Guidelines on Stress Testing 2020

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Contents

Definitions: v
Introduction 1
Section 1: Scope and Coverage 2
Section 2: Elements of Stress Testing Framework 2
2.1 Objectives of Stress Testing 2
(a) Risk Management Tool 2
(b) Supervisory/Institutional Considerations 2
2.2 Governance Structure 3
2.3 Resource Adequacy 3
2.4 Data and IT Infrastructure 4
Section 3: Guidance on Scenario Analysis 4
3.1 Objectives 4
3.2 Risk Coverage Scenario 5
3.3 Models and Methodologies 6
3.4 Construction of Scenarios 7
3.5 Regular Review and Challenge 10
3.6 Results Communication and Feedback 11
Section 4: Sensitivity Analysis of Banks, DFIs, IBs/IBBs and MFBs 11
4.1 Banks and DFIs 12
4.2 Islamic Banks and Islamic Bank Branches 13
4.3 Microfinance Banks (MFBs) 14
Section 5: Reporting Requirements and Controls 14
Annexures 16
Annexure 1: Examples of Scenarios for MST 16
Baseline Scenario 16
Annexure 2: Shocks for Banks (excluding IBs/IBBs) and DFIs 20
Section A: Credit Shocks 20
Section B: Operational Shocks 23

Section C: Market Shocks 24
Section D: Liquidity Shocks 26
Annexure 3: Islamic Banks and Islamic Bank Branches 29
Section A: *Credit Shocks* 29
Section B: Operational Shocks 35
Section C: Market Shocks 36
Section D: Integrated Credit and Market Shocks 39
Section E: Liquidity Shocks 41
Annexure 4: Microfinance Banks 44
Section A: Credit Shocks 44
Section B: Operational Shocks 45
Section C: Market Shocks 46
Section D: Liquidity Shocks 47

Definitions:

1. **Alpha factor:** [*Islamic Banks*] A measure of the proportion of actual credit and market risk on assets financed by investment account holders' funds that is transferred to shareholders – that is, the displaced commercial risk. The value of *alpha* varies from 0 to 1.

2. **Displaced Commercial Risk (DCR):** [*Islamic Banks*] The situation where an institution acting as a muḍārib donates a part of its profit to the investment account holders in order to smooth the returns payable to them.

3. **Domestic Systemically Important Banks (D-SIBs):** Institutions of such size, market interconnectedness and importance that their failure could have a significant negative impact on the banking system and overall economy.

4. **Islamic Collective Investment Scheme (ICIS):** [*Islamic Banks*] Any structured shariah-compliant financial scheme where investors have pooled their capital contributions in a fund by subscribing to units or shares of equal value.

5. **Profit Sharing Investment Account (PSIA):** [*Islamic Banks*] Profit-sharing investment account represents the pool of investment funds placed with an institution offering Islamic financial services (IIFS) on the basis of Muḍārabah.

6. **Restricted Profit Sharing Investment-Accounts (RPSIA):** [*Islamic Banks*] PSIAs where the account holders authorize the IIFS to invest their funds based on Muḍārabah or agency contracts with certain restrictions as to where, how and for what purpose these funds are to be invested.

7. **Risk based supervision (RBS):** A forward-looking approach where the supervisor assesses various business areas of the financial institutions, and associated quality of management and internal control, to identify the areas of greatest risk and concern.

8. **Sample of D-SIBs:** The banks identified based on identification criteria set out in section 3.1 of BPRD circular No. 04 of 2018.

9. **Scenario Analysis: A**ssesses the impact of extreme but plausible scenarios on a given portfolio/ financial position of an institution/system, using sophisticated modeling techniques and typically incorporating macroeconomic variables.

10. **Sensitivity Analysis: A**ssesses the possible impact of a set of assumed single factor (hypothetical or historically adverse) credit, market, operational and liquidity shocks on the solvency and liquidity profile of banks/DFIs, MFBs and IBs/IBBs.

11. **Unrestricted Profit-Sharing Investment Accounts (UPSIA):** [*Islamic Banks*] The PSIAs where account holders authorize the IIFS to invest their funds based on Muḍārabah contracts without imposing any restrictions. The IIFS can commingle these funds with their own funds and invest them in a pooled portfolio.

Introduction

1. The State Bank of Pakistan (SBP) issued the first detailed guidelines on Stress Testing (ST) in 2005.[1] The global financial crisis of 2008 brought many changes on the regulatory and supervisory landscape and further highlighted the need for stress testing. Accordingly, SBP published an enhanced set of guidelines in 2012.[2]

2. The financial supervisory and regulatory environment continues to evolve. On the international front, Global Systemically Important Banks (**G-SIBs**) are being assessed annually for the stress testing, while the Bank for International Settlements (BIS) issued revised Stress Testing principles in 2018[3] wherein it has consolidated the guidelines on core elements of stress testing framework including objectives, governance, processes, methodology, resources etc. On the domestic front, SBP has rolled out a framework for designation and enhanced supervision of Domestic Systemically Important Banks (D-SIBs) in April, 2018.[4] The framework, among other things requires the D-SIBs to conduct macro stress testing as part of the Internal Capital Adequacy Assessment Program (ICAAP). Moreover, the SBP is working to implement the Risk Based Supervision (RBS) framework,[5] as a forward-looking approach towards the identification of relevant financial risks. Furthermore, Islamic Banks and Microfinance Institutions have increased in size and diversity. In view of the above developments as well as the insights gained from the application of existing framework, SBP has prepared a revised suite of ST guidelines to strengthen the existing stress testing framework in line with new domestic and global developments.

3. The document is divided into five sections. Section 1 covers the scope and coverage of the ST framework; Section 2 details the elements of the ST framework. Section 3 contains the guidelines for Scenario Analysis, also known as Macro Stress Testing (MST), to be conducted by the sample of D-SIBs.[6] Section 4 contains the minimum set of predefined shocks to be used for Sensitivity Analysis of banks, DFIs, IBs/IBBs and MFBs. Finally, Section 5 provides instructions on reporting requirements. Annexures, containing examples of scenario analysis and detailing the nature of shocks to be used in sensitivity analysis, are included at the end of the document.

[1] BSD Circular 5 of 2005

[2] BSD Circular 1 of 2012

[3] See "Stress Testing Principles", Bank of International Settlements, October 2018

[4] See BPRD Circular No. 04 dated April 13, 2018 for details on criteria for classification as D-SIB

[5] See SBP Strategic Plan 2020

[6] See BPRD Circular No. 04 dated April 13, 2018 for details on criteria for classification as "sample of D-SIBs"

Section 1: Scope and Coverage

4. The revised ST exercises cover two strands of methodologies: Sensitivity Analysis and Scenario Analysis. While specific instructions on these methodologies are given in the relevant sections of the document, the current guidelines would be applicable to the following institutions regulated by SBP as follows:

    i. All banks, DFIs, IBs/IBBs and MFBs shall conduct sensitivity analysis covered under **Section 4**, on a *quarterly* basis, to examine the short-term impact of adverse changes (shocks) in some key variable(s) on the financial position of the institution. The shocks covered in the exercise arise mainly due to credit, market, operational and liquidity risks.

    ii. The sample of D-SIBs shall *additionally* be required to conduct scenario analysis – MST, covered under **Section 3**, *annually*, to assess the impact of extreme but plausible macro-financial shocks on the institution's risk profile using econometric modelling techniques. Other banks keeping in view their size and complexity, are also encouraged to develop expertise and conduct MST. The risk coverage should be commensurate with an institution's business profile and its susceptibility to macro-financial dynamics.

Section 2: Elements of Stress Testing Framework

2.1 Objectives of Stress Testing

(a) Risk Management Tool

5. The ST exercise should be forward-looking and shall be the primary tool in risk identification and monitoring at the institution. The exercise results should be reported to and discussed in the Risk Management Committee (RMC) regularly and may be used as an input in formulating strategic objectives and decisions.[7] Banks may use the results to calibrate risk appetite, capital planning, liquidity and funding risk assessment, contingency planning and recovery/resolution planning. The results may also be used to support internal capital and liquidity adequacy assessments, portfolio management and new trade/product approval processes.

(b) Supervisory/Institutional Considerations

6. From the risk management perspective, the analysis generally involves certain metrics, for example CET1, CAR and liquidity ratios, to quantify the impact of relevant risks. These

[7] RMC in the documents means RMC of the management unless otherwise specified.

metrics may be compared to regulatory requirements in order to identify vulnerabilities. Other risk measures include, change in level of profits, regulatory capital, risk-weighted assets, liquidity levels, asset values, cash flows, loan loss provisions and level of non-performing assets. These would help in gauging the level and severity of emerging vulnerabilities and formulating suitable plans to address these potential weaknesses.

7. Beside regular iterations of ST analysis, the framework should be flexible enough to facilitate ad-hoc stress tests for specific events. For example, the impact of change in the policy rate, fluctuations in the value of domestic currency, IT breaches, or closure of business in a specific region/sector.

2.2 Governance Structure

8. The Board of Directors (BoD) shall be responsible for establishing a robust ST program in the institution as well as its oversight. The RMC shall be responsible for its design and implementation. The RMC shall document the policies and procedures of the ST program and build capacity to conduct additional tests for risks relevant to their institution. The appropriate number of staff with relevant technical skills shall be designated for the ST exercises, with clearly defined roles and responsibilities. The RMC shall ensure that the results and findings of the ST exercise are incorporated in the institution's decision-making process. Finally, the results of ST exercise shall be presented to the BoD, at least annually. However, in case serious vulnerabilities are highlighted during the exercise, the results would be presented in the meeting of BoD falling immediately after the finalization of ST results.

2.3 Resource Adequacy

9. The RMC should ensure that an adequate organizational structure is in place to execute the ST framework effectively. Any observed deficiencies in the structure and framework should be brought to the notice of the BoD. Importantly, the ST staff needs to be adequately skilled and have the access to tools needed to perform assigned tasks effectively. Especially, the MST team should have expertise in risk management, macroeconomics, financial accounting, econometrics, and be conversant with SBP rules & regulations. The assignment of tasks and responsibilities should be properly documented and clearly communicated to the entire team.

2.4 Data and IT Infrastructure

10. The data used in stress testing should be accurate, complete and available in a timely manner. The granularity level can depend on the data type and frequency of exercise. The data infrastructure should be flexible enough to support targeted and ad-hoc stress tests. Institutions should review the quality and robustness of data and IT infrastructure as a part of their regular review of ST framework. The BoD shall ensure that policies and procedures are in place to identify and address material information deficiencies.

11. For scenario analysis i.e., MST, the institutions should have an IT infrastructure that can automate data-related processes and maintain large sets of historical macro-financial data.[8] The availability of relevant statistical and/or computing software should also be ensured.

Section 3: Guidance on Scenario Analysis

12. The scenario analysis involves assessment of the impact of extreme but plausible shocks on an institution's risk profile and financial position using econometric modelling techniques. The models generally incorporate various idiosyncratic and systemic macro-financial factors, which are assumed to capture the inter-linkages and feedbacks among various sectors of the macro-economy – hence the name macro stress testing (MST). The banks shall develop and implement the MST framework incorporating advanced modelling approaches.

3.1 Objectives

13. The objectives of the MST should be formally documented in a clear and coherent manner, keeping in view the basic purpose of assessing the resilience of the bank to severe yet plausible shock scenarios. The objectives should be approved by the BoD and aligned with the institution's overall risk management framework.

14. The objectives shall categorize scenario analysis as an integral part of risk management process. The scope of MST framework should be clearly defined by RMC and commensurate with the institution's size, business portfolio, complexity of activities and risk exposures. To appropriately design the MST framework, banks should assess the depth of their businesses across various criteria.

15. The criteria may, inter alia, include:

[8] For further guidance, see BCBS's "Principles for Effective Risk Data Aggregation and Risk Reporting", available at: https://www.bis.org/publ/bcbs239.pdf

i. Size of operations in each sector/area
ii. Risk appetite
iii. Capital and funding structure
iv. Nature and complexity of exposures in terms of products
v. Depositors/customers and contracts
vi. Size and fragility of outsourced services like information technology (IT) and payment systems

16. Simple entity-level stress tests may not capture the risks to specific business segments, as they may be offset on the aggregate level. Therefore, the scope could be expanded from institution-wide analysis to a more granular level, such as portfolio/sector level assessments.

17. Banks having a significant overseas representation should stress test specific portfolios or business entities in foreign regions using scenarios capturing region specific macro-financial dynamics. However, if the foreign subsidiary of the local bank is already conducting scenario analysis as per instructions of the host regulators, the results of the exercise may simply be incorporated in the overall MST results.

3.2 Risk Coverage Scenario

18. Banks should identify all material and relevant risks, emanating from macro-financial dynamics through a comprehensive exercise of risk identification. The identification process should cover every aspect of institutions' risk profile including on- and off-balance sheet exposures. Sector and segment specific risks, such as a downfall in textile sector due to cotton crop failure or an economic slowdown severely affecting the corporate sector, may also be included. The relevant risks can be identified based on historical events and/or hypothetical future events. If required, SBP may engage with banks for discussions on alternate risk scenarios during the development process.

19. For institution-wide stress tests, banks should evaluate the resilience against adverse shocks like moderate or severe economic downturn, natural disasters, political events, fall in asset (collateral) prices, volatility in energy prices, interest rates and exchange rates, and worsening of correspondent banking. Banks should also focus on the financial implications of macroeconomic adversities on balance sheet in terms of credit, market, liquidity and operational risks.

20. Operational and misconduct risks such as failure of covenants, reputational risks, regulatory risks, penalties due to AML/CFT and losses due to cyber breaches may be included as additional risks. Further, bank-specific elements, such as failure of significant business line,

economic turmoil in risk concentrated sectors, segments, or geographical regions (country and transfer risks) that could weigh on banks' profitability should be considered as well. Exclusion of any of the material risk factors should also be fully justified and documented.

21. Simple aggregation of individual risks may underestimate the true impact of stress events. For example, the aggregated risks at institution level may offset the significant region-specific vulnerabilities. Thus, it is desirable that banks should stress test on both, individual portfolio and aggregated level.

22. Although, the banks are encouraged to stress test business portfolios along a range of relevant risk factors, they are required to conduct resilience analysis taking into account credit, market and operational risks. This means that the impact of shocks would be translated to the solvency via profitability and capital position of the bank. For assessment and inference, the adequacy of post-shock capital would be gauged against the relevant regulatory benchmark.

3.3 Models and Methodologies

23. The models, methodologies and level of sophistication should be commensurate with the desired objectives and usage of MST results. The interlinkages across risk factors, being modelled distinctly, should not be underestimated. Therefore, careful consideration shall be given to choosing appropriate modelling techniques and building consistent calibrations across models. The selected modelling techniques, model specifications, assumptions and judgments shall be appropriately justified and challenged to ensure validity.

24. Models should adequately account for feedback effects. The feedback models, such as structural or reduced form vector auto-regression (VAR) models, may be employed for the purpose. However, banks should consider a range of modelling techniques from univariate (e.g., ARIMA, ARIMAX etc.) to multivariate (e.g., VAR, SVAR, BVAR, VEC, ARDL etc.) dynamic feedback models, keeping in view the desired sophistication level. The target risks, for example, credit, market, operational and liquidity, should also be modelled using the appropriate models or indicators. Examples include, Merton-type structural models of measuring distance to default, value-at-risk (VaR), credit VaR, relevant financial soundness indicators (FSIs), etc.[9]

[9] See e.g., IMF (2014). A Guide to IMF Stress Testing – Methods and Models.
BIS (2017). Supervisory and Bank Stress Testing: A Range of Practices. December.
Mario Quagliariello, (2009). Stress Testing the Banking System, Methodologies and Applications. Cambridge University Press.

25. Banks should not rely on any single model; instead maintain an inventory of models including model validation tools. Models should be robust and capable of incorporating a continuously changing environment and flexible enough to support targeted and ad hoc stress tests.

26. Generally, the models should be based on quarterly data and the projection horizon should cover at least eight (8) quarters. However, banks are encouraged to develop insights for a longer time period of up to 5 years as well. Banks may increase the frequency of models, e.g. models may use monthly data, where the adequate length of historical data is not available.[10] However, where models with meaningful, reliable and robust quantitative estimations are not available for any certain business line or risk area, banks should take support of qualitative expert judgments and assessments alongside quantitative analysis.

27. For complex models, banks should be wary of the model risks. It can be minimized through taking sufficiently conservative view when setting assumptions, specifically qualitative assumptions. Frequent and conservative expert review may also be helpful. Importantly, the assumptions deriving certain sensitivities in results should be appropriately acknowledged and a regular check on their relevance should be ensured. The limitations of models should be analyzed, acknowledged and accounted for when interpreting results. The model comparison and rationale for eliminating other possible approaches should be documented, where possible.

28. The selected models, assumptions and judgments should be properly documented and presented at least before the RMC of the BoD, along with the results. The performance of models should be analyzed and validated by the ST team (e.g., validation through techniques such as back-testing, etc.) and made available to the RMC of the BoD, in order to provide a deeper view on the relevance of results, when taking policy or strategic decisions.

3.4 Construction of Scenarios

29. Institutions should consider a range of stress scenarios including, baseline, hypothetical, historical as well as reverse stress test (RST) scenarios. Baseline scenario should capture the business as usual environment and project the outlook of bank over the projection horizon. Further, the banks should design at least one historical scenario designated to recurrence of the historical adverse period, for example, the severe macroeconomic stress experienced during 2008 in the wake of external sector vulnerabilities and historically high inflation levels. Banks shall run at least one hypothetically designed stressed scenario, in addition to

[10] For example, GDP is available at an annual frequency, which can be proxied via monthly data on Large-scale Manufacturing.

baseline and historical scenarios. Additionally, the RST scenario may assume a worst-case scenario (e.g. failure of a bank) and then proceed to identify the circumstances, which may cause this to happen.

30. Banks can have multiple internally consistent stress scenarios focusing on distinct risks. Banks are responsible for the development of their own stress scenarios. Banks may, however, like to refer to Financial Stability Reviews, published annually, for examples of macro scenarios. **Annexure 1** provides description of few scenarios analyzed in the Financial Stability Reviews-2019.

31. The baseline scenario, in principle, should be entirely model-based and may not impose any type of stress. However, those of the business decisions and economic policy changes that would be implemented within the projection period, may be included to improve the accuracy of baseline scenario. The baseline scenario can be used as a benchmark to compare the results of stress scenarios to identify any regulatory shortfall.

32. For historical scenario, banks should analyze the historical data carefully and identify adverse periods, considering the macro-financial and political environment. The primary reason to include this scenario is to assess whether the bank is able to sustain the adverse periods from history, if these recur today. The position of banks under this scenario should be compared with the position during the past adverse times and the strengths and weaknesses should be highlighted. The comparison would help banks to strengthen their risk management strategies and take appropriate actions beforehand, in case the results show vulnerabilities towards historical shocks. This would also help in understanding the dynamic behavior of risk correlations during stress periods and devising risk mitigation and recovery plans.

33. When designing hypothetical scenarios, the banks should identify the stage of the macro economy and financial sector over the respective cycles. This would provide insights into present macro-financial conditions and help in designing scenarios accordingly. For example, if economy is identified to be in an expansionary period, the team should identify the key drivers and assume the deterioration in these indicators under stress scenarios. Likewise, if economy is going through a contraction, the assumption of further deterioration in key driving factors might help in anchoring the financial health of the bank, in case the recession prolongs or goes deeper. The designed scenarios should be severe enough to be able to provide meaningful assessment for bank's risk profile. Banks can design various scenarios differing in terms of severity such as, moderate, adverse and severely adverse scenarios.

34. The RST assumes a worst-case scenario, i.e. failure/insolvency of a bank, and then proceeds to identify and evaluate the circumstances which may cause this to happen. This may be due to vulnerabilities associated with credit, operational, market, liquidity or reputational risks. After carrying out such analysis, banks can devise some strategies to mitigate the identified areas of vulnerability. Banks may also consider other scenarios in RST, for instance, falling of CAR below the minimum regulatory benchmark.

35. The key benefit of such an approach is the elaborate consideration of various sources of risks that can undermine an institution's existence. The approach to identify such factors can be qualitative or quantitative, depending upon the sophistication of tools available. A rigorous quantitative approach can be used to identify a specific level of loss or erosion of capital by a certain amount/percentage. The bank can then work backward to identify the conditions that can cause the calculated losses. It is expected that the idea of RST shall be used as a potential tool to not only generate a fruitful discussion on the key vulnerabilities of financial institutions but also as an effective mechanism for internal communication about the risks faced by these institutions.

36. The team should also take into account the emerging and dormant risks. For this purpose, effective dialogue with the subject or area specialists within or outside the bank would help gauge diverse views on the topic. Banks should not only depend on the historical interlinks of risk factors but should also account for the changing degrees of correlations.

37. An internally consistent and plausible narrative for all the scenarios should be developed, discussed and critically challenged at an appropriate level and be properly documented. The scenario building process may require banks to consider range of assumptions. Such assumptions should be critically reviewed and documented with adequate justification.

38. Typically, three types of shocks are considered in stress testing based on the length of shock events i.e. V-shaped, L-shaped and U-shaped. The shapes are envisaged in terms of recovery. V-shape assumes quick recovery; L-shape assumes a sharp fall and protracted downturn while U-shaped assumes recovery towards the end of projection horizon. Under this terminology, banks should build at least one L-shaped scenario or highly adverse scenario. For moderate risk scenario, banks can design a V- or U-shaped scenario. The magnitudes of stress for risk triggers should be consistent with the narrative of scenarios.

39. Banks may employ countercyclical approach for designing severities of scenarios.[11] As suggested by this approach, the severity of risks or risk variables would upsurge when there

[11] For details on countercyclical approach, please see the severity design of Annual Cyclical Scenario (ACS) in "The Bank of England's approach to stress testing the UK banking system" October 2015, available at:

is boom in business or credit cycle. Likewise, the degree of severity would be lower during recession period.

40. Banks can choose between absolute and relative calibrations of risk variables. Scenarios based on absolute approach are supposed to calibrate the risk variables in an unconditional way. For example, GDP growth reaches a certain level. Conversely, relative calibrations should be based on present economic conditions and level of risk indicators. For example, GDP growth declines by certain percentage. For relative calibrations, banks should be wary of designing sufficiently severe scenarios. For example, in case GDP is substantially above potential trend, a two percent decline in GDP growth may not be sufficiently severe to pose any threats to macro-financial conditions of economy. Whereas, a two percent decline in GDP growth, when output is below potential, would be highly adverse and can be problematic for both the macro economy and the financial sector.

41. Moreover, the dormant risks to banks' profitability or balance sheet should also be taken under consideration. For example, if a bank did not face technology breaches in its business history, yet such operational risks are highly plausible and should be included in the scenarios. The severity of risks that lack extensive data or did not face crisis periods so far should be designed based on the judgment of ST team.

3.5 Regular Review and Challenge

42. The complete MST framework should be regularly reviewed, at least within three years, and challenged by the RMC. This would help improve the framework to produce effective results and assist in making informed policy decisions. For technical details, RMC may get the models and methodologies validated from external experts of relevant subject areas, if required.

43. Banks should ensure that the review process is critical enough to identify the loopholes, limitations, inconsistencies and areas of improvement in the MST approach. Banks should account for the provided comments and update the MST processes accordingly. Moreover, the review process should also analyze proper and adequate incorporation of MST results in decision-making processes.

https://www.bankofengland.co.uk/news/2015/october/boe-publishes-approach-to-stress-testing-the-uk-banking-system.

3.6 Results Communication and Feedback

44. Besides discussing in the RMC, the banks should present detailed results along with methodologies before the BoD, at least annually. Banks should effectively disseminate the MST framework and results across the institution to seek feedback from appropriate levels in the hierarchy. Banks should also ensure that the interpretation of results is easily understandable and ensure transparency at all levels.

45. Banks shall submit the MST framework developed and implemented under these guidelines, as specified in **Section 5**, covering the following minimum areas:

    A. Objectives, scope and governance structure
    B. Narratives and calibrations for all scenarios
    C. Methodologies including assumptions, data, models, statistical software and working files.
    D. Results including, pre- and post-shock levels of risk indicators
    E. Minutes of RMC and BoD meetings held for the presentation of MST results including all comments, views, suggestions and plans for remedial actions.

46. Return A requires one-time submission, while returns B – E would be submitted on an annual basis. Resubmission of A would be required in case of significant changes.

Section 4: Sensitivity Analysis of Banks, DFIs, IBs/IBBs and MFBs

47. Sensitivity analysis is used to provide an initial assessment of a portfolio's vulnerability to a given risk factor or a set of closely related factors. The risk factors are stressed with different degrees of severity in order to better understand an institution's true weaknesses and the non-linear impact of events on loss profiles. The severity is either hypothetically assumed or is based on historical maximum/minimum.[12]

48. The following sub-sections describe the minimum set of hypothetical shocks, which capture credit, market, operational and liquidity risks that the financial institutions shall apply. A shock in the spirit of reverse stress testing has also been included in the credit shocks, in order to gauge the levels of infection that might cause a financial institution's business model to become unviable. Generally, three levels of each shock are considered: minor, moderate and major.

[12] Throughout the Sensitivity Analysis, the shock involving institution specific data, *historical* means a period of 10 years or the period of operations of the financial institution, whichever is less - unless the period is specifically mentioned.

49. The banks should assess the levels of post-shock CAR. If found to be below the regulatory cutoffs under minor/mild credit, market and operational scenarios, financial institutions may consider taking steps to improve their risk profiles. Similarly, if the post-shock level of liquid assets is negative, and/or the Liquidity Coverage Ratio (LCR)[13] and Net Stable Funding Ratio (NSFR)[14] are below their regulatory minimums in liquidity scenarios, financial institutions should take measures to improve their liquidity profiles.

4.1 Banks and DFIs

50. The banks[15] are subjected to *eight* credit shocks (C1-C8), which capture the impact of downgrade of the overall advances portfolio, reduction in the value of collateral, and sector specific shocks to the loan portfolio. A shock to capture the critical levels of infection ratio is also included in the credit shocks. The impact of credit shocks is measured by tracking the increase in provisions after an event that could lead to a deterioration in an institution's credit portfolio. There are *three* operational shocks (O1-O3), which could be due to AML/CFT violations, cybersecurity breaches, and other general operational losses such as fraud, litigation losses or a natural disaster. There are *five* market shocks (M1-M5): three due to adverse movements in the interest rates and one each for the variations in the exchange rate and the stock (equity) market.

51. The banks are subjected to *five* liquidity shocks (L1-L5). The first three measure the impact of withdrawals of deposits and/or unsecured borrowings on the liquid assets held by banks. The L4 measures the post-shock LCR, if High Quality Liquid Assets (HQLA)[16] decline or the net cash outflows over 30 days rise. Fifth shock (L5) measures the post-shock NSFR, if there is a decline in available funding due to a fall in funding from various non-financial agencies or decline in demand/term deposits.

52. The DFIs shall apply all operational and market shocks, six credit shocks (C1-C5 & C8) and one liquidity shock (L2).

53. Details of credit, operational, market and liquidity shocks for banks and DFIs are available in **Annexure 2**.

[13] See BPRD Circular No.08 of 2016 for more details on LCR Requirements

[14] See BPRD Circular No.08 of 2016 for more details on NSFR Requirements

[15] In Section 4.1, banks mean banks excluding IBs, IBBs and MFBs.

[16] High quality liquid assets that can be readily sold or used as collateral to obtain funds at little or no loss of value under a stress scenario.

4.2 Islamic Banks and Islamic Bank Branches

54. Islamic banks/Islamic bank branches (IBs/IBBs) – the Islamic Financial Institutions (IFIs) - are mandatorily required to perform a set of sensitivity-based stress tests to evaluate their resilience against credit, market, liquidity and operational risks.[17] Moreover, two integrated shock scenarios are required to be performed to evaluate resilience in crisis-like situations.

55. In order to assess credit risk, Islamic banks are subjected to *six* shocks (C1-C6). First three shocks focus on overall, sector-wise and segment-wise portfolios of financings. The fourth and the fifth shocks assess credit concentration in top financings and decline in value of underlying collateral, respectively. First four credit shocks assess how IBs/IBBs will be affected by the shock if assets under stress are fully financed by UPSIA. The last shock captures the levels of infection where the NPFs to financings ratio becomes critically high.

56. *Three* market shocks (M1-M3) are designed to assess how solvency of Islamic banks will be affected in case of decrease in value of inventories, trading book assets and foreign currencies, respectively. *Four* operational shocks (O1-O4) have been designed to assess the resilience of Islamic banks in situations like AML/CFT violations, cyber security breaches, Sharia non-compliance and general operational failures.

57. *Two* integrated shocks have been designed to assess the implications of a crisis-like situation. Integrated shocks have been designed by combining different scenarios of credit and market shocks discussed above. IBs/IBBs are required to assess the impact of different credit, market and operational risk related shocks on Capital Adequacy Ratio (CAR) and Common Equity Tier 1 (CET 1).

58. *Three* liquidity shocks (L1-L3) have been designed to test the liquidity profile of Islamic banks. First liquidity shock assumes withdrawal of different types of retail and wholesale deposits while the second one assumes withdrawal of UPSIA-related deposits for five consecutive days. For these liquidity shocks, the impact is evaluated through indicative ratios of liquid assets to total deposits and, liquid assets to total assets. Finally, the last liquidity shock assumes decline in HQLA, increase in contractual outflows and decrease in contractual inflows with a view to assess the implications of these developments upon indicative Liquidity Coverage Ratio (LCR).

59. Details of credit, market, operational and liquidity shocks for IBs/IBBs are available in **Annexure 3**.

[17] In this document, IFIs mean IBs/IBBs licensed and regulated by the SBP. Therefore, for the purpose of these guidelines, IFI and IB/IBB would be used interchangeably.

4.3 Microfinance Banks (MFBs)

60. To assess the resilience of MFBs, specific shocks have been designed to capture risks unique to this segment of banking industry. MFBs generally have customers with a lower net worth and thus a higher risk profile. Moreover, MFBs are involved in relatively more sector specific lending. Therefore, even moderate macroeconomic shocks may amplify the credit, market and liquidity risks faced by these institutions.

61. MFBs are subjected to *four* credit shocks (C1-C4). First two are designed to assess the impact of adverse shifts in the overall loan portfolio as well as the portfolios of three sectors: Agriculture, Enterprise and Livestock. The third shock accounts for a depletion in value of collateral held against the loans/advances. The last shock captures the levels of infection where the NPL to loans ratio becomes critically high.

62. Besides, *three* operational shocks (O1-O3) have been designed to assess resilience of MFBs in situations like AML/CFT violations, cyber security breaches and general operational losses.

63. Penultimate, *three* market shocks (M1-M3) are also considered. These include increase in interest rates assuming parallel shifts and steepening of yield curve and a decrease in interest rates with flattening of yield curve. Finally, four liquidity shocks (L1-L4) consist of depletion of liquid assets, withdrawal of top 25 depositors, withdrawal of 50 percent of unstable deposits and withdrawal of high volume deposits.

64. Details of credit, market, operational and liquidity shocks for MFBs are available in **Annexure 4**.

Section 5: Reporting Requirements and Controls

65. **Reporting requirements**
    a. The sample of D-SIBs, shall incorporate the MST and RST results as of December 31 (based on annual Audited numbers) in the relevant section(s) of Internal Capital Adequacy Assessment Process (ICAAP) document and submit the ICAAP to SBP on an annual basis by May 31 of the following year. (see Section 3.6 for details)
    b. While Banks and DFIs will continue to conduct quarterly SA exercise on the shocks under these guidelines, they are no longer required to submit the quarterly results to SBP.
    c. IBs/IBBs and MFBs are, however, required to submit the results of quarterly SA exercise on the shocks under these guidelines, for four quarters, with first submission based on

end Q4CY20 statistics. The results shall be submitted, on the prescribed templates, within 15 working days after the end of the quarter **(Annexure-B)**.

d. The banks, DFIs and IBs/IBBs shall submit quarterly data, as per revised templates, for SBP's in-house stress testing, within 15 working days after the end of the quarter (**Annexure-C**).
e. The above information shall be submitted through SBP's Data Acquisition Portal (DAP) as per the prescribed timelines.

66. **Controls**

(a) Banks/DFIs/IBs/IBBs and MFBs are required to discuss the results of respective ST exercises in the meetings of Risk Management Committee (RMC) and utilize it for preparing contingency plans, if necessary, for identified vulnerabilities. Any material vulnerability(ies) may, however, be brought to the notice of the Board of Directors (BoD).[18]
(b) The SBP inspection teams may review the implementation of ST processes, including, but not limited to, a random check of: results, minutes of the meetings of the RMC and/or BoD, steps taken to address material vulnerabilities, etc.
(c) The SBP, as part of its supervisory process, will regularly conduct its own in-house ST exercises and, if required, may engage with banks/DFIs/IBs/MFBs for any risk mitigation measures/contingency plans based on the outcome of the exercises.
(d) SBP may review the ST Guidelines in the light of the new development both at domestic and international level.

[18] 'Material vulnerabilities' mean any breach of regulatory benchmark(s) on application of, for example, baseline and/or historical shocks (MST) or minor/mild shocks (SA).

Annexures

Annexure 1: Examples of Scenarios for MST

Following examples of macro-scenarios are extracted from Financial Stability Review 2019, published by SBP.

Baseline Scenario

The baseline scenario, Scenario 0, is built on the basis of observed dynamics of the domestic and global outbreak of COVID-19 and the associated policy response to the crisis. The global economy was facing rising uncertainty and declining sentiment amid global supply chain disruptions owing to lockdown in China since January 2020. Since the detection of initial cases at the end of February 2020 in Pakistan, different strategies are being adopted to mitigate the spread of disease. These include closures of educational institutions, halt on public transportation services, ban on mass gatherings and imposition of economic lockdowns except for essential sectors such as food, medical services and financial services. Lockdowns, across different provinces, started in the second half of March and continue to be in effect at the time of finalization of this report (end of April 2020). These lockdowns and unprecedented level of uncertainty have led to mutually re-enforcing aggregate supply and demand shocks to economy. On supply side, the services sector in general (61.21% of GDP) and subsectors of wholesale & retail trade (18.9% of GDP) and, transport, storage & communication (12.9% of GDP) in particular are hit by the shock. The services sector is likely to be hard-hit by the crisis as its value addition is highly time-specific and cannot be reclaimed once disrupted due to lockdowns. Large scale manufacturing (10.19% of GDP) is also expected to be badly hit by the lockdowns. Value addition of agriculture (18.53% of GDP) may also decline due to low demand amid bans on mass gatherings and closure of restaurants. Apart from these supply disruptions, domestic private consumption and investment demand conditions are also very weak owing to heightened level of uncertainty.19

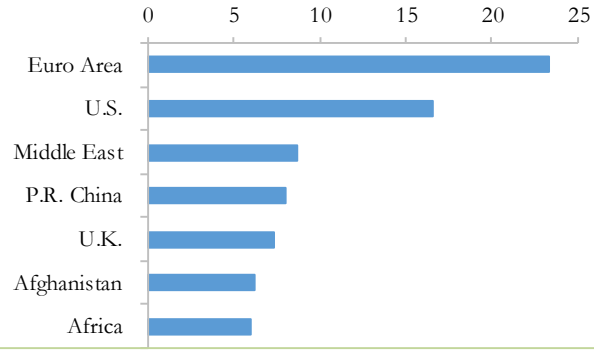
In addition, external demand is also expected to be on the lower side. Prior to the start of the GHC, Pakistani exports had started to signal revival in volume terms.20 However, in the post-GHC environment, Pakistan's major export destinations are severely affected by COVID-19 and therefore, export demand is likely to be weak (Chart 4.1 and 4.2).

[19] All GDP shares are based on FY19 data.

[20] SBP (2020), Monetary Policy Statement, January

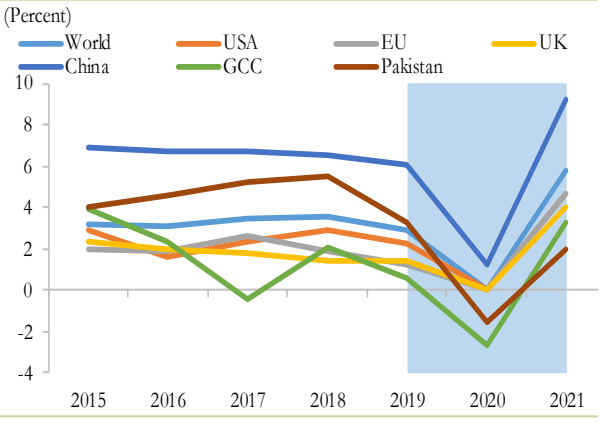
Chart 4.1: Key Export Destinations of Pakistan

(5-Years Average of Percent Share in Total Pakistan Exports)



Source: IMF Direction of Trade Annual Statistics

Chart 4.2: GDP Growth Rates in Key Economies



Source: IMF

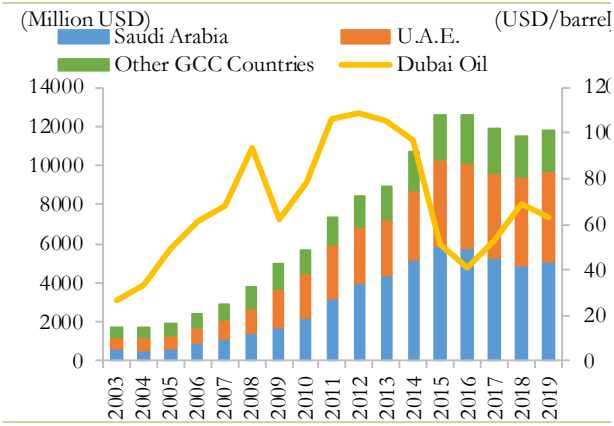
Accordingly, in sync with international observers,21 Scenario 0 assumes that the GDP growth rate will decline to -1.5 percent for FY20 before gradually recovering to 2 percent in FY21 and ultimately reaching 5 percent in the medium term by 2024.

Along with the exports, workers' remittances constitute a key source of foreign exchange inflows for Pakistan. However, owing to weak demand in the EU, USA, and China, oil prices are at historically low levels. This situation implies that remittances from the western hemisphere as well as from Middle East may observe substantial moderation (Chart 4.3). However, on a positive note, low oil prices and weak domestic demand are likely to cause a substantial reduction in the import bill.22 Further, IMF funding under its Rapid Financing Instrument and other facilities/relief expected through multilateral and bilateral support will help meet immediate balance of payment (BoP) needs arising in the context of imports to control pandemic amid tapering inflows due to weak exports and remittances. Based on these developments, the current account deficit is expected to broadly maintain the trajectory that it recently achieved under IMF stabilization program. As a result, volatility in exchange rate should remain contained.

[21] IMF (2020) forecasts Pakistan GDP growth for FY20 to -1.5 percent. World Economic Outlook, April. World Bank (2020) also forecasts Pakistan GDP growth in the range of -1.3 to -2.2 percent with significant downside risks. World Bank South Asia Economic Focus, April.

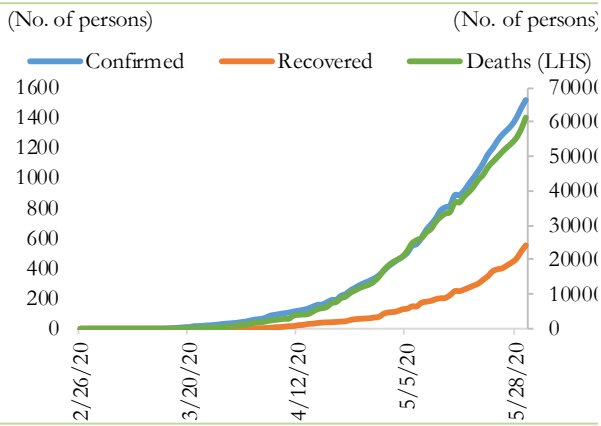
[22] Payments for imports of petroleum products accounted for 26.40 percent of total imports bill in FY19.

Chart 4.3: Remittances from Middle East and Oil Prices



Source: SBP and World Bank Commodity Prices

Chart 4.4: Domestic Spread of COVID-19



Source: Data Hub

On the back of weak demand, lower oil prices and a stable exchange rate, the baseline scenario assumes that inflation will come down to 11-12 percent during FY20, 7-9 percent during FY21 and 5-7 percent over medium term by 2024. In accordance with weak demand and decelerating inflation, the interest rate is also assumed to follow a declining trajectory.

Stress Scenario

The hypothetical stress scenario, Scenario 1, has been built around a more severe scenario regarding the spread and duration of COVID-19 in Pakistan and across the globe. So far, despite a persistent rise in the number of confirmed patients, the number of deaths and critical patients have been quite limited in Pakistan (Chart 4.4).

However, in the absence of any concrete developments regarding the discovery of a vaccine/cure for the pandemic so far, the risk of a widespread and prolonged contagion—both at home and across the world—remains elevated. The risk of a sharp domestic outbreak is also exacerbated owing to population density, inter-provincial migrant workers, urban slums and the limited capacity of the health infrastructure to handle a mass-level outbreak. Apart from a more prolonged duration of the current contagion, risk of its reemergence in coming years after initial success of containment efforts also cannot be ruled out. Consequently, the economic environment is expected to be clouded by an unprecedented level of uncertainty.

Against this backdrop, Scenario 1, assumes a protracted and widespread outbreak of COVID-19 at home and in rest of the world. The scenario also assumes a reemergence of the disease in CY21.[23] If this scenario materializes, it is likely to substantially curb domestic economic activity and employment by necessitating stringent social distancing measures e.g. prolonged

[23] In terms of the global spread and duration of COVID-19, Scenario 1 follows the assumptions under the most severe downside scenario from the latest IMF World Economic Outlook. IMF (2020), World Economic Outlook, April.

lockdowns to contain the spread of the contagion. The stress scenario assumes that GDP registers a negative growth of 1.5 percent in FY20 with a further slide to negative 5.0 percent during FY21.24 GDP growth is assumed to gradually recover to 3 percent by FY24.

The scenario assumes that reductions in aggregate supply will dominate slack in aggregate demand; thereby leading to an upward pressure on prices. In the recent past, food inflation has been presenting a challenge for domestic policy makers (see Chapter 1). Against a backdrop of more severe domestic supply chain disruptions, greater bottlenecks in regional trade and elevated demand due to potential panic buying amid continued lockdowns, food inflation could push up headline inflation. To be precise, the scenario assumes that average inflation may rise to 15 percent25 during FY21 before gradually returning to 9 percent by FY24. This situation may necessitate an appropriate monetary policy response to check inflationary expectations. Since the scenario assumes that supply losses will dominate the slack in demand, import demand, especially for essential items, may also rise. Considering the weak demand for exports and low remittances, this high demand for imports could translate into pressures on the current account balance and exchange rate.

[24] At peak level during FY21, the stress scenario assumes 7 percent less GDP growth relative to baseline.
[25] At peak level during FY21, the stress scenario assumes 7 percent higher inflation relative to baseline.

Annexure 2: Shocks for Banks (excluding IBs/IBBs) and DFIs

Section A: Credit Shocks

For each of the credit risk scenario, banks/DFIs should follow the steps below:

1. Determine the additional provisioning requirement under each shock. The benefit of liquid securities against the defaulted portfolio may be taken into account while calculating additional provisions;
2. Provisioning requirements for each classification is as follows: Substandard (25%), Doubtful (50%) and Loss (100%).[26]
3. Compute tax-adjusted impact of the additional provisions on capital. Compute after-shock Risk Weighted Assets (RWAs) net of additional provisions.[27]
4. Calculate post-shock Capital Adequacy Ratio ($\mathrm{CAR_{PS}}$).

Credit Shock 1 (C1). *Adverse Shift in Overall Loan Portfolio*

This scenario estimates the impact of deterioration in the credit quality of banks/DFIs' overall credit portfolio by applying the following three levels of hypothetical shocks:

(i) 5% of performing loans move to substandard (SS), 50% of substandard loans move to doubtful (DF) and 50% of doubtful Loans move to the loss category of NPLs;
(ii) 10% of performing loans move to substandard, 70% of substandard loans move to doubtful and 70% of doubtful loans move to the loss category of NPLs; and
(iii) 20% of performing loans move to substandard, 100% of substandard loans move to doubtful and 100% of doubtful loans move to the loss category of NPLs.

Let x percent of performing loans (PLs) moves to SS, y percent moves to DF and z percent migrates to loss and τ be the tax rate. Then additional provisions can be computed as:

$$\Delta\mathrm{Prov} = [(\mathrm{PLs} \times x \times \mathrm{CR}_{SS}) + (\mathrm{SS} \times y \times \mathrm{CR}_{DF}) + (\mathrm{DF} \times z)],$$

where CR is the applicable effective provision coverage ratio for each category of NPLs. Change in profit can be computed by applying tax adjustment,

$$\Delta\mathrm{Profit} = (1 - \tau)\Delta\mathrm{Prov}.$$

The post-shock CAR

$$\mathrm{CAR_{PS}} = \frac{\mathrm{Capital} - \Delta\mathrm{Profit}}{\mathrm{RWA} - \Delta\mathrm{Prov}}.$$

[26] The provisioning requirements are as per existing Prudential Regulations. However, any subsequent revisions/changes in the provisioning requirements shall be taken into account accordingly.
[27] Additional adjustment in RWAs may be required in case there is an increase in risk weight of an asset due deterioration in risk rating.

Credit Shock 2 (C2). *Default of Top Borrowers*

This scenario intends to ascertain the risk of credit concentration in financial institutions. Banks/DFIs should estimate the additional provisioning against the default (under substandard category) of their (i) **top 2**, (ii) **top 3** and (iii) **top 5** performing borrowers/groups, selected based on amount of exposure.

This shock should separately be applied to:

A. *Fund based exposure* of top private sector borrowers/groups, identified based on fund based exposure only; and
B. *Sum of the Fund based and Non-Fund based exposures* of top private sector borrowers/groups, identified based on gross sum of the fund based and credit equivalent of non-fund-based exposures. For calculation of impact under this shock, the credit conversion factor, as prescribed under BSD Circular No. 8 of 2006, should be applied to the non-fund-based exposure to calculate credit equivalent amount. This credit equivalent amount should be added to the fund based exposure to get the total credit exposure (on balance sheet & off balance sheet) and provision be created on the sum balance, accordingly under this shock.

Under these shocks (A & B), the impact of the increase in NPLs should also be taken on risk weighted assets, by increasing the risk weight of the un-provided part of the additional NPLs to 100%.[28]

Credit Shock 3 (C3). *Depletion in Value of Collateral*

This scenario assumes that the forced sale value (FSV) of overall pledged/collateralized assets, held by banks against the performing loans, falls drastically due to stressed economic conditions. This would lead to an increase in RWAs as the risk profile of loans will deteriorate. In order to account for this fall, banks shall calculate their CAR with three levels of shock where their RWAs increase by (i) 10%, (ii) 20 % and (iii) 30%.

Credit Shock 4 (C4). *Adverse Migration of Non-Investment Grade Corporate Borrowers*

This scenario assumes a stressed situation where loans to below investment grade borrowers (rated as 7, 8 and 9 as per BSD circular No. 8 of 2007) become non-performing. Banks/DFIs should calculate the additional provisioning requirements under the following three levels of shocks:

[28] For instance a top borrower carries 50% credit risk weight on its outstanding loan of say Rs100 million. Assuming the loan becomes substandard, a provision of 25% shall be deducted from capital. Since the loan becomes non-performing, the risk weight of the remaining 75% shall increase to 100%, thus increasing the credit risk weighted assets of the borrower from Rs 50m to Rs75 million. This additional Rs25 million should be added to the pre-shock credit risk weighted assets of the bank.

(i) Classify all loans to borrowers mapped under rating class 9 under loss category;
(ii) Classify all loans to borrowers mapped under rating class 8 and 9 under doubtful and loss category respectively; and
(iii) Classify all loans to borrowers mapped under rating class 7, 8 and 9 under substandard, doubtful and loss category respectively.

This shock should separately be applied to:

A. *Fund based exposure* only of the non-investment grade borrowers/groups; and
B. *Sum of the Fund based and Non-Fund based exposure* of private sector borrowers/groups. For calculation of the impact under this shock, the credit conversion factors, prescribed under BSD Circular No. 8 of 2006, should be applied to the non-fund-based exposure to calculate total credit exposure.

Similar to that of the CR-2, under these shocks (A & B) the impact of increase in NPLs should also be taken on RWAs, by increasing the risk weight of the unprovided part of the additional NPLs to 100%.

Credit Shock 5 (C5). *Deterioration in Default Rates of Corporate Credit Portfolio*
This scenario assumes deterioration in the quarterly default rates of the overall corporate credit portfolio. For this purpose, benchmark default rate for the corporate portfolio needs to be calculated based on the average of the default rates[29] of the last four quarters. The three shock levels for this scenario are (i) 1.5 times, (ii) 2 times and (iii) 2.5 times of this benchmark default rate. Under each scenario, assume the defaulted exposure is classified under substandard category.

Following formula should be used to calculate quarterly default rate using outstanding exposures of the borrowers:

$$\text{Default Rate of quarter } i = DR_{qi} = \frac{D_{qi}}{(L_{pi} - R_i)}$$

Here:

$D_{qi} =$ Amount of defaults at the end of the quarter i out of the total L_{pi}.
$L_{pi} =$ Outstanding amount of performing loans at the beginning of the quarter i.
$R_i =$ Repayments i.e. Amount of loans repaid during the quarter i out of the total L_{pi}.

[29] An exposure is categorized under default if (i) it is classified under substandard category or below and/or claims are overdue by 90 days or more; or (ii) it has undergone restructuring/rescheduling.

Calibrate the shock and calculate the impact of additional provisioning on capital adequacy ratio of the bank.

Credit Shock 6 (C6). *Adverse shift in SME & Agriculture Loans' Portfolio*

This scenario captures the impact of increased provisioning requirements due to deterioration in the quality of loans to both SME and Agriculture Sector under the following three levels of shocks:

(i) 5% of performing loans move to substandard, 50% of substandard loans move to doubtful and 50% of doubtful loans move to the loss category of NPLs;
(ii) 10% of performing loans move to substandard, 70% of substandard loans move to doubtful and 70% of doubtful loans move to the loss category of NPLs; and
(iii) 20% of performing loans move to substandard, 100% of substandard loans move to doubtful and 100% of doubtful loans move to the loss category of NPLs.

Credit Shock 7 (C7). *Deterioration in the Loans of Consumer Portfolio*

This estimates the impact of weak economic outlook with attendant rise in unemployment, erosion in purchasing power of the borrowers, and increase in defaults in the overall consumer loan portfolio. The three levels of shocks assume (i) 5%, (ii) 10% and (iii) 20% of performing loans becoming overdue by 90 days and/or subjectively classified under the substandard category of NPLs.

Credit Shock 8 (C8). *Critical Infection Levels*

This shock estimates the NPLs to loan ratio (NPLR), assuming that the loans/advances remain at the current level and additional NPLs are directly categorized into the loss category. The banks should compute critical level of NPLR for three levels of shocks where NPLs rise to the extent that: (i) the CAR falls below the regulatory level, (ii) NPLR rises to the maximum level reached over the past 10 years, and (iii) capital is wiped out.

Section B: Operational Shocks

For all the operational shocks, it is assumed that the losses are paid for by cash/low risk assets, thus they will not impact the value of RWAs. The impact on capital would however be adjusted for tax as in credit shocks.

Operational Shock 1 (O1). *Penalty due to AML/CFT Violations*

This scenario assumes that bank/DFI recognizes losses/penalty due to Anti Money Laundering and Combating the Financing of Terrorism (AML/CFT) violations. Resultantly, the decline in

capital may amount to (i) 0.5% of total assets (ii) 2% of total assets and (iii) the largest such penalty imposed on the institution over the last 10 years.

Operational Shock 2 (O2). *Losses due to Cybersecurity Breaches*

This scenario assumes that the bank/DFI recognizes losses due to cybersecurity breaches. The decline in capital may amount to (i) 0.25% of total assets (ii) 1% of total assets and (iii) the largest cybersecurity related loss suffered by the institution over the last 10 years.

Operational Shock 3 (O3). *General Operational Losses*

This scenario assumes that bank/DFI recognizes general losses due to, e.g., penalty from regulators, cybercrime, IT breaches, fraud, litigation, natural disaster or any other adverse operational event. The decline in capital may amount to (i) 1x quarterly gross income (GI) (ii) 2x of quarterly GI and (iii) 3x of quarterly GI.

Section C: Market Shocks

Interest Rate Shock 1 (IR1). *Impact of Decrease in Interest Rates*

This scenario assumes the impact of decrease in interest rates along all maturities by (i) 2%, (ii) 3% and (iii) 4%. Changes in interest rate have an impact on interest bearing assets through two channels namely, *repricing* and *revaluation*.

(a) The impact on the net interest income (NII) using the *repricing* gaps:
- Determine total amount of Rate Sensitive Assets (RSA) and Rate Sensitive Liabilities (RSL);
- Compute the GAP between RSA and RSL i.e. GAP = RSA – RSL;
- Calculate ΔProfit = $GAP \times \Delta r \ (1 - \tau)$
- Calculate post shock CAR (without adjustment to RWAs).

(b) The impact of *revaluation* gains/losses can be determined by:
- Calculating the *modified* duration (MD) of the Available For Sale (AFS) and Held for Trading (HFT) portfolios
- Value of AFS should be determined after excluding investments in shares/equities
- Computing revaluation gain (loss) = $-\Delta r \times [(MD_{AFS} \times Value\ of\ AFS) + (MD_{HFT} \times Value\ of\ HFT)]$)
- Adjust the capital with revaluation gains/losses.

The post-shock CAR will be computed after making adjustments due to both repricing and revaluation effects of interest rate changes.

Interest Rate Shock 2 (IR2): *Impact of Parallel Shift in the Yield Curve*

This scenario captures impact of an upward movement of the yield curve by assuming increase in interest rates along all the maturities by (i) 2%, (ii) 3% and (iii) 4%. The impact on CAR of the change in interest rates shall be calculated considering both *repricing* and *revaluation* effects as demonstrated in IR-1.

Interest Rate Shock 3 (IR3): *Impact of Movement in the Slope of Yield Curve*

This scenario captures the impact of changes in the yield curve (shift, flattening or steepening of the yield curve) on Net Worth of banks/DFIs by assuming following changes in the interest rates along different maturities.

(i) 3% increase in interest rates of up to 1 year maturity (four buckets), 2.5% increase in interest rates of over-one year to up to 5 year maturity (four buckets) and 2% increase in interest rates on the remaining maturities (three buckets) - assuming an upward shift coupled with a flattening of the yield curve; [30]
(ii) 4% increase in interest rates of up to 1 year maturity (four buckets), 3% increase in interest rates of over-one year to up to 5 year maturity (four buckets) and 2% increase in interest rates on the remaining maturities (three buckets) - assuming an upward shift coupled with a flattening of the yield curve; and
(iii) 2% increase in interest rates of up to 1 year maturity (four buckets), 2.5% increase in interest rates of over-one year up to 5 year maturity (four buckets) and 3% increase in interest rates on the remaining maturities (three buckets)- assuming an upward shift coupled with steepening of the yield curve.

Impact of this shock shall be calculated using methodology as mentioned under IR-1.

Exchange Rate Shock 1 (ER1). *Depreciation of PKR Exchange Rate*

This scenario captures the *direct* foreign exchange risk[31] by applying three different levels of shocks i.e. assuming depreciation in PKR by (i) 20%, (ii) 30% and (iii) 50%. The shock is applicable both to on-balance sheet as well as off-balance sheet foreign currency exposures of bank/DFI. Based on the overall exposure[32], compute the amount of profit/loss and revised CAR (on tax adjusted basis) for the assumed depreciation in PKR under each of the three shocks.

[30] These eleven (11) maturity buckets as per the Quarterly Report of Conditions submitted to SBP under the Reporting Chart of Accounts through the Data Ware House Portal.

[31] Exchange rate risk may be either a) direct wherein banks/DFIs hold a position in foreign currency; or b) indirect where a foreign currency position is held by the bank's clients.

[32] Difference of net *short* foreign currency positions and net *long* foreign currency positions.

Equity Shock 1 (EQ1). *Decline in General Equity/Stock Market Prices*

The scenario captures the impact of adverse movements in the stock market. Banks/DFIs may apply three levels of shocks, assuming a fall in general equity prices by (i) 30%, (ii) 40% and (iii) 50% on their equity exposures/investments, and compute the amount of profit/loss and report the tax-adjusted impact on their revised CAR.

For this shock, equity exposure should include both direct and indirect equity exposures. The direct equity exposure includes all investments in shares/TFCs/Mutual Funds (excluding investments in associates & subsidiaries), whereas, indirect exposure includes financing/lending against shares/TFCs/Mutual Funds. Fall in value of direct equity investments under the shocks will be equivalent to the shock level. However, in case of financing/lending, the impact shall be calculated after adjusting the margins held by the banks.[33]

Section D: Liquidity Shocks

Liquidity Shock 1 (L1). *Withdrawal of Deposits & Borrowings over a Given Period*

This shock assumes a significant withdrawal of deposits and unsecured borrowings for a particular time period. The shock assumes withdrawal of the liabilities for consecutive three days as per the followings:

(i) Withdrawal of deposits & unsecured borrowings by 5% on Day 1;
(ii) Withdrawal of deposits & unsecured borrowings by 5% on Day 1 and an additional 10% on Day 2; and
(iii) Withdrawal of deposits & unsecured borrowings by 5% on Day 1, an additional 10% on Day 2 and another 10% on Day 3.

The amount of withdrawal of the liabilities should be deducted from the liquid assets and the level of remaining liquid assets needs to be re-calculated after each day. The post shock liquid assets to total assets ratio then may be calculated.[34]

Liquidity Shock 2 (L2). *Withdrawal of Wholesale Deposits & Deposits of Financial Institutions*

This shock measures impact of high volatility in private sector wholesale deposits and deposits/unsecured borrowings from financial institutions on the liquidity conditions of a

[33] For instance, a bank has extended financing of Rs100 million against shares of Rs130 million assuming a 30% margin requirement. Under a shock of 50% decline in equity price, the value of shares will fall to Rs65million, and the bank will book loss of Rs35 million (100-65).
34 Needless to mention that the total assets would also be adjusted for the amount of withdrawals.

bank/DFI. The shock assumes withdrawal of these deposits and borrowings for consecutive three days, as per the following sequence:

(i) Withdrawal of the private sector wholesale deposits and deposits/unsecured borrowings from financial institutions by 10% on Day 1;
(ii) Withdrawal of the private sector wholesale deposits and deposits/unsecured borrowings from financial institutions by 10% on Day 1 and an additional 30% on Day 2; and
(iii) Withdrawal of the private sector wholesale deposits and deposits/unsecured borrowings from financial institutions by 10% on Day 1, an additional 30% on Day 2, 60% on Day 3 and 100% on Day 4.

This withdrawal of the wholesale deposits & interbank liabilities should be deducted from the available liquid assets and the level of remaining liquid assets needs to be recalculated after each day.

Liquidity Shock 3 (L3). *Withdrawal of Top Deposits*

This scenario estimates the impact of deposit concentration on the resilience of banks/DFIs by assuming a withdrawal by key depositors. Three different levels of shocks assume complete withdrawals by (i) top 10, (ii) top 15 and (iii) top 20 depositors respectively. In order to honour the assumed withdrawals, liquid assets would be utilized, and after-shock liquid assets to total assets ratio shall be calculated.

Liquidity Shock 4 (L4). *Shock to Liquidity Coverage Ratio*

The LCR is defined as

$$\text{LCR} = \frac{\text{High Quality Liquid Assets (HQLA)}^{35}}{\text{Total Net Cash Outflows over the Next 30 Calendar Days}^{36}}$$

Banks should calculate after-shock LCR by using each of the following three scenarios:

(i) Applying 20% haircut to the value of Investments in Government Securities and 20% decline in value of marketable securities while calculating HQLA
(ii) An increase in the run-off rate of stable retail deposits to 10%, unstable retail deposits to 20% and 'unsecured wholesale funding provided by non-financial corporate customers, sovereigns, central banks, multilateral development banks and PSEs' to 50%.

[35] High quality liquid assets that can be readily sold or used as collateral to obtain funds at little or no loss of value under a stress scenario
[36] Total expected cash outflows – Min {total expected cash inflows; 75% of total expected cash outflows}

(iii) Applying 20% haircut to the value of Investments in Government Securities while calculating HQLA and increasing the denominator 'Total Net Cash Outflows' by 20%.

Liquidity Shock 5 (L5). *Shock to Net Stable Funding Ratio (NSFR)*

The NSFR is defined as

$$\text{NFSR} = \frac{\text{Amount of Available Stable Funding}}{\text{Amount of Required Stable Funding}}$$

Banks should calculate after-shock NSFR by using each of the following scenarios:

(i) A 30% decline in funding with residual maturity of < 1 year from non-financial corporate customers, sovereigns, PSEs, and multilateral and national development banks.

(ii) A 30% fall in the "Stable" and "Less Stable" (as defined in the LCR) demand and/or term deposits from retail and small business customers - with residual maturity of < 1 year.

(iii) A 20% decline in funding with residual maturity of < 1 year from non-financial corporate customers, sovereigns, PSEs, and multilateral and national development banks and 20 % fall in "Stable" and "Less Stable" (as defined in the LCR) demand and/or term deposits from retail and small business customers - with residual maturity of < 1 year.

Annexure 3: Islamic Banks and Islamic Bank Branches

Section A: *Credit Shocks*

Credit Shock 1 (C1). *Shock to financings portfolio*

There are three parts of C1, which assess the deterioration of credit quality along different financing types, banking book assets and displaced commercial risk (DCR).

Credit shock 1A (C1A). *Increase in NPFs for different financing types*

Scenario C1A assumes that a severe recession leads to a significant reduction in repayment capacity of IB/IBB's clients and, results into an increase in non-performing financings (NPFs) in different asset types e.g. Murabaha, Ijara, Diminishing Musharaka, Salam and Istisna, etc. The shock assumes that 10 percent of all performing financings become substandard (SS). Additionally, the migration rates from SS to doubtful (DF) and DF to Loss categories of NPFs for different types of financings are given in **Table 1**.

Table 1: Assumed Increase (%) in NPFs Portfolio

Financing Type	*Doubtful*	*Loss*
Murabaha Financing	25	20
Salam Financing	10	5
Istisna Financing	20	15
Musharaka Financing	50	30
Ijara	15	10
Diminishing musharaka Financing	50	40
Export Finance	5	5
Other Islamic modes of finance	30	20

For credit risk shock C1A, the IB/IBB should:

1. Calculate the impact of increase in NPFs upon provisions,
2. Calculate the tax-adjusted impact of increase in provision upon post-shock CAR and CET1 ratio.

Methodology for Calculation of Post-Shock CAR and CET1 Ratios

Let p_X be proportion of additional NPF related to financing type X. Then

$$\Delta \text{NPF}^X = p_X \times X_0,$$

where X_0 is the pre-shock level of financing for type X. The tax adjusted additional provisions can be calculated by

$$\Delta\text{Prov}^{\text{X}} = \Delta\text{NPF}^{\text{X}} \times \text{CR}$$

where CR is the applicable effective provision coverage ratio for each category of NPF. After tax change in profit can be calculated by

$$\Delta\text{Profit}^{\text{X}} = (1 - \tau)\Delta\text{Prov}^{\text{X}}$$

where τ is the tax rate applicable on IB/IBB. For all stress tests, the CR would be as per the relevant Prudential Regulations.

Additional provisions for all types of financing (X) e.g., Murabaha, Ijarah, Istisna, Salam etc. as well as for different categories of NPFs e.g. SS, DF and Loss mentioned in various credit shocks shall be calculated in the same way.

The post shock CAR_{PS} and CET1_{PS} ratio may be computed as[37]

$$\text{CAR}_{\text{PS}} = \frac{\text{Capital} - \sum_{X=1}^{N} \Delta\text{Profit}^{\text{X}}}{\text{RWA} - \sum_{X=1}^{N} \Delta\text{Prov}^{\text{X}}}$$

$$\text{CET1}_{\text{PS}} = \frac{\text{CET1} - \sum_{X=1}^{N} \Delta\text{Profit}^{\text{X}}}{\text{RWA} - \sum_{X=1}^{N} \Delta\text{Prov}^{\text{X}}}$$

Credit shock 1B (C1B). *Decline in value of banking books assets*

The shock C1B assumes that sever recession leads to substantial reduction in market value of assets in the banking book of IB/IBB. This reduction in market value of assets is *coupled* with an increase in NPFs as discussed in shock C1A. Here banking book exposure includes equity exposures i.e. Musharaka, Mudaraba portfolios and Sukuk (available for sale and held to maturity). Shock C1B assumes that market value of banking book assets declines as per rates given in **Table 2**.

Table 2: Assumed Decline in Investment Value

Investment Types	*Percent*
Mudaraba Investments in Banking Book	15
Musharaka Investments in Banking Book	15
Sukuk	
- Public Sector Sukuk in Banking Book	10
- Private Sector Sukuk in Banking Book	30

[37] We use a simplifying assumption that the average risk weight across the whole financing portfolio is 100% so that the reduction in the amount of the RWA due to the increase in provisions is also at 100%.

For C1B, the IB/IBB should calculate the tax-adjusted impact of decrease in value of investments on post-shock CAR and CET1 ratios.

Methodology for Calculation of Post-Shock CAR and CET1 Ratios

Let q_Y be proportion of decrease in value of investment type Y. Then

$$\Delta \mathrm{Inv}^{\mathrm{Y}} = q_Y \times \mathrm{Inv}_0^Y,$$

where $\mathrm{Inv}_0^{\mathrm{Y}}$ is the pre-shock value of investment type Y.
After tax change in profit is calculated by

$$\Delta \mathrm{Profit}^Y = (1-\tau)\Delta \mathrm{Inv}^Y$$

Additional provisions for all types of investments (Y) e.g., Musharaka, Mudaraba and Sukuk etc. mentioned in various credit shocks shall be calculated.

The post shock $\mathrm{CAR}_{\mathrm{PS}}$ and $\mathrm{CET1}_{\mathrm{PS}}$ ratio may be computed as

$$\mathrm{CAR}_{\mathrm{PS}} = \frac{\mathrm{Capital} - \sum_{X=1}^{N} \Delta \mathrm{Pov}^{\mathrm{X}} - \sum_{Y=1}^{M} \Delta \mathrm{Profit}^{\mathrm{Y}}}{\mathrm{RWA} - \sum_{X=1}^{N} \Delta \mathrm{Prov}^{\mathrm{X}} - \sum_{Y=1}^{M} \Delta \mathrm{Inv}^{\mathrm{Y}}}$$

$$\mathrm{CET1}_{\mathrm{PS}} = \frac{\mathrm{CET1} - \sum_{X=1}^{N} \Delta \mathrm{Prov}^{\mathrm{X}} - \sum_{Y=1}^{M} \Delta \mathrm{Profit}^{\mathrm{Y}}}{\mathrm{RWA} - \sum_{X=1}^{N} \Delta \mathrm{Prov}^{\mathrm{X}} - \sum_{Y=1}^{M} \Delta \mathrm{Inv}^{\mathrm{Y}}}$$

Credit shock 1C (C1C). *Impact of DCR*

Shock C1C uses the extreme assumption that all stressed assets under shock C1A and C1B are financed by unrestricted profit sharing investment account holders (UPSIA). In principle, UPSIAs are governed by Mudaraba contract where profits are shared between IB/IBB (Mudarib) and investor (Rabb-ul-maal) as per agreed ratio. All losses are to be borne by the investor except for the situations where losses have occurred due to negligence of IB/IBB. Due to their loss absorbing characteristic, UPSIA are very similar to bank's equity and therefore, do not need additional capital cover. However, in dual banking system, IB's/IBB's are under pressure to provide market comparable return to investors. Therefore, in situations when returns on assets financed by UPSIA are below market returns, IBs/IBBs may opt to apportion a share of their own profits to satisfy expectations of UPSIA, with a view to retain them. Under extreme form of this arrangement, IBs/IBBs bear the entire risk and UPSIA closely resemble deposits in conventional banks.[38] This leads to displacement of commercial risk (DCR) from investment

[38] Sharia Board of IDB declares this practice Sharia-Non Compliant. IFSB Technical Note on Stress Testing for IIFS, 2016.

account holder towards IB/IBB. As a result, IBs/IBBs are required to have capital cover to manage DCR. Alpha (α) represents the share of the risk borne by IB/IBBs.

A value of '**0**' for α means that UPSIA are being run as pure Mudaraba and IB/IBB is not facing credit and market risks of these assets. A value of '**1**' for α indicates that IB/IBB faces 100 percent of risks for assets financed by UPSIA. While conducting stress testing exercise, IB/IBB may use appropriate value of α in light of their business practices.

Methodology for Calculation of Post-Shock CAR and CET1 Ratios

As the shock C1C incorporates impact of both, an increase in NPFs and a decrease in value of investments; therefore, change in provisions is given by:

$$\Delta \text{Prov}_{\alpha} = \alpha \times \{[\Delta \text{Inv}^{Y} + \Delta \text{NPF}^{\text{X}} \times \text{CR}]\}$$

After tax change in profit is given by:

$$\Delta \text{Prov}_{\alpha} = \alpha \times (1 - \tau)\Delta \text{Prov}_{\alpha}$$

After incorporating α factor to assess impact of UPSIA and aggregating across all financing and investment types, the post-shock CAR_{PS} and CET1_{PS} ratio may be computed as

$$\text{CAR}_{\text{PS}} = \frac{\text{Capital} - \sum \Delta \text{Profit}_{\alpha}}{\text{RWA} - \sum \Delta \text{Prov}_{\alpha}}$$

$$\text{CET1}_{\text{PS}} = \frac{\text{CET1} - \sum \Delta \text{Profit}_{\alpha}}{\text{RWA} - \sum \Delta \text{Prov}_{\alpha}}$$

Credit Shock 2 (C2). *Shock to sector wise financings*

The credit shock C2 is also computed in two stages.

Credit shock 2A (C2A). *Increase in NPFs for different sectors of economy*

At first stage, it assumes increase in NPFs of the major sectors of financings such as textile, agribusiness, sugar, cement, chemical etc. under the stressed macroeconomic scenario. The IB should assume that 10 percent of performing financings for all sectors become substandard. Migrations to relative more adverse categories of NPLs are given in **Table 3**.

Methodology for calculation of post-shock CET1 and CAR ratios is similar to the methodology explained in Credit Shock C1A. The only difference is that in C1A, assets of IB/IBB were classified as different modes of financing whereas in C2A, IB's/IBB's assets are classified with reference to different sectors of economy.

Table 3: Assumed Increase (%) in NPFs Portfolio- Sector wise Credit Shock 2

Sector	*Doubtful*	*Loss*
Chemical & Pharmaceuticals	5	20
Textile	5	50
Agribusiness	5	20
Cement	5	20
Sugar	5	15
Shoes & leather garments	5	10
Automobile & transportation equipment	5	50
Financial	5	10
Insurance	5	5
Electronic & electrical appliances	5	10
Production & transmission of energy	5	10
Individuals	5	50
Others	5	50

Credit shock 2B (C2B). *Impact of DCR*

The second stage of the shock assumes that the sector wise financings portfolio under C2A has been financed by UPSIA, and an alpha factor has been applied to estimate the impact on regulatory capital requirements. Methodology for calculation of post-shock CET1 and CAR is similar to the methodology explained in C1C. Please note that this shock does not take into account the decline in investment values of banking book; therefore $\Delta Inv = 0$.

Credit Risk 3 (C3). *Increase in NPFs for different segments*

This shock also has two stages, namely; Credit Shock 3A and Credit Shock 3B.

Credit shock 3A (C3A). *Increase in segment wise NPFs*

This shock has been designed to gauge the impact of exposure of IB/IBB in different segments of financings. The IB/IBB should assume that 10 percent of performing financings related to all segments become substandard (SS). The migration rates from SS to Doubtful (DF) and from DF to Loss categories of NPFs are given in **Table 4**.

Methodology for calculation of post-shock CET1 and CAR ratios is similar to the methodology explained in C1A. The only difference is that in C1A, assets of IB/IBB were classified as different modes of financing whereas in C3A, IB's/IBB's assets are classified with reference to different portfolio segments.

Table 4: Assumed Increase (%) in NPFs- Business Segment wise- Credit Shock 3

Business Segment	*Doubtful*	*Loss*
Corporate	10	50
SME	10	30
Agriculture Financing	10	10
Consumer Financing	10	30
Commodity Financing	10	10
Others	10	10

Credit Shock 3B (C3B). *Impact of DCR*

This stage of shock assumes that the financing portfolio is funded by UPSIA, and hence, the impact of alpha factor has been taken into account. Methodology for calculation of post-shock CET1 and CAR is similar to the methodology explained in credit C1C, with $\Delta \text{Inv} = 0$.

Credit Shock 4 (C4). *Default of Top Financings*

Credit shock 4A (C4A). *Impact of fund based exposure*

This scenario intends to evaluate the risk of credit concentration. IBs/IBBs should estimate the additional provisioning against the default of their (***i***) **top 2**, (***ii***) **top 3** and (***iii***) **top 5** performing financings of private sector, selected based on the amount of fund based exposure. The impact of increase in NPFs should also be taken on risk weighted assets, by increasing the risk weight of the un-provided part of the additional NPFs to 100%.[39]

Credit shock 4B (C4B). *Impact of fund based and non-fund based exposure*

IBs/IBBs should estimate the additional provisioning against the default of their (***i***) **top 2**, (***ii***) **top 3** and (***iii***) **top 5** performing financings of private sector, selected based on gross sum of fund based and non-fund based exposures.

For calculation of impact under this shock, the credit conversion factor, as prescribed under BSD Circular No. 8 of 2006, should be applied to the non-fund based exposure to arrive at credit equivalent amount (CEA). The CEA should be added to the fund based exposure to get the total credit exposure (on- & off- balance sheet) and provision be created on the sum balance, accordingly under this shock.

[39] For instance a top borrower carries 50% credit risk weight on its outstanding loan of say Rs100 million. Assuming the loan becomes substandard, a provision of 25% shall be deducted from capital. Since the loan becomes non-performing, the risk weight of the remaining 75% shall increase to 100%, thus increasing the credit risk weighted assets of the borrower from Rs 50m to Rs75 million. This additional Rs25 million should be added to the pre-shock credit risk weighted assets of the bank.

The impact of the increase in NPFs should also be taken on risk weighted assets, by increasing the risk weight of the un-provided part of the additional NPFs to 100%.

Credit shock 4C (C4C). *Impact of DCR*

Credit shock C4C assumes that financings under shock in shock C4B are being financed by PSIA. Accordingly, IBs/IBBs should apply appropriate *alpha* factor to compute the losses and post shock capital ratios.

Credit Shock 5 (C5). *Depletion in Value of Collateral*

This scenario assumes that the forced sale value (FSV) of overall pledged/collateralized (underlying) assets, held by IB/IBB against the performing financings, falls drastically due to stressed economic conditions. This would lead to an increase in RWAs as the risk profile of financings will deteriorate. In order to account for this fall, banks shall calculate their CAR and CET1 ratio with three levels of shock with RWAs increasing by (***i***) 10%, (***ii***) 20 % and (***iii***) 30%.

Credit Shock 6 (C6). *Critical Infection Levels*

This shock estimates the NPFs to financings ratio (NPFR), assuming that the outstanding amount of financings remain at the current level and additional NPFs are directly categorized into the loss category. The three levels of shocks are needed to be computed by IBs/IBBs where NPFs rise to the extent that: (i) the CAR falls below the regulatory level, (ii) NPFR rises to the maximum level reached over the past 10 years, and (iii) capital is wiped out.

Section B: Operational Shocks

For all the operational shocks (O1-O4), it is assumed that the losses are paid for by cash/low risk assets, thus they will not impact the value of RWAs. The impact on capital would however be adjusted for tax as in credit shocks.

Operational Shock 1 (O1). *Penalty due to AML/CFT Violations*

This scenario assumes that the IB/IBB recognizes losses due to Anti Money Laundering and Combating the Financing of Terrorism (AML/CFT) violations. The decline in capital may amount to (i) 1% of total assets (ii) 3% of total assets and (iii) the largest penalty imposed on the institution over the last 10 years.

Operational Shock 2 (O2). *Losses due to Cybersecurity Breaches*

This scenario assumes that IB/IBB recognizes losses due to cybersecurity breaches. The decline in capital may amount to (i) 1% of total assets (ii) 2% of total assets and (iii) the largest cybersecurity related loss suffered by the institution over the last 10 years.

Operational Shock 3 (O3). *Losses due to Sharia-Non Compliance*

This scenario assumes that IB/IBB recognizes loss due to Sharia Non-Compliant elements in their products and services. These losses may arise in the form of purification of income, regulatory penalties and/or reputational losses. The decline in capital may amount to (i) 0.5% of total assets (ii) 1.5% of total assets and (iii) the largest Sharia Non-Compliance related loss suffered by the institution over the last 10 years.

Operational Shock 4 (O4). *General Operational Losses*

This scenario assumes that IB/IBB recognizes losses due to penalty from regulators, cybercrime, IT breaches, fraud, litigation, or natural disaster or any other adverse operational event. The decline in capital may amount to (i) 1x quarterly gross income (ii) 2x of quarterly gross income and (iii) 3x of quarterly gross income.

Section C: Market Shocks

Islamic financial institutions deal with exchange based instruments, for example, Murabaha, Salam and Istisna, which are based on the sale or purchase of an asset; and Ijarah, which is based on selling the usufruct of such an asset. In such products, the bank's gross return is the spread between the cost of the asset and the amount that can be recovered from selling or leasing it. Hence, these financing contracts involve exposure to market price risk in respect of the value of the assets involved. Therefore, IBs/IBBs carry commodity/asset price risks on their books. To gauge the asset price risk, commodity price shocks have been designed in this exercise. Moreover, these market shocks also consider the impact of a significant decline in value of trading book portfolio, including Sukuk, equities and foreign currency. Detailed shocks are listed below.

Market Shock 1 (M1). *Inventory Price Shock*

This shock assumes deflationary trend in the economy where prices of commodities fall drastically, thus causing a significant decline in the market value of the inventory held under the financings contracts. The level of decrease has been hypothetically assumed and given in **Table 5**. The decrease in the prices of inventories will require to book deficit, which will either be absorbed by the profits or by the common equity. Since under the stressed scenario, profits of

the banks are assumed to be very low, therefore the impact of this shock has been taken on common equity and regulatory capital. The impact has also been adjusted in RWAs to arrive at aftershock CET1 ratio and CAR.

Table 5: Assumed Decrease in Prices of Inventory - Market Shock I

Inventory Type	*Percent*
Murabaha Inventory	15
Ijara Assets	20
Istisna Inventory	15
Salam Inventory	15
Tijara Inventory	15
Other Inventory (Musawwama etc.)	15

Methodology for calculation of post-shock CAR and CET1 ratio is similar to the methodology explained in Credit Shock C1B. The only difference being the fact now we apply decrease in value of different types of inventories rather than investments.

Market Shock 2 (M2). *Shock to Trading portfolio of Sukuk, Islamic Collective Investments (ICI) and Equities.*

This shock has two stages, namely; M2A and M2B.

Market Shock 2A (M2A). *Shock to value of Sukuk, ICIS and equities*

The investment book of IFIs generally has Sukuk, which are prone to market shocks and should be regularly stress tested. Moreover, these institutions invest in Islamic collective investment schemes (ICIS) and stock market equities, the prices of which are subject to market shocks as well. This shock, therefore, assumes significant decrease in the value of Sukuk, ICIS and stock market equities (see **Table 6**).

Table 6: Assumed Decrease in Market Value in Trading Portfolio

Investments	*Percent*
Sukuk	
- Public Sector	10
- Private Sector	30
Islamic Collective Investment Schemes	15
Equity Position	30

Methodology for calculation of post-shock CAR and CET1 ratio is similar to the methodology explained in Credit Shock C1B. However, we use different risk weights for different types of

investments. Risk weights for Sukuk, ICI Schemes and equities are 50%, 150% and 200%, respectively.

Market Shock 2B (M2B). *Impact of DCR*

Here it is assumed that the investments portfolio, considered in M2A, was funded by the UPSIA, hence, the impact of alpha factor has been considered while estimating aftershock common equity tier I capital ratio and capital adequacy ratio.

Using the methodology explained in C1C, M2B assesses the implications of DCR.

Market Shock 3 (M3): *Currency Price Shock*

This shock assesses resilience of IFI towards depreciation of local currency against the major currencies in the trading book of the bank. The institution should assume a depreciation rate equal to the maximum local currency depreciation (annual) over the last three years against major currencies including the US dollar, Great Britain pound, Japanese Yen, Euro and any other currencies if it constitutes equal to or more than 10 percent of net position. A short position in any of these major foreign currencies would result in a deficit for the bank. This trading book loss will reduce the common equity as well as the risk weighted assets of the bank.

To compute the impact of local currency depreciation upon IB's/IBB's CET1 ratio and CAR, net position for all foreign currency assets is to be calculated. For instance, in case of USD, net position is calculated by subtracting dollar-denominated liabilities from dollar-denominated assets:

$$NOP^{\$} = Liabilities^{\$} - Assets^{\$}$$

Revaluation losses are computed by multiplying assumed local currency depreciation with *negative* of net position:

$$\text{Revaluation Loss}^{\$} = (\text{PKR dep against \$}) \times \text{NOP}^{\$}$$

If IB/IBB has a net long position in USD, then depreciation of PKR against USD will cause revaluation gains and vice versa. Revaluation losses against all foreign currency exposures should be calculated and summed in terms of local currency. Finally, these total revaluation losses can be subtracted from pre-shock level of capital and risk weighted assets to computed post shock CAR and CET1 ratios.

Section D: Integrated Credit and Market Shocks

Designing a consistent macroeconomic stress scenario is necessary for estimating reliable results. For the purpose of analysis in this exercise, two shock scenarios have been designed which take into account the impact of economic distress on both the credit and market risk portfolios of IBs/IBBs.

Integrated Credit and Market Shock Scenario 1 (ICM1)

The Integrated Shock Scenario 1 is a combination of Credit Shock 1 (C1) and Market Shock 1 (M1). The scenario assumes a recession, which may lead to a significant decline in repayment capacity of borrowers, resulting in additional defaults in financings portfolio (Murabaha, Ijara, Salam, lstisna, Diminishing Musharaka, etc. excluding its inventory). In the weakened domestic economic activity, prices of assets (inventory and banking book assets) and locally produced commodities contract significantly.

Table 7A: Assumed Increase (%) in NPFs of Financing Portfolio- Credit Shock I

Financing Type	*Doubtful*	*Loss*
Murabaha Financing	25	20
Salam Financing	10	5
Istina Financing	20	15
Musharaka Financing	50	30
Ijara	15	10
Diminishing musharaka Financing	50	40
Export Finance	5	5
Other Islamic modes of finance	30	20

Table 7B: Assumed decline in Banking Book and Inventories

	Percent
Investments	
Mudaraba Investments in Banking Book	15
Musharaka Investments in Banking Book	15
Sukuk in Banking Book	10
Inventories	
Murabaha Inventory	15
Ijara Assets	20
Istisna Inventory	15
Salam Inventory	15
Tijara Inventory	15
Other Inventory (Musawwama etc.)	15

Impact of shock upon CET1 ratio and CAR can be calculated using methodology explained in Credit Shock C1A (increase in NPFs) and C1B (decrease in value of investments/inventories) by applying rates given in **Table 7A** and **Table 7B**. The shock also incorporates alpha factor to account for the implications of DCR as explained in C1C.

Integrated Credit and Market Shock Scenario 2 (ICM2)

The second integrated scenario combines credit shock 3 (C3) and market shock 2 (C2). It assumes that deterioration in the performance of different segments of economy may lead to a significant decline in real estate and housing prices and hence trigger additional defaults. The defaults are assumed to be highest in mortgage and SME loans. Additionally, a two-tier sovereign rating cut may lead to a sharp increase in required yields on fixed-income instruments. Increase in benchmark rates on Ijarah Sukuk thus results in a decline in the value of Sukuk investments. Equity market also experiences a significant decline. Assuming the financing and trading portfolios are funded by un-restricted profit sharing investment account (UPSIA), the shock also incorporates alpha factor to account for the implications of DCR as explained in C1C.

Table 8A: Assumed Increase (%) in NPFs of Financing Portfolio

Business Segment	*Doubtful*	*Loss*
Corporate	10	50
SME	10	30
Agriculture Financing	10	10
Consumer Financing	10	30
Commodity Financing	10	10
Others	10	10

Table 8B: Assumed Decrease in Market Value in Trading Portfolio

Investments	*Percent*
Sukuk	
- Public Sector	10
- Private Sector	30
Islamic Collective Investment Schemes	15
`	30

Impact of shock upon CET1 ratio and CAR can be calculated using methodology explained in Credit Shock C3A (increase in segment wise NPFs) and Market Shock M2A (decrease in value of investments) and applying rates given in **Table 8A** and **Table 8B**.

Section E: Liquidity Shocks

Liquidity Risk 1 (L1). *Significant Withdrawals of Deposits*

This shock considers that under the distressed macroeconomic scenario, the losses from asset side force a reduction in profits to be distributed to UPSIA. This may result in a significant drawdown of wholesale, retail/individual and Financial Institutions' deposits (see **Table 9**). The IB/IBB should apply separate drawdown factors to wholesale deposits, retail and individual deposits and deposits of financial institutions. This significant withdrawal will decrease the liquid assets of the institution.

Table 9: Assumed Withdrawals of Deposits

Deposit Category	*Percent*
Wholesale Deposits	30
Retail / Individuals Deposits	20
Financial Institutions Deposits	100

We use post-shock liquid assets (LA) to total assets (TA) ratio (LAR) and post-shock LA to total deposits (TD) ratio (LDR) to assess the impact of this shock on the liquidity profile of the IFI. Total additional withdrawals are calculated by simply multiplying amounts of different deposits types with corresponding draw-down factors given in **Table 9**.

$$\text{Total withdrawals} = 0.3 * \text{Wholesale dep.} + 0.2 * \text{Retail dep.} + \text{Finacial inst. dep.}$$

Post shock LAR and LDR may be calculated as

$$\text{LAR}_{\text{PS}} = \frac{\text{LA}_0 - \text{Total withdrawals}}{\text{TA}_0 - \text{Total withdrawals}}$$

And

$$\text{LAD}_{\text{PS}} = \frac{\text{TD}_0 - \text{Total withdrawals}}{\text{TA}_0 - \text{Total withdrawals}},$$

where LA_0, TA_0 and TD_0 represent pre-shock levels of liquid assets, total assets and total deposits.

Liquidity Risk 2 (L2). *Consecutive withdrawal of PSIA*

This shock assumes significant withdrawal of UPSIA for consecutive 5 days and assesses its impact on liquid assets of the IFI (see **Table 10**). The drawdown factors for consecutive 5 days have been assumed keeping in view the severity of the shock.

Let UPSIA_0 represents pre-shock level of investment account deposits. Withdrawals for different days may be computed in such a way that withdrawal factor is applied on remaining deposits. For instance, withdrawals on Day 1, Day 2 and Day 3 (WD1, WD2 and WD3) may be computed as:

$$\text{WD1} = 0.02 * \text{UPSIA}_0$$
$$\text{WD2} = 0.05 * (\text{UPSIA}_0 - \text{WD1}) = 0.05 * (\text{UPSIA}_0 - 0.02 * \text{UPSIA}_0)$$
$$\text{WD3} = 0.1 * (\text{UPSIA}_0 - \text{WD1} - \text{WD2})$$

Table 10: Assumed Withdrawals of PSIA

Withdrawals on	*Percent*
Day 1	2
Day 2	5
Day 3	10
Day 4	10
Day 5	10

By sequentially subtracting cumulative withdrawals from pre-shock value of liquid assets, we may assess level of liquid assets at different days of shock. This can determine on which day liquidity crunch is faced by the IFI and pushes it into liquidity crisis.

Indicative LAR and LDR may be calculated by using quantum of liquid assets at Day 5.

Liquidity Risk 3 (L3). *Shock to (Proxy) Liquidity Coverage Ratio*

This shock assumes a significant decline in High Quality Liquid Assets (HQLA), an increase in 30 days liquidity needs of the IFI and assesses its impact on indicative/Proxy Liquidity Coverage Ratio (LCR). This LCR, which is a measure of 30 days-stressed liquidity position of banks, has been designed broadly in line with the Basel III requirements. The shock assumes a decline in the value of HQLA under the distressed market and liquidity scenario, which would affect the bank's capacity to meet its short term obligations (see **Table 11**). Moreover, the shock also assumes an increase in contractual outflows and a decline in contractual inflows during the next 30 days. Aftershock LCR of greater than 1 ($\text{LCR} > 1$) indicates the bank's resilience to 30-day stressed liquidity needs.

Table 11: Assumed Shock to LCR

Changes in liquid inflows/outflows	*Percent*
Decline in the HQLAs	20
Increase in Cash Outflows	10
Decrease in Cash Inflows	10

Post-shock values of HQLA, cash outflows and cash inflows may be calculated by applying assumed factors given in **Table 12** to pre-shock values of corresponding variables. Post shock proxy LCR may be calculated as:

$$\text{Proxy LCR}_1 = \frac{\text{HQLA}_1}{\max[(\text{cash outflows} - \text{cash inflows}), \frac{1}{4} * \text{cash outflows}]}$$

Annexure 4: Microfinance Banks

Section A: Credit Shocks

For each of the credit risk scenario, MFBs should follow three steps:

1. Determine additional provisioning requirements under each shock. The benefit of liquid securities against the defaulted portfolio may be taken into account while calculating the additional provisions;
2. Compute impact of additional provisions on both Capital and Risk Weighted Assets (RWAs)
3. Calculate after-shock Capital Adequacy Ratio (CAR).

In all credit shocks, 'the highest quarterly increase in non-performing loans (NPLs)' means the highest rate of increase in NPLs observed since Q1CY13 or since the start of operations of the MFB.

Credit Shock 1 (C1). *Adverse Shift in Overall Loan Portfolio*

The hypothetical scenario assumes adverse credit shock to the overall loan portfolio and gauges its impact on CAR of the MFBs. It is assumed that there is (***i***) a downgrade of 50% of NPLs *each* from OAEM to Substandard (SS), SS to Doubtful (DF) and DF to Loss; and (***ii***) historically highest increase in NPLs. The quantum of impact on CAR shall be calculated as

$$\Delta\text{Prov} = [(\text{OAEM} \times 0.5 \times \text{CR}) + (\text{SS} \times 0.5 \times \text{CR}) + (\text{DF} \times 0.5)],$$
$$\Delta\text{Profit} = \Delta\text{Prov} \times (1 - \tau),$$

where, CR is the applicable effective provision coverage ratio for each category of NPLs and τ is the applicable tax rate. The post-shock CAR is given by

$$\text{CAR}_{\text{PS}} = \frac{\text{Capital} - \Delta\text{Profit}}{\text{RWA} - \Delta\text{Prov}}.$$

Credit Shock 2 (C2). *Increase in NPLs of Sectors*

This shock assumes an increase in NPLs of Agriculture, Enterprise and Livestock sectors equivalent to (***i***) 5 percent and (***ii***) historically highest increase in NPLs.

Let the increase be (h), the additional provisions (ΔProv) for each sector may be computed based on gross loans (GL) as

$$\Delta\text{Prov} = \text{GL} \times \text{h}.$$

Credit Shock 3 (C3). *Depletion in Value of Collateral*

The scenario assumes that forced sale value (FSV) of collateralized assets held by MFB against their advances decreases drastically due to adverse impact of macroeconomic conditions. This would lead to an increase in risk-weighted assets (RWAs), as the risk profile of loans will deteriorate. In order to capture this risk, MFBs shall calculate their CAR with following three levels of shock: assume increase in RWAs by (***i***) 10%, (***ii***) 20 % and (***iii***) 30%.

Credit Shock 4 (C4). *Critical Infection Levels*

This shock estimates the NPLs to loan ratio (NPLR), assuming that the outstanding amount of advances remains at the current level and additional NPLs are directly categorized into the loss category. The three levels of shocks where NPLs rise to the extent that: (i) the CAR falls below the regulatory level (ii) capital is wiped out.

Section B: Operational Shocks

For all operational shock, it will be assumed that the losses are paid for by cash/low risk assets, thus they will not impact the value of RWAs. The impact on capital would however be adjusted for tax as in credit shocks.

Operational Shock 1 (O1). *Penalty due to AML/CFT Violations*

This scenario assumes that MFB recognizes losses due to Anti Money Laundering and Combating the Financing of Terrorism (AML/CFT) violations. The decline in capital may amount to (***i***) 1% of total assets (***ii***) 3% of total assets and (***iii***) the largest penalty imposed on the institution over the last 10 years.

Operational Shock 2 (O2). *Losses due to Cybersecurity Breaches*

This scenario assumes that MFB recognizes losses due to cybersecurity breaches. The decline in capital may amount to (i) 0.25% of total assets (ii) 1.5% of total assets and (iii) the largest cybersecurity related loss suffered by the institution over the last 10 years.

Operational Shock 3 (O3). *General Operational Losses*

This scenario assumes that MFB recognizes losses due to, e.g., penalty from regulators, cybercrime, IT breaches, fraud, litigation, natural disaster or any other adverse operational

event. The decline in capital may amount to (***i***) 0.5x quarterly gross income (***ii***) 0.75x of quarterly gross income and (***iii***) 1x of quarterly gross income.

Section C: Market Shocks

These shocks examine the impact of movements in financial market prices on the capital position of MFBs. Financial institutions' capital position may be affected when there is a change in the interest rate, exchange rate and equity prices. However, at minimum, MFBs are required to compute and report consequences of interest rate shocks.

Interest Rate Risk: Interest rate shocks may have an adverse impact on the balance sheet of MFBs. The institutions should take following steps to estimate the effect of changes in yield curve:

1. Determine the rate sensitive assets and liabilities (RSAs and RSLs) along one-month maturity, 1-3 month maturity, etc.
2. Find total gap (TG) as

$$\mathrm{TG} = \sum_{i}^{N} \mathrm{RS}A_i - \mathrm{RS}L_i$$

   TG = Total Gap
   Where i = 1, 2, 3….N represent the maturity buckets
3. Calculate the re-pricing gains/losses (ΔP) as

$$\Delta \mathrm{P} = \mathrm{TG} \times \Delta \mathrm{r}\ (1 - \tau)$$

4. Add tax-adjusted gains/losses (ΔP) to the capital and calculate CAR.

Interest Rate Shock 1 (IR1). *Increase in Interest Rates*

This scenario evaluates the impact of (***i***) 1%, (***ii***) 1.5% and (***iii***) 2% parallel upward movements along all maturities of yield curve on net worth of the institution.

Interest Rate Shock 2 (IR2). *Increase in interest rates with steepening of Yield Curve*

The second scenario assumes a historical shock due to an upward shift coupled with steepening of the yield curve by increasing the interest rates along 3m, 6m, 1y and 2y & above maturities, equivalent to the maximum quarterly increase experienced since June-2008.

Interest Rate Shock 3 (IR3). *Decrease in interest rates with flattening of Yield Curve*

Third shock assumes downward shift plus flattening of the yield curve by decreasing of the interest rates along 3m, 6m, 1y and 2y & above maturities equivalent to historically maximum decrease in interest rates experienced since June-2008.

Section D: Liquidity Shocks

Liquidity shocks assess the bank's ability to meet its liabilities during various stressful events. For the purpose of liquidity risk shocks, liquid assets includes:

(i) Cash and balances with SBP & NBP
(ii) Balances with other banks/NBFIs/MFBs
(iii) Money at call & short notice
(iv) PIB (unencumbered)
(v) MTB (unencumbered)

Stress events include following four liquidity shocks:

Liquidity Shock 1 (L1). *Depletion of Liquid Assets*

This shock assumes the impact of *negative* gap between assets and liabilities maturing within *one month* (Gap^{1M}) on liquid asset ratio (LAR). It is assumed that the assets will decline by the amount of gap. The impact on LAR can be computed as:

$$\text{Post shock LAR}_1 = \frac{\text{Liquid Assets} - Gap^{1\text{M}}}{\text{Total Assets} - Gap^{1\text{M}}}$$

Liquidity Shock 2 (L2). *Withdrawal of top 25 Depositors*

This shock tests the interlinkage between deposit concentration and resilience of MFB by assuming withdrawal of top 25 depositors and its impact on liquidity position. The post shock LAR would be calculated by subtracting the total amount of top 25 depositors ($T25D$) from liquid and total assets

$$\text{Post shock LAR}_2 = \frac{\text{Liquid Assets} - \text{T25D}}{\text{Total Assets} - \text{T25D}}$$

Liquidity Shock 3 (L3). *Withdrawal of 50 percent of unstable deposits*

The scenario assumes the withdrawal of 50 percent of unstable deposits for a particular time and its impact on liquid assets. For calculations

1. Calculate the volume of (A) total deposits (Current account, saving and Term deposit), (B) liquid assets, (C) highest volume of deposits during last 50 weeks and (D) lowest volume of deposits during last 50 weeks.
2. Compute stable part of deposits as: SD = *Min* [D, A – 0.5×(C-D)].
3. Compute unstable part of deposits as: UD = A × [1- (SD/A)]
4. Compute after shock LAR as

$$\text{Post shock LAR}_3 = \frac{\text{B} - [0.5 \times \text{UD}]}{\text{Total Assets} - [0.5 \times \text{UD}]}$$

Liquidity Shock 4 (L4). *Withdrawal of high volume deposits*

This shock assumes effect of withdrawal of 25 percent high volume deposits i.e. deposits with Rs.100,000 and above, on liquid assets. The impact can be calculated as

- Calculate the value of total assets, total deposits, liquid assets and deposits of Rs.100,000 & above ($D100K$).
- Compute after shock LAR as

$$\text{Post shock LAR}_4 = \frac{\text{Liquid Assets} - [0.25 \times \text{D100K}]}{\text{Total Assets} - [0.25 \times \text{D100K}]}$$