

STRESS-TESTING METHODOLOGY FOR THE LIQUIDITY AND FINANCIAL STABILITY OF COMMERCIAL BANKS UNDER MACROECONOMIC SHOCKS

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Abstract: The thesis systematises the modern methodology of stress testing the liquidity and financial stability of commercial banks under macroeconomic shocks, and proposes directions for its improvement. Stress testing is treated as an integrated framework that combines macroeconomic scenario design, translation of shocks into balance-sheet metrics, and aggregation of results into supervisory-level indicators. Drawing on the works of Borio, Drehmann and Tsatsaronis, Schuermann, Acharya, Berger and Bouwman, Adrian and Shin, Basel Committee documents and the practices of the ECB, Federal Reserve and IMF, the paper distinguishes four generations of banking stress tests — top-down macroeconomic scenarios, bottom-up bank-by-bank projections, integrated solvency-liquidity stress tests and macroprudential system-wide stress tests. A summary table of the four generations is presented. The paper concludes that under the conditions of digital banking and increasing macroeconomic uncertainty, the modern methodology must combine forward-looking scenarios, dynamic-balance-sheet modelling, network contagion analysis and real-time supervisory analytics.

Keywords: commercial bank, stress testing, macroeconomic shocks, liquidity risk, financial stability, Basel III, EBA/ECB stress tests, macroprudential policy, dynamic balance sheet, network contagion.

Introduction

Stress testing has emerged as one of the central instruments of prudential banking supervision in the aftermath of the 2008 global financial crisis. It provides supervisors, banks and investors with a forward-looking assessment of the resilience of the banking system to adverse macroeconomic shocks and supports the calibration of capital and liquidity buffers. The COVID-19 pandemic in 2020, the interest-rate cycle of 2022–2023, the 2023 collapse of U.S. mid-sized banks and the current geopolitical uncertainty of 2024–2026 have all reinforced the importance of a robust, coherent and dynamic stress-testing framework.

The relevance of the topic is reinforced by three factors. First, the traditional Basel III LCR and NSFR ratios provide only a static picture of a bank's liquidity position and do not capture the dynamic interaction of liquidity and solvency shocks under adverse macroeconomic scenarios. Second, the digital transformation of banking has qualitatively changed the speed of deposit outflows and requires new stress-testing horizons and behavioural assumptions. Third, in the Republic of Uzbekistan the Central Bank has since 2020 been developing its stress-testing capacity, and the systematic review of international best practice is a necessary methodological basis for its further improvement.

The aim of this thesis is to systematise the modern methodology of stress testing the liquidity and financial stability of commercial banks under macroeconomic shocks and to propose directions for its improvement, with particular reference to the banking system of the Republic of Uzbekistan. The methodology relies on scientific abstraction, comparative and structural analysis, the historical-logical method and content analysis of publications indexed in Scopus and Web of Science over the last decade, as well as regulatory documents of the Basel Committee, EBA, ECB, Federal Reserve and IMF.

Main body

The methodology of banking stress testing has evolved through four consecutive generations. The first generation — top-down macroeconomic scenarios — emerged in the late 1990s and early 2000s and consisted in the design of a small number of adverse macroeconomic scenarios (a mild recession, a severe recession, a deflationary shock) and their translation into aggregate banking-sector projections through a small set of macro-financial elasticities. Sorge (2004) and Foglia (2009) systematised the early experience with this generation of stress tests. Its main advantage was simplicity and comparability across countries, while its main limitation was the neglect of bank-specific heterogeneity.

The second generation — bottom-up bank-by-bank stress tests — emerged after 2009 in the form of the U.S. Federal Reserve's Supervisory Capital Assessment Program (SCAP) and the European Banking Authority's stress-testing exercises. Under this approach, each bank projects its balance sheet and profit-and-loss statement three years ahead under a common macroeconomic scenario provided by the supervisor, using its own internal models. Acharya, Engle and Pierret (2014) and Schuermann (2014) demonstrated the value of this generation of stress tests as a supervisory disclosure and market-discipline instrument. Its main limitation is the potential inconsistency of models across banks and the lack of endogenous behavioural responses.

The third generation — integrated solvency-liquidity stress tests — has emerged over the past decade in response to the 2008 crisis's lesson that liquidity and solvency shocks are deeply interconnected. Barnhill and Schumacher (2011), Puhr and Schmitz (2014) and the ECB Macroprudential Bulletin (2019) proposed frameworks that combine the projection of solvency ratios with the projection of liquidity ratios (LCR, NSFR) under a common macroeconomic scenario, allowing supervisors to assess the joint distribution of shocks. This generation of stress tests explicitly recognises that a solvency shock can trigger a liquidity shock through the confidence channel, and vice versa. Basel Committee (2018) documented the emergence of this generation as a supervisory standard.

The fourth — macroprudential system-wide — generation has been shaped by the works of Borio, Drehmann and Tsatsaronis (2014), Adrian and Shin (2010), Acharya (2009) and Cont, Moussa and Santos (2013). Under this approach, stress tests explicitly incorporate network contagion, fire-sale externalities, feedback loops between banks and the real economy, and behavioural responses of depositors and creditors. The IMF Financial Sector Assessment Program (FSAP) has adopted elements of this generation for global systemic assessments. The comparison of the four generations is summarised in Table 1.

Table 1. Evolution of the methodology of banking stress tests under macroeconomic shocks



Generation	Key representatives (year)	Central idea and instruments
Top-down macroeconomic	Sorge (2004); Foglia (2009)	Small set of adverse macro scenarios translated into aggregate banking projections through elasticities
Bottom-up bank-by-bank	Acharya, Engle & Pierret (2014); Schuermann (2014); EBA/Fed practice	Each bank projects own balance sheet under a common macro scenario using its internal models
Integrated solvency-liquidity	Barnhill & Schumacher (2011); Puh & Schmitz (2014); ECB (2019)	Joint projection of capital, LCR and NSFR under a common macro scenario with confidence-channel feedback
Macroprudential system-wide	Borio, Drehmann & Tsatsaronis (2014); Adrian & Shin (2010); Cont, Moussa & Santos (2013)	Network contagion, fire-sale externalities, macro-financial feedback and behavioural responses

For the banking system of the Republic of Uzbekistan, the improvement of the stress-testing framework should be organised along five directions. First, the introduction of a national three-scenario stress-testing suite (baseline, adverse and severely adverse) covering three-year horizons and updated annually. Second, the integration of liquidity and solvency projections into a single dynamic-balance-sheet model. Third, the development of a network module capable of tracing contagion through the domestic interbank market. Fourth, the inclusion of digital-run scenarios in which mobile-banking withdrawal rates and social-media signalling are explicitly modelled. Fifth, the systematic publication of stress-test results as an element of supervisory transparency. These directions align the national framework with the modern fourth-generation international practice.

The methodological choice between static and dynamic balance-sheet assumptions has fundamental implications for the reliability of stress-test results. Under the static-balance-sheet approach, banks are assumed to maintain their balance sheet unchanged over the stress horizon; this is the approach traditionally used by the EBA in its stress-testing exercises. Under the dynamic-balance-sheet approach, banks are allowed to adjust their balance sheet in response to the stress scenario; this approach is used by the Federal Reserve in the DFAST and CCAR programs. Kohn and Liang (2019) systematically compared the two approaches and concluded that dynamic-balance-sheet assumptions produce more realistic projections but require significantly more supervisory resources and modelling expertise.

The integration of climate-related and geopolitical risks into stress-testing frameworks has emerged as an important new frontier. The European Central Bank conducted its first climate stress test

in 2022, and the Bank of England in 2023 published an extensive climate stress-testing exercise. Geopolitical risks — including sanctions, cyber-warfare and supply-chain disruptions — have been increasingly incorporated into the adverse scenarios of major supervisors. The IMF Global Financial Stability Report (April 2024) recommends that emerging-market supervisors, including the Central Bank of the Republic of Uzbekistan, gradually incorporate these new risk dimensions into their stress-testing programs.

Conclusion

The conducted study leads to four generalising conclusions. First, the methodology of banking stress testing has evolved through four generations — top-down macro, bottom-up bank-by-bank, integrated solvency-liquidity and macroprudential system-wide — each of which enriched rather than replaced the previous one. Second, the modern generation of stress tests must combine forward-looking macroeconomic scenarios, dynamic-balance-sheet modelling, network contagion analysis and behavioural responses to digital shocks. Third, the 2023 collapse of U.S. mid-sized banks demonstrated that traditional LCR-based stress tests significantly underestimate the true speed of deposit outflows in banks with a high share of uninsured deposits and require the introduction of digital-run scenarios.

Fourth, for the banking system of the Republic of Uzbekistan the priority directions of further work are the development of a national three-scenario stress-testing suite, the integration of liquidity and solvency projections into a unified dynamic-balance-sheet model, the introduction of network contagion and digital-run modules and the systematic publication of stress-test results. The consistent implementation of these directions will substantially strengthen the resilience of the national banking system to macroeconomic shocks and align it with modern international standards.

In addition to the four generalising conclusions above, the study identifies several implementation priorities for the Republic of Uzbekistan. First, the establishment of a dedicated stress-testing unit within the Central Bank, staffed by specialists in macro-financial modelling, network analytics and behavioural economics. Second, the development of a national macroeconomic scenario generator drawing on the experience of the ECB, the Federal Reserve and the IMF. Third, the introduction of an annual bottom-up stress-testing exercise covering all systemically important commercial banks. Fourth, the systematic publication of stress-test results and the establishment of a mandatory response protocol for banks that fall short of supervisory thresholds. The consistent implementation of these priorities will substantially strengthen the resilience of the national banking system to macroeconomic shocks.

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