ACTUARIAL ROLES IN BANK STRESS TESTING

Steven Chen

Oliver Wyman Actuarial Consulting

December 2015
Contents

- Stress testing overview
- Stress testing regulatory requirements
- Stress testing framework
Section 1

STRESS TESTING OVERVIEW
Introduction to stress testing

What is Stress Testing?

An analysis or simulation designed to determine the ability of a given financial instrument or financial institution to deal with an economic crisis.

Why do people worry about it?

- **Board/ senior management** want to know if their current business strategy leaves them over exposed in a particular scenario (e.g. cyber attack)?

- **Heads of Business Units** want to know how robust their portfolio of financial instruments will be in a certain economic scenario (e.g. if interest rates rise by 250 bps).

- **Regulators** want to know if an institution has enough capital to withstand a severe economic downturn (e.g. another credit crunch)?

- Results of these simulations help financial institutions act pre-emptively to better prepare for extreme, yet plausible scenarios.
Stress testing has become an important tool in risk management in terms of understanding and communicating risks

Roles of stress testing in risk management

- To communicate the bank’s risk profile to senior management: 100%
- To understand the nature of the bank’s risk profile: 95.3%
- To set limits for risk-taking: 60.5%
- To conduct contingency planning: 48.8%
- To allocate capital: 18.6%

Source: Bank of International Settlements survey
Furthermore, stress testing is being increasingly embedded by banks into key business applications and management processes.

### Enterprise-wide stress testing

Current and planned use (% of respondents)

<table>
<thead>
<tr>
<th>Category</th>
<th>Use today</th>
<th>Planned over next year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital adequacy</td>
<td>96%</td>
<td>2%</td>
</tr>
<tr>
<td>Risk ID/Risk assessment</td>
<td>78%</td>
<td>16%</td>
</tr>
<tr>
<td>Risk appetite</td>
<td>56%</td>
<td>29%</td>
</tr>
<tr>
<td>Strategic planning</td>
<td>45%</td>
<td>22%</td>
</tr>
<tr>
<td>Planning / budgeting</td>
<td>45%</td>
<td>22%</td>
</tr>
<tr>
<td>Contingency planning</td>
<td>51%</td>
<td>18%</td>
</tr>
<tr>
<td>Limit setting</td>
<td>51%</td>
<td>13%</td>
</tr>
<tr>
<td>Risk measurement vs. limits</td>
<td>46%</td>
<td>12%</td>
</tr>
<tr>
<td>Capital allocation</td>
<td>20%</td>
<td>20%</td>
</tr>
<tr>
<td>Credit portfolio struct.</td>
<td>12%</td>
<td>20%</td>
</tr>
<tr>
<td>Performance measurement</td>
<td>12%</td>
<td>16%</td>
</tr>
<tr>
<td>Pricing</td>
<td>6%</td>
<td>10%</td>
</tr>
<tr>
<td>Origination strategy</td>
<td>12%</td>
<td></td>
</tr>
</tbody>
</table>

**Key emphasis to date**

- Growing use, often rather informative than prescriptive
- Primarily informative/anecdotal

In best practice stress testing serves both regulatory and business objectives

Regulatory driven objectives

- Ensuring institution understands the risks it is holding
- Ensuring the institution is adequately capitalised today, in future under basic and in stressed conditions
- Ensuring Risk Appetite is linked into Capital Adequacy calculations and monitored
- Ensuring EC methodology is appropriately challenged
- Ensuring losses are appropriately forecasted
- Ensuring adequate support is provided for management decisions (on a regular and ad-hoc basis)

Business objectives

- Ensuring annual business plans reflect not only a base case but also other potential scenarios
- Base strategic investment decisions on a multitude of planning scenarios
- Understand the overall risk profile of the business and communicate it to Senior management
- Set limits for risk-taking, i.e. redistributing risk-taking in order to decrease vulnerability
- Provide input into portfolio steering activities
- Perform loss forecasting and assess impacts on business
- Use as early warning signals and conduct contingency planning
- Support external communication to investors and other stakeholders

Stress testing is not a standalone risk management activity but always works in conjunction with other activities

From a business perspective stress testing can support decision making by delivering better information
Section 2

STRESS TESTING REGULATORY REQUIREMENTS
The current regulatory stress testing started as a crisis response tool

Failure of the old regime

- The banks that failed during the crisis in the US and UK were all “well capitalized” based on the existing standards
- Regulators needed to do something different and big – and then show the results and how they got there – to regain the market’s and the public’s trust

Enter stress testing

- Scenario had to be easy to understand and credibly severe
- Importantly, Fed developed its own models to project losses and profits
  - This provided an extremely important ability to form your own view

Aftermath

- Stress test results produced new information about bank health and asset quality
- Information was new and credible; for example, the 2009 FED stress testing showed that 10 banks needed a total of $75bn in capital
## Examples of stress testing exercises applied by major Supervisory Authorities

<table>
<thead>
<tr>
<th></th>
<th>FED</th>
<th>EBA/ECB</th>
<th>PRA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Year of start</strong></td>
<td>2009</td>
<td>2009</td>
<td>2009</td>
</tr>
<tr>
<td><strong>Approach</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Based on a standardised data request</td>
<td>• Based on a standardised data request</td>
<td>• Run alongside the EBA’s EU-wide exercise</td>
</tr>
<tr>
<td></td>
<td>• Assessed under three supervisory developed scenarios (i.e. baseline, adverse, severely adverse)</td>
<td>• Assessed under two scenarios: baseline and adverse</td>
<td>• Includes a number of additional UK layers to the EBA stress test (i.e. UK Variant)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Primarily bank led</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Join-up of Asset Quality Review (AQR) results</td>
<td></td>
</tr>
<tr>
<td><strong>Perimeter</strong></td>
<td>All BHC with consolidated assets &gt;50BN$ (i.e. 31 in 2015)</td>
<td>128 EU banks which cover at least 50% of each national banking sector</td>
<td>8 major UK banks and building societies</td>
</tr>
</tbody>
</table>
The 2014 EBA stress test

- Timeframe in scope: 3 years, 2014-2016
- Two scenarios defined: baseline and adverse scenarios
  - The adverse scenario reflected increase in global bond yield, further deterioration of credit quality, stalling policy reform and lack of bank balance sheet repair
- The scope of the risk types include credit risk, market risk, sovereign risk, securitization risk, cost of funding and interest income and other
- Static balance sheet assumed – portfolio composition does not change from YE2013 through time horizon
- Hurdle rate
  - Baseline scenario: 8% Common Equity Tier 1 ratio
  - Adverse scenario: 5.5% Common Equity Tier 1 ratio
The U.S. CCAR program: brought to you by DFA and the Federal Reserve

- CCAR: Comprehensive Capital Assessment and Review
  - Comprehensive: losses and revenues; balance sheet (on and off) and income statement; all risks!
- Timeframe in scope: 9 quarters
- Five scenarios: three supervisory developed scenarios and two institution developed scenario
  - The severely adverse scenario reflected substantial weakening in global economic activity and large reductions in asset prices; US corporates suffer financial distress of a severe recession, as spreads widen and equity prices fall; oil prices also rise to $110 per barrel
- Multiple minimum capital ratios
  - Tier 1 common ratio, Common Equity Tier 1 ratio, etc.
  - 4.5% Common Equity Tier 1 ratio
- No significant capital action can be done without it
  - No increase in dividends, share repurchase programs
  - No M&A activity
Section 3

STRESS TESTING FRAMEWORK
Overview of stress testing framework

1. **Strategic**
   - **Credit impairment** (by segment)
     - How should we model each asset class, reflecting specific regional and product behaviours and working around data limitations?
   - **RWA** (by segment)
     - How do we align RWA assumptions around credit impairment in a tractable way?
     - How do we model balance sheet dynamics (asset replacement strategy)?
   - **Interest income** (by segment)
     - How do we align forecasts and stresses with bottom up plans in a tractable way?
     - How do we account for second order effects (limited ability to reprice stressed assets, prepayment dynamics, etc.)?
   - **Interest expense** (by segment)
     - How do we predict the future given structural break in pricing and supply dynamics?
     - How do we account for recent changes in policy, regulation or customer behaviour – and which are likely to be permanent vs. transitory?
   - **Other**
     - How should other line items be dealt with?
     - Including
       - New lending flows
       - Prepayments and amortisation
       - Pension fund
       - Trading income
       - Fees and commissions
       - Operational expenses
   - **IT**
     - What can we do to streamline processes?
     - What information needs to be captured to support future refinements/back testing?
     - Can we conduct ad hoc stress tests in very short order (<1 week)?

2. **Organisation and governance**
   - What roles should senior management play through the process? How do we get their input in a timely manner?
   - What should the timing and sequencing be of each key step in the process?
   - What are the blockages in the process and how can they be streamlined?
   - How can we address concerns of regulators or other stakeholders, at home and abroad?
   - What validation processes need to be put in place?
   - Etc.

3. **Scenario design**
   - How to design scenarios?
   - How to ensure the scenarios have been applied consistently across different businesses/P&L and balance sheet items?
   - What additional constraints should we impose, and how should we ensure compliance?

4. **Analytics**
   - **Credit impairment** (by segment)
   - **RWA** (by segment)
   - **Interest income** (by segment)
   - **Interest expense** (by segment)
   - **Other**
   - **IT**

5. **Data**
   - What data gaps are there between the desired approach and the current situation?
   - How should the data gaps be filled in an efficient manner?
   - Etc.
Strategic implications
Regulators expect banks to use stress testing results to inform business decisions

Stress testing programmes should be actionable and inform decision making at all appropriate management levels of an institution. The stress testing programme, as part of a range of risk management tools, supports different business decisions and processes including strategic decisions.

– CEBS Guidelines on Stress Testing, Section 2, Guideline 3
Strategic implications
Sensitivity analysis of strategic initiatives will enhance management understanding of potential deviation from planned course of action.

Base and Stress regulatory ratios could consider impact of potential strategic actions under different scenarios

CET 1 ratio under different secured lending strategies

- **Base BAU**
- **Base – 20% ↑ in secured lending**
- **Base – 50% ↑ in secured lending**
- **Stress – BAU**
- **Stress – 20% ↑ in secured lending**
- **Stress – 50% ↑ in secured lending**

Comments

- For internal purposes, consider performing pro-forma analysis that uses as a “lever” the Bank’s strategic priorities.
- Will allow the bank to better understand its likely performance under stress for a variety of strategic options (e.g., rebalancing of portfolios).
- In turn, improved understanding can inform decisions about potential range of capital actions given a strategic decision.

Note: for illustrative purposes only; does not reflect any stress analysis.
### Organisation and governance

Three typical models are observed, with larger banks moving towards an integrated bottom-up or dual approach.

<table>
<thead>
<tr>
<th>Description</th>
<th>Top-down only</th>
<th>Bottom-up</th>
<th>Full bottom-up/dual approach</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stress testing</strong></td>
<td>Stress testing done through centrally owned models</td>
<td>Business unit stress testing compiled at Group, with Group defined scenarios</td>
<td>As with the Bottom-up, except with much greater involvement of Finance, Treasury and Strategy in the process</td>
</tr>
<tr>
<td><strong>Focused on Risk metrics</strong></td>
<td>Focused on Risk metrics (Capital, Liquidity, impairments)</td>
<td>Focused on Risk metrics (impairments, RWA) with other aspects (P&amp;L and balance sheet) receiving some attentions</td>
<td>Stress testing used to drive strategic decision making</td>
</tr>
<tr>
<td><strong>Liquidity, Credit, Market risk</strong></td>
<td>Liquidity, Credit, Market risk all done separately</td>
<td>Liquidity, Credit, Market risk all done separately (liquidity generally done in the centre)</td>
<td>Linked directly to capital and funding allocation through risk appetite</td>
</tr>
<tr>
<td><strong>Used for regulatory requirements and Risk Appetite statements</strong></td>
<td>Used for regulatory submissions and risk-aspects of planning (e.g. capital management)</td>
<td>Integrated approach taken to all risk types, liquidity and P&amp;L items</td>
<td></td>
</tr>
<tr>
<td><strong>Organization</strong></td>
<td>Group Risk/Finance led</td>
<td>Group Risk/Finance coordinated in centre</td>
<td>Range of leadership models, with some institutions opting for cross-functional “Head of stress testing” organization</td>
</tr>
<tr>
<td><strong>BU teams take lead in stress testing, generally reporting into divisional management – often without being dedicated to stress testing</strong></td>
<td>BU teams take lead in stress testing, generally reporting into divisional management – often without being dedicated to stress testing</td>
<td>BU staff either part of planning teams or dedicated staff</td>
<td></td>
</tr>
<tr>
<td><strong>Calendar</strong></td>
<td>Calculation exercise typically several weeks</td>
<td>1–4 months</td>
<td>1–4 months (with planning cycle)</td>
</tr>
<tr>
<td><strong>1–4 months</strong></td>
<td>Depends critically on quality of process and analytics in BUs</td>
<td>Depends critically on quality of process and analytics in BUs</td>
<td></td>
</tr>
<tr>
<td><strong>Typical institutions</strong></td>
<td>Smaller, credit-focused regionals</td>
<td>Most larger, more complex institutions</td>
<td>Some leading larger, complex groups</td>
</tr>
</tbody>
</table>
Scenario design
Best practice scenario design is an iterative process, including a range of scenarios that are aligned to business and economic uncertainties.

- Scenarios taxonomy must cover relevant threats and opportunities
  - “Ad hoc” investigation of specific current concerns
  - Constant issues (to allow through-time comparison)
  - Confidence interval based (reg. requirement)
  - Reverse stress tests
  - Etc.
- Scenario discovery should include feedback from regular processes (e.g. planning/budgeting rounds, risk appetite setting, etc.)
- Numerous stakeholders included (Group economics, Risk, Finance, Business leaders, etc.)
- Scenarios reconsidered/re-designed after each round

Aim is not to “predict the future”. Instead to highlight a set of issues through risk and financial forecasting and facilitate preparation for the unexpected.

Scenario taxonomy and examples

Economic scenarios
- Macro economic possibilities
- Economic “shock” impacts
  - Deflation/hyper inflation
  - Currency collapse

External changes
- Regulatory initiatives
- Market/competitive changes
  - Capital increase
  - Ban on short selling

Market events
- Key markets shut down
- Volatility in specific areas
  - FX market halts
  - Gold market

Internal sensitivities
- Known concentrations, issues and sensitivities
- One off events
  - Default of largest name
  - Drop in real estate market
Analytics
There is a wide spectrum of methodologies for both wholesale and retail credit risk stress testing

Wholesale portfolio stress testing methodologies

<table>
<thead>
<tr>
<th>Methodology</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECAP approach</td>
<td>Use the same model as for ECAP (e.g. Merton model)</td>
</tr>
<tr>
<td></td>
<td>Stress to a 1 in X confidence level, as opposed to a particular macro scenario (1 in X set based on judgment around overall severity of scenario)</td>
</tr>
<tr>
<td>Econometric macro approach</td>
<td>Internal and/or external default series used to derive relationships to macroeconomic factors</td>
</tr>
<tr>
<td>Conditional transition approach</td>
<td>Transition matrices conditional on specific economic scenarios</td>
</tr>
<tr>
<td></td>
<td>Summarize transition matrix into default index used for regression on macro factors</td>
</tr>
<tr>
<td>Bottom-up loan level approach</td>
<td>Model relationship between macro and micro economic factors; stress tests based on macro scenarios</td>
</tr>
<tr>
<td></td>
<td>Rules-based prediction of default (e.g. LTV/DSC thresholds)</td>
</tr>
</tbody>
</table>

Retail portfolio stress testing methodologies

<table>
<thead>
<tr>
<th>Methodology</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple transition matrix approach</td>
<td>Use historical roll-rate data, but apply stress to base using judgment</td>
</tr>
<tr>
<td>Econometric macro approach</td>
<td>Internal and/or external default series used to derive relationships to macroeconomic factors</td>
</tr>
<tr>
<td></td>
<td>Regressions used to estimate forward</td>
</tr>
<tr>
<td>Macro-enhanced roll-rate approach</td>
<td>Transition matrices conditional on specific economic scenarios</td>
</tr>
<tr>
<td></td>
<td>Key roll-rates (i.e. Current-to-30; 60-to-90) regressed against macro factors</td>
</tr>
<tr>
<td>Conditional roll-rate approach</td>
<td>Model relationship between macro and micro economic factors through a loan level roll rate</td>
</tr>
<tr>
<td></td>
<td>Probabilities of payoff, default, migration estimated by regression</td>
</tr>
</tbody>
</table>
Infrastructure
Regulation BCBS239 is driving the medium term changes in IT and data infrastructure in financial institutions

Comments

- Data should be of the ‘appropriate’ quality and granularity for timely extraction and aggregation of risks at various dimensions (e.g. legal entity, lines of business)
- Market participants investing significant resources into upgrading legacy systems to meet BCBS239 expectations
- Systems will need to meet both internal and external expectations

Key areas for consideration

- Definition of appropriate level of granularity required for slicing and dicing of data along various dimensions
- Definition of acceptable amount of time for extracting and aggregating data for different reporting purposes
- Assessment of areas where manual sourcing might be appropriate
- Future-proofing the system design – sufficient level of flexibility required to handle an appropriate amount of process and/or methodology changes
- Entities/regions leveraging IT and/or data synergies with Group