Stress Testing Methodology

Securities and Market Risk

Loss Estimation

Securities
Session Objectives

1. Securities Overview
2. Range of Practices
3. Scenario Design

Securities
Session Objectives

1. **Securities Overview**
2. Range of Practices
3. Supervisory Expectations

Securities Overview

- Securities portfolios may need to be assessed for credit risk, market risk, or both
  - This presentation will focus on assessment of credit risk
- Objective of stress testing securities portfolios for credit risk is to determine the magnitude of realized and anticipated losses due to write-downs in a stressed environment
- Nature of securities portfolios presents challenges:
  - Many heterogeneous sub-asset classes (e.g. corporate bonds, RMBS), potentially needing distinct models
  - Historical credit loss data is quite sparse for some asset classes (e.g. sovereign bonds, municipal bonds)
  - Collateral data is quite sparse for some structured asset classes (though improving)

Securities Overview: Methodology

- Stress-testing models for securities can generally be divided into two groups:
  - Direct obligations: Corporate bonds, sovereign bonds, municipal bonds
  - Structured products: Asset-backed securities, commercial mortgage-backed securities, residential mortgage-backed securities, collateralized loan obligations
- Assets in each of these two classes may require fundamentally different modeling approaches
- Even within a group, different models may be needed for different asset classes
  - Loss drivers may be completely different for corporate vs. sovereign bonds, for example
- May even be challenging to classify different securities appropriately
  - For example, a foreign municipal bond—should it be assessed under the sovereign model or the municipal model?

Securities Overview

- CCAR evaluation to date has focused on the BHC's methodologies for calculating other-than-temporary impairment (OTTI) on equities and credit sensitive bonds
- In accordance with U.S. GAAP, only credit losses are recognized in earnings/P&L

For Reference:

Credit Loss Component of OTTI losses	+	Non-Credit Loss Component of OTTI Losses	+	Net Unrealized Gains/ (Losses) on Remaining Securities	➡	Total MTM Losses

Amount Recognized in Earnings

Total Other-Than-Temporary Impairment

Amount Recognized in Other Comprehensive Income

Total MTM Losses

***Assumption: no securities sales**

Securities Risk
Session Objectives

1. Securities Overview
2. **Range of Practices**
3. Supervisory Expectations

Securities: Range of Practices (Direct Obligations)

- Commonly assessed via conditional expected loss approach
- (Probability of Default) x (Loss Given Default) x (Exposure at Default)
- PD commonly assessed via a ratings-based approach (stressed transition matrix)
- Historical default data is sparse for some asset classes (municipal bonds, sovereign bonds)
  - Some firms apply corporate bond transition data and provide evidence that it is conservative
- Firms may leverage wholesale models for direct obligation securities, but should validate them for that specific use
- Models should capture both security-specific and country-specific performance data for relevant portfolios

Securities: Transition Matrix (Simplified Example)

- Goal: Determine 2-year stressed PD for BBB-rated bond
- Stressed 1-year PD for BBB bond: 0.75%
  - 2-year stressed PD (no migration): 0.75% + (1 - 0.75%)*0.75% = 1.49%
- Simplified 1y stressed transition matrix:

	A	BBB	BB	Default
A				0.20%
BBB	1.00%	89.25%	9.00%	0.75%
BB				2.30%

  - 2-year stressed PD (with migration):
    - 0.75% + 1.00%*0.20% + 89.25%*0.75% + 9.00%*2.30%
  - 2-year stressed PD (with migration): 1.63%

Securities: Range of Practices (Structured Products)

- Commonly assessed via discounted cash flow approach
  - Model performance of underlying collateral pool
  - Model cash flows through deal waterfall
  - Credit loss recognized when amortized cost is higher than market value
- Many firms use vendor models
  - Validation may be challenging due to lack of full transparency
- Models should capture relevant collateral risk factors (e.g. HPI for RMBS)
- Models should not rely solely on a ratings-based approach

Securities: Structured Finance Credit OTTI (Simplified Example)

- Goal: Project credit OTTI on a tranche of a residential mortgage-backed security (RMBS) under a stressed scenario
- Step 1: Determine drivers of collateral performance (losses & prepayments)
  - E.g. house price appreciation, unemployment rate, mortgage rate
- Step 2: Project macro drivers (scenario)
- Step 3: Project collateral performance
  - E.g. using regressions for default rate, prepayment rate, loss severity
- Steps 4 & 5: Project cash flows on collateral & securitization tranches
  - Commonly done using specialized structured finance software such as Intex
- Step 6: Calculate present value of cash flows to the tranche of interest, discounting by tranche coupon rate
- Step 7: Compare present value to book value of position
  - Any shortfall can be considered credit OTTI

Scenario Design and Securities

- Heterogeneity of portfolios may mean that scenarios need to capture a wide range of risk factors
  - E.g. residential home price index, commercial property price index, corporate bond spreads…
- May be challenging to link performance of certain portfolios to macroeconomic risk factors
  - Municipal bonds, sovereign bonds and credit card ABS continue to be the most difficult to model
- Scenario should stress risk factors for firm's key exposures

Securities: Range of Practices (General)

- Firms should test all credit-sensitive securities for credit impairment
  - Lagging firms test only credit-impaired positions or securities meeting certain criteria (e.g. non-investment grade)
- Use of management judgment should be limited and well-supported in documentation
  - Leading practice to use conservative approaches such as recognizing credit losses in early quarters rather than spread over entire scenario horizon
- Firms should have methodologies that explicitly translate assumed scenario conditions into estimated losses

Securities
Session Objectives

1. Securities Overview
2. Range of Practices
3. **Supervisory Expectations**

Supervisory Expectations

- Estimation methods should generate results that conform to standard accounting treatment, are consistent with scenario conditions, and are appropriately sensitive to changes in key variables
- Any assumptions (e.g., assumptions related to loss recognition) should be consistent with the intent of a stress testing exercise
- Models should be independently validated for their use in projecting OTTI losses for specific classes of securities
- BHCs with leading practices used estimation methods that capture both security-specific and country-specific performance data for relevant portfolios
- Some firms used conservatism and assumed a full market value write-down after impairment (versus just the credit component)

Supervisory Expectations

- BHCs with lagging practices did not test all credit sensitive securities for potential OTTI
  - Rather, they tested only currently impaired positions or securities that met a certain criteria (e.g., only securities rated below investment grade) for OTTI
- BHCs should not rely solely on a ratings-based threshold to determine OTTI for structured products
- In some cases, BHCs excluded key explanatory variables for certain asset classes
  - Ex. The unemployment rate was used to project OTTI losses for non-agency residential mortgage-backed securities (RMBS), but the housing price index (HPI) was excluded even though the theory and empirical evidence points to a strong relationship between mortgage losses and housing prices

Market Risk
Session Objectives

1. **Overview of market risk in the context of enterprise-wide stress scenario analysis**
2. Scenario design
3. Market risk loss estimation approaches
4. Range of practice discussion and observed strengths and weaknesses

Market Risk Overview

- Market risk is the risk of loss on a position that could result from movements in market prices, including:
  - Changes in the general level of interest rates, credit spreads, equity prices, foreign exchange rates, or commodity prices
- Objective of market risk stress testing is to determine the magnitude of potential losses in a BHC's trading portfolio due to valuation changes that arise from market movements during a stress scenario
- Nature of traded positions introduces challenges
  - Losses can result from changes in value as well as counterparty and issuer defaults
  - Dynamic portfolios, which are subject to frequent composition changes and active hedging strategies, complicate the nine quarter planning horizon
  - Typically requires many more risk factors to adequately describe stressful scenarios

Market Risk Overview: Methodology

- Market risk stress testing can be grouped into two broad categories
  - Probabilistic approaches
    - Generates a distribution of potential portfolio-level profit and loss (P&L) across many different, but possible scenarios
    - Commonly used for risk management
    - More difficult to implement for stress testing
  - Deterministic approaches
    - Generates point estimates of portfolio-level losses under specific stress scenarios
    - Greater conceptual similarity to approaches used for other risk dimensions
    - Generally used for stress testing market risk

Market Risk Overview: Implementation

- Market risk does not suffer from data limitations and methodological uncertainty to the same extent as other risks
- Pricing models, risk infrastructure, and risk management processes already exist and can be adapted to stress testing
  - Implementation requires assumptions and modeling choices:
    - Determining the magnitude of risk factor moves
    - Valuing positions subject to those risk factor movements
- Dynamic nature is simplified by assuming an instantaneous shock
  - Consistent with a major financial dislocation, featuring large declines in asset prices and large increases in asset price volatility and credit spreads, followed by a severe economic contraction
  - Eliminates portfolio rebalancing and related perfect foresight concerns
  - Addresses potential inability to exit certain positions in a market dislocation

Market Risk Overview: Valuation

- In principle, revaluation for stress testing can be carried out using the same infrastructure and calculators as conventional risk measurement tools
  - In practice, revaluation methods often rely on simplifying assumptions and approximations to speed calculation
  - Approximations perform adequately for small movements in risk factors associated with daily revaluation
  - Given large risk-factor moves assumed in stress testing, full-revaluation methods should be used—especially for nonlinear positions where value depends on multiple risk factors
  - Limited use of approximation is acceptable if analyses confirm that potential measurement error is not significant

Market Risk
Session Objectives

1. Overview of market risk in the context of enterprise-wide stress scenario analysis
2. **Scenario design**
3. Market risk loss estimation approaches
4. Range of practice discussion and observed strengths and weaknesses

Scenario Design and Market Risk

- Methodology choice has clear implications for scenario design
- When using probabilistic methods, the firms is often attempting to infer and/or link the scenario to P&L outcomes that have been reached through a scenario-agnostic approach
- When using deterministic approaches, a number of broad narratives that cover various adverse scenarios should be considered
  - Scenarios should stress products where the firm has a large market share or where complex, related positions could be impacted
  - Translating broad narratives regarding market events into detailed factor shocks is critical step
    - Usually involves a combination of historical events and projections
    - Market shocks should result in plausible risk and rate outcomes

Scenario Design and Market Risk

- U.S. supervisory approach to market risk (“Global Market Shock”) is unique and warrants discussion
- BHCs with significant trading activity (6) and counterparty credit risk (8) are subject to additional requirements
  - Must apply one-time, hypothetical shocks defined by supervisors across a broad set of risk factors to their trading and counterparty positions
    - Shocks involve large and sudden changes in asset prices, rates, and spreads, reflecting general market dislocation and heightened uncertainty
  - Must also estimate and report potential losses and related effects associated with the instantaneous and unexpected default of their largest counterparty across derivatives, securities lending, and repos

Market Risk
Session Objectives

1. Overview of market risk in the context of enterprise-wide stress scenario analysis
2. Scenario design
3. **Market risk loss estimation approaches**
4. **Range of practice discussion and observed strengths and weaknesses**

Probabilistic Estimation Approaches

- Probabilistic approaches measure risk using statistical quantities describing the conditional or unconditional profit and loss distribution of a portfolio over some specified horizon
  - Provide useful insight into a range of scenarios that generate stress losses
  - These approaches are complex and lack transparency
    - Difficult to communicate the methodology and stress scenarios to senior management and board of directors
  - Lack of clear linkage to a concrete scenario makes it difficult to determine what action can be taken to mitigate risks

Probabilistic Estimation Approaches

- Common probabilistic approaches
  - Variance-covariance method: using variance-covariance matrix, either for conditional or unconditional problem, to calculate VaR or expected shortfall (ES), where the core of the approach relies on the historical relationships to quantify risk
    - VaR: estimating value at a specific confidence level of the P&L distribution
    - ES: averaging across all levels of the tail of a P&L distribution
  - Historical simulation: estimating risk by quantifying the loss operator under the empirical distribution of the data
  - Monte Carlo: relying on simulations of an explicit parametric model for risk-factor changes

Deterministic Estimation Approaches

- Deterministic approaches rely on risk factor movements to generate a single set of scenario-dependent losses using the following steps:
  - Design and select stress scenario
  - Translate scenario into risk factor movements
  - Value positions and construct aggregate, portfolio level P&L under stress conditions
- Relies on concrete scenarios, which are easier to communicate
- Uses a limited set of scenarios, which may miss circumstances that result in large losses