

**SEACEN**



**Maybank**

## **Stress Testing**

**Dr. John Lee, Group Chief Risk Officer**

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# Agenda

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- Introduction
- Stress Testing Methodology
- BNM Reporting Requirements for Stress Testing
- Challenges in Stress Testing

# Introduction

## Risk Issues Surrounding the Global Financial Crisis ('GFC')

### **CORRELATION OF RISKS**

Lack of analysis and consideration on the impact of credit default and counterparty credit risk to market and liquidity risk

### **MARKET LIQUIDITY ASSUMPTION**

Market liquidity was assumed be available at all levels, in all time periods, for all maturities, at an appropriate price

### **NON COMPREHENSIVE STRESS TESTING**

Lack of spill over and second round effects and inadequate magnitude of shocks on risk parameters for stressed scenarios

### **OVER RELIANCE ON RATING AGENCIES**

Government and investors were over reliant on rating agencies' assessment of mortgage securities

### **COMPLEXITY OF PRODUCTS**

Investors did not fully understand the underlying assumptions and collaterals attached to mortgage securities led to inaccurate valuation of products

### **MODEL RISK**

Identification of wrong risk factors (e.g. ignoring basis risk) and incorrect distribution of risk parameters, i.e. volatility and correlations led to MTM losses and non-reflective VaR calculations.

### **RELIABILITY OF DATA INPUT**

Quality of external ratings and inaccurate valuation of mortgage securities reduced the credibility of data input for VaR calculations.

### **INEFFECTIVENESS OF CAPITAL MANAGEMENT**

Financial Institutions did not have a comprehensive capital management programme and did not adequately link their capital management to stress testing

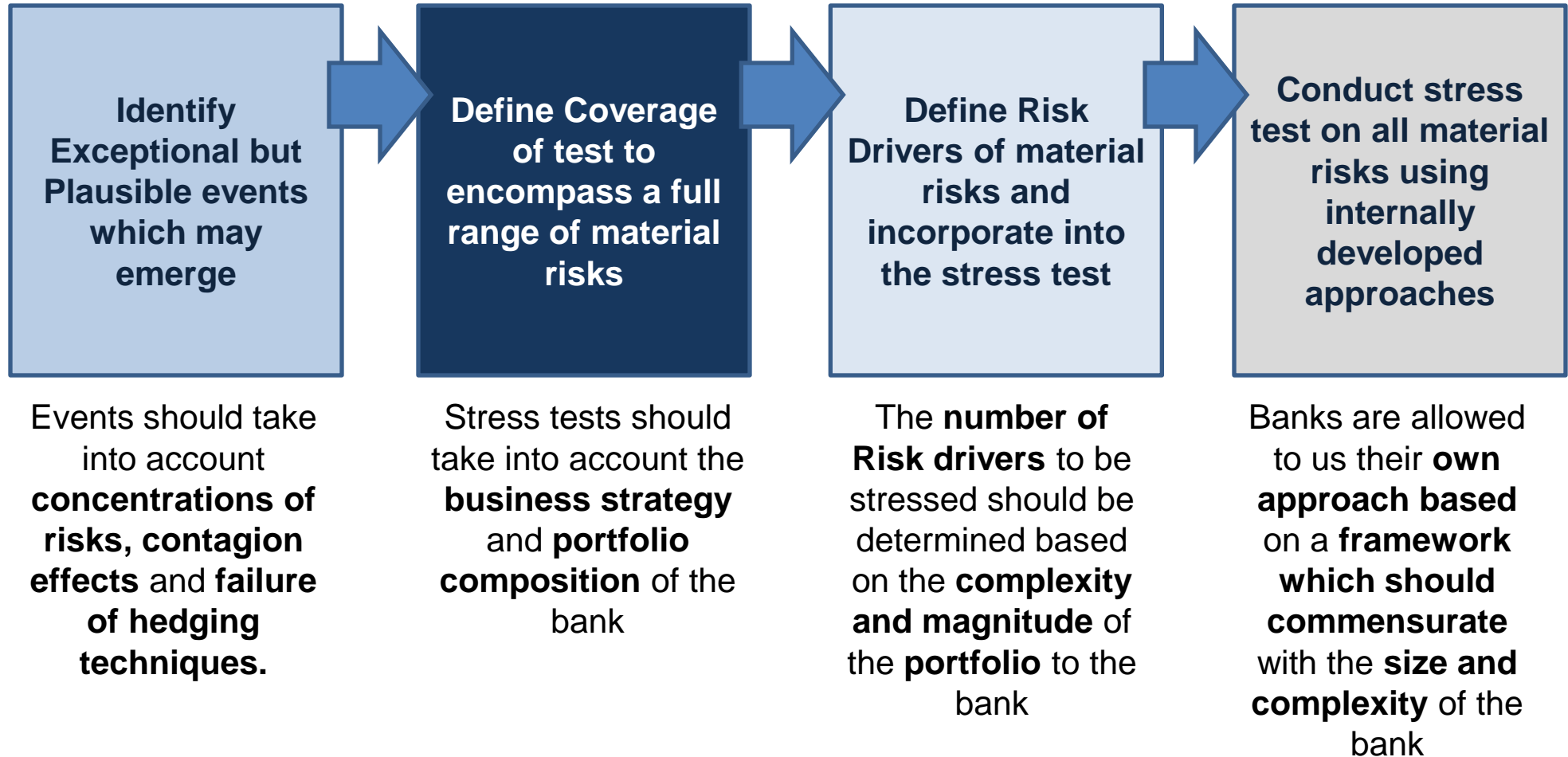
### **LACK OF OVERSIGHT BY CENTRAL BANKS**

Central banks lacked oversight over the dealings of the investment banks, basing information only on internally generated VaR calculations of the banks.

# Introduction

## Stress Testing

Stress testing involves identifying **possible events** or **future changes** in **financial** and **economic** conditions which could have **unfavorable effects** on a financial institution and its **ability to withstand** such changes.



# Introduction

## Stress Testing from a Basel II Perspective

A rigorous, forward looking stress testing is an integral part of a bank's risk management process, which enables the bank to **assess the impact** to its **capital adequacy** arising from **adverse events** or **changes in market conditions**.

### Forward-looking assessment of risk

Stress testing provides a forward looking approach to risk assessment and is an effective contingency planning tool.

### Assists in overcoming model and data limitations

Stress testing also assists banks to overcome model and historical data limitations, which may not fully capture the idiosyncrasies of adverse events

### Supports internal and external communication

Stress testing also facilitates the communication process when dealing with unexpected events

### Setting of internal targets for capital and risk taking capacities

Stress testing allows the bank to determine an appropriate internal capital target and its optimum risk taking capacity

### Integral to Capital and Liquidity Planning

Integration into the capital and liquidity contingency planning process is crucial to effective crisis management

### Allows the bank to prepare for the unexpected

Stress testing facilitates the development of response strategies, risk mitigations and contingency plans across a range of conditions

## Introduction

### Importance of Stress Testing Post-GFC

Stress testing has become a more **crucial part of daily portfolio management** fuelled by **regulatory requirements** and a **weakening economic environment** following the GFC. For instance:

- In US, Supervisory Capital Assessment Program (SCAP) was conducted by Federal Reserves in 2009 with main objective to ensure that major Bank Holding Companies (BHCs) **had sufficient capital to weather an adverse economic environment** while maintaining capacity to lend.
- In 2011 Fed's Comprehensive Capital Analysis and Review (CCAR), **stress test was conducted to assess the BHCs' capital planning processes.**
- Committee of European Banking Supervisors (CEBS) conducted EU-wide stress test in 2010 involving 20 EU supervisors, 27 member states, 91 Banks representing 65% of EU banking assets.
- In 2011, the 2<sup>nd</sup> EU-wide stress test was conducted by European Banking Authority (EBA), which was established to continue CEBS 2010 stress test.

## Introduction

### BNM's Requirements on Stress Testing

In March 2007, Bank Negara Malaysia (BNM) issued the "Guideline on Stress Testing", which provides guidance and principles on the critical areas, as well as specific requirements expected:

#### **Stress Testing as a Decision Making Tool**

BNM stresses the importance of stress testing as a tool which should serve in the decision making and strategic management process of banks

#### **Coverage and Risk Factors**

BNM also provides broad direction in terms of coverage and risk factors required in stress tests – group wide and all material risks.

#### **Frequency of Stress Tests**

Stress testing should also be conducted based on the current circumstance of the bank, and should reflect the changing risk profile of the institution

#### **Magnitude of Shock and Second Round Effects**

Magnitude of shock should be greater than conservative estimates over a business cycle and take into account second round effects (e.g. 1 stress factor impacting another factor)

#### **Governance and Oversight of the Process**

The Board and Senior Management are responsible to ensure stress tests are implemented, communicated, and actioned. Regular and independent assessment of results should also be conducted.

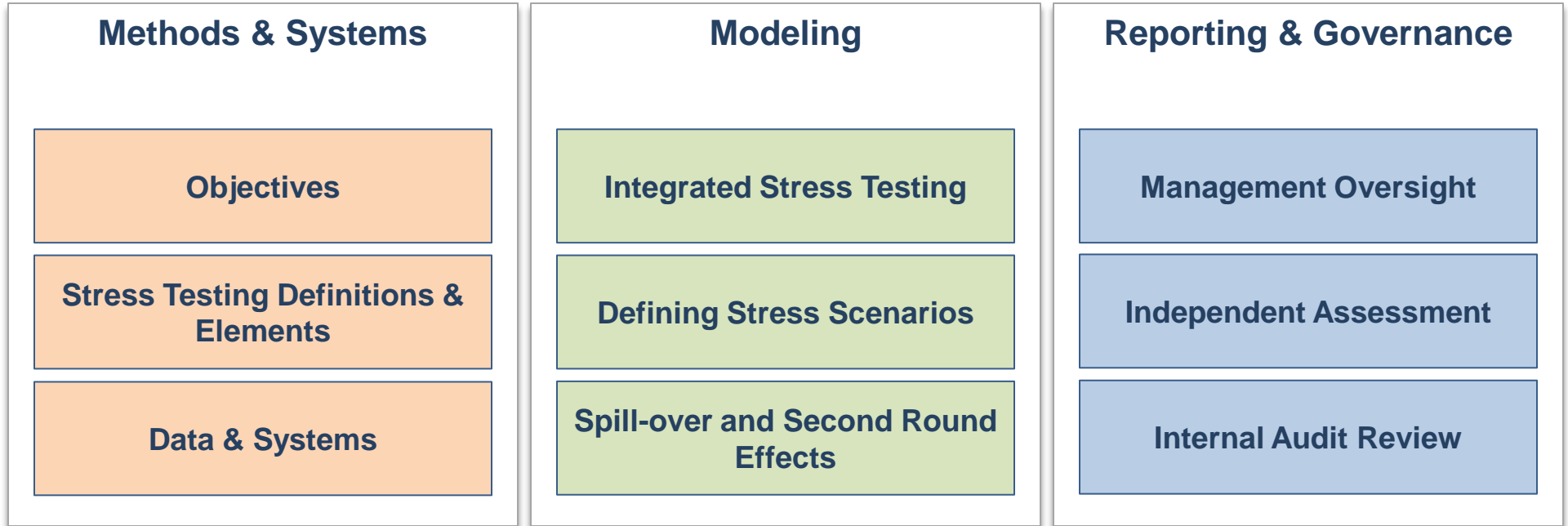
#### **Reporting to the Regulators**

Results from the stress tests should also be reported to BNM on a regular basis, and specific scenarios defined by BNM should also be tested.

# Stress Testing Methodology

## Stress Testing Framework

Stress testing is used as a risk management tool for the evaluation of the potential impact on the bank's Capital, Liquidity, Profit and Asset Quality under extreme adverse but plausible events.





# Stress Testing Methodology

## Methods & Systems – Objectives

Methods & Systems	Modeling	Reporting & Governance
Objectives	Integrated Stress Testing	Management Oversight
Stress Testing Definitions & Elements	Defining Stress Scenarios	Independent Assessment
Data & Systems	Spill-over and Second Round Effects	Internal Audit Review

Defining the objectives is the starting point of any stress test exercise:

Evaluate the Bank's ability to meet its capital requirements at all times throughout a reasonably severe economic recession and not just adequacy of capital today

Capital

Evaluate the Bank's ability to meet its financial obligation at any time

Liquidity

Evaluate the impact of stress testing against baseline profit as profits normally act as the first line of defense before dipping into capital

Profit

Evaluate the quality of assets in terms of financing, treasury/investment portfolios and other assets to identify existing and potential loss exposure to the Bank

Asset Quality

# Stress Testing Methodology

## Methods & Systems – Stress Testing Definitions & Elements

Methods & Systems	Modeling	Reporting & Governance
Objectives	Integrated Stress Testing	Management Oversight
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Stress testing is comprised of two distinct categories, **Scenario Based** or **Sensitivity Based** stress testing. The following describes the definition of the two approaches.

Category	Description	Approach
<h3>Scenario Based</h3>	<ul style="list-style-type: none"> <li>Scenario based approach moves multiple risk factors based on a constructed or defined scenario (e.g. equity, interest rates, ratings downgrade, GDP)</li> <li>Scenarios can be historical or hypothetical in nature.</li> <li>Scenarios can be portfolio driven (portfolio vulnerabilities defined first) or event driven (events drive risk factors to stress).</li> </ul>	<pre> graph TD     subgraph Portfolio_Driven [Portfolio Driven]         P[Portfolio] --&gt; RF1[Risk Factors]         RF1 --&gt; E1[Event]     end     subgraph Event_Driven [Event Driven]         E2[Event] --&gt; RF2[Risk Factors]     end     </pre>
<h3>Sensitivity Based</h3>	<ul style="list-style-type: none"> <li>Sensitivity Based stress testing moves a particular risk factor or a small number of closely related risk factors (e.g. parallel yield curve shock)</li> <li>Is relatively quicker and can be used to form a “First approximation” of impact on portfolio.</li> </ul>	<pre> graph TD     RF[Risk Factors] --&gt; P[Portfolio]     </pre>

# Stress Testing Methodology

## Methods & Systems – Stress Testing Definitions & Elements

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In the scenario based approach, scenarios and its risk drivers are defined to determine what the causal impact of the risk drivers are on the bank's portfolio, profit or risk profile:

### Scenarios

- GDP
- Unemployment
- FX Rate
- Inflation
- Interest Rate Movements
- Equity Price Fluctuation
- Property Price

### Risk Drivers

- Yield Curve Shocks
- Ratings Downgrade
- Impairment Rise
- Trading Book Value Impacted
- Banking Book Value Impacted



### Causal Impact

Income/Profit

- Net Interest Income
- Impairment Losses

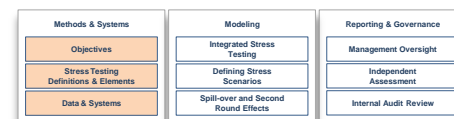
Risk Profile

- Credit RWA Increase
- Market RWA Increase
- Operational RWA Increase

Source: Maybank Analysis

# Stress Testing Methodology

## Methods & Systems – Stress Testing Definitions & Elements



The following are some examples of scenario setting, loss quantification approaches and action plans taken during a typical stress testing exercise:

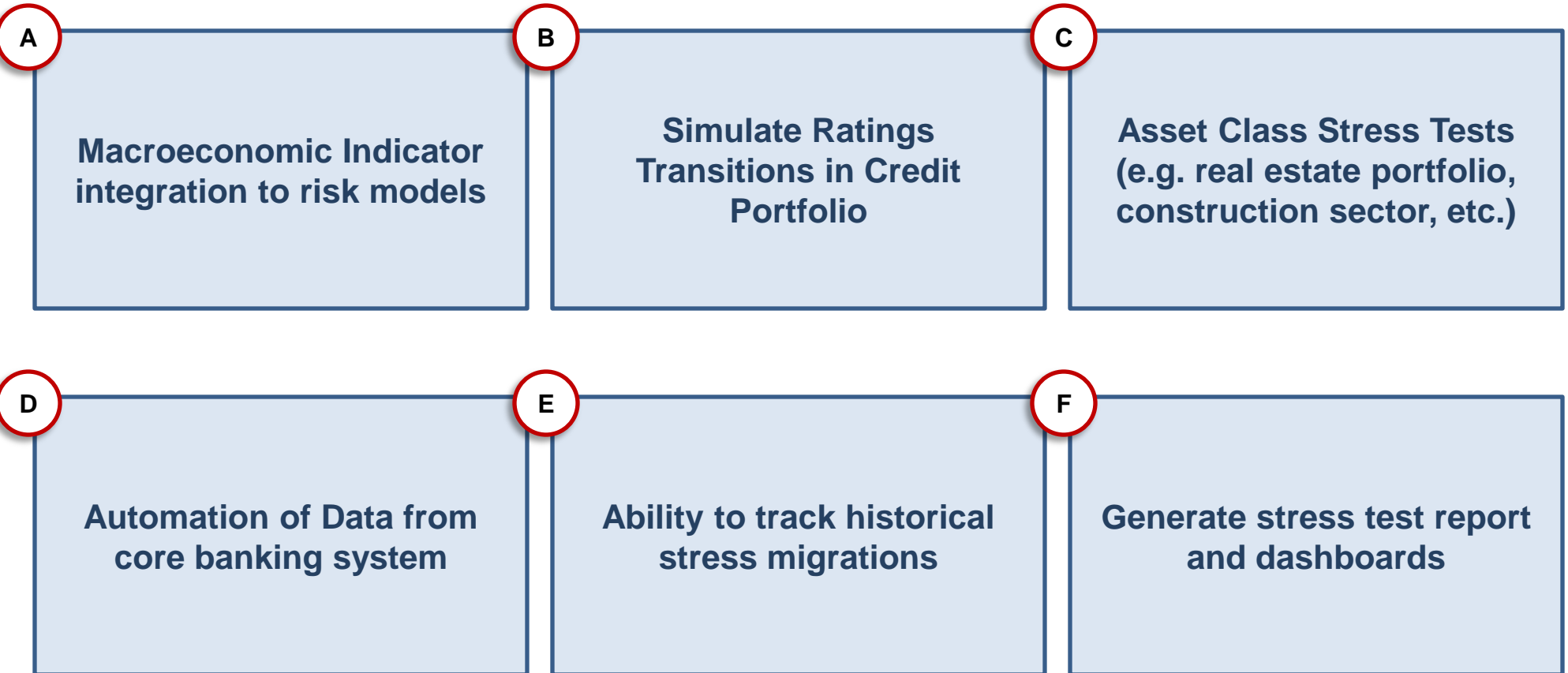
Scenario Setting	Loss Quantification	Results and Action Steps
<b>Historical scenarios</b> <ul style="list-style-type: none"> <li>▪ Asian Financial Crisis 97-98</li> <li>▪ Credit Crisis 2008</li> </ul>	<b>Pillar 1 stress tests</b> <ul style="list-style-type: none"> <li>▪ Stress the IRB parameters (PD, EAD, LGD)</li> <li>▪ Bottom-up and/or top-down approach</li> </ul>	<b>Review by experts</b> <ul style="list-style-type: none"> <li>▪ Discuss with Business</li> <li>▪ Discuss with Finance</li> <li>▪ Discuss with Capital Management</li> </ul>
<b>Hypothetical scenarios</b> <ul style="list-style-type: none"> <li>▪ Judgment-driven</li> <li>▪ Inputs from experts required</li> <li>▪ Could be a mix of historical and hypothetical scenarios (hybrids)</li> </ul>	<b>Pillar 2 stress tests</b> <ul style="list-style-type: none"> <li>▪ Stress testing all material risks</li> <li>▪ Aggregation of results (Pillar 1 and Pillar 2 risks)</li> </ul>	<b>Communication with stakeholders</b> (Board, Senior Management and Regulators) <ul style="list-style-type: none"> <li>▪ Nature of risk profiles</li> <li>▪ Potential downside losses (risk appetite)</li> <li>▪ Inputs for capital planning for 3-5 years</li> <li>▪ Limit setting</li> <li>▪ Contingency planning in event stress event occurs</li> </ul>
<b>Impact on key macroeconomic indicators</b> (GDP, interest rates, FX, inflation, unemployment) <ul style="list-style-type: none"> <li>▪ Use regression analyses to establish relationships</li> </ul>	<b>Implications on Profit and Loss, Asset Quality and Capital Adequacy</b> <ul style="list-style-type: none"> <li>▪ Impairment losses</li> <li>▪ Trading losses</li> <li>▪ RWAs, Expected Losses</li> </ul>	
Use historical analyses to establish <b>correlation</b> to losses		

# Stress Testing Methodology

## Methods & Systems – Data & Systems

Methods & Systems	Modeling	Reporting & Governance
Objectives	Integrated Stress Testing	Management Oversight
Stress Testing Definitions & Elements	Defining Stress Scenarios	Independent Assessment
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Stress testing can be a time consuming process, some organizations have automated this process through systems. Typical stress testing automation encompasses the following capabilities:

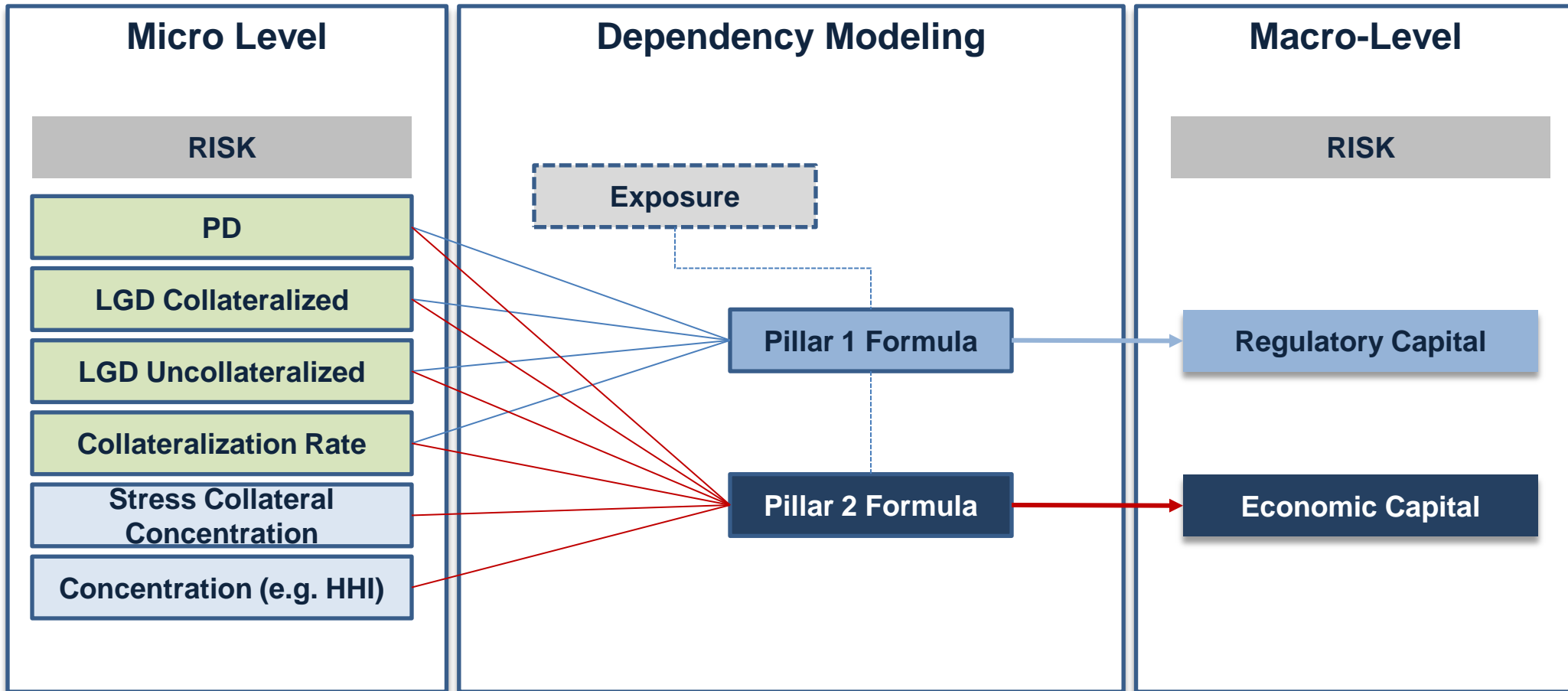


# Stress Testing Methodology

## Modeling – Integrated Stress Testing (Capital)

Methods & Systems	Modeling	Reporting & Governance
Objectives	Integrated Stress Testing	Management Oversight
Stress Testing Definitions & Elements	Defining Stress Scenarios	Independent Assessment
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Part of the Pillar 2 requirements for banks' **Internal Capital Adequacy Assessment Process 'ICAAP'**, banks are required to **integrate their stress testing process into their planning**. The following approach can be adopted for this purpose:



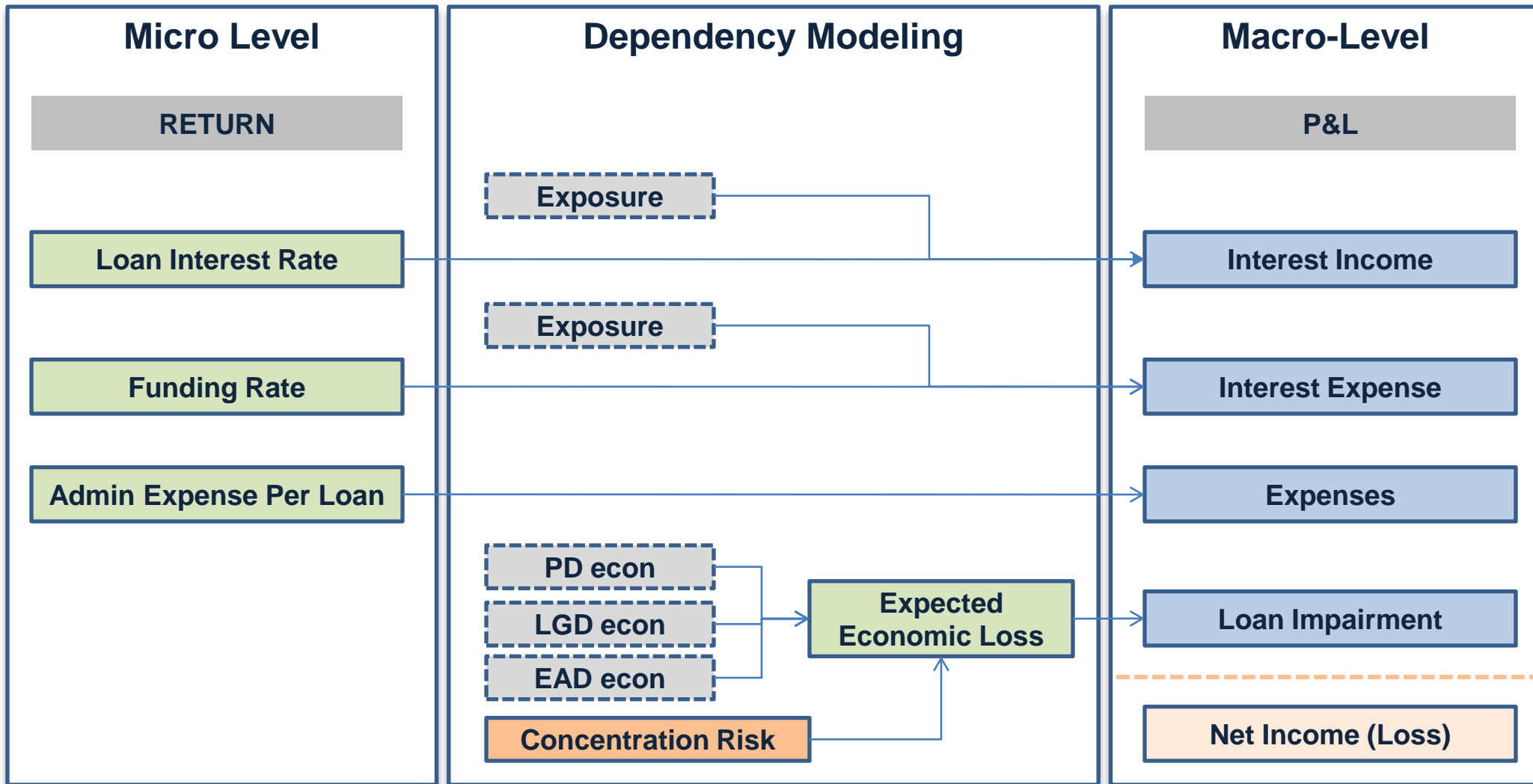
Source: Maybank Analysis

# Stress Testing Methodology

## Modeling – Integrated Stress Testing (P&L)

Methods & Systems	Modeling	Reporting & Governance
Objectives	Integrated Stress Testing	Management Oversight
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The same dependency modeling approach can be used to model stresses on the P&L of the bank as well, an example of this approach is described:

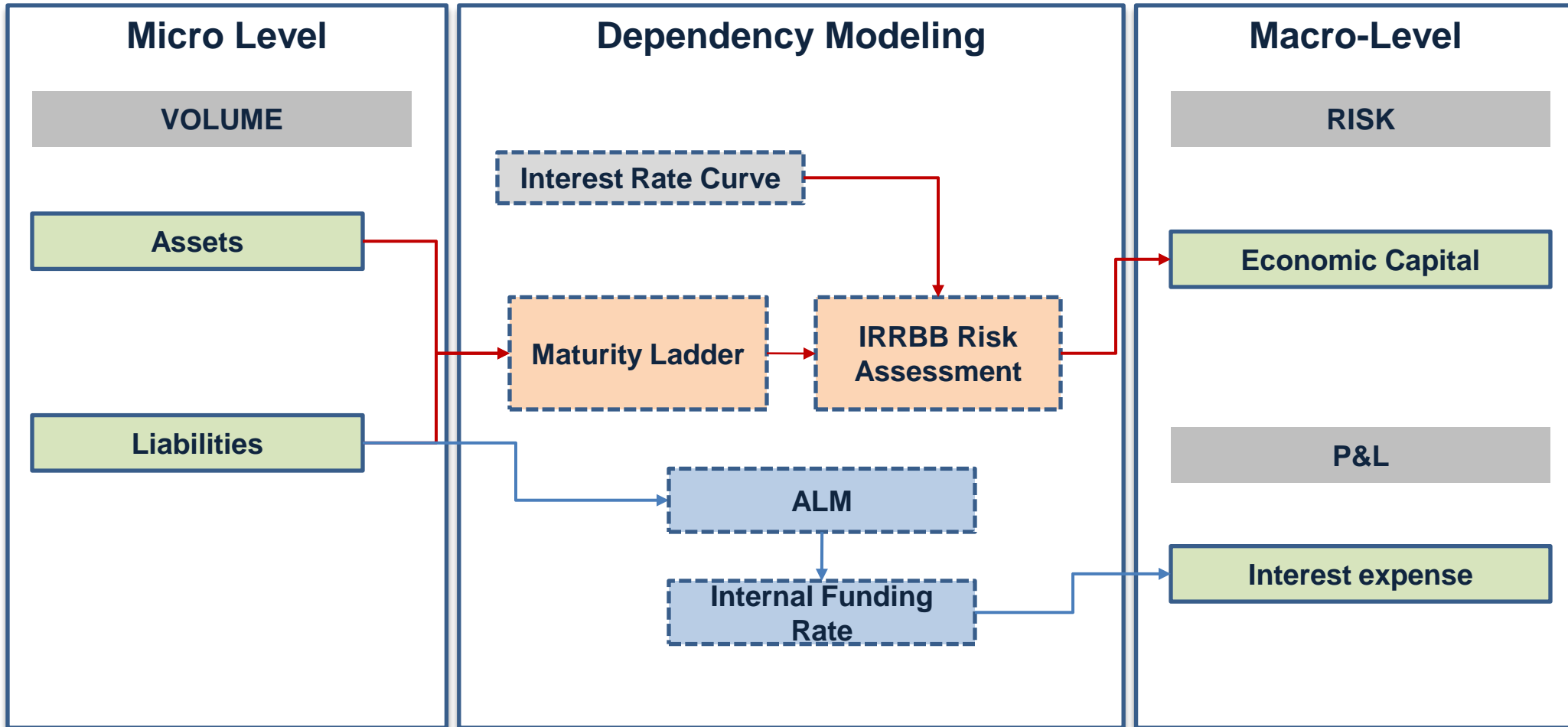


# Stress Testing Methodology

## Modeling – Integrated Stress Testing (ALM Risk)

Methods & Systems	Modeling	Reporting & Governance
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ALM risks are mainly related to interest rate risks, and in a broader sense, also applies to liquidity risk. Interest Rate Risk in the Banking Book ('IRRBB') can be modeled using the following approach:



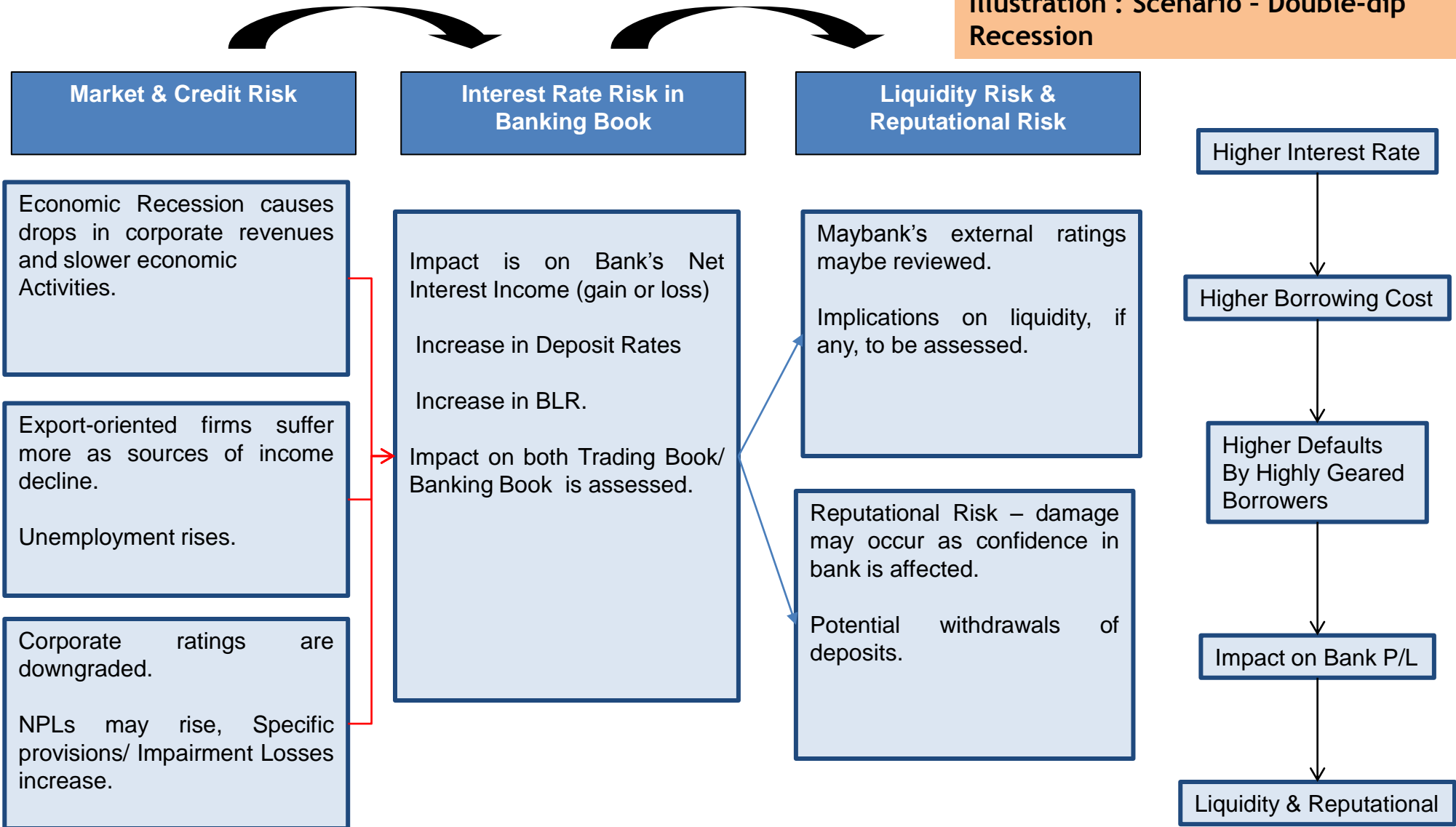


# Stress Testing Methodology

## Modeling – Defining the Stress Scenario

Methods & Systems	Modeling	Reporting & Governance
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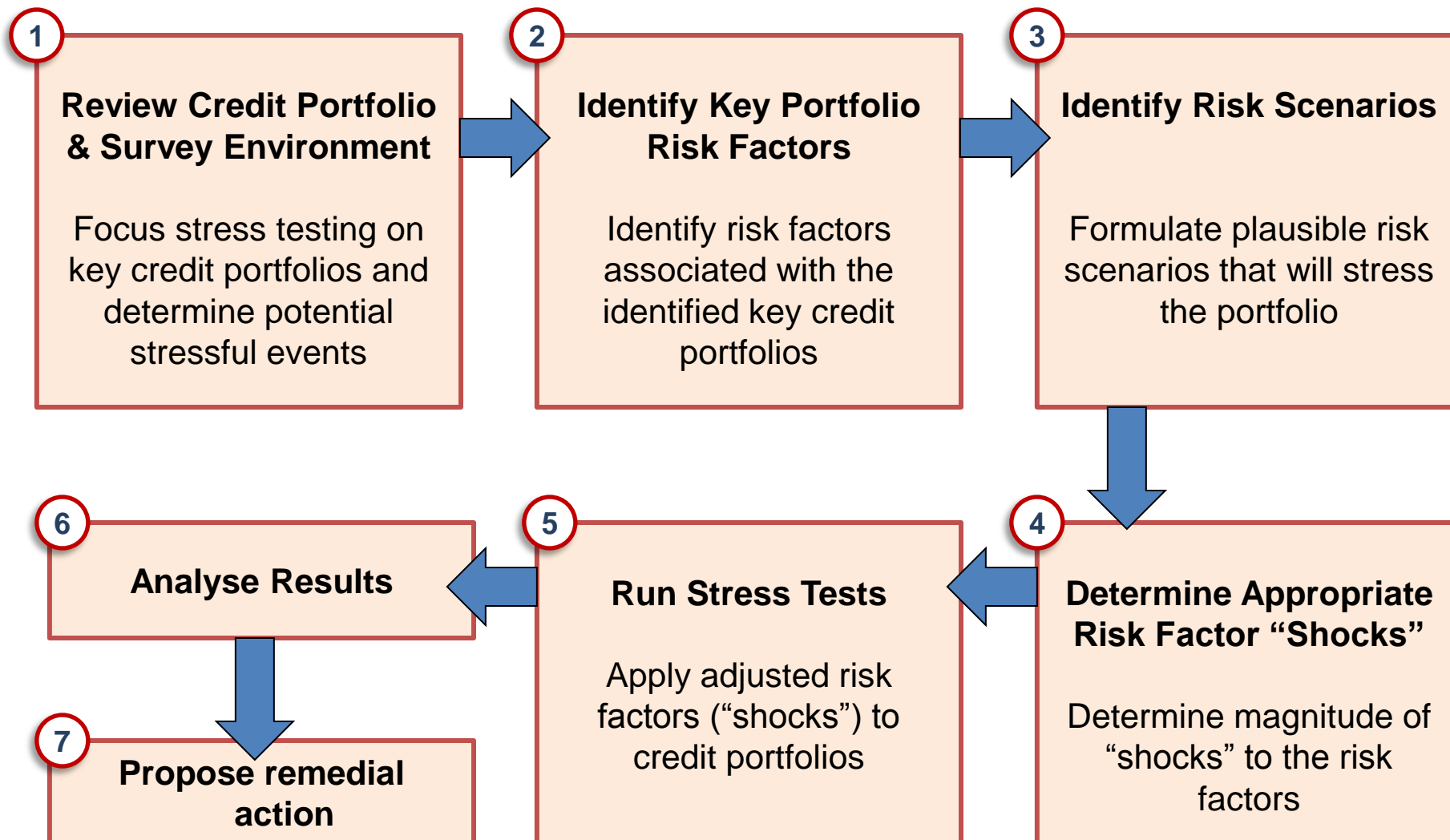
### Illustration : Scenario - Double-dip Recession



# Stress Testing Methodology

## Modeling – Credit Risk Stress Test Example

Methods & Systems	Modeling	Reporting & Governance
Objectives	Integrated Stress Testing	Management Oversight
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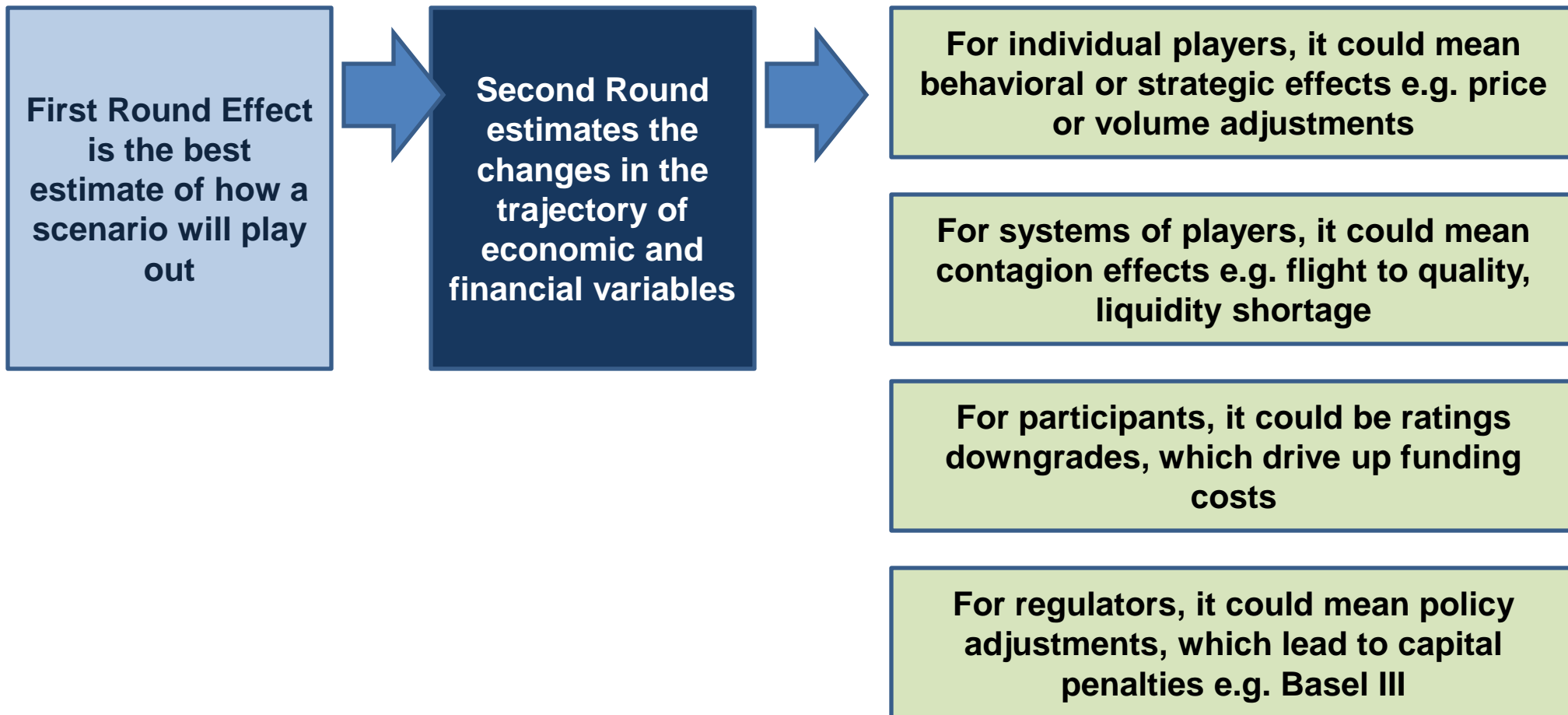


# Stress Testing Methodology

## Modeling – Spill Over & Second Round Effects

Methods & Systems	Modeling	Reporting & Governance
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Data & Systems	Spill-over and Second Round Effects	Internal Audit Review

Another key area which BNM requires is the inclusion of **spill-over and second round effects**. This is intended to address impacts of adverse condition of **one risk factor on multiple other risk factors** (e.g. oil price hikes will impact energy dependent industries).

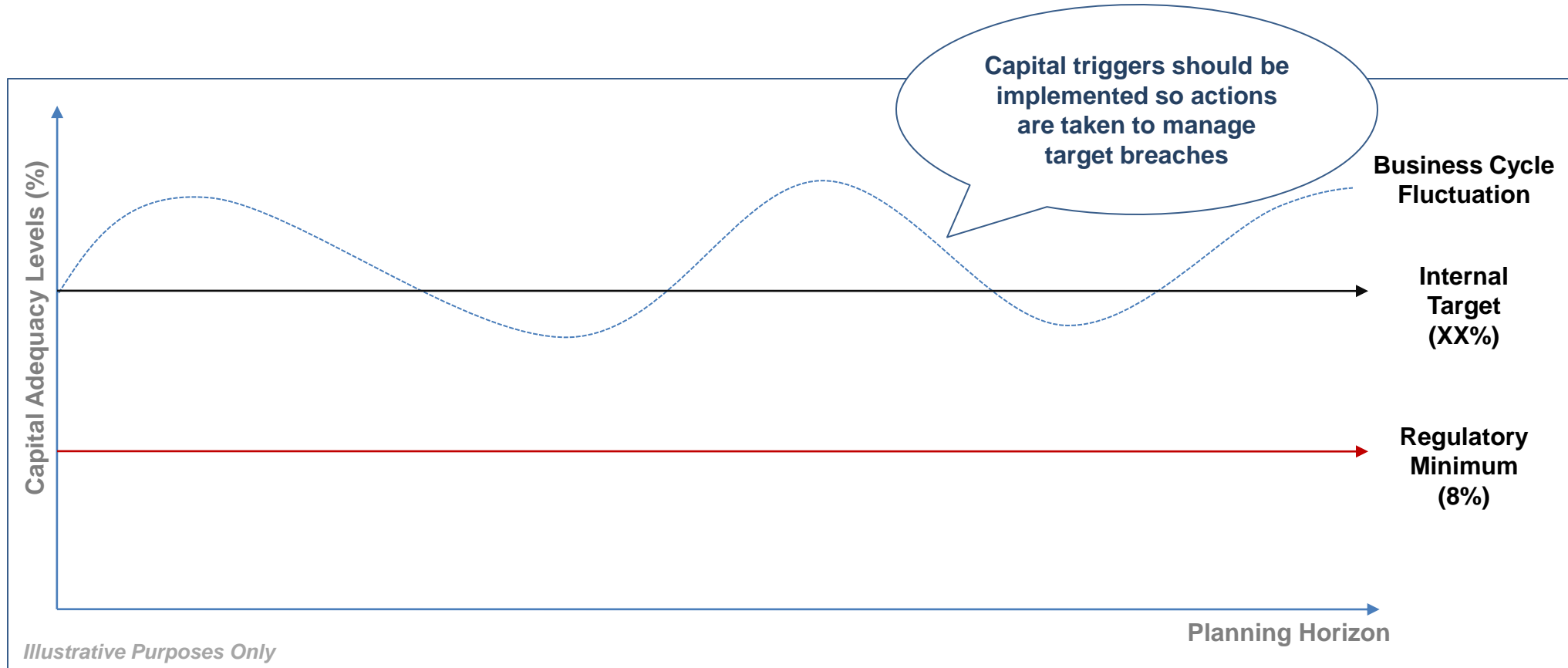


# Stress Testing Methodology

## Reporting & Governance – Management Oversight

Methods & Systems	Modeling	Reporting & Governance
Objectives	Integrated Stress Testing	Management Oversight
Stress Testing Definitions & Elements	Defining Stress Scenarios	Independent Assessment
Data & Systems	Spill-over and Second Round Effects	Internal Audit Review

Results of **stress testing** should be **integrated** into the bank's ICAAP **and monitored** to ensure that the bank maintains **capital buffers in excess** of the required regulatory minimum and be able to withstand **economic cycle troughs**:



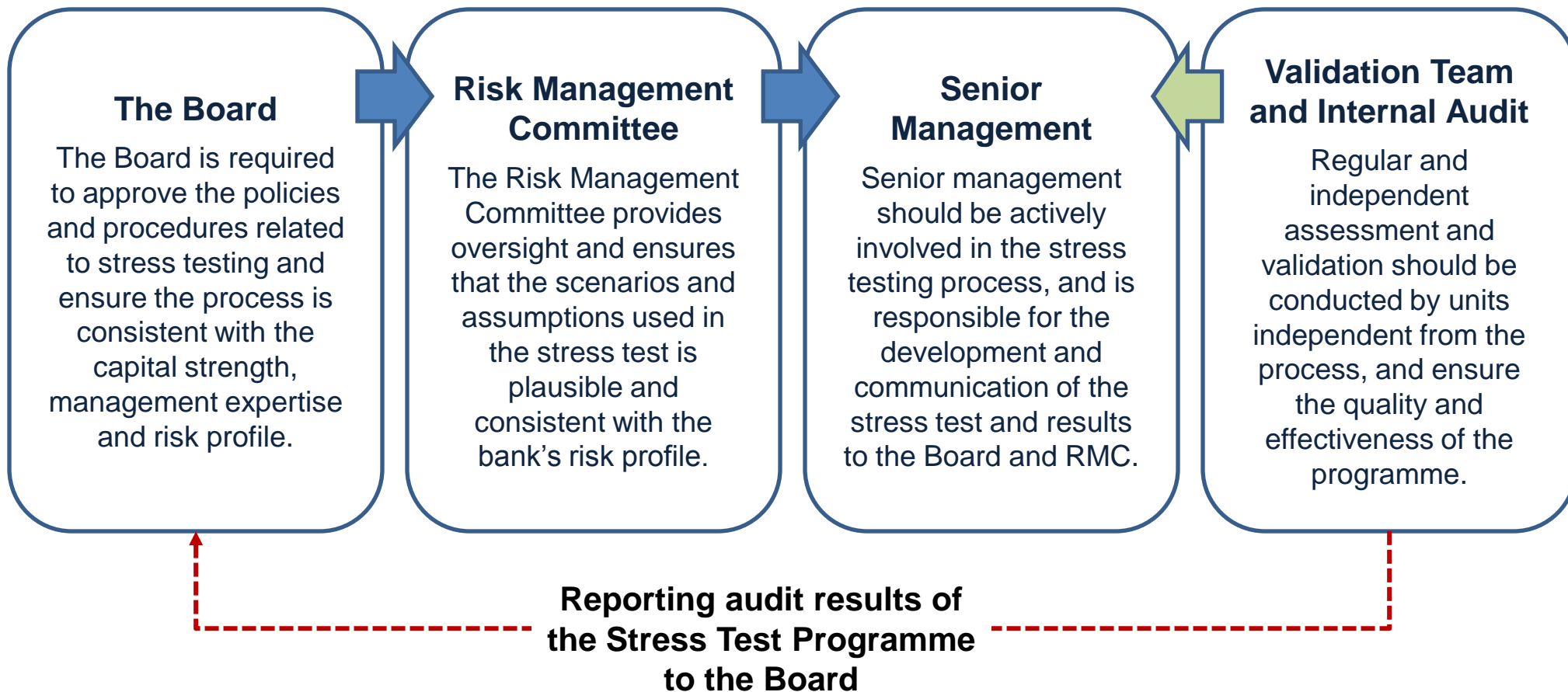
Source: Maybank Analysis

# Stress Testing Methodology

## Reporting & Governance – Independent Assessment and Audit Review

Methods & Systems	Modeling	Reporting & Governance
Objectives	Integrated Stress Testing	Management Oversight
Stress Testing Definitions & Elements	Defining Stress Scenarios	Independent Assessment
Data & Systems	Spill-over and Second Round Effects	Internal Audit Review

BNM requires that the Stress Testing Programme have in place **effective** and **independent Board and Senior Management oversight** and involvement in the stress test programme.



# Challenges in Stress Testing

## Potential Issues & Challenges

(1/3)

The following are some potential issues & challenges which may arise during the stress testing process:

### Area of Concern

### Challenges

### Potential Solutions

#### Meaningful Scenario Formulation

- Generation of new scenario – largely recession-related
- Formulation of scenario which is relevant to the bank's core activities
- Enterprise-wide stress testing, relevancy of the scenario to geographically different portfolios -- with different systemic risk

- Building Scenario Library - tracking of global events
- To conduct standalone stress testing based on the local scenario to reflect the systemic risk

#### Risk Parameterization

- Lacking of model/quantitative method to translate scenario into risk parameters (e.g. PD, LGD)
- Mostly based on expert judgment and sometimes broad assumptions.

- Investment in modeling methodology – cost vs. benefit study
- Working closely with the Economist on the macroeconomic projection to improve estimation

# Challenges in Stress Testing

## Potential Issues & Challenges

(2/3)

The following are some potential issues & challenges which may arise during the stress testing process:

### Area of Concern

### Challenges

### Potential Solutions

#### Defining and Quantifying Assumptions

- Challenging to determine degree of severity used for stress testing.
- Mostly external data used for this purpose.

- Severity level – mild, moderate, severe based on internal loss experience/expert judgment
- ‘Back-test’ stress results with actual performance during periods of stress

#### Integrated Stress Testing

- Aggregation of risks and incorporating correlation and diversification effects challenging.
- Coordination across entities and line of businesses.
- Integrating stress testing to business and strategic planning process.

- Use correlation matrices, factor models, or multi-step Monte Carlo simulations using copulas
- Organize working group committee, with representatives from different entity/risk and/or business unit

# Challenges in Stress Testing

## Potential Issues & Challenges

(3/3)

The following are some potential issues & challenges which may arise during the stress testing process:

### Area of Concern

### Challenges

### Potential Solutions

#### Data and Technology challenges

- Integrating accurate risk data in a timely manner across organization
- Lacking of internal historical data to establish the relationship of portfolio and economic condition for modeling of econometrics.
- Absence of robust infrastructure which is flexible to accommodate different stress test
- The need to churn out stress test result fast within a short period for decision making – time consuming.

- Automation cost benefit study.
- Ensure data management is well developed, and data integrity is prioritized.
- Implement 'single-source of truth' principle in data management.
- To ride on external historical data as proxy to build the econometric model.



# Questions & Answers