Establishing shock parameters for a liquidity analysis under deleveraging: how far is too far?

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1. Definition of a stress test

- Analysis of a scenario aimed at capturing the adverse outcome of a given combination of values taken by a subset of risk factors, given a particular set of constraints imposed on the rest of the risk factors considered to be relevant for a given event (e.g. a bank's liquidity shortfall under assumptions made on the withdrawal rates or reduced inflows in respect to both its liabilities/funding sources and asset-side inflows , in a given macroeconomic environment/ under a set of constraints).

- Because the purpose of such an analysis is to uncover vulnerabilities, the multivariate tail of the distribution of such risk factors is the point of interest

- The outcome of the scenario is expressed in terms of the total amount of loss /shortfall and compared against a benchmark, usually taken as the expected value of the loss in the high density region of the multivariate distribution.

- The estimate of a probability of occurrence of the loss conditional on the given constraints is crucial in determining whether or not the scenario is a "true" stress test scenario. Associating a constraint value for which the combination of the risk factors is too frequently met does not qualify, neither does a value that is so extreme that the outcome of the analysis is known beforehand.

2. Potential users of liquidity stress test analysis

- Supervisory Authority - under a micro-prudential approach. The number of risk factors included for such purpose might be higher than those included for the rest of the users.

- Central Bank - both in order to link the monetary policy stance to the developments in the amount of shortfalls following such analyses and to become aware of possible systemic risks, should common risk factors apply.

- Creditors, Investors and Rating Agencies

  Communicating the results of such tests to these categories must be done with caution, so as to avoid the common misunderstanding of the goal and assumptions underlying such analysis and running the risk of being taken as probable outcomes.

It depends…

Is the available data sufficient for the analysis?

Running simulations on data sets that have a too high degree of aggregation usually covers up specific vulnerabilities (e.g. A liquidity analysis failing to differentiate between total inflows and outflows on a certain maturity bucket, on currency structure and/or generating source)

Is the data put into the model expected to be relevant for the near future?

In statistical terms, the distribution of the risk factors, dependent on both their marginal/unconditional values and their inter-dependence of sample analysis must allow for an out of time validation. Are there reasons to believe that the " landscape" is changing?

Are such analyses useful?

Is the model well understood?

- Regardless of how “smart” a model is, if its complexity is such that the basic functioning of the model is a black-box for the supervisor or policy maker, it will run into the risk of not been taken seriously and be acted upon.

- The model, allowing for certain specificities, must be regarded as a general accepted approach in the literature, enabling others than the developers,(the outlay person for) the understanding of its inner workings.

- Models are data-dependent; the higher the length and frequency of the data, the easier it is to adapt to a wider array of models. Transformations of raw data should be clearly underlined as limitations to the simulation (e.g. linking lower-frequency macroeconomic indicators to higher-frequency micro data using proxy, highly-correlated auxiliaries.)

Are such analyses useful?

The scope, benchmark and setbacks of the analysis – are they clearly stated?

- Analysts must be aware of the limitations of the model due to data availability and quality, to the methodology employed and time constraints. Nevertheless, in order to ensure a particular line of action, before actually making use of the results, annalists should firmly believe in the outcome given the scenario rather than use time constraints as an excuse. As such, time awarded for study and analysis should be commensurate with its scope.

- Because of the low-probability of a stress –test scenario, benchmarking against a "normal" outcome is a must, helping the management in the decision making process and allowing for a feedback on the inputs/restrictions to the adverse scenarios.

- Broadening the scope of the analysis by increasing the number of risk factors included usually leads to the problem of dimensionality; the actual simulation increases in a non-linear way in its complexity.

4. Constructing a scenario

- The correlation between withdrawal events is low in high-density areas, and unknown in the tails. Given less than perfect correlation between risk factors, the potential negative outcome of an event described by a set of randomly generated values should be less than the sum of its separate effects described by the individual risk factors (sensitivities). An inverse correlation between factors is associated with hedging strategies and it has been largely used in portfolio management.
- However, for values imposed as restrictions on a subset of the relevant risk factors and given the presence of correlation among factors, the frequency of a risk factor taking an extreme-left value is no longer the result of the integral of its probability density function up to that point, but a higher, unknown value.
- Based on assumptions on the shape of the unconditional distribution of the risk factors and taking into account the changing nature of the correlation of risk factors as we move towards the tail as opposed to the high-density region (that is, based on a co-dependence structure, a copula) the aim is to sample from this multivariate tail a set of risk factor values given constraints on other factors.

5. Liquidity analysis – the idiosyncratic approach

Given the same leverage, each bank has its own funding structure, depending on the:

- ✓ reliance on domestic deposits from retail and corporate
- ✓ reliance on external funding either inside a banking group or with a third party with differing liquidity and financial risk
- ✓ reliance on short-term interbank funding
- ✓ reliance on the ability to raise funding on the capital markets issuing debt either directly or, if applicable, via parent support
- ✓ Model of business largely influencing the liquidity needs, depending on the maturity mismatch of its assets and liabilities
- ✓ Stage of the economic cycle, influencing inflows via expected NPLs and the cost of funding, dependent on creditor's perception of risk
- ✓ access to currency swaps, allowing a bank to deploy large mismatches of its loans/deposits ratios when looked at from a currency perspective rather than in general

It is for this reason that applying different assumptions for different banks might be preferable to a system-wide uniform approach.

Liquidity analysis – the idiosyncratic approach

The current liquidity regulation implies reporting data on actual(residual) maturity in the following buckets: <1 month,1-3 months, 3-6 months, 6-12 months, >12 months.

Ratios are computed for each bucket as follows:

- numerators called “effective liquidity”, represent a proxy for all inflows that are expected to be generated at a minimum over a certain period by assets or off-balance sheet items and are estimated by applying regulatory haircuts on the accounting values

- Denominators, called “necessary liquidity” are a proxy for all outflows expected to occur under a somewhat stressed scenario, given that a large part of funding is assumed not be rolled over at its maturity.

- For each maturity bucket, the positive difference between effective and necessary liquidity is considered as a source available to meet potential liquidity shortfalls on longer maturity buckets. A credit institution is considered to be in compliance with the regulation if none of the ratios drops below 1.

Liquidity analysis – the idiosyncratic approach

The data used by the Supervision Department (part of NBR), is also used for assessing liquidity under adverse scenarios. However:

- There are no specific assumptions on the funding's stable part depending on the source of funding. Rather, all short-term funding is considered as necessary if provided through swaps, interbank market, maturing debt issues, repos with the central bank.

- For deposits and external funding granted by parent institutions and other financial institutions, a separate assumption is made, depending on the bank's own historical withdrawal rates for each of the components. A simplistic approach is to take the worst monthly withdrawal rate for each component and apply it to the existing source of funding spreading the shock uniformly over the analyzed horizon, for each bank (of course a different model of withdrawal can be applied rather than assume a uniform one).

- Then, a table or chart showing the moment when the bank will face a liquidity deficit assuming the persistence of the shock over a given period of time (analyzed horizon) can be produced, as well as the estimated shortfall assuming that the shortfalls are additive (of course, this is a rather severe assumption). The study is carried out both for all currencies and for each individual currency, to see any significant currency funding shortages that might not be covered. The table below shows an example of how a liquidity deficit would build up over a given horizon (in the example, the horizon represents the first 20 days and is based on a previous analysis; the name of the banks, their market share and the cumulative deficit have been changed).

Liquidity analysis – the idiosyncratic approach

Day	Cumulative liquidity deficit (mil. eur)	Market share of banks with liquidity deficit	EURO LIQUIDITY DEFICIT										
1	0.8	5.29%	B2	B5	B7	B8	B9						
2	1.5	5.29%	B2	B5	B7	B8	B9						
3	4.2	7.36%	B2	B5	B7	B8	B9	B11					
4	7.1	7.36%	B2	B5	B7	B8	B9	B11					
5	9.9	7.36%	B2	B5	B7	B8	B9	B11					
6	12.7	7.36%	B2	B5	B7	B8	B9	B11					
7	15.6	7.36%	B2	B5	B7	B8	B9	B11					
8	18.7	7.48%	B2	B5	B6	B7	B8	B9	B11				
9	21.8	7.70%	B2	B3	B5	B6	B7	B8	B9	B11			
10	25.6	7.70%	B2	B3	B5	B6	B7	B8	B9	B11			
11	29.4	7.82%	B2	B3	B5	B6	B7	B8	B9	B10	B11		
12	32.8	7.82%	B2	B3	B5	B6	B7	B8	B9	B10	B11		
13	36.2	7.82%	B2	B3	B5	B6	B7	B8	B9	B10	B11		
14	39.6	7.82%	B2	B3	B5	B6	B7	B8	B9	B10	B11		
15	42.9	7.82%	B2	B3	B5	B6	B7	B8	B9	B10	B11		
16	48.3	9.30%	B1	B2	B3	B5	B6	B7	B8	B9	B10	B11	
17	54.4	9.30%	B1	B2	B3	B5	B6	B7	B8	B9	B10	B11	
18	60.5	9.30%	B1	B2	B3	B5	B6	B7	B8	B9	B10	B11	
19	66.8	10.40%	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11
20	73.6	10.40%	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11

Liquidity analysis – the idiosyncratic approach

But what if withdrawals are even more severe than those implied by the historical worst case?

It is for this reason that assumptions on the distribution and co-dependence of the distribution of withdrawals/increases in the amount of the funding sources will be made and this is the point of departure for constructing the stress test parameters that is going to be implemented

6. Constructing the adverse liquidity under deleverage

- Now, the estimate of the impact on the liquidity position of a bank, by applying haircuts representing the sample drawing is expressed in terms of the presence/absence of a shortfall on a pre-defined number of maturity buckets (e.g. following a sample of haircuts generated from the conditional multivariate distribution, the liquidity excess/shortfall is estimated for the first two maturity buckets: <1 month, 1-3 months). The procedure is repeated using a Monte Carlo approach, so as to come up with an estimate of how often shortfalls occur and what their mean value might be.

- Defining an appropriate threshold in terms of probability, supervisory or other action can then be taken. Systemic risk might then be added as the degree to which losses/shortfalls at individual credit institutions move together to cause shortfalls that are significant at a system level. That is, which is the repartition of system losses conditional on the losses incurred at individual banks

Constructing the adverse liquidity under deleverage

Such an approach, however similar the results might be when compared to other simulations using expert judgment techniques, has the advantage of comparability over time.

For as long as the “mapping” of the risk factors does not change, the estimates obtained should produce fairly good results/ “good bad scenarios”

More importantly, the outcome should consist of extreme scenarios where the actual, unobserved shortfalls should be consistent with the estimates

Thank you!