OLIVER WYMAN

ADB

STRESS TESTING

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Yen Chu Cheng
Senior Manager

Jason Ekberg
Senior Manager

FINANCIAL SERVICES

MARSH & McLENNAN COMPANIES

Main points we want to get across today

- The crisis has highlighted the shortcomings in stress testing frameworks, particularly in how they are generated and how they are used by management
- Generating effective scenarios requires a robust data driven process and lateral thinking, e.g. reverse stresses – expert insight is essential to ensure business relevance
- Scenario-based goes beyond risk management and should support business decision making and contingency planning – as well as a wide range of management processes
- Senior management and business buy-in remains key to derive maximum use of stress testing frameworks and planning

Section 1 | Lessons learned from the crisis

Stress and scenario testing is highlighted by many as a gap in banks' risk management frameworks

Need for stress-testing highlighted

- Industry difficulties attributed in part to misunderstanding the impact of "events"
  - Appropriate stresses not considered
  - Impact of stresses not well understood
- Stress-testing near the top of the agenda for regulators, rating agencies and analysts
  - Recent BIS and UK FSA publications
  - Government support design/execution
  - Broker reports and valuations
- Economic outlook particularly uncertain, with uncertainty underscoring the need for stress testing insights
  - Characteristics of the current recession unclear (deflation, hyper-inflation…?)
  - Post crisis regulatory and competitive landscape unclear

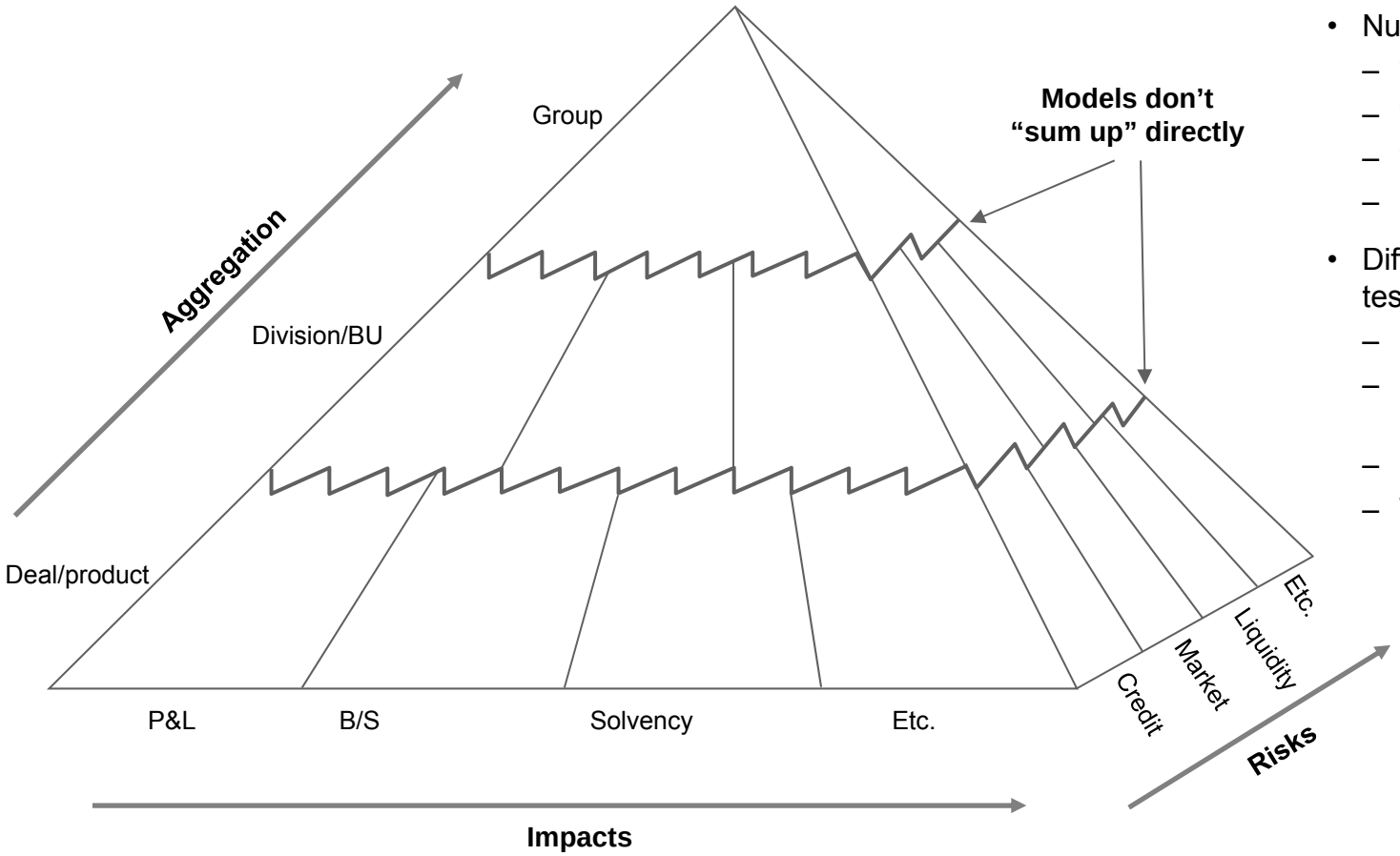
Many institutions fall short of requirements

- Few executives regularly utilise stress/scenario results in decision making
  - Limited value realised from current capabilities
- Most institutions lack elements of analytical "technology"
  - Most have some siloed models (e.g. liquidity stresses)…
  - …though few meaningfully model the impact of scenarios
  - Many miss a holistic view of all risks/ products/businesses
- Substantial ambiguity about required or best practice
  - Regulatory requirements
  - Processes and what to do with the insights provided

Lower recent defaults/losses in many of the Asia Pacific portfolios in recent years highlights the importance of forward looking, rather than backward looking, metrics

Challenge: There is significant ambiguity over issues that stress testing should cover, and the role in the organisation

Illustrative stress testing framework

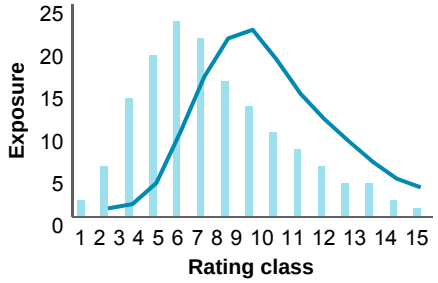


- Numerous interpretations of
  - "Sensitivity analysis"
  - "Stress testing"
  - "Scenario planning"
  - Etc.
- Differing views over stress testing's role in
  - Risk management
  - Strategic/business management
  - Regulatory compliance
  - Target setting…

It is important to get the “big picture” right beyond the individual scenario methodology and definitions

Sensitivity tests

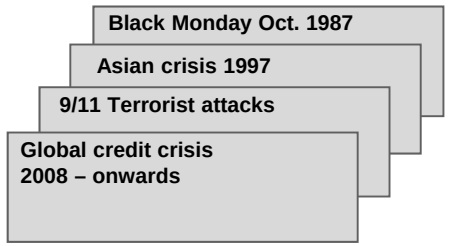
- Defined by shift in underlying variable
- Relatively easy to define and implement
  - Often used at trading desk and business line level
- Shifts in several variables have to be used in order to “simulate” historical events
- Correct use of stressed correlations between risk types is crucial
  - Difficult to parameterise



Scenario tests

Historical scenarios

- Choice of different scenarios that are most relevant for different parts of the portfolio
- Coverage at least of major risks in the portfolio



Hypothetical scenarios

- More relevant to portfolio and current market environment than historical scenarios
- Labour intensive
- Involve more judgement
  - Usually created with input from experts
    - Management
    - Business level
    - Macro-economic models

Hybrid scenarios

- Hypothetical scenarios that are based on historical scenarios
  - Adjusted historical scenarios
  - Price sensitivities are set using historical events
  - Effects of events on market liquidity are set using historical scenarios

- Get high level estimate of likelihood of each scenario
- Ensure coverage of all risk types that the bank faces
- Ensure coverage of major portfolios by dedicated elements in each stress scenario

Trade-off of comprehensibility vs. realism is crucial – get the “big picture” of scenarios right

The industry has begun to address challenges across four key areas
Past stress testing framework vs. emerging framework

Historical stress testing framework

- **Range of scenarios considered**
  - Often based on statistical intervals (“1 in 25”)
  - Consideration of historical events (“1990’s recession”)
  - Sets of events deemed by management to be severe but plausible
- **Scope**
  - Siloed approach to addressing each risk type
  - “Mechanical” approach taken by Risk Management, often based on historical relationships and events
- **Governance and use**
  - Risk management the primary audience, with the aim of meeting Basel II/Pillar II challenges
  - Limited use in business processes or decision making
- **Practical approach**
  - Ad hoc analysis by Group Risk
  - Conducted in isolation from many other risk management processes

Emerging stress testing framework

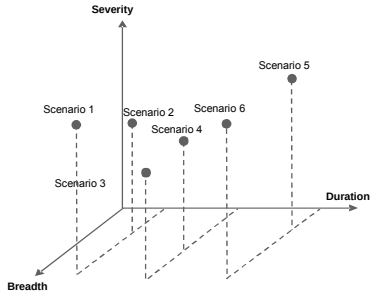
- **Range of scenarios considered**
  - Less focus on statistical/historical relationships
  - Focus on forward-looking and creative challenges
  - Reverse stress-tests (i.e. scenarios that break the business model)
- **Scope**
  - Holistic view of risks, business and threat types, with particular focus on liquidity and reputation
  - Focus on “contagion”, both within the Group and across the broader industry
  - Increased input from experts across a range of business disciplines
- **Governance and use**
  - Board level issue for debate
  - Consideration of scenario impacts across a broad range of processes (e.g. contingency planning)
- **Practical approach**
  - Business-as-usual process, embedded in regular reporting and strategy development

Lower recent defaults/losses in many of the Asia Pacific portfolios in recent years highlights the importance of forward looking, rather than backward looking, metrics

To create real impact from stress testing while meeting compliance goals, processes and analytics must be addressed simultaneously…

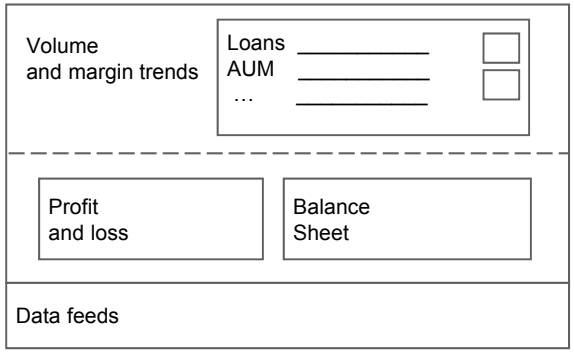
Stress testing framework

Scenario generation
Defining and agreeing stresses



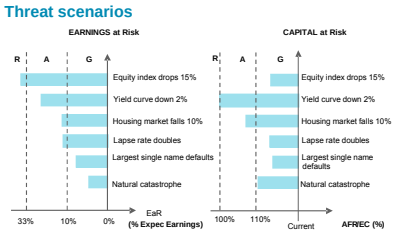
- Identify relevant risks, contagions and concentrations
- Agree scenario sets that challenge conventional wisdom

Analytics
Modelling the impact of stresses



- Assess impact of scenarios on businesses
- Enrich current measures and metrics (e.g. Capital, earnings…)

Use
Ensuring that results drive business decisions



- Develop mitigation techniques and contingent strategies
- Link into risk appetite, monitoring and forecasting

Feedback loop

Responsibility: regulators, government and all members of institutions

Responsibility: risk, finance and treasury

Responsibility: executives and managers

…However, this is not without challenges along each step of the way

Major challenges of stress testing

Scenario generation
Defining and agreeing stresses

- Developing a set of stresses that meet contradictory pressures…
  - Identify specific risks, concentrations and contagions
  - Provide comparability through time
  - Account for current macro conditions
- …while avoiding
  - Production of an unwieldy large set of scenarios
  - "Group think" in scenario development
- Generating buy-in and ensuring scenarios address the **next** banking crisis

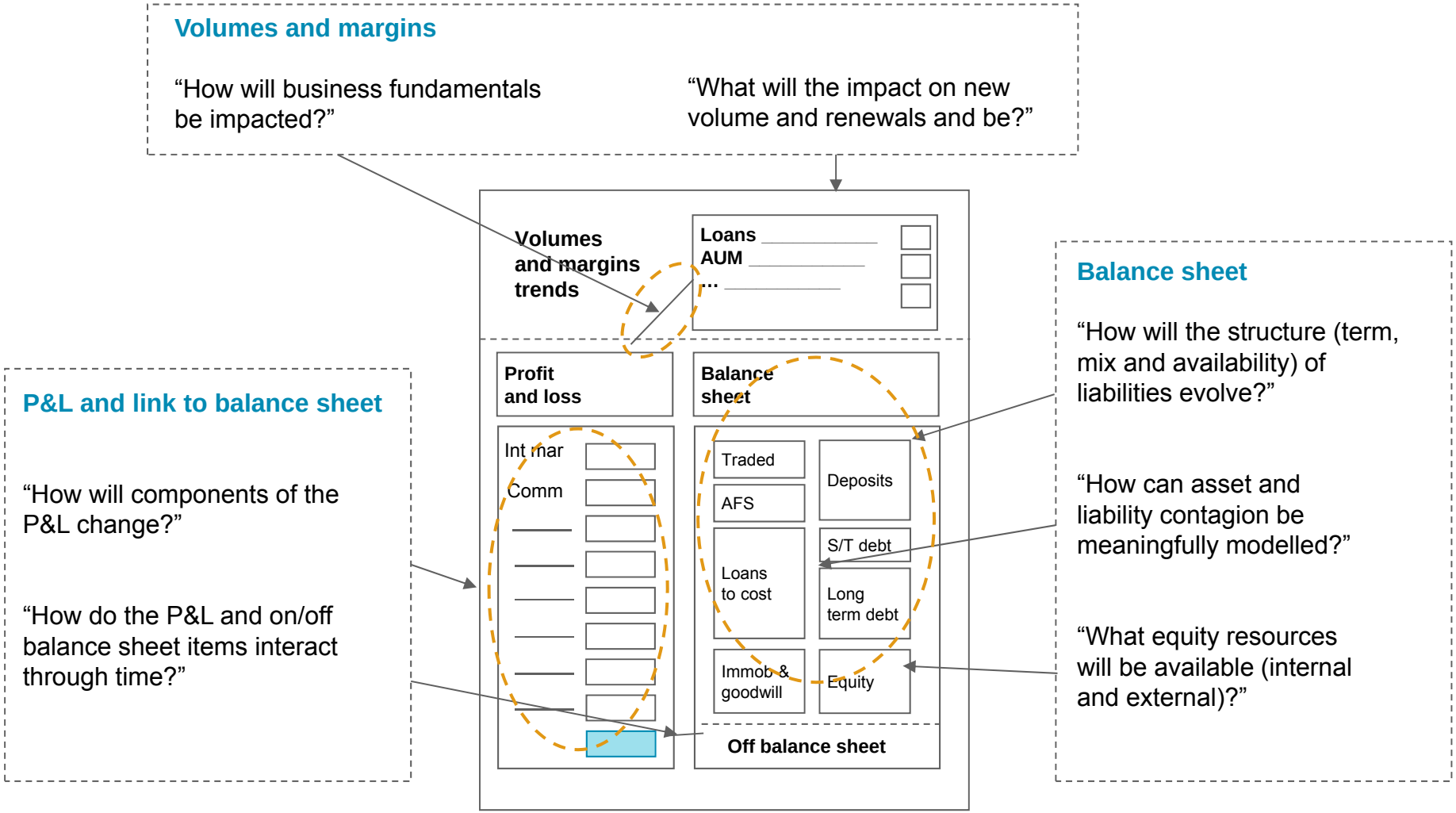
Analytics
Modelling the impact of stresses

- Assess the impact of scenarios across the full range of metrics
  - Funding and capital impact
  - Portfolio specific outcomes
  - New business margin and volumes
- Ensure analytics are flexible enough to model strategic choices
  - e.g. Impact of changing credit policies
- Interpreting and explaining key results and issues (e.g. Capital, earnings...)

Use
Ensuring that results drive business decisions

- Develop strategies considering a range of possible scenarios
  - Position for upside, limit downside
  - Link into planning process
- Develop contingent strategies to gain early mover advantage
  - e.g. Macro hedging
- Monitor situation and use scenarios for short term forecasting
- Link scenarios into risk appetite

Methodology should provide comprehensive output covering P&L, balance sheet, volumes and margins on (re-) underwriting

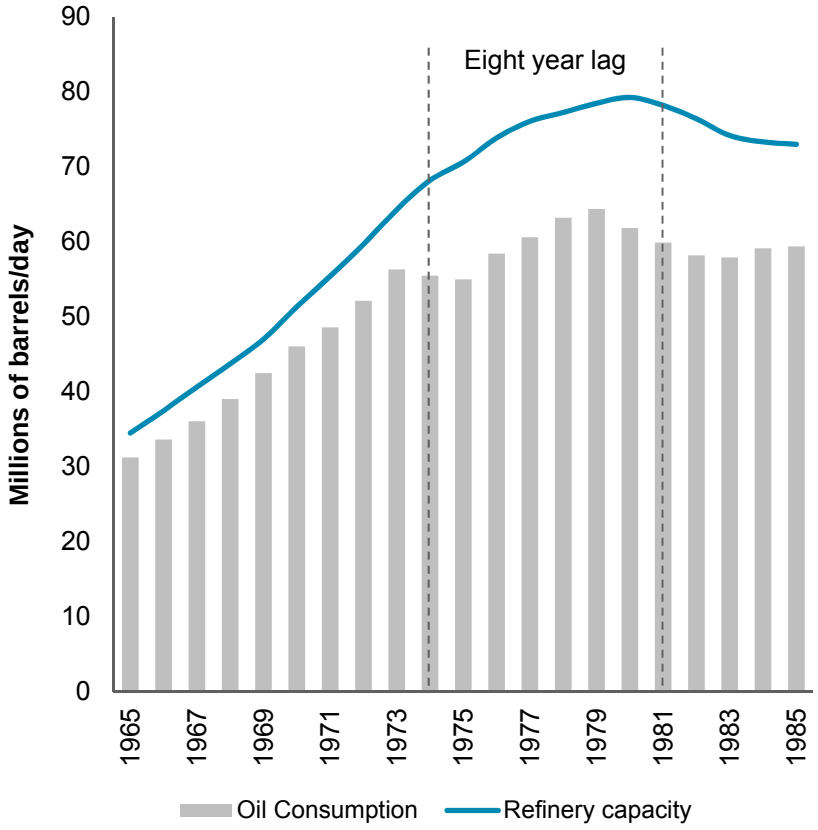


Section 2 | Generating scenarios

Few Financial Services companies have fully realised the benefit of scenario based planning, though in other industries benefits have been made clear

Oil Capacity and Demand 1965–1985

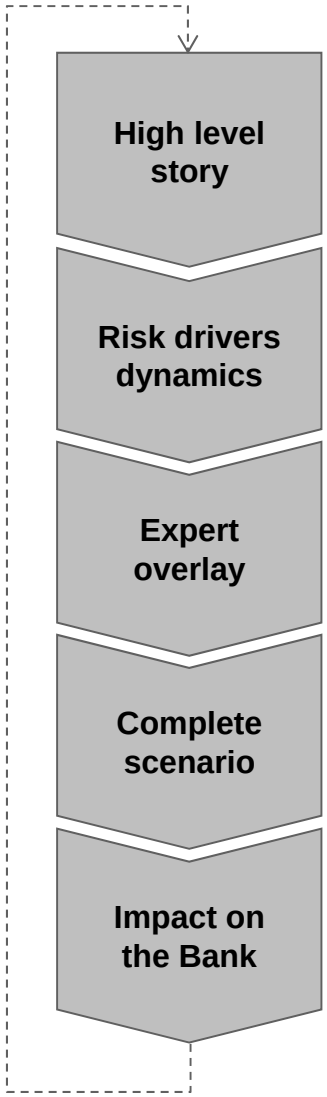
Industry slow to react to paradigm change



- Shock in early 1970s resulted in over-supply from Oil companies
  - Steady 6% p.a. growth of 1960s built into supply plans
  - Slow to react to paradigm change
- Shell had begun to use scenarios in the 1960s, including a scenario that simulated a lasting reduction in demand and Middle Eastern political interference
- As a result, when the macro-economy began to mirror this scenario, it was able to change its plans ahead of the rest of the market
  - Avoided over-supply problems of its competitors
- Shell continues to use scenario planning as a steering tool
  - Current scenarios include significant political shift towards renewable energy
  - Scenarios have a tangible impact on the business strategies developed, leaving it better prepared for macro changes

Source: BP Statistical Review 2008

To maximize the value of stress testing, we propose using a five step iterative process



Draw a coherent and plausible story that would impact the activity of the Bank

Example

"House prices fall 40%"

Historical and academic theory analysis to calculate interconnection between risk drivers

Example

House prices fall 40%, what happens to GDP, interest rates, unemployment, stock markets…

Challenge historical relationships before scenarios are finalised. Incorporate

- Executives' opinions on changing relationships
- Specific experts' inputs

All relevant factors are detailed and quantified

Running the model the effects of the scenario on the Bank are quantified

Scenario definition – Key insights
Draw a coherent high level story, make it severe, make it complete

- Stress scenarios should be coherent big picture “stories” and forecast all relevant risk drivers
- One should operate a library of standard stress tests complemented with a few, ad hoc scenarios and reverse stress tests indicating at which severity the bank breaks
- Scenarios should be generated starting from a blend of historical and hypothetical scenarios: Key is to parameterize all relevant risk drivers
- Reverse Stress testing provides the reference point what “we’re betting the bank on” – Regulators are pushing it as it avoids the tedious compromises on the appropriate severity of a scenario
- Non-financial risks should also be considered: both as standalone scenarios and as part of the broader scenario

Best practice scenario generation is an iterative process, including a range of sources of scenarios that aligned to business and economic uncertainties

- Scenarios taxonomy must cover relevant threats and opportunities
  - Constant issues (to allow through-time comparison)
  - Confidence interval based (reg. requirement)
  - "Ad hoc" investigation of specific current concerns
  - 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

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

Aim is not to predict the future. Instead to highlight a set of issues and facilitate preparation for the unexpected

Three different types of scenario are seen in the market – best practice organisations combine all three types

Scenarios considered for stress testing – Three types

1 Industrialised "Scenario libraries"

- **Description**
  - Small set of generic scenarios that remain constant through time – one-off exercise based on historical scenarios
  - Focused on 3/4 main macro-economic factors
- **Aim, role and benefit**
  - Provide a consistent view of the risk profile through time
  - Avoid undue focus on short term conditions
- **Examples (typically 2–3 run)**
  - Early' 90s downturn
  - Mild recession
  - Property price fall
  - Equity market crash (dotcom)
  - Bird flu epidemic

2 "Ad hoc" scenarios

- **Description**
  - Forward looking scenarios addressing current macro-economic, concerns
  - Regularly updated
  - Consider a wider range of macro-economic factors
- **Aim, role and benefit**
  - Show potential impact of macro-economic concerns on the Group
- **Examples (typically 5–10)**
  - UK government downgrade
  - Eastern European government default
  - Deflation
  - Sustained inflation and rising interest rates

3 Bottom up/ Reverse scenarios

- **Description**
  - Identification of very specific events that might cause a large loss – or threaten the bank – in a specific area
  - Not necessarily linked to macro-economic factors
  - Updated constantly
- **Aim, role and benefit**
  - Risk identification and mitigation: do not necessarily trigger a full stress test/capital plan calculation
  - Foster creativity and buy-in through the Group
  - Potential feed into FSA "reverse stress testing"
- **Examples (number depends on business complexity)**
  - Hedging strategy breakdown
  - Default of large single counterparty
  - Institution-specific liquidity crisis

The quantity and complexity of scenarios can differ based on size and sophistication of the institution

1

No scenarios considered

- Stress test is a mere sensitivity test without linkage to macro-economic factors

2

One scenario considered

- A single macro-economic stress scenario is considered – usually the scenario provided by the regulator

3

Two to four scenarios considered

- Various scenarios considered, covering general economic stresses
  - Base case
  - Downturns of different severities
- Scenario provided by regulator may be amongst them
- A probability of occurrence may be associated to each scenario (e.g. 1-in-25,1-in-10)

4

Five or more scenarios considered

- A variety of scenarios, including general macro-economic ones…
  - Mild recession
  - Sever recession
- …and specific, event-driven stresses; e.g.
  - Pandemic
  - Regulatory changes
  - Decline in property prices
  - Rising commodity prices
- Other risks are stressed (market, operational, business, etc.) in consistency with credit risk scenarios

However, following generation, scenarios should remain forward-looking and subjected to regular reviews to ensure they stay relevant under changing conditions…

Methodology for scenario generation

1

Historical scenarios

- Scenarios linked to historical data – assume future crises will have impact similar to past
- Frequently use scalars (e.g. peak-to-average)
- May be linked to confidence intervals (1-in-25, 1-in-10)

2

Forward-looking scenarios

- Future crises may differ from past ones
- Econometric approaches are combined with expert judgment
- e.g. – FSA approach for scenario generation
  - Average of market forecasts
  - Adjusted by forecasting error on the "bad" side

Market/Best practice

Scenario review processes

1

No process established

- No process established for coming up/ reviewing scenarios
- Rather than a recurrent process, stress test is considered a one-off exercise derived from
  - Crisis in financial sector
  - Punctual regulatory request

2

Regular process for generating/reviewing scenarios

- Stress scenarios are reviewed regularly to
  - Update information
  - Consider inclusion of additional scenarios

Market/Best practice

…whilst being realistic about what is achievable given intrinsic challenges in stress testing

Intrinsic challenges

1. Scenarios may be different to the past
   - As such, inferences from past experience may not be relevant to forward looking scenario periods
2. Lack of available data
   - Shortage of historical time series
   - Little or none of this will be similar to the scenarios considered

3. Human judgement element of rating tools difficult to predict
   - Error around expert predictions of qualitative factors
4. Re-rating behaviour is unpredictable and subject to change
   - Differences in re-rating behaviour more likely during downturns

Implications

→ **Expert understanding is essential**

→ **Realistic expectations should temper desire for sophistication**

To ensure business relevance – Stress scenarios should be based on true economic drivers rather than the parameters of the calculation engine

Topic	Basic practice	Best practice
Credit risk – PD calculation	• Undifferentiated rating stress (e.g. 2-grade shift for all obligors) • Limited use of historical regression or well-thought out expert view	• Model considers historical data with explicit link between PD and scenario factors • Supplement with expert judgment to discuss and challenge different scenarios used in the model
Credit risk – LGD calculation	• Use downturn LGD from RWA calculation • No linkage to scenario factors	• Model that link scenario factors to LGDs (either Bottom-up or Top-down) • Differentiates between point-in-time loss rate and LGD used in RWA calculation
Market risk	• Ad hoc process exists • Stress testing covers parts but not all of market risk factors (interest rates, equity prices, exchange rates, credit spreads, volatility)	• Tool to test positions in financial instruments in the trading/loan books under various stressed conditions across all relevant factors
Other risks	• No formal process to quantify the effect of other risks (liquidity, reputational) • Considers these risks as an afterthought in the framework	• Framework to assess and quantify effects of shocks to funding (liquidity risk) • Considers non-financial risk (reputational) on both standalone (impact on reputation of a scenario) and as part of inter-connected risk framework (how reputational risk may effect share prices, etc.)

To ensure comprehensiveness, non-financial risks should also be considered: Both as standalone scenarios and as part of big picture

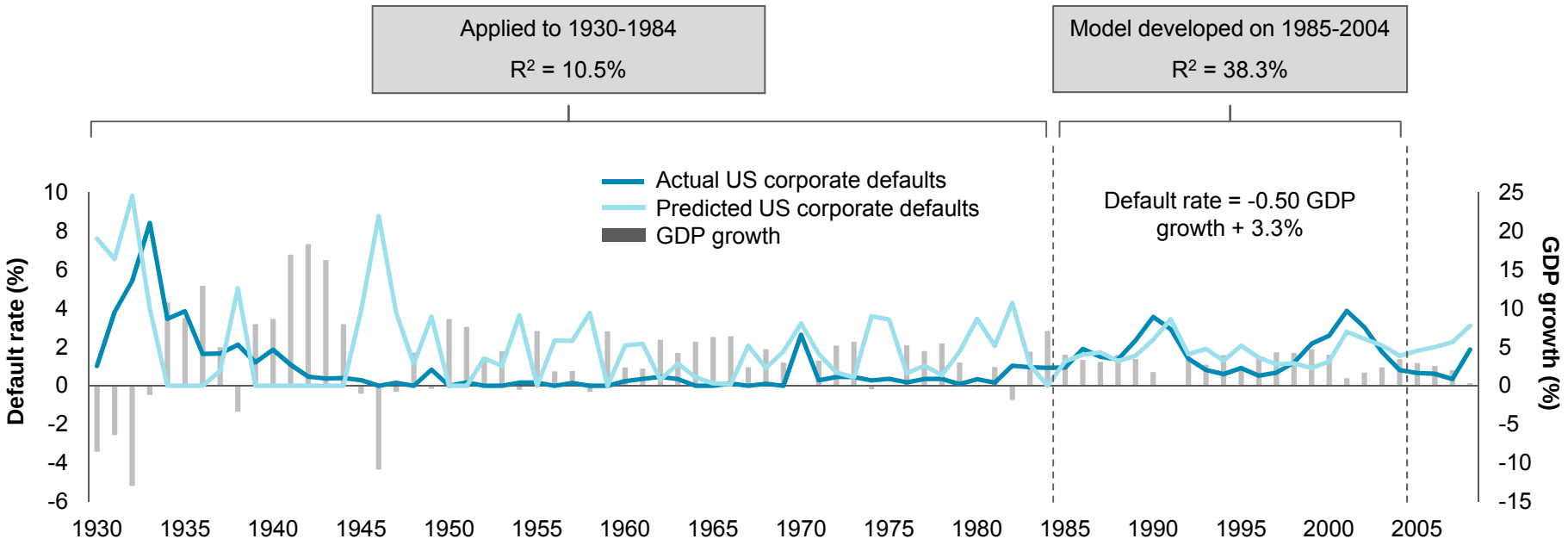
Standalone scenarios

- Typical “top 10” operational risks largely uncorrelated to other risk events
  - Rogue trader
  - Systems failure
  - Fraud
- These scenarios should be considered standalone with causality fully considered
  - Impact on reputation
  - Impact on funding position
- For more stringent stress, may be combined with broader stress scenario
  - Impact of operational risk event may be greater during times of stress

Connected risks

- Reputational risk
  - Scenario has impact on reputation
  - Reputational damage further impacts on the position of the bank in the crisis
- Reputational damage has wide-ranging and lasting damage
  - Long-term damage to share price
  - Impact on employees, clients, business partners
- Should be considered in context of scenario planning/stress-testing
  - Are there any aspects of the scenario that impact on reputation?
  - Does change to reputation impact on the effect of the scenario?

To ensure a forward-looking view, historical time series should be combined with forward-looking experts opinions during scenario generation



Implications

- Macro factors affect credit risk differently at different periods in time
- It is essential to fully understand the scenarios considered
- Expert judgement is key, and should complement stress testing models

1. Analysis is shown only for illustrative purposes – the model may not be ideally formed even with a single factor (at least lag and factor transformations could be considered)
Source: Bureau of Economic Analysis, Moody's

Example: Using a combination of approaches to triangulate stress scenario, with a significant role for expert judgement

Triangulated PD projections

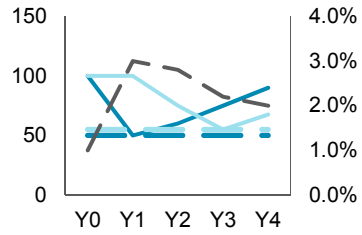
"Core" methodology

Bottom-up risk driver analysis

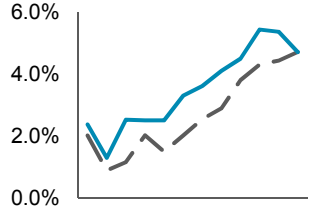
- Relationships defined between macro factors and individual model factors
  - Based on historical regression and expert judgement
  - Pragmatism required
- Split by industry as far as practical

Impact of rating system

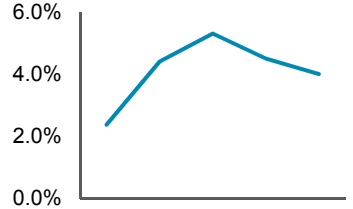
Lag on financials



Overrides

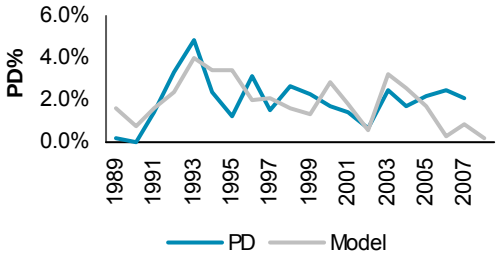


Core projection



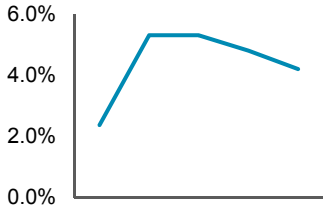
Triangulation points

Regression model for default rates



- Regressions to link scenarios to PD experience (may need to be recreated)

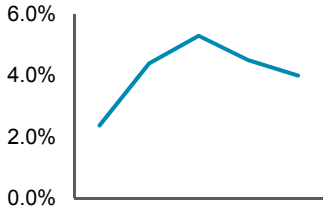
Triangulation projection 1



External benchmarks

- Compare results to external benchmarks as a sanity check on results
  - E.g. Historical rating agency migrations

Triangulation projection 2



Rating system overlay

Final projection based on directed expert judgement

- Understand dynamics of the scenarios considered
- Consider core projection against triangulation points
- Understand reasons for differences between projections
- **Justify final PD projection**

In summary: The ideal stress scenario

- Defines a clear “big picture”
  – e.g. liquidity crunch, world recession, stagflation
- Is relevant
  – Scenarios specifically designed keeping in mind the risks the Bank is exposed to
- Is plausible
  – Stress tests must be realistic and be based off scenarios that are extreme and yet have a chance of happening
- Is complete
  – A scenario must articulate the “big picture” by forecasting ALL necessary risk drivers
- Is consistent
  – Forecasting of risk drivers must be done coherently accounting also for conjoint dynamics
- Is up-to-date
  – Stress scenarios must be updated regularly ensuring consistency with market events

Section 3 | Using the results

The most common mistake is to regard scenario planning as a regulatory exercise only

1

Regulator only

- Stress test results do not inform any business decisions – exercise is performed solely for compliance purposes

2

Risk function

- Results are reported to/signed-off by head of risk function
- Main purpose is gain understanding of sensitivity of Economic Capital numbers

Common practice

3

(Senior) Business management

- Conclusions of Stress test results are reported to/signed-off by senior management
  - CEO, CFO, CRO
  - Board
- Results are discussed and used to drive capital and business planning

Common practice

Best practice peers are using stress testing to inform risk identification and mitigation, as well as for business planning

Uses of stress testing

Planning	Contingency planning	• Determine impact of specific stress scenario and build contingency plan (e.g. hedge/sale/business reduction etc.) • Assess validity of existing contingency plans
	Limit new business/renewals	• Set new capital/balance sheet constraints if adverse loss scenarios are outside risk appetite
	Budgeting/Capital management	• Forecast loan losses to feed into P&L budget, with impact on future business volumes and cost base
	Workout capacity management	• Determine likely flow of files to workout, to enable development of resources and capabilities in advance
	Risk appetite assessment	• Assess risk exposures against risk appetite
Risk identification	Trigger more detailed stress-testing	• Identify high-risk portfolios/names to be investigated further
	Add deals to watch list	• Identify names to be added to watch list
Risk mitigation	Macro-hedging/portfolio sale	• Identify risk hot-spots outside risk appetite • Build business case for purchase of macro hedge/portfolio sale
	Single-name hedging/asset sale	• Identify name-level risks for hedging/sale
	Transfer to Workout and recovery	• Identify names to be transferred directly to workout for restructuring/recovery

The extent of embedding often depends on the management processes and the scenario type

Use of stress test results – by type of scenario

Section		1. Industrialised "Scenario libraries"	2. "Ad hoc" scenarios	3. Bottom up scenarios
Planning	Contingency planning	✓	✓	✓
	Limit new business/renewals		✓	
	Budgeting/Capital management		✓	
	Risk appetite assessment	✓	✓	
	Workout capacity management		✓	
Risk ident.	Trigger more detailed stress-testing		✓	✓
	Add deals to **watch list**		✓	
Risk mitig.	Macro-hedging/portfolio sale	✓	✓	✓
	Single-name hedging/asset sale		✓	✓
	Transfer to Workout and recovery		✓	
Addressee		• Business unit management • Executive board	• Executive board • Business unit management	• Product/segment level management • Escalated where appropriate
Frequency		• Quarterly	• Quarterly at least • Carried out "ad hoc"/ when needed	• On-going/"ad hoc"

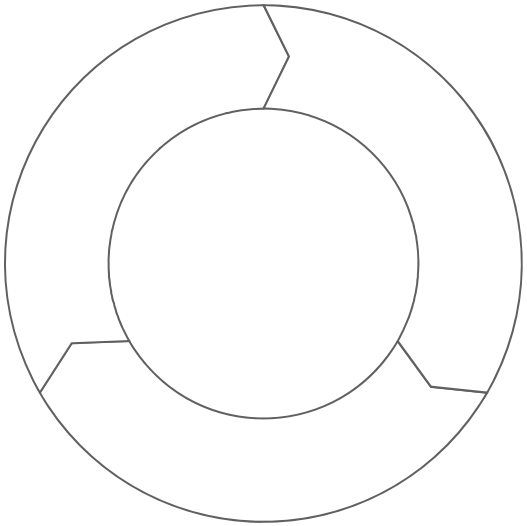
Effective use of scenarios in decision making requires senior buy-in and supporting processes

- **Senior team with wide range of business buy-in**
  - Central team close to the board
  - Embedded at all levels of the organisation where strategic decisions are taken
- **Embedded modelling**
  - Risk projection models linked to scenarios
  - Finance models linked to scenarios
  - Growth, pre-payment and other business models linked to scenarios
- **Scenario development processes**
  - Plausible forward looking scenarios
  - Regularly reviewed/updated scenario suite
- **Strategic planning processes**
  - Planning cycle that generates new scenarios frequently
  - Economic monitoring reports as early warning signals
  - Creation of contingent strategies and policies that change dynamically

Risk appetite, limit setting and stress testing are all closely interlinked and required in conjunction with each other

1 Strategy and risk appetite setting

- Formulating the strategy, including embedding explicit consideration of risk-reward trade offs
- Providing the business with a philosophical view of acceptable and unacceptable sources of risk
- Steering the portfolio and coordinating risk taking activities across the bank



2 Limit setting

- Cascading exposure/capital from the Group to the BU level
  - Individual large exposures
  - Industries
- Setting limits across additional risk dimensions
- Communicating risk appetite in actionable format

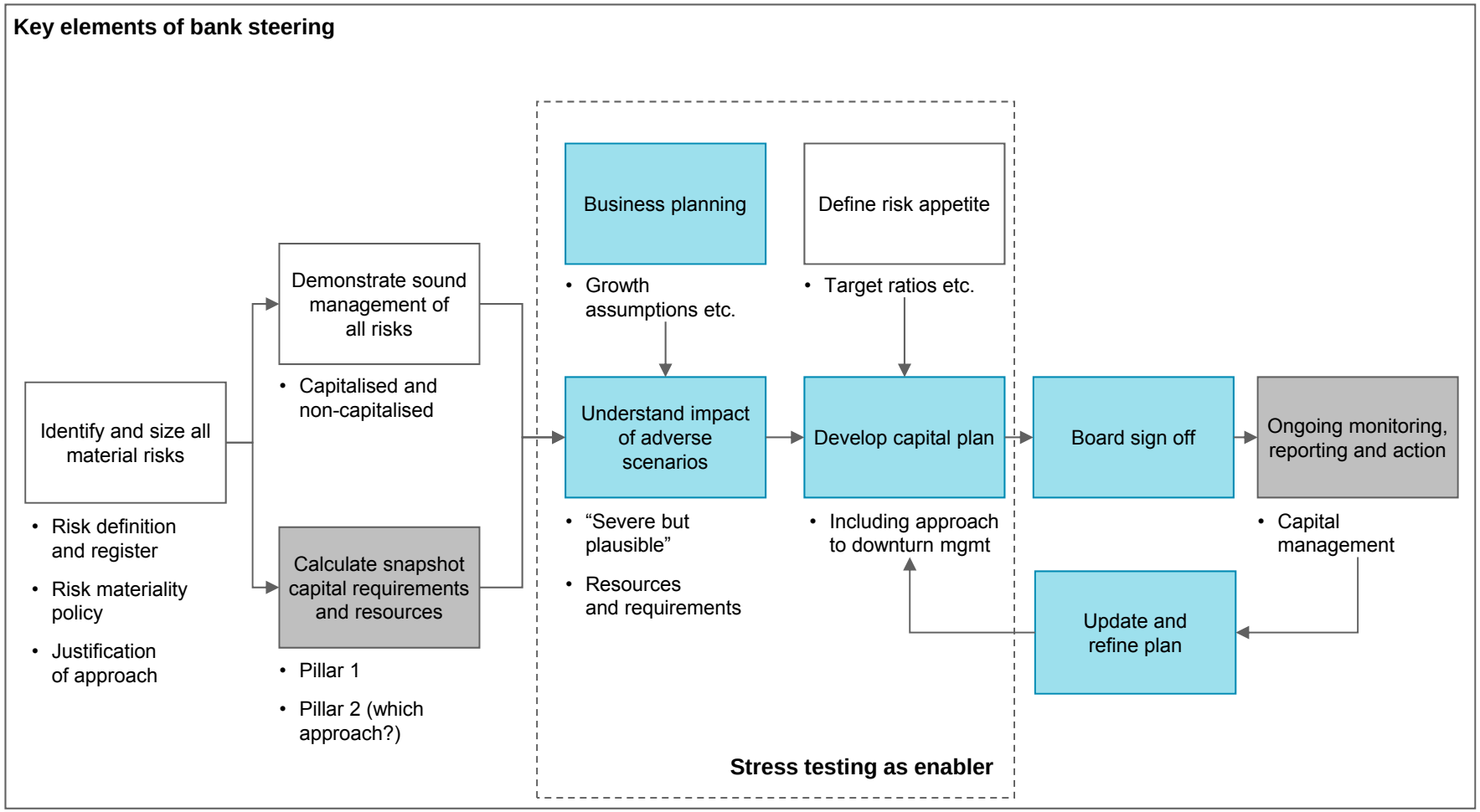
3 Stress testing analysis

- Define a set of stress scenarios and relevant scenario parameters
  - Depends on the stress testing approach, senior management involvement at this stage can be critical
- What do the implied limits mean under the stress scenarios?
  - P&L and capital impact
- Profitability analysis ideally taken into account to provide a full picture

Example: Embedding stress-testing and scenario planning into risk appetite frameworks

Constraint	Traditional risk appetite statement	Additional scenario-based statements
Target debt rating	• We will maintain our AA rating even in a 1 in 10 event	• Plans must ensure we remain AA under any core scenarios
Capital adequacy	• We will maintain our regulatory capital adequacy even in a 1 in 50 event	• We will remain out regulatory capital adequacy under any considered scenario
Earnings volatility	• We will not miss consensus earnings forecasts by more than 25% more often than 1 year in 10	• Scenario-based plans should ensure we stay within 25% of communicated earnings projections
Liquidity	• We will ensure that liquidity resources are sufficient to meet a 1 in 100 liquidity event	• We will have sufficient liquidity to continue doing business under any or our planning scenarios
Concentrations	• We will not have more than 5% of the bank's RWA at risk to one counterparty • The top 10 customers will not account for more than 20% of total RWA	• We will not have more than 20% of the bank's RWA at risk to a 1 in 25 movement in any single macro factor
Operational risk	• Operational losses will not exceed 5% of revenue in any year • Top 10 risks will be managed with escalation procedures	• We will plan to survive a top 10 operational risk event together with any of our planning scenarios

Example: Stress testing is an important enabler for central bank steering processes…



Example: …and should play a central role in the management of capital adequacy through establishing a forward-looking view

Risk-based capital	"Base" capital projection	Stressed capital projection	Inclusion of mitigating actions	Capital plan
• Snapshot of risk-based capital requirement • Covering all material risks • Inclusion only of "convincing" diversification benefits • Use for capital planning limited because • Backward looking • Portfolio is assumed static	• Multi-year projection of risk-based capital – the base case capital plan • Evolution of business plans linked to forecast capital, earnings and costs • Assumes a particular state of the economy over planning period	• What would the impact of a severe downturn be – On capital? – On earnings and costs? • Multiple stresses will be required • Stress test must be appropriately severe (not limited by historical scenarios)	• What management actions could be taken to reduce the impact of a severe downturn? • What would be the expected impact of these actions? • What contingency plans have been put in place? • Will these be available in all scenarios?	• Capital adequacy and its forecast • Stress test impact and contingency action • Monitoring framework • Implementation strategy

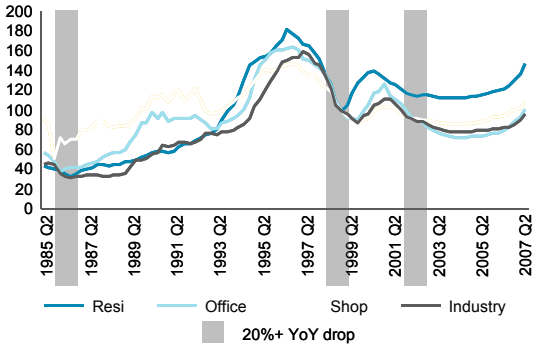
Example: Stress testing is a critical tool to estimate concentration limits

Illustrative

Setting bottom-up Risk Appetite for real estate exposures using stressed scenarios

Design stress scenario

Singapore property price indices
1985-present



- Design macro or industry-specific scenario
- Analyse historical real estate price movements

Parameterise losses

Price drops

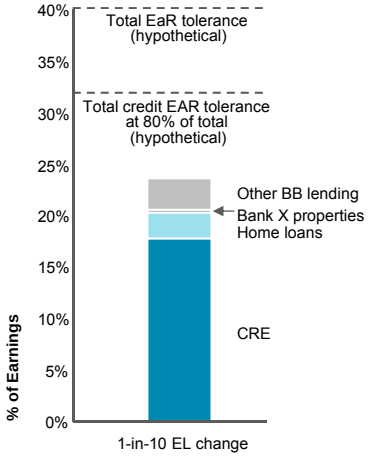
	CRE	Resi	Equity
SG	-20%	-30%	-35%
MY	-15%	-20%	-25%
Others	-20%	-20%	-30%

Loss parameters

	CRE	Resi
PD	▲ 6%	▲ 4%
LGD	▲ 25%	▲ 35%

- Scenario driven into loss estimates through
  - Prices
  - PD
  - LGD

Estimate impact

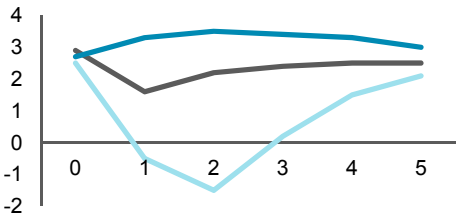


- Impact on earnings and/or capital
- Decide whether acceptable to Bank

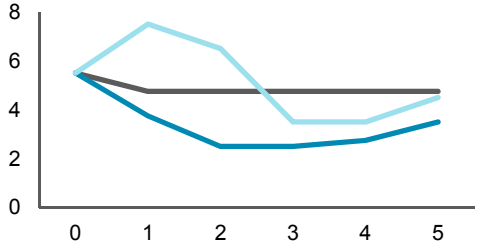
Example: An institutionalised approach to scenario-based planning also facilitates use of outputs in practical decision-making such as contingency planning

Pre-considered planning scenarios

GDP % Change



Interest rates



Monitoring of external market developments

Factor	Current best estimate (full year)
GDP growth	-0.2%
Interest rates	3.5%
Etc.	

Early warning signals

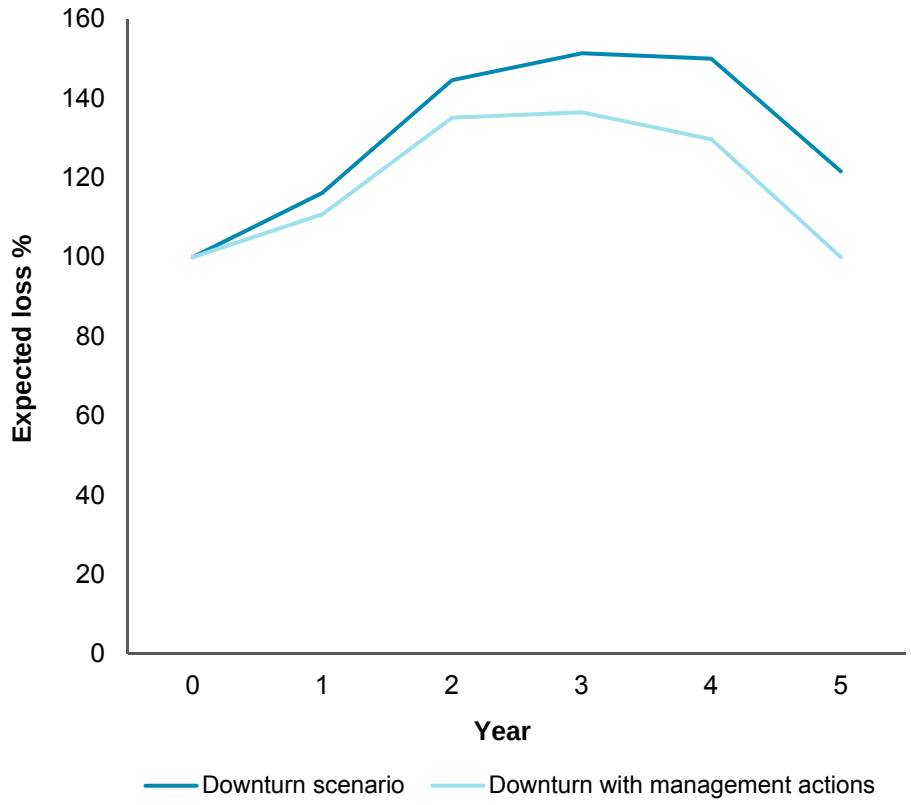
- Current scenario appears like scenario 2
  - Under this scenario the market will develop as XX
  - This suggests a change in strategy of XX

Comments

- **Economic conditions monitored on a regular basis**
  - Best estimates updated regularly along key dimensions (house prices, GDP growth, unemployment, interest rates, etc.)
- **Economic conditions can be compared against pre-test scenarios**
  - Check for the emergence of stories that fit pre-tested scenarios
  - Check emergence of results compared to scenarios
- **Acts as "early warning system"**
  - Early signs point to other developments as described in the scenario
- **Provides first mover advantage**
  - Spotting early means reacting early

Example: Designing scenario planning over medium-term also supports mitigating management action – which may be slow to take effect

Effect of mitigating actions
Disguised client example



Approach

- **Mitigating actions slow to have any impact**
  - e.g. Tighter lending criteria
  - Usually little action possible against in-force business
  - Portfolio churn often slow
- **Some actions can be taken to increase scope for management action**
  - Shorter maturity requirements
  - Increase capital/liquidity buffers
- **Strategic business decisions often slow to bear fruit**
  - New country, product, etc.
  - Changes in HR model

Beyond immediate decision making, stress-testing can benefit a range of management processes

- Cultural and behavioural challenges remain for almost all firms
  - "That will never happen"
  - "We'll all be dead anyway"
  - Etc.
- Short term aims include
  - Board education
  - Visible actions (e.g. hedging, reduction of exposure)
- Long term aim is to incorporate in a broad range of processes (see RHS)

Example processes benefiting from stress testing thought

	Stress testing aims
Strategic planning and management	• Development of strategy mindful of opportunities and threats, shaping the profile of the organisation • Engage in meaningful analysis of threats/opportunities from specific businesses
Budgeting	• Scenario Input into targets and budgets
Loss emergence forecasting	• Short term estimation of (generally credit) loss forecasts
ICAAP/regulation	• Meet evolving requirements and expectations
Deal/ product design	• Include the impact of unexpected in designing balance sheet items
Macro hedging	• Purchase of specific instruments to hedge against extreme losses in some exposures
Investor communication	• Provide IR with a fact base to help allay analyst/ investor fears
Risk appetite	• Using stress testing to define elements of the risk appetite
Reporting/MI	• Inclusion of result and impacts in standard reporting packs

Example: A coherent stress testing framework leads to more effective, informative risk reports, which can be used by management to steer the risk profile

Disguised client example

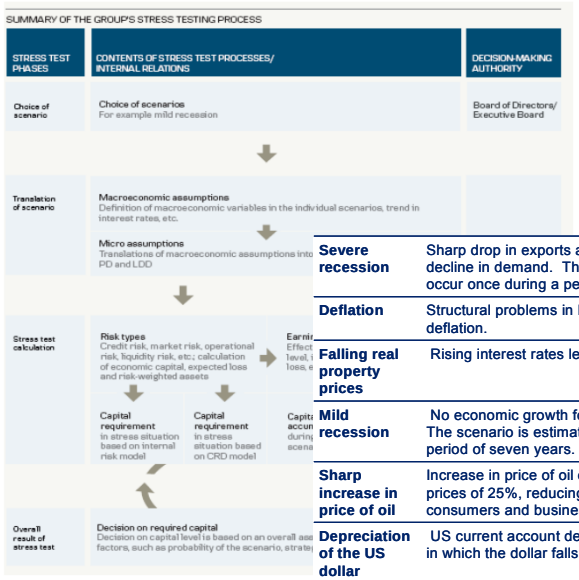
Typical defects of stress test reporting

- Information is not appropriate for target audience
  - Not easy to read and interpret
  - Focused on review and analysis, lack of action-oriented comments “so what”
  - Reports are too long and contain too much irrelevant information
- Unclear positioning within the overall reporting architecture
  - Numbers/analysis partly inconsistent with other reports
  - No reconciliation with other important metrics
  - Not comprehensive and self-contained to allow conclusions on business issues
- Insufficient standardisation
  - Every area uses their own templates, focus areas, terminology etc. (compare, e.g. credit risk vs. natural-catastrophe risk)
  - Reporting format is not stable

- Action-oriented, relevant analytics with informative comments
- Focus is on future trends and developments – past reviewed only to infer views about the future
- Clear positioning within financial and risk reporting
- Consistent structure, starting from aggregate risk profile, with drill down into individual risk drivers

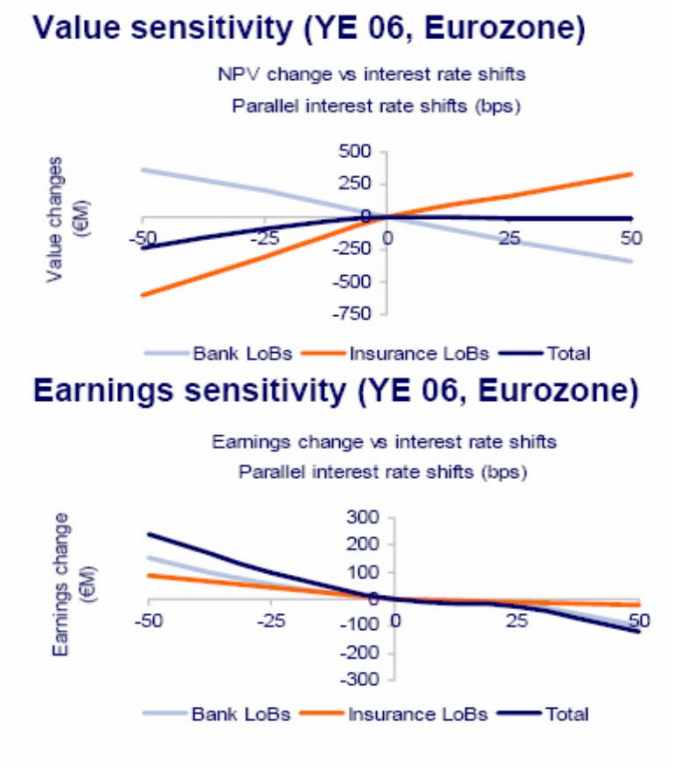
Example: Emerging industry trend to disclose selected stress test results as part of investor communication – pre-empting analysts' outside-in views

Danske Bank[1] – Detailed description of the framework and scenarios considered



Severe recession	Sharp drop in exports and rising taxes lead to a decline in demand. The scenario is estimated to occur once during a period of 25 years.
Deflation	Structural problems in Europe lead to recession and deflation.
Falling real property prices	Rising interest rates lead to falling property prices.
Mild recession	No economic growth for two consecutive quarters. The scenario is estimated to occur once during a period of seven years.
Sharp increase in price of oil	Increase in price of oil of 50% and in commodity prices of 25%, reducing purchasing power (for both consumers and businesses).
Depreciation of the US dollar	US current account deficit triggers a global recession in which the dollar falls 25%.
Bird flu	Bird flu becomes an epidemic and causes a significant decline in GDP.
Liquidity crisis in banking sector	A liquidity crisis triggers credit losses and impairs capital procurement.
Liquidity crisis, Danske Bank Group	One of Danske Bank Group's largest customers files for bankruptcy and the Group's rating is downgraded.

ING[2] – Specific quantitative results for risks of concern



1. Danske Bank, 2007, P85
2. ING Investor Day, 9 September 2007, P30