CORP BBB_10Y | | 1.39 | 1.47 | 1.81 | 1.72 | 1.25 | 0.67 | 0.17 | -0.30 | -0.46 |
| | USD_Corp_A_1Y | 1,039,884,594 | 0.96 | 2.09 | 3.02 | 2.67 | 1.71 | 1.99 | 2.34 | 2.69 | 2.53 |
| | USD_Corp_A_5Y | | 1.60 | 2.29 | 2.79 | 2.89 | 2.39 | 2.31 | 2.33 | 2.34 | 2.10 |
| | USD_Corp_A_10Y | | 2.08 | 2.30 | 2.32 | 2.90 | 2.89 | 2.56 | 2.32 | 2.08 | 1.79 |
| Municipal Bonds - General Obligations | USD_Corp_AA_1Y | 213,487,413 | 0.81 | 1.77 | 2.52 | 2.39 | 1.65 | 2.04 | 2.45 | 2.83 | 2.67 |
| | USD_Corp_AA_5Y | | 1.31 | 1.94 | 2.37 | 2.55 | 2.13 | 2.24 | 2.40 | 2.54 | 2.32 |
| | USD_Corp_AA_10Y | | 1.40 | 1.93 | 2.26 | 2.56 | 2.25 | 2.32 | 2.43 | 2.51 | 2.28 |
| | USD_Corp BBB_1Y | 83,949,592 | 1.27 | 2.72 | 3.97 | 3.33 | 2.10 | 2.23 | 2.41 | 2.56 | 2.35 |
| | USD_Corp BBB_5Y | | 1.61 | 2.73 | 3.65 | 3.32 | 2.40 | 2.32 | 2.32 | 2.33 | 2.09 |
| | USD_Corp BBB_10Y | | 2.20 | 2.80 | 3.20 | 3.40 | 3.00 | 2.60 | 2.30 | 2.00 | 1.70 |
| | BFV_GO_A_1Y | 205,923,179 | 0.09 | 0.53 | 0.69 | 0.85 | 0.69 | 0.53 | 0.48 | 0.40 | 0.35 |
| | BFV_GO_A_5Y | | 0.48 | 0.94 | 1.05 | 1.22 | 1.11 | 0.92 | 0.79 | 0.64 | 0.56 |
| | BFV_GO_A_10Y | | 0.04 | 1.50 | 1.66 | 1.96 | 1.97 | 1.62 | 1.41 | 1.17 | 1.00 |
| Municipal Bonds - Revenue | BFV_GO_AA_1Y | 989,356,949 | 0.22 | 0.58 | 0.72 | 0.79 | 0.59 | 0.49 | 0.44 | 0.37 | 0.30 |
| | BFV_GO_AA_5Y | | 0.41 | 0.81 | 0.89 | 1.05 | 0.95 | 0.79 | 0.67 | 0.55 | 0.48 |
| | BFV_GO_AA_10Y | | 0.42 | 0.81 | 0.90 | 1.05 | 0.95 | 0.79 | 0.68 | 0.55 | 0.48 |
| | BFV_TR_AA_1Y | 448,531,337 | 0.25 | 0.59 | 0.73 | 0.78 | 0.59 | 0.49 | 0.43 | 0.37 | 0.31 |
| | BFV_TR_AA_5Y | | 0.39 | 0.76 | 0.84 | 0.99 | 0.89 | 0.74 | 0.64 | 0.52 | 0.45 |
| | BFV_TR_AA_10Y | | 0.41 | 0.79 | 0.88 | 1.03 | 0.93 | 0.77 | 0.66 | 0.54 | 0.47 |
| | BFV_UT_A_1Y | 105,869,857 | 0.32 | 0.84 | 1.09 | 1.25 | 1.04 | 0.85 | 0.71 | 0.54 | 0.40 |
| | BFV_UT_A_5Y | | 0.39 | 1.11 | 1.23 | 1.45 | 1.34 | 1.09 | 0.91 | 0.72 | 0.59 |
| | BFV_UT_A_10Y | | 0.52 | 1.01 | 1.12 | 1.31 | 1.18 | 0.98 | 0.84 | 0.69 | 0.60 |
| | BFV_UT_AA_1Y | 686,570,476 | 0.28 | 0.70 | 0.88 | 0.99 | 0.77 | 0.63 | 0.53 | 0.42 | 0.32 |
| | BFV_UT_AA_5Y | | 0.45 | 0.95 | 0.96 | 1.13 | 1.03 | 0.85 | 0.73 | 0.58 | 0.51 |
| | BFV_UT_AA_10Y | | 0.41 | 0.80 | 0.89 | 1.04 | 0.94 | 0.78 | 0.67 | 0.54 | 0.48 |
| ABCP | BFV_ED_AA_1Y | 375,426,826 | 0.21 | 0.58 | 0.72 | 0.76 | 0.60 | 0.49 | 0.42 | 0.34 | 0.27 |
| | BFV_ED_AA_5Y | | 0.44 | 0.80 | 0.90 | 1.05 | 0.94 | 0.78 | 0.67 | 0.55 | 0.49 |
| | BFV_ED_AA_10Y | | 0.41 | 0.79 | 0.88 | 1.03 | 0.93 | 0.77 | 0.66 | 0.54 | 0.47 |
| | BFV_REV_A_1Y | 1,233,321,375 | 0.28 | 0.72 | 0.94 | 1.06 | 0.89 | 0.73 | 0.61 | 0.47 | 0.34 |
| | BFV_REV_A_5Y | | 0.40 | 1.15 | 1.27 | 1.51 | 1.39 | 1.13 | 0.94 | 0.75 | 0.62 |
| | BFV_REV_A_10Y | | 0.03 | 1.22 | 1.36 | 1.60 | 1.61 | 1.32 | 1.15 | 0.95 | 0.82 |
| ABCP | ABCP | 1,903,605,887 | 0.42 | 0.93 | 0.87 | 0.87 | 0.66 | 0.45 | 0.34 | 0.27 | 0.22 |
| International Bonds | USD INTERNATIONAL FINLAND 1Y | 14,083,738 | 0.52 | 0.60 | 0.70 | 0.75 | 0.65 | 0.63 | 0.54 | 0.45 | 0.37 |
| | USD INTERNATIONAL FINLAND 5Y | | 1.56 | 1.80 | 1.60 | 1.49 | 1.37 | 1.21 | 1.07 | 0.97 | 0.85 |
| | USD INTERNATIONAL FINLAND 10Y | | 1.56 | 1.80 | 1.60 | 1.49 | 1.37 | 1.21 | 1.07 | 0.97 | 0.85 |
| | GBP INTERNATIONAL BELGIUM 1Y | 88,399,041 | 2.07 | 2.26 | 1.91 | 1.71 | 1.36 | 1.06 | 0.76 | 0.48 | 0.19 |
| | GBP INTERNATIONAL BELGIUM 5Y | | 2.13 | 2.38 | 2.64 | 2.31 | 2.10 | 1.78 | 1.46 | 1.27 | 1.10 |
| | GBP INTERNATIONAL BELGIUM 10Y | | 2.13 | 2.38 | 2.64 | 2.31 | 2.10 | 1.78 | 1.46 | 1.27 | 1.10 |
| | EUR INTERNATIONAL SWEDEN 1Y | 140,187,876 | 0.52 | 0.60 | 0.70 | 0.75 | 0.65 | 0.63 | 0.54 | 0.45 | 0.37 |
| | EUR INTERNATIONAL SWEDEN 5Y | | 1.56 | 1.80 | 1.60 | 1.49 | 1.37 | 1.21 | 1.07 | 0.97 | 0.85 |
| | EUR INTERNATIONAL SWEDEN 10Y | | 1.56 | 1.80 | 1.60 | 1.49 | 1.37 | 1.21 | 1.07 | 0.97 | 0.85 |
| | USD INTERNATIONAL SWEDEN 1Y | | 0.52 | 0.60 | 0.70 | 0.75 | 0.65 | 0.63 | 0.54 | 0.45 | 0.37 |
| | USD INTERNATIONAL SWEDEN 5Y | | 1.56 | 1.80 | 1.60 | 1.49 | 1.37 | 1.21 | 1.07 | 0.97 | 0.85 |
| | USD INTERNATIONAL SWEDEN 10Y | | 1.56 | 1.80 | 1.60 | 1.49 | 1.37 | 1.21 | 1.07 | 0.97 | 0.85 |

Credit Spread shock forecasts for the BHC Stress Scenario

| Asset Type | Segment | Market Value (12/31/2015) | PQ1 | PQ2 | PQ3 | PQ4 | PQ5 | PQ6 | PQ7 | PQ8 | PQ9 |
|----------------------|-------------------|------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Agency MBS 15Y FNMA | FNMA15_CC | 3,145,288,581 | 0.91 | 0.81 | 0.87 | 0.84 | 0.73 | 0.57 | 0.45 | 0.35 | 0.28 |
| | FNMA15_4 | 602,376,199 | 0.91 | 0.70 | 0.68 | 0.56 | 0.42 | 0.25 | 0.16 | 0.09 | 0.07 |
| | FNMA15_4p5 | 585,028,346 | 1.05 | 0.81 | 0.79 | 0.64 | 0.48 | 0.29 | 0.18 | 0.10 | 0.08 |
| Agency MBS 15Y FHLMC | FHLMC15_CC | 3,400,054,997 | 0.89 | 0.76 | 0.80 | 0.74 | 0.63 | 0.47 | 0.36 | 0.27 | 0.22 |
| | FHLMC15_4 | 512,209,539 | 1.31 | 1.07 | 1.06 | 0.90 | 0.69 | 0.42 | 0.25 | 0.12 | 0.07 |
| | FHLMC15_4p5_2005 | 86,166,708 | 1.10 | 0.89 | 0.89 | 0.77 | 0.58 | 0.36 | 0.23 | 0.13 | 0.09 |
| | FHLMC15_4p5_2009 | 257,257,166 | 1.04 | 0.80 | 0.78 | 0.64 | 0.48 | 0.29 | 0.18 | 0.10 | 0.07 |
| | FHLMC15_5_2005 | 53,480,053 | 1.00 | 1.06 | 0.97 | 0.82 | 0.62 | 0.38 | 0.21 | 0.10 | 0.05 |
| | FHLMC15_5_2008 | 142,595,171 | 1.00 | 1.11 | 1.01 | 0.86 | 0.64 | 0.39 | 0.22 | 0.10 | 0.05 |
| Agency MBS 15Y GNMA | GNMA15_CC | 926,671 | 0.25 | 1.44 | 1.19 | 1.15 | 0.92 | 0.65 | 0.37 | 0.19 | 0.06 |
| Agency MBS 30Y FNMA | FNMA30_CC | 307,778,093 | 0.53 | 0.47 | 0.51 | 0.48 | 0.42 | 0.33 | 0.26 | 0.20 | 0.16 |
| | FNMA30_4p5 | 56,663,874 | 0.62 | 0.53 | 0.55 | 0.50 | 0.42 | 0.31 | 0.24 | 0.17 | 0.14 |
| | FNMA30_5_p5 | 249,708,756 | 0.82 | 0.73 | 0.80 | 0.77 | 0.70 | 0.57 | 0.47 | 0.38 | 0.32 |
| Agency MBS 30Y FHLMC | FHLMC30_CC | 110,600,739 | 0.56 | 0.57 | 0.54 | 0.49 | 0.39 | 0.28 | 0.18 | 0.12 | 0.08 |
| Agency MBS 30Y GNMA | GNMA30_CC | 254,272,445 | 0.86 | 0.76 | 0.82 | 0.78 | 0.68 | 0.52 | 0.42 | 0.32 | 0.26 |
| Agency Hybrid | FNMA5_1_3 | 1,504,447,899 | 1.61 | 1.54 | 1.43 | 1.23 | 0.95 | 0.63 | 0.39 | 0.24 | 0.17 |
| | FHLMS_1_3 | 777,392,592 | 1.48 | 1.37 | 1.28 | 1.10 | 0.83 | 0.53 | 0.31 | 0.17 | 0.10 |
| Agency CMO | CMO_PAC_2WAL | 396,701,003 | 1.65 | 1.99 | 2.09 | 2.05 | 1.71 | 1.20 | 0.88 | 0.57 | 0.43 |
| | CMO_PAC_10WAL | | 1.54 | 1.83 | 1.89 | 1.83 | 1.54 | 1.07 | 0.78 | 0.50 | 0.39 |
| | CMO_SEQ_2WAL | 449,757,792 | 0.99 | 1.72 | 1.65 | 1.61 | 1.32 | 0.94 | 0.64 | 0.40 | 0.26 |
| | CMO_SEQ_10WAL | | 1.68 | 2.04 | 2.11 | 2.06 | 1.74 | 1.25 | 0.94 | 0.65 | 0.53 |
| | CMO_FLTSTR_6p5 | 5,129,103,946 | 0.36 | 0.94 | 1.05 | 1.16 | 1.00 | 0.82 | 0.67 | 0.56 | 0.47 |
| | CMO_FLTSTR_7 | | 0.36 | 0.81 | 0.90 | 0.99 | 0.84 | 0.69 | 0.55 | 0.45 | 0.36 |
| | CMO_FLTFLT_6p5 | 1,295,453,859 | 0.27 | 0.79 | 0.93 | 1.05 | 0.97 | 0.79 | 0.62 | 0.51 | 0.40 |
| | CMO_FLTFLT_7 | | 0.34 | 0.80 | 0.88 | 0.96 | 0.82 | 0.66 | 0.51 | 0.41 | 0.32 |
| Agency CMBS | GNMA_CMBS_3p5Y | 141,091,676 | 1.83 | 1.63 | 1.58 | 1.37 | 1.08 | 0.74 | 0.50 | 0.34 | 0.26 |
| | GNMA_CMBS_12Y | | 1.28 | 1.13 | 1.10 | 0.96 | 0.75 | 0.51 | 0.35 | 0.24 | 0.18 |
| | FNMA_DUS_5to10Y | 2,195,272,360 | 1.77 | 1.45 | 1.45 | 1.23 | 0.97 | 0.65 | 0.45 | 0.30 | 0.24 |
| Non Agency CMBS | FHLMC_CMBS_A2_10Y | 1,683,635,964 | 1.48 | 1.31 | 1.27 | 1.11 | 0.87 | 0.59 | 0.41 | 0.27 | 0.21 |
| | CMBS_2005_A | 1,295,421,981 | 5.65 | 7.57 | 7.58 | 7.44 | 6.77 | 5.48 | 4.11 | 3.20 | 2.52 |
| | CMBS_2005_AU | 96,578,019 | 13.47 | 24.15 | 24.41 | 25.27 | 24.01 | 20.43 | 15.62 | 12.53 | 9.90 |
| Agency Bonds | AgencyDeb_Srt | 371,000,000 | 1.22 | 1.27 | 1.18 | 1.04 | 0.83 | 0.58 | 0.38 | 0.26 | 0.20 |
| | AgencyDeb_Int | | 0.98 | 0.79 | 0.78 | 0.67 | 0.53 | 0.34 | 0.24 | 0.16 | 0.13 |
| | AgencyDeb_Lng | | 0.30 | 0.34 | 0.33 | 0.30 | 0.26 | 0.20 | 0.14 | 0.11 | 0.09 |
| CLO | CLO_AAA_3M | 2,351,000,000 | 2.69 | 3.94 | 5.03 | 5.88 | 5.22 | 4.45 | 3.70 | 2.95 | 2.30 |
| ABS | ABS_AT_AAA_1 | 1,097,056,098 | 3.91 | 2.82 | 2.80 | 2.24 | 1.74 | 1.20 | 0.86 | 0.59 | 0.47 |
| | ABS_AT_AAA_3 | | 5.93 | 4.83 | 5.01 | 4.61 | 3.45 | 2.48 | 1.74 | 1.20 | 0.90 |
| | ABS_CC_AAA_3 | 1,185,171,903 | 4.62 | 3.89 | 4.10 | 3.73 | 2.76 | 2.00 | 1.43 | 0.97 | 0.72 |
| | ABS_CC_AAA_7 | | 4.77 | 4.09 | 4.32 | 3.97 | 2.93 | 2.12 | 1.51 | 1.03 | 0.76 |
| | ABS_SL_AAA_1 | 610,771,999 | 2.79 | 2.23 | 2.14 | 1.79 | 1.40 | 0.97 | 0.71 | 0.48 | 0.37 |
| | ABS_SL_AAA_7 | | 4.75 | 3.49 | 3.46 | 2.80 | 2.12 | 1.54 | 1.16 | 0.86 | 0.70 |
| | iBoxx_Canada_Cov | 887,392,867 | 0.92 | 2.43 | 2.35 | 2.32 | 2.10 | 1.42 | 0.87 | 0.50 | 0.24 |
| Covered Bonds | iBoxx_EUR_Canada | 117,512,503 | 0.39 | 1.23 | 1.13 | 1.11 | 0.98 | 0.66 | 0.38 | 0.20 | 0.08 |
| | iBoxx_EUR_GB | 362,873,078 | 1.41 | 4.01 | 3.55 | 3.29 | 2.67 | 1.92 | 1.24 | 0.81 | 0.52 |
| | iBoxx_EUR_Ntlnds | 239,609,102 | 0.25 | 1.53 | 1.39 | 1.38 | 1.18 | 0.97 | 0.73 | 0.58 | 0.45 |
| | iBoxx_EUR_Scanl | 554,326,635 | 0.33 | 1.18 | 1.05 | 1.00 | 0.83 | 0.63 | 0.44 | 0.31 | 0.22 |
| | RMBs_Prime_AAA | 820,556,218 | 4.67 | 7.27 | 9.61 | 11.15 | 12.62 | 11.05 | 9.90 | 8.56 | 7.10 |
| Non Agency RMBS | RMBs_AltA_AAA | 1,332,122,987 | 12.35 | 15.91 | 19.64 | 22.28 | 21.27 | 18.06 | 15.69 | 12.95 | 10.33 |
| | RMBs_AltA_AA | 284,290,870 | 12.32 | 20.84 | 27.77 | 33.12 | 33.71 | 28.79 | 24.42 | 19.90 | 15.45 |
| | RMBs_SubPrime_AAA | 100,548,288 | 3.71 | 8.43 | 12.68 | 15.86 | 18.86 | 17.21 | 15.62 | 13.52 | 11.11 |
| | EUR_DCH_AA | 147,278,146 | 8.56 | 9.07 | 9.65 | 9.62 | 7.29 | 5.16 | 3.67 | 2.53 | 1.95 |
| EUR MBS | EUR_DCH_5t10_AAA | 214,533,408 | 2.04 | 2.49 | 2.86 | 3.07 | 2.31 | 1.69 | 1.26 | 0.90 | 0.72 |
| | EUR_IR_BBB | 119,329,995 | 33.24 | 36.97 | 42.17 | 42.60 | 41.28 | 30.78 | 25.47 | 22.46 | 20.22 |
| | GBP_UK_0t3_AAA | 623,340,088 | 7.85 | 7.33 | 7.25 | 6.70 | 5.41 | 3.88 | 2.82 | 2.03 | 1.63 |
| GBP MBS | GBP_UK_3t5_AAA | | 4.97 | 4.05 | 4.23 | 3.75 | 3.03 | 2.35 | 1.87 | 1.48 | 1.32 |
| | GBP_UK_5t10_AAA | | 3.08 | 3.39 | 3.91 | 4.10 | 3.60 | 3.02 | 2.53 | 2.10 | 1.82 |
| | SOV_EUR_FRA_1Y | 1,978,377,538 | 2.13 | 2.32 | 1.96 | 1.76 | 1.39 | 1.09 | 0.78 | 0.50 | 0.20 |
| EUR Sovereigns | SOV_EUR_FRA_5Y | | 1.47 | 1.82 | 1.49 | 1.19 | 0.91 | 0.67 | 0.42 | 0.22 | 0.04 |
| | SOV_EUR_FRA_10Y | | 1.47 | 1.82 | 1.49 | 1.19 | 0.91 | 0.67 | 0.42 | 0.22 | 0.04 |
| | SOV_EUR_NLD_3Y | 1,039,888,729 | 2.16 | 2.36 | 1.99 | 1.79 | 1.42 | 1.11 | 0.79 | 0.51 | 0.21 |
| | SOV_EUR_NLD_5Y | | 1.41 | 1.46 | 1.43 | 1.14 | 0.95 | 0.71 | 0.48 | 0.50 | 0.44 |
| | SOV_EUR_NLD_10Y | | 1.41 | 1.46 | 1.43 | 1.14 | 0.95 | 0.71 | 0.48 | 0.50 | 0.44 |

Credit Spread shock forecasts for the BHC Stress Scenario

| Asset Type | Segment | Market Value (12/31/2015) | PQ1 | PQ2 | PQ3 | PQ4 | PQ5 | PQ6 | PQ7 | PQ8 | PQ9 |
|---------------------------------------|-------------------------------|------------------------------|------|------|------|------|------|------|------|-------|-------|
| EUR Sovereigns | SOV_EUR_BEL_1Y | 1,004,810,141 | 2.07 | 2.26 | 1.91 | 1.71 | 1.36 | 1.06 | 0.76 | 0.48 | 0.19 |
| | SOV_EUR_BEL_5Y | | 2.13 | 2.38 | 2.64 | 2.31 | 2.10 | 1.78 | 1.46 | 1.27 | 1.10 |
| | SOV_EUR_BEL_10Y | | 2.13 | 2.38 | 2.64 | 2.31 | 2.10 | 1.78 | 1.46 | 1.27 | 1.10 |
| | SOV_EUR_ITA_1Y | | 2.42 | 2.85 | 2.43 | 2.20 | 1.78 | 1.48 | 1.23 | 0.97 | 0.78 |
| | SOV_EUR_ITA_5Y | 1,377,253,640 | 1.83 | 2.34 | 1.89 | 1.59 | 1.23 | 0.95 | 0.77 | 0.61 | 0.54 |
| | SOV_EUR_ITA_10Y | | 1.83 | 2.34 | 1.89 | 1.59 | 1.23 | 0.95 | 0.77 | 0.61 | 0.54 |
| | SOV_EUR_SPA_1Y | | 2.55 | 2.97 | 2.57 | 2.32 | 1.91 | 1.59 | 1.33 | 1.08 | 0.89 |
| | SOV_EUR_SPA_5Y | 1,926,954,727 | 2.14 | 2.22 | 1.99 | 1.69 | 1.42 | 1.05 | 0.80 | 0.67 | 0.53 |
| | SOV_EUR_SPA_10Y | | 2.14 | 2.22 | 1.99 | 1.69 | 1.42 | 1.05 | 0.80 | 0.67 | 0.53 |
| | SOV_EUR_IRL_1Y | | 2.80 | 3.83 | 2.95 | 2.40 | 2.14 | 2.02 | 1.81 | 1.59 | 1.44 |
| | SOV_EUR_IRL_5Y | 760,978,042 | 2.72 | 4.01 | 3.21 | 2.70 | 2.26 | 2.04 | 1.83 | 1.66 | 1.47 |
| | SOV_EUR_IRL_10Y | | 2.72 | 4.01 | 3.21 | 2.70 | 2.26 | 2.04 | 1.83 | 1.66 | 1.47 |
| | SOV_EUR_SWE_1Y | | 0.52 | 0.60 | 0.70 | 0.75 | 0.65 | 0.63 | 0.54 | 0.45 | 0.37 |
| | SOV_EUR_SWE_5Y | 137,820,783 | 1.56 | 1.80 | 1.60 | 1.49 | 1.37 | 1.21 | 1.07 | 0.97 | 0.85 |
| | SOV_EUR_SWE_10Y | | 1.56 | 1.80 | 1.60 | 1.49 | 1.37 | 1.21 | 1.07 | 0.97 | 0.85 |
| EUR Corporates | EUR_CORP_A_1Y | 179,100,994 | 2.90 | 2.59 | 2.66 | 2.43 | 1.82 | 1.17 | 0.73 | 0.37 | 0.20 |
| | EUR_CORP_A_5Y | | 2.32 | 2.16 | 2.24 | 2.09 | 1.57 | 1.01 | 0.62 | 0.30 | 0.13 |
| | EUR_CORP_A_10Y | | 1.98 | 1.92 | 2.01 | 1.91 | 1.45 | 0.95 | 0.60 | 0.30 | 0.14 |
| | EUR_CORP_AA_1Y | 88,778,804 | 2.23 | 2.00 | 2.05 | 1.86 | 1.39 | 0.89 | 0.55 | 0.27 | 0.13 |
| | EUR_CORP_AA_5Y | | 1.77 | 1.63 | 1.69 | 1.56 | 1.14 | 0.69 | 0.38 | 0.12 | -0.01 |
| | EUR_CORP_AA_10Y | | 1.37 | 1.32 | 1.40 | 1.32 | 0.95 | 0.55 | 0.27 | 0.03 | -0.09 |
| | EUR_CORP BBB_1Y | 154,025,687 | 3.15 | 2.82 | 2.90 | 2.64 | 1.99 | 1.29 | 0.82 | 0.43 | 0.24 |
| | EUR_CORP BBB_5Y | | 2.85 | 2.67 | 2.77 | 2.59 | 1.94 | 1.25 | 0.76 | 0.36 | 0.15 |
| | EUR_CORP BBB_10Y | | 2.92 | 2.83 | 2.96 | 2.82 | 2.17 | 1.48 | 0.99 | 0.57 | 0.35 |
| USD corporates | USD_CORP_A_1Y | 1,039,884,594 | 2.62 | 2.63 | 2.84 | 2.73 | 1.92 | 0.98 | 0.35 | -0.20 | -0.37 |
| | USD_CORP_A_5Y | | 2.60 | 2.62 | 2.82 | 2.72 | 1.91 | 0.97 | 0.34 | -0.20 | -0.38 |
| | USD_CORP_A_10Y | | 2.37 | 2.38 | 2.57 | 2.48 | 1.73 | 0.86 | 0.28 | -0.22 | -0.38 |
| | USD_CORP_AA_1Y | 213,487,413 | 2.24 | 2.25 | 2.42 | 2.34 | 1.66 | 0.87 | 0.34 | -0.12 | -0.27 |
| | USD_CORP_AA_5Y | | 2.19 | 2.20 | 2.37 | 2.29 | 1.62 | 0.85 | 0.33 | -0.12 | -0.26 |
| | USD_CORP_AA_10Y | | 2.24 | 2.26 | 2.42 | 2.34 | 1.69 | 0.93 | 0.42 | -0.02 | -0.16 |
| | USD_CORP BBB_1Y | 83,949,592 | 3.23 | 3.25 | 3.50 | 3.38 | 2.40 | 1.28 | 0.51 | -0.14 | -0.35 |
| | USD_CORP BBB_5Y | | 3.21 | 3.23 | 3.48 | 3.36 | 2.39 | 1.27 | 0.51 | -0.14 | -0.35 |
| | USD_CORP BBB_10Y | | 3.18 | 3.20 | 3.44 | 3.32 | 2.36 | 1.25 | 0.50 | -0.14 | -0.35 |
| Municipal Bonds - General Obligations | BFV_GO_A_1Y | 205,923,179 | 0.38 | 0.41 | 0.51 | 0.53 | 0.58 | 0.42 | 0.36 | 0.30 | 0.24 |
| | BFV_GO_A_5Y | | 0.53 | 0.90 | 0.92 | 0.97 | 0.99 | 0.82 | 0.66 | 0.57 | 0.45 |
| | BFV_GO_A_10Y | | 0.04 | 1.52 | 1.48 | 1.64 | 1.64 | 1.54 | 1.17 | 1.03 | 0.84 |
| | BFV_GO_AA_1Y | 989,356,949 | 0.41 | 0.41 | 0.50 | 0.53 | 0.51 | 0.37 | 0.33 | 0.27 | 0.21 |
| | BFV_GO_AA_5Y | | 0.46 | 0.77 | 0.79 | 0.83 | 0.85 | 0.71 | 0.56 | 0.48 | 0.38 |
| | BFV_GO_AA_10Y | | 0.45 | 0.77 | 0.80 | 0.83 | 0.86 | 0.71 | 0.57 | 0.49 | 0.38 |
| Municipal Bonds - Revenue | BFV_TR_AA_1Y | 448,531,337 | 0.48 | 0.46 | 0.55 | 0.56 | 0.53 | 0.38 | 0.34 | 0.27 | 0.21 |
| | BFV_TR_AA_5Y | | 0.43 | 0.72 | 0.75 | 0.78 | 0.80 | 0.67 | 0.53 | 0.46 | 0.36 |
| | BFV_TR_AA_10Y | | 0.45 | 0.75 | 0.77 | 0.81 | 0.83 | 0.69 | 0.55 | 0.47 | 0.37 |
| | BFV_UT_A_1Y | 105,869,857 | 0.58 | 0.73 | 0.93 | 1.04 | 0.95 | 0.69 | 0.57 | 0.43 | 0.31 |
| | BFV_UT_A_5Y | | 0.47 | 1.30 | 1.27 | 1.34 | 1.30 | 1.05 | 0.80 | 0.66 | 0.50 |
| | BFV_UT_A_10Y | | 0.57 | 0.96 | 0.99 | 1.04 | 1.06 | 0.88 | 0.71 | 0.61 | 0.48 |
| | BFV_UT_AA_1Y | 686,570,476 | 0.50 | 0.57 | 0.70 | 0.77 | 0.68 | 0.49 | 0.42 | 0.32 | 0.24 |
| | BFV_UT_AA_5Y | | 0.53 | 0.84 | 0.89 | 0.93 | 0.94 | 0.78 | 0.62 | 0.52 | 0.41 |
| | BFV_UT_AA_10Y | | 0.45 | 0.76 | 0.78 | 0.82 | 0.84 | 0.70 | 0.56 | 0.48 | 0.38 |
| | BFV_ED_AA_1Y | 375,426,826 | 0.40 | 0.43 | 0.52 | 0.55 | 0.54 | 0.39 | 0.34 | 0.26 | 0.20 |
| | BFV_ED_AA_5Y | | 0.54 | 0.81 | 0.83 | 0.86 | 0.87 | 0.72 | 0.57 | 0.49 | 0.39 |
| | BFV_ED_AA_10Y | | 0.45 | 0.75 | 0.78 | 0.81 | 0.83 | 0.69 | 0.55 | 0.48 | 0.37 |
| | BFV_REV_A_1Y | 1,233,321,375 | 0.50 | 0.63 | 0.80 | 0.90 | 0.82 | 0.60 | 0.49 | 0.37 | 0.27 |
| | BFV_REV_A_5Y | | 0.49 | 1.35 | 1.32 | 1.39 | 1.35 | 1.09 | 0.83 | 0.68 | 0.52 |
| | BFV_REV_A_10Y | | 0.03 | 1.24 | 1.20 | 1.33 | 1.34 | 1.25 | 0.95 | 0.84 | 0.68 |
| ABCP | ABCP | 1,903,605,887 | 1.06 | 2.12 | 1.77 | 1.61 | 1.30 | 0.96 | 0.69 | 0.50 | 0.38 |
| International Bonds | USD INTERNATIONAL FINLAND 1Y | 14,083,738 | 0.52 | 0.60 | 0.70 | 0.75 | 0.65 | 0.63 | 0.54 | 0.45 | 0.37 |
| | USD INTERNATIONAL FINLAND 5Y | | 1.56 | 1.80 | 1.60 | 1.49 | 1.37 | 1.21 | 1.07 | 0.97 | 0.85 |
| | USD INTERNATIONAL FINLAND 10Y | | 1.56 | 1.80 | 1.60 | 1.49 | 1.37 | 1.21 | 1.07 | 0.97 | 0.85 |
| | GBP INTERNATIONAL BELGIUM 1Y | 88,399,041 | 2.07 | 2.26 | 1.91 | 1.71 | 1.36 | 1.06 | 0.76 | 0.48 | 0.19 |
| | GBP INTERNATIONAL BELGIUM 5Y | | 2.13 | 2.38 | 2.64 | 2.31 | 2.10 | 1.78 | 1.46 | 1.27 | 1.10 |
| | GBP INTERNATIONAL BELGIUM 10Y | | 2.13 | 2.38 | 2.64 | 2.31 | 2.10 | 1.78 | 1.46 | 1.27 | 1.10 |
| | EUR INTERNATIONAL SWEDEN 1Y | 140,187,876 | 0.52 | 0.60 | 0.70 | 0.75 | 0.65 | 0.63 | 0.54 | 0.45 | 0.37 |
| | EUR INTERNATIONAL SWEDEN 5Y | | 1.56 | 1.80 | 1.60 | 1.49 | 1.37 | 1.21 | 1.07 | 0.97 | 0.85 |
| | EUR INTERNATIONAL SWEDEN 10Y | | 1.56 | 1.80 | 1.60 | 1.49 | 1.37 | 1.21 | 1.07 | 0.97 | 0.85 |

The following segments were not subjected to any credit shocks in CCAR 2016

- US Treasury
- German, UK, Singapore Sovereign Bonds
- Supranational Bonds
- Equities and Private Placements

Implementation of credit spread term structure in the primary model

| <i>Using Term structure for curves</i> | | |
|--|---------------------|-----------------------------------|
| Security Type | Term Segment | Implemented term structure |
| CMO (PAC, SEQ.) | 2WAL | 0-5Y |
| | 10WAL | 5Y+ |
| Agency Debentures | AgencyDeb_Srt | <3Y |
| | AgencyDeb_Int | 3-7Y |
| | AgencyDeb_Lng | 7Y+ |
| Auto ABS | ABS_AT_AAA_1 | 0-2Y |
| | ABS_AT_AAA_3 | >=3Y |
| Credit Card ABS | ABS_CC_AAA_3 | 0-5Y |
| | ABS_CC_AAA_7 | 5Y+ |
| Student Loan ABS | ABS_SL_AAA_1 | <5Y |
| | ABS_SL_AAA_7 | >=5Y |
| Floor Plan ABS | ABS_AT_AAA_1 | 0-2Y |
| | ABS_AT_AAA_3 | >=3Y |
| GBP MBS | GBP_UK_0t3_AAA | <3Y |
| | GBP_UK_3t5_AAA | >=3Y, <5Y |
| | GBP_UK_5t10_AAA | >=5Y |
| Corporate Bonds | 1Y | 0-3Y |
| | 5Y | >3Y, <=7Y |
| | 10Y | 7Y+ |
| Municipal Bonds | 1Y | 0-3Y |
| | 5Y | >3Y, <=7Y |
| | 10Y | 7Y+ |
| Sovereign Bonds | 1Y | 0-2Y |
| | 10Y | 2Y+ |

M. Appendix H: Regulatory Purpose of the Model

The below are outlined in the CCAR guidelines released by the Federal Reserve:

“AFS Fair Value OCI”

As noted previously, this section on common themes identified by supervisors in CCAR 2014 regarding BHC practices for AFS Fair Value OCI was communicated to the BHCs subsequent to the other sections of this appendix. Under U.S. Generally Accepted Accounting Principles (GAAP), changes in the fair value of AFS securities are reflected in changes in accumulated other comprehensive income (AOCI); however, prior to issuance of the revised capital framework, these changes were not reflected in the calculation of regulatory capital. In accordance with the revised capital framework, BHCs with total consolidated assets of \$250 billion or more or on balance sheet foreign exposures of \$10 billion or more (advanced approaches BHCs) must reflect AOCI items in their regulatory capital beginning in the second quarter of the planning horizon (the first quarter of 2014). Under the transition provisions of the revised capital framework, regulatory capital for advanced approaches BHCs must include 20 percent of eligible AOCI in 2014, 40 percent in 2015, and 60 percent in 2016. This guidance applies only to advanced approaches BHCs; it does not apply to BHCs with total consolidated assets of \$50 billion or more that are not advanced approaches BHCs. Advanced approaches BHCs are expected to evaluate all AFS (and

impaired HTM) securities for changes in unrealized gains and losses that flow through OCI under stress scenarios. Stressing fair value is expected to reflect movements in projected spreads, interest rates, foreign exchange rates, and any other relevant factors specific to each asset class. Historical spread and price data may be sourced externally or internally; however, information utilized should be representative of the BHC's portfolio at a sufficiently granular level to capture the inherent risks of the assets.

Additionally, the data utilized for projection is expected to span a sufficient period of time that includes a period of vulnerability for that asset class. Advanced approaches BHCs with weaker practices either chose historical data from indices that did not represent the inherent risk in their portfolios or evaluated a too limited a time frame of spread movements. In order to appropriately capture the risks inherent in AFS agency mortgage-backed securities (MBS), advanced approaches BHCs should stress assets at a security level and substantially all risk be subject to cashflows modeling. The stress test should capture changes in prepayments, interest rates, and spreads. BHCs with better practices used cashflows models to project losses on every asset in their portfolio, while BHCs with lagging practices utilized sensitivity{based approaches (on a security and portfolio{level basis). Changes in fair value of securities should be projected using scenario {derived interest rates and spreads projected over the planning horizon.

Advanced approaches BHCs should use the spreads that are consistent with scenario conditions. Better practices reflected forecasting agency MBS fair value changes through a forward full revaluation, repricing at every quarter or at multiple points in the time horizon. There was limited variation across BHCs in approaches for stressing Treasury securities. Advanced approaches BHCs should explicitly link interest rate moves to scenario conditions. BHCs with better practices utilized full revaluation. Lagging BHCs did not holistically capture future price changes and instead projected price movements based only upon sensitivities. For AFS credit sensitive assets, advanced approaches BHCs are expected to project changes in fair value consistent with assumed scenario conditions. Better practices included a projection of interest rate and spread changes using cashflow modeling with explicit linkage to the projected scenario horizon. Advanced approaches BHCs are expected to support the appropriateness of scenario variables specifically for each asset class. For example, if a BHC utilizes the same key explanatory variable for every asset class, there should be empirical support of a strong relationship between the explanatory variable and each asset class. The BHCs with the better practices utilized a regression {based methodology that captured the risk characteristics of the portfolio at a granular level, with clear documentation of key assumptions, limitations, and other considerations. If an advanced approaches BHC contemplates reinvestments, investments should be clearly articulated with supporting rationale that is consistent with scenario conditions. New purchases and reallocations should also be subject to fair value changes across the remaining time horizon. BHCs with lagging practices did not contemplate any future changes in unrealized gains and losses for new asset purchases. Consistent with expectations as laid out in *Capital Planning at Large Bank Holding Companies: Supervisory Expectations and Range of Current Practice*, all models utilized to project unrealized gains and losses should be independently validated. Any judgment used, including choice of data and key explanatory variables, should be well supported and subject to independent challenge. In order to transparently evaluate the full functionality of AFS fair value OCI models, the Federal Reserve expects advanced approaches BHCs to clearly document their key methodologies and assumptions used in estimating unrealized gains and losses. Documentation should concisely explain methodologies used for each asset class, with relevant macroeconomic or other risk drivers, and demonstrate relationships between these drivers and estimates. The source and time frame of historical data utilized should also be clearly detailed, including support for the dataset chosen relative to

the appropriate risk inherent in the portfolio. Documentation should also be developed and maintained to detail how the projections are consistent with the BHC's scenario conditions. “