ASSESSMENT OF RISKS IN THE BANKING SYSTEM BY STRESS TESTING AT THE NATIONAL DEPOSIT INSURANCE FUND

Ádám Banai – Péter Lang

ABSTRACT
To be able to respond timely to a credit institution becoming insolvent, the National Deposit Insurance Fund (NDIF) continuously monitors the development of the insured institutions' resilience to shocks. It carries out this activity, among others, by stress tests based on macroeconomic scenarios, in cooperation with the Central Bank of Hungary (MNB). During this exercise, firstly the results of solvency and liquidity stress tests are jointly taken into account, in a composite risk indicator. Secondly, using a simple approach, it calculates shock measures of deposit withdrawals that are sufficient to make credit institutions illiquid. This paper provides a brief overview of the methodology of these stress tests.[1]

JEL codes: G21, G28

Keywords: deposit insurance, NDIF, bank failure, financial stability, stress test

1. INTRODUCTION

Deposit insurance or deposit guarantee schemes play a crucial role in maintaining financial stability as they strengthen depositors' confidence in financial institutions by protecting guaranteed deposits in the event of a credit institution becoming insolvent. By doing so, they also prevent potential bank runs. With a view to improving confidence, in addition to an increased coverage limit (to EUR 100 000 from 2011), the payout deadline will also be gradually reduced to seven working days by 2024. Meanwhile, both the total deposits proportional to the balance sheet total and the share of guaranteed deposits within the total deposits of large European banks have increased in recent years. According to the end-of-the-year data of the European Banking Authority (EBA) for 2016, the stock of guaranteed deposits in European banks amounted to more than EUR 7,000 billion.

Having regard to this crucial role and the significant exposures involved, it is of utmost importance that deposit insurers, including the NDIF in Hungary, are able to respond timely in the event of a credit institution's insolvency, in order

1 We are indebted to *Balázs Vajai* and *István Tóth* for their help to the preparation of this paper.

to prevent potentially significant adverse social effects. Such a timely response involves issues of funding, as the NDIF is not obliged[2] – and not able, for that matter – to pay unlimited compensation at any time from its available funds. Operational risks are also entailed, as deposit insurance providers should be able to deploy sufficient human resources to manage the compensation process (as well as adequate provisions for temporarily recruiting additional staff) and have at hand the consolidated deposit data required for payouts to ensure timely compensation. Preparation for this is significantly easier if deposit insurers can accurately assess the shock-absorbing capacity of the insured credit institutions.

In order not to rely solely on current indicator values for the purpose of risk assessment, but also to have an insight into the development of bank risk indicators under the forecasted baseline macroeconomic scenario and under certain risk scenarios which may occur at a fixed – typically low – probability but may result in significant losses, the NDIF engages in stress testing based on macroeconomic scenarios. Such stress tests are risk assessment tools that not only allow for the identification of vulnerable institutions under a specific scenario but also reveal risk factors that are particularly detrimental to resilience to shocks, as well as their temporal dimension. In essence, stress tests are complex simulation exercises which show how the shock-absorption capacity of the respective credit institutions would change over the testing horizon in the event a risk scenario described by the relevant macro variables occurs[3].

It is also paramount for the Central Bank of Hungary (Magyar Nemzeti Bank – MNB), which is mainly responsible for guarding financial stability, that the NDIF fulfils its functions effectively and reliably. For deposit insurance is a last-resort component of the financial safety net, which may prevent bank runs and thereby problems which could potentially lead to serious ramifications to the real economy and threaten the functioning of the whole banking system. An equally important task of the NDIF is to protect the assets of depositors. In lack of such a protection, bank failure may pose significant social risks, too. In view of these considerations, it is a common interest of the NDIF and the MNB that the NDIF monitors the risk of banks by stress testing. To this end, the two institutions have engaged in cooperation, under which the NDIF carries out its risk assessment activity relying on the stress testing models and technical assistance of the MNB.

2 However, if necessary, the NDIF may use other funds for compensation in addition to its existing reserves.

3 Risk scenarios are typically not only based on historical data, but also on expert risk assessment, and are defined as a scenario of low anticipated probability which, however, is still plausible and relevant. Since a reliable estimation of the multidimensional distribution of the examined macro variables is not possible due to the scarcity of data available, the scenario cannot be assigned an exact value of probability.

This risk assessment is based on two approaches. Firstly, the previously mentioned stress tests are performed to see how the risk-absorption capacity of the respective credit institutions would change under a specific macroeconomic scenario. In addition, using a simple method, the reverse question is also analysed: how adverse a scenario would be needed for a credit institution to become insolvent. The following two sections are dedicated to the presentation of these two approaches and their results.

2. STRESS TESTS AND THE AGGREGATE RISK WEIGHT

The MNB applies two different stress tests focusing on credit risk and liquidity, respectively, for a forward-looking risk assessment of the banking system and the identification of systemic risks. The currently applied credit risk stress test is discussed in detail in *Banai* et al. (2013) and the liquidity stress test in MNB (2016).

Our *credit risk stress test* spans a two-year time horizon and uses a top-down approach (i.e. applying the same methods and uniform parameters in the calculations for each bank). It is also supplemented with the quantification of market risk. As risk factors, changes in GDP, employment and the prices of residential real estates, as well as the development of the reference interest rate, the foreign exchange rate and the risk premium were considered. In contrast to the scenario corresponding to the forecast published in the *Inflation report* of the central bank and regarded as most probable, under the usual stress scenario it is assumed that a serious but plausible shock will occur early in the second quarter of the forecast horizon, pushing up the Hungarian risk premium, reducing external demand for our products and weakening the HUF exchange rate. All this would reduce growth in the Hungarian economy, deteriorate employment and cause a sudden fall in real estate prices. Our testing framework is based on the calculation of expected losses, therefore, separate estimates are made for the earnings before loan losses and the expected loan losses.

Our *liquidity stress test* measures the impact of the assumed simultaneous occurrence of financial market turmoil, extensive deposit withdrawals and drawdowns of credit lines as well as withdrawal of owners' funds on the liquidity coverage ratio (LCR) of banks over a 30-day horizon. More specifically, the stress test analyses the simultaneous impact of the following low-probability shock events:

1) revaluation of items that are sensitive to the interest rate from a liquidity aspect as a result of a significant rise in the policy rate;
2) revaluation of the derivative holdings as a result of a considerable foreign exchange rate depreciation;

3) withdrawal of household and corporate deposits;
4) drawdown of household and corporate credit lines;
5) withdrawal of owner's funds to a degree that exceeds plans significantly; and
6) non-performance on interbank exposures as a result of the above shocks.

In our stress test, we also took into account adjustment channels with the help of which institutions can improve their LCR adequacy in the short run, and which do not or only moderately involve reputational risk, and are at the banks' disposal even in stress situations. If the bank fails to meet the liquidity requirement even following these corrective steps, it will be compelled to sell assets, which will trigger a price change and thus contagion effects. These effects are modelled in a so-called 'contagion model'.

Our stress tests should be applied with the proviso that they assess credit institutions' compliance with regulatory capital and liquidity requirements. Moreover, it is only the liquidity stress test that reckons with adjustment possibilities, while regulatory responses are not considered in either of the tests. Therefore, they are not capable of directly defining whether the NDIF will have a payment obligation under a specific stress scenario. Furthermore, based on our experience from recent stress tests – as a result of the high shock-absorbing capacity of Hungarian banks, attributable to a large extent to the sound functioning of the financial system and the stringent regulatory capital and liquidity requirements – under a plausible stress scenario, the NDIF not only would not have a payment obligation, but banks would actually rarely even infringe regulatory requirements. Nonetheless, the stress testing framework of the MNB may be suitable for the purpose of risk assessment by the NDIF, provided that the aim is not to directly connect the NDIF's intervention with a macroeconomic scenario, but rather to define a scenario-specific risk ranking, pointing out the riskiest institutions.

Due to their differences, consolidating the results of the two tests is far from straightforward. Accordingly, it is proposed to weight the variables used in the methodology by calculating their aggregate risk score featured in the calculation method of risk-based contributions laid down as a requirement by the EBA and implemented by MNB Decree No. 19/2016, thereby creating a composite indicator. According to the method of calculating risk-based contributions, aggregate risk scores are calculated on the basis of the leverage ratio, the capital adequacy coverage ratio, the LCR, the ratio of non-performing loans (NPL), the ratio of risk-weighted assets (RWA) to the balance sheet total, the return on assets (ROA) and the potential coverage of the deposit guarantee scheme (*Table 1*).[4]

4 Individual risk scores are assigned to the specific risk indicator values. The aggregate risk score is their weighted sum. (The weights had been specified by the EBA.) Aggregate risk weights are assigned to the corresponding aggregate risk score values.

Table 1

Calculation of aggregate risk scores and weights

	Indicator	Weight of indicator in the model	Range	Risk score
Capital	Leverage ratio	12%	0%≤ x <6,5%	100
			6,5%≤ x <9%	66
			9%≤ x <15%	33
			15%≤ x	0
	Capital adequacy coverage ratio	12%	x<100%	100
			100%≤ x <200%	50
			200%≤ x	0
Liquidity	LCR	24%	0%≤ x <60%	100
			60%≤ x <100%	50
			100%≤ x	0
Asset quality	NPL	18%	0%≤ x <10%	0
			10%≤ x <21%	50
			21%≤ x	100
Business model and management	RWA/Assets	8,5%	0%≤ x <20%	0
			20%≤ x <50%	33
			50%≤ x <60%	66
			60%≤ x	100
	ROA	8,5%	x<-3%	100
			-3%≤ x <2%	50
			2%≤ x	0
Potential loss of deposit insurance scheme		17%	0%≤ x <150%	100
			150%≤ x <400%	50
			400%≤ x	0

$$ARS_i = \sum_{j=1}^{n} IW_j \times IRS_j$$

ARW values assigned to each ARS

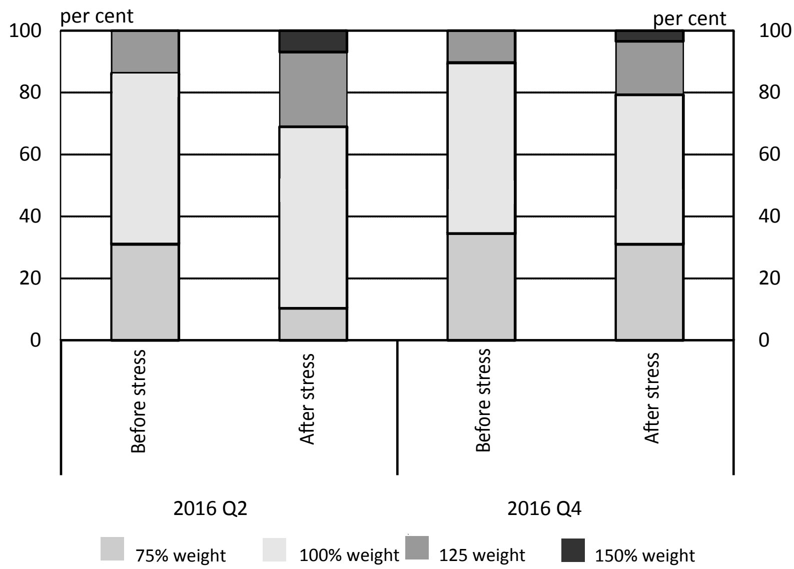
Risk class	Aggregate risk score (ARS)	Aggregate risk weight (ARW)
1	0 - 30	75%
2	30 - 50	100%
3	50 - 60	125%
4	60 -	150%

Source: NDIF

The stressed value of the composite indicator is obtained by calculating stressed values (under a specific risk scenario) for the variables used in the methodology with the stress tests presented above and inserting these stressed values into the formula of the composite indicator. As a result, in addition to the benefit of having a single composite indicator at our disposal for a consistent assessment of banks' risk, the results after stress obtained in a specific stress scenario are readily comparable to the results before stress under the calculation method of risk-based contributions.

The sector-level distribution of aggregate risk weights before and after stress in 2016 Q2 and Q4 are presented in Figure 2. The Figure shows that while none of the institutions were classified into the riskiest category of an assigned weight of 150 per cent before stress, after stress, there is a shift in the distributions towards higher risk in both reference periods: not only the 150 per cent category appears but the share of institutions in the second most risky category of 125 per cent also increases significantly.

Figure 1
Sector-level distribution of aggregate risk weights before and after stress in the banking system



Source: NDIF, MNB

3. REVERSE STRESS TESTS

In order to be prepared for shock-like deposit withdrawals, it may also be helpful for deposit insurers to be aware of how large a deposit withdrawal shock (i.e. bank run by depositors) would be required for illiquidity to set in at an institution. This provides a useful indication of the possibilities – and time[5] –available for intervention before the credit institution would become insolvent. Reverse stress tests examine questions of this type. In general, they may be described as tests seeking the most probable constellation of simultaneous shocks of a size that would be enough to make a bank insolvent.

Despite their increased popularity in recent years and their conceptual appeal, there is still room for development in the methodology of reverse stress testing (*Grundke–Pliszka*, 2015). The main reason for this may be that the algorithms of classic stress tests relying on macroeconomic scenarios are typically not invertible. For in stress tests where banks influence each other's results (by contagion arising from adjustment possibilities or through the interbank market), the same result for a specific bank may be obtained in different ways. Even if banks do not have an influence on each other's performance, due to the multidimensional feature of the macro variables (risk factors) making up the scenario, several different vectors of risk factors may lead to the same outcome. Given this situation, it is the most useful from a practical point of view to identify the most probable one of these scenarios. To be able to do this, however, we would need to know the multidimensional distribution of the risk factors, but there is no sufficient data at our disposal for a corresponding estimation due to the low frequency of macroeconomic data series as well as their short available time series in the case of Hungary.

Nevertheless, building on the liquidity stress test, it is possible to determine in a simple framework the size of shock caused by a single risk factor (or even several factors associated to a fixed degree) which is sufficient for a financial institution to reach the illiquidity limit. Of the sources of risk incorporated in the model, stress arising from deposit withdrawals are of primary interest for the NDIF, as it is typically this type of shock that requires the fastest intervention by the Fund. This exercise was carried out taking that priority into account.

In our calculations, compared to the original stress testing procedure used for calculating the stressed LCR for the aggregate risk weight, in addition to the re

5 When evaluating the pace of development of panic deposit withdrawals, the upcoming change in the related infrastructure should be taken into account. Within the instant payment system to be implemented in 2019, payment service providers will be required to complete domestic transfers (up to a value of HUF 10 million) at any time within five seconds. This may also significantly accelerate potential bank runs.

alisation of the stress scenario we have allowed for adjustment possibilities but did not take contagion into account. The reason for this is that the inclusion of channels of contagion would significantly complicate calculations under the reverse stress test (e.g. the results would be dependent on the number of constituent institutions in the system). By this procedure, it is implicitly assumed that the adjustment by a given bank does not lead to a price impact and, as a result, fire sales in the market of corporate bonds and mortgage covered bonds. In our opinion, this is not a far-fetched assumption if stress and consequently adjustment pressure on a single institution is considered. Importantly, this way, institutions can be reviewed separately. Consequently, the outcome for a specific institution is independent of which market participants are taken into account.

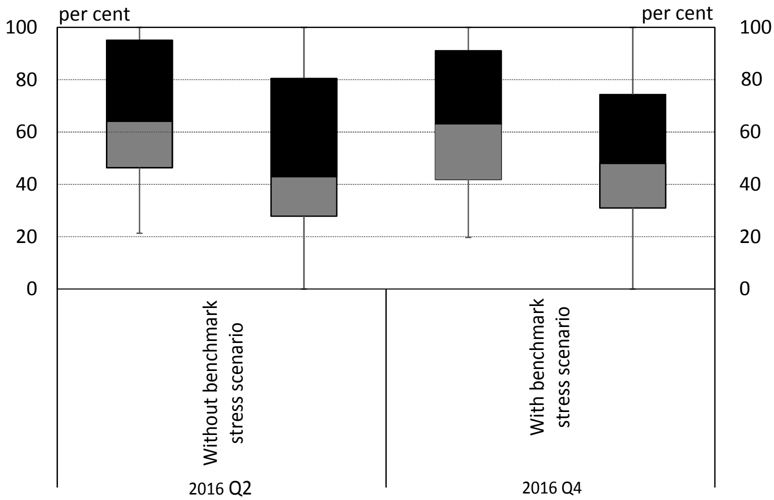
For the calculations, the size of stress on the household deposits of banks was changed (considering an equivalent size of stress on corporate deposits) so that the LCR of the bank would drop to 0 per cent. The calculations were performed both with and without the standard stress measures assumed for the other risk factors in the liquidity stress test. In our results (*Figure 2*), the extreme case when the LCR does not fall below 0 per cent even in the case of maximum deposit withdrawal was assigned, while the other extremity, when the stress measures under the benchmark stress scenario lead to a decline of the bank's LCR below 0 per cent even without deposit withdrawal was associated with a value representing the highest risk.

The Figure shows that the median institution would exceed the illiquidity limit – provided that no other stresses occur – only in the case of the withdrawal of about 60 per cent of its deposits. This value is of course reduced by the realisation of other risk factors of the standard stress scenario in the liquidity stress test. When these measures are taken into account, even the shock-like withdrawal of 40 to 50 per cent of deposits of the median institution would be enough. However, attention should be paid to the lower end of the distribution: in both periods, even without the benchmark stress scenario there exists an institution, in the case of which the withdrawal of only 20 per cent of the deposits would result in illiquidity.

4. SUMMARY

It is of paramount importance for financial stability that the NDIF fulfils its functions timely, effectively and reliably. Preparation for this is significantly easier for deposit insurers if they can accurately assess the development of the shock-absorbing capacity of the credit institutions they insure. To this end, the NDIF regularly assesses the risks of banks with the cooperation of the MNB, using among other things the stress tests developed by the central bank.

Figure 2
Sector-level distribution of (equal) household and corporate deposit withdrawal shock sizes turning the bank into illiquidity, with and without a benchmark stress scenario



Source: MNB

The NDIF takes into account the outcome of the credit risk and liquidity stress tests developed by the MNB jointly, by calculating a composite risk indicator featured in the calculation method of risk-based contributions laid down as a requirement by the EBA. This allows not only for risk ranking under a specific stress scenario, paying particular attention to the riskiest institutions, but – as a benefit of the uniform framework – also for easy comparability with the results before stress under the calculation method of risk-based contributions, emphasizing the impact of the potential stress.

In the event of an ongoing bank run by depositors, it is also a useful tool for the NDIF to reverse and answer the question examined under stress tests: how large a shock would make a specific financial institution insolvent. Although the methodology of reverse stress tests, which seek to answer questions of this kind, raises a number of fundamental problems in general, once only stress on household deposits (and on corporate deposits, equalling in size with the former) is put under scrutiny within the framework of the liquidity stress test, and some simplifying assumptions are made, it is easy to quantify the measures of stress that are sufficient to make the institutions illiquid. According to our results, a deposit withdrawal of a considerable amount, about 60 per cent would be required for the median institution to reach the illiquidity limit. However, for some institutions, deposit withdrawals of only 20 per cent may lead to insolvency.

REFERENCES

MNB Decree No. 19/2016 of 25 May 2016 on the detailed rules of determining variable risk-based contributions by the members of the National Deposit Insurance Fund [19/2016. (V. 25.) MNB rendelet az Országos Betétbiztosítási Alap tagjai által fizetendő kockázatalapú változó díj megállapításának részletes szabályairól.]. Budapest: Magyar Nemzeti Bank.

Banai Ádám – Hosszú Zsuzsanna – Körmendi Gyöngyi – Sóvágó Sándor – Szegedi Róbert (2013): Stress testing at the Magyar Nemzeti Bank [Stressztesztek a Magyar Nemzeti Bank gyakorlatában]. MNB Occasional Papers 109, Budapest: Magyar Nemzeti Bank.

EBA (2015). Guidelines on methods for calculating contributions to deposit guarantee schemes (EBA/GL/2015/10). London: European Banking Authority.

Grundke, P. – Pliszka, K. (2015). A macroeconomic reverse stress test. Deutsche Bundesbank Discussion Papers, No. 30/2015. Frankfurt am Main: Deutsche Bundesbank.

MNB (2016). Financial Stability Report (May 2016) [Pénzügyi Stabilitási Jelentés (2016. május)]. Budapest: Magyar Nemzeti Bank.