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STRESS TESTING THE MALAYSIAN & LABUAN IBFC BANKING SECTORS—TECHNICAL NOTE

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TECHNICAL NOTE

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MONETARY AND CAPITAL MARKETS DEPARTMENT

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GLOSSARY

BNM	Bank Negara Malaysia
BU	Bottom-Up
CAR	Capital adequacy ratio
CCFs	Credit Conversion Factors
CCR	Core Capital Ratio
CLP	Credit Loss Projections
DFIs	Development Financial Institutions
D-SIBs	Domestic Systemically Important Banks
EAD	Exposure at Default
EBA	European Banking Authority
EL	Expected Loss
EM	Emerging Markets
FSA	Financial Services Act
FSAP	Financial Sector Assessment Program
GDP	Gross Domestic Product
GFC	Global Financial Crisis
G-SIBs	Global Systemically Important Banks
IFSA	Islamic Financial Services Act
IMF	International Monetary Fund
LCR	Liquidity Coverage Ratio
LFSA	Labuan Financial Services Authority
LGD	Loss given default
LOLR	Lender of last resort
LTV	Loan-to-value
NPA	Non-performing asset
NPL	Non-performing loan
NSFR	Net Stable Funding Ratio
LIBFC	Labuan International Business and Financial Center
OBS	Off-Balance Sheet
PD	Probability of default
P&L	Profit and Loss
QIS	Quantitative Impact Study
RWCR	Risk Weighted Capital Ratio
SCAP	Supervisory Capital Assessment Program
SIBs	Systemically Important Banks
SIFIs	Systemically Important Financial Institutions
ST	Stress Testing
TD	Top-Down
UL	Unexpected Loss
WB	World Bank
WEO	World Economic Outlook

EXECUTIVE SUMMARY

This note summarizes the stress tests (ST) undertaken for the Malaysian banking system as part of the Financial Sector Assessment Program (FSAP).[1] The STs also cover in a minimal way the Labuan International Business and Financial Center (IBFC), located offshore of the Malaysian mainland.[2] The first component of the STs involved multi-year (2012–2016) macroeconomic stress tests performed over three scenarios: baseline, adverse S1 (V-shaped recession), and adverse S2 (L-shaped slow growth). Comparative static (single-year) sensitivity tests, covering credit, market and liquidity risks were undertaken. Separate TD liquidity and contagion risk stress tests were also undertaken. The FSAP team ran the top-down (TD) STs based on annual end-2011 and granular supervisory data, while participating banks implemented the bottom up (BU) STs using the prescribed macroeconomic scenarios assumptions and sensitivity analysis shock parameters with broad guidance by BNM. Actual credit and market risk shock parameters and balance sheet projections applied in the BU multi-year macroeconomic stress tests are derived and modeled internally by participating banks. All STs were set-up and undertaken in close cooperation with BNM. The stress tests were carried out on a solo-entity basis, to ensure Islamic banks and conventional banks could be stress tested separately and to ensure that stress testing at group consolidation level did not mask vulnerabilities in solvency, liquidity, or contagion risk at subsidiary or branch level.

All banks were subject to solvency, liquidity and contagion tests in the macroeconomic stress testing set-up. The solvency tests (TD and BU) assessed the resilience of the Malaysian banking system under three macroeconomic scenarios from 2012 to 2016. Several different measures of capital adequacy were considered (Tier 1 (CCR) and CAR (RWCR)).[3] TD Liquidity STs simulated banks' resilience against sudden withdrawal of funding as well as risk from maturity mismatch and rollover risk. TD contagion risk testing was analyzed by BNM using an internal interbank exposure model. The model sought to identify spillovers and knock-on effects (on other banks) of single and simultaneous (pair-wise) bank failures due to iterative simulations of joint credit and funding shocks in the interbank market.

Single year BU sensitivity tests for Malaysian banks covered various single-factor credit and market risk shocks. A multi-factor BU sensitivity liquidity test was also carried out by participating banks and extended to not only key onshore banks but covered some Labuan entities and overseas subsidiaries. Most of the impacts of these shocks were determined on Tier 1 (CCR) capital ratio as a comparative static change without any offsetting capital actions by

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[1] Prepared by Mohamed Norat (IMF) in the context of the 2013 Malaysia FSAP (http://www.imf.org/external/pubs/ft/scr/2013/cr1352.pdf)

[2] Stress testing of Labuan-based banks as solo entities and identifying clearly Labuan-specific risks was not possible from a TD perspective as the data was not sufficiently granular for Labuan branches to undertake TD STs. Two material Labuan subsidiaries were covered in the BU STs. The mission noted that stress testing capabilities were still being developed in Labuan.

[3] Core Capital Ratio (CCR) and Risk Weighted Capital Ratio reflect Malaysian capital regulations.

banks or by the authorities. All credit and market risk shocks directly impact Tier-1 capital without consideration of impacts from other buffers (income, provisions). This results in a "clean" impact on capital.

The findings suggest that the on-shore banking system in Malaysia has substantial capital buffers to absorb credit losses on its credit risk exposures. Conventional banks are able to benefit from buffers provided by significant income as a first line of defense against credit losses. Some larger domestic banks benefit from income in terms of strong revenues from domestic operations as well as potential income from overseas operations. In adverse tail-risk scenarios linked to a further conflagration of the GFC it is likely that such profits and revenues would decline more significantly than banks have accounted for. For the baseline those buffers increase in line with projected growth in risk-weighted assets. Consequently, without an increase in capital, solvency ratios are unlikely to increase, and actually decrease for some banks, even in the baseline.[4]

Under the adverse scenarios banking system buffers would fall far more in the TD ST than in the BU ST. This reflects higher assumed tail-risk loss parameters across the cycle and related credit risk parameters in the TD ST than banks themselves have accounted for in the BU ST, as well as differences in income and earnings assumptions.[5] Moreover, the solvency deterioration is far more marked and rapid at individual bank-by-bank level for the TD ST than for the BU ST. The adverse scenarios should be viewed as hypothetical but plausible scenarios: they are by definition tail-risk scenarios in which banks for the BU ST should assume more conservative loss rates and related credit risk parameters such as loss given defaults (LGDs) and probability of defaults (PDs) beyond historical worse case values. Notwithstanding this key credit risk discrepancy, banking system solvency remains above the 8 percent CAR (RWCR) and 4 percent Tier 1 (CCR) minimum regulatory capital level for both the TD and BU ST. Bank-by-bank, we find Islamic banks buffers are somewhat weaker, resulting in greater solvency deterioration relative to other domestic and foreign commercial banks, driven mostly by their lower starting capital.

Sensitivity tests indicated that solvency was impacted most by credit risk shocks. They ranked well above market risk shocks. In particular, higher credit risk parameters for housing loans and higher risk weights for sovereign bonds accounted for the largest credit risk shocks. For Malaysian banks, credit risk accounts for the large proportion of risk on their balance sheets. Any material increase in the risk parameters of key loan concentrations for banks such as housing loans has a sizeable banking-system impact, while impact for some individual banks

[4] Solvency will not be strengthened if capital uplift from retained profits does not grow as fast as RWAs.

[5] The TD ST utilized higher constant through the cycle loss rates for most loan items (credit risk parameters) than banks in the BU ST (where credit risk parameters, income were varied across years). However, for some items (selected retail loan segments) and some banks in specific years, loss rates were higher in the BU ST. More conservative income projections were used in the TD ST for certain income items (interest income, fee and other income). Trading income projections were more conservative in the BU ST than that used for the TD ST.

can be far greater. The recent trend of increases in household leverage, rising house prices and prospects of further global uncertainties may result in housing market problems that could migrate to deterioration in banks' balance sheets and the wider economy.[6] Dealing with sovereign risk from both a solvency and liquidity perspective is very challenging, but the note makes clear that a practical first step in addressing the issue would be to make transparent the linkages between the sovereign and the banking sector. This should address ownership, loan exposures, or other tangible implicit or explicit support.

TD liquidity tests found that Malaysian banks were robust to medium liquidity stress events at the short-end (less than 1-month maturity). Rolling over longer-term funding and dealing with mismatches at longer maturities remains very challenging. Severe liquidity distress would be even more damaging to many Malaysian banks. The TD liquidity tests assumed a medium stress scenario (half Lehman event) assuming higher withdrawal rates of deposits—a reasonable assumption in Malaysia in severe stress scenarios (Lehman-like event) since all deposits (retail and wholesale) are de facto at call.[7] Malaysian banks would also find difficulty in such scenarios in rolling over short and longer term funding from capital markets, especially dollar funding wherein many Malaysian banks have a cumulative net short liquidity position. The TD liquidity ST show that linking solvency and liquidity risks leads to a better capture of deterioration in solvency and the revealing of wider bank vulnerabilities. Malaysian banks have yet to migrate to Basel III liquidity metrics and uncertainty exists given the preliminary data from the latest Quantitative Impact Study (QIS) about how Malaysian banks are positioned. We suspect given the results already observed on the other liquidity tests that Malaysian banks would be better positioned to meet the shorter-term Liquidity Coverage Ratio (LCR) measure; but the longer-term Net Stable Funding Ratio (NSFR) may prove to be more challenging, as it is with banks globally.

Contagion risk was deemed to be less significant either due to single or simultaneous defaults of too-big-to-fail banks, or too-interconnected banks. Larger domestic banks have significant interbank lending and borrowing exposures which are widely distributed across different types of counterparties (own subsidiaries, foreign banks, Islamic and investment subsidiaries). While individual defaults by such large domestic banks have non-trivial contagion impacts (maximum 3 induced failures, 2 of which contained within own banking group), the simultaneous default of 2 large banks can lead to a larger impact, up to a maximum of 5 induced bank failures. In particular, Islamic and investment banks which are subsidiaries of a parent commercial bank seemed more vulnerable to other bank failures, in particular the parent bank.

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[6] BNM will need to ensure enhanced monitoring of household leverage and review the effectiveness of macroprudential measures to tackle such risks.

[7] Lehman-like event relates to some of the high run-off rates seen by some banks in advanced economies, run-off rates for Malaysian banks were not as high as these values during the actual Lehman episode, this may reflect the fact the financial crisis was not centered around Asia and that many Asian countries strengthened their safety net (deposit insurance) at the time to insure all deposits. Lehman-like event therefore relates to a hypothetical stress scenario at higher run-off rates for demand deposits and for other bank liabilities. The liquidity stress test is therefore a test against a standard rather than an actual event faced by the Malaysian banks.

Failure of U.K. and locally incorporated European banks has little or no interbank contagion impact on the Malaysian banking system. Continued model development is important given results flow from model set-up and specificity.

Stress Testing Recommendations

Page	Recommendations	Priority High (H) Medium(M) Low (L)
Current Stress Testing Regime		
Page 16	Adopt multi-year macroeconomic stress testing for TD and BU. Aim to capture prolonged period of stress. Specifically, banks should utilize higher than historical credit risk parameters for adverse, tail-risk scenarios as part of all BU STs and own internal stress testing. Multi-year macroeconomic stress testing will be a useful complement to determining supervisory action based on microprudential and macroprudential measures and resolution and recovery analysis.	High
Page 19	Stress Testing of Financial Conglomerates should be undertaken including nonbank and any significant unregulated entities as part of recently passed FSA and IFSA legislation. BNM should also address contagion risk within the conglomerate between bank to nonbank and vice-versa.	Medium
Page 19	Labuan stress test improvements linked with offsite and onsite supervision improvements. Improvements in data, stress testing capability of LFSA and stress test standards brought in line with onshore banks. LFSA to conduct stress testing for Labuan banks in conjunction with BNM, and contagion risk to mainland parents and within Labuan should be investigated.	Medium
Stress Test Results		
Page 28	Encourage smaller Islamic banks with lower starting capital to hold larger buffers above regulatory minimum capital. All Islamic banks should adopt higher loss absorbency through a mix of improved provisioning, conservative credit risk modeling for internal stress tests, prudent valuation of balance sheets and/or greater earnings or profit retention for organic capital growth.	Medium
Page 39	Banks to increase their resilience to liquidity stress by lengthening the maturity of their funding tackle the on-call nature of deposits and add to liquefiable assets. On liquidity stress testing, increase granularity of data on actual cash flow and behavioral data over and above existing BNM Liquidity Framework requirements. Finalize and publish transition to Basel III liquidity metrics based on QIS data and supervisory interrogation and review. Identify and interrogate differences in net inflow of assets between domestic and Islamic banks. Assess whether current emergency liquidity and deposit guarantee measures in severe liquidity stress scenarios may inhibit banks' own liquidity resilience.	Medium
Page 46	On contagion risk BNM should continue enhancing their pre-existing sensitivity testing work for their network model against changes in assumptions, exposures (mapping and types), contagion triggers and other forms of contagion channels. BNM should also seek to more fully integrate solvency, liquidity ST inputs simultaneously within the contagion risk model.	Low
Page 47	Increase transparency, publication and communication of stress test results. Build on existing framework by presenting more TD and especially BU data, after ensuring confidentiality. Continue and enhance feedback to banks in the form of a market-wide discussion of results and bank-specific feedback through one-on-one meetings in line with advanced supervisory stress testing practices, as recommended by the BCBS. Continue and enhance training, adopting best practice for bank stress testers on developing tail-risk stress test scenarios, and improvements to credit, market, liquidity and contagion risk modeling.	Low

I. INTRODUCTION

A. Malaysian Banks' Performance and the Global Financial Crisis

1. **Malaysian banks have so far managed to navigate the worst effects of Global Financial Crisis (GFC) helped in part by their substantial capital and liquidity buffers and a lack of exposure to the subprime crisis and affected counterparties.** As a highly open economy, Malaysia was not immune to the global economic downturn, having suffered a substantial 6.2 percent peak-to-trough decline in real GDP growth for the first quarter of 2009. BNM undertook several preemptive and timely measures to tackle the impact on Malaysia of the GFC. Malaysia was an early adopter of fiscal stimulus measures while BNM eased monetary policy and put in place a set of comprehensive measures to sustain access to financing by small and medium enterprises. This helped to arrest the heightened risk aversion by banks and preserve domestic growth momentum, pushing the economy out of recession into recovery.[8]

Table 1. Malaysian Banking System Key Balance Sheet Metrics

Metrics (Percent)	2007	2008	2009	2010	2011
Risk Weighted Capital Ratio (RWCR)	13.2	12.6	15.4	14.8	15.1
Core Capital Ratio (CCR)	10.2	10.6	13.8	13.0	13.2
Return on Assets (ROA)	1.5	1.5	1.2	1.5	1.6
Return on Equity (ROE)	19.8	18.6	14.0	16.6	17.4
Liquid Assets to Total Assets	14.3	14.6	14.2	15.6	16
Liquid Assets to Short-term Liabilities	38.5	41.9	42.9	48.1	45.5
Net Impaired Loans Ratio (Net NPL)	3.2	2.2	1.8	2.3	1.8

Source BNM, FSR 2011, Table A.1.

2. **The resilience of the Malaysian banking system at the height of the GFC helped to ensure a continuous flow of funds to the economy.** Indeed, capital (RWCR, CCR) and liquidity buffers were at historical high levels at the height of the GFC, and have since improved further as the economy has grown at around 5 percent year-on-year (Table 1). Profitability (ROA, ROE) of the banks remained robust over the period, even accounting for the dip in 2009 as the Malaysian economy contracted. Asset and credit quality did not suffer any significant deterioration with net NPLs around the 2 percent mark (Appendix 1). In part this reflected the strong action by BNM after the Asian Financial Crisis[9] for banks to enhance their credit risk management, infrastructure and underwriting practices. Banks have also over the period of the GFC actively managed to de-risk their balance sheets and thereby maintain asset

[8] For actual details on various fiscal, monetary and financial policies undertaken by authorities in the GFC see Mohammad bin Ibrahim, *Impact of the Global Crisis on Malaysia's Financial System*, BIS Papers No.54, pp267-278.

[9] The Financial Sector Masterplan and Capital Market Masterplan (2001-2010) acted as both developmental and reform blueprints to restore and increase the resilience of the financial system in the aftermath of the Asian Financial Crisis in 1997.

quality through stringent provisioning policies and write-offs of irrecoverable loans—avoiding some of the problems inherent in ever-greening of loans and general forbearance.

3. **As the GFC continues to evolve from a housing-led, credit and liquidity crisis to a full blown sovereign-banking crisis in Europe, the Malaysian banking system continues to show resilience to adverse global economic and turbulent financial conditions, so far**. Malaysian banks have continued to supply credit and carry out the intermediation process as domestic demand has remained strong and external and regional trade surprisingly resilient. This has helped to support banks' balance sheets with increased capital and liquidity bolstered by strong profitability and lack of asset quality concerns. Malaysian banks also have not had any significant direct exposures to weak Euro-area sovereigns. Tighter and volatile wholesale funding conditions have had fewer impacts on Malaysian banks given excess liquidity and stable domestic funding profiles, at least so far. Nevertheless, Malaysia is not immune to global uncertainties and further deterioration of the external environment may be less favorable to Malaysian banks and the real economy.

4. **Stronger capital, liquidity, and higher loss absorbency through improved profitability and asset quality positions[10] of Malaysian banks have been further reinforced by an intensive supervisory and regulatory regime by BNM**. BNM has instituted a well developed risk focused, regulatory and supervisory regime, consisting of a hands-on and intensive program of on-site supervision and extensive and comprehensive off-site macro- and micro-surveillance that is fully integrated with its on-site supervision. BNM supervisors have adopted and transmitted well thought out set of risk management and internal risk control expectations of the banks, they have specified higher than minimum capital requirements and a useful liquidity framework, though given deposits are on call (but stable) resilience to severe liquidity stress would be a concern. BNM have also undertaken effective coordination and information sharing with foreign supervisory authorities. Strong effective supervision allied to domestic macroeconomic resilience and nimble policy action, so far, has ensured Malaysian banks continue to navigate the GFC relatively smoothly.

5. **Current stress-testing arrangements by BNM have developed over time as part of the supervisory off-site toolkit.** It is conservative and risk-based in principle, and allied to BNM's practice of enforcing dividend and earnings retention ensures higher loss-absorbency of Malaysian banks now than prior to the Asian Financial Crisis. Stress testing arrangements, as applied to single-year sensitivity and scenario-based stress tests applied by BNM, encourage banks to account for key risks. However, there are also key developments such as multi-year

[10] Improved asset quality can be reflected in lower impairment charges on consumer and corporate loans, of course this reflects the stage of the credit cycle. Malaysian banks have benefitted from a sustained period of credit expansion and stronger profitability driven by strong net interest, and fee income together. However the possibility of an extreme shock together with a simultaneous downward turn in the credit cycle could result in extreme losses that could overwhelm Malaysian banks balance sheets even given prudent underwriting standards and conservative loan loss provisioning. The fact that Malaysian banks have had significant buffers they have shown considerable resilience so far to global financial shocks.

macroeconomic ST and tail-risk credit risk calibration to further enhance BNM ST capabilities. Stress testing guidelines require Malaysian banks to build capital buffers through earnings retention well in advance of adverse market conditions, when capital increases could become costly. In addition Malaysian banks' capital and/or dividend disbursement to shareholders is vetted by BNM to ensure any capital deficiency or weak loss absorbency identified by banks' stress tests is addressed by enforcement action to retain earnings and raise capital organically.

6. **Conservative supervision and regular sensitivity and thematic stress-testing set against the backdrop of a resilient domestic macroeconomic environment has boosted Malaysian banks capital and liquidity buffers**. Capital ratios in particular are well in excess of Basel III requirements. Malaysian banks RWCR in 2011 stood at 15.1 percent and is above BNM (8 percent) and Basel III minimum total capital requirement of 8 percent or 10.5 percent including the 2.5 percent capital conservation buffer. Tier 1 (CCR) capital in 2011 stood at 13.2 percent well above the Basel III Tier 1 ratio requirement of 6.0 percent from 2015. Basel III LCR (which is a minimum standard) will now be less challenging for Malaysian banks to meet with current LCRs around the 60-80 percent for the majority of banks[11] against the required 60 percent from 2015. However, increased demand for stable retail deposits by banks is unlikely to be met quickly given households' compulsory contribution to pension funds such as the Employees Provident Fund (EPF) and alternative investment opportunities in entities such as Permodalan Nasional Berhad (PNB). [12]

B. Malaysian Banks Differentiated Business Models

7. **Malaysian banks operate in a dual banking system wherein conventional and Islamic banks are both an important part of the financial intermediation process.** Conventional banks come in various forms as domestic commercial or foreign commercial variants—there are conventional investment banks both as part of a parent group structure or on a standalone basis. Islamic banks in Malaysia form around 20 percent of the banking system, and come in several variants: the majorities are subsidiaries of the conventional parent group. There are only two domestic standalone Islamic banks in Malaysia but three foreign (Middle Eastern) stand alone banks. The remaining Islamic banks are windows of two foreign commercial banks and 2 DFIs. Islamic banking in principle is based on risk-sharing, but risk or loss sharing is not deeply embedded in Malaysia, or globally for that matter.

8. **Malaysian banks have diversified balance sheets.** Using a select sample (Table 2) of banks it is clear on the asset side that loans, sovereign and private debt securities (PDS) dominate while banks are predominantly funded through deposits rather than wholesale

[11] Financial Stability and Payment System Report 2010, Bank Negara Malaysia. Recent changes by BCBS to LCR have a phase-in of the LCR beginning at 60 percent in 2015 rising to 100 percent by 2019.

[12] Banks can also add to their liquefiable assets to raise the LCR, or authorities apply reduce run-off rates and drawdown rates on the liability components and lower haircuts on assets. The revisions to the LCR by the BCBS on 6 January 2013 have eased banks ability globally to meet the new revised measure, though it still remains a minimum standard, authorities will continue to adopt stricter liquidity requirements.

(securities) funding. In terms of balance sheet size, domestic commercial banks dominate the banking landscape. Investment banks in particular have small balance sheet size. Loans, securities held and amounts due from other financial institutions form the vast majority of banks' assets. In terms of risk concentration this suggests clearly that credit (including counterparty) risk is the largest element for domestic, foreign commercial and Islamic banks, with market risk important for investment banks reflecting their large proportion (in terms of asset share) of securities held. On the liability side most domestic and foreign commercial banks, and many Islamic banks, are deposit-funded with little wholesale funding. Deposits are at call and a proportion (50 percent) is non-retail. Two Islamic banks, IB8 and IB13, have sizeable wholesale funding as a proportion of their liabilities (Figure 1).

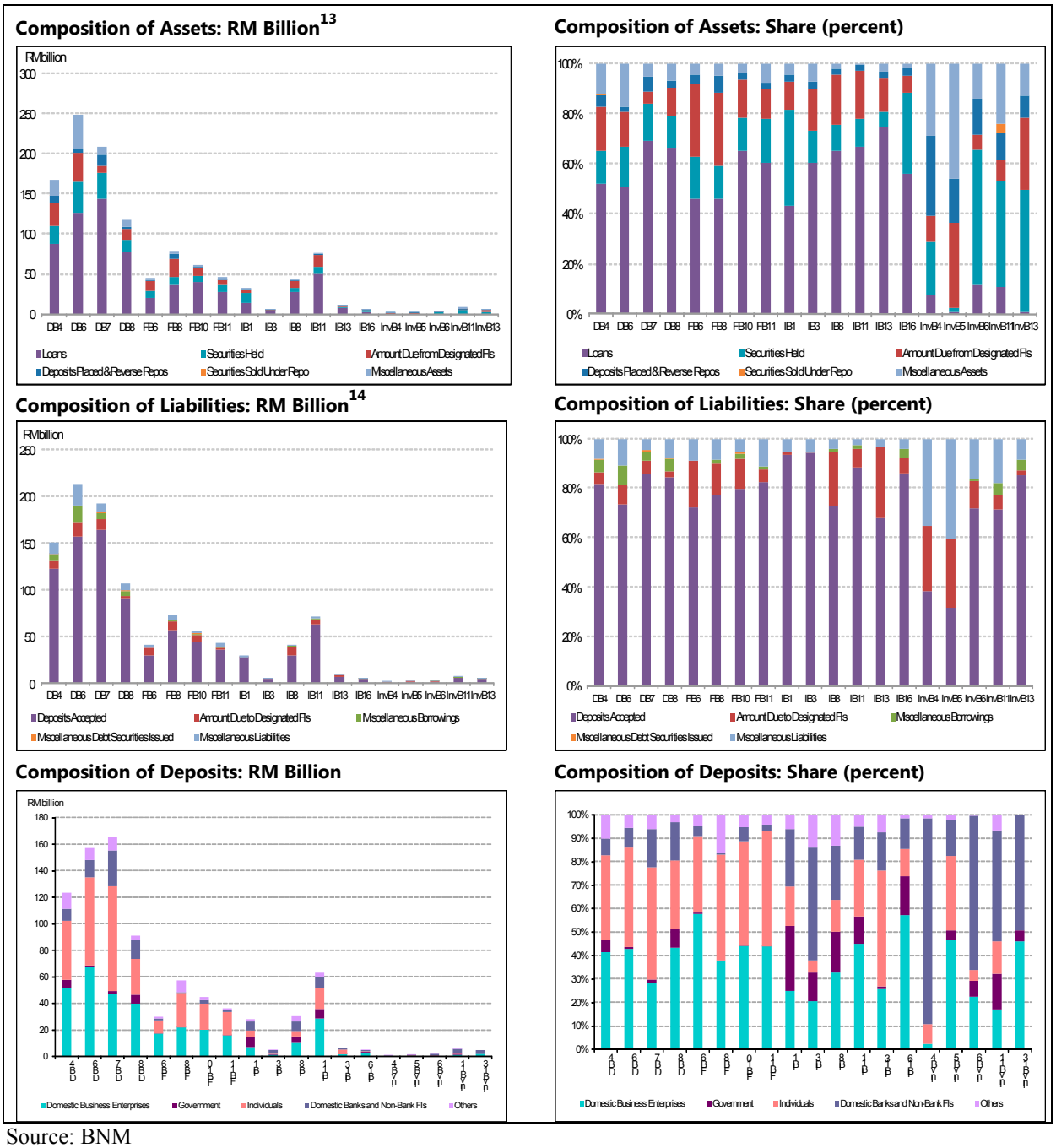
Table 2. Malaysian Bank Select Sample

Code	Classification
DB4	Domestic Commercial Bank
DB6	Domestic Commercial Bank
DB7	Domestic Commercial Bank
DB8	Domestic Commercial Bank
FB6	Foreign Commercial Bank
FB8	Foreign Commercial Bank
FB10	Foreign Commercial Bank
FB11	Foreign Commercial Bank
IB1	Standalone Islamic Bank
IB3	Standalone Islamic Bank
IB8	Bank-backed Islamic Bank
IB11	Bank-backed Islamic Bank
IB13	Bank-backed Islamic Bank
IB16	Bank-backed Islamic Bank
InvB4	Bank-backed Investment Bank
InvB5	Bank-backed Investment Bank
InvB6	Standalone Investment Bank
InvB11	Standalone Investment Bank
InvB13	Bank-backed Investment Bank

Source: BNM (distinct from banks in FSAP stress test)

9. **Deposits are concentrated in the large domestic commercial banks, as expected.** The vast majority of deposits are from households and domestic business enterprises, though government deposits play an important, possibly developmental role for Islamic banks. Government deposits play an important role in some Islamic banks in the sample—in part this could reflect a move by government agencies to adopt shariah-based transactions resulting in deposits with Islamic banks. This action (if not in intent) would be part of the authorities' developmental commitment to support the growth and development of Islamic banking institutions and Islamic finance in line with the financial sector blueprint (Figure 1).

Figure 1. Asset and Liability Structure of Select Malaysian Banks

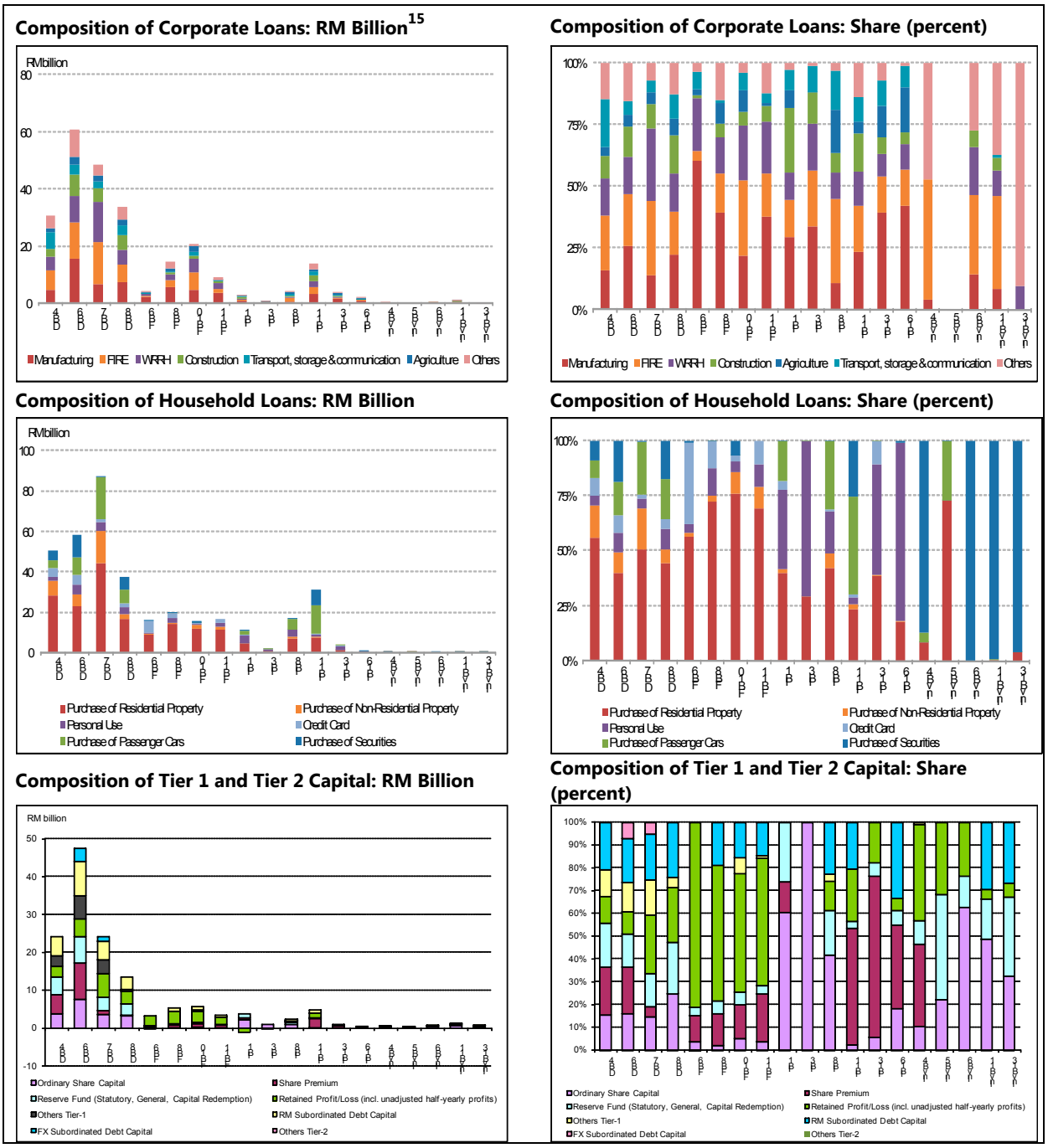


Source: BNM

[13] Miscellaneous assets includes gold, cash, notes, coins, investments, goodwill, deferred allowance, other debtors, deposits and repayments, fx margin with exchanges, fx income receivable, other items.

[14] Miscellaneous borrowings include subordinated borrowing, HP & leasing papers under refinancing arrangement, recourse obligation on loans sold to Cagamas.

Figure 2. Loans and Capital Structure of Select Malaysian Banks



Source: BNM

10. **Domestic banks dominate the corporate loans sector with manufacturing, finance, insurance, real estate and wholesale retail trade the largest components (Figure 2).** Most Islamic banks have higher balance sheet exposures towards the household sector (about

[15] FIRE – Finance Insurance Real Estate and business activities; WRRH – Wholesale, Retail Trade, Restaurants and Hotels.

61 percent), one Islamic bank (IB1) as a proportion of total corporate loans has a sizeable construction exposure. This raises the possibility of Islamic banks' vulnerability to systemic real estate cycles due to their credit concentration in real estate and construction. Investment banks as a whole tend to be less involved in this loan sector, with largest exposure to finance, insurance and real estate; one bank has no exposure at all—InvB5. Islamic banks (IB8 and IB16) have relatively a larger share of exposure to agricultural loans (Figure 2).

11. **Household loans form one of the largest loan components of Malaysian banks with domestic and foreign banks active in the mortgage (residential and nonresidential), credit cards and auto loans.** Islamic and investment banks have a more skewed household loan profile. Islamic banks have large exposures to residential, auto loans and significantly personal loans, while credit card loans are much less significant. One investment bank has significant exposure to residential and auto loans extended to staff—InvB5. Most investment banks given their activities have exposure to loans for the purchase of securities (Figure 2).

12. **Large balance sheet size dictates that Malaysian commercial domestic banks hold significant capital and have the most diversified capital structure with both debt and equity instruments.** Islamic banks hold predominantly common equity Tier 1 capital—in part this may reflect Islamic banks' tendency to hold more equity than debt or possibly the paucity of available Islamic debt instruments. For non-standalone banks a question remains whether this is contributed by the parent entity. Foreign commercial banks tend to hold more retained earnings and debt as capital that other types of banks. The greater proportion of debt tends to suggest that foreign commercial banks may be more vulnerable to losses given debt capital's low loss absorbency capacity than equity. A feature that seems to be significant across all banks (especially foreign commercial banks) is the importance of retained earnings and profits in contributing to the overall capital structure. Retained earnings enable banks to grow capital organically. The recent strong performance of the domestic economy has helped Malaysian banks to be resilient to the GFC and has provided a boost to their capital levels. This in turn has enabled them to progress to Basel III capital requirements ahead of time.

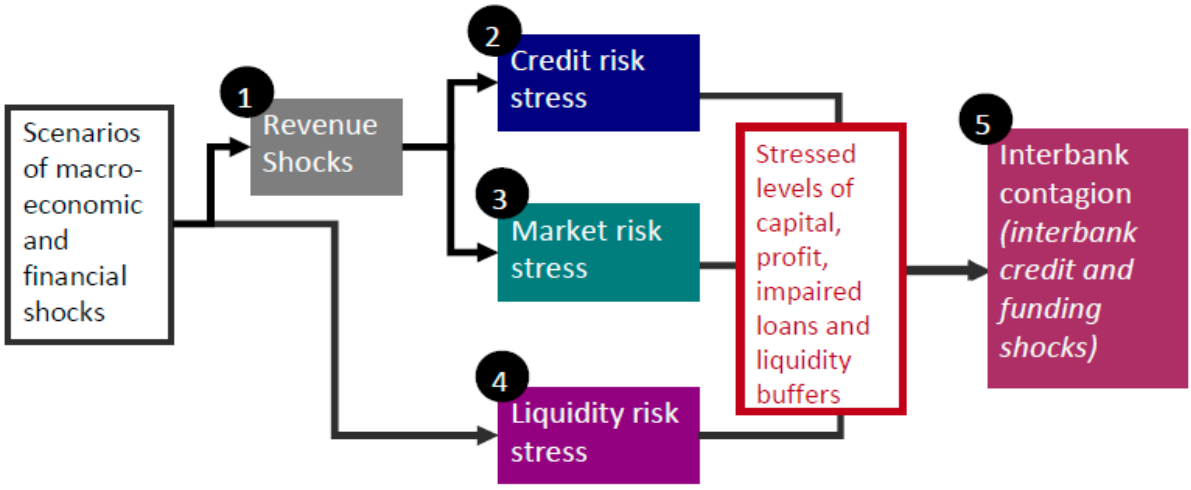
II. Current BNM Stress Testing Regime

A. Background

13. **Stress Testing procedures and processes are already very well developed at BNM with shocks being applied at the macro (TD) and micro (BU) level.** TD shocks are applied at the system wide level and can cover revenue, credit, market, liquidity and contagion risks shocks. At the BU level these shocks can be applied at the bank level with supervisors recalibrating TD shocks to reflect bank-specific risk profiles (default history, loss rates, asset quality and risk-absorbing capacity of capital) and portfolios. Supervisors also take into account bank-specific risk management and governance controls with recalibration undertaken mainly to account for risk profiles of banks while recalibration for internal controls is more limited.

14. **The main drivers of revenue and risk shocks impacting at the system and bank-specific level typically arise due to various macroeconomic and financial shocks (Figure 3).** Projecting various macroeconomic financial shock scenarios is used to stress financial system and individual banks' resilience and financial stability. The shocks taken together are expected to impact the banking system and individual banks' profitability, capital and liquidity buffers after accounting for provisioning and valuation changes. Deterioration in capital and liquidity buffers create solvency issues and default concerns for some banks which can then play out through interbank exposures into wider systemic contagion in the banking and financial system as a whole. As expected and taking evidence seen from Figure 1 and Figure 2 earlier, losses due to credit risk exposures are expected to have the most significant impact on bank profitability and capital.

Figure 3. BNM Stress Testing Approach



Source: BNM

15. **BNM uses a risk-sensitive approach to single-year sensitivity and scenario stress testing.** For such stress tests macroeconomic scenarios are considered including adverse scenarios. Values for shocks and parameters for the key risk areas are applied in a conservative fashion. With regard to adverse macroeconomic scenarios in recent stress tests BNM have considered an intensification of the European debt crisis which conflagrates the GFC, allied to an unsupportive and weaker domestic macroeconomic environment. Other aspects such as increased financial volatility resulting in increased risk aversion, credit and liquidity crunches, and deleveraging globally have also been considered as part of the their hypothetical scenario building. The willingness of BNM from their TD perspective to explore extreme scenarios adds credibility to their stress testing exercises by highlighting ahead of time shortfalls in banks' capital and liquidity buffers, and deterioration in asset quality, loan loss provisioning and valuation practices. BNM use results from the adverse scenarios to signal to banks to boost their

loss-absorbing capital through earnings retention and to rein in capital and dividend disbursements to shareholders.[16]

Table 3. Recent BNM Scenario-based Stress Test assumptions and Shock Parameters

Macroeconomic & Financial Shocks	Key Assumptions & range of shock parameters
Malaysia GDP Shock	More severe than 2009 economic contraction
Revenue Shock	More than 40 percent decline in different revenue segments
Credit Risk Shock: PD = Probability of Default LGD = Loss Given Default	More severe PD and LGD for different loan portfolios • Doubling of current PD • Higher downturn LGD than historical experience More severe rating migration and default rates for private debt securities/sukuk than historical worst experience in 1998 and 2001 • LGD up to 100 percent Acceleration in the utilization of committed and contingent facilities of up to 100 percent
Market Risk Shock	Extreme decline in FBM KLCI Sharp depreciation in 8 major currencies against the ringgit Interest rate rise shocks (up to 250bp) across different tenures, taking into account: • Steepening of the MGS yield curve • Widening of credit spreads between MGS and PDS • Basis risk

Source: Financial Stability and Payment System Report 2011, BNM

16. **Under the adverse macroeconomic scenario as part of BNM's own published stress tests, capital ratios in terms of RWCR and CCR of the banking system remained above 13 percent and 11 percent respectively.**[17] Introducing more extreme assumptions of domestic economic contraction and financial market volatility within the context of a global financial crisis, RWCR and CCR would fall to 8 percent and 6 percent. The capital impact, even under the worse case macroeconomic scenario, results in capital ratio levels for the Malaysian banking system still above current regulatory minimum levels. What is clear from this result is that a conflagration of the global financial crisis which has important downside impacts on credit, and market risks with contagion spillovers to global trade and finance would impact the capital buffers of the Malaysian banks quite severely. Moreover, BNM stress testing currently is in the form of sensitivity stress tests and shocks which are by definition single-year stress tests. It is not clear how resilient in terms of capital and liquidity buffers the banks or the Malaysian banking system would be under adverse or extreme scenarios that were prolonged and took the

[16] Federal Reserve mandated stress tests under Dodd-Frank also now take enforcement action with regard to capital disbursements. While EBA stress tests, so far does not suggest how to raise capital but simply identifies capital shortfalls to be made up. EBA stress tests in 2013 will be used to limit capital disbursements.

[17] See recently published BNM stress tests in: Financial Stability and Payment System Report 2011.

form of multi-year shocks. The stress tests conducted in the remainder of this Technical Note will seek to address such issues.

17. **BNM have successfully utilized single-year stress tests to assess the resilience of Malaysian banks (and insurers) as well as the banking system, under severe and extreme macroeconomic and financial scenarios, including that of key parameters of risk items impacting banks' balance sheets**. This approach has ensured that BNM has been able to challenge banks' revenue, future profitability and loan loss provisioning arising out of backward-looking balance sheets, often under benign macroeconomic conditions. In turn this approach has helped BNM to identify early capital shortfalls and ensure earnings retention is used to grow capital organically within the bank.[18]

Recommendation

Further improvements could be made to the stress testing regime, by adopting multiple-year TD and BU macroeconomic stress testing. This would help to further identify weakness in capital loss absorbency of Malaysian banks and the banking system under a prolonged period of stress. In adverse scenarios bank revenues are not able to recover immediately, compounded by weaker loan loss provisioning and rapid growth in NPLs. More conservative loss rates and higher credit risk parameters (PDs, LGDs) beyond historical highs should be used by banks in the BU and own internal stress tests. Multiple-year stress testing would help to project the path for monetary and fiscal policies while simultaneously re-calibrating counter-cyclical macroprudential and microprudential policies. Finally, multiple-year TD and BU stress testing is also important in the context of determining bank or banking system life-time losses and recapitalization needs, as well as the appropriate form of banking system consolidation in the context of recovery and resolution planning.

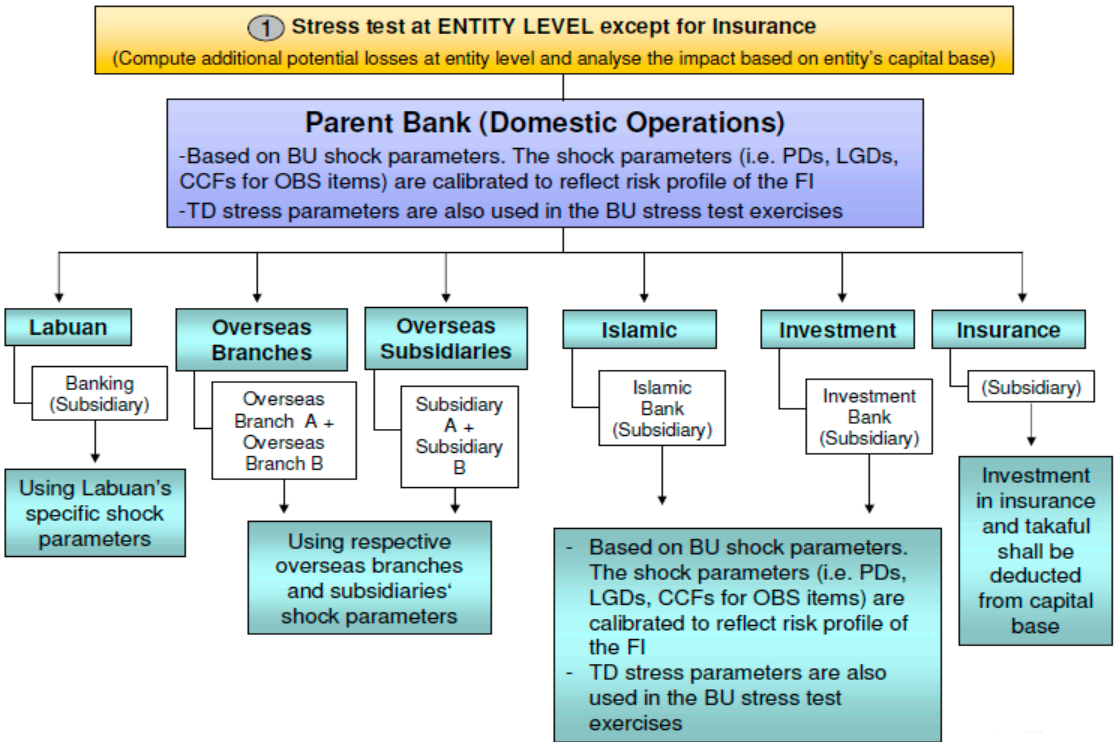
B. Consolidated Group and Solo Entity Stress Testing

18. **BNM undertake both TD and BU stress testing at solo entity level ensuring that dedicated capital is allocated and is sufficient for the operations of these various subsidiaries and branches.** BNM conduct BU stress testing at solo entity level ensuring that potential losses emanating from that entity impact its own capital base independent of the impact on the group level (Figure 4). TD macro scenarios are meshed with the BU stress testing. Supervisors calibrate bank-specific credit risk parameters (PDs, LGDs, CCFs) and align them with the solo entity's risk profile. Here BNM will often look at a solo entity's portfolio quality, bad debt recovery profile, and their internal stress testing regimes. In part, historical trends and robustness of bank specific PDs and LGDs are assessed with utilization rates of off-balance sheet exposures through the economic cycle. The calibration process challenges banks' optimistic values of shock parameters. BNM will try to scale upwards (and downwards) these parameters to reflect forward-looking risks and more tail-risk scenarios. BNM's supervisory

[18] Banks undertake multi-year ST (3-years) as part of guidelines on Basel II–ICAAP process since 2011.

calibration actions are in accordance with good practice as recommended by the BCBS in terms of supervisory implementation of stress testing principles.[19]

Figure 4. Solo Entity Level Stress Testing

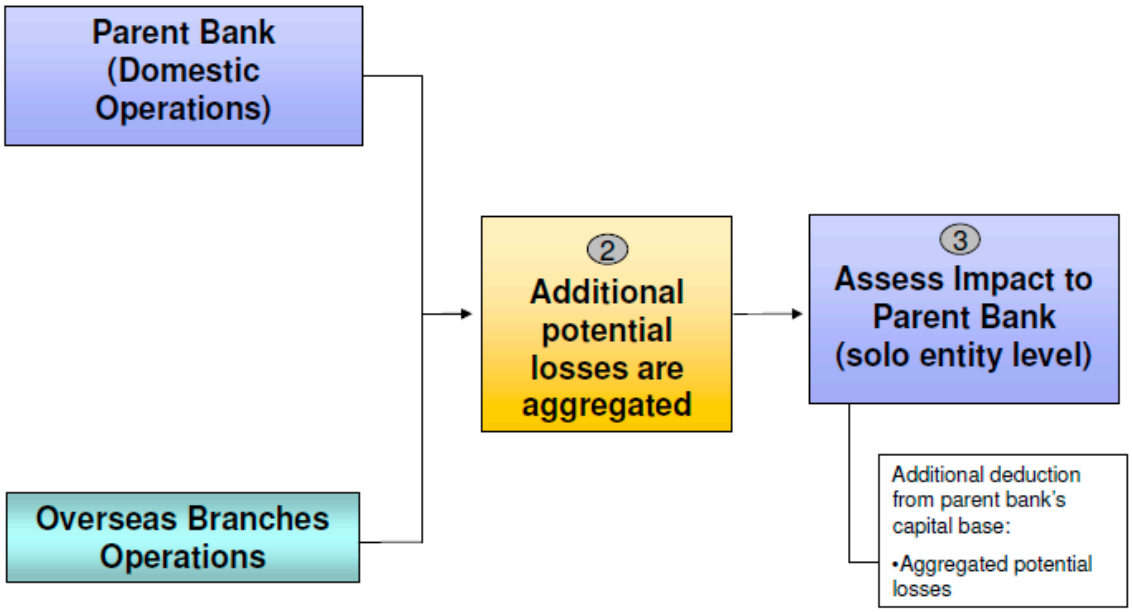


Source: BNM

19. **Labuan solo entities which are bank subsidiaries also have their credit risk parameters calibrated by BNM to reflect specific Labuan risks.** At present LFSA do not play a role in the calibration process of credit risk parameters and do not conduct any off-site or on-site work related to Labuan subsidiaries. BNM applies shocks to Labuan based entities which are then rolled up as part of the stress tests for the parent bank. There seems to be no separate stress testing of Labuan based entities distinct from their parent bank and no stress testing of foreign Labuan based entities whose parents are outside Malaysia and not part of the locally-incorporated foreign bank. BNM have argued that this is less of an issue given that Labuan as a whole provides a small contribution to the overall banking system (6 percent) and Labuan-based entities only account for 3 percent of the total assets of the parent bank. Labuan entity data was not granular enough to undertake a TD exercise. BNM are aiming to enhance data capture and stress testing capabilities of Labuan entities, in line with materiality to onshore banks.

[19] Basel Committee on Banking Supervision, *Peer review of supervisory authorities' implementation of stress testing principles*, April 2012, Bank for International Settlements.

Figure 5. Solo Entity Parent Bank Level Stress Testing



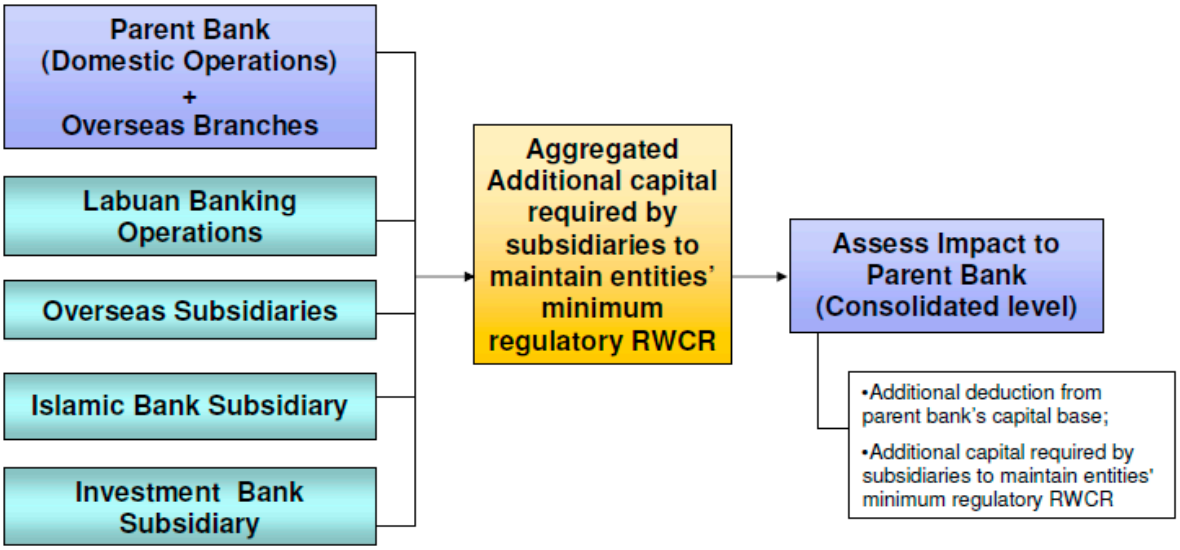
Source: BNM

20. **Solo entity stress testing is also conducted by BNM at the level of the parent bank.** BNM would typically aggregate losses from both the parent bank domestic activities and those of its overseas branches (excluding the subs, but including the Labuan entity's exposure). Ultimately, losses are combined and impact is then seen from the perspective of deduction on the parent bank's capital. The assumption here is that branches (unlike the subs) are not ring-fenced, with the parent responsible for supplementing the overseas branch capital for losses sustained in those units. The main Malaysian bank branches are located in Singapore.

21. **BNM also undertakes consolidated Banking Group Supervision to address the issues of risk within banking groups; but stress testing of complex financial conglomerates headed by a nonbank parent has yet to be undertaken**. This is a key weakness. BNM has yet to undertake group level stress testing of financial holding companies (FHCs) under new supervisory powers. BNM's approach to banking group consolidated level stress testing ensures that solo entity stress testing is combined with parent bank level stress testing, identifying capital deterioration from each entity in the group. Overall, the capital needs are then aggregated at the banking group level and solo parent bank level after capital has been "downstreamed" to subsidiaries to maintain their minimum RWCR at 8 percent under stress scenarios (Figure 6). The main motivations behind banking group level stress testing is to capture interdependencies of entities within the group as well as identifying key source of vulnerabilities within it. In doing so BNM are able to assess more effectively the resilience of complex banking groups. However, in Malaysia, 6 of the largest 8 domestic financial conglomerates wherein banking is important are headed by a FHC not a parent bank. BNM do not have explicit supervisory reach to fully group stress test these FHCs. A key risk remains that risk transfers may be occurring within the FHC group structure between, say, banks and insurers

that are not captured in current stress tests. In effect, higher risk may be transferred to entities in the FHCs which are lightly regulated compared to banks. Potentially this could mean that there could be a build-up of systemic risk originating from domestic SIFIs without BNM having any early warning.

Figure 6. Banking Group (Consolidated) Level Stress Testing



Source: BNM

Recommendation

BNM should undertake stress testing for financial conglomerates especially those that have nonbanks as the parent under FSA and IFSA legislation which came into force on 30 June 2013. BNM need to monitor and identify the nature of risk transfers between banks and nonbanks including the development of new products resulting from financial innovation. BNM and LFSA should as a matter of priority improve data reporting requirements of Labuan-based entities in line with onshore bank data reporting standards. BNM and LFSA should also continue to implement improvements for stress testing Labuan-based Malaysian and non-Malaysian solo-entities both from a TD and BU perspective and without recourse to consolidation with the parent bank. Moreover, LFSA independently should at a minimum be able to carry out a TD stress tests of such entities.

C. Approach and Coverage

22. **Stress tests for the Malaysian banking system covered a variety of solvency, liquidity, sensitivity and contagion tests conducted on a TD and BU basis.** Solvency tests conducted on a TD basis were carried out by the FSAP team using an IMF balance-sheet based toolkit and supervisory data provided for 36 banks as of end 2011.[20,21] The BU stress tests were carried out by banks and covered several areas such as solvency and sensitivity tests. Banks implemented BU ST using the prescribed macroeconomic assumptions and sensitivity analysis parameters based on banks' own internal models, under the broad guidance of BNM. BNM undertook contagion tests (Appendix 3).

23. **The TD ST toolkit links balance sheet based tests with portfolio model elements and is geared toward Basel II/III**. Its main advantage consists of an economic assessment of solvency under stress by a more refined approach to the impact on RWAs. Although RWAs are the denominator of key capitalization ratios (Total Capital, Tier 1, Common/Core Tier 1), their impact under stressed conditions has often been underappreciated. Moreover, the framework addresses this point not only for banks under the Basel II IRB approach, but also for banks that currently use the Basel II Standardized Approach (StA) (or Basel I) for credit risk through a quasi-Internal Rating Based (QIRB) approach.[22] By allowing for a stress of RWAs, the framework not only benefits from higher risk sensitivity, but also addresses issues brought to light by the crisis such as the increase in the thickness of the tails of loss distributions under adverse scenarios.

D. Macroeconomic Scenarios

24. The TD and BU STs were carried out over three macroeconomic scenarios covering risk evolution and losses of banks over a baseline and two adverse scenarios. The FSAP team provided projections (2012-2016) for various macroeconomic variables—real GDP, unemployment, inflation. Also provided were forecasts of financial and asset price variables - covering stock prices, volatility, house price index, conventional and Islamic interest rates both short-term, and long-term, commodity prices (rubber, palm oil, and oil) as well as bilateral exchange rates and real GDP growth rates for several neighboring countries.

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[20] Schmeider C., Puhr, C, and Hassan, M (2011) Next Generation Balance Sheet Stress Testing, International Monetary Fund, WP/11/83.

[21] The coverage of banks for the TD covered domestic and foreign commercial banks, Islamic banks, and Investment banks. Labuan banks were not an explicit part of the TD sample but were consolidated as part of the parent bank. Labuan data was not sufficiently granular for the purposes of the TD stress tests. However, additional banks included in the BU sample separately did identify Labuan entities.

[22] Basel I and the Basel II Standardized Approach for will be treated as one type of approach, namely a statutory one; in contrast to economic approaches (Internal Rating based Approach, economic capital models).

25. **The Baseline scenario reflects a continuation of the current economic progress in Malaysia where real GDP growth hovers around 5 percent, in part helped by strong domestic consumption and investment.** The baseline forecast is in line with the April 2012 IMF WEO forecasts for Malaysia, where in addition to the resilient domestic performance the economy is also little impacted from the adverse sovereign-banking spillovers in Europe, US slowdown and concerns over the "fiscal cliff" and slowdown being experienced in Asia. Unemployment remains low at 3 percent, house and asset prices continue to rise (Figure 7).

26. **The Adverse scenario 1 (S1)[23], involves a Malaysian recession but with a slow recovery back to the current 5 percent growth benchmark—'V-shaped' real GDP growth path**. Even though the initial peak-to-trough decline in real GDP growth in 2013 would adversely impact banks' balance sheets through credit losses, lower income and revenue generation, banks are expected to recover slowly and further bolster their solvency resilience through capital buildup on the upswing. At the end of 2016 real GDP growth recovers at 5.2 percent, and while unemployment rises and property and asset prices fall in the early part of the forecast horizon they also recover later on in the horizon.

27. **Adverse scenario (S2)[15] involves a mild recession but then no robust recovery with the economy undergoing a period of low growth—'L-shaped' real GDP growth.** In such circumstances banks ability to bolster their solvency in the upswing is heavily compromised as credit losses continue to mount and income and revenue generation falls away over the forecast horizon. Unemployment continues to rise through the forecast horizon and house and asset prices continue to fall. These financial shocks in addition to the real GDP growth profile are damaging to banks' balance sheets.

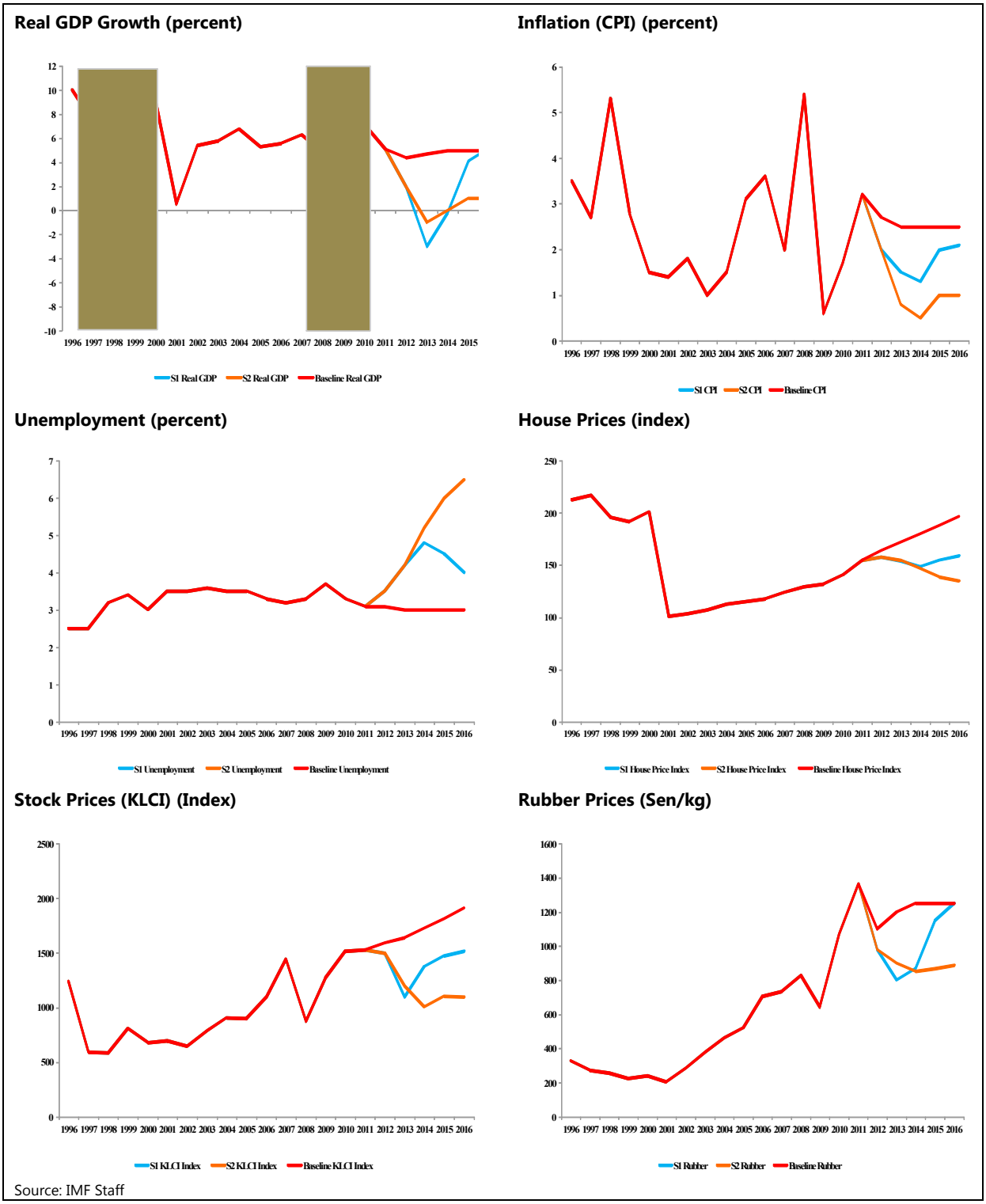
28. **Adverse scenarios S1 and S2 arise on the back of a further conflagration of the global financial crisis (GFC)**. The adverse scenarios S1 and S2 are realizable in part due to a further worsening of the GFC. The negative trade impacts and capital outflows could be problematic for Malaysia. In addition increased global uncertainty and increased risk aversion reduces both consumption and investment. Lower oil and commodity prices impact Malaysia's fiscal and debt position given their importance to state revenue generation. The reduced fiscal space to tackle unemployment in the low growth period beyond one year leads to rising unemployment, and a collapse in property prices and asset prices more generally. The global economic and financial shocks together with other domestic shocks will through various transmission mechanisms impact financial stability (Appendix 2).

29. **Bank solvency is expected to evolve through the horizon 2012–2016 broadly in line with the three macroeconomic scenarios**. Satellite models are used to project the main financial variables affecting bank solvency—in the case of Malaysia the models relate to credit losses, credit growth and profit growth (impacting pre-impairment revenue and income). The

[23] Not actual forecasts by BNM and do not provide any indication of policy responses under stressed conditions, but hypothetical macroeconomic scenarios devised for the sole purposes of FSAP Stress Testing.

satellite (regression) models were provided by BNM and were simple in form. Satellite models can be less robust model incoherence, lack of fit can occur.

Figure 7. Macroeconomic and Asset Price Variables 2012–2016



Source: IMF Staff

III. Stress Tests Results

A. Top-Down Solvency Stress Test Results

30. **The top-down results indicate that major banks are well capitalized and resilient to distress.** System wide CAR and Tier 1 capital remain above minimum thresholds even under adverse scenarios (Figure 8).[24] Credit loss is the largest driver of capital deterioration, followed by lower income levels of banks in adverse scenarios and negative credit growth. Bank solvency evolves through the forecast horizon 2012–2016 in the three macroeconomic scenarios through the use of satellite models. Satellite models are used to project the main financial variables affecting bank solvency. In the case of Malaysia they are changes in impaired loans, credit growth and profit growth (impacting pre-impairment revenue and income). The FSAP team utilized the satellite models provided by BNM.

31. **Tier 1 capital distribution across banks deteriorates most rapidly in the adverse scenarios (Figure 8) and later in the forecast horizon**. The capital deterioration in the baseline scenario is heavily influenced by credit growth which increases RWAs, and less so by credit losses. Under the adverse scenarios credit losses dominate but are hardly offset by trading and bank income and revenue which remain sluggish in adverse S1, but decline more markedly in a low growth adverse S2 scenario. In the baseline at the end of 2016 one Islamic bank is below the 4 percent Tier 1 ratio; in the adverse S1 and adverse S2 scenarios two Islamic banks and three Islamic banks, respectively, are below 4 percent Tier 1 ratios.

32. **Under the adverse scenario S2, the capitalization needs (using Basel III simulations) for the Malaysian banking system may increase by 3 times vis-à-vis adverse scenario S1, or 0.4 percent relative to banking system total assets.** But this is only in 2016, driven mainly by smaller banks.[25] Even under a period of prolonged low growth where banks' ability to offset credit losses is compromised by lower income levels, recapitalization needs in 2016 are around RM 7 billion (Figure 8). This would be the amount required to bring them above the minimum of regulatory total capital adequacy ratio.

33. **Smaller Islamic banks are more vulnerable to credit loss in the adverse scenarios, in part due to their lower starting capital than conventional banks.** Islamic banks are impacted by credit risk which is compounded given their less diversified business models. Specifically, Islamic banks have fewer trading assets and activities as a proportion of total assets than conventional banks, with greater credit concentration in lending activities such as residential mortgages, personal and auto loans. Under adverse scenarios some Islamic banks with lower starting capital bases suffer more rapid capital deterioration.[26]

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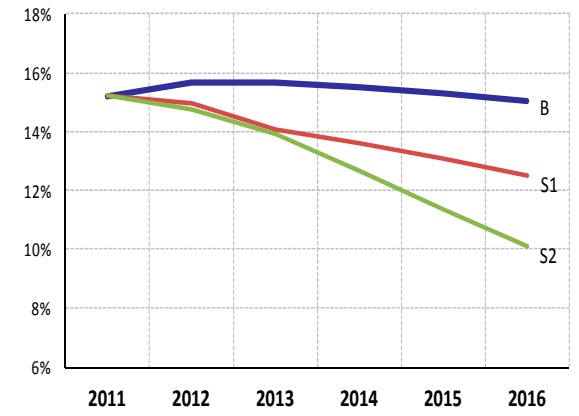
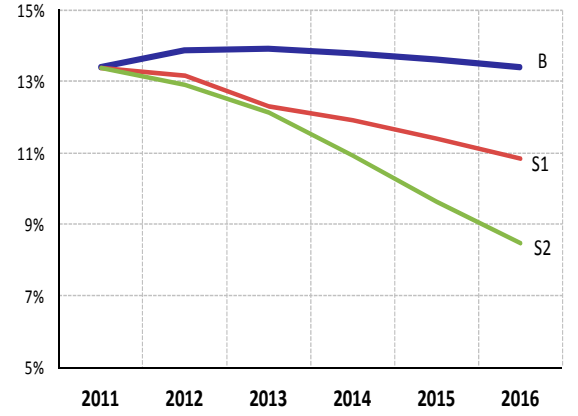
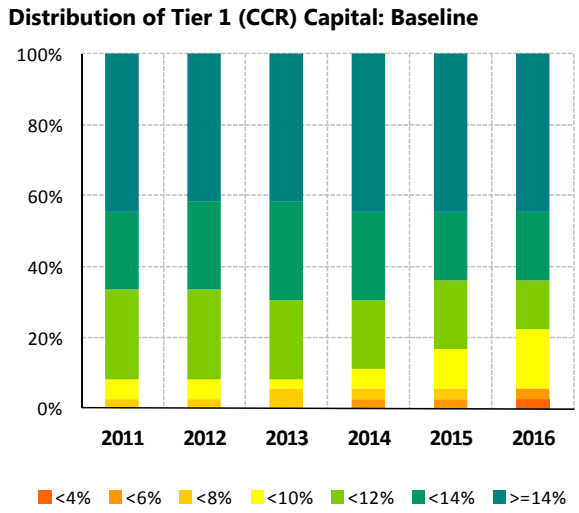
[24] Current minimum Basel II requirements are: CAR (RWCR)—8 percent, while Tier 1 (CCR)—4 percent.
[25] This is mainly smaller domestic and foreign commercial banks, and some smaller Islamic banks.
[26] In Malaysia, capital management of subsidiaries of commercial banks is carried out on a group-wide basis; this allows some subsidiary Islamic banks to maintain lower capital positions. Lower capital positions and solvency

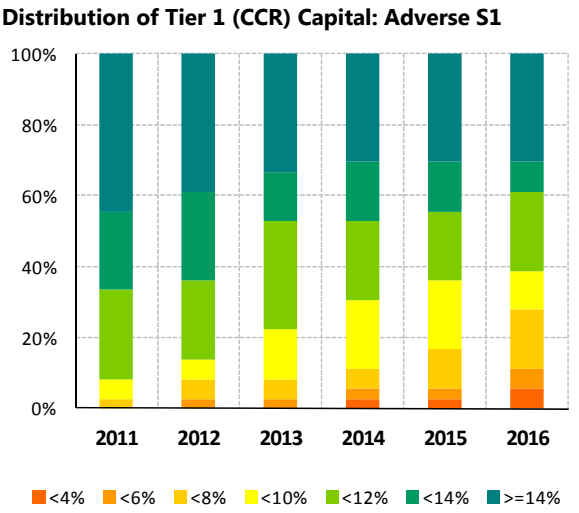
(continued)

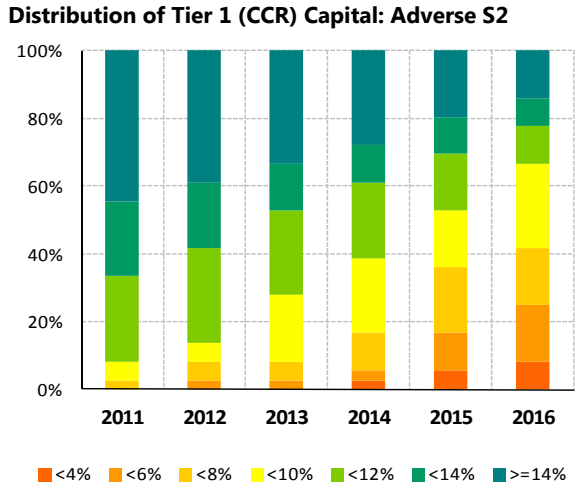
Figure 8. Top-Down System and Bank-by-Bank Solvency Stress Test Results

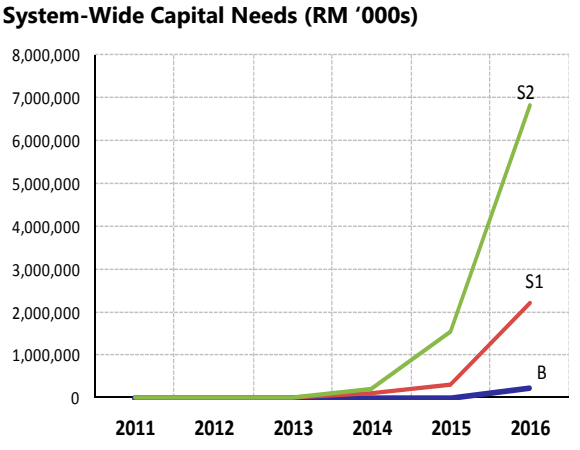












Source: IMF Staff Calculations, BNM data

Results calculated on the basis of a simple average of banks in the sample.

deterioration of some smaller Islamic banks may manifest itself in reputational risks to the group in adverse scenarios.

34. **Malaysian banks are resilient to stress at system and bank level even under adverse scenarios in the TD stress tests.** Loss rates and credit risk parameters are generally higher in the TD stress test (except for some retail loan segments, for some banks, in some years) than in banks' own BU estimates. Under the hypothetical but plausible adverse scenarios, including lower bank income for certain items, recalibration results in more significant solvency deterioration. But most banks (except some Islamic banks) still remain above 4 percent Tier 1 ratios. BNM currently undertake both on-site and off-site supervisory work to calibrate statistically each bank's specific risk profile. Credit risk parameters such as PDs, LGDs and loss rates for loan types and for Basel II equivalent sectors can be determined at granular levels. Loss rates and credit risk parameters are an important determinant of credit losses—the largest component impacting Malaysian banks' solvency. The higher the loss rates and credit risk parameters the larger the credit losses are in the macroeconomic scenarios and the more significant the deterioration in bank capital.

35. **BNM's TD approach in their sensitivity and scenario tests is to use historical highs from actual bank loss experience, taking the worst loss case and applying it to other banks.** While this is certainly one approach to estimating credit risk parameters and loss rates, and is the approach we have used for the baseline, it may still be unrepresentative of what could happen in future tail-risk scenarios. In tail-risk scenarios, credit deterioration and losses can be very marked beyond past historical highs.[27] Increase in credit losses in the adverse scenarios, with lower bank income growth assumptions for certain items due to this higher credit risk sensitivity, implies more marked solvency weakness for some smaller Islamic banks resulting in wiping out their capital.

B. Bottom-UP Stress Test Results

Macroeconomic Solvency Stress Tests

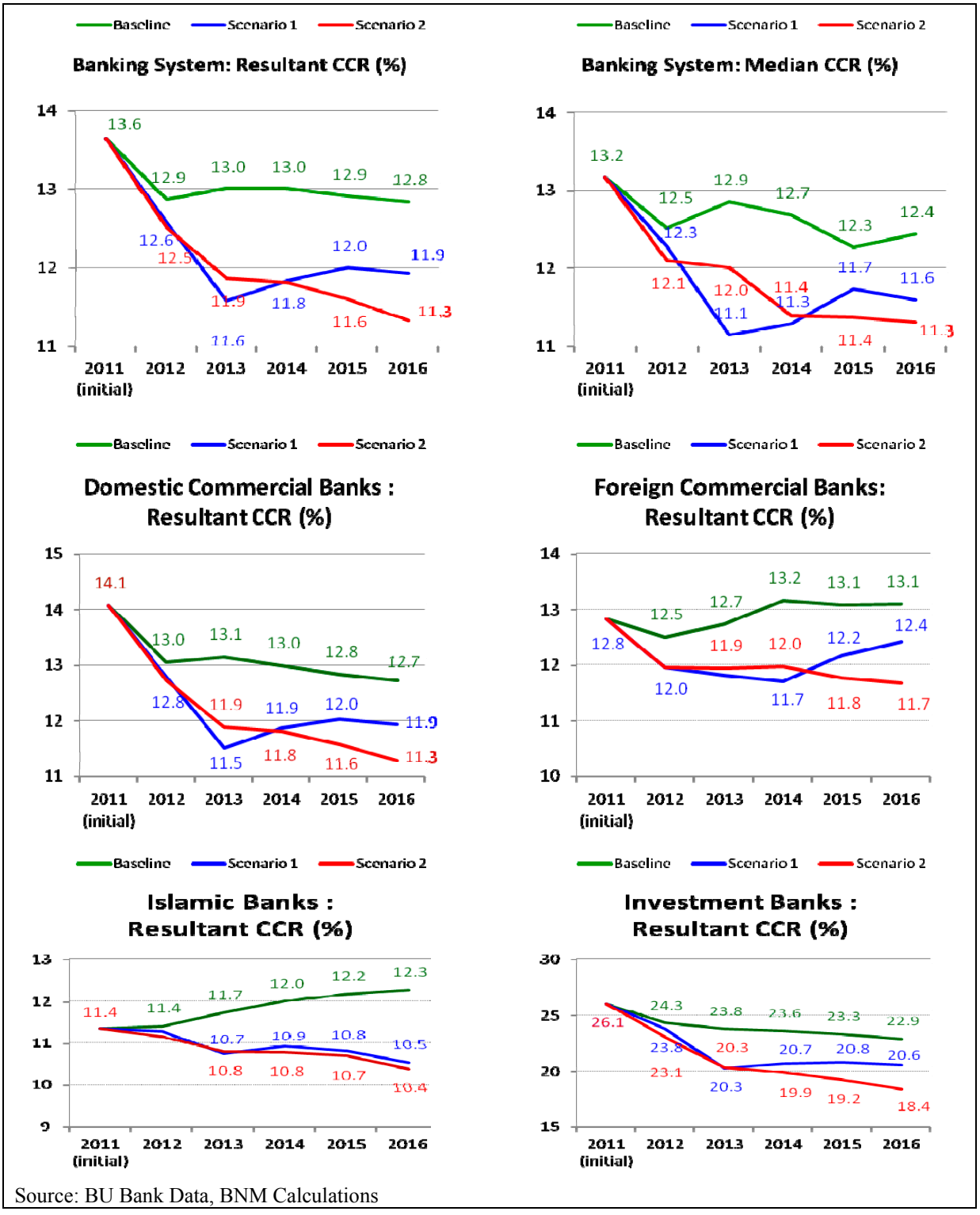
36. **The BU stress test results indicate similar to the TD results that the banking system and major banks are resilient to distress in all scenarios.** The differences between the TD and BU ST are due to differences in credit risk parameters, and bank income in the adverse scenarios. System wide CAR (RWCR) and Tier 1 (CCR) ratios remain above hurdle rates of 8 percent and 4 percent (Figure 9).[28] However, the variation in solvency deterioration across the scenarios is greater in the TD than the BU exercise. The contrast with the TD results is much starker in terms of solvency deterioration and much more marked at system level than evidenced from the BU results. In this regard, BU STs conducted by BNM are crucial in ensuring robustness of ST conducted by banks as a forward looking capital management tool. In

[27] Higher credit risk parameters have been observed in other Emerging Market economies. Credit risk parameters have been higher in Eurozone crisis countries (Ireland, Greece, Portugal, and Spain).

[28] The Malaysian capital standards and ratios such as the Risk weighted Capital Ratio – RWCR, and the Core Capital Ratio – CCR are somewhat more conservative than their Basel II equivalents such as the Total Capital Adequacy Ratio (CAR) and Tier 1 ratio. CCR is a narrow form of capital including only Tier 1 assets, while the RWCR also includes Tier 2 instruments. See Appendix 4.

practice, such supervisory BU ST intervention plays a vital role in enriching overall ST analysis of BNM and in informing macro- and micro-prudential assessments and policy measures.

Figure 9. Bottom-Up System and Bank-by-Bank Solvency Stress Test Results



Source: BU Bank Data, BNM Calculations

37. **Solvency declines at banking system level (in terms of RWCR and CCR) across all three scenarios, including the baseline**. In the baseline scenario the decline in CCR and RWCR is mostly due to a growth in risk-weighted assets (no capital raising allowed) with total credit and market losses increasing gradually over five years in tandem with an expansion of banks' balance sheet amid sound macroeconomic conditions. In the adverse scenario S1, the lowest resultant CCR and RWCR occurs in 2013 when the recession is at its height. Marginal improvements in solvency then result over 2014–2016, even though the GDP growth pick-up is rapid (Figure 9). This suggests an asymmetric solvency impact path with bank capital hit in a downturn with increase in bank capital muted and slow in the recovery phase (assuming no capital raising actions). For adverse scenario S2, a more continuous and steady decline in solvency through the forecast horizon 2012–2016 is apparent. There is no capital recovery in the smaller upswing as the low growth environment limits any significant capital uplift from insufficient retained earnings or reductions in risk-weighted assets through deleveraging.

38. **The solvency impact on different types of banks reflects differences in business strategies and how they are expected to evolve over the different scenarios.**

- *Domestic commercial banks and investment banks* tend to follow the main trends elaborated as above for the banking system, across the three scenarios.

- For *foreign commercial banks* in the baseline, capitalisation ratio rose from 2012–2014, and stabilized thereafter. This is attributed to income growth which outpaced loan growth in the first three years of the ST. This has helped foreign commercial banks to buffer some business-as-usual losses compared to domestic commercial banks. Foreign banks raised their capital ratios after the downturn in 2013 in both adverse scenarios, benefiting from improvements in gross operating income and retained earnings. Foreign commercial banks are agile in deleveraging rapidly.

- *Islamic banks*, similar to foreign commercial banks, are able to manage the growth in RWA as their balance sheets grow. Unlike commercial banks, Islamic banks are impacted hard by adverse scenarios with a continuous decline in capital ratios over the period 2012–2016. This may in part reflect concentrated portfolios and credit concentration in certain sectors that are impacted hard by adverse scenarios, such as auto and personal loans with similar concentration in housing, agriculture, and manufacturing. Islamic banks may also be more vulnerable to adverse scenarios due to their lower solvency starting positions, even though Islamic subsidiaries are assumed to be supported by a strong capital commitment by the parent.

39. **Solvency variation is more evident at the level of banks across the macroeconomic scenarios, some Islamic banks in particular falling below 8 percent CCR thresholds in adverse scenarios in the BU and TD ST at the end of the forecast horizon**. The capital distribution (in terms of RWCR and CCR) is skewed to the downside across all scenarios. In the baseline scenario (Figure 10) no banks recorded a CCR below 8 percent, while one domestic bank recorded a RWCR below 10 percent. In the adverse scenarios, Islamic banks suffer more

rapid and continuous solvency deterioration than other banks given their credit concentrations, such that one Islamic bank recorded a RWCR below 8 percent in adverse scenarios S1 and S2. Weaker solvency performance by Islamic banks over the macroeconomic scenarios was also confirmed from the TD ST results; but again the results were starker due to the greater adversity assumed in the TD ST results. Around fifteen banks in scenario S2 were below the 8 percent CCR at the end of stress test horizon for TD ST, of which eight were Islamic banks and the rest smaller domestic and foreign commercial banks. This evidence makes clear that multi-year macroeconomic stress testing is essential to fully comprehend how banks' solvency deterioration can be more rapid and extensive than over a single year. With regard to Islamic banks' lower solvency start positions, even with the parent bank providing capital support to ensure the Islamic subsidiary remains viable, reputational risk to the overall banking group may still exist. We do not assume any early supervisory prudential action over the macroeconomic scenarios to boost Islamic banks' capital ratios if and when the first signs of marked solvency deterioration are evident.

Recommendation

Notwithstanding parent capital support of their Islamic subsidiaries, it would be prudent for BNM to ensure Islamic subsidiaries in particular have higher capital ratios in line with conventional, commercial banks in Malaysia to buffer against adverse macroeconomic scenarios. Reputational risk to the overall banking group is real even though Islamic subsidiaries or even standalone Islamic banks are not systemic with regard to the overall Malaysian banking system (see Contagion Risk STs).[29]

Sensitivity Analysis—Single Factor stress tests

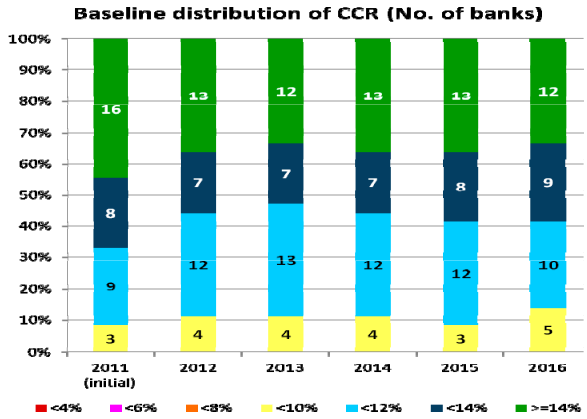
40. Single-factor sensitivity tests covered a variety of credit and market risks. Five single-factor credit shocks and seven single-factor market risks were applied to all 36 banks in the sample (Appendix 5). The sensitivity tests are assumed to be comparative static changes with no offsetting capital impact allowed, to obtain a clearer view of capitalization changes. In addition, no earnings buffer is assumed, and all credit and market risk shocks directly impact Tier-1 capital. The capitalization impact at the level of the banking system across each of these credit and market risk shocks decreased Basel II and Basel III capital ratios by less than 1 percentage point (ppt). The capital impact broadly for commercial banks was greater than Islamic and investment banks over most shocks. At the level of individual banks the capital ratio decreases were much wider, and for specific banks the impact was substantial (Figure 11).[30]

[29] It is not possible to determine, without further data and analysis, whether the failure of an Islamic subsidiary or standalone Islamic bank would be systemic for the Islamic banking system in Malaysia.

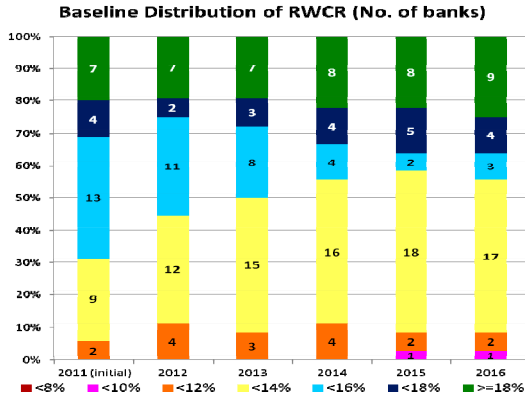
[30] This reflects different business models of banks, their unique balance sheet structures and the differences in the credit and market risk exposures.

Figure 10. Bottom-Up Capital Distributions by Banks

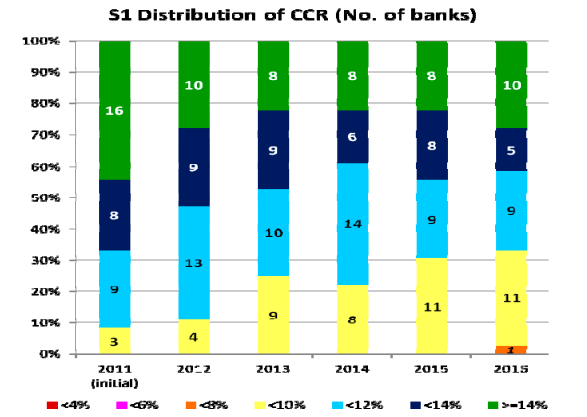
Baseline Scenario Tier 1 (CCR) Ratio Distributions



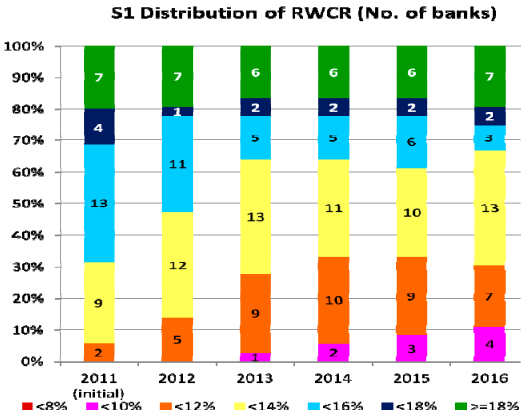
Baseline Scenario CAR (RWCR) Ratio Distributions



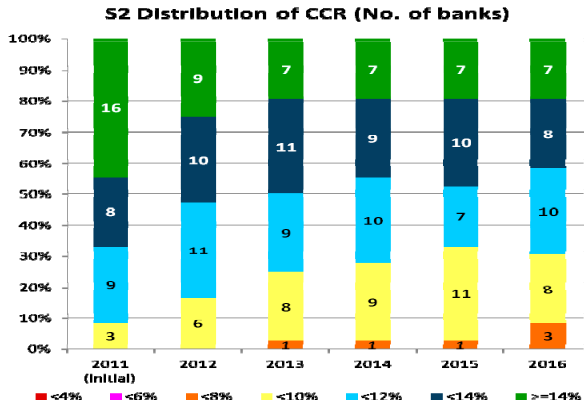
Adverse S1 Scenario Tier 1 (CCR) Ratio Distributions



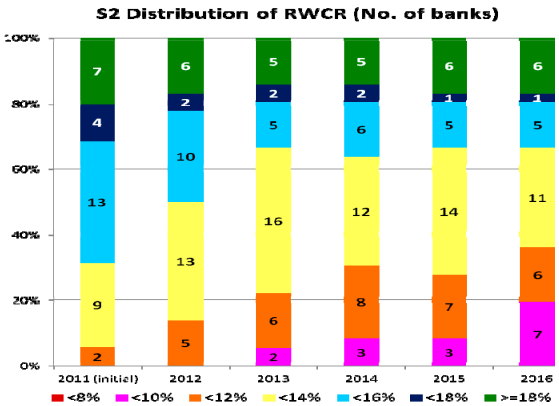
Adverse S1 Scenario CAR (RWCR) Ratio Distributions



Adverse S2 Scenario Tier 1 (CCR) Ratio Distributions



Adverse S2 Scenario CAR (RWCR) Ratio Distributions



Source:BU Bank Data, BNM Calculations

41. **Credit risk shocks, especially increased loss rates translated into higher PDs and LGDs for housing loans, have the greatest impact on system and individual capital ratios CAR (RWCR) and Tier 1 (CCR).**[31] Credit risk shocks related to housing loans' portfolio (CRS4 and CRS5) which involves PD and LGD shocks on current stock of performing housing loans (both to individuals and non-individuals), irrespective of credit grade of borrowers/accounts, recorded the most significant capital impact on commercial and Islamic banks. The majority of Investment banks were not impacted in median terms, given their different business models and a lack of retail lending. Some foreign commercial, Islamic and domestic commercial banks were more significantly impacted with capital decreases in their Basel II and Basel III ratios ranging from 200–560bps. For a single year shock, that represents a large solvency impact which reflects the large credit concentration some banks have to housing loans. The credit risk shocks CRS4 and CRS5 also impacted the most number of banks, suggesting the importance of housing loans to a large part of the Malaysian banking system. Another possible reason that increasing the credit risk parameters on these housing loans impacts so many banks to different degrees is linked to the banks' own credit risk management practice and past history with regard to housing loan defaults. Banks with a more troubled history may be more inclined to mark down losses and defaults earlier and to a greater degree than banks that have had a more favorable historical experience. For some Malaysian banks that have migrated to Basel II advanced IRB (internal models) approach, this could be reflected in markedly higher risk weights, LGDs, and PDs for housing loans than other banks.

42. **Credit risks shocks arising from holdings of PDS and sukuk due to either increased defaults of such corporate bond securities or the migration to weaker ratings is most significant for Investment banks**. Malaysian Investment banks, given their business profile, are expected to have large holdings of private corporate debt securities including sukuk. Any potential increase in defaults of these corporate debt securities (CRS1) or migration to weaker ratings (CRS2) has significant counterparty credit risk impact on these banks, translating to significant losses across nearly all Investment banks.[32] In median terms the impact for Investment banks is a decline in their capital ratios by around 40–140bps (Table 4). The impact on some investment banks given their credit concentration and significant holdings of these securities is actually far larger, with capital impacts ranging at the top-end around a 680bps (CRS1) and 836 bps (CRS2) decline in capital ratios for a given investment bank (Figure 11). Domestic, foreign commercial and Islamic banks have far smaller holdings of these private corporate debt securities with median impact around 20bps (Table 4 and Figure 11).

[31] The credit risk shocks on housing loans look at increasing PDs and LGDs to the following values. In the BU stress tests results they are labeled as CRS 4 and CRS 5. For CRS 4: PD=7 percent, LGD=20percent, while for CRS 5: PD=10 percent, LGD=30 percent.

[32] Default rates and rating migration rates were applied to all corporate debt securities held in AFS, HFT and HTM portfolios, including those rated by international rating agencies. Provisioning rate, assumed at 100%.

43. **An increase in risk weights of sovereign securities (MGS and GII) results in a substantial credit risk shock across all banks. Most banks for collateral, solvency and liquidity reasons will hold government securities such as MGS and GII**. The results show that increasing risk-weights on these securities from 0 to 20 percent will in median terms result in a 20–40bps decline in capital ratios (Table 4). While for some Investment banks in particular their significant holdings of government securities can result in a capital decline of 700–1070bps (Figure 11). In Malaysia as in other countries the sovereign-bank link is an important one. Sovereign risk could be potentially damaging for bank solvency, which in turn could impact sovereign debt positions if they recapitalize the banks. We have looked at sovereign risk in a particular way here through risk-weights. The actual solvency deterioration that occurs is somewhat difficult to deal with fully through acting on sovereign exposure.[33] This is a live issue without a resolution given the importance of unencumbered sovereign debt holdings for the Basel III capital and liquidity rules. Notwithstanding the absence of sovereign exposure limits, many countries, including Malaysia, could provide greater disclosure of the inter-linkages and exposures between banks and the sovereign, as European banks have done under the EBA ST exercises.

Table 4. Bottom-Up Single Factor Sensitivity Stress Tests

Median capitalisation and median impact		CCR (Basel II) percent	(+/- ppts)	RWCR (Basel II) percent	(+/- ppts)	CET1 Ratio (Basel III) percent	(+/- ppts)
BANKING SYSTEM (36)	CRS 1	12.7	(0.2)	14.3	(0.1)	11.0	(0.2)
	CRS 2	12.7	(0.0)	14.5	(0.1)	11.2	(0.0)
	CRS 3	12.7	(0.3)	14.5	(0.3)	10.9	(0.2)
	CRS 4	12.4	(0.3)	14.3	(0.3)	10.7	(0.3)
	CRS 5	11.8	(0.6)	13.6	(0.7)	10.2	(0.6)
	MRS 1	12.8	(0.1)	14.6	(0.1)	12.8	(0.1)
	MRS 2	12.8	0.1	15.1	0.1	12.8	0.1
	MRS 3	12.8	(0.1)	14.6	(0.1)	12.8	(0.1)
	MRS 4	12.8	(0.0)	14.6	(0.0)	12.8	(0.0)
	MRS 5	12.9	0.0	15.0	0.0	12.9	0.0
	MRS 6	12.8	0.0	14.7	0.0	12.8	0.0
	MRS 7	12.8	0.0	14.7	0.0	12.8	0.0
COMMERCIAL BKS	CRS 1	12.7	(0.2)	14.3	(0.1)	9.6	(0.2)
	CRS 2	12.6	(0.0)	14.5	(0.0)	9.8	(0.0)
	CRS 3	12.6	(0.2)	14.5	(0.2)	9.7	(0.2)
	CRS 4	12.1	(0.5)	14.3	(0.5)	8.7	(0.5)
	CRS 5	11.4	(1.1)	13.6	(1.1)	8.1	(1.0)
	MRS 1	12.7	(0.2)	14.4	(0.2)	12.7	(0.2)
	MRS 2	12.8	0.1	15.1	0.1	12.8	0.2
	MRS 3	12.7	(0.1)	14.5	(0.1)	12.7	(0.1)

[33] One way would be to impose limits on large exposures.

	MRS 4	12.7	(0.1)	14.6	(0.1)	12.7	(0.0)
	MRS 5	12.9	0.0	15.0	0.0	12.9	0.0
	MRS 6	12.8	0.0	14.7	0.0	12.8	0.0
	MRS 7	12.8	0.0	14.7	0.0	12.8	0.0
	CRS 1	10.9	(0.0)	13.2	(0.0)	10.8	(0.0)
	CRS 2	10.9	(0.0)	13.1	(0.0)	10.8	(0.0)
	CRS 3	10.7	(0.3)	12.8	(0.4)	10.7	(0.3)
ISLAMIC BANKS	**CRS 4**	10.6	(0.3)	12.7	(0.4)	10.5	(0.3)
	CRS 5	10.1	(0.7)	12.2	(0.8)	10.1	(0.7)
	MRS 1	10.9	(0.0)	13.1	(0.0)	10.9	(0.0)
	MRS 2	10.9	0.0	13.5	0.0	10.9	0.0
	MRS 3	10.9	(0.0)	13.1	(0.0)	10.9	(0.0)
	MRS 4	10.9	0.0	13.1	0.0	10.9	0.0
	MRS 5	10.8	0.0	13.2	0.0	10.8	0.0
	MRS 6	10.9	0.0	13.2	0.0	10.9	0.0
	MRS 7	10.9	0.0	13.2	0.0	10.9	0.0
	CRS 1	21.1	(1.3)	21.1	(1.3)	22.8	(1.4)
	CRS 2	22.7	(0.6)	22.7	(0.6)	23.6	(0.4)
	CRS 3	22.9	(0.3)	22.9	(0.3)	21.9	(0.3)
INVESTMENT BANKS	**CRS 4**	23.3	0.0	23.3	0.0	24.7	0.0
	CRS 5	23.3	0.0	23.3	0.0	24.7	0.0
	MRS 1	23.3	(0.1)	23.3	(0.1)	23.3	(0.1)
	MRS 2	23.3	0.1	23.3	0.1	23.3	0.1
	MRS 3	23.3	(0.1)	23.3	(0.1)	23.3	(0.1)
	MRS 4	23.3	(0.0)	23.3	(0.0)	23.3	(0.0)
	MRS 5	23.3	0.0	23.3	0.0	23.3	0.0
	MRS 6	23.3	(0.2)	23.3	(0.2)	23.3	0.0
	MRS 7	23.3	(0.1)	23.3	(0.1)	23.3	(0.0)

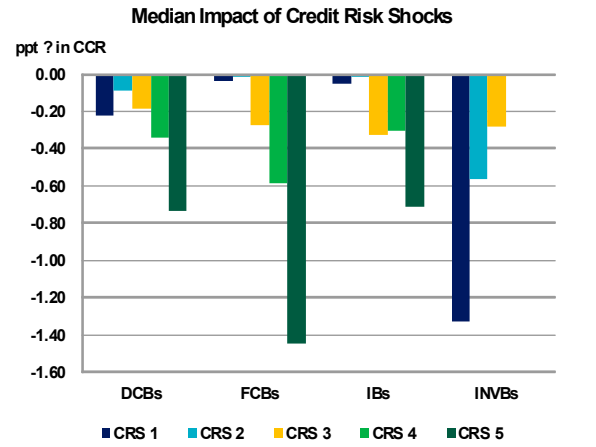
Source: BU Bank Data, BNM Calculations

CRS 1.	Defaults of PDS/sukuks and other corporate debt securities by rating
CRS 2.	Credit rating migration shock for PDS/sukuks and other corporate debt securities by rating
CRS 3.	Shock on risk weight for MGS and GII
CRS 4.	PD and LGD shocks on Housing Loans [PD=7percent, LGD=20percent]
CRS 5.	PD and LGD shocks on Housing Loans [PD=10percent, LGD=30percent]
MRS 1.	Interest Rate Risk Shock: Parallel upward shift in yield curve [+300 bps]
MRS 2.	Interest Rate Risk Shock: Parallel downward shift in yield curve [-250 bps]
MRS 3.	Interest Rate Risk Shock: Steepening of yield curve
MRS 4.	Interest Rate Risk Shock: Widening of credit spreads
MRS 5.	Foreign Exchange Risk Shock (see Appendix 5)
MRS 6.	Equity Risk Shock (Decline in FBM KLCI index (-67.3percent) to 500 pts]
MRS 7.	Equity Risk Shock [Decline in FBM KLCI index (-47.7percent) to 800 pts]

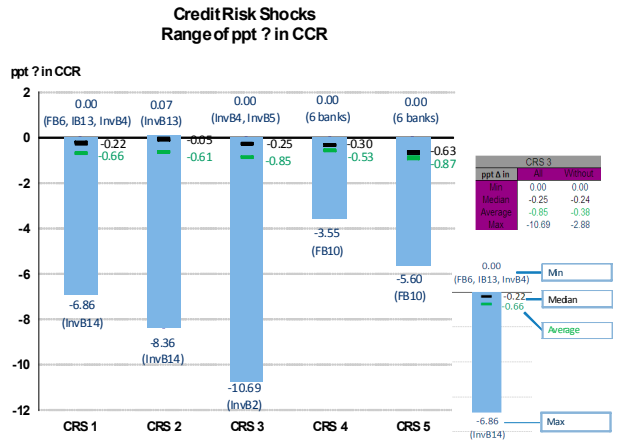
44. **The foreign exchange shock (MRS5) has the least impact on the banking system.** Some banks with sizeable net open U.S. and Singapore dollar positions benefit from the appreciation of the U.S. and Singapore dollar against the Malaysian Ringgit. At the level of the banking system, the impact on the capital ratios is no more than a 30bps decline from pre-shock capital ratios. From an individual bank perspective the biggest gainers (+70bps) and losers (-36bps) arise due to their sizeable US and Singapore dollar positions.

Figure 11. Bottom-Up Single-Factor Credit and Market Risk Shocks on Tier 1 (CCR)

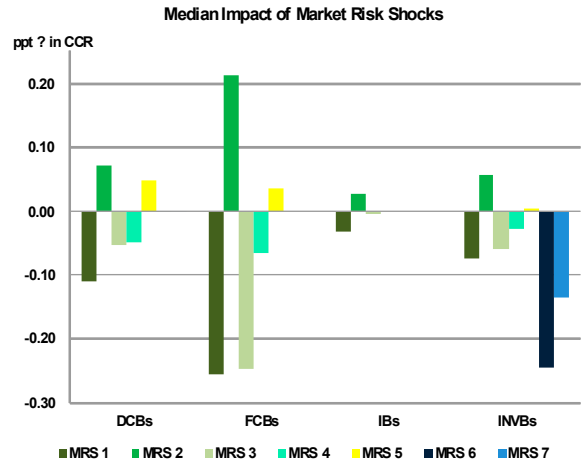
Single-Factor Credit Shock by Bank Type (ppt Changes)



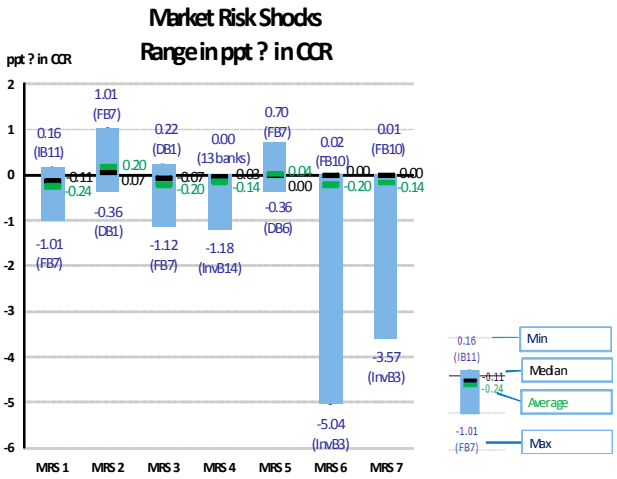
Single-Factor Credit Shock by Distribution (ppt Changes)



Single-Factor Market Shock by Bank Type (ppt Changes)



Single-Factor Market Shock by Distribution (ppt Changes)



Source:BU Bank Data, BNM Calculations

45. **Interest rate shocks (MRS1-MRS4) such as an upward shift, and or steepening of the yield curve, as expected negatively impact the banking system and banks' capital ratios.** Investment banks in particular lose the most in terms of upward shift or steepening of the yield curve with their CAR (RWCR) declining by 10-90bps, while banking system

declines are only 11bps (Figure 11). The marked-to-market (MTM) declines from these interest rate shocks are most significant for investment banks given their larger holding of fixed income products in their trading books. In the case of a parallel downward shift banks see a MTM gain, with the banking system gaining by 7 bps against pre-shock capital ratios.

46. **An equity risk shock in terms of a decline in the FBM KLCI is similar to interest rate shocks in that they have the greatest (MTM) impact on Investment banks given their larger equity investments in their trading books.**[34] A decline in the FBM KLCI results in a decline of capital ratios of all banks (except four) of around 10–90bps. The banking system impact is around 30bps decline. One investment bank recorded a very significant decline of 360–500bps.

Sensitivity Analysis—Multi-Factor Liquidity Stress Tests[35]

47. **The Malaysian banking system records a net cumulative surplus of Malaysian Ringgit (RM) (resilient in Ringgit terms) which arises due to a mismatch between assets and liabilities in the less than one month bucket.** This multi-factor liquidity stress test was undertaken to assess the liquidity implications on ringgit and U.S. dollar cash flows in terms of a simultaneous impact of: deposit withdrawals, crystallization of undrawn commitments and guarantees, no rollovers of interbank funding and foreign exchange swaps, and the application of haircuts on liquefiable assets to reflect widespread market distress. For RM denominated assets and liabilities, the cumulative net shortfall for the domestic commercial banks is around RM 6 billion ($1.8 billion U.S. Dollars). At the banking system level there is an overall net surplus of RM23.8 billion in available cumulative mismatch to accommodate further liquidity stress over the one-month horizon (Figure 12). This is in part driven by the net surplus recorded figures by foreign commercial, Islamic and Investment banks. Around 64 percent of all banks in the sample recorded a net RM denominated surplus but 36 percent of the banking system would be short of RM liquidity due to a multi-factor liquidity shock. A strong view emerging from this multi-factor liquidity test was that a bank was more likely to be in a net shortfall/surplus position if its pre-shock starting point was a net shortfall/surplus. Although the recent global financial crisis in 2008–09 saw severe liquidity and funding shocks propagating across multiple financial systems, Malaysian banks continued to maintain liquidity buffers without experiencing severe funding pressures or sudden fund withdrawals from their deposit-based funding structure, even during the Lehman bankruptcy episode. The preemptive temporary blanket guarantee on deposits by Government reinforced the stability of deposit movements in the banking system.

48. **Malaysian banks both at banking system level and by bank type would be short of dollar liquidity if a multi-factor liquidity shock were to impact assets and liabilities in**

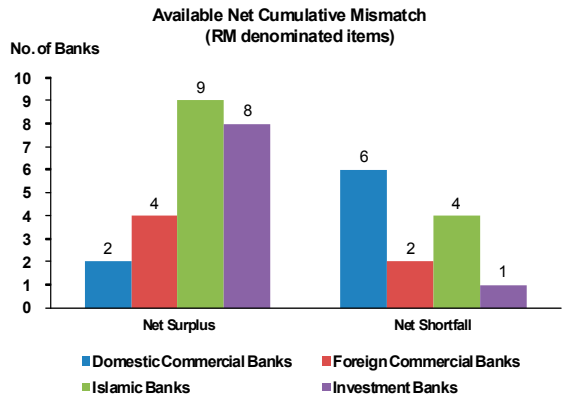
[34] Equity risk shock is covered under a market risk shock (MRS6) and (MRS7). For MRS6: decline in FBM KLCI index (-67.3 percent) to 500 pts and MRS7: decline in FBM KLCI index (-47.7 percent) to 800 pts.

[35] Specific, more comprehensive liquidity risk tests are conducted in the next section.

the less than one-month bucket. In dollar liquidity terms the cumulative net shortfall for the banking system is being driven by all types of banks but predominantly domestic and foreign commercial banks with a need of U.S. $6.4 billion (Figure 12). Around 76 percent of the banking system recorded a U.S. dollar liquidity shortfall. Similar to RM denominated net shortfalls, U.S. dollar liquidity shortfalls would be most likely if the pre-shock starting point was a net shortfall position and application of run-off rates on retail and corporate US dollar deposits range from 30–100 percent. Some banks have used less severe retail run-off rates and draw downs with a sizeable part of the banking system recording a liquidity shortfall. In the context of a worsening of the Eurozone/GFC crisis, Malaysian banks may find their access to U.S. dollar liquidity severely impacted given their current net U.S. dollar shortfall positions. The ability to maintain U.S. dollar deposits and access dollar funding in markets may be adversely curtailed. In a crisis situation it is clear the BNM through its domestic liquidity operations and foreign exchange (FX) swap operations could easily fill the liquidity shortfalls in both RM and dollar terms. Improved liquidity risk management by banks in this area would help to avoid financial fragility.

Figure 12. Bottom-Up Multi-Factor Liquidity Risk-Net Cumulative Mismatch

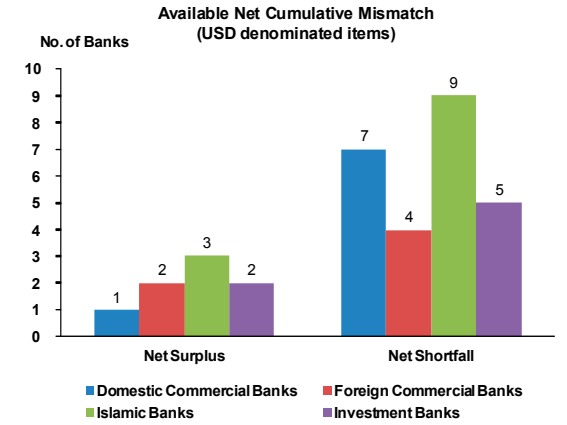
Multi-Factor Liquidity Shock by Bank Type (RM)



Multi-Factor Liquidity Shock Net Cumulative Mismatch (RM)

RM Denominated	Available Net Cumulative Mismatch (RM bil)	% of Deposit	% of Liquefiable Assets
Banking System	23.8	3.2	
Commercial Banks	*10.3*	*1.6*	
Domestic	(6.0)		5.9
Foreign	16.3	12.7	
Islamic Banks	*10.1*	*8.6*	
Investment Banks	*3.4*	*78.7*	

Multi-Factor Liquidity Shock by Bank Type (USD)



Multi-Factor Liquidity Shock Net Cumulative Mismatch (USD)

USD Denominated	Available Net Cumulative Mismatch (USD bil)*	% of Deposit
Banking System	(6.4)	
Commercial Banks	*(6.0)*	
Domestic	(3.3)	
Foreign	(2.7)	
Islamic Banks	*(0.2)*	
Investment Banks	*(0.2)*	

Source:BU Bank Data, BNM Calculations

49. **Labuan-based solo entities indicated a somewhat mixed response with regard to RM denominated and U.S. dollar denominated liquidity, but U.S. dollar liquidity shortage was very sizeable for one entity.** Only two Labuan-based entities were assessed with regard to a multi-factor liquidity shock, one entity recorded a RM denominated cumulative net shortfall while the other entity recorded a net surplus. However one entity recorded a very sizeable cumulative U.S. dollar surplus, even greater than the larger on-shore solo entities, except one.[36] We are unable to discern given the small sample size whether this represents a more general Labuan U.S. dollar financial fragility issue.

C. Liquidity Risk Stress tests

50. **TD liquidity STs were conducted using a recent comprehensive framework used for several FSAPs.**[37] The toolkit enables a variety of liquidity STs to be conducted given data availability. Given the granularity of liquidity data provided by BNM for the TD toolkit, the FSAP team was able to conduct a series of liquidity STs. The toolkit is able to undertake an implied cash flow test with two different approaches. First a tool to simulate bank-run type scenarios while accounting for fire sales of liquid assets and or central bank liquidity provision subject to eligible collateral and haircuts. Second, it has a liquidity gap analysis module that matches assets and liabilities for different maturity buckets under different stress assumptions, including rollover risk. The tool is also capable of calculating simplified Basel III liquidity metrics (LCR and NSFR). Simplified estimations of Basel III liquidity measures can be conducted using QIS data collected by BNM, but reported data is still undergoing intensive supervisory review. Taking this into account, BNM and the FSAP Team agreed that it was not timely to use existing Basel III measurements in this TD liquidity ST.

51. **The TD liquidity ST toolkit is also able to undertake more cash-flow based liquidity tests and link solvency risks with liquidity risks**. Cash-flow liquidity tests require detailed data on contractual cash flows for different maturity buckets and behavioral data based on banks' financial/funding plans. If the latter are not available, the tool can be run on contractual cash-flows only, and behavioral flows can be modeled based on the stress test assumptions. The calibrated scenarios then denote roll-over assumptions for contractual cash outflows and cash-inflows. The former focus on funding risk while the latter take into account the banks' objective to maintain its franchise value even under stress.[38] The toolkit also allows linking liquidity and solvency risk from three complementary perspectives. The assumptions are crucial for these tests and require sound judgment by the stress tester. First, the module allows simulating the increase in funding costs from a change in solvency,

[36] Given the tax advantages of locating in Labuan and the ease of carrying out non-RM transactions such a large net shortfall reflects a sizeable Labuan-based U.S. dollar liquidity risk.

[37] C. Schmeider, H. Hesse, B. Neudorfer, C. Puhr, S. Schmitz, *Next Generation System-Wide Liquidity Stress Testing*, IMF WP/12/3.

[38] If behavioral cash-flows are available, the stress test assumptions can be applied to these. Behavioral cash-flows are challenging to collect, they allow individual bank strategies, i.e. future funding mix to be considered.

indicated by a change in a bank's (implied) rating. The tool enables simulating the partial or full closure of funding markets (both long and short-term) depending on the level of capitalization with or without considering solvency stress. Third, it allows examining the potential impact of concentration in funding and a name crisis on banks' liquidity positions.

52. **The short-term daily liquidity ST suggests that majority of banks are able to survive through the week to make it into the weekend**. [39] The results for a mild stress scenario indicated that nearly all Malaysian banks were able to pass and survive. In a medium stress scenario (half Lehman) type event six banks would fail after day five (Table 5). The majority of these banks are domestic, foreign commercial and Investment banks. Some Islamic banks had a relatively better performance on this test which was suggestive of lower run-off rates, reinforced by the 100 percent deposit guarantee in the early part of the GFC. On average Islamic banks applied higher run-off rates on deposits relative to commercial banks. Islamic banks also record a greater potential of higher fire-sale prices for their assets adding to their inflows, although many such assets are unlikely to be more readily liquefiable than for domestic or foreign commercial banks. This result puts into context the results from the multifactor liquidity stress tests where most Islamic banks (like foreign commercial and investment banks) recorded net cumulative surplus in RM denominated liquidity but a net shortfall in U.S. dollar liquidity.

Table 5. Five-day Implied Cash-Flow Test under Medium Liquidity Stress[40]

Days of survival	Bank failures	Survival Rate of Banks (Percent)	Survival of Assets (Percent)
0	0	100.0	100.0
1	0	100.0	100.0
2	0	100.0	100.0
3	0	100.0	100.0
4	2	94.4	83.8
5	6	83.3	70.4

Source: BNM, IMF Staff Calculations

Table 6. 30-day Implied Cash-Flow Test under Medium Liquidity Stress

Survival	Number of Banks	Percent of Banks	Percent of Assets
No	14	38.9	50.3
Yes	22	61.1	49.7

Source: BNM, IMF Staff Calculations

[39] An important standard liquidity stress test utilizes a time horizon of five days (a business week) for a bank to survive liquidity stress (including a bank run). This assumes that the central bank is then able to resolve the crisis including closing of banks during the weekend. Run-off rates for deposits were in line with half the run-off rates (medium stress) seen for global banks at the time of the Lehman crisis. Run-off rates for short-term funding are in line with rates observed for EM banks in past crises, and have been used in recent FSAPs.

[40] We use assumptions on percent outflow of: deposits, short-term funding which is equivalent to an event half as severe as a Lehman event. See C. Schmeider, H. Hesse, B. Neudorfer, C. Puhr, S. Schmitz, *Next Generation System-Wide Liquidity Stress Testing*, IMF WP/12/3 for more details on actual run-off rates.

53. **Malaysian banks as expected would find survival over a longer period (30-day) under a medium stress scenario more challenging**. Fourteen Malaysian banks would fail to survive over a 30-day period (Table 6). It is the larger domestic and foreign commercial banks that would fail which represent a large part of bank assets from the ST sample of banks, while Islamic banks would tend to survive. As before the main driver is the relatively significant inflow from the fire sale of its assets. Certainly it is worth exploring in greater detail the issue raised by these implied cash flow tests: why Islamic banks on the whole tend to have relatively stable deposits (smaller proportionate outflows) and greater proportionate inflows from fire sale of assets compared to domestic commercial banks?

Table 7. Maturity Mismatch/Rollover Tests

	Test 2.2A		Test 2.2B		Test 2.2C	
Bucket	Cumulative no. of banks with shortfall	Shortfall (Percent of total Assets)	Cumulative no. of banks with shortfall	Shortfall (Percent of total Assets)	Cumulative no. of banks with shortfall	Shortfall (Percent of total Assets)
Up to 1week (Inv banks: 3 days)	15	36.7%	23	65.9%	23	65.9%
1 week - 1month (Inv banks: 4days - 1	23	56.4%	34	99.8%	30	86.7%
1-3 months	28	66.2%	36	100.0%	32	93.4%
3-6 months	29	66.6%	36	100.0%	32	93.4%
6-12 months	29	66.6%	36	100.0%	32	93.4%
>1 year	32	69.4%	36	100.0%	34	94.2%

Source: BNM, IMF Staff Calculations

54. **The maturity mismatch/rollover tests indicate that as maturities lengthen the maturity mismatch and shortfalls widen (Test 2.2A).** Moreover with no possibility of moving free assets across buckets (Test 2.2B) or due to dynamic rollover (Test 2.2C), more banks encounter liquidity shortfalls at shorter maturity buckets. The results indicate that liquidity stress is greater in funding longer-term assets and in the midst of a stress scenario only very short-term funding is able to be rolled over - and even that with some difficulty for the majority of banks (Table 7).

Table 8. Fully Fledged Cash Flow Tests

	Test 2.3.		
Bucket	Cumulative no. of banks with shortfall	Shortfall (Percent of total Assets)	Cumulated CBC of Banking System (after Gap & HC)
1 week - 1month (Inv banks: 4days - 1	10	24.6%	28,788,108
1-3 months	19	50.9%	-7,205,196
3-6 months	24	62.7%	-33,948,894
6-12 months	26	70.4%	-81,092,150
>1 year	36	100.0%	-528,397,017

Source: BNM, IMF Staff Calculations

55. **The fully-fledged cash flow tests (Table 8) indicate that after net inflows and outflows of cash, and including counterbalancing liquid assets and haircuts on them, shortfalls arise in nearly all maturity buckets.** In a scenario of liquidity stress, actual cash flow data of the banks does suggest that liquidity shortages will arise for the majority of banks at nearly all maturity buckets, suggesting that funding beyond a month will be difficult for most banks.

56. **Linking solvency inputs to the liquidity stress tests makes clear that increases in credit risk will impact solvency, which will be further impacted by increased funding costs**. The impact at system level is not dramatic in this case (Table 9) for the additional solvency impact of funding costs. However, for individual banks it can be significant. In particular, increases in funding costs for some Investment banks impacts their solvency far more significantly than for other types of banks.

Table 9. Solvency Shocks Impacts on Funding Costs

	Total Capital (percent)	Tier 1 Capital (percent)
Capitalization before Test	**15.2**	**13.3**
Capitalization (Stress), without Funding Costs	**10.3**	**5.9**
Capitalization (Stress), including Funding Costs	**10.1**	**5.7**

Recommendation

The liquidity stress tests have identified that BNM should focus on improvements in banks' liquidity resilience through tackling maturity mismatches at different tenors and the at call nature of all deposits in Malaysia.[41] *BNM should also seek to improve banks' liquidity data over and above the existing BNM Liquidity Framework requirements by providing an increased granularity of actual cash flow and behavioral cash-flow data. Moving forward, this will be addressed via the implementation of Basel III requirements in Malaysia in accordance to the global timeline. However it is worth bearing in mind that Islamic banks globally face challenges with regards to tackling liquidity. For example, the availability of shariah-compliant high quality liquidity assets remains an important challenge for Islamic banks globally in meeting the Basel III Liquidity Coverage Ratio. Notwithstanding liquidity challenges facing Islamic banks, many Islamic banks performed well in the liquidity stress scenarios at least relative to domestic commercial banks. Further analysis is required as to why net inflows due to fire sale of assets should be relatively higher for Islamic banks. The maturity mismatch and rollover stress tests indicate that only very short term funding is easier to rollover for Malaysian banks. This may suggest that challenges lie ahead for Malaysian banks to increase the duration of their funding. BNM is in the final stage of reconciling the QIS data to finalize LCR and NSFR numbers of banks to assess the scale of this longer-term funding shortfall and the possible implications for banks' balance sheet structures. We would advise this is completed at the earliest opportunity.*

[41] Where it is possible time-limits could be placed on deposit withdrawal.

D. Contagion Risk Stress Tests

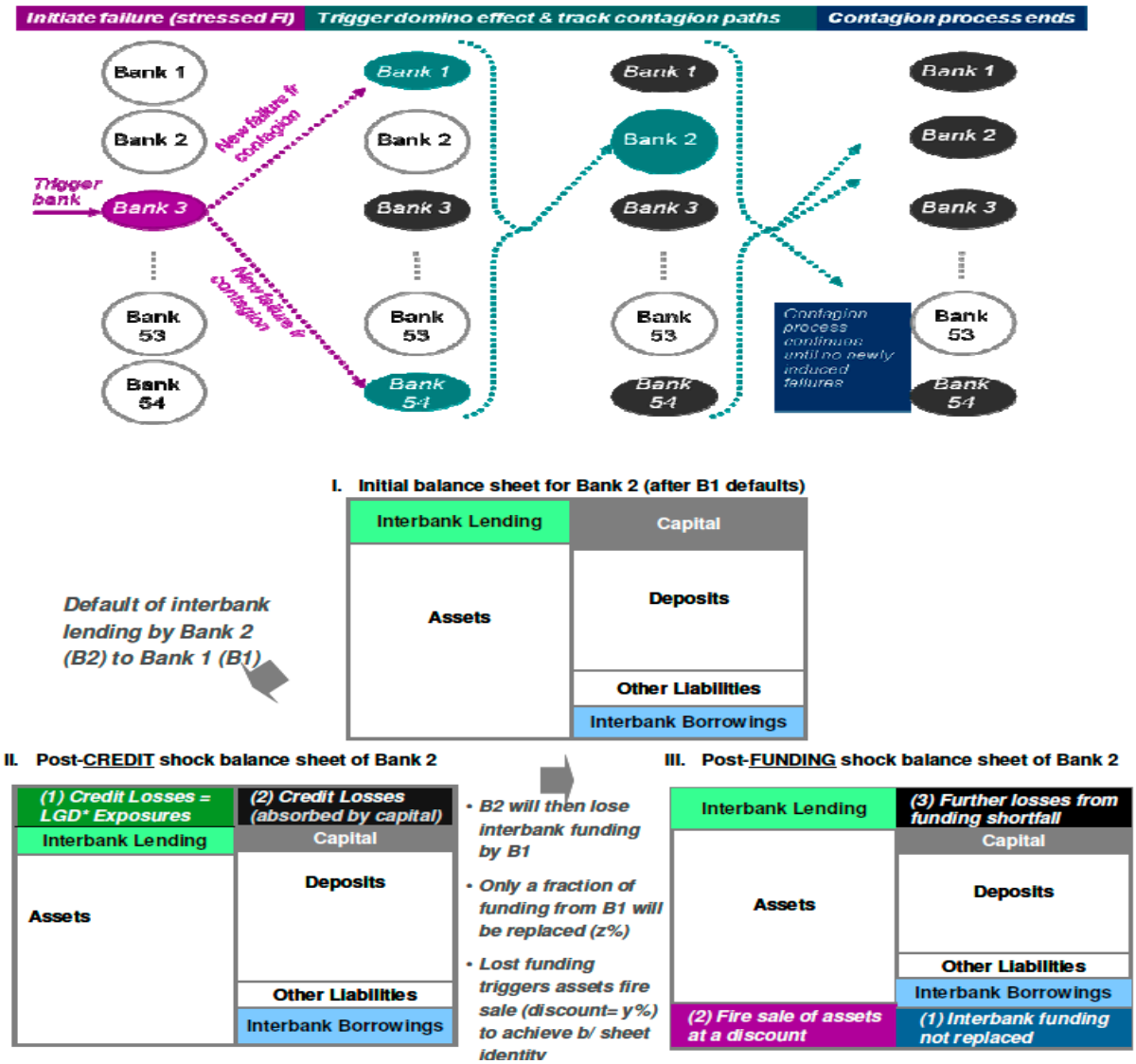
57. **The FSAP team utilized BNM's contagion risk model which is based on interbank exposures to capture interconnectedness and contagion impact from simulated bank failures.**[42] The network-based contagion risk model is a solvency stress test tool that captures gross interbank lending and borrowing relationships among Malaysian banks, denominated in both ringgit and foreign currencies, and measures the domino effects from simulated bank failure (or failures). The model is able to accommodate single and simultaneous failures in the interbank market while tracking the contagion path, quantifying potential capital losses and cumulative credit and funding shocks through balance sheet impacts (Figure 13). Key assumptions and shock parameters used in this test are as follows. First, trigger bank(s) default on outstanding interbank borrowing from all other banks (across all remaining maturities), and other banks are compelled to absorb 100 percent loss from default on all interbank loans to trigger bank(s). Next, trigger bank(s) is simulated to stop providing interbank funding in the market (assume no-rollover of all outstanding interbank funding across all remaining maturities provided to all other banks) causing liquidity shocks on banks funded by trigger bank(s). Other banks will need to replace the 'lost' funding (assume 50 pecent of funding needs through interbank market are not replaceable) through fire sale of assets (with a haircut of 50 percent) to restore respective balance sheets. The high haircut applied represents an important source of systemic risk, where the forced sale of assets may trigger a decline in the market value of other banks' portfolios. This simultaneous credit and funding contagion shock is simulated in an iterative manner until no additional bank has a resultant RWCR of <8 percent, taking into account any RWA adjustments to interbank loans which is set at 20 percent.

58. **In the first part of the interbank contagion risk analysis, individual bank failure is simulated one-at-a-time to examine the potential impact of joint credit and funding shocks across all interbank players (56 banks in total).** The potential contagion impact is assessed to be limited, with a maximum induced failure of 3 banks or a maximum of 2 contagion rounds (Table 10). Contagion impact is mostly contained within the trigger bank's banking group i.e. spillover to own subsidiaries. The largest domino effect from a single trigger bank is expected to affect the solvency position of 3 other banks within only one contagion round, indicating manageable adverse spillovers to other banks in the interbank market. Banking system RWCR is expected to remain above 13.7 percent, after absorbing losses arising from cumulative loan defaults and fire sale of assets by all affected banks. With different assumptions and slightly adapted model architecture, contagion impacts and bank failure may be more or less severe than that articulated here.

[42] This model set-up was facilitated by in-house work and IMF (2009) TA on assessing systemic linkages using model-based approaches. The data sample was larger than for other stress tests using a 55-bank sample.

59. **The vulnerability of banks to shocks in the interbank market is also assessed to be limited, as measured by the maximum hazard rate of 3.6 percent[43] (absolute hazard of 2)** [44]. Low hazard rate implies that the banking system and individual banks are not susceptible to significant spillovers arising from joint credit and funding shocks in the interbank market. A particular bank is expected to fail at most twice if all other banks are assumed to default one-at-a-time (Table 11).

Figure 13. BNM Contagion Model—Mapping Bank Failure to Balance Sheet Impacts



Source: BNM

[43] Defined as the total number of simulations in which a particular bank fails as a percentage of total number of simulations i.e. 55.

[44] The number of simulations it takes for a particular bank to fail.

Table 10. Contagion path and capital impact from banks that induced additional failures

Contagion Path			Cumulative Contagion Impact		
Trigger Defaulting Bank	Round 1	Round 2	No. of induced failure(s)	% BS capital eroded	Resultant BS RWCR
Bank 6	Bank 34, Bank 43, Bank 50		3	8.8	13.7
Bank 7	Bank 50		1	4.3	14.4
Bank 4	Bank 44	Bank 31	2	7.3	13.9
Bank 1	Bank 40	Bank 29	2	3.0	14.6
Bank 31	Bank 44		1	5.6	14.2
Bank 3	Bank 42		1	0.9	14.9
Bank 16	Bank 36		1	1.7	14.8
Bank 36	Bank 16		1	1.7	14.8

Source: BNM

Table 11. List of banks that may fail due to 55 individual defaults (one-at-a-time)

Banks	Absolute hazard	Hazard rate (%)
Bank 44	2	3.6
Bank 50	2	3.6
Bank 40	1	1.8
Bank 42	1	1.8
Bank 43	1	1.8
Bank 34	1	1.8
Bank 31	1	1.8
Bank 16	1	1.8
Bank 36	1	1.8

Source: BNM

60. **In the second part of the analysis, scenario-based simulations are conducted to examine the impact of simultaneous defaults (two or more-at-a-time) of a selected set of banks.** The scenarios (based on common themes of systemic linkages and impact) and the selection of trigger banks are as follows:

- Scenario 1: Four largest domestic and foreign banks (by asset size)–to assess interbank contagion impact from "too-big-to-fail" banks (Table 12);
- Scenario 2: Four most connected banks (by interbank borrowing counterparty)–to assess interbank contagion from "too-interconnected-to-fail" banks (Table 13);
- Scenario 3: Four most connected Islamic banks and investment banks (by interbank borrowing counterparty)–to assess contagion effects from Islamic and investment banks which borrow from a wide range of counterparties (Table 14); and
- Scenario 4: Seven locally-incorporated European banks (LIEBs) –to assess potential interbank shocks from LIEBs should deleveraging pressures intensify amid a worsened European debt crisis scenario (Table 15).

Table 12. Simultaneous (pair-wise) default of four largest domestic and foreign banks

Trigger Defaulting Bank	Round 1	Round 2	No. of induced failure(s)	% BS capital eroded	Resultant BS RWCR (%)
Bank 6 + Bank 7	Bank 34, Bank 43, Bank 50		3	11.4	13.3
Bank 6 + Bank 4	Bank 34, Bank 43, Bank 50, Bank 44	Bank 31	5	16.1	12.6
Bank 6 + Bank 5	Bank 34, Bank 43, Bank 50		3	11.3	13.3
Bank 4 + Bank 5	Bank 44	Bank 31	2	9.8	13.6
Bank 16 + Bank 21	Bank 36		1	1.8	14.8
Bank 18 + Bank 19			0	0.3	15.0
Bank 16 + Bank 19	Bank 36		1	1.8	14.8
Bank 18 + Bank 21			0	0.3	15.0

Source: BNM

Table 13. Simultaneous (pair-wise) default of four most connected domestic and Islamic banks

Trigger Defaulting Bank	Round 1	Round 2	No. of induced failure(s)	% BS capital eroded	Resultant BS RWCR (%)
Bank 1 + Bank 3	Bank 40, Bank 29, Bank 42		3	3.7	14.5
Bank 31 + Bank 32	Bank 44		1	6.7	14.0
Bank 1 + Bank 31	Bank 40, Bank 44	Bank 29	3	8.7	13.7
Bank 3 + Bank 32	Bank 42		1	1.7	14.8

Source: BNM

Table 14. Simultaneous (pair-wise) default of four most connected Islamic and Investment banks

Trigger default banks	Round 1	# induced failure(s)	% of BS capital base eroded	Resultant BS RWCR (%)
Bank 31 + Bank 32	Bank 44	1	6.7	14.0
Bank 34 + Bank 24		0	1.5	14.8
Bank 31 + Bank 34	Bank 44	1	7.0	14.0
Bank 31 + Bank 24	Bank 44	1	5.8	14.2
Bank 46 + Bank 40		0	0.9	14.9
Bank 53 + Bank 50		0	1.8	14.8
Bank 46 + Bank 53		0	0.6	14.9
Bank 46 + Bank 50		0	2.0	14.7

Source: BNM

Table 15. Simultaneous (multiple) default of LIEBs

Trigger default banks	Round 1	Number of induced failure(s)	% of BS capital base eroded	Resultant BS RWCR (%)
5 UK-based LIEBs Bank 19 + Bank 37 + Bank 16 + Bank 36 + Bank 9		0	2.2	14.7
All LIEBs		0	2.2	14.7

Source: BNM

61. **The scenario-based simulation results (simultaneous defaults of two banks) indicate that contagion effects are manageable**. The highest number of induced failures was due to a joint default of two large domestic commercial banks, in which 5 additional banks may default within 2 contagion rounds (Table 12), potentially eroding 16 percent of total banking system capital base. Nonetheless, overall banking system RWCR is expected to remain at 12.6 percent. Another feature evident (Table 12–Table 14) is the somewhat greater susceptibility of default of Islamic and Investment banks through single or multiple contagion rounds, no matter if the trigger banks were domestic, foreign, Islamic or Investment banks. These failures are mainly due to defaults of their parent bank or Islamic subsidiary. This might suggest group wide funding and liquidity arrangements may create potential for contagion vulnerability through such interconnectedness. In crisis or stressed circumstances, crisis liquidity operations by BNM or wider recapitalization by authorities could break the contagion impact in any given bank or the system. However that ultimately may not reduce systemic risk. Rather it may provide time for the authorities to resolve weaker banks. In summary, the results of the contagion impact analysis are as follows:

- Scenario 1: Contagion from failure of four largest domestic and foreign banks (by assets)—manageable impact. A maximum number of induced failures of 5 banks within 2 contagion rounds (Table 12). While failure of large domestic banks can result in multiple other bank defaults, the FSAP team was somewhat surprised at the magnitude of the solvency impact. We would have expected a much larger banking system solvency impact from these "too-big-to-fail" bank defaults. One consideration that may be driving the lack of impact is the magnitude of interbank exposures, especially their size relative to other exposures, e.g. for different loan portfolios, derivatives or off-balance sheet exposures.

- Scenario 2: Contagion impact from the four most connected banks (by number of counterparties) has limited impact, with a maximum number of induced failures of 3 banks within 1 contagion round (Table 13). The combination of a most connected domestic and Islamic bank had the most significant solvency impact. This may be suggestive of the existence of banks that are jointly key connected nodes of the interbank network with regard to contagion risk. Intra-group funding dynamics and

centralised group liquidity management especially between sister banks could explain this result.

- Scenario 3: Contagion impact from the four most connected Islamic and investment banks (by number of counterparties) has limited impact. A maximum number of induced failures of 1 bank within 1 contagion round (Table 14). This suggests that Islamic banks on their own do not have sufficient size or scale of operations yet to be systemic for the rest of the banking system.

- Scenario 4: In the context of a worsening Eurozone or GFC, simultaneous failure of all UK subsidiaries in Malaysia would not result in defaults of any other bank. Indeed even failure of all European bank subsidiaries in Malaysia would not be systemically important, with no contagion impact to any other Malaysian bank (Table 15). This is not surprising given the small size of these banks. However, this does not mean that tail-risk scenarios of a worsening of the Eurozone or GFC would not be problematic for Malaysian or other banking systems as the macroeconomic, trade and curtailment of bank revenue, profits and increased NPLs would be significant adverse effects.

Recommendation

The FSAP team would recommend that BNM continue developing their pre-existing contagion model sensitivity work. BNM should explore novel and new changes in assumptions not previously undertaken. New triggers of failure and or new types of credit and liquidity shocks, including changes in contagion path and use of other types of exposures should be considered to ensure robustness and comprehensiveness of contagion risk stress tests. We would also encourage the development of a separate contagion model for Islamic banks. It would be interesting to see how systemic the failure of one or more Islamic banks would map out for the Islamic banking sector rather than the banking system as a whole. *We would encourage the authorities to continue developing the contagion risk model as an addition and complement to their off-site supervisory and surveillance assessments of systemic risk. We also believe that contagion risk modeling may be helpful for complex financial conglomerates to see how intra-group exposures could cause simultaneous defaults of bank and nonbank entities as part of the group.[45] Another area where contagion risk modeling could be utilized would be to model defaults of Labuan entities on onshore and other Labuan banks.*

[45] BNM should share their model with large FHCs and groups to enable them to map their own internal network and vulnerabilities that could arise from such interconnectedness.

IV. KEY CONCLUSIONS

62. **The Malaysian banking system has so far proven itself to be resilient to the uncertain and volatile global and financial economic outlook, but caution is warranted.** In context of the adverse scenarios outlined here, which suggests a further conflagration of the GFC, structural changes to the Malaysian economy could occur with contagion from abroad impacting the real economy, and the trade and banking system in a significant way through current macroeconomic and financial channels. A loss of confidence by Malaysian consumers under these adverse, but plausible, scenarios could dramatically impact domestic consumption. Together with limited fiscal and monetary space, this could choke off domestic demand which has so far (under the baseline) kept the Malaysian economy resilient to global headwinds. The TD solvency tests indicate that, with higher credit-risk parameters under adverse scenarios than historically observed and with challenging macroeconomic conditions limiting bank revenue and profitability growth, some banks—especially some Islamic banks—may need additional capital to be better prepared for a prolonged period of economic malaise. The BU solvency tests indicated less solvency decline in the adverse scenarios. We would advise BNM to ensure banks are fully able to apply tail-risk scenarios in regard to their own stress testing. Specifically, banks should exercise caution when using historical values for loss rates and credit risk parameters (PDs, LGDs). The future tail-risk scenarios can be very different and often more severe than past historical data may suggest. One way to calibrate such credit risk parameters for tail-risk scenarios would be to use reverse stress testing, where credit risk parameters are set much higher. These parameters can be calibrated downwards to the point below which a certain threshold majority of banks are solvent, but above which a critical mass of banks would be insolvent.

63. **BNM is active and forward-looking with regard to determining banks' risk profiles, and has self-assessed its stress-testing capabilities against BCBS supervisory stress testing principles as "intermediate but with advanced features"**.[46] Notwithstanding its stress testing capabilities, it could continue to interrogate banks' internal models for those on the Advanced IRB approach to ensure they remain resilient to tail-risk scenarios. BNM should ensure Labuan bank stress- testing capabilities and data are in line with standards required for onshore banks. In addition BNM should also start to stress-test financial conglomerates and nonbanks that are deemed systemically important under recent legislation. BNM could also seek to integrate more fully its solvency, liquidity and contagion risk testing such that inputs from one feed into the other. With regard to liquidity stress testing, banks need to build increased resilience, independently of the authorities' liquidity and deposit support. BNM could start to report LCR and NSFR from latest QIS data to be able to assess Malaysian banks' readiness to meet the Basel III liquidity metrics. Furthermore Malaysian banks are hampered in rolling over longer term funding in the liquidity area with net shortfalls arising at all maturities beyond a month in a stressed scenario.

[46] We have not undertaken an assessment on the BCBS principles but we find that BNM's own assessment is fair and balanced at this time. We do not see any reason with sufficient resources and improvements to their ST framework as articulated in this Technical Note that BNM could not move to "advanced status".

APPENDIX 1. MALAYSIA: INDICATORS OF FINANCIAL SYSTEM SOUNDNESS, 2006–2011

	2006	2007	2008	2009	2010	2011
Banking Sector						
Risk-Weighted Capital Ratio	13.5	13.2	12.6	15.4	14.8	15.1
Core Capital Ratio	10.7	10.2	10.6	13.8	13.0	13.2
Leverage Ratio *(Total Shareholders' Funds to Assets)*	7.0	7.7	8.3	9.2	9.0	8.9
Return on Assets	1.3	1.5	1.5	1.2	1.5	1.6
Return on Equity	16.2	19.8	18.6	14.0	16.6	17.4
Liquid Assets-to-Total Assets	8.0	9.3	10.3	11.5	12.8	16.0
Liquid Assets-to-Short-term Liabilties		38.5	41.9	42.9	48.1	46.5
Net Non-performing Loans Ratio [1]	4.8	3.2	2.2	1.8	2.3	1.8
Gross Non-performing Loans Ratio	8.5	6.5	4.8	3.6	3.4	2.7
Provisions-to-Non-performing Loans	50.7	62.9	74.2	82.4	89.6	99.6
Duration Weighted Net Position to Capital Base	7.5	4.4	3.0	5.0	4.9	4.9
Net Open Positions in FX to Capital Base [2]	4.7	5.1	10.5	12.6	8.9	7.2
Net Open Positions in Equities to Capital Base	2.5	2.5	0.9	0.9	1.2	0.9
Development Financial Institutions [3]						
Lending to Targeted Sectors (% change)	17.5	18.7	16.3	18.5	13.0	7.1
Deposits Mobilized (% change)	11.1	12.4	18.5	14.4	20.5	16.1
Non-performing Loans Ratio	10.0	8.8	6.6	6.8	9.0	7.2
Provisions-to-Non-performing Loans				90.5	70.2	79.0
Return on Assets	1.5	1.9	2.9	2.3	2.2	2.7
Leverage Ratio *(Total Shareholders' Funds-to-Assets)*	13.3	13.8	16.0	14.8	13.7	13.7
Insurance Sector [2]						
Capital Adequacy Ratio (Conventional Only)	139.6	158.4	187.6	225.7	224.6	222.5
Life Insurance & Family Takaful						
Excess Income over Outgo (MYR billion)	12.2	14.6	8.7	12.6	14.1	12.7
New Business Premiums / Contributions (MYR billion)	9.6	0.3	0.1	10.0	11.2	10.0
Capital Adequacy Ratio (conventional only)	146.1	151.8	200.0	254.4	253.2	248.5
General Insurance & General Takaful						
Underwriting Profit (MYR billion)	0.5	-0.1	0.2	0.9	0.9	0.6
Operating Profit (MYR billion)	1.5	1.3	0.8	2.1	2.1	1.8
Gross Direct Premiums / Contributions (MYR billion)	10.5	11.0	12.0	12.8	14.1	15.4
Claims Ratio	60.0	65.0	61.2	60.3	52.1	66.0
Capital Adequacy Ratio (conventional only)	182.8	182.1	181.1	184.9	204.4	222.9
Household Sector						
Household Debt (MYR billion)	395.5	422.9	465.2	510.8	580.6	653.1
Household Financial Asset (MYR billion)	978.3	1160.0	1068.2	1225.8	1333.3	1499.8
Household Debt-to-GDP Ratio	68.8	65.9	62.7	75.1	75.8	76.6
Household Financial Assets-to-Total Household Debt Ratio	247.4	274.3	229.6	240.0	236.3	229.6
Household Liquid Financial Assets-to-Total Household Debt Ratio	157.7	175.3	141.5	152.6	154.1	148.1
Debt Service Ratio	39.1	41.1	39.5	49.0	47.8	48.1
Non-performing Loans Ratio of Household Sector	7.1	5.3	4.1	3.1	2.3	1.9
Corporate Sector						
Return on Assets	5.1	5.8	3.7	4.3	4.8	4.8
Return on Equity	10.0	11.5	7.3	8.0	8.9	8.4
Debt-to-Equity Ratio	50.3	47.9	52.7	44.7	40.7	44.8
Interest Coverage Ratio (times)	4.6	5.5	4.3	4.9	7.5	6.3
Operating Margin	10.9	10.9	9.0	10.7	10.7	11.4
Non-performing Loans Ratio of Business Sector	10.2	8.0	6.0	4.7	5.2	4.1

Source: BNM

1. Beginning January 2010, non-performing loans include impaired loans for banks that have adopted the Financial Reporting Standards (FRS) 139.

2. Beginning January 2008, the computation of net open position to capital base is based on Basel I Standardised Approach for Market Risk for foreign exchange risk.

3. Refers to development financial institutions under the Development Financial Institutions Act 2002.

APPENDIX 2. MALAYSIA: RISK ASSESSMENT MATRIX

Nature/Source of Main Threats	Likelihood of Realization of Threat (in the next 1–3 years) (high, medium, or low)	Expected Impact on Financial Stability if Threat is Realized (high, medium, or low)
Slowdown in economic growth	*Staff assessment:* ***Medium*** Domestic demand continues to be resilient supported by both public (government) expenditures and robust private consumption and sound investment. The prospect of elections (they must be held by mid 2013) will mean that in reality fiscal policy will remain supportive. Together with accommodative monetary policies (low interest rates) given the benign inflation outlook, macroeconomic policies should help mitigate the effects of lower external demand (see next risk). Weaker US growth, recession in the eurozone and slower growth in China and rest of Asia, remains a real threat. Strong trade and financial linkages with Europe, U.S., and China and rest of Asia, imply that Malaysia would remain vulnerable to a drop in demand for its exports, including commodities. The real economy trade impacts would be most significant given domestic banks benefit currently from robust domestic growth.	*Staff assessment:* ***Medium/ Low*** A weaker economy would dampen corporate and small business profits and employment, and undermine credit quality. House and asset prices could also be impacted by slowdown in real GDP growth, further impacting household, and bank and non-bank corporate balance sheets. The key to household financial stress will be the employment situation. Given the seeming low level of non EPF financial asset buffers of many households, a prolonged period of unemployment could lead to a substantial increase in NPLs. The expectation is that policymakers would be able to mitigate financial economy impacts through more favorable liquidity provision by BNM and accommodative monetary policy.
Sharp reversal of capital inflows	*Staff assessment:* ***Medium*** The downside risk of sharp and unpredictable reversals remains and this reversal could be driven by a range of changes in the external environment (see above), particularly a rise in risk aversion, or domestic shocks, such as election uncertainty.	*Staff assessment:* ***Medium/Low*** A reversal of capital flows is likely to impact the net external balance adversely with possible negative impacts on asset prices. Cross-border bank lending would also be reduced by Malaysian banks, though given robust domestic credit; total credit may remain well anchored. With ample reserves, downside risks could be mitigated by authorities' use of exchange rate policies and/or foreign exchange intervention The experience in 2008–09 and more recently indicates such pressures can be managed.
Decline in real estate and CRE prices	*Staff assessment:* ***Medium*** Gross household debt has risen notably (74 percent of GDP); most of this debt is	*Staff assessment:* ***Medium*** Loans to households and nonfinancial corporates form a significant part of

	in the form of mortgages (50 percent of total) and car (auto) loans (17 percent of total). Much has been made of household debt being offset by higher financial assets, though recent evidence suggest that the distribution of assets/liabilities and wealth is highly skewed, with majority held by the top 20 percent. In the face of unexpected shocks (domestic or external) causing a protracted recession, the ability of households to meet payments on mortgages will be negatively constrained. Given current and foreseeable low unemployment, robust earnings growth and credit expansion, the domestic conditions currently mitigate against sudden house price falls. Having said this some sectors of the property market may be starting to overheat and macroprudential and microprudential action has been used to address this.	domestic banks' loan portfolios. The concern arises whether a housing or CRE property bubble has emerged. BNM has applied a 70 percent LTV on third mortgages/ property only, this may not be sufficient. Additional direct action may be needed to reduce property price pressures (through taxes, and prudent restrictions on first and second mortgages). Rising unemployment or prospects for rising interest rates could impact housing and CRE prices adversely, impacting banks' balance sheets through lower valuations of real estate assets under foreclosure, higher NPLs and higher provisioning due to defaults by households and corporates on their debt. The financial spillovers from falls in house prices could adversely impact the real sector both through bank's balance sheets (deleveraging and lower credit provision) and reduction in consumption as wealth effects take hold from a fall in house prices.
Sovereign distress - MTM reductions in sovereign and GLC linked securities.	*Staff assessment:* ***Low*** Malaysia's Federal Government debt - around 52 percent - remains a concern. Inaction or lack of medium-to-longer term fiscal consolidation plans may significantly raise sovereign bond yields and CDS spreads. The market consensus currently is that fiscal consolidation plans remain inadequate to put public debt on a sustained downward trajectory. On the other hand, asset holdings by Petronas and Khazanah are substantial.	*Staff assessment:* ***Medium*** While banks are not substantially exposed to Malaysian government debt, holdings of GLC securities by Malaysian banks both in terms of their banking and trading book holdings, as well as EPF holdings, are not easy to estimate, in part because GLCs are included within 'private sector' for most data purposes. Substantial interlinkages could in the event of severe budgetary problems result in an adverse sovereign-banking loop, which would have significant negative real economy (growth) impacts.

APPENDIX 3. STRESS TEST MATRIX (STEM) FOR THE BANKING SECTOR: SOLVENCY RISK[47]

Domain	Assumptions	
	Bottom-Up (BU) by Banks	**Top-Down (TD) by FSAP Team**

Type of tests	• Macro-scenario analysis
	• Sensitivity analysis
	  ○ 5 single-factor credit shocks
	  ○ 7 single-factor market risk shocks
	(see Appendix 6 for more details)
		• Macro-scenario analysis

Institutions involved and market share	• 36 banks (commercial, Islamic and investment banks) including exposures of Labuan branches • 83 percent of banking system assets	
Data source and reference date	• Supervisory data as at end-2011 • Unconsolidated solo basis - to separate commercial, Islamic, investment, Labuan and material overseas subsidiaries	• Supervisory data as at end-2011 • Unconsolidated solo basis - to separate commercial, Islamic and investment subsidiaries
Horizon	• Macro-scenario analysis (5-year i.e. 2012-2016) • Sensitivity analysis (1-year)	• Macro-scenario analysis (5-year) • Contagion risk analysis (instantaneous contagion impact on solvency)
Methodology	• Macro-scenario analysis – Using consistent macroeconomic assumptions (harmonized by IMF/BNM for stress test purposes only), banks adopted internal models for (i) balance sheet and income projections, and (ii) calibration of credit and market shock parameters • Sensitivity analysis – shocks calibrated by BNM and IMF	• Macro-scenario analysis – TD solvency test based on Schmeider et al (2012), using macro assumptions consistent with BU (harmonized by IMF/BNM for stress test purposes only)

Macro assumptions	• Macro-scenario analysis
	  ○ Baseline :Latest WEO forecasts; taking into account conflagration of Europe sovereign debt crisis and GFC
	  ○ Adverse S1: V-shaped recession and slow recovery (peak to trough decline of 2.6SD with respect to average real GDP growth over the previous 12 years)
	  ○ Adverse S2: L-Shaped recession and prolonged low growth peak to trough decline of 1.3SD with respect to average real GDP growth over the previous 12 years, but low growth is persistent).
	• Macroeconomic conditions/variables: GDP, inflation, interest rates, exchange rates, unemployment, property prices, and various asset prices (CPO, crude oil, rubber)	

[47] Conventional Banks (commercial and investment banks) form approx 77 percent of banking system assets, Islamic banks form 23 percent. There are 25 commercial banks, 15 investment banks, 17 Islamic banks, 5 international Islamic banks, and 2 other financial institutions.

	○ Including GDP, exchange rates and inflation rates for 8 major countries • Financial market indicator conditions/variables (harmonized by BNM/IMF): KLIBOR and KLIRR rates, KLCI index and volatility, yields on public and private debt securities (MGS, GII and PDS), average financing/mortgage rates ○ Magnitudes of shocks determined by past (large) historical events, domestic or external.	
Risks/ factors assessed and Behavioral adjustment	• Balance sheet projections (y-o-y) based on business strategy/ portfolio adjustments and risk appetite settings, consistent with common stress test scenarios ○ Loan growth (by business sectors and retail segments) ○ Growth in trading and investment securities portfolios ○ Overall RWA growth ○ Growth in deposits and other main funding sources • Revenue growth and shocks ○ Net interest income, trading and investment income, fee income and other income • Profit and retained earnings ○ Tax rates and dividend payout rates based on current practices ○ No planned capital raising activities are included • Credit risk shocks ○ PD and LGD shocks (by loan segments) ○ Increase in impaired loans and shocks on collateral value • Market risk shocks ○ MTM losses/gains based on net of interest rate, FX, equity and exposures • Shocks on off-balance sheet exposures ○ Higher drawdowns on credit facilities	• Satellite models linking to macro variables ○ BNM provided satellite model estimations linking system-wide credit growth, impaired loans and gross operating income, according to stress test scenarios • Shocks on impaired loans and stressed credit loss rates (by business sectors and retail segments) ○ BNM provided estimations of credit loss rates (baseline scenario), based on satellite models linking PDs and LGDs (by business sectors and retail segments) ○ Credit loss rates (by business sectors and retail segments) for adverse scenarios adjusted by FSAP Team based on benchmark EME FSAPs and expert judgment • Higher RWAs on sovereign exposures • Consistent industry-wide dividend payout and tax rates applied • Only organic capital growth is imputed
Calibration of risk/shock parameters	• Revenue shocks (modeled based on actual downturn experience, and calibrated y-o-y shocks based on scenarios and balance sheet projections) • Credit risk shocks (modeled based	• Point in time credit risk parameters • Point in time loss rates • Including stressed and adverse credit risk parameters and loss rates

	on actual downturn experience, and calibrated y-o-y shocks based on scenarios) ○ PD and LGD shocks (by loan segments); or ○ Stressed impaired loans flow rates ○ Shocks on collateral value • Market risk shocks ○ MTM losses/gains based on net of interest rate, FX, equity and exposures	
Regulatory standards	• Hurdle rate, e.g., Basel II CAR (RWCR) 8 percent, Tier 1 (CCR) 4 percent • Capital definition based on Basel II and III (both with local regulatory finishes) • StA and F-IRB, A-IRB	
Results	Sensitivity analysis • Median/aggregate impact on CAR/Tier1/RWA and CET1 ratio (bank by bank, by industry and system-wide) • Losses as percentage of capital base, CET1 and RWA Macro-scenario analysis • Median/aggregate impact on CAR/Tier1/RWA and CET1 ratio (bank by bank, by industry and system-wide) • Losses as percentage of capital base, CET1 and RWA • Stressed capital distribution by banks	Macro-scenario analysis • Aggregate impact on CAR/Tier1 and CET1 ratio (bank by bank, by industry and system-wide) • CAR/Tier1 shortfall (system wide) • Stressed capital distribution by banks

Stress Test Matrix (STeM) for the Banking Sector: Liquidity Risk [1/]

Domain	Assumptions	
	Bottom-Up (BU) by Banks	**Top-Down (TD) by FSAP Team**

Type of tests	• Multi-factor liquidity risk shocks (on ringgit and US dollar denominated assets and liabilities)	• Liquidity test
		  ○ Implied and or fully funded cash-flow tests
		  ○ maturity mismatch test/ rollover risk test
		  ○ liquidity-solvency link test

Institutions involved and market share	• 36 banks (commercial, Islamic and investment banks) including exposures of Labuan branches • 83percent of banking system assets	
Data source and reference date	• Supervisory data as at end-2011 • Unconsolidated solo basis - to separate commercial, Islamic, investment, Labuan and material overseas subsidiaries	• Supervisory data as at end-2011 • Unconsolidated solo basis - to separate commercial, Islamic, investment
Horizon	• 1-month	• 5 days, 30 days, up to 1 year

Methodology	• Simultaneous liquidity shocks due to
	  ○ deposit withdrawals
	  ○ crystallization of commitment and contingencies, higher drawdown of undrawn credit facilities
	  ○ no rollovers of interbank funding and FX swaps
	  ○ haircuts on liquefiable assets
	• Scenario-based multi-factor liquidity risk shocks, applied to MYR and USD exposures, are calibrated by BNM (and agreed by IMF), and driven by institution-specific and market wide distress events e.g.
	  ○ Market-wide risk aversion
	  ○ Dry-up of interbank or wholesale funding markets
	  ○ Fire sale of assets
	  ○ Counterparty risk concerns
	  ○ Capital deterioration
	  ○ Credit rating downgrades
		• Use of IMF Liquidity Testing approach – see Schmeider et al (2012) IMF WP/12/3

Risks and shock parameters	<u>For RM denominated items based on BNM Liquidity Framework</u>
	▪ Bank-specific liquidity shocks on different types of instruments/ customers, *subject to cap and floor, as specified below*:
	1) *Retail deposit withdrawals*
	  ○ Largest 30-day horizon run-off rates observed in the past 5 years for each type of deposit:
	  - Fixed deposit
	  - Savings deposit
		• Scenario-based Liquidity Analysis
		• Applied to RM and Foreign currency exposures, with on- and off-balance sheet linkages
		• Liquidity shock parameters (bank runs):
		  ○ Run-off rates (baseline and adverse) varied for retail, corporate, interbank deposits, stressed run-off rates for non-resident deposits.
		  ○ Dry-up of interbank or wholesale

	- Current account deposit - Call money - General investment deposit - Specific investment deposit o Floor: 5 percent o Capped at 30 percent ***2)*** *Corporate deposit and NIDs withdrawals* o Largest 30-day horizon run-off rates observed in the past 5 years for each type of deposit: • Floor: 30 percent • Capped at 75 percent for the following: - Fixed deposit - Savings deposit - Current account deposit - General investment deposit - Specific investment deposit • Capped at 100percent for the following: - Call money - Short term deposit - NIDs ***3)*** *Drawdown on commitments and guarantees* o Largest drawdown rates observed in the past 5 years over 30-day horizon o Floor: 5 percent o Capped at: - 20 percent for credit facilities - 100 percent for liquidity facilities ▪ Common shocks for all banks on the following: ***1)*** *No rollover of interbank and FX swaps maturing within 30 days* ***2)*** *Haircuts on Class 1 liquefiable assets: 10 percent* ***3)*** *Haircuts on Class 2 liquefiable assets: 30 percent* <u>For USD denominated items based on BNM Liquidity Framework</u> ▪ Bank-specific liquidity shocks on different types of instruments/ customers: o *Largest 30-day horizon run-off rates observed in the past 5 years for each type of deposits* o *Largest drawdown rates observed over 30-day horizon for commitments and guarantees* • *No rollover of interbank and FX swap for amounts maturing within 30 days*	funding (secured and unsecured). o Liquidity shock due to realization of commitment and contingencies, higher drawdown of undrawn credit facilities, crystallization of guarantees (asset encumbrance). o Liquidity shocks due to failure of rollover of maturity assets. o Valuation reduction in liquefiable assets, stressed haircuts, discounted cash flows (lower PV), due to higher risk-premium, fire-sales. o Liquidity losses due to forbearance—lower principal and coupon repayments. • Calibrated based on advanced economies Lehman-type (market-wide) events
Regulatory standards	• Net available cumulative mismatches to accommodate liquidity shocks (up to 1 month) - as per BNM Liquidity Framework	• Hurdle metrics, e.g., how long (days, weeks, months) can banks withstand shocks, how many banks show a shortfall

Results	For ringgit:
	• Net available cumulative mismatch to accommodate liquidity shocks (up to 1 month)
	  ○ Surplus as a percentage of remaining ringgit deposits (fixed, savings and current)
	  ○ Shortfall as a percentage of discounted value of Class-1 and Class 2 liquefiable assets
	
	For US dollars:
	• Net available cumulative mismatch to accommodate liquidity shocks (up to 1 month)
	  ○ Surplus as a percentage of remaining US dollars deposits (fixed, savings and current)
		• Time taken by banks to withstand liquidity shocks (days, weeks, months)
		• How many banks fall short; as a percentage of liquid assets?
		• Liquid assets divided by short-term liabilities due in 30 days

Stress Test Matrix (STeM) for the Banking Sector: Other Systemic Tests [1/]
(e.g., Contagion/Spillover Risk)

Domain	Assumptions
	Top-down Contagion Risk Analysis by BNM
Institutions included and market share	• 53 banks (commercial, Islamic investment banks), excluding 3 newly-established banks • 99.8 percent of banking system assets
Data and baseline date	• Supervisory data as at end-2011 • Unconsolidated solo basis - to separate commercial, Islamic, investment banks

Methodology	• Use BNM Interbank contagion risk model
	  • Based on gross interbank lending and borrowing relationships among all banks
	  • Seeks to measure the extent of domino effects from simulated bank failure(s) in the interbank market, track the contagion path and quantify potential capital losses due to cumulative credit and funding shocks
	  • Identify potential systemic super-spreaders and less systemic counterparties
	• Initialization of this model involves simulating a particular bank failure or a set of bank failure(s) (defined as trigger bank(s)) which defaults on its interbank borrowing and resort to cutting back funding to all other interbank players (excluding BNM as an interbank counterparty). Post-initialization, the model simulates two forms of contagion shocks on all other banks, disregarding any policy responses by BNM:
	
	1. Credit shocks:
	
	▪ Trigger bank(s) default on outstanding interbank borrowing from all other banks (across all remaining maturity); and
	
	▪ Other banks are compelled to absorb 100 percent loss from default on all interbank loans to trigger bank(s).

Domain	Assumptions
	Top-down Contagion Risk Analysis by BNM
	2. Funding shocks: ▪ Trigger bank(s) stop providing interbank funding in the market (assume no-rollover of all outstanding interbank funding across all remaining maturity provided to all other banks) causing liquidity shocks on banks funded by trigger bank(s); and ▪ Other banks will need to replace the 'lost' funding (assume 50 percent of funding needs through interbank market is not replaceable) through fire sale of assets (with a haircut of 50 percent) to restore respective balance sheet. The high haircut applied represents an important source of systemic risk, where the forced sale of assets may trigger decline in market value of other banks' portfolio. • The simultaneous credit and funding contagion shocks is simulated in an iterative manner until no additional bank has a resultant RWCR of <8 percent.
Shocks assumptions	• Solvency hurdle rate or failure threshold = RWCR < 8 percent • Risk-weight for interbank loans = 20 percent • Loss given default (LGD) of interbank loans = 100 percent • Percent of funding not refinanced upon each failure = 50 percent • Haircut on fire sale of assets = 50 percent
Type of tests and scenario design	• Single default (simulating one-at-a-time hypothetical failures) to determine the (i) degree of contagion effects, and (ii) vulnerability to joint credit and funding shocks, of each bank via the interbank market • Scenario-based simultaneous defaults (simulating two- or more-at-a-time failures) based on common themes of systemic linkages and impact: o Scenario 1: Four largest domestic and foreign banks (by asset size)—to assess interbank contagion impact from "too-big-to-fail" banks o Scenario 2: Four most connected banks (by interbank borrowing counterparty)—to assess interbank contagion from "too-interconnected-to-fail" banks o Scenario 3: Four most connected Islamic banks and investment banks (by interbank borrowing counterparty)—to assess contagion effects from Islamic and investment banks which borrows from a wide range of counterparties o Scenario 4: Seven locally incorporated European Banks (LIEBs)—to assess potential interbank shocks from LIEBs should deleveraging pressures intensify amid a worsened European debt crisis scenario
Results	Single default simulations • Degree of contagion effect by each bank o As measured by (i) contagion path, (ii) no. of contagion rounds, (iii) total banking system capital erosion and (iv) resultant system RWCR • Degree of vulnerability of each bank to shocks in interbank market o As measured by (i) hazard rate and (ii) absolute hazard Scenario-bases simulations • Degree of contagion effect by a group of banks o As measured by (i) contagion path, (ii) no. of contagion rounds, (iii) total banking system capital erosion and (iv) resultant system RWCR

APPENDIX 4. MALAYSIAN CAPITAL FRAMEWORK VS BCBS BASEL II

Malaysia utilizes two key capital ratios Risk Weighted Capital Ratio (RWCR) and core Capital Ratio (CCR) to determine solvency of its Banks. These are related to Basel II equivalents – Tier 1, and CET1. BNM has outlined that RWCR and CCR capital ratios are Basel II equivalent, but a degree more conservative in various ways (see below). For example, Available for Sale (AFS) gains are not allowed to be taken up in Malaysia but are under the Basel II capital metrics**.**

Differences between the Malaysian capital framework vs. BCBS Basel II
Definition of Capital (numerator of capital ratio)

- Deductions are currently made at the total capital level (except for goodwill, which is deducted from Tier 1 capital) instead of 50 percent from Tier 1 capital and 50 percent from Tier 2 Capital. (See Part C in Annex 1a of BCBS's Basel II Standard);

- For banking institutions that use the Standardized Approach for credit risk, inclusion of general provision in Tier 2 capital is currently not subjected to the limit prescribed by the BCBS as stipulated in paragraph 49(x)(a) of BCBS's Basel II standard;

- Tier 3 capital is not recognized in the regulatory capital base; and

- No recognition of the available-for-sale revaluation reserves in Tier 2 capital although BCBS's Basel II standard (paragraph 49(vi)) allows for recognition of 45 percent of these reserves in Tier 2 capital.

Credit Risk

Adoption of more conservative treatment based on benchmarking of other regulatory practices, whereby 20 percent credit conversion factor (CCF) applied on un-utilized credit card lines instead of 0 percent CCF (paragraph 2.84 of RWCAF and paragraph 2.101 CAFIB)

Differentiated risk weights to better reflect the underlying risk of specific exposures: Risk weights applied on performing residential mortgages range from 35 percent to 100 percent based on the loan-to-value (LTV) ratio of each exposure, instead of a standard 35 percent risk weight (paragraphs 2.32 to 2.33 of RWCAF and paragraphs 2.39 to 2.40 of CAFIB; and Term loans for personal use with an original maturity of more than 5 years are 100 percent risk weighted, instead of 75 percent risk weight (paragraph 2.29(i) of RWCAF and 2.37 of CAFIB).

Market Risk

Higher interest rate and equity risk capital charges for exposures to non-G10 countries to reflect more volatile financial market conditions observed in emerging economies

Large Exposure Risk Requirement

While not required under the Basel rules, a Large Exposure Risk Requirement applies in Malaysia (Part E of RWCAF and CAFIB):

• Banking institutions to compute capital requirements for large exposure risks in relation to holdings of equities; and

• Investment banks to compute capital requirements for large exposure risks in relation to exposure to a single counterparty arising from unsettled trades and free deliveries in the normal course of trading in equities. The large exposure risk requirement capital charge is equivalent to the corresponding counterparty risk requirement stipulated in paragraph 7 of Appendix IX of RWCAF.

Addressing the specificities of Islamic finance

The CAFIB which reflects the specificities of Islamic banking operations was developed in line with the Capital Adequacy Standards issued by the IFSB and is similar to the RWCAF for conventional banking institutions with refinements to incorporate amongst others, the following requirements:

• Risk exposures of Islamic banking transactions are determined based on underlying Shariah contracts (asset-based, lease-based, equity based contracts); and

• Credit and market risks of the exposures funded by Mudharabah funds (i.e. profit sharing and loss-bearing fund placements), where the risks are absorbed by the fund provider instead of the Islamic banking institutions, may be excluded from the RWCR computation, subject to conditions stipulated in the Guidelines on The Recognition and Measurement of Profit Sharing Investment Account as Risk Absorbent (issued on 1 January 2008).

Other elements of Basel II and Basel II.5 not yet adopted in Malaysia

• Standardized approach (SA) and internal models method (IMM) for counterparty credit risk

- Introduction of the more advanced approaches for counterparty credit risk was considered to be less critical as exposures to derivative contracts have remained insignificant. Ongoing developments in regard to counterparty credit risk management under the Basel III would also help inform whether these approaches should be introduced or allowed much sooner.

• IRB Approach for securitization

- Securitization exposures of banking institutions in Malaysia have remained very minimal. With capital requirements on securitization exposures still

evolving under Basel III, any changes would only be introduced once the new requirements are finalized.

• Advanced Measurement Approach for operational risk

- The operational risk measurement among most Malaysian banking institutions has been basic. As such, the supervisory focus has been on developing a proper operational risk management framework including oversight arrangements and developing a strong operational risk culture and awareness before allowing the adoption of the more advanced approach for operational risk measurement.

Basel II.5

The Basel II.5 enhancement package which relates mainly to strengthened capital requirements for trading book and complex securitization exposures has yet to be implemented in Malaysia, and is not expected to be a priority for Malaysia in the immediate term. While these markets and activities have developed more noticeably in Malaysia over recent years, such activities remain relatively insignificant (e.g. correlation trading) and less complex, with risks remaining at manageable levels (e.g. there are no re-securitization structures in Malaysia).

APPENDIX 5. TYPES AND PARAMETERS FOR SENSITIVITY ANALYSIS SHOCKS

RISK AREA	TYPE OF SENSITIVITY SHOCK PARAMETERS	REMARKS or MAGNITUDE OF SHOCK PARAMETERS
Credit Risk	**CRS 1.** Defaults of PDS/sukuks and other corporate debt securities by rating	• Different default rates applied to corporate debt securities issued in Malaysia/EMEs and advance economies
	CRS 2. Credit rating migration shock for PDS/sukuks and other corporate debt securities by rating	• Different migration rates applied to corporate debt securities issued in Malaysia/EMEs and advance economies
	CRS 3. Shock on risk weight for MGS and GII	• Increase in risk weights for MGS and GII from 0 percent to 20 percent
	CRS 4. PD and LGD shocks on Housing Loans	• PD=7 percent, LGD=20 percent
	CRS 5. PD and LGD shocks on Housing Loans	• PD=10 percent, LGD=30 percent
Market Risk	**MRS 1.** Interest Rate Risk Shock: Parallel upward shift in yield curve	• +300 bps
	MRS 2. Interest Rate Risk Shock: Parallel downward shift in yield curve	• -250 bps
	MRS 3. Interest Rate Risk Shock: Steepening of yield curve	• Short Term (<1 year): 46 bps • Medium Term (1 year to 5 years): 252 bps • Long Term (>5 years): 268 bps
	MRS 4. Interest Rate Risk Shock: Widening of credit spreads	• Short Term (<1 year): 142 bps • Medium Term (1 year to 5 years): 228 bps • Long Term (>5 years): 256 bps
	MRS 5. Foreign Exchange Risk Shock	• USD +20 percent • SGD +17 percent • HKD +15 percent • JPY +20 percent • EUR -20 percent • GBP +15 percent • AUD +20 percent • IDR +10 percent
	MRS 6. Equity Risk Shock	• FBM KLCI decline (-67.3 percent) to 500 pts
	MRS 7. Equity Risk Shock	• FBM KLCI decline (-47.7 percent) to 800 pts