Special Topic 4 The Banking Sector Stress Testing

In order to improve the systemic financial risk monitoring and early warning system, to promote more forward-looking and more rigorous financial stability assessments, and to make stress testing a more powerful tool in macroprudential management and in prevention of systemic financial risks, the PBC carried out the banking sector stress testing in the first half of 2019. A selected sample of 1 171 banks was required to undergo the stress testing, which aimed to evaluate the impact of extreme but plausible shocks on the resilience of the banking sector. The stress testing was composed of solvency stress tests and liquidity stress tests.

I. General Description of the Stress Testing

Sample banks. The tests covered a selection of 6 large commercial banks, 12 joint-stock commercial banks, 68 city commercial banks, 383 rural commercial banks, 212 rural credit cooperatives, 8 rural cooperative banks, 435 village and township banks, 8 private banks and 39 foreign banks. As of end 2018, the total assets of the 1 171 tested banks stood at 70.3 percent of the total assets of all the banking institutions. Among the sample banks, 30 large- and medium-sized commercial banks with assets over RMB 800 billion[①] were requested to undergo solvency stress tests and liquidity tests, while the rest 1 141 banks were requested to undergo solvency tests based on sensitivity analysis and liquidity stress tests.

Test Approaches. Solvency stress tests, which were conducted either based on macroeconomic scenarios or on sensitivity analysis, evaluated the adverse impact of economic downturn and risk deterioration in overall or key areas on capital adequacy of banks. Liquidity stress tests examined the capacity of banks to withstand large withdrawals of funding of different maturities caused by liquidity risk factors, including policy changes, macroeconomic fluctuation, unexpected events, etc. All the tests were conducted based on end-2018 data.

Pass-fail Criteria. For the solvency tests based

① Including 6 large commercial banks (Industrial and Commercial Bank of China, Agricultural Bank of China, Bank of China, China Construction Bank, Bank of Communications and Postal Savings Bank of China), 12 joint-stock commercial banks (China CITIC Bank, China Everbright Bank, Huaxia Bank, China Minsheng Bank, China Merchants Bank, Industrial Bank, China Guangfa Bank, Pingan Bank, Shanghai Pudong Development Bank, Hengfeng Bank, Zheshang Bank and Bohai Bank), 9 city commercial banks (Bank of Beijing, Bank of Shanghai, Bank of Jiangsu, Bank of Nanjing, Bank of Ningbo, Shengjing Bank, Huishang Bank, Bank of Hangzhou and Bank of Jinzhou) and 3 rural commercial banks (Chongqing Rural Commercial Bank, Beijing Rural Commercial Bank and Shanghai Rural Commercial Bank).

on macroeconomic scenarios, a bank would fail the test if the post-stress CET1 ratio falls below 7.5 percent, or if Tier1 ratio falls below 8.5 percent, or if total CAR falls below 10.5 percent (the 2.5 percent capital conservation buffer requirement included). For the solvency tests based on sensitivity analysis, a bank would fail the test if its CAR falls below 10.5 percent after the shock. For the liquidity tests, banks could counterbalance negative funding gaps (where cash outflows exceed cash inflows) by liquidating their eligible high-quality liquid assets or by using the eligible high-quality liquid assets as collaterals to obtain liquidity assistance from the PBC. Only when a bank has no eligible high-quality liquid assets and there are still negative funding gaps, it would fail the test.

Stress Scenarios[①]**.** Two scenarios were designed for the solvency stress tests - an adverse scenario and a severely adverse scenario. The scenarios were calibrated on factors including GDP growth rate, inflation rate, policy interest rate, short-term and long-term market interest rate, RMB to USD exchange rate, etc. Sensitivity analysis tested the impact of a set of independent variables, including NPL ratio in the whole credit portfolio, NPL ratio in specific industries, loss given default, changes in the bond yield curve, etc. Liquidity stress tests used an adverse scenario and a severely adverse scenario. Building blocks for these scenarios were roll-off rates of assets and run-off rates of funding sources or contingent liabilities of the banks. In each scenario, a maturity ladder analysis was adopted to calculate the net funding gaps for each individual bank (Table 2.2).

Table 2.2 Scenarios for the Banking Sector Stress Tests

Approaches	Risk Exposure		Stress Scenarios
Solvency Tests based on Macro-economic Scenarios	Credit Risk	Loans	• Adverse: GDP growth rate down to 5.3 percent y-o-y • Severely Adverse: GDP growth rate down to 4.15 percent y-o-y (Other macroeconomic indicators were calibrated by macro econometric models)
		Investment Receivables	
	Market Risk	Interest Rate Risk on Banking Book	• Adverse: interest rate of liabilities up by 65 bps, lending rate up by 39 bps, and interest rate of other assets up by 65 bps • Severely Adverse: interest rate of liabilities up by 167 bps, lending rate up by 100 bps, and interest rate of other assets up by 167 bps
		Bond Port-folios	• Adverse: short-term interest rate up by 65 bps, and long-term interest rate up by 83 bps • Severely Adverse: short-term interest rate up by 167 bps, and long-term interest rate up by 215 bps
		FX Expo-sure	• Adverse: RMB depreciating by 3.17 percent against USD • Severely Adverse: RMB depreciating by 4.23 percent against USD

① The stress scenarios were based on projections of macro econometric models, and should not be interpreted as the PBC's judgments on the macro economy.

(concluded)

Approaches	Risk Exposure	Stress Scenarios
Solvency Tests based on Sensitivity Analysis	Loans	• Mild Shock: NPL ratio up by 100 percent① • Medium Shock: NPL ratio up by 300 percent • Severe Shock: NPL ratio up by 700 percent
	Real Estate Loans	• Mild Shock: NPL ratios of real estate development loans② and housing purchase loans③ up by 5 percentage points④ • Medium Shock: NPL ratio of real estate development loans up by 10 percentage points, and NPL ratio of housing purchase loans up by 7 percentage points • Severe Shock: NPL ratio of real estate development loans up by 15 percentage points, and NPL ratio of housing purchase loans up by 10 percentage points
	Local Government Debt⑤	• Mild Shock: NPA ratio up by 5 percentage points • Medium Shock: NPA ratio up by 10 percentage points • Severe Shock: NPA ratio up by 15 percentage points
	Concentration Risk	• Mild Shock: The largest group client defaults with the loss given default rate of 60 percent • Medium Shock: The largest three group clients default with the loss given default rate of 60 percent • Severe Shock: The largest five group clients default with the loss given default rate of 60 percent
	Credit Risk of the Off-balance Sheet Exposures⑥	• Mild Shock: 5 percent loss in the sponsored off-balance sheet exposures • Medium Shock: 10 percent loss in the sponsored off-balance sheet exposures • Severe Shock: 15 percent loss in the sponsored off-balance sheet exposures
	Investment Losses	• Shock 1: 400 bps parallel upward shift in the non-policy financial bond yield curve • Shock 2: 400 bps parallel upward shift in the non-financial corporate bond yield curve • Shock 3: 10 percent loss in the non-bond investments
Liquidity Tests	On balance Sheet Items and Contingent Liabilities	• 2 scenarios: adverse and severely adverse • Based on maturity, assigning different roll-off rates and run-off rates to assets and funding sources, respectively

Notes: ① Assuming that the initial NPL ratio is X%, up by n% means that the NPL ratio becomes X% (1+n%)。
② Real estate development loans include land development loans and housing development loans. Land development loans include land reserve loans to government agencies. Housing development loans include residential housing development loans (including indemnificatory housing), commercial housing development loans and other real estate development loans.
③ Housing purchase loans could be extended to enterprises, governmental organizations and individuals. The enterprise housing purchase loans include commercial housing loans and operating loans for the purpose of property management, while housing purchase loans extended to individuals could be used either for commercial or residential purpose.
④ Assuming that the initial NPL ratio is X%, up by n percentage points means that NPL ratio becomes (X+n) %.
⑤ Including investments in local government bonds, loans to government-invested projects, funding to local governments through SPVs (e.g. wealth management products, trust investment schemes, etc.) and other fund raisings that take the local government fiscal revenue as the source of repayment.
⑥ According to the calibration of Sheet G4B-2 in the regulatory reporting system, off-balance sheet exposures include loan facilities equivalent to loans, transaction-related contingent exposures, short-term contingent exposures related to trades, commitments, sales and purchase agreements of which banks retain credit risks, forward asset purchases, forward time deposits, partially-paid stocks and securities, securities lent out or collateralized by banks, other off-balance sheet items, and ABS-related off-balance sheet exposures. Banks are assumed to hold margins as much as 50 percent of the off-balance sheet exposures; once there are losses, banks would pay the amount that is beyond the margins.

II. Overall Results of the Solvency Stress Tests

1. Solvency Tests based on Macroeconomic Scenarios

The 30 tested banks remain resilient to external shocks as a whole. According to the results of solvency tests based on macroeconomic scenarios, the 30 banks are of relatively strong capital adequacy and sound performance. Under the adverse and severely adverse scenarios, their CET 1 ratio would fall from an actual level of 10.95 percent to 10.16 percent and 8.34 percent respectively, Tier 1 ratio would fall from 11.66 percent to 10.83 percent and 9.04 percent respectively, and total CAR would fall from 14.43 percent to 13.47 percent and 11.78 percent respectively (Figure 2.21). Even dropping by 2.65 percentage points after the most severe hypothetical shock, total CAR of the 30 banks remains well above the minimum regulatory requirement, which confirms the banks' strong capabilities to withstand a severe macroeconomic shock. Nine banks fail the test under the adverse scenario while seventeen banks fail the test under the severely adverse scenario. It should be noted that the PBC has adopted more rigorous hurdle rates for stress testing compared to internationally normal practice. According to Basel III rules, the 2.5 percent capital conservation buffer is an additional cushion that is beyond the minimum capital requirement. In common practice worldwide, the hurdle rates in stress tests normally do not include the capital conservation buffer. If we remove the capital conservation buffer requirement from the hurdle rates of PBC's stress testing, one and seven banks would fail the tests under the adverse scenario and the severely adverse scenario, respectively (Figure 2.22).

Figure 2.21 Overall Results of Solvency Tests based on Macroeconomic Scenarios

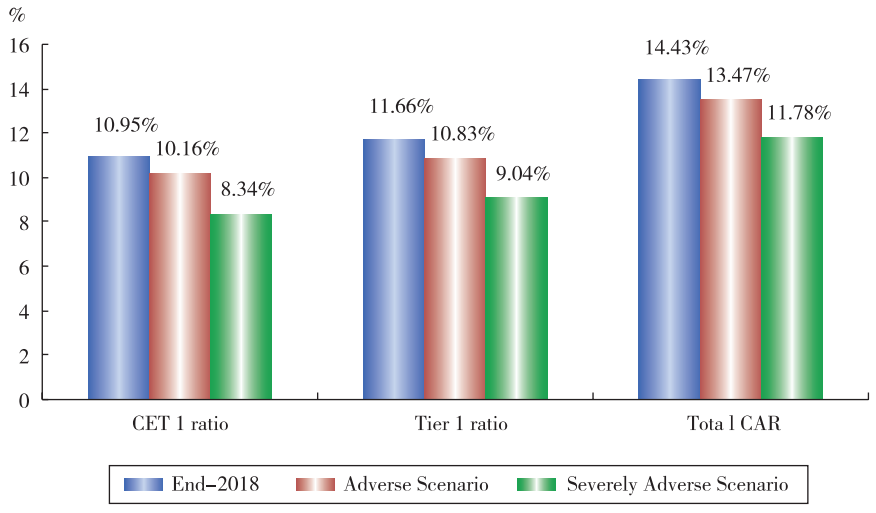
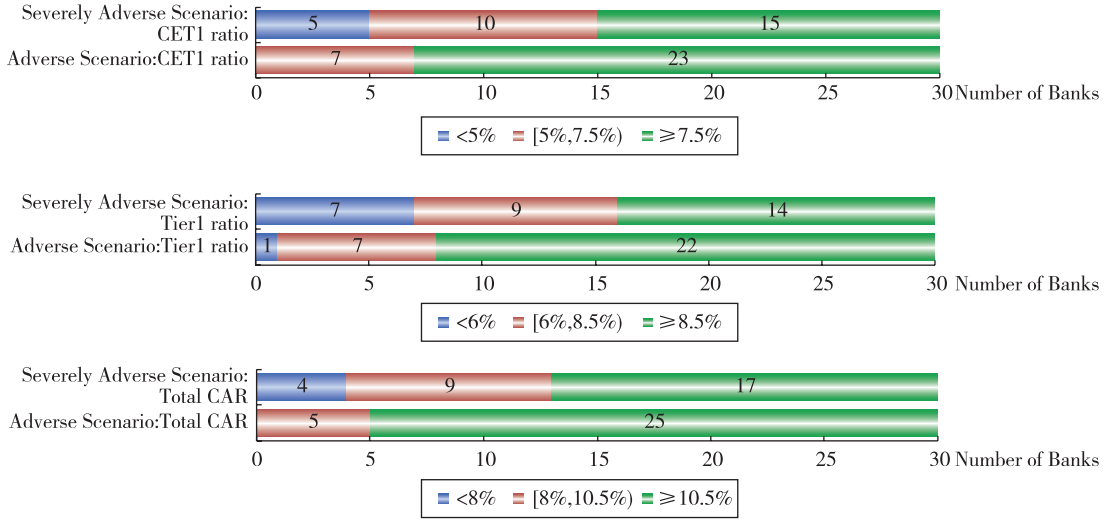


Figure 2.22 Distribution of the Tested Banks' CARs after Shock

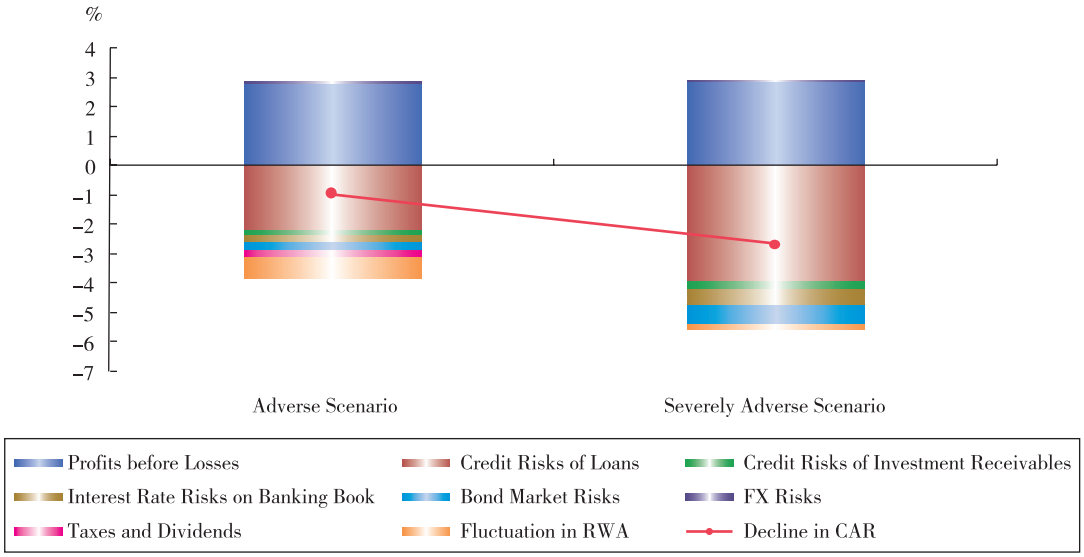


Credit risk is the main source of risks for the 30 banks. Under the severely adverse scenario, credit risk losses contribute to almost 80 percent of the total losses. The key driving factors are deterioration of loan quality and increase of the NPL ratio in a severe recession. Under the adverse scenario and severely adverse scenario, the NPL ratio of the 30 banks would increase from 1.46 percent to 5.42 percent and 7.38 percent respectively, leading the total CAR down by 2.2 percentage points and 3.92 percentage points respectively(Figure 2.23).

Market risk bears limited influence. Compared to credit risk, market risk has relatively modest impact on capital adequacy of the 30 banks. Under the severely adverse scenario, interest rate risks on banking book and bond investment risks would lower the total CAR by 0.54 and 0.64 percentage point respectively; while RMB depreciation would level the total CAR up by 0.01 percentage point (Figure 2.23).

Adequate provisioning and stable profitability could effectively alleviate the pressure on capital adequacy. As of end-2018, the overall provision coverage ratio of the 30 banks was 216.7 percent, far above the minimum regulatory requirement. As a countercyclical management tool, loan loss provisions could be used as a buffer against a recession. In addition, the overall profitability of the banks is quite strong. As of end-2018, average ROA of the 30 banks stood as 0.92 percent. By absorbing losses ahead of capital in stress, banks' profits could be leveraged as the mitigant for the pressure on capital positions.

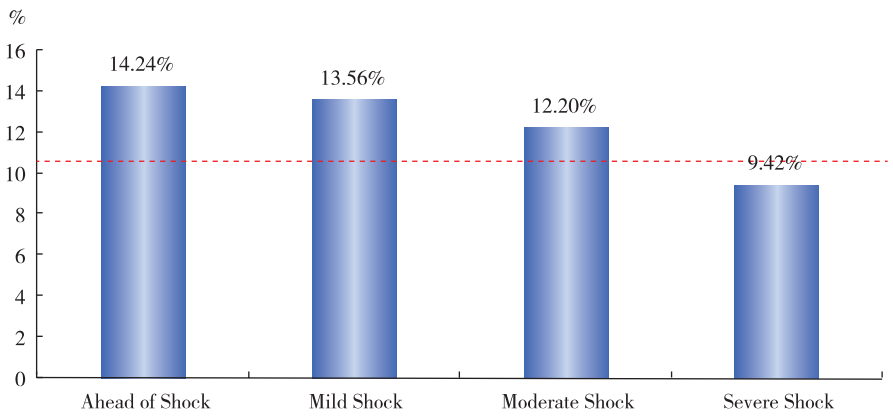
Figure 2.23 Contribution to Changes in the CAR



2. Solvency Tests based on Sensitivity Analysis

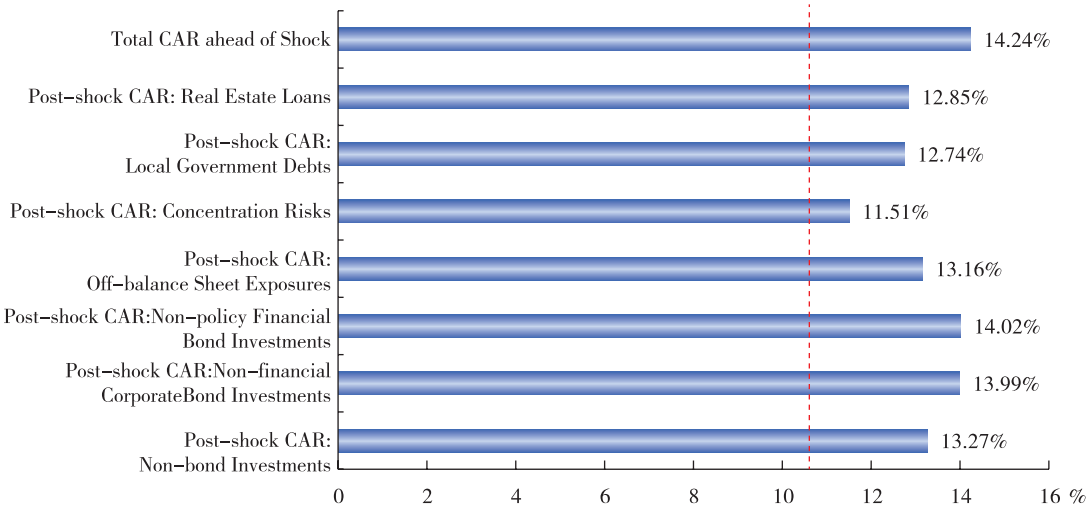
The banking system is generally sustainable to credit deterioration. As of end-2018, total loan balance of the 1 171 banks amounted to RMB 103.72 trillion, with a NPL ratio of 1.7 percent. Against the mild shock, the average CAR of the tested banks would decrease from 14.24 percent to 13.56 percent, a drop of 0.68 percentage point. Against the moderate shock, the average CAR of the tested banks would decrease by 2.04 percentage points to 12.20 percent. Against the severe shock, the average CAR of the tested banks would decrease by 4.82 percentage points to 9.42 percent (Figure 2.24).

Figure 2.24 Solvency Tests based on Sensitivity Analysis



Attention should be paid to risks embedded in certain key areas. As revealed by the results of solvency tests based on sensitivity analysis, concentration risks, local government debts, real estate loans and off-balance sheet businesses give rise to risk concerns. If concentration risks deteriorate in the most severe way, the CAR of the 1 171 banks would decline from 14.24 percent to 11.51 percent, with a drop of 2.73 percentage points. Against the most severe credit deterioration in local government liabilities, the CAR of the tested banks would drop by 1.5 percentage points to 12.74 percent. Against the most severe credit deterioration in real estate loans, the CAR of the tested banks would drop by 1.39 percentage points to 12.85 percent. Against the most severe credit deterioration in off-balance sheet exposures, the CAR of the tested banks would drop by 1.08 percentage points to 13.16 percent (Figure 2.25).

Figure 2.25 Results of Solvency Tests based on Sensitivity Analysis in Key Areas(severe shocks)



III. Overall Results of Liquidity Stress Tests

Banks' resilience against liquidity risks should be further improved. Liquidity tests were undertaken to assess the capacity of banks to withstand funding pressures within a 7-day, a 30-day and a 90-day period respectively. In adverse scenario and severely adverse scenario, 90 banks and 159 banks fail the tests, accounting for 7.69 percent and 13.58 percent of the total sample, respectively. Under the severely adverse scenario, 10 among the 30 large- and medium-sized banks have liquidity shortfalls after all eligible high-quality liquid assets are depleted.

Management of off-balance sheet businesses should be strengthened for some individual banks. The liquidity tests enlarged coverage

to off-balance sheet exposures[①], and applied more prudent run-off rates than those in the LCR framework, over 10 times of the LCR run-off rates for some exposures. The results indicate that several banks that fail the tests have a large scale of off-balance sheet exposures. Such banks should be cautious of the unexpected consequences caused by cash outflows of contingent liabilities in extreme circumstances, and improve their management of off-balance businesses.

① E.g. the undrawn credit facilities or liquidity facilities that cannot be unconditionally withdrawn, credit facilities or liquidity facilities that can be unconditionally withdrawn, letters of guarantee, letters of credit, and other trade financing instruments.