

*Bielenka G.V.*

## **STRESS TESTING APPLICATION IN RISK-MANAGEMENT SYSTEMS OF UKRAINIAN BANKS**

*Г.В. Бєленька,  
аспірант, Національний університет «Києво-Могилянська академія»*

### **ЗАСТОСУВАННЯ СТРЕС-ТЕСТУВАННЯ У СИСТЕМАХ РИЗИК-МЕНЕДЖМЕНТУ УКРАЇНСЬКИХ БАНКІВ**

***Annotation.** The article aims to develop the scheme of stress testing process in a commercial bank, focusing on the main tasks of the procedure, its stages, and approaches to estimation of different banking risk types. The proposed methodology can be used in estimation of potential risks inherent to the activity of Ukrainian banks, and can serve as a basis for development of internal risk-management tools, as well as for supervisory policy elaboration.*

***Key words:** stress testing, banking risk, commercial bank.*

***Анотація.** Статтю присвячено розробці схеми процесу стрес-тестування у комерційному банку. Розглянуто основні завдання стрес-тестування, етапи процедури та підходи до оцінки індивідуальних ризиків. Запропонований підхід може використовуватись під час оцінки потенційних ризиків, притаманних діяльності українських банків, і може служити базою для розробки інструментів управління банківськими ризиками, а також для створення регулятивних документів у галузі банківського нагляду.*

***Ключові слова:** стрес-тестування, банківські ризики, комерційний банк.*

**Introduction.** The financial crisis, which started in Ukraine in autumn of 2008, has elicited the necessity in enhancing the risk management systems in commercial banks. One of analytical instruments, aimed to provide estimation of potential losses in case of possible downturns in financial sector and other adverse movements in the economy, is stress-testing.

Stress-testing as a risk-management tool has been discussed in numerous articles by Western authors, such as M. Cihak, M. Jones, P. Hilbers, G. Hoggarth, G. Slack, M. Sorge and others. In Ukrainian economic research, the topic of stress-testing has not been studied yet. Some issues related to analysis of financial stability of the banks are highlighted in the works of Ukrainian economists, including O. I. Kireev, G. T. Karcheva, S. M. Mischenko, V. V. Vitlinsky, V. O. Zinchenko.

A significant number of studies on stress-testing of the banking systems has been created within the FSAP (Financial Sector Assessment Program), initiated by International Monetary Fund and the World Bank [5]. During this program, a number of stress tests have been developed and successfully applied to estimate the financial stability of the banking systems in Great Britain, Czech Republic, Hungary, Canada, Austria and other countries.

In 2004, the NBU in its Resolution №361 mentioned stress-testing as a tool that is recommended for application in market and liquidity risk management of commercial banks [1, p. 31], while in 2009, the methodological recommendations on stress-testing application were approved by NBU Resolution №460 [2]. Still, a lot of theoretical and methodological issues remain unresolved. Firstly, the commercial banks need to develop the stress-testing models

themselves. Secondly, the tools for stress scenario creation need to be developed yet, and structure of factors influencing banking risk exposures has to be analyzed. In addition, no ready-made stress-testing schemes for Ukrainian banks currently exist. Moreover, the approaches and models of stress-testing, which would take into account the peculiarities of Ukrainian financial sector, banking regulation and market specifics, are not fully developed. Therefore, there arises a necessity in describing a schedule for stress-testing of a commercial bank, unified enough to allow aggregation and analysis on the banking system level, and at the same time flexible enough to let every individual bank include the factors specific for its risk profile.

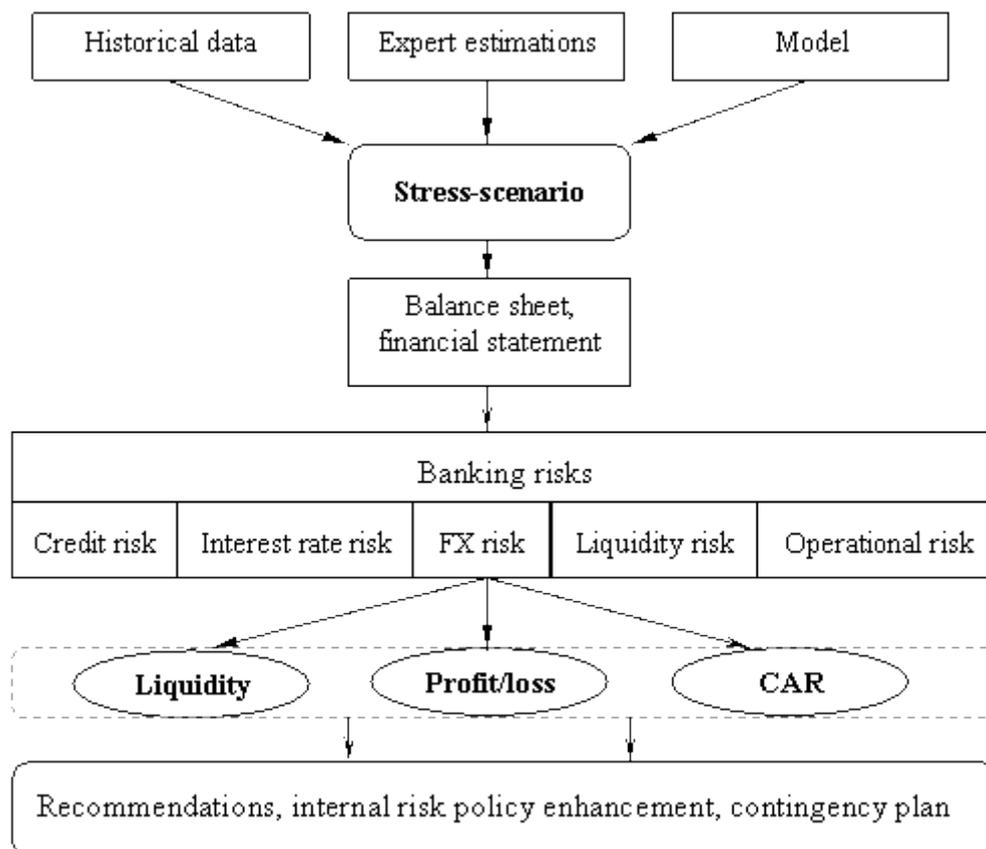
**Problem setup.** The goal of this article is to present a comprehensive scheme of stress-testing procedure for a commercial bank, associated tasks and needs in cooperation between different structural units of the bank. The developed scheme would allow addressing the major types of banking risks (credit, liquidity, market, and operational) and encompassing a unified approach to estimation of possible bank losses from stress scenario realization. Descriptive, comparative and graphical methods are applied.

**Research results.** Stress testing is defined as a technique «used to assess the vulnerability of a portfolio to major changes in the macroeconomic environment or to exceptional, but plausible events» [3, p. 4]. The main tasks of stress testing is quantification of impact of a chosen stress-scenario (set of changes in risk factors) on the bank's assets, liabilities, capital and profit; estimation of potential losses from stress-scenario realization and possibilities of absorbing such losses; estimation of quality of the risk-management procedures applied.

NBU describes two main approaches to stress testing: scenario analysis and sensitivity analysis. Scenario analysis involves construction and application of a stress-scenario, including the changes in most important risk factors that could influence the financial standing of the bank (for example, FX rates, interest rates, change in GDP or disposable income). Sensitivity analysis envisages estimation of impact of moment change in one risk factor only, with other factors fixed [2, p.4–6]. This article undertakes the stress-scenario approach as a more realistic one.

In order to construct a stress-scenario and apply it to bank's balance sheet data, both expert estimations and statistical methods may be used. Stress-scenarios may be based on the historical crises (for example, financial crises of 1998 and 2008), on expert judgement (hypothetical but plausible events), or on a macroeconomic model (which allows linking the changes in banking shocks to the dynamics of key macroeconomic indicators). Important requirements for a stress-scenario are its internal consistency, possibility of occurrence and inclusion of risk factors which are most important for the bank's activity. Each bank should design the stress-scenarios in the way that they could account for the bank's risk profile, portfolio structure and the range of banking products offered.

On the next step of analysis, the developed stress-scenario is applied to the data of bank's balance sheet and financial statement, in order to trace the resulting changes in the bank's assets, liabilities, capital and profits. The approach taken in this article envisages setting the main targets crucial for the bank (here, three targets are: capital adequacy ratio (CAR), as an important covenant set by NBU and Basel Committee on Banking Supervision; bank's profit, as the indicator most widely used in managerial planning and decision-making; and liquidity sufficiency, which is needed for normal bank's functioning). Therefore, impact of scenario realization on mentioned targets is studied by following scheme (see Figure 1).



**Figure 1. Stress testing scheme under scenario approach.**

For the purpose of liquidity estimation, it is recommended to use the expected cashflow table. All the expected cashflows from main groups of assets (customer loan repayments, new loan disbursements, interbank placements, maturing securities) and liabilities (customer deposit dynamics, scheduled repayment of interbank takings, planned attraction of new funding), as well as other flows (for example, expected utilization of credit lines), are sorted into maturity baskets (such as: up to 1 week, from 1 week to 1 month, 1-3 months, 3-6 months, 6 months-1 year, over 1 year). Sufficiency of liquidity in each time interval is checked by calculating the gap between inflows and outflows, and also by estimating the cumulated gap (the sum of gaps in all baskets preceding the target one).

To analyze the effect on the bank's profitability, measured by current year profit/loss, it is necessary to trace the impact of stress-scenario on its main components (revaluation result, loan loss provision expenses, net interest income, other income/expenses), and aggregate the resulting changes.

As for capital adequacy ratio (CAR), it is assessed by dividing regulatory capital by risk-weighted assets. Therefore, the analysis needs to estimate the changes from stress-scenario impact in both of these components.

The estimation of stress-scenario impact on the bank's liquidity, profitability and capital adequacy can be conducted through assessment of the change in different types of banking risks. Five main risk types are included into stress-testing procedure, including credit, interest rate, foreign exchange, liquidity, and operational ones. The impact of each of the risks on the bank's target indicators (liquidity stock, profit/loss, CAR) is traced.

Credit risk is the possibility of a loss due to the inability of the counterparty to fulfill its contractual obligations. Three types of indicators should be estimated while performing stress testing: the change (worsening) in category of loans in the bank's loan portfolio, additional loan loss provision to be allocated, and expected non-repayments on loans in monthly breakdown. Value of net losses, resulting from need to allocate additional provision to cover non-performing loans (NPL), is mapped into profit/loss and further impacts regulatory capital change. Shift in loan category results in growth of risk-weighted assets (RWA), thus decreasing CAR. Sum of expected non-repayments on loans is estimated while assessing the liquidity flows.

Interest rate risk refers to the possibility of losses resulting from change in interest margin (difference of average rates on interest-bearing assets and liabilities). Change in interest rates would influence the net interest income and thus profit/loss, which is a part of regulatory capital. Also, change in interest rates can lead to change in customers' solvency and in NPL, as described above. In addition, volumes and costs of interest-bearing assets and liabilities (loans,

deposits, interbank takings, securities etc.) may change as a result of shift in demand for them, in response to interest rate movement. The latter factor would also influence the liquidity flows.

Foreign exchange risk is attributed to probability of fluctuations in the value of positions in foreign currencies and banking metals. The change in FX rates is translated into revaluation of the bank's assets and liabilities, which leads to change in position and influences the profit/loss. Also, such components of CAR as risk-weighted assets, open FX position, long-term gap (difference between assets and liabilities with remaining maturity over 1 year), and subloan included into regulatory capital, are revalued. As for impact on liquidity, the change in FX rates may influence the solvency of customers (leading to change in loan repayments) and the demand for different types of deposits (on-demand versus term, UAH-denominated versus FX-denominated, general inflow or outflow).

Liquidity risk is the risk that the bank may become insolvent and unable to meet its obligations to counterparties. It is reasonable to model the realization of liquidity risk by including into liquidity flow table the daily outflow of certain share of customer deposits, determined by the scenario, during the given amount of days. Čihák [4, p. 21] proposes to use 5-day horizon, or the working week, as the minimal term generally needed to take measures on liquidity deficit removal. The impact on profit/loss and CAR in this case results from additional costs of getting liquidity (interest to be paid on attracted funding, or discounts due to quick sale of assets).

Operational risk is associated with probability of losses from inadequacies or errors in internal processes, actions of employees and systems, or external events. The estimated amount of loss from operational risk realization under given scenario is mapped directly on profit/loss and further included into regulatory capital.

Based on the results of aggregation of the individual risk impacts on the target indicators, the resulting influence of stress-scenario is determined, including the potential weaknesses of the bank's financial standing, possibilities for improvement of current asset-liability structure, potential capital and liquidity needs, and expected decrease in profitability associated with stress-scenario realization. Further, the results of analysis can be used to develop recommendations on risk-management and contingency measures, such as anti-crisis plans.

**Conclusions.** Stress testing is a useful tool of risk estimation in a commercial bank, giving the guidelines to actions needed to maintain financial stability of a banking institution, namely, keeping the sufficient stocks of liquidity and capital, and at the same time achieving the planned profitability level. Regular conducting of stress testing helps to enhance the internal risk policies and to develop action plan for the cases of bank-specific or systemic financial crises.

This article outlines a schedule that can be used for stress testing of a commercial bank. Further research could be undertaken to incorporate into the proposed schedule more detailed estimations of assets, liabilities and financial result changes under the impact of shocks (for example, improve a credit-risk model by segmenting the enterprise loan portfolio by industry; include the business growth model to adjust the liquidity need predictions; embed the liquid asset pricing model to allow better prediction of asset portfolio value changes under given scenario).

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