

Macroprudential and Microprudential Applications of Stress Testing in Malaysia

Stress testing is an integral component of the Bank's financial stability framework. Used in conjunction with other microprudential and macroprudential assessment tools, stress testing supports the Bank's financial stability assessments and facilitates pre-emptive policy actions through forward-looking examinations on the performance of banks' capital and liquidity positions under various adverse market conditions and the robustness of their contingency plans. Since the late 1990s, stress testing applications have evolved to provide a wider coverage of risks and include multi-faceted approaches, reflecting the increasing complexity and interdependency of systemic and institutional risk dimensions.

Stress tests have been more widely used for some time now by financial institutions to formulate business strategy and planning, for capital management, and to set an institution's risk appetite and limits. Experience with the use of stress tests during the Global Financial Crisis also demonstrates the importance of their informational value to markets during times of stress – both on the extent of institutional soundness of banks and on the potential for wider spillovers to the financial system. As observed during the crisis, such information can contribute towards significantly reducing market uncertainty, especially under stressed conditions, and potentially, the cost of resolution.

This article provides an overview of the Bank's stress testing framework, covering the main approaches used and the key features of the design and application of stress tests.

Multiple and Integrated Applications

The Bank's approach to stress testing combines top-down and bottom-up approaches both to detect and assess vulnerabilities in the financial system as a whole, and to identify specific risks to individual financial institutions. A top-down approach to stress testing is one which applies a defined set of macroeconomic scenarios and related stress factors to aggregate portfolios of exposures in order to identify vulnerabilities in the financial system which can arise from changes in economic and financial conditions. In contrast, a bottom-up stress testing process adopts a more granular approach that is tailored to an institution's specific portfolio mix and historical experience, and allows room to capture variations in institutional responses to changes in market conditions. Given the margin for error in modelling techniques and key assumptions used in the conduct of stress tests, and the inherent limitations of both top-down and bottom-up approaches, the combination of multiple stress testing approaches in Malaysia serves to support a more robust assessment of systemic stability and institutional soundness. These approaches are illustrated in Diagram 1 and elaborated below.

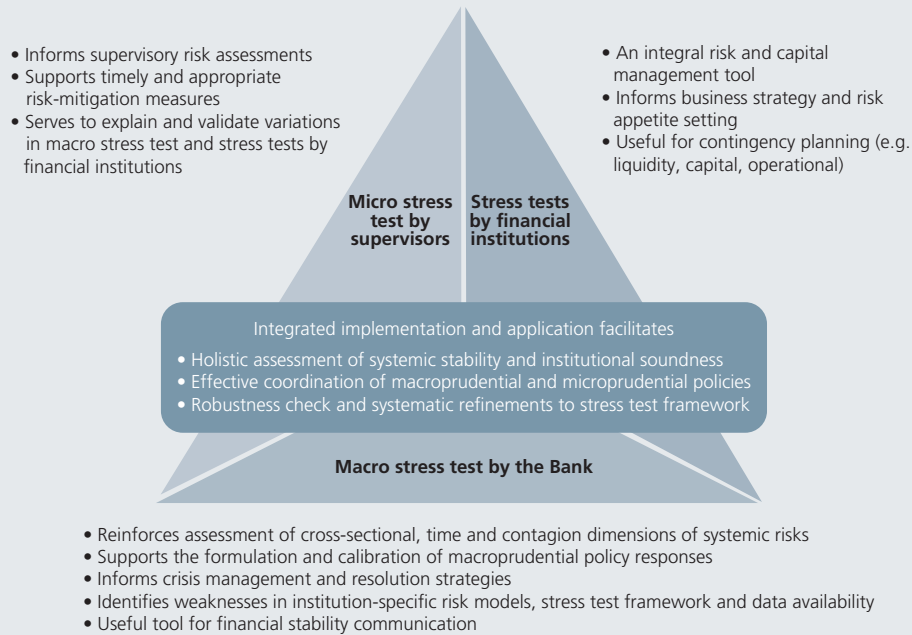
(i) Macro stress test by the Bank

The macro stress test represents a top-down approach that is used to (i) assess system-wide resilience and behaviour under exceptional but plausible risk events; (ii) identify systemic risks and vulnerabilities, including cross-sector or cross-institution contagion, and the potential spillovers to the broader economy; and (iii) determine potential system-wide capital and liquidity needs under stress conditions.

Macro stress tests were first used during the Asian Financial Crisis in 1997/98 to form the basis for decisions on the formulation of a holistic resolution strategy to address the crisis. By projecting the potential deterioration in asset quality and impairment in the revenue generating capacity of banks across the financial system, the stress tests facilitated the assessment of the potential scale, scope and financial resources required of the institutional arrangements that were put in place at that time. Information obtained through the stress tests on the potential losses and capital shortfalls was critical in shaping the recapitalisation and asset carve-out strategies which followed. Since then, macro stress tests have become a regular feature of the Bank's financial stability assessments and are used to evaluate pre-emptive actions by the Bank to address emerging risks well before conditions deteriorate to the point of an imminent

Diagram 1

Multiple Approaches and Applications of Stress Testing



system-wide crisis. When used in conjunction with sensitivity analyses and other early warning indicators, the macro stress tests provide valuable information for deciding on the nature, timing and calibration of macroprudential policy responses. The results of macro stress tests are deliberated at the Financial Stability Committee of the Bank.

(ii) Stress tests by financial institutions

Stress testing by financial institutions has been a prudential requirement since 1998, a bottom-up approach to complement the macro stress test. When first introduced, these stress tests were conducted by financial institutions using a set of scenarios and shock parameters prescribed by the Bank. This offered an opportunity for financial institutions to build internal stress testing capabilities while providing useful, if relatively generic, insights into potential vulnerabilities of individual institutions to risks. This prescriptive approach was substituted in 2007 with a more customised approach following significant improvements in the risk management capacity, infrastructure and practices of financial institutions over time. Today, financial institutions are required to conduct stress tests that reflect the unique risk profiles and major risk drivers of their business. Such tests must comply with the Guidelines on Stress Testing issued by the Bank which set out expectations on the design, implementation and governance of the stress testing process by financial institutions. In addition, to bolster the efficacy of stress tests as a risk and capital management tool, the tests must satisfy the 'use-test' criteria, where financial institutions must be able to demonstrate that the stress test results are actually used by management for the purpose of business planning, setting of risk appetite and limits, and for the management of capital and liquidity. The results of the stress tests are submitted bi-annually to the Bank and used by the Bank to validate and enrich the micro stress tests undertaken by supervisors. The stress tests by financial institutions also feed into and complement the conduct of forward-looking multi-year stress testing as part of the Internal Capital Adequacy Assessment Process (ICAAP) for the purpose of determining institutional regulatory and internal capital targets.

(iii) Micro stress tests by supervisors

Micro stress tests by supervisors, also a bottom-up approach, are conducted primarily to assess vulnerabilities and the risk-bearing capacity of individual financial institutions. Forward-looking information derived from these tests has become increasingly important to better inform the Bank's supervisory assessments and interventions which aim to identify and address risks in a timely manner. Results of the tests are deliberated during regular engagements between supervisors and financial institutions to obtain a view on the adequacy of an institution's contingency plans, risk mitigation strategies and financial buffers. Where relevant, the Bank may, based on these engagements, require institutions to increase capital and liquidity buffers, including through adjustments to dividend payments or by reining in expansion plans. In addition, micro stress tests serve to cross-check the results of macro stress tests and stress tests by financial institutions. Supervisory micro stress testing serves a particularly important role in (i) reducing the risk of overdependence on complex and computationally-intensive models; (ii) identifying institution-specific vulnerabilities and cross-institutional interlinkages that might be obscured in aggregated data and system-wide estimations; and (iii) encouraging financial institutions to observe an appropriate degree of prudence in conducting internal stress tests and to maintain an adequate focus on tail-risks.

The three stress testing approaches are closely coordinated and integrated within the Bank. The macro stress test provides an important robustness check to bottom-up tests, while achieving consistent applications of stress factors across all institutions to support the identification of system-wide vulnerabilities. It can also promptly surface weaknesses in the data quality and risk management models and practices of individual financial institutions. It also fosters a deeper understanding of the impact of collective behavioural responses to stress and the potential for second-order effects arising from systemic linkages between the financial system and the macroeconomy, thus contributing to more comprehensive risk assessments by supervisors and financial institutions.

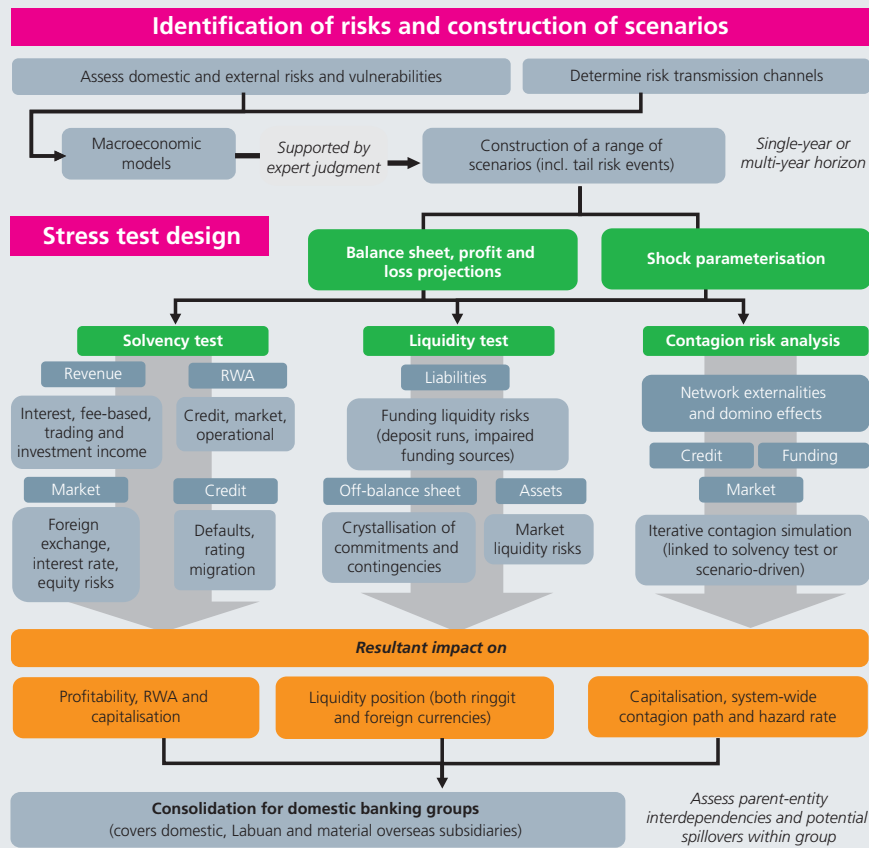
Micro stress tests, in turn, draw on and refine the shock parameters used in macro stress tests to provide a better depiction of institution-specific risk profiles, taking into account different degrees of each institution's sensitivity and behavioural responses to common risk factors. This reflects an institution's specific internal risk control and business strategies, while preserving a level of consistency in application (through a reference to macroeconomic scenarios provided by macro stress tests) and an appropriate focus on tail-risks. Coordination between the stress tests also works in the other direction, where inputs from micro-level supervisory stress tests are used to validate and refine the system-wide calibration of shock parameters used in macro stress tests. Combining the forward-looking analyses from these multiple approaches provides a sound basis for the Bank's risk outlook and policy decisions.

Key Features of the Bank's Stress Testing Framework**(i) Identification of risks and construction of stress test scenarios**

For the purpose of the stress tests, three scenarios – baseline, adverse and extreme – are constructed from a range of economic and financial indicators using macroeconomic modelling techniques that capture domestic and global economic conditions and the channels through which risks are likely to be transmitted based on defined relationships between different economic sectors (Diagram 2). The stress scenarios are generally applied over a one-year horizon (except where the Bank judges that institution-specific circumstances call for an extended horizon, for example to more fully capture the impact of stress, or to assess the potential impact of planned material changes in strategy). In the stress tests conducted for the Financial Sector Assessment Program in 2012, the time horizon was extended to five years to assess the resilience of the banks to different recovery paths of the economy following an economic shock event. By applying econometric models and statistical approaches, the identified scenarios and corresponding macro-financial variables are used to calibrate shock parameters for all risk areas covered in the stress tests and then applied to project financial institutions' balance sheets.

Diagram 2

Key Elements and Processes of the Bank's Stress Testing Framework



Three principal stress tests are conducted – a solvency test, a liquidity test and an analysis of contagion risk. To minimise model risks associated with non-linearities and structural breaks that are typically observed during severe stress periods, expert collective judgment and cross-country historical experience are used in the calibration process to mitigate the underestimation of shocks.

(ii) Scope of application

Macro and micro stress tests are conducted at the entity level and consolidated at the group level for banking groups. The capacity of the parent entity to absorb losses is further assessed if the results of entity-level stress tests of any subsidiary within the group breach the minimum thresholds. In this event, the shock parameters are further refined to take into account parent-entity interdependencies and potential contagion or spillovers within the group. Stress tests are also performed on the material overseas operations of financial institutions based on macroeconomic and financial scenarios and shock parameters that are calibrated to the operating environment in the host jurisdictions and the risk profiles and internal controls of such operations.

(iii) Solvency stress test

The scenario-based solvency stress test incorporates simultaneous shocks on revenue, credit and market risk exposures. These shocks are simulated at the system-wide or institutional level using the Bank's internal satellite models. Revenue shocks are applied by simulating the effect

of slower loan repayments and lower income from securities held and proprietary trading activities on gross operating, trading and investment income. Credit risk shocks typically involve simulating the impact of macroeconomic conditions and changes in the credit quality of major asset classes on profit (through increased provisions and write-offs due to changes in debt servicing capacity) and capital (through higher risk weights applied to exposures to provide for unexpected losses). The relevant shocks include (i) an increase in the probability of default and loss given default for various financing segments; (ii) accelerated credit rating migrations and higher corresponding defaults on fixed income securities and rated business loans; and (iii) higher utilisation of undrawn commitments and contingencies, combined with higher defaults during stress periods. To simulate potential mark-to-market and valuation losses from trading book portfolios, shocks are applied to interest rate, equity and foreign exchange risk exposures. Interest rate risk shocks include (i) the steepening or flattening of yield curves; (ii) the widening of credit spreads between Malaysian Government Securities and private debt securities; and (iii) increasing basis risks. Foreign exchange shocks simulate the effects of extreme volatility in the exchange rate of multiple major currencies against the ringgit on financial institutions' net long or short positions, while equity shocks are translated into extreme declines in the equity market and applied to financial institutions' proprietary equity holdings and share margin financing portfolios.

(iv) Liquidity stress test

The liquidity stress test involves multi-factor cash flow analyses to assess the potential liquidity shortfall of banks within a one-month horizon for both ringgit and major foreign currency-denominated assets and liabilities. The scenarios feature a combination of market-wide and institution-specific stress events such as rating downgrades and acute capital erosion leading to heightened risk aversion. On the liability side, runs on deposits are simulated based on the historical worst run-off rates experienced by financial institutions, covering negotiable instruments of deposit (NID), and retail, corporate and short-term deposits. The potential impact from a sudden drying-up of interbank funding and impairment of foreign currency swap markets is simulated by restraining the rollover of interbank borrowings and foreign exchange swaps payable maturing within a specified time horizon. In addition, the drawdown of commitments and contingencies is assumed to increase to capture potential outflows from all off-balance sheet liquidity or credit facilities extended by banks. On the asset side, an erosion in the value of liquefiable assets to buffer against liquidity shocks, differentiated by types of securities, is simulated using market risk shocks applied in the solvency test.

(v) Network contagion analysis

The Bank's stress testing framework also includes an assessment of potential contagion effects from simultaneous credit and funding shocks in the interbank market. This is used to identify and assess the effects of systemic linkages associated with banks that are 'too big to fail' or 'too interconnected to fail'. The approach applies an analysis of network externalities arising from interbank relationships within the banking system to measure the extent of spillover (or domino) effects propagated by simulated bank failures in the interbank market. This is achieved by tracking the contagion path and quantifying potential capital losses arising from iterative credit and funding shocks. The simulation begins with a particular bank failure or a set of bank failures (defined as trigger banks). Two forms of contagion shocks are then simulated, disregarding any policy responses by the Bank. The first is a credit shock, in which the trigger banks default on interbank borrowings from all banks, compelling these banks to absorb losses. The second contagion effect is that of a funding shock in which the trigger banks cease to provide interbank funding, causing liquidity strains for the banks that they fund. Affected institutions are assumed to replace the 'lost' funding, through asset fire sales to restore their balance sheets. Depressed asset prices in turn trigger a wide-spread decline in the market value of other banks' portfolios. The simultaneous credit and funding contagion shocks are simulated in an iterative manner until no additional bank falls below the specified solvency threshold. By observing the reverberation of credit and funding shocks, this stress test seeks to identify (i) banks that are significant sources of contagion; and (ii) banks that are highly vulnerable to contagion effects.

