Opportunities for Actuaries in Banking

Measurement and modelling of interest rate risk in the banking book (IRRBB)

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Iain Allan
Yash Ratanpal (Acies LLP)

6 June 2024
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• Challenges and opportunities in IRRBB measurement

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A brief on the banking business model and introduction to IRRBB
Overview of the Banking Business Model

Core Business Model

- **Liabilities**
  - Deposits
  - Borrowings
  - Capital

- **Assets**
  - Loans and advances
  - Investments
  - Other assets

- **Bank**
  - Funding
    - Interest expense
  - Lending
    - Interest income

Net interest income

Other Business Models

- **Trading**
  - Equity and fixed income
  - FX and commodities
  - Derivatives
  - P/L from trading

- **Investment banking**
  - Underwriting
  - M&A
  - Advisory
  - Advisory fee

- **Other services**
  - Transaction banking
  - Wealth management
  - Other services
  - Fee income

Opportunities for Actuaries in Banking: Measurement and modelling of IRRBB – 6 June 2024
Key Risks Faced by Banks Today

1. Credit Risk
   - Credit scoring and underwriting
   - Expected credit loss (PD, LGD, EAD)
   - Concentration risk
   - Counterparty credit risk

2. Market Risk
   - Interest rate risk
   - Equity risk
   - FX risk
   - Commodity risk
   - Other market risks

3. Operational Risk
   - Fraud risk
   - Legal risk
   - System failure

4. Liquidity risk
   - Cashflow gap risk
   - Prepayment risk
   - Early redemption risk
   - Contingency planning risk

5. Profitability risk
   - Fund-transfer pricing risk
   - Cost allocation risk
   - Product pricing risk

6. New-age risks
   - Digital banking risk
   - Model risk
   - Climate change

*Risks illustrated above might not be exhaustive and / or comprehensive.
Introduction to IRRBB: Definition, Components and Impact on Banks

“Interest rate risk in the banking book (IRRBB) refers to the current or prospective risk to a bank’s capital and to its earnings, arising from the impact of adverse movements in interest rates on its banking book.”
– Basel Committee on Banking Supervision

Components of IRRBB

- **Gap Risk**
  - Difference in term structure and timing of rate resets between interest rate sensitive assets and liabilities
  - E.g. rate of interest paid on liabilities increases before the rate received on assets

- **Basis Risk**
  - Correlation risk on financial instruments that have similar tenors but are priced using different interest rate indices
  - E.g. an asset priced off LIBOR funded by a liability priced off US Treasuries

- **Option Risk**
  - Automatic option risk – explicitly embedded derivatives within loans such as a capped rate loans
  - Behavioral option risk – prepayment on loans or early redemption on deposits due to change in interest rate

Impact of IRRBB on Banks

- **Impact on Economic Value**
  - Change in future cashflows for floating rate exposures
  - Change in present value of future cash flows for all positions
  - Impact on economic value of the bank’s assets, liabilities and off-balance sheet instruments

- **Impact on Earnings**
  - Change in interest income and expense
  - Change in interest rate sensitive operating income and expense
  - Impact on net interest income (NII) and overall income of bank
Revised Basel standards for IRRBB measurement (SRP 31)
Revised Basel Standards for IRRBB

Key Highlights of the Revised BCBS Standards on IRRBB

- Revised standardized framework with 6 supervisory scenarios for stress testing
- Usage of both Economic value (EVE) and earnings-based measures (NII) to assess IRRBB
- Option to adopt an internal measurement system (IMS), failure of which would lead to mandatory adoption of SA
- Independent model validation framework required for IMS
- Detailed quantitative and qualitative disclosures
- Revised disclosures to enable peer-to-peer comparison
- Disclose IRRBB management & mitigation strategies, underlying modelling assumptions & parameters.
- Guidelines issued to supervisors on how to conduct a detailed assessment of IMS
- Compare change in EVE to 15% of a bank's Tier 1 capital as opposed to the former 20% of the bank's total capital.

Revised Basel Timeline:
- September 1997: Principles for management of interest rate risk
- July 2004: Principles for management and supervision of interest rate risk
- June 2015: Risk management, capital treatment and supervision of IRRBB
- April 2016: Revised IRRBB standards
- December 2023: Consultative document: Recalibration of shocks for IRRBB
Key Principles of Revised Basel Standards for IRRBB

- Stress Testing Framework
  - Standardized set of supervisory Stress Scenarios
  - Design of internal IMS interest rate shock scenarios

- Measurement and Modelling
  - Identification of Exposure
  - Quantification of Risk
  - Assessment of Impact

- Risk Governance and Oversight
  - Monitoring and Control
  - Reporting

- Data Integrity
  - Conceptual Soundness and Outcomes Analysis
  - Ongoing Model Monitoring

- Model Risk Management

- Capital Adequacy Assessment
  - Capital Adequacy Assessment (EVE)
  - Capital Buffer Assessment (NII)
  - Capital Allocation
  - Integration with ICAAP

- Reporting & Disclosures
  - management reporting
  - Qualitative public disclosures
  - Quantitative public disclosures

- Supervisory Review
  - Outlier & Materiality tests for Identification of Outlier Banks
  - Sensitivity to key assumptions
  - Standalone and Peer Evaluation
  - Mandatory adoption of Standardised Framework

Relevant Stakeholders

- Board and Senior Management
- Regulators
- ALCO
- Other Stakeholders

Opportunities for Actuaries in Banking: Measurement and modelling of IRRBB – 6 June 2024
Principle 1: Risk Governance and Oversight

<table>
<thead>
<tr>
<th>Key Points</th>
<th>Identification and Monitoring</th>
<th>Delegation and Resourcing</th>
<th>Policies and Procedures</th>
<th>Risk Appetite and Policy Limits</th>
<th>Internal Control and Audit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Delineation of banking book &amp; trading book exposures</td>
<td>• Dedicated governing body for IRRBB management</td>
<td>• Regular review of the level and trend of the bank’s IRRBB exposures</td>
<td>• Clearly defined risk appetite statement</td>
<td>• IRRBB identification, measurement, monitoring and control processes to be reviewed by an internal or external auditor on a regular basis.</td>
</tr>
<tr>
<td></td>
<td>• Review and testing of new products to ensure that the IRRBB risks are well understood before roll-out</td>
<td>• Separate and well-defined independent departments for identification, measurement, monitoring and control</td>
<td>• Understand potential linkages with market, liquidity, credit and operational risk.</td>
<td>• Risk limits should be identified for aggregate firm, individual business units, portfolios, instrument types &amp; sub risk categories with systems in place to escalate breach of thresholds without delay</td>
<td>• Reports written by internal/external auditors should be made available during supervisory review.</td>
</tr>
<tr>
<td></td>
<td>• Specific identification for credit spread risk in the banking book (CSRBB)</td>
<td>• IRRBB functions to be independent from risk-taking functions of the bank</td>
<td>• All IRRBB policies should be reviewed periodically (at least annually) and revised as needed</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Opportunities for Actuaries in Banking:**

Measurement and modelling of IRRBB – 6 June 2024
Principle 2: IRRBB Measurement: Evolution of Approaches

**Evolution of IRRBB Measurement Approaches**

- **Repricing gap analysis**: Gap between interest rate sensitive assets and liabilities across time buckets.
- **Duration gap analysis**: Modified duration gap between rate sensitive assets and liabilities.
- **PV01**: Impact on economic value due to single basis point change across all tenors.
- **EVE simulations**: Full-revaluation of EVE across parallel and non-parallel IR scenarios.
- **NII simulations**: Granular NII simulations across parallel and non-parallel IR scenarios.

**Evolution of Balance Sheet Projection Assumptions**

- **Run-off balance sheet**: Existing assets and liabilities run-off over time and not replaced on maturity.
- **Constant balance sheet**: Instantaneous and identical replacement of assets and liabilities as they mature.
- **Dynamic balance sheet**: Balance sheet evolves over time as per future business strategy and expectations.

Specific focus of today’s session: Opportunities for Actuaries in Banking: Measurement and modelling of IRRBB – 6 June 2024
**Principal 2: IRRBB Measurement: EVE vs NII**

*In addition to the impact of an interest rate shock on its economic value, a bank’s policy approach should take into account its ability to generate stable earnings sufficient to maintain its normal business operations*  
- Basel Committee on Banking Supervision

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Economic Value of Equity (EVE)</th>
<th>Net Interest Income (NII)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outcome</strong></td>
<td>• Measures change in the NPV of the bank’s assets, liabilities and off-balance sheet items subject to specific interest rate shock and stress scenarios</td>
<td>• Measures changes to future profitability within a given time horizon eventually affecting future levels of a bank’s own equity capital</td>
</tr>
</tbody>
</table>
| **Assessment Horizon**    | • Long term measure of risk  
  • Reflects changes in value over the remaining life of the bank’s assets, liabilities and off-balance sheet items, i.e. until all positions have run off | • Short to medium term measure of risk (3-5 years)  
  • Does not fully capture those risks that will continue to impact profit and loss accounts beyond the period of estimation |
| **New Business Assumption** | • Calculated on a run-off balance sheet  
  • Considers the NPV of repricing cash flows of instruments on the bank’s balance sheet or accounted for as an off-balance sheet item | • Usually calculated on a constant balance sheet i.e., assume rollover of maturing items and / or dynamic balance sheet (new business projections) |

*The Committee acknowledges the importance of managing IRRBB through both economic value and earnings-based measures. If a bank solely minimizes its economic value risk by matching the repricing of its assets with liabilities beyond the short term, it could run the risk of earnings volatility.*  
- Basel Committee on Banking Supervision
Both economic value and earnings-based measures of IRRBB are significantly impacted due to presence of behavioral optionalities. A bank should use robust predictive models to make behavioral assumptions about how an instrument’s actual maturity may vary from the instrument’s contractual terms.

<table>
<thead>
<tr>
<th>Risk Category</th>
<th>Product Coverage</th>
<th>Associated Behavioural Risk to Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepayment risk</td>
<td>Fixed rate loans</td>
<td>Risk of early prepayment on loans across various interest rate shock and stress scenarios. A bank must assess the expected average prepayment speed under each interest rate shock scenario. E.g. if interest rates decrease, borrowers of fixed rate loans might increase speed of prepayment and re-finance loans at lower rate of interest.</td>
</tr>
<tr>
<td>Early redemption risk</td>
<td>Fixed term deposits</td>
<td>Risk of early redemption on term deposits across various interest rate shock and stress scenarios. A bank must assess the expected average redemption speed under each interest rate shock scenario. E.g. if interest rates increase, depositors might increase speed of redemption to seek higher returns on alternate investments / deposit opportunities.</td>
</tr>
<tr>
<td>Drawdown risk</td>
<td>Committed and undrawn lines of credit</td>
<td>Banks may sell options to retail customers (e.g. prospective mortgage buyers or renewers) whereby, for a limited period, the customers can choose to draw down a loan at a committed rate.</td>
</tr>
<tr>
<td>NMD Volatility risk</td>
<td>Non-maturity deposits (NMDs)</td>
<td>Current and savings account deposits that have no maturity date and can be withdrawn anytime. A bank should analyze its depositor base to identify the proportion of core deposits (i.e. NMDs which are unlikely to be withdrawn even under significant changes in interest rate environment).</td>
</tr>
</tbody>
</table>
Both economic value and earnings-based measures of IRRBB are significantly impacted due to presence of behavioral optionalties. A bank should use robust predictive models to make behavioral assumptions about how an instrument’s actual maturity may vary from the instrument’s contractual terms.

### Coverage of Behavioural Modelling and Assumptions

<table>
<thead>
<tr>
<th>Risk Category</th>
<th>Product Coverage</th>
<th>Commonly-used Parameters for Behavioural Modelling</th>
</tr>
</thead>
</table>
| Prepayment risk       | Fixed rate loans                  | - Loan size, loan-to-value (LTV) ratio, borrower characteristics, contractual interest rates, seasoning, geographical location etc.  
                        |                     | - Macroeconomic variables such as stock indices, unemployment rates, GDP, inflation and housing price indices to model loan prepayment behavior |
| Early redemption risk | Fixed term deposits               | - Deposit size, depositor characteristics, funding channel (e.g. direct or brokered deposit), contractual interest rates, seasonal factors, geographical location etc.  
                        |                     | - Macroeconomic variables such as stock indices, unemployment rates, GDP, inflation and housing price indices to model deposit redemption behavior |
| Drawdown risk         | Committed and undrawn lines of credit | - Borrower characteristics, geographical location (including competitive environment and local premium conventions), customer relationship with bank as evidenced by cross-products |
|                       |                                   | - Remaining maturity of the commitment, seasoning and remaining term of the mortgage                               |
| NMD Volatility risk   | Non-maturity deposits (NMDs)      | - Responsiveness of product rates to changes in market interest rates, spread between a bank’s offer rate and market rate, competition from other firms, geographical location and demographical factors  
                        |                     | - Depositor characteristics (e.g. retail/wholesale) and account characteristics (e.g. transactional/non-transactional). |

Opportunities for Actuaries in Banking: Measurement and modelling of IRRBB – 6 June 2024
Banks are expected to calculate impact on economic value and earnings across multiple interest rate scenarios. These scenarios should be a combination of:

- 6 supervisory interest rate shock scenarios prescribed by BCBS (Standardized shock scenarios)
- Internally selected interest rate shock scenarios addressing the bank’s risk profile (ICAAP)

### Standardized Shock Scenarios

- BCBS has prescribed six interest rate shock scenarios to capture parallel and non-parallel gap risks.
- These scenarios are applied to IRRBB exposures in each currency for which the bank has material positions.
- In order to accommodate heterogeneous economic environments across jurisdictions, the six shock scenarios reflect currency-specific absolute shocks as specified in Table 1 below.

<table>
<thead>
<tr>
<th>Currency</th>
<th>ARS</th>
<th>AUD</th>
<th>BRL</th>
<th>CAD</th>
<th>CHF</th>
<th>CNY</th>
<th>EUR</th>
<th>GBP</th>
<th>HKD</th>
<th>IDR</th>
<th>INR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parallel</td>
<td>400</td>
<td>300</td>
<td>400</td>
<td>200</td>
<td>100</td>
<td>250</td>
<td>200</td>
<td>250</td>
<td>200</td>
<td>250</td>
<td>200</td>
</tr>
<tr>
<td>Short</td>
<td>500</td>
<td>450</td>
<td>500</td>
<td>300</td>
<td>150</td>
<td>300</td>
<td>250</td>
<td>300</td>
<td>250</td>
<td>300</td>
<td>250</td>
</tr>
<tr>
<td>Long</td>
<td>300</td>
<td>200</td>
<td>300</td>
<td>150</td>
<td>100</td>
<td>150</td>
<td>100</td>
<td>150</td>
<td>100</td>
<td>150</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Currency</th>
<th>JPY</th>
<th>KRW</th>
<th>MXN</th>
<th>RUB</th>
<th>SAR</th>
<th>SEK</th>
<th>SGD</th>
<th>TRY</th>
<th>USD</th>
<th>ZAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parallel</td>
<td>100</td>
<td>300</td>
<td>400</td>
<td>400</td>
<td>200</td>
<td>200</td>
<td>150</td>
<td>400</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>Short</td>
<td>100</td>
<td>400</td>
<td>500</td>
<td>500</td>
<td>300</td>
<td>300</td>
<td>200</td>
<td>500</td>
<td>300</td>
<td>500</td>
</tr>
<tr>
<td>Long</td>
<td>100</td>
<td>200</td>
<td>300</td>
<td>300</td>
<td>150</td>
<td>150</td>
<td>100</td>
<td>300</td>
<td>150</td>
<td>300</td>
</tr>
</tbody>
</table>
Principal 3: IRRBB Stress Testing: Standardized Scenarios

### Parallel Shocks

- **BPS SHOCK**
  - -600 to 600
- **TENOR (YEARS)**
  - 0.0028 to 25

- **Parallel Shock Up**
- **Baseline Central**
- **Parallel Shock Down**

### Short Rate Shocks

- **BPS SHOCK**
  - -600 to 600
- **TENOR (YEARS)**
  - 0.0028 to 25

- **Baseline Central**
- **Short Rate Shock Up (BPS)**
- **Short Rate Shock Down (Bps)**

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16
Rotational Shocks

- Baseline Central
- Steepener Shock (BPS)
- Flattener Shock (BPS)

TENOR (YEARS)

BPS SHOCK
Principal 3: IRRBB Stress Testing: IMS Scenarios

Considerations to Design Internal IMS Shock Scenarios

- Shape and level of the current term structure of interest rates
- Historical and implied volatilities of interest rate term structures
- Effects of negative interest rate scenarios on assets and liabilities
- Scenarios should cover parallel, non-parallel gap risk, basis risk and option risk
- Interaction of IRRBB with other risks (e.g. credit risk, liquidity risk).

Adverse changes in the spreads of new assets/liabilities replacing maturing assets/liabilities maturing.

Changes in portfolio composition due to internal and external factors

Changes in portfolio composition due to internal and external factors

New products and markets where only limited historical data are available;

Qualitative and quantitative reverse stress testing

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Principal 4: Model Risk Management

Models Required for IRRBB

- Balance sheet projection models
- Interest rate forecasting models
- Behavioural models
- Models for embedded optionality's
- FX & Volatility forecasting models

Model Risk Management Cycle

1. Model development
2. Model validation
3. Approval decision
4. Internal Audit
5. Rejection decision
6. Ongoing monitoring

Three Pillars of Model Validation

- Data integrity
- Conceptual soundness and stability
- Ongoing model monitoring
Principal 4: Model Risk Management

Data Integrity

- Reliable Data Sources
- Automated Data Inputs
- Periodic Review of Data Mapping

Conceptual Soundness Assessment and Stability Analysis

- Assess modelling assumptions, limitations & methodologies
- Assess segmentation, variable selection and pricing techniques for instruments
- Assess stability of NMDs, early redemptions and prepayments
- Usage of conceptual, statistical and performance tests

Ongoing Model Monitoring

- Document detailed developmental evidence & analysis for IMS
- Establish back testing thresholds for ongoing model monitoring
- Draft policies and set frequency for re-calibration and re-validation of IMS models
- Articulate policies for model transition, including change and version control authorizations.
“Banks are responsible for evaluating the level of capital that they should hold, and for ensuring that this is sufficient to cover IRRBB and its related risks. The outcomes of the capital adequacy for IRRBB should be considered in a bank’s ICAAP and flow through to assessments of capital associated with business lines.”

– Basel Committee on Banking Supervision

Factors to consider for assessment of capital adequacy:

What is the size and tenor of internal limits on IRRBB exposures and are they breached during assessments?

What is the effectiveness and expected cost of hedging open positions?

What is the sensitivity of internal measures of IRRBB to key modelling assumptions?

What is the impact of shock and stress scenarios on positions priced off different interest rate indices (basis risk)?

What is the impact of economic value and NII of mismatched positions in different currencies?

What is the impact of embedded losses from a capital adequacy perspective?

What is the cross organisational distribution of capital and the overall capital adequacy on consolidated basis?

What are the circumstances under which the risk might crystallise?
### Principal 6: Reporting and Disclosures

The revised standards on IRRBB require extensive MIS reporting to internal management and detailed qualitative and quantitative public disclosures illustrating impact on EVE and NII across supervisory interest rate scenarios.

**Management Reporting**

<table>
<thead>
<tr>
<th>Minimum Reporting Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Summaries of aggregate IRRBB exposures and explanatory text to highlight the key drivers of IRRBB</td>
</tr>
<tr>
<td>• Reports demonstrating compliance with IRRBB policies and limits</td>
</tr>
<tr>
<td>• Key modelling assumptions and stress test results (NMD, prepayments, currency aggregation etc.)</td>
</tr>
<tr>
<td>• Summaries of the reviews of IRRBB policies, procedures and adequacy of measurement systems and findings of internal/external auditors</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Monitoring Metrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Current exposure v/s policy limits</td>
</tr>
<tr>
<td>• Results of periodic model reviews and audits</td>
</tr>
<tr>
<td>• Past modelling forecasts v/s actual results</td>
</tr>
<tr>
<td>• Focus on portfolios with significant MTM impact</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Management Review</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Regular and detailed reviews</td>
</tr>
<tr>
<td>• Ensure that analysis and risk management activities related to IRRBB are conducted by competent staff with technical knowledge and experience</td>
</tr>
</tbody>
</table>

**Public Disclosures**

<table>
<thead>
<tr>
<th>Qualitative Disclosures</th>
</tr>
</thead>
<tbody>
<tr>
<td>• How the bank defines IRRBB for purposes of risk control and measurement.</td>
</tr>
<tr>
<td>• Description of the bank's overall IRRBB management and mitigation strategies (Role of ALCO, hedging, limits, audit etc.)</td>
</tr>
<tr>
<td>• Description of measures and scenarios used to calculate IRRBB and periodicity of calculation</td>
</tr>
<tr>
<td>• Description and rationale for modelling assumptions</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quantitative Disclosures (Δ EVE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Assume run-off balance sheet</td>
</tr>
<tr>
<td>• Include cashflows from all interest rate sensitive assets, liabilities and off-BS items</td>
</tr>
<tr>
<td>• Disclose if cashflows discounted using risk-free rates or spread adjusted risk-free rates</td>
</tr>
<tr>
<td>• Exclude own equity for computation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quantitative Disclosures (Δ NII)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Assume constant balance sheet</td>
</tr>
<tr>
<td>• Change in projected NII over a forward-looking rolling 12-month period compared with the bank's own best estimate 12-month projections</td>
</tr>
</tbody>
</table>
## Illustrative Reporting Formats Prescribed by the Regulator for Public Disclosures

### Table A: Qualitative Disclosures

**Purpose:** To provide a description of the risk management objectives and policies concerning IRRBB.

**Scope of application:** Mandatory for all banks within the scope of application set out in Section B.

**Context:** Qualitative and quantitative information. Quantitative information is based on the daily or monthly average of the year or the data as of the reporting date.

**Frequency:** Annual.

**Format:** Flexible.

**Qualitative disclosure:**

- **a** A description of how the bank defines IRRBB for purposes of risk control and measurement.
- **b** A description of the bank’s overall IRRBB management and mitigation strategies, including monitoring of EVE and NE in relation to established limits, hedging practices, conduct of stress testing, and comparison with the risk and practices of the ACCC, the bank’s practices to ensure appropriate model validation, and timely update in response to changing market conditions.
- **c** The periodicity of the calculation of the bank’s IRRBB measures and a description of the specific measures that the bank uses to gauge its sensitivity to IRRBB.
- **d** A description of the interest rate shock and stress scenarios that the bank uses to estimate changes in the economic value and in earnings.
- **e** Where significant modelling assumptions used in the bank’s SIVS (i.e., the EVE metric generated by the bank for purposes other than disclosures or for internal assessment of capital adequacy) are different from the modelling assumptions prescribed for the disclosure in Table B, the bank should provide a description of these assumptions and of their directional implications and explain its rationale for making these assumptions (e.g., historical data, published research, management judgment and analysis).
- **f** A high-level description of how the bank hedges its IRRBB, as well as the associated accounting treatment.
- **g** A high-level description of key modelling and parametric assumptions used in calculating EVE and ANE in Table B, which includes:
  - For EVE, whether commercial earnings and other spread components have been included in the cash flows used in the computation and discount rate used.
  - How the average replicating maturity of non-maturity deposits has been determined (including any unique product characteristics that affect assessment of replicating behavior).
  - The methodology used to estimate the prepayment rates of consumer loans, and/or the prepayment rates for time deposits, and other significant assumptions.
  - Any other assumptions including for instruments with behavioral optionsality that have been excluded that have a material impact on the disclosed EVE and ANE in Table B, including an explanation of why these are material.
  - Any methods of aggregation across currencies and any significant interest rate correlations between different currencies.

### Table B: Quantitative Disclosures

#### Table B: Quantitative Disclosures

**Scope of application:** Mandatory for all banks within the scope of application set out in Section B.

**Context:** Quantitative information.

**Frequency:** Annual, as at the bank’s financial year-end.

**Format:** Fixed.

**Accompanying narrative:** Commentary on the significance of the reported values and an explanation of any material changes since the previous reporting period.

<table>
<thead>
<tr>
<th>In reporting currency</th>
<th>ΔEVE</th>
<th>ΔANE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Period</td>
<td>T</td>
<td>T-1</td>
</tr>
<tr>
<td>Parallel up</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parallel down</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steeper</td>
<td></td>
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<tr>
<td>Parter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short rate up</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short rate down</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum</td>
<td>T</td>
<td>T-1</td>
</tr>
</tbody>
</table>

**Tier 1 Capital**

**Definitions**

- For each of the supervisory prescribed interest rate shock scenarios, the banks must report for the current period and for the previous period:
  1. The change in the economic value of equity based on its IRRBB, using a run-off balance sheet and an instantaneous shock or based on the result of the standardized framework as set out in Section II if the bank has chosen to adjust the framework.
  2. The change in projected NI over a forward looking 12-month period, compared with the bank’s own best estimate 12-month projection, using a constant balance sheet assumption and an instantaneous shock.
Principal 7: Supervisory Review

The revised guidelines have enhanced the supervisory review process to elaborate on the factors which supervisors should consider when assessing the Bank's level and management of IRRBB exposures.

- NMD assumptions
- Behavioral optionality assumptions
- Repricing cashflows
- Types of yield curves and scenarios used for stress testing
- Level of exposure to AIRO
- Significant currencies
- EVE across scenarios
- NII across scenarios
- Treatment of own equity
- Spread / Margin assumptions
- Currency aggregation

- Adequacy of governance and oversight
- Level of Bank’s knowledge on IRRBB
- Robustness of internal model validation
- Internal MIS and monitoring
- Risk limits and controls
- Robust stress testing
- Independent review and audits
- Effective hedging strategies
- Level of capital
- Peer benchmarking

- Outlier / materiality tests that compare $\Delta$ EVE to at least 15% of Tier 1 capital
- Corrective actions if Bank’s IRRBB framework is deemed to be inadequate:
  - Reduce IRRBB exposure via hedging
  - Raise additional capital
  - Constraints on IMS parameters used by bank
  - Improve risk management framework

Opportunities for Actuaries in Banking:
Measurement and modelling of IRRBB – 6 June 2024
Illustrative case study for IRRBB modelling and EVE calculation
Stage 1 – Allocation of positions in the banking book

Interest rate-sensitive banking book positions need to be allocated to one of three categories i.e. amenable, less amenable and not amenable to standardization.

Stage 2 – Cashflow generation and bucketing across scenarios

- Positions amenable to standardization: Vanilla fixed and floating rate loans without any optionality (Refer to Table 1 in Annexure II)
- Positions less amenable to standardization: Explicit or embedded options (Swaptions, cap / floors etc.) that are excluded from this step and considered as part of Stage 4
- Positions that are not amenable to standardization: Separate treatment for:
  - (a) NMDs
  - (b) Fixed Rate Loans with prepayment risk
  - (b) Term Deposits with early redemption risk

Stage 3 – Calculation of EVE (without AIRO adjustment)

Determination of $\Delta$ EVE for relevant interest rate shock scenarios for each currency. The $\Delta$ EVE is measured per currency for all six prescribed interest rate shock scenarios.

$EVE_{ic}^{CAP} = \sum_{k=1}^{K} CF_{ic}(k) \cdot DF_{ic}(t_k)$

$DF_{ic}(t_k) = \exp(-R_{ic} t_k)$

Stage 4– Calculation of $\Delta$ EVE (with AIRO adjustment)

- Explicit and embedded options excluded in Stage 1 are revalued under each interest rate shock scenario
- Add-ons for changes in the value of automatic interest rate options (whether explicit or embedded) are added to the EVE measure under $e^c$

$\Delta EVE_{ic} = \sum_{k=1}^{K} CF_{ic}(k) \cdot DF_{ic}(t_k) - \sum_{k=1}^{K} CF_{ic}(k) \cdot DF_{ic}(t_k) + KAO_{ic}$

Stage 5– Calculation of standardized EVE measure

The $\Delta$ EVE under the standardized framework will be the maximum of the worst aggregated reductions to EVE across the six supervisory prescribed interest rate shocks. (Refer to Annexure IV)

Standardized EVE risk measure

$\max_{c \in [1, 2, \ldots, 6]} \left\{ \max_{0: \sum_{c=1}^{6} \Delta EVE_{ic} > 0} \left( 0: \sum_{c=1}^{6} \Delta EVE_{ic} \right) \right\}$
Stage 5 – Calculation of Standardized EVE Measure

Standardized EVE Measure after Currency Aggregation

Standardised EVE risk measure = \max_{i \in \{1,2,\ldots,6\}} \left\{ \max \left( 0; \sum_{c: EV(EVE_i c) < 0} \frac{\Delta EVE_i c}{\text{loss in currency } c} \right) \right\}

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Capped (\Delta) EVE</th>
<th>(\Delta) EVE (CCY Aggregated*)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>INR</td>
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<td>Short-Rate Down</td>
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<td>0</td>
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<tr>
<td>Max (Standardized EVE Measure)</td>
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<tr>
<td>15% of Tier 1 Capital</td>
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<td>Breach / No Breach</td>
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</tbody>
</table>

*Assuming an INR/USD FX rate of 75

Opportunities for Actuaries in Banking: Measurement and modelling of IRRBB – 6 June 2024
Challenges, opportunities and Q/A
Challenges and Opportunities in IRRBB Measurement

**Term Structure Modelling**
Need for stochastic interest rate term structure models for forward looking IR scenarios that consider negative rate regimes

**Behavioral Modelling**
Robust behavioral models based on statistical / regression / machine-learning techniques for exposures with uncertain cashflow profiles (NMDs, prepayments and early redemptions)

**Balance Sheet Projection**
Sophisticated projection models required to reflect evolution of business assumptions and reinvestment strategies

**AIRO Valuation**
Extensive volatility and option pricing models required for AIRO valuation based on tree-based and simulation approaches

**Data Integrity and Processing**
Automated data pipelines that can handle huge volumes of data integrity checks and processing to facilitate IRRBB measurement and modelling

**New-Age Compute and Technology**
New-age technology stack capable of handling big data and parallel-processing required to practically implement IRRBB models

**Model Risk Management**
Need to maintain a strong model risk management cycle covering inventory of all models required for IRRBB

**Detailed Reporting and Disclosures**
Extensive reporting and disclosures required by supervisors both at deal and aggregated levels. Failure would lead to increased capital requirements
Opportunities for Actuaries in Banking: Measurement and modelling of IRRBB – 6 June 2024
Thank you