Stress Testing Methodology

Business Line Earnings Analysis and Revenue Forecasting

Robustness of a large bank holding company's capital adequacy process should be evaluated based on the following elements……..

……………..(iii) A clear definition of available capital resources and an effective process for forecasting available capital resources (including any forecasted revenues) over the same range of adverse scenarios and environments used for loss forecasting;

-Federal Reserve Capital Plan Rule, November 2011

Session Objectives

1. Earnings as a key capital resource
2. Relationship between loss estimation and earnings analysis
3. Framework for evaluating revenue and expense projection processes
4. Range of practice considerations

Objective 1:
Capital Resource

1. **Earnings as a key capital resource**
2. Relationship between loss estimation and earnings analysis
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Earnings and Capital

Earnings are a critical source of capital to absorb losses

- In stressful conditions, earnings likely the sole means to replenish capital given an expectation of constrained access to external sources

Bank earnings consist of three components:

- Pre-provision net revenues (PPNR)
- Provision for loan losses
- Other losses

PPNR is the core source:

- Net interest income
- Non interest income
- Non interest expense

CCAR 2012, Supervisory Model Results	
Pre-Provision Net Revenue (1)	294
Provision for Loan Losses	(324)
Securities impairment	(31)
Market losses	(116)
Other losses	(45)
Net Income Before Taxes	**(222)**

(1) Net of Operational Risk Losses and mortgage litigation cost estimates.

Source: Comprehensive Capital Analysis and Review 2012: Methodology and Results for Stress Scenario Projections, March 2012

PPNR Drivers

Interest Income	• Return on earning assets • Primarily loans and investments
-Interest Expense	• Cost of funding the balance sheet/activities • Deposits, borrowings and debt
+Non Interest Income	• Service charges, commissions, fees, etc. • Transaction or volume driven
-Non Interest Expense	• Compensation • Other overhead and operational costs

PPNR Drivers

- Earnings are driven by balance sheet volume, activity and pricing
  - Balance Sheet: Size, portfolio mix, and activity (incl. off-balance sheet)
  - Pricing: Interest rates earned/charged; Service charges and fees
- Banks should understand the relationship between their assets and liabilities and related revenues and expenses under various conditions.
- To do so, requires:
  - Understanding the bank's risk appetite, LOBs/activities, and strategies
  - Awareness of key revenue and expense sources and drivers
    - Higher consumer spending → increased credit card interest income
    - Higher stock market activity → increased investment management fees
  - Capture of these drivers and relationships through conceptually sound estimation approaches to yield reliable forward-looking baseline and stress estimates

Objective 2: Loss Estimation and Earnings

1. Earnings as a key capital resource
2. **Relationship between loss estimation and earnings analysis**
3. Framework for evaluating revenue and expense projection processes
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Integrated Projections

- Estimating revenues and expenses is challenging given:
  - Diverse array of products, activities, risks, and related characteristics and drivers that comprise a typical bank's revenue streams
  - The evolving nature of PPNR estimation methodologies
  - The need to integrate multi-level information sources (line of business, Treasury, senior management/directorate) to confirm results
- An additional challenge is the need to integrate revenue estimation with other capital stress testing processes, namely, loss forecasting
  - Balances for loss estimates must be the same as for revenue forecasting, including transition to delinquency/nonperforming status
  - Recognition that certain expenses are likewise influenced by adverse conditions (i.e., OREO expenses increase as losses escalate) and need to be addressed

Administration

- In administering PPNR estimation, no single approach for effective enterprise development, integration and finalization of forecasts
  - Successes (and challenges) have been achieved by all options
    - Central (i.e., top-down), Line of Business (i.e., bottom-up), or combination
- Irrespective of approach, effective processes typically demonstrate
  - Open lines of communication and multi-level information flows:
    - Board of directors and senior management
    - Functional: Lines of business, Treasury, Finance, Accounting
    - Other: Risk and Audit
  - Effective aggregation processes
    - Rigorous review, challenge to confirm estimates
    - Identification and communication of process-related weaknesses and limitations to facilitate awareness of potential impacts

Objective 3
Evaluation Framework

1. Earnings as a key capital resource
2. Relationship between loss estimation and earnings analysis
3. **Framework for evaluating revenue and expense projection processes**
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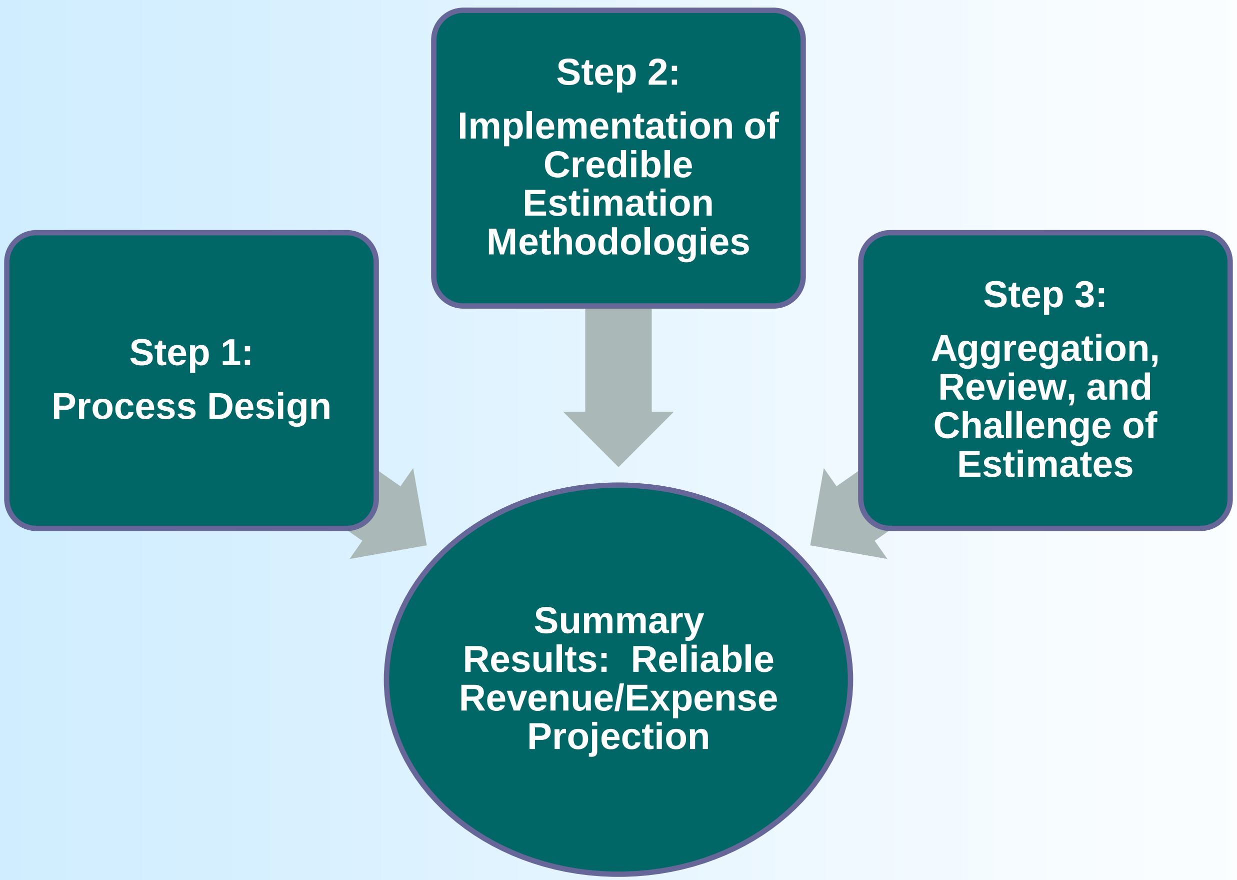
Building Blocks to Effective Revenue Projection



Step 1: Process Design

- Banks with stronger practices apply a consistent enterprise approach
  - PPNR represents a diverse set of potential revenue streams and, as such, specific estimation techniques across the firm will vary
  - As a first step, attempts should be made to seek empirical evidence of a relationship between stress assumptions and forecast outcomes.
    - If successful, model development activities are initiated, including a thorough evaluation of relevant macro-variables, with the resultant model subject to rigorous validation to ensure appropriateness for the intended use.
    - If model development is not successful or suitable, estimation may take place via a judgment-based approach (sound methodology, consideration of relevant data and assumptions, and informed by empirical analysis or studies).
  - Enterprise standards are applied to ensure process robustness, transparency and documentation.

Step 2: Estimation Methodologies

- Specific estimation approaches for the various revenue and expense components likely to vary based on:
  - Size and complexity of the firm and the complexity of the specific revenue/expense item
  - Materiality of the item to the bank's total revenues and overall net income
  - Suitability of statistically-based options as available
- Specific approaches include:
  - Formal statistical models (i.e., Regression analysis)
  - "Expert rules" systems (judgment-based)
  - Hybrid approaches
- Stronger approaches usually combine quantitative methods with management judgment to fully inform PPNR estimates

Estimation Methodologies

- An effective estimation methodology:
  - Is conceptually sound, well supported and well documented, with reasonable support for key assumptions and judgmental aspects
  - Credibly captures key revenue and expense drivers at an appropriate level of segmentation and translates the impact of stressful conditions into credible PPNR estimates
  - Generates results that demonstrate sensitivity to scenario conditions with multiple layers of review and challenge to ensure:
    - Estimates are reasonable, coherent, and consistent with scenario conditions
    - Methodology weaknesses and limitations are identified and addressed
  - Conforms with regulatory, accounting and other requirements
  - Is subject to independent review and validation, administered by effective procedures and controls, and subject to review by internal audit

Projecting Net Interest Income

- Net interest income estimation serves as the core PPNR revenue source for most banks.
  - The portfolio of interest bearing assets and liabilities is the foundation
  - NII estimation should effectively capture the influence of scenario conditions on interest rates and the balance sheet (giving consideration to how current positions may evolve over time).
  - Key inputs that influence estimates:
    - Assumptions for scenario- based interest rates, curves and spreads
    - Dynamic cash flow estimates by leveraging available asset and liability management systems and processes that incorporate
      - Contractual terms (i.e., loan payments, maturities and pricing (caps, floors and variable rate features)
      - Customer behavior assumptions (i.e., Voluntary loan prepayments, deposit runoff)
    - Changes in loan performance (losses , delinquency or nonperforming)

Balance Sheet Estimation

- Two approaches to estimating balance sheet positions

1. **Balance Sheet Component Approach**
   - Balances are projected for assets and liabilities (component approach: new business, purchases/ sales, payments/maturities, prepayments, defaults).
   - Under this approach, the bank would model new business originations (reflects proj. net new business and/or replacement of maturing assets)
   - Quarter-ending balances for each item are added or subtracted to produce an ending balance
   - Ending balances reviewed for reasonableness
2. **Target Balance Approach**
   - Qtr-ending balance for assets/liabilities is projected, other inputs incorporated, and new NBO derived
   - Ending balance/NBO reviewed for reasonableness

Example: Mortgage Loans

Beginning Balance

\+ New Business Originations (Approach #1)

\+ Asset Purchases

\- Asset Sales

\- Contractual Maturities

\- Prepayments

\- Defaults

= Ending Balance (Approach #2)

Other Considerations

- Balance projections are a key input to scenario analysis given the direct impact on loss, revenue/expense and RWA estimation.
- Assumptions are critical; BHCs should ensure coherency with other estimation processes and avoid favorable assumptions that cannot be reasonably assured in the assumed stress conditions
  - Examples of aggressive or favorable assumptions include:
    - Increase in market share or “flight-to-quality” deposits
    - Large asset mix changes that decrease risk weights and improve capital ratios
    - Funding mix changes that increase deposits and reduce funding costs ($)
    - Significant balance sheet shrinkage
  - BHCs that do make favorable assumptions should ensure they are well supported based on empirical analysis or other compelling evidence

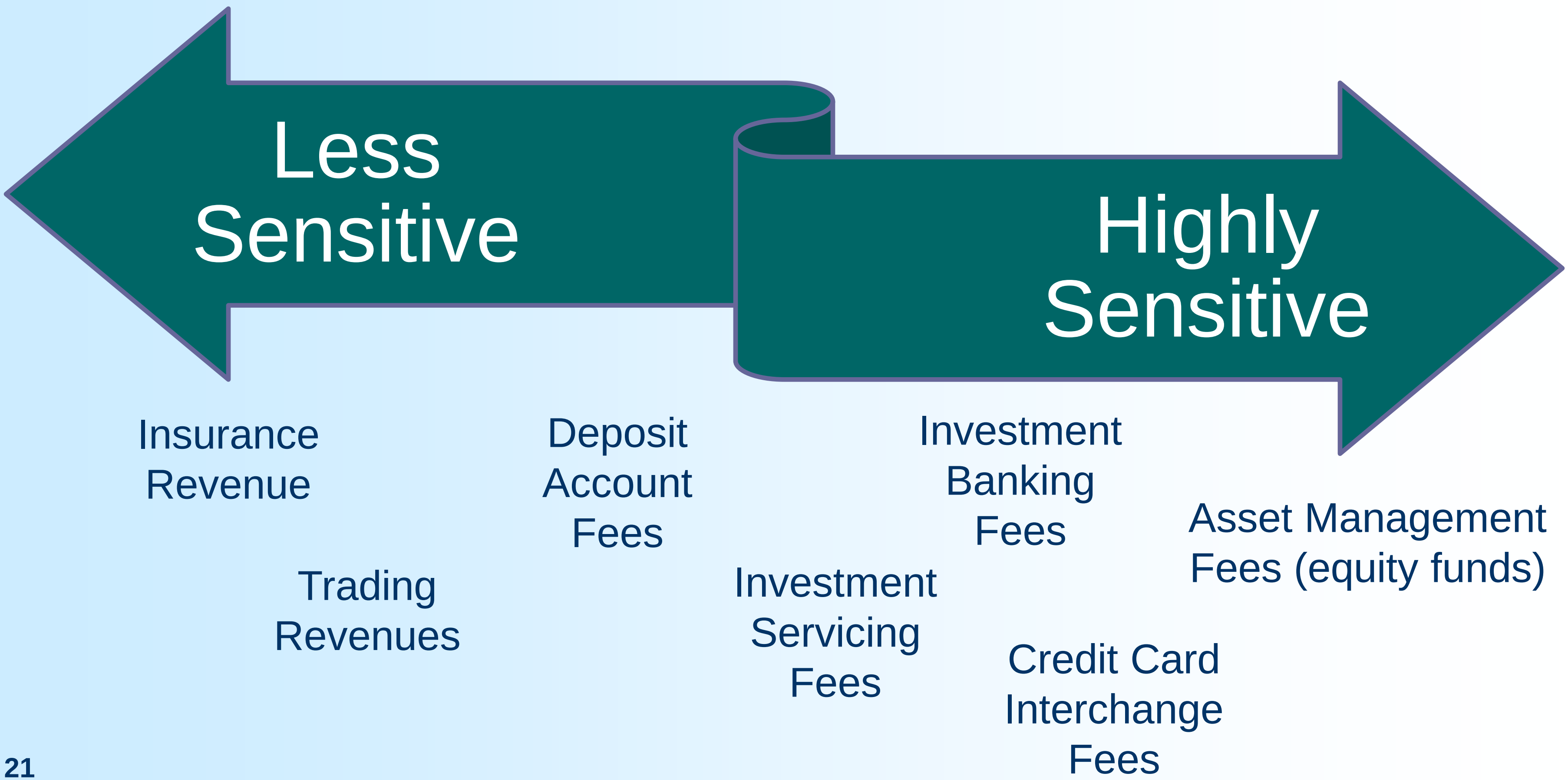
Projecting Non Interest Income

- Non interest income represents a diverse set of sources and is an increasingly important revenue source for banks
  - Typically generated as a function of volume or transaction activity
- Generally, two types of sources
  - Credit Related (related to traditional banking activities)
    - By product/line of business
    - Origination v. Servicing
    - Other
  - Non-Credit Related (other sources of income)
    - Trading
    - Investment Management
    - Insurance
    - Service charges, commissions and fees (deposits, mortgage banking)
    - Other

Non Interest Income

- Modeling of fee income is challenging for many banks
  - Credible methodologies continue to evolve
    - Reliable methodologies exist for some fee income sources
      - Example: Investment Management fees can be estimated via a model that projects asset under management over the scenario horizon to an equity index (S&P 500).
    - In other cases, linkages not easily established or other issues noted, requiring more simplistic ‘top-down’ approaches or judgment-based estimation
      - Examples: Trading Income – difficult to model for stressful conditions. Deposit fee income – many banks report data issues (quality and sufficiency) impairing use of more granular estimation approaches.
  - Data issues are prevalent
    - Internal data issues include insufficient histories or quality, significant merger activity, and/or regulatory reform which impacts data utility (e..g., U.S., Durbin amendment which significantly reduced debit card interchange fees)
    - External data difficult to find on certain items (deposit fee income by product)

Non Interest Income: Sensitivity to Macro Factors



Non Interest Income: Common Drivers

Revenue Items	Commonly Cited Drivers
Mortgage origination production margins	Interest rates, HPI, unemployment
Loan fees	Loan balances
Deposit fees	Deposit balances, number of accounts
Trading revenues	Stock market index, VIX
Credit card interchange fees	Unemployment, GDP
Auto lease revenue	Used car sales, prices
Asset management fees	Stock market levels, GDP

Non Interest Expense

- Estimation approaches should:
  - Identify and assess all expense sources and understand key activity drivers, particularly the impact of changing scenario conditions.
    - Employee compensation and benefits
    - Processing/Software
    - Occupancy (Plant, Property and Equipment)
    - Credit/Collections and Other
  - Generate expense projections that are aligned with balance sheet and revenue estimates and reflect the same strategic business assumptions
    - Examples:
      - If a BHC projects portfolio growth, additional headcount may be necessary to support increased underwriting activity
      - As credit quality deteriorates in a downturn, additional headcount may be necessary to manage increased collection activity
    - Additional headcount = increased compensation expenses

Non Interest Expense: Fixed vs. Variable Costs

Not so Variable

Highly Variable

Property expenses based on a long term lease

Amortization of deferred compensation

Employee benefits

Salaries

Non contractual marketing expenses

Non Interest Expense

- Areas of particular interest:
  - Linking compensation (largest component of NIE) changes to scenario conditions sometimes produces questionable outcomes
    - Timing, reasonableness of headcount reduction plans (as applicable)
      - Outcomes give the impression of perfect foresight of scenario conditions
    - Interaction of incentive compensation projections with market and loan losses; competition in particular labor markets
  - Coherence of planned headcount reductions with projected balance sheet and revenues
    - For example, targeted compensation reductions that contradict projections elsewhere for increased line of business activity
  - Some expenses increase in bad times
    - Other Real Estate Owned (OREO)

Non Interest Expense

- If a BHC assumes material expense reductions, management should:
  - Demonstrate that the assumptions are reasonable and conservative
  - Support them with analysis of historical data or empirical evidence
  - Consider how differences in the business environment and the severity of the economic conditions may impact the firm's ability to execute such actions, even if they were able to do so in the past
  - Document how they intend to realize the expense reductions
  - Evaluate the impact of projected expense reduction strategies on the BHC's future revenues, expenses, and operating structure

Step 3: Aggregation, Review, and Challenge

- Revenue and expense results should be aggregated at the enterprise level for input into capital planning
  - Aggregation process should include rigorous review and challenge of assumptions, management judgment/overlays, and results
    - Do the results reasonably reflect assumed scenario conditions? Are the differences across scenarios explainable? Are outcomes coherent to other estimation areas, to the broader scenario?
    - Are key inputs and assumptions reasonable and well supported?
      - Reasonableness of asset and funding mixes, yield and cost expectations, market behaviors and strategies?
    - Are all material exposures properly accounted for?
    - Was management judgment in developing estimates applied in a reasonable, transparent, consistent, and well supported manner?
    - Do results account for process weaknesses and limitations?

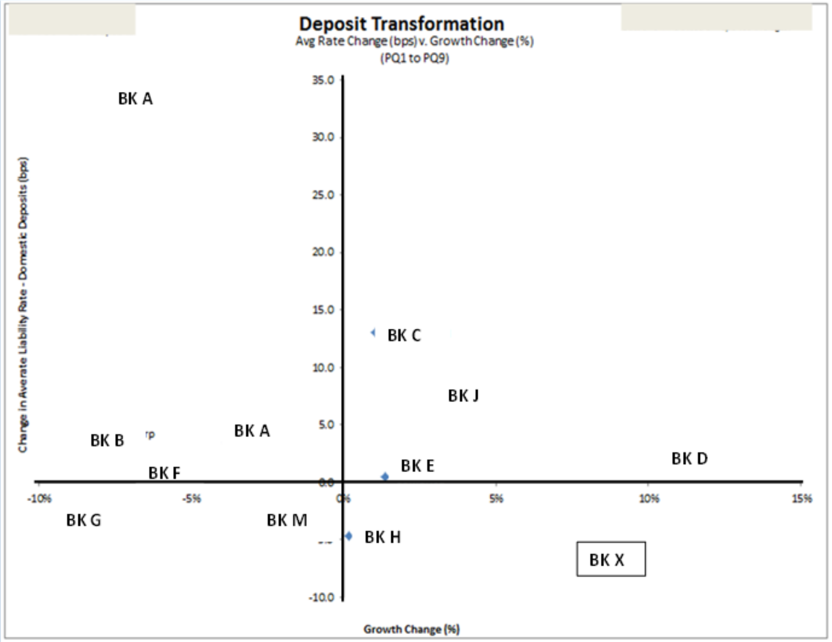
Mini-Case:
NII – Interest Expense

Facts:

Scenario: BHC Stress - Severe recession; flat interest rate path

Forecast (BHC Stress)

- Retail Deposits: Over 9Q horizon, Bank X projects total deposits ($) to increase by 18% with a 6 bp reduction in average cost of funding (see chart).
- Wholesale Funding: Bank projects volume to be unchanged (base to stress) with spreads to widen at 50% of the projected scenario stress spreads (150 bp versus 300 bp for peer banks)
- Bank notes favorable 2008-10 experience.



Question

- Do the projections demonstrate an appropriate linkage to assumed conditions and are they conservative and well supported?

Mini-Case:
NII – Interest Expense

Discussion:

- Bank X's projections are rooted in a 'Flight to Quality' assumption.
- Issues
  - Bank X assumed that outcomes for the assumed stress scenario will mirror experiences of the 2008-10 financial disruption (not a conservative assumption).
  - Projected increase in deposits and related lower average deposit product cost is not intuitive, lacks coherence to normal rate/balance relationship.
    - ↑ deposit rates (typically) produces ↑ deposit balances
  - Review/challenge did not highlight key assumption ('flight to quality') underlying deposit rate and balance projections and potential influence on forecasts.
- Impact
  - Forecast BHC stress scenario interest expenses are likely understated and deposit balances overstated. PPNR is likely overstated.

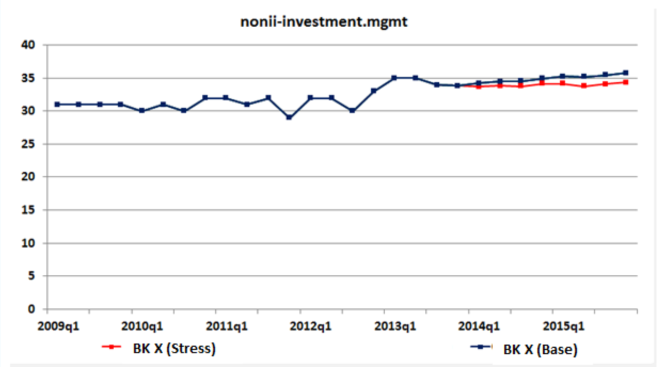
Mini-Case Study
Non-Interest Income

Facts:

Scenario: BHC Stress - Severe recession; major stock market decline with late recovery

Estimation Approach

- Bank has a well-established IM line of business and client mix; demonstrated performance in all market conditions.
- BHC AUM Composition: 70% Equities, 20% Fixed Income, 10% Cash
- Bank X projects IM fees using a ‘top down’ approach.
  - Methodology: Quantitative approach (Regression: Relationship of change in total IM revenues to GDP changes). Model validated (No issues).



Forecast: See chart.

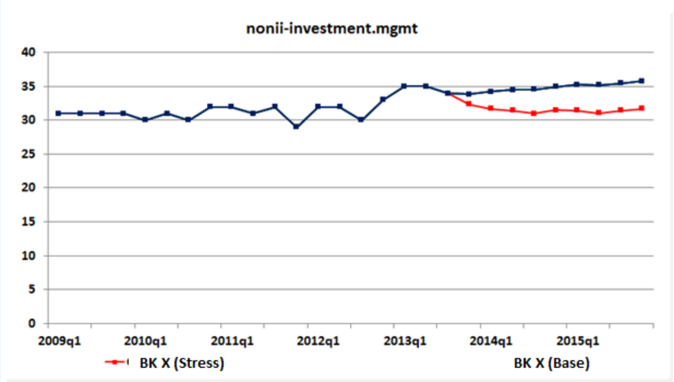
Question

- Do the projections demonstrate an appropriate linkage to assumed conditions and are they conservative and well supported?

Mini-Case Study
Non-Interest Income

Discussion:

- Estimation approach lacks granularity (no segmentation by key revenue sources and drivers).



- Issues
  - Scenario impacts (major decline in stock market) not fully captured.
    - AUM mix is largely comprised of equities
    - Does not analyze for potential changes in mix as scenario evolves
  - Projections not sufficiently sensitive to assumed conditions.
  - Review/challenge (LOB) did not address limitation in estimation approach.
- Impact
  - Forecast BHC stress scenario IM revenues likely overstated (see revised chart). PPNR is overstated.

Mini-Case Study
Non Interest Expense

Facts:

Scenario: BHC Stress; Deep, prolonged recession with late recovery

Estimation Approach

- Bank uses a model to estimate headcount for compensation expense projections.
  - Effective segmentation by job roles projected to vary (i.e., commission-based and problem asset workout staff) versus likely to remain constant.
    - Model (regression; relationship of headcount to changes in GDP) to estimate headcount for jobs that vary with conditions. Model validated (no issues).
    - Judgmental approach to estimate headcount for other jobs' (administration, risk and control); assumed to remain flat compared to baseline.

Forecast: Projected 12% decline in headcount (across-the-board sales force reduction (notably, in strategic lines of business), off set by increases in workout staff)

Question

- Do the projections demonstrate an appropriate linkage to assumed conditions and are they conservative and well supported?

Mini-Case Study
Non Interest Expense

Discussion:

- Bank strict reliance modeled approach to forecast staffing headcount led to projection results that lack credibility.
- Issues:
  - ‘Significant Headcount Reduction’ assumption not well supported.
    - Projected reductions were not achieved in prior recession.
    - If projected headcount reduction realized, would have severely constrained lines of business targeted as being strategic and core to bank’s revenues and market position.
    - Other: Projected outcomes did not factor in severance costs.
  - As a result, quantitative projections were perceived as not reliable given high uncertainty that bank could implement projected reductions.
  - Review/challenge (Central) did not identify over-reliance on model results.
- Impact
  - Stress scenario non Interest Expense (Compensation and Benefits) is likely understated for stress scenario. PPNR is overstated.

Objectives 4:
Range of Practice

1. Earnings as a key capital resource
2. Relationship between loss estimation and earnings analysis
3. Framework for evaluating revenue and expense projection processes
4. **Range of practice considerations**

Revenue Estimation

- A wide range of estimation practices are observed:
  - **Net Interest Income (NII)** approaches are generally more advanced
    - Longer data history for interest income and interest expense models
    - Use of ALM processes (cash flow engine) for ’business as usual’ processes can be leveraged to develop credible estimates of NII
    - Use of ‘feeder’ models (loan pre-payment and deposit decay models)
  - **Non Interest Income** approaches are mixed
    - Some fee income sources (e.g., asset management) can be estimated using well developed statistical techniques, while other sources (e.g., trading revenue) are more difficult to model and require judgmental approaches
  - **Non Interest Expense** approaches tend to be judgment-based
    - Some expenses (e.g., loan collections) exhibit stronger relationships to scenario conditions, but many do not (e.g., compensation)

Better Practices

- Better practice banks demonstrate . . .
  - Credible, reliable estimation processes that yield results that demonstrate consistency with assumed scenario conditions.
  - Engaged, process ownership, continuous improvement, and informed, multi-level information flows.
  - Full acknowledgement and communication of material process-related weaknesses and limitations, with use of sensitivity analysis to inform an understanding of impacts.
  - Effective review and challenge processes, including reasonably detailed minutes that capture critical discussions, decisions made and supporting rationale.
  - Well developed policies, procedures, controls and model risk management. Process documentation is transparent.

Weaker Practices

- Weaker practice banks demonstrate . . .
  - Treatment of stress testing and revenue expense estimation as a compliance exercise.
  - Deficient processes (material weaknesses in methodology, data, segmentation, and/or assumptions; lack of credible review and challenge)
  - Outcomes and results lack rigor, coherency, and credibility.
    - Stress results did not show sufficiently stressed declines in revenue relative to scenario conditions.
    - Conflicting or inconsistent results across estimation areas.
  - Weak processes, controls and documentation

Questions?