Annex

Concepts and methodologies

a) **Short-term Liquidity Ratio (IL)** – conceptually similar to the Liquidity Coverage Ratio (LCR), it is the ratio between the stock of liquid assets held by the institution and the net stressed cash flows (estimated disbursements in the next 21 business days under a stress scenario). Therefore, institutions with IL above one (100%) have enough liquid assets to withstand this stress scenario.

   i. Liquid assets – liquid resources available for each conglomerate/institution to honor its stressed cash flows for the next 21 business days. It is the sum of highly liquid assets, release of required reserves (due to deposits run-off) and supplemental resources.

      a. Highly liquid assets - These include: i) unencumbered Brazilian sovereign bonds held by the institution or received as a collateral in reverse repurchase agreement operations (reverse repos); ii) stocks listed in Ibovespa index; iii) liquid quotas of investment funds; iv) cash; and (v) free central bank reserves.

      b. Release of required reserves – amount of the required reserves that would be released to the institution due to the deposit run-off estimated in the stressed cash flows calculation.

      c. Supplemental resources – other options for monetization in the scenario's time-horizon, such as: Bank Deposit Certificate (CDB), Bank Deposit Receipt (RDB), Interbank Deposit (DI), long positions in box strategies (options), reverse repurchase agreements (reverse repos) backed by private securities.

   ii. Stressed cash flows – an estimate of the amount of cash that the institution needs within the scenario's timeframe (21 business days) under a stress scenario. The analyses take into account retail deposits run-off, wholesale funding run-off, market stress and net contractual cash flows.

      a. Retail deposits run-off – estimate of the necessary amount to cover the retail-customers withdrawals in demand deposits, time deposits, savings accounts, box strategies, securities issued by the bank, and repurchase agreements (repos) backed by private securities.

      b. Wholesale funding run-off – estimate of the necessary amount to cover the possibility of early redemption of the liability positions from the three largest market counterparties.

c. Market stress – estimate of the necessary amount to cover losses arising from market movements affecting the liquid assets or others positions that may cause a cash outflow of the institutions in the stress scenario. The losses comprise: i) margin calls; ii) pre-settlements of derivatives contracts; iii) losses on the marked-to-market values of the liquid assets.

d. Net contractual cash flow – payments due in derivatives positions and in contractual cash flows (assets and liabilities positions) with market agents, maturing within the horizon of the scenario.

b) Structural Liquidity Ratio (ILE) - it is the ratio between the available stable funding (part of the equity and liabilities on which the institution can rely for a one-year horizon) and the required stable funding (part of the assets, including off-balance-sheet assets, which must be financed by stable funding because they have long maturities and/or low liquidity). Institutions with ILE equal or above one (100%) are less susceptible to future liquidity problems. The calculation methodology is based on the final version of the Net Stable Funding Ratio (NSFR), which was introduced as a minimum mandatory compliance in October, 2018.

i. Available stable funding – the funding that shall remain in the institution for at least a year. The main sources of banks' stable funding are the capital; non-redeemable liabilities with residual maturities above one year regardless of counterparty; and funding with no maturity or with a maturity of less than a year coming from retail customers.

ii. Required stable funding – the amount of stable funding needed to finance the long-term activities of financial institutions. Therefore, it takes into account the liquidity and the maturity of the assets of the institution. The long-term assets are mainly the credit portfolio maturing in over a year; nonperforming assets; less liquid or encumbered securities (i.e. margin requirement in clearings); fixed assets; and the items deducted from the regulatory capital.

c) Total Capital Ratio – Basel Committee on Banking Supervision international concept, consisting of the system regulatory capital (RC) divided by the system RWA. In Brazil, until September 2013, the minimum required ratio was the factor "F", according to Resolution CMN 3,490, of 29 August 2007, and Circular BCB 3,360, of September 12, 2007. Until October 2013, financial institutions and other institutions authorized to operate should observe the 11% limit established by the BCB, except for individual credit unions not affiliated to central units. From October 2013 on, the minimum required ratio has been disciplined by the Resolution 4,193, of March 1, 2013, which defines a convergent calendar, requiring 11% of RWA from October 2013 to December 2015; 9.875% in 2016; 9.25% in 2017; 8.625% in 2018; and 8% from 2019 on. On top of this requirement must be added a capital buffer, as mentioned in the Common Equity Tier 1 (CET1) Ratio topic.

d) Tier 1 Capital Ratio – According the Resolution 4,193, of 2013, a Tier 1 Capital requirement became effective from October 2013 on, corresponding to 5.5% of RWA, from October 2013 to December 014, and 6% from January 2015 on. On top of this requirement must be added a capital buffer, as mentioned in the Common Equity Tier 1 (CET1) Ratio topic.

e) Common Equity Tier I Ratio (CET1) – According the Resolution 4,193, 2013, a CET1 capital requirement became effective from October 2013 on, corresponding to 4.5% of RWA. In addition to this requirement, the Resolution established a capital buffer, composed by the following items: conservation, countercyclical and systemic. The conservation buffer requirement corresponds to the following RWA percentages: zero, until December 31, 2015; 0.625%, from January to December 2016; 1.25%, from January to December 2017; 1.875%, from January to December 2018; and 2.5% from January 2019 on. The countercyclical buffer requirement is limited to the following maximum RWA percentage: zero, until December 31, 2015;

0.625%, from January to December 2016; 1.25%, from January to December 2017; 1.875%, from January to December 2018; and 2.5% from January 2019 on. The systemic buffer requirement is limited to the maximum RWA percentage: zero until December 31, 2016; 0.5%, from January to December 2017; 1.0%, from January to December 2018; and 2.0% from January 2019 on.

f) Leverage ratio – Basel Committee on Banking Supervision international concept, consisting of Tier I Capital to Total Exposure ratio. In Brazil, the BCB Circular 3.748, of February 27, 2015, established the leverage ratio (LR) methodology. This index intends to complement the current prudential requirements, through a simple, transparent and non-sensitive risk metric. The leverage ratio minimum requirement of 3.0% was established by the Resolution CMN nº 4,615, of November 30th, 2017, which is effective from January 2018 on, applicable for institutions classified as S1 or S2, accordingly to the Resolution CMN no 4,553, of January 1st, 2017.

Concepts and methodologies – Capital stress

1.1 Stress test – Introduction

The stress tests executed in BCB comprise a macroeconomic stress test as well as sensitivity analysis to relevant risk factors. These exercises are simulations executed by the BCB in order to estimate potential losses and capital shortfalls in the banking system stemming from extreme adverse, but plausible, scenarios. It also provides assessment of the resiliency of either an individual institution or the banking system as a whole. Hence, it is possible to determine the impact on the capital of institutions taking into consideration unexpected, and thus, not provisioned losses caused by changes in macroeconomic variables.

For each stressed scenario new capital ratios (Basel Ratio, Tier 1 and CET1) are calculated. A financial institution is considered as non-compliant whether any of its capital ratios is below the minimum required and classified as insolvent in the case of total depletion of the CET1. The relevance of non-compliant and/or technically insolvent institutions is assessed and the additional capital required in order that no other bank could get non-compliant is calculated. The relevance of and individual entity is determined based on the representativeness of its Adjusted Assets with respect to the assets of the whole banking system.

The positive effects of the activation of the triggers related to Tier 2 and Additional Tier 1 capitals, in which values are converted into CET1 capital, are classified as income. Furthermore the requirement of additional capital buffers, according to the Resolution no. 4,193 with the redaction given by the Resolution no. 4,443 from Oct. 29th 2015, is taken into account in the calculation of capital shortfalls. And finally, the framework also considers the potential changes of registration and uses of deferred taxes and its implications on regulatory capital calculations, according to the Resolution no. 4,192, from Mar 1st 2013, and posterior modifications.

1.2 Macroeconomic Stress Test

The macroeconomic stress test framework is an exercise that consists of the application of adverse macroeconomic scenarios and the simulation of how the balance sheet of each financial institution individually would behave under such scenarios. With those information in hands, capital shortfall of the whole system is calculated.

1.2.1 Scenarios design

Three macroeconomic scenarios are designed, all of them with time horizon of twelve quarters, based on market information, having the following macroeconomic variables: 1) economic activity (Economic Activity Index measured by the BCB – IBC-Br); 2) exchange rate (Brazilian Real vs US Dollar parity); 3) Brazilian Benchmark Interest Rate (measured by the Selic rate); 4) inflation rate (measured by the National Index of Price to the Ample Consumer – IPCA – accumulated in twelve months); 5) Brazil´s country risk premium (EMBI+Br spread, calculated by J.P. Morgan Chase); 6) the 10-yr US Treasury Yield; 7) unemployment rate (calculated by the IBGE based upon the Brazilian National Household Sample Survey – PNADC); and 8) commodities index (CRB index, calculated by Thomson Reuters/CoreCommodity). All variables are measured as a 3-month average.

The baseline scenario is built using the median of the market expectations (Focus report) for the following variables: economic activity, interest rates, FX (foreign exchange) rates and inflation. The GDP – Focus expectation – and the IBC-Br (VAR variable) are perfectly correlated. The Brazil´s country risk premium, unemployment rate and commodity index are kept constant over the forecast horizon. On the other hand, the path of the 10-yr US Treasury Yield is defined according to the adverse scenario published by the Board of Governors of the Federal Reserve System in the report "2018 Supervisory Scenarios for Annual Stress Tests Required under the Dodd-Frank Act Stress Testing Rules and the Capital Plan Rule".

The Structural Break scenario is obtained by verifying the historic periods in which each variable showed the greatest change (either positive or negative) through an eight-month interval. In each identified period, it is added the subsequent four quarters in order to form the total projection horizon (three years). Then, the changes between each quarter are calculated and applied onto the observed values of the variables in the reference date.

In the Worst Historical scenario, repetition of the macroeconomic variables behavior is simulated, through a six-quarters rolling window since July 2003. Each window is plugged into dynamic panel data models and the historical scenario is the one with the lowest earnings before taxes.

1.2.2 Stress simulation

The stress simulation is done by projecting six basic groups of the income statement, trying to represent the operational performance of banks presented in the last income statement (net non-operational income are not considered in the test):

1. Net interest income: comprises net credit income, accrued income from bonds and securities and funding costs;

2. Non-interest income: mark-to-market effects, hedges and exchange rates variations;

3. Fees & commissions;

4. Non-consolidated companies;

5. Administrative expenses and;

6. Provisions expenses.

In the "net interest income", credit and bonds/securities income as well as funding costs are modeled based on the Selic rate. The total funding is adjusted according to their credit portfolio volume, in the proportion of 1:1. Provision expenses are estimated based on the problem assets evolution, resulting from the macroeconomic scenario.

The non-interest group is modeled by applying a shock on market risk sensible positions observed in the starting date of the test. The stressed market risk factors are obtained out of the macroeconomic scenario and positions are then recalculated. The result is the difference between the stressed and the initial values. This amount is applied on the first quarter of projection and incorporated into the final result.

The BCB changed the methodology used in order to capture the interest risk exposures. Hence, from the second semester of 2018 onwards this method will be different. Until recently the shocks were applied only on the trading book positions, all of them informed by banks, according to the Circular No. 3,354, from June, 25th of 2007. However this criteria is no longer in place and now the framework will encompass all the liquid positions, notably both government and corporate bonds as well as derivatives. The effect of this change is that the number of exposures subjected to these shocks have increased, which make the "non-interest" group more significant in the stress test.

The "Fees & Commissions", "Non-consolidated companies" and "Administrative Expenses" groups are modeled by making use of dynamic panel data models, obtained with the same macroeconomic variables employed in the scenarios.

Besides the performance simulation, verified through the income statement, the Central Bank of Brazil has incorporated the inter-financial contagion into the macroeconomic stress test framework from the first semester of 2019 onwards. In each quarter of the stress test time horizon, there is a verification whether any institution falls below the minimum threshold of 4% of the Core Tier 1 capital ratio. If this is the case, the inter-financial contagion is estimated. The uncollateralized interbank exposures issued by that institution are assumed as losses in the creditors´ balance sheet, and then capital is recalculated. If any financial firm also falls below that threshold, the process is repeated iteratively until there is no more institution below the threshold. The stress test continues with new affected capital levels and the process is repeated in all quarters of the projection, until the end of the time horizon.

1.3 Sensitivity Analysis - Introduction

Sensitivity analysis complements the macroeconomic stress test framework. Its objective is to assess the individual effects of credit or market risk factors that might affect the regulatory capital of institutions, causing eventual capital shortfalls. Those analyses are conducted by applying incremental variations in such risk factors, keeping the other factors fixed.

1.3.1 Sensitivity Analysis – Changes in market risk factors

The exposures subjected to interest rate changes (e.g. fixed rates, currency coupons, price indexes and interest rates) listed in the trading book are stressed. The positions at all vertices (from 21 to 2,520 days) are recalculated after the application of shocks as well as the financial impact on banks' capital positions. Stressed exposures also affect risk weighted assets (RWA) components. In the case of fixed rates, new regulatory parameters of capital requirements are recalculated based on every new yield curve generated by a shock.

Exposures in foreign currency, gold and other instruments subject to changes in the exchange rates are also stressed, and their impacts on capital and RWA estimated. Here we assume that all exposures are revalued following the percentage points projected for the stressed USD/BRL exchange rate.

We apply shocks individually in each factor, the interest rate and the exchange rate, starting at their current values, in steps of 10% in both directions, until it reaches 200% and 10% of its current value, on the upside and on the downside, respectively. After recalculating capital ratios, we evaluate both the regulatory capital adequacy ratios and the solvency of banks.

The calculation of interest rate shocks follows the same methodology as for the "non-interest" items of the macroeconomic stress test. For the other risk factors all the balance sheet positions are considered.

1.3.2 Sensitivity Analysis – Increases in problem assets

This analysis tries to measure the effect of problem assets increases over the regulatory capital of institutions. We increase problem assets up to 150% of its current level and compute the additional provision required. These additional provisions affect both banks' capital positions and the RWA component of the required capital. After recalculating capital ratios, regulatory capital adequacy and the solvency of banks are evaluated.

1.3.3 Sensitivity Analysis – Fall in housing prices

The objective of this exercise is to estimate the impacts of fall in housing prices over the capital of financial institutions with outstanding mortgages. Prior to the simulations we proxy housing prices with the value of the updated collateral provided for the loan using the IVG-R index, adding the variations measured by the index since the date that the loan was generated until the date of simulation.

The analysis consists of reducing house prices, simulating a sequence of decreases in steps of 5 p.p. In each step collaterals that become lower than 90% of the remaining loan are considered delinquent.

The loss of each delinquent loan is equal to the difference between the outstanding balance and the present value of the amount recovered from the foreclosure process. In order to calculate the recovered amount, we calculate new housing prices after shocks, net of taxes, maintenance fees and costs related to the foreclosure process. In addition, we consider that the sale in the foreclosure process is done with a discount proportional to the reduction of price due to the shock. The present value is obtained by discounting that sale amount by the 1-year future rate negotiated in the BM&FBovespa. New regulatory capital ratios of each institution are calculated considering the estimated losses to the related decline in housing price.