Embedding Liquidity & Interest Rate Risk into Stress Testing

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Nordics Webinar Series

Episode 1
Monday, 15 June
10:00 BST | 11:00 CEST
The Economic Outlook for the Nordics - Impact of COVID-19

Episode 2
Thursday, 18 June
14:00 BST | 15:00 CEST
Embedding Liquidity and Interest Rate Risk Stress Testing into Your Organisation
Key Takeaways from Episode 1

The Economic Outlook for the Nordics - Impact of COVID-19

1) 2020 output reduction in Nordics will be substantial despite declining rate of infections but the increase in unemployment is smaller than elsewhere.

2) Strong fiscal position allows the Nordic countries to support their economies.

3) Actions of central banks help to reduce the level of short and long term interest rates.

4) Risks to the expected recovery include subsequent breakouts of the COVID-19, rising debt, trade wars, and oil prices for oil exporters such as Norway.
Introduction & Speakers

Juan Licari, PhD
Managing Director

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Head of Business Analytics, APAC

Risk & Finance Solutions and Economics & Business Analytics
Agenda

1. The Case: Common Scenarios and Behavioral Models
2. A Framework: Common Scenarios and Behavioural Models
3. Case Studies: Forward-looking Behavioural Models
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The Case: Common Scenarios and Behavioral Models
Achieving an Integrated Balance Sheet View
Cross-discipline scenario alignment

IFRS 9
- Typically 3-5 scenarios for baseline, upside, downside
- Not tail event, relatively probable
- Not bank-specific but representing global risk

ICAAP
- Stress scenarios based on Bank’s Pillar 1 & Pillar II risks
- Risk factors external to the Bank (COVID-19 paths, trade-wars, climate change, etc.)
- Scenarios might include baseline, mild and severe outcomes

IRRBB
- Standardized shock scenarios
- Bank’s risk profile ICAAP
- Historical worst and IR stress scenarios
- Additional bespoke stress scenarios relevant for the Bank

ILAAP
- Typically 3 stress scenarios based on the Bank’s individual business model, risk profile, and market wide stress
- Short and protracted stress scenarios, severe but plausible
- Typically baseline and stress scenarios

Standalone Regulatory Stress Tests
- Specific scenarios provided by regulators on a regular basis/ad hoc such as EBA, PRA, CCAR, MAS, etc.
- Narratives and scenario path but for specific variables only
- Stress testing across different risk departments
### Discipline-specific Scenario Examples

**Example: IRR shocks with an host of artificial assumptions**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Description</th>
<th>Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parallel up</strong></td>
<td>A constant parallel shock up across all time bucket</td>
<td>$\Delta R_{parallel,c}(t_k) = +\bar{R}_{parallel,c}$</td>
</tr>
<tr>
<td><strong>Parallel down</strong></td>
<td>A constant parallel down across all time buckets</td>
<td>$\Delta R_{parallel,c}(t_k) = -\bar{R}_{parallel,c}$</td>
</tr>
<tr>
<td><strong>Steepener</strong></td>
<td>Involves rotations to the term structure. Short rates move down and long rates move up</td>
<td>$\Delta R_{steepener,c}(t_k) = -0.65 \cdot</td>
</tr>
<tr>
<td><strong>Flattener</strong></td>
<td>Involves rotations to the term structure. Short rates move up and long rates move down</td>
<td>$\Delta R_{flattener,c}(t_k) = +0.8 \cdot</td>
</tr>
<tr>
<td><strong>Short rate up</strong></td>
<td>Rates are shocked up such that greatest uplift is at the shortest tenor midpoint &amp; diminishes towards zero at the longest point in the term structure</td>
<td>$\Delta R_{short,c}(t_k) = \pm \bar{R}<em>{short,c} \cdot S</em>{short}(t_k) = \pm \bar{R}_{short,c} \cdot \frac{e^{-t_k}}{x}$</td>
</tr>
<tr>
<td><strong>Short rate down</strong></td>
<td>Long rates shock down such that the largest uplift is in the longest tenor &amp; diminishes to zero at the shortest point in the term structure</td>
<td>$\Delta R_{short,c}(t_k) = \pm \bar{R}<em>{short,c} \cdot S</em>{short}(t_k) = \pm \bar{R}_{short,c} \cdot \frac{e^{-t_k}}{x}$</td>
</tr>
</tbody>
</table>
Integrating Across Disciplines – Business Case
An opportunity for better risk management

**Cost saving**
Unified approaches can be handled in a single system to manage different risks. This will help save a lot of money for the Bank.

**Comparable reports**
Producing reports based on both operational and regulatory dimensions is key to take the good decisions.

**Regulatory Compliance**
Banks need to be prepared for new regulatory requirements and must be able to forecast accurately the regulatory analytics.

**Risk Limits & Risk-adjusted pricing**
Models need to be shared by the Bank and be consistent for all risks. The price of each transaction should reflect the variety of these risks.
Discipline-Agnostic Scenarios
Combine a comprehensive macro-framework with severity variables

Discipline-Agnostic Macro Economic Scenarios

- Macroeconomics: HPI, GDP, unemployment, equity indexes, interest rates, CDS, inflation etc
- Severity Narratives: Financial Crisis, Sovereign Crisis, Fiscal Space/ Policymaker Intervention
- Product/Customer Characteristics

Cross-Discipline Risk Models

- Balance Sheet projections
  - Assets (including credit lifecycle)
  - Liabilities
- P&L/Value projections
  - NII, NIR, NIE, EaR, EVE
  - IFRS 9 Provisions
  - Net profit/loss

- Liquidity Ratios
- Own Funds
- Capital Ratios

RWA projections/Capital charges
- Market
- Credit
- Operational
Discipline-Agnostic Scenarios
A comprehensive macroeconomic framework

**Baseline Scenario - Policy Rate/Euribor spread, %**

**Baseline Scenario - Euribor**

**Core Economic Indicators**
- Domestic lending rates
- Consumption
- Wages and salaries
- Global financial markets
- Monetary policy rate
- Investment
- Government
- Labor force
- Population
- Prices
- Exchange rates
- Exports
- Potential GDP
- Imports
- Unemployment rate
- GDP

**Additional Risk Indicators**
- Swap Rates Curves
- Sovereign Bond Yield Curves
- Stock Market Indices
- Financial and Sovereign CDS by Sector and Rating
- and many more...
Discipline-Agnostic Behavioural Models
Leverage inter-linkages between disciplines

Modelling Impact on balance sheet

**Models Driving:**
- **Assets**
  - Changes in Assets
    - Loan drawdowns
    - Credit Losses
    - Prepayment speeds
  - Changes in value of marketable assets
    - Mark-to-market values
    - Increased haircuts in assets
  - Off Balance Sheet Items
- **Liabilities**
  - Changes in Liabilities
    - Deposit Volumes
    - Term Deposit Early Redemption
  - Off Balance Sheet Items

**X-discipline Risk Models**

- Stress period begins
- Shock
- Asset Prepayment/Credit loss
- Asset recovery as rate environment normalises
- Equilibrium returns

Embedding Liquidity & Interest Rate Risk into Stress Testing
Assess Risk Accurately and Protect Profitability
Realistic and bank-specific analysis

Common Scenarios & Models

- Market Data Shifts
- Common Behaviour Models
- Severity Narratives

Interest Rate Risk, Credit & Liquidity Results per Scenario to Influence Decision-Making
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A Framework: Common Scenarios and Behavioural Models
Linking Macro Indicators with Risk Models

Critical for forward-looking capital and liquidity planning

1. Macroeconomic Indicators
   - Baseline scenario forecast
   - Alternative stress scenarios
   - Alternative upside scenarios
   - Event-driven scenarios
   - Regulatory stress testing scenarios

2. Risk Models
   - Interest rate term structure
   - Customer behavior
   - Liquidity risk
   - Credit risk and provisioning for regulatory capital, IFRS9
   - Early warning indicators

3. Key Measures
   - Liquidity risk gaps, survival period
   - Interest risk gaps
   - Net interest income
   - Economic value of equity
   - Balance sheet, P&L, RWA projections
   - Expected credit loss
   - Internal and regulatory capital requirement
Embedding Liquidity & Interest Rate Risk into Stress Testing

Scenario Generation Framework
Shocks to forecast factors for modelling behaviours

Core Economic Concepts
- National Accounts
- Balance of Payments
- Government Finance
- Industrial Production
- Price Indices
- Interest Rates
- Labor Markets
- Home Price Indices
- and many more...

Additional Market Risk Indicators
- Swap Rates Curves
- Sovereign Bond Yield Curves
- Stock Market Indices
- Implied Market Volatilities
- Asset-backed Securities
- Mortgage-backed Securities
- Corporate and Sovereign CDS by Sector and Rating
- Corporate and Sovereign Credit Migrations
- and many more...

Diagram:
- Global financial markets
  - Prices
  - Import prices
  - Global prices
  - Domestic lending rates
  - Monetary policy rate
  - Exchange rates
  - Government
  - Investment
  - Consumption
  - Exports
  - Imports
  - GDP
  - Wages and salaries
  - Labor force
  - Employment
  - Unemployment rate
  - Potential GDP
  - Population
Scenario Forecast of Key Behavioural Factors
iTraxx CDS in Europe, example of baseline and stress scenarios

**Europe Junior Financials**, 1-year to 10-year maturities

**Sovereign Western Europe**, 5-year to 10-year maturities
Scenario Forecast of Key Behavioural Factors
Severity shift for baseline and two alternative scenarios, examples
Modelling Expected Behaviours
Linking scenarios with net cash-flows from assets and liabilities

DATA INPUT

Economic Scenarios:
Deterministic Simulations

Bank’s Data:
Customer Characteristics
Product Characteristics

MODELS

Call deposits withdrawal
Term deposits early withdrawal
Loan commitments drawdown
Loan prepayment
Probability of default, delinquencies
Loss given default, exposure at default

OUTPUT

Account-level, forward-looking, scenario-conditional projections of behavioural risk metrics

Portfolio-level, forward-looking, scenario-conditional projections of cash flows
Challenges of Behavioural Modelling
For interest rate risk in the banking book, liquidity and credit metrics

Data Availability
- Granularity, frequency, consistency, completeness, and quality
- Limitations can put constraints on the type of modeling techniques
- Macroeconomic scenarios historical data and forecast

Framework Integrity
- Single view of risk across the bank
- Enforce consistency of results by establishing and common modeling framework
- Model governance, re-calibration updates, monitoring, use test

Model Design
- Building robust models using relevant quantitative methods
- Finding appropriate model specification using variable search algorithms
- Detailed documentation and knowledge transfer

Model Implementation
- Implementation into key interest rate risk and liquidity metric calculations
- Implementation into credit risk metric calculation
- Ensuring continuity through detailed user manuals
3 Case Studies: Forward-looking Behavioural Models
### Example Drivers for Different Behavioural Models

**For interest rate risk in banking book, liquidity and credit risks**

#### Loans subject to prepayment risk
- Loan size, LTV
- Borrower characteristics
- Contractual and current interest rates
- Geographical location
- Demography
- Taxes
- Changes in family composition
- Original and remaining maturity
- Seasoning
- **Macroeconomic variables** (e.g. stock price index, unemployment rates, inflation and HPI)

#### Loan commitments drawdowns
- Borrower characteristics
- Geographical location, including competitive environment and local premium conventions
- Customer relationship with bank
- Remaining maturity of the commitment
- Seasoning and remaining term
- **Macroeconomic variables**

#### Term deposits subject to early withdrawal risk
- Deposit size, depositor characteristics
- Funding channel
- Contractual interest rates
- Seasonal factors, geographical location and competitive environment
- Remaining maturity and other historical factors
- Insurance coverage
- Bank’s reputation
- **Macroeconomic variables**

#### Call deposits
- Responsiveness of product rates to changes in market interest rates
- Current level of interest rates
- Spread between a bank’s offer rate and market rate
- Competition from other banks
- Bank’s reputation, geographical location and demographic characteristics of customer base
- Insurance coverage
- **Macroeconomic variables**
Propensity to Withdraw Modelling Example
Capturing motives for willingness to withdraw and place funds

![Graph showing levels of call deposits over time with different scenarios: History, Baseline pre-pandemic, Baseline, Downside, Severe downside.]

**Level of call deposits**
- History
- Baseline pre-pandemic
- Baseline
- S3: Downside
- S4: Severe downside

- Million monetary units
- 2017M01 to 2029M01

*Assuming complete pass-through

![Graph showing percentage change year ago with different scenarios: History, Baseline pre-pandemic, Baseline, Downside, Severe downside.]

**Percentage change year ago**
- History
- Baseline pre-pandemic
- Baseline
- S3: Downside
- S4: Severe downside

- 2017M01 to 2029M01

*Assuming complete pass-through*
Prepayment Risk Modelling Example
Capturing incentives for early amortization

### Prepayment Rate, %

<table>
<thead>
<tr>
<th>Year</th>
<th>Baseline pre-pandemic</th>
<th>Baseline</th>
<th>S3: Downside</th>
<th>S4: Severe downside</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020M07</td>
<td>7.8%</td>
<td>5.8%</td>
<td>4.5%</td>
<td>2.8%</td>
</tr>
<tr>
<td>2021M01</td>
<td>6.5%</td>
<td>5.0%</td>
<td>3.2%</td>
<td>1.9%</td>
</tr>
<tr>
<td>2021M07</td>
<td>5.5%</td>
<td>4.4%</td>
<td>2.4%</td>
<td>1.4%</td>
</tr>
<tr>
<td>2022M01</td>
<td>4.5%</td>
<td>3.3%</td>
<td>1.8%</td>
<td>1.0%</td>
</tr>
<tr>
<td>2022M07</td>
<td>3.5%</td>
<td>2.5%</td>
<td>1.2%</td>
<td>0.6%</td>
</tr>
</tbody>
</table>

### Driver Composition

- Loan lifecycle: 47%
- Customer characteristics: 15%
- Updated LTV with HPI: 4%
- Other loan characteristics: 10%

Sources: Mortgage Portfolio Analyzer, Moody’s Analytics
Delinquency and Credit Loss Modelling Example
Capturing borrowers’ ability to repay and corresponding losses

Sources: Mortgage Portfolio Analyzer, Moody’s Analytics
Cash Flow Projection Example

Uncertainty of inflows affected by prepayments, delinquencies & losses
Credit Facility Drawdown Modelling Example
Capturing the behaviour of committed facility counterparties

Sample Facility Usage

Outstanding Indebtedness, % change

- Baseline pre-pandemic
- Baseline
- S3: Downside
- S4: Severe downside

Balance
Credit Limit

Expected outflow
Undrawn amount

Drawn Amount

Time

2019Q1 2022Q1 2025Q1
Key Takeaways
A great opportunity for better risk management

- Combine scenarios & granular data for forecast models
- Develop robust models, monitoring & validation
- Integrate models and systems
- Create detailed & comparable documentation & reporting
- Set up framework integrity through governance
- Establish a single view of risk across bank

Q&A

Email us at help@economy.com