Monetary Authority of Singapore

Microprudential Stress Testing

Justin Teo
Assistant Director | Specialist Risk Department
Monetary Authority of Singapore
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Macro- vs Micro-prudential Stress Testing

Microprudential stress test

- Institution-specific (as opposed to system level) risks
- Banks design the stress test with regulatory oversight.
- Several types of stress tests for different purposes
  - Single factor analysis vs scenario-based approach
  - Single risk types coverage vs firm-wide analysis
- Bottom-up approach:
  - Different banks stress different risk factors, depending on vulnerabilities. Similarly, different scenarios for the scenario-based approach.
  - Different level of sophistication: larger and complex banks expected to be more sophisticated.

Microprudential complements macroprudential stress testing

- Microprudential stress test captures institution-specific risks that may be missed or lightly covered in macroprudential stress test

Three Pillars of Basel II

Pillar 1	Pillar 2	Pillar 3
Minimum Capital Requirements	*Supervisory Review Process*	*Market Discipline*
▪ Calculation of capital requirements • Credit risk • Operational risk • Market risk	▪ Principles-based approach ▪ Covers all risks	▪ Disclosure requirements • Capital structure • Risk exposures • Risk assessment processes

Objectives of ICAAP / SREP

Ensure banks have adequate capital to support all risks.

- Risks covered under Pillar 1 – Banks should not rely on Pillar 1 numbers without determining whether the numbers are appropriate.
- Risks not covered under Pillar 1 – e.g. interest rate risk in the banking book (IRRBB), credit concentration risk, business and strategic risk, reputational risk, liquidity risk, residual risk.
- Factors external to the bank – e.g. economic cycle effects.

Ensure banks have adequate capital to withstand stress.

- Stress over a range of scenarios, under capital planning.

Encourage banks to develop and use better risk management techniques.

- Use of economic capital (EC) approaches has been spurred on, in part, by Pillar 2. EC is one way of assessing/ measuring capital needs.

Types of stress tests

- Definition of stress testing (as defined by the Bank for International Settlements)
  - A risk management technique used to evaluate the potential effects on a bank's financial condition of a specific event or movement in a set of financial variables

By type:	Details
Sensitivity analysis	• Single-factor analysis • Advantages: less complex; useful building block; easily understood • Disadvantages: may not reflect reality
Scenarios analysis	• Multi-factor analysis • Historical or hypothetical scenarios (see next slide for advantages and disadvantages of each)
By coverage:	
Risk-type bespoke	• Cover only specific risk types • Well-established within banks
Group-wide	• Covers multiple risk types • Generally less evolved

Range of Scenarios

Scenario analysis	Details
Historical scenarios	• Use observed values of risk factors prevalent during actual past stress events to revalue current portfolios • Advantages: – easily accepted by management (i.e. plausible) – provide useful information about behaviour of risk drivers during times of stress • Disadvantage: – recent changes in environment not captured – relevance questionable
Hypothetical scenarios	• Used to simulate "what-if" analysis on events that have not occurred but could be a significant threat • Advantage: – platform for management to identify potential threats – relevant • Disadvantage: – may lack realism and thus susceptible to challenge – a lot of judgement required

ICAAP Process – Three Key Steps

ICAAP goes beyond capital accounting to capital management.

Organisational Structure and Governance

- Ownership, Clear lines of responsibilities, Sufficient expert resources dedicated, Internal controls

Risk Identification & Measurement

- Identify key current and emerging risks
- Quantify risks
  - Level of sophistication is tailored to size and complexity of risks
- Aggregation of capitalised risks
- Understand differences between internal capital and regulatory capital

Projection & Tolerance Setting

- Projection and stress testing: comprehensive suite of stresses and scenarios
- Specification of risk appetite (i.e. the amount of risk a bank is able and willing to accept) with respect to biz plan
- Main stakeholder expectations
  - Capital and earnings implications

Management & Communication

- Develop capital plan with respect to risk, taking into account the bank's strategic focus and biz plan
- Regular monitoring and reporting
- Management actions
- Communication

Supporting Infrastructure (Data & IT)

Adapted from Oliver Wyman

ICAAP Process – Projection (incl. Stress Testing)

Risk Identification

- Identify potential risk sensitivities and vulnerabilities based on the bank's risk exposures:
  - By risk types
  - By activities
- Understand interactions between risk types and dependencies between activities.

Scenario Development

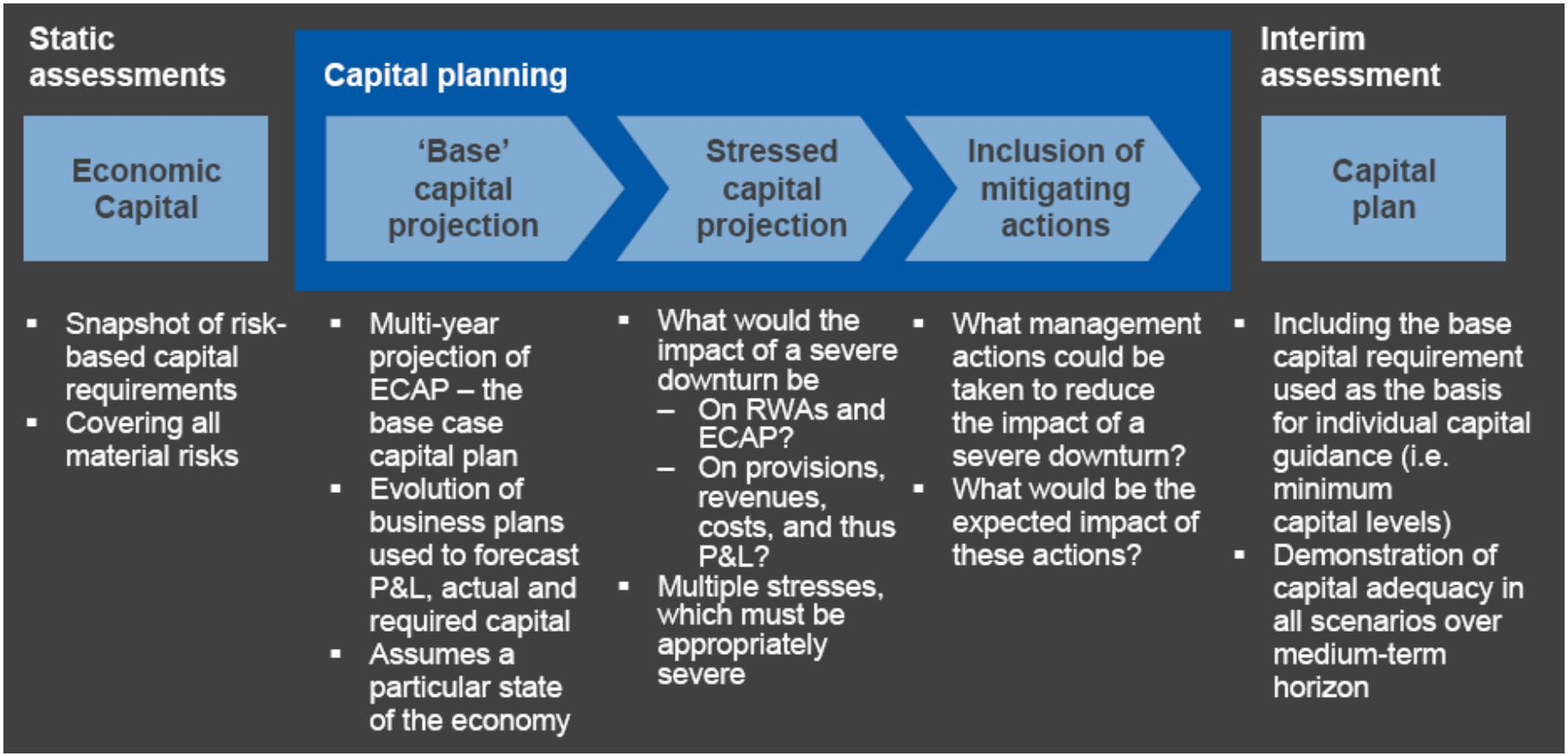
- Develop, select and prioritise relevant risk scenarios for testing and reporting based on identified risk sensitivities, vulnerabilities and cross-risk/ activity linkages
- Reverse stress test scenarios (that will lead to business failures) to help uncover hidden vulnerabilities

Risk Quantification

- Review the likelihood and severity of the scenarios
- Classify and align the risks with risk appetite (i.e. the risk the bank is able and willing to take) and business strategy
- Benchmark potential losses against capital adequacy

Adapted from Oliver Wyman

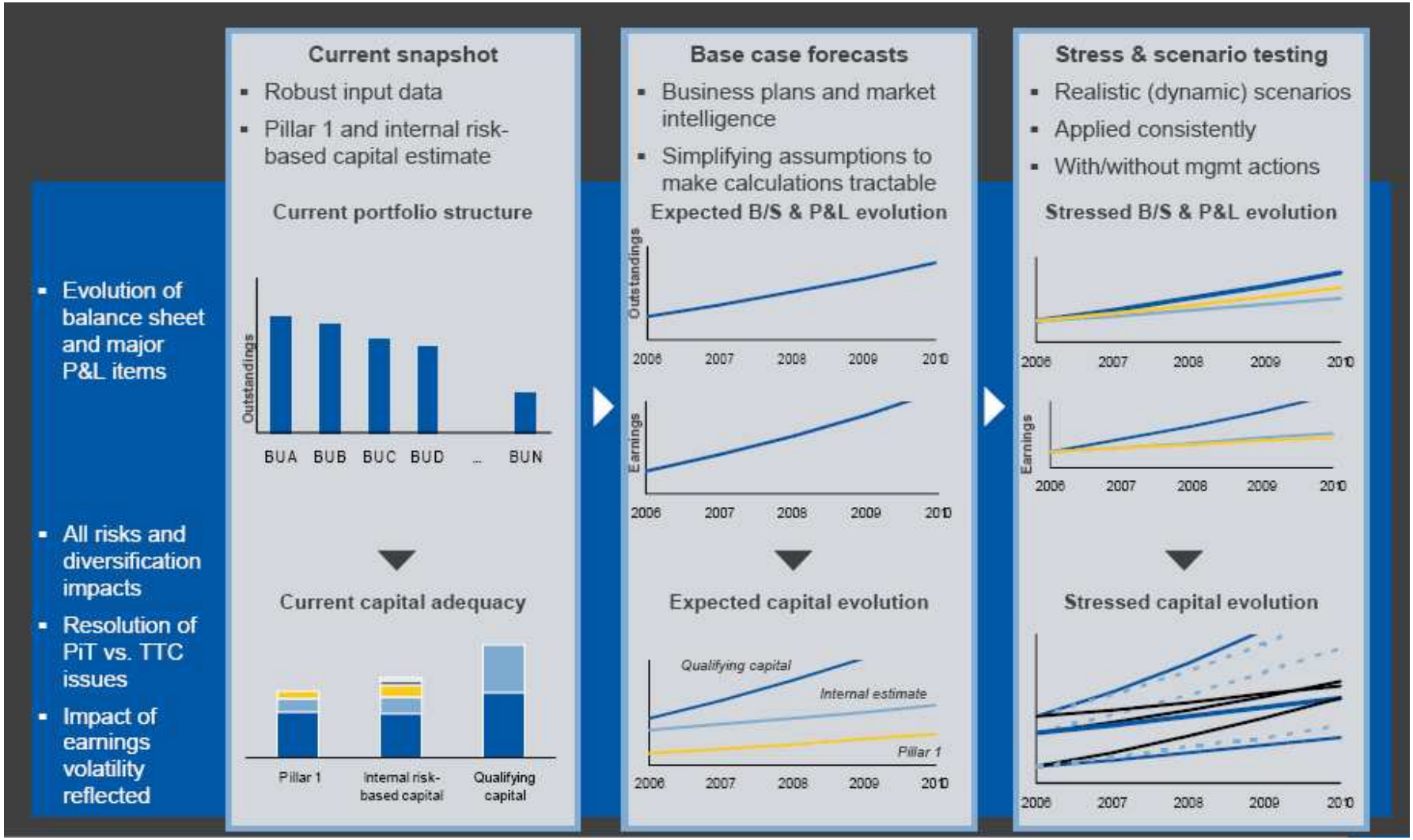
ICAAP Process – Projection (incl. Stress Testing)



Adapted from Oliver Wyman

ICAAP Process – Projection (incl. Stress Testing)

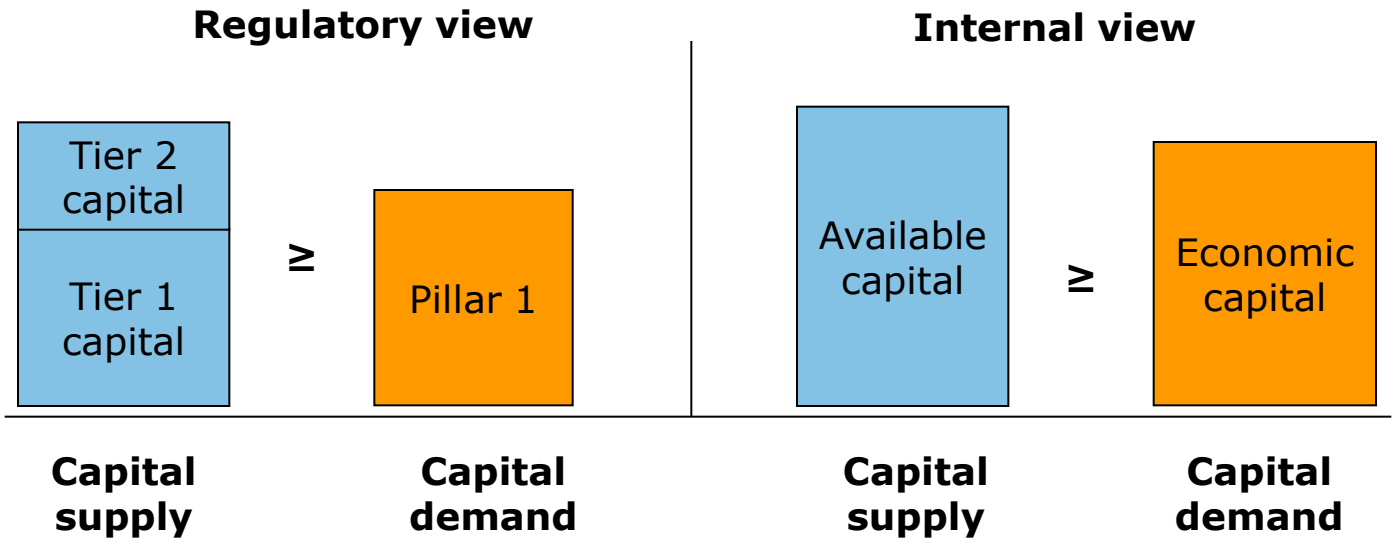
Quantitative capital forecasting capabilities



From Oliver Wyman

Capital Planning and Pillar 2 Stress Testing

- Consideration of various perspectives; toggling necessary
  - Internal (creditors and shareholders)
  - Regulatory
  - Others (e.g. rating agencies, market)
- Definition of capital supply and capital demand may differ across perspectives



Capital Planning and Pillar 2 Stress Testing

- **Emphasis on firm-wide scenario-analysis on capital adequacy**
- **Key expectations of a Reporting Bank under the capital planning element:**
  - Forecast its future performance based on its business plan
  - Subject the capital plan to stress tests
  - Assess the financial impact on its capital plan and the level of required capital before and after management actions
  - Assess the credibility of management actions
  - Identify how future capital needs (as required under the above stress tests) will be funded

- Capital planning element is to make the ICAAP a **forward-looking process**, capable of enabling a bank to make timely responses to changes in risk profile and external environment. **Stress testing** is a crucial component.

Capital Planning and Pillar 2 Stress Testing

Part I: Assessment of process

- Capital planning framework
  - Capital planning structure
  - Capital planning process
- Stress testing framework
  - Proportionality
  - Role of senior management
  - Calibration
  - Communication
  - Interpretation
  - IT systems and resources
  - Documentation and review

Part II: Assessment of capital plan

- Capital plan and Pillar 2 capital stress test
  - Robustness of capital plan
  - Quality and composition of capital
  - Pillar 2 capital stress tests (elements as above)

Overall supervisory assessment of the bank

Assessment of Stress Testing Framework

Capital planning framework

Capital planning structure

Capital planning process

Other Elements

Stress Testing framework

Overview

- Evolving industry practices, no single "correct" methodology

Proportionality

- Assess if the complexity of the framework is commensurate with the size and sophistication of the bank

Role of senior management

- Assess if senior management plays an active governance role

Calibration

- Types of stress tests employed
  - Assess if the types of stress tests employed are appropriate
- Range of scenarios
  - Assess if the scenario is appropriate for the bank's circumstances
- Severity
  - Assess if the scenario is sufficiently severe

Assessment of Stress Testing Framework

Capital planning framework

- Capital planning structure
- Capital planning process
- Other Elements

Stress Testing framework

Reporting and communication

- Assess if the stress test results are reported and communicated to senior management in a comprehensible and meaningful manner
- Assess management actions

Interpretation of stress test results

- Assess if the stress test results are used in business planning, risk management and capital planning

IT systems, human resource and data quality

- IT systems
- Human resource
- Data quality

Documentation and review

- Assess that there is proper documentation and review of the framework

Assessment of the Capital Plan

- Capital plan and Pillar 2 capital stress test
  - Base case scenario
  - Pillar 2 capital stress tests
  - Robustness of capital plan

Base case capital plan

- Assess the robustness of the base case capital plan

Pillar 2 Capital Stress Test scenario

Calibration and approach

- Assess if the scenario chosen is appropriate and sufficiently severe (i.e. one reflecting a severe economic downturn)
- Assess the robustness of the methodologies used to link the scenario to risk drivers, in order to derive the impact on capital demand and supply

Scope and coverage

- Assess if the scope and coverage of the stress test is appropriate
  - Material risks
  - Business units
  - Portfolios and exposures
  - Both regulatory and internal view of capital

Assessment of the Capital Plan

Capital plan and Pillar 2 capital stress test

- Base case scenario
- Pillar 2 capital stress tests
- Robustness of capital plan

Time horizon

- Assess if the time horizon of the stress test appropriate

Management actions

- Assess if management actions have been considered and factored following the Pillar 2 Capital Stress Test results
- Assess if the proposed management actions are appropriate and credible

Robustness of capital plan

- Assess if the capital plan is sufficiently robust

Reverse Stress Test

- Review any reverse stress test by the bank.
- Review any measures to prevent or mitigate the vulnerabilities identified.

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Macroprudential Stress Testing

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Macro- vs Micro-prudential Stress Testing

Macroprudential stress test

- System-level (as opposed to single FI) risks
- Active involvement of regulator in the stress test design
- May be bottom-up or top-down in approach:
  - Bottom-up: application of common scenario(s) by FIs to their respective exposures; enables peer analysis which could be used to provide useful feedback to FIs to improve on their stress test methodologies;
  - Top-down: central bank/regulator's internal models; may include various forms of financial linkages/connectedness which cannot be carried out through a bottom-up stress test; may incorporate reaction by FIs; may include macrofinancial linkages; may include policy action

Macroprudential complements microprudential stress testing

- Macroprudential stress test captures system-wide risks that would not be captured even if every bank conducts microprudential stress tests

Macroprudential Stress Testing - Participation

Participating FIs

•Microprudential: All FIs.

•Macroprudential: If possible, all Fis. Otherwise, at least FIs of systemic importance (size, interconnectedness, substitutability, etc) supplemented by supervisory judgment e.g. small banks with high growth or niche players

•FIs' stress test capability is less of a consideration

- allow simpler methods initially, for the less capable
- useful just to get FIs to think about potential adverse developments, how they could be affected and therefore preventive measures to take

Macroprudential Stress Testing - Scenarios

Setting of scenario in macroprudential stress testing

- Include relevant macroeconomic and financial variables for the Singapore financial system
  - False sense of comfort if relevant variables are excluded
  - Breakdown into more granular segments is useful to identify specific areas of vulnerabilities and for supervisory follow-up
- Useful to get inputs from onsite supervisors, in particular on new types of activities and risks
- Use of appropriate time horizon, which depends on financial cycle or length of time for financial stress to materialise on the banks' books
- Use of more than one set of parameter values for market risk
  - Use a range of parameter values, else could miss certain risk such as those posed by barrier options. Biggest move in parameters may not result in the biggest losses.

Macroprudential Stress Testing - Scenarios

- Useful to know beforehand FIs' business models (exposures and funding) e.g. whether they are net borrowers or lenders.
- Take note of risks which tend to be ignored, as indicated in recent IMF paper (*"Macrofinancial Stress Testing – Principles & Practices"*, Aug 2012)
  - sovereign, funding, systemic liquidity, counterparty, downgrade, contagion, cross-border, low profitability and regulation risk.
- Size of shocks: specific past crises, historical worst, multiples of standard deviation, model-based
- Use of macroeconometric model supplemented by satellite models on other variables; expert judgment

Macroprudential Stress Testing - Assumptions

Scope and assumptions which could have impact on the results

- Coverage of exposures (off-balance sheet)
- Date of exposures/positions used: December exposures may not be reflective of typical exposures due to year-end winding down
- Management action and assumptions of FI's ability to do so (e.g. raising capital); resolution/non-resolution of non-performing loans (NPLs); treatment of write-offs
- Static or growing balance sheet; assumptions for P&L items
- Assumptions on business as usual practices e.g. accounting rules
- Group vs single entity
- Trading vs booking basis

Macroprudential Stress Testing - Methodology

- Heterogenous set of Fis. Therefore
  - different business models
  - different regulatory regimes at HQ
  - different levels of sophistication
- Methodology
  - scorecard, econometric models, KMV-type models, expert judgment, etc
- Regardless of approach/methodology, FIs are asked to report results using standardised templates provided by MAS

Macroprudential Stress Testing – Analysis

- Check for reasonableness of results.
- Meet FIs to challenge methodologies and assumptions.
- Carry out peer analysis based on the bottom-up stress test conducted by FIs. Identify areas of vulnerabilities and weaknesses in methodology.
- Cross-check FIs' bottom-up stress test results with MAS' own top-down stress tests and other analyses (likelihood of observing results reported by FIs, common borrowers analysis, etc)

Macroprudential Stress Testing – Follow Ups

- Supervisors meet with FIs to better understand vulnerabilities and to discuss what needs to be done.
- Supervisor notes down areas for improvement in the industry-wide stress test process for the following year.

Macroprudential Stress Testing – Contagion

- For countries which host a large number of interbank players, it is important to assess if interbank stresses could cause financial instability
- Study how funding and solvency stresses propagate through the domestic interbank network
  - How many other bank failures as a result of initial bank failure(s), assuming varying degree of non-repayment and "haircuts"
  - Foreign bank branches do not have capital requirement, so "failure" occurs when some measure of net assets (i.e. liabilities over assets) turns negative; some banks already see negative values for this measure even before any stress test, so need another "failure" condition
  - For efficiency, constructed a simulator to carry out exercise

Conclusion

Microprudential Stress Testing

- ICAAP is a forward-looking process, to enable a bank to make timely responses to changes in risk profile and external environment. Stress testing is crucial.
- Supervisors need to assess both the FI's stress testing framework and the stress test results. Challenge FI's assumptions and analysis.

Macroprudential Stress Testing

- Singapore started stress testing on a small scale.
- Gained much experience over time. Continue to enhance process.

Thank you