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STRESS TESTING

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**Monetary and Capital Markets
Department**

This Technical Note was prepared by IMF staff in the context of the Financial Sector Assessment Program mission in the Russian Federation, led by Karl Habermeier. It contains technical analysis and detailed information underpinning the FSAP's findings and recommendations. Further information on the FSAP can be found at

<http://www.imf.org/external/np/fsap/fssa.aspx>

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Glossary

AQR	Asset Quality Review
BU	Bottom-up
CAR	Capital adequacy ratio
CBR	Central Bank of the Russian Federation
FSAP	Financial Sector Assessment Program
FSSA	Financial System Stability Assessment
FX	Foreign exchange
GDP	Gross domestic product
NCOs	Net charge offs
NII	Net interest income
NPLs	Nonperforming Loans
RF	Reserve Fund
RWAs	Risk-weighted assets
SIB	Systemically important bank
SOB	State-owned commercial bank (bank with state shares)
TD	Top-down
WEO	World Economic Outlook

EXECUTIVE SUMMARY

This note presents the methodology and results of stress tests of the financial sector carried out as part of the 2016 Financial Sector Assessment Program (FSAP) for the Russian Federation.¹ To provide a comprehensive assessment of the banking system, the stress testing exercise comprised several different tests: a top-down stress test performed by the Central Bank of Russia (CBR), a bottom-up stress test performed by banks, a separate top-down exercise that included asset quality adjustments performed by staff, single-factor tests performed by CBR, and liquidity tests performed by CBR.

The stress tests focused on banks, reflecting the structure of the Russian financial sector, which is relatively small and bank-dominated. Bank assets amounted to 103 percent of the gross domestic product (GDP) at end-2015. Pension funds, insurance, and mutual funds have assets of 3.6, 2.0, and 1.7 percent of GDP, respectively.

The stress tests showed that the banking system is likely to need additional capital. Even in the baseline scenario, certain banks will need new capital owing to low profitability and increasing credit losses. The required resources are higher in the stress scenarios, but remain manageable. If public funds are needed for recapitalization, there is sufficient fiscal space, provided that fiscal policy remains prudent. Stress tests should be supplemented by a granular and comprehensive review of banks' asset portfolios to gauge capitalization needs.

¹ This note was prepared as part of the 2016 FSAP ([Financial Sector Assessment Program](#)). Staff would like to thank CBR's supervisory stress testing team for the open exchange of methodologies and excellent discussions of tests and results. All stress tests were discussed and agreed by CBR and staff. The principal authors of this note are (in alphabetical order) Adrian Alter, Nazim Belhocine, Ricardo Cervantes, and Fabian Lipinsky under the guidance of Dale Gray.

PERFORMANCE OF THE BANKING SECTOR

1. The banking sector is heavily concentrated, and state ownership continues to be important. The largest 20 banks account for three quarters of system assets, while the top 10 banks extend about 70 percent of total lending. State-owned commercial banks, dominated by Sberbank and VTB Group, accounted for 60 percent of system assets at end-2015. Bank concentration measured by the Herfindahl-Hirschman Index is close to the European median. Banks' business model relies mainly on credit intermediation. The majority of assets are loans (70 percent of banking assets), followed by securities (mostly in domestic government and corporate bonds), and interbank lending. Banks are mainly funded by deposits of non-financial corporations and individuals.²

2. Despite recent stress, reported capital remains adequate on average, and liquidity has improved (Figure 1 and Table 1). The capital adequacy ratio (CAR) of banks was broadly stable in 2015 at about 13 percent, thanks to the capital injection program and regulatory forbearance. After forbearance was reduced in early 2016, the CAR fell to 12 percent. Liquidity has improved, with the loan-to-deposit ratio decreasing to 115 percent by end-2015 from its recent peak of 125 percent, reflecting increased retail deposits, falling credit growth, and government spending out of the Reserve Fund (RF). However, there is considerable dispersion around these averages, as reflected in the closures of many, mainly small, banks.

3. Loan portfolio quality and profitability have deteriorated (Figure 2). Nonperforming loans (NPLs) have increased, with household overdue loans reaching 8.4 percent of total loans by February 2016, compared to 6.5 percent for the corporate sector. Overall NPLs were stable in May–December 2015, reflecting loan rescheduling and regulatory forbearance. Bank profitability has dropped markedly—with the return on assets reaching 0.3 percent at end-2015—to levels similar to those observed during the global financial crisis. Several factors explain these developments. On the revenue side, net interest margins have contracted, reflecting slower asset growth and higher policy rates. In addition, net fees and commissions fell in line with net interest income (NII). On the expenditure side, non-interest expenses declined at a lower rate than NII, while provisions have risen sharply owing to the deterioration in loan portfolios.

4. Connected lending and loan concentration continue to be of concern, with possible implications for asset quality. Large exposures stood at 261 percent of capital in February 2016. The reported numbers may, however, understate the extent of related party lending: a narrow definition of related parties and connected relationships, coupled with weak implementation of the concept of beneficial owner, prevents CBR from linking all exposures. Stricter rules were published in 2014 but implementation has been postponed twice until January 2017.³

² For further information on banks' assets and liabilities, please see "Russian Federation: Financial System Stability Assessment," IMF Country Report No. 16/231, July 2016.

³ Related party lending from banks to parties owned by the lending banks' shareholders is of more concern than lending from state-owned banks to state-owned enterprises, which have typically a higher credit rating.

5. Performance across the system is uneven and medium-sized banks appear particularly vulnerable. Banks in the 21–50 segment, by asset size, show the weakest performance, with a negative return on equity of about 25 percent in 2015Q4. These banks did not benefit from the capital injection program and were particularly exposed to underperforming unsecured consumer lending. Two banks in this segment are currently undergoing resolution. Profits of the whole system remained slightly positive owing to the performance of a few of the largest banks.

6. Banks' net foreign exchange (FX) exposures appear to be within prudent limits. Banks are adhering to regulatory limits on net open FX positions, with a total overall limit of 20 percent of capital. The net foreign asset position of banks has continued to improve and reached US\$100 billion at end-2015, reflecting foreign deposit withdrawals and deleveraging following the imposition of sanctions.

7. Cross-border bank exposures are declining. Based on Bank for International Settlements (BIS) data, the exposure of foreign banks to Russia has halved since the onset of the geopolitical tensions in 2014 to about US\$110 billion by end-2015. Forty percent of foreign bank claims are concentrated in France and Italy (US\$26 and US\$19 billion). Russian international investment position data suggests a cross-border exposure of Russian banks of about US\$245 billion at end-2015 (below 20 percent of GDP), of which two thirds are loans and deposits. Russian banks' subsidiaries operate primarily in Austria, Turkey, and Cyprus.⁴

8. The banking sector—while currently stable—is exposed to significant risks, asset quality being the largest. Even in the absence of a further macroeconomic deterioration, credit losses could be significant. Unsecured consumer lending in 2011–14 has already led to an increase in NPLs in the retail sector. The increase in NPLs in the corporate sector has been smaller thus far, but overdue loans have been rising in various industries, in particular in construction and real estate, where contracts were denominated in FX and were not rolled over when the exchange rate depreciated. Other sectors experiencing increased credit risks include mining, trade, and agriculture, which suffered from low domestic demand and a slowdown in government spending, and also pre-existing weaknesses in the case of mining.

9. There is considerable uncertainty about the strength of loan portfolios. CBR inspections of asset quality have revealed violations, including lending to shell companies, overvaluation of collateral, misreporting, and unreliable financial statements. Nonperforming assets may thus be higher than reported, reflecting: (i) lower quality of restructured loans; (ii) potentially under-provisioned and under-collateralized portfolios; and (iii) transfer of distressed assets to affiliated off-balance sheet entities that are not subject to consolidated supervision.

10. At a system-wide level, liquidity risk is contained, but individual vulnerabilities remain. The short-term focus and segmented nature of the money market increases the vulnerability of the

⁴ The exposure of Russian banks to Ukraine, including interbank loans and loans to individuals and firms, was estimated at 1.1 percent of Russia's GDP in January 2016.

banking system to liquidity shocks going forward.⁵ Large banks hold sizeable stocks of high-quality assets and have access to unsecured funding. Lower-rated small and medium-sized banks do not have access to the same low-cost sources of funding, and instead rely on higher yielding collateral, short-term secured markets, and CBR. These banks are vulnerable to liquidity dry-ups.

11. Market risk, including sovereign risk, appears contained, but data limitations make the assessment difficult. Securities portfolios account for 15 percent of total assets at end-2015, and consist mainly of debt securities, but also include small shares of equities and minority interest holdings. While direct sovereign risk is small (sovereign securities constitute only a quarter of debt security portfolios), indirect sovereign risk arising from the state-owned financial and non-financial corporate sectors is likely greater, given that a large share of the banking sector and many large corporations are state-owned.⁶

STRESS TEST DESIGN

12. Several solvency stress tests were performed—top-down by CBR, bottom-up by banks, and top-down by staff (Appendix I). The top down (TD) tests had a horizon of five years, while the bottom up (BU) test had a horizon of one year. The resilience of the system was assessed relative to the regulatory capital adequacy minimums: 4 ½ percent for Common Equity Tier 1 and 8 percent for the total CAR.⁷ The stress tests covered a wide range of risks, including credit, market, interest rate, and liquidity:

- Asset quality, income, and capital of individual banks were modeled under three macroeconomic scenarios: baseline, V-shaped, and L-shaped. This allows for a bank-by-bank assessment of possible needs for additional capital.
- The TD solvency stress test performed by CBR covered essentially all of the banks in the system (681 in total) and were based on Russian accounting standards, on a stand-alone basis.⁸
- The BU stress test covered 12 banks, including the 10 SIBs, accounting for two thirds of system assets.

⁵ During late 2014, the significant fall in oil prices and the flight from ruble denominated assets led to large margin calls on the secured interbank market and the emergence of collateral constraints. As a result, market rates were pushed through CBR's interest rate corridor ceiling, and the yield curve became inverted for two–three days.

⁶ A comprehensive analysis of sovereign risks was not undertaken given that supervisory data were not available.

⁷ Russian banks will be required to report capital ratios according to Basel III, which includes a phased-in capital conservation buffer and a systemic surcharge for D-SIBs. These buffers are, however, are intended to be released during periods of stress and were not activated in 2015, when GDP declined by 3.7 percent. In view of the more severe adverse scenarios and the slow recovery in the baseline scenario, CBR and the FSAP team agreed to use hurdle rates based on current requirements.

⁸ The cut-off date for the data used by CBR and staff was December 31, 2015.

- The TD stress test performed by staff used publicly available data for 37 banks accounting for about 82 percent of system assets, and covered credit and interest rate risk. The data captures consolidated banking groups and is based on International Financial Reporting Standards (IFRS), which somewhat limits the impact of regulatory forbearance.⁹
- To allow the quantification of a full shock-to-recovery cycle, the top-down tests were calibrated over a horizon of five years. The horizon of the bottom-up tests was one year.
- Staff's analysis focused on credit and interest rate risks affecting net interest income, which is consistent with the fact that the main function of Russian banks is to intermediate savings and extend loans. Credit risk also covered deterioration in the loan portfolio due to depreciation (notably FX risk). In addition, the TD by CBR and BU stress tests also covered market and liquidity risks.

13. Adjustments were made to provisioning levels in the staff's TD stress test. Staff estimated the effect on capital adequacy of weak restructured loans and under-provisioning using aggregated data from CBR and information from market participants. First, staff estimated the impact of the migration of a certain part of restructured loans into lower loan categories associated with higher provisioning rates. While restructured loans stand at about 30 percent of large loans, one third of the restructured loans were estimated to be of weaker quality at end-2015. The migration of such loans resulted in an increase of loan impairment charges by 1 percentage point of total loans. Second, staff accounted for under-provisioning in each loan category, with the loan impairment charges increasing by an additional 2.2 percentage points. The overall effect of restructuring and under-provisioning was thus assessed to be about 3.3 percentage points.

14. In addition, CBR carried out single-factor tests and system-wide liquidity stress tests. The liquidity stress test included three scenarios (mild, severe, very severe) with a test horizon of one month. The scenarios entail increasingly large outflows from most liability categories and increasingly high discounts on non-liquid asset categories. The scenarios assume no CBR or interbank financing. The liquidity stress tests assess the extent to which liquidity outflows exceed the available liquid assets.

TOP-DOWN SOLVENCY STRESS TESTS BY STAFF

15. This section explains staff's TD solvency stress tests. It covers: (i) the stress-testing methodology; (ii) the macroeconomic scenarios; (iii) the models used to map the macroeconomic scenarios into credit losses, income statement projections, and balance sheet items; (iv) other assumptions governing regulatory capital during stress test scenarios, including changes in risk-weighted assets (RWAs) and changes in provisions resulting from asset quality adjustments; and (v) the results of the stress tests.

⁹ IFRS provide less discretion in applying forbearance. Consequently, using IFRS entails a stricter loan classification.

A. Stress-Testing Methodology

16. Staff's top-down stress testing methodology applied panel regression techniques similar to those used in advanced economy FSAPs (Figure 3).¹⁰ In the case of Russia, consideration needed to be given to higher volatility in the exchange rate, inflation, and interest rates. Consequently, the model was designed to accurately capture the effects of substantial exchange rate depreciation and increases in inflation transmitted through adverse changes in net interest income and loan impairment charges (due to increasing interest rates).

17. The model focused on loan impairment charges to net income. This has the advantage that differences in loan categorization and in accounting for losses do not influence the stress tests. Loans are classified into five categories, with loans in categories IV and V defined as NPLs. However, provisions and charges to the income statement are also necessary for loans in categories I to III. Focusing on NPLs could thus understate provisions and charges to the income statement. Moreover, loan categorization and write-offs may be handled differently in different countries, and hence distort stress testing results. Focusing on loan impairment charges incorporates the combined effect of changes in probabilities of default and loss given default.

B. Macroeconomic Scenarios

18. The macroeconomic stress scenarios quantified the impact of negative oil price shocks calibrated to tail events in the oil price probability distribution (Table 2, Figures 4 and 5).

These shocks, in turn, were calibrated to tail events of the oil price probability distribution. The authorities and the FSAP team agreed on three macroeconomic scenarios.¹¹ In the V-shaped scenario, oil prices fall to US\$19 per barrel, while in the L-shaped scenario, they fall to US\$25 per barrel but recover more slowly. These tail events have strong adverse effects on GDP and unemployment. They also entail further large exchange rate depreciation, in view of the relationship between oil prices and RUB/US\$ rate. Inflation and short-term interest rates respond strongly to the exchange rate depreciation. In the medium term, the scenarios are conservative. The Brent oil price recovers only moderately to US\$40 and US\$37 in 2020 in the V-shaped and L-shaped stress scenarios, and annual real GDP growth converges to one percent in both scenarios, half a percentage point below 2020 baseline growth.

19. Under the stress scenarios, banks' profitability suffers, reflecting deterioration in asset quality and lower interest margins. Lower corporate and household incomes result in worsening of the quality of domestic loan portfolios, with ruble-denominated consumer and corporate loans hit the hardest. Exchange rate depreciation leads to weaker performance of portfolios in foreign currency with very low provisioning.¹² In addition, exchange rate depreciation triggers higher domestic inflation, which in turn is reflected in higher interest rates. As a result of higher funding

¹⁰ Such as Switzerland and the United States.

¹¹ The baseline scenario followed closely the projections from IMF's WEO as of end of 2015.

¹² Generally, FX loans are mostly extended to the largest and strongest corporations in Russia. Consequently, provisioning rates are lower and NPLs tend to increase less than for ruble denominated loans.

costs and the inability to fully adjust the interest rate on the asset side owing to maturity mismatch, banks' net interest margin shrinks in the short term. By the end of the five-year horizon, net interest margins recover, while loan loss provisions moderate.

C. Balance Sheet and Income Statement Growth Projections

20. Bank finances were projected conditional on the macroeconomic scenarios (Figure 6).

Over the five-year stress testing horizon, balance sheet and net income items were projected based on the statistical relationships with macroeconomic indicators, bank specific characteristics, and other assumptions. In each scenario, these projections helped to calculate bank-specific capital dynamics and capital ratios.

21. Statistical relationships were estimated for each balance sheet and income statement item necessary to project bank capital ratios (Table 3).¹³

The determinants in each relationship were selected from a pool of macrofinancial indicators combined with bank-level characteristics. Several specifications were considered for each dependent variable, drawing on economic theory and the literature.¹⁴

Balance sheet growth projections

22. The growth rate of gross loans is estimated using a panel data regression with bank fixed effects.

It is assumed that higher economic activity and the interaction between the GDP growth rate and the type of bank would affect these dynamics.¹⁵ The growth rate of assets is assumed to be affected by the growth rate in gross loans, which is the most important asset category for the Russian banks.

23. Net charge offs (NCOs) are estimated as a share of gross loans. Intuitively, the dynamics of NCOs are modeled based on the negative relationship with real output, house prices, and loan growth. In contrast, higher interest rates and the term premium are found to be positively associated with NCOs.

Income statement growth projections

24. Net income is disaggregated into six components: net interest income, trading income, non-interest expenses, net fees and commissions, other net income and provisions.

Net interest income depends on interest rates and the growth in loans and deposits.¹⁶ By contrast, loan provision growth is negatively associated with real output growth and the term premium, while

¹³ The statistical relationships were estimated over the sample period 2005Q1 to 2015Q3.

¹⁴ For robustness purposes, different definitions of the dependent variables were considered. For example, the results of quarterly and annual (yoy) growth rates or ratios to other items (such as percent of gross loans) were compared. The best regression models were chosen using several criteria: economic interpretation and significance, relatively higher R^2 in comparison to other models, and parsimony. Moreover, deviations from the mean point estimates were used to check robustness.

¹⁵ To accommodate the persistence of gross loans, the lagged dependent variable is included in the specification.

¹⁶ Loans and deposits are assumed to grow at the same rate.

an increase in the unemployment rate amplifies provisions growth. Risks stemming from lending in foreign currency and the impact of depreciation are captured by the term premium. When the exchange rate depreciates, inflation and short-term interest rates tend to increase, resulting in a decline in the term premium and an increase in loan impairment charges. Alternative specifications with the exchange rate in the regression resulted in a lower model fit overall.

25. Trading income increases during crises, but the fitted relationship is not very strong.

Trading income growth is associated with a higher term premium and real estate prices. Other income items such as non-interest expense (y-o-y growth), net fees and commissions (y-o-y growth) are modeled in a simplified way in relation to total asset growth. Lastly, other net income (percent of total assets) is negatively driven by the term premium and real estate prices (y-o-y growth).¹⁷

D. Risk-Weighted Assets and Asset Quality

26. As Russian banks determine risk weights according to the standardized approach, risk weights were assumed to be constant, at two different levels: 90 percent and 100 percent.

The value of 90 percent is in line with the average risk weight observed at the end of 2015. However, both theory and the empirical literature indicate that risk weights increase during crises.¹⁸ Thus, the stress tests were also run with an increased risk weight of 100 percent. In line with the observed data, dividend payouts (in case profits are positive) and taxes were fixed at 20 percent over the stress testing horizon.

27. The potential overestimation of capital ratios was addressed by adjusting for the estimated effects of restructured bad loans and under-provisioning (Figure 7).

Staff estimated the extent to which restructured bad loans and under-provisioning affect capital adequacy, using aggregated data from CBR and information obtained during meetings with market participants and CBR.¹⁹ First, staff estimated the impact of migration of a certain part of restructured loans into lower loan categories associated with higher provisioning rates. While restructured loans stand at about 31 percent of large loans, one-third of the restructured loans were estimated to be of weaker loan quality at the end of 2015.²⁰ The migration of such loans resulted in an increase of provisions by about 1 percentage point in total. Second, staff also accounted for under-provisioning in each loan category. As a result, provisions increase by an additional 2.2 percentage points. The total effect of restructuring and under-provisioning on provisions was assessed to be about 3.3 percentage points.

¹⁷ Owing to the very poor fit of the regression, trading income is assumed to be constant over the stress test horizon. Similarly, the residual component (other net income) is assumed to be constant.

¹⁸ For details, see for example Hardy, D., and C. Schmieder. "Rules of Thumb for Bank Solvency Stress Testing." WP 13–232, International Monetary Fund, 2013.

¹⁹ Staff assessed asset quality conservatively, taking the higher end of reported weak restructured loans, and conservative provisioning rates and collateral values based on discussions with market participants and CBR.

²⁰ The evolution of restructured loans by bank type is depicted in Figure 6 (bottom panel).

E. Results

28. Two sets of results are presented. The first takes as its point of departure reported bank capital ratios at the end of Q3 2015, with no adjustments for regulatory forbearance, and risk weights averaging 90 percent. In the second set, by contrast, an adjustment is made to initial bank capital ratios for under-provisioning and restructuring of bad loans. In addition, risk weights average 100 instead of 90 percent to account for deteriorating asset quality under stress.

29. The first set of results shows an estimated capital deficit of about ½ and 2 ½ percent of GDP in the baseline and stress scenarios respectively (Table 4). CBR and staff estimated an aggregate capital deficit—defined as the peak deficit during the five-year stress test horizon—of 0.3 and 0.4 percent of GDP, respectively, in the baseline scenario. The deficit increases in the stress scenarios compared to the baseline by about 2 percentage points. CBR estimated a deficit of 2.5 and 2.1 percent of GDP in the V-shape and L-shape scenarios, respectively. Staff estimated deficits of 2.4 and 2.7 percent of GDP in the V-shape and L-shape scenarios.

30. The more conservative second set of staff results shows higher capital deficits of about 1 percent and 4 ½ percent of GDP in the baseline and in the stress scenarios, respectively. Including the effects of restructuring and under-provisioning increases the capital deficit by 0.6 percentage points in the baseline scenario and by about 2 percentage points in the stress scenarios. Staff estimated capital deficits of 4.6 and 4.4 percent of GDP in the V-shape and L-shape scenarios respectively. While the magnitude of deficits is similar in both scenarios, peak level deficits occur in different years—2017 in the V-shape scenario, and 2019 in the L-shape scenario.

31. The detailed results for the V-shape scenario show that the system could face serious challenges (Figure 8). In the results including asset quality adjustment, banks with capital ratio breaches account for 87 percent of banking sector assets in 2017. The median CET1 capital and total capital ratios fall to 0.8 percentage point and 3.5 percentage points, respectively, in 2017. The results without the asset quality adjustment are less severe.

32. The detailed results for the L-shape scenario show a similar picture. With the asset quality adjustment, cumulative capital deficit accounts for 4.4 percent of GDP in the L-shape scenario, and the median total capital ratio bottoms out at 7.8 percent of RWA in 2018.

33. There are capital shortfalls even in the baseline scenario, when asset quality adjustments are taken into account. Minimum regulatory capital requirements are breached by 15 out of 37 banks in 2017 accounting for about 37 percent of banking sector assets. This said, the median CET1 capital and total capital ratios are 5.5 and 9.9 percent, respectively, in 2017, above regulatory minima.

34. The stress test results indicate that some large banks as well as medium- and small-sized banks could face difficulties under the stress scenarios. According to staff's stress tests, some large state-owned, private, and foreign banks breach capital ratios under the stress scenarios (with and without the asset quality adjustment), pointing to relatively weaker banks in each

category.²¹ In the medium term, staff estimates imply that some weak banks, accounting for about 40 percent of banking sector assets, have difficulties returning to profitability, owing to low capital levels and profitability at the end of 2015, as well as moderate medium-term GDP growth projections. According to CBR, weak large banks recover in the medium term.²² However, some medium- and small-sized banks (accounting for about 5 percent of banking system asset and not included in staff's sample) accumulate large capital deficits by 2020.

35. These results are mitigated by the small size of the banking system and sound macroeconomic policies. Although the cumulative capital deficits are not negligible, the estimated economic costs of recapitalization are manageable, given the relatively small size of the Russian banking sector relative to GDP, low government debt, high FX reserves, and sound monetary policy.

COMPARISON OF CBR AND STAFF TOP-DOWN RESULTS

36. The corresponding CBR and staff top-down stress tests show similar capital deficits (Figure 8). The panel data regression techniques used are broadly similar. While staff projects banks' asset and equity position (liabilities are a residual), CBR has developed a suite of models that projects liabilities and equity (with asset projections being the residual). Credit losses peak in the first year in the staff's stress tests, while the CBR shows them peaking in the second year (owing to a lagged effect). The dynamics of capital ratios and capital deficits are very similar. Capital ratios bottom in 2017 and recover. Estimated capital deficits are also similar.

BOTTOM-UP STRESS TESTS

37. CBR's top-down analysis is more conservative than banks' own assessment (Tables 5 and 6). In the baseline scenario, banks' bottom-up results show that one bank would have a capital deficit of RUB 3 billion, whereas the top-down results show one bank with a capital deficit of RUB 65 billion. In the V-shaped scenario, bottom-up results show six banks with capital deficits of RUB 199 billion, while the top-down results show seven banks with capital deficits of RUB 522 billion—2.6 times higher. In the L-shape scenario, bottom-up results show two banks with capital deficits of RUB 70 billion, while the top-down results show six banks with capital deficits totaling RUB 426 billion—6 times higher. Along with credit risk, market risk in particular seems to be underestimated by banks.

²¹ The bulk of the reported capital deficits arise at state-owned banks, which is not surprising given that they are by far the largest banks.

²² The fast pace of recovery in CBR's methodology is due to different sensitivities of net interest income and expenses with respect to macroeconomic variables in CBR's and staff's satellite models.

SINGLE-FACTOR STRESS TESTS

38. The CBR's single factor stress tests consisted of one credit risk scenario and four market risk scenarios (Table 7).

- *The credit risk scenario* assumes default of each bank's top five (non-bank) borrowers. Results show that 338 banks with 82.5 percent of banking system assets experience an aggregate capital deficit of RUB 1,519 billion.
- *Market risk scenarios.* An exchange rate depreciation of 20 percent shows that five banks comprising 0.1 percent of system assets would have a capital deficit of RUB 0.2 billion. A 30 percent decline in the value of equity holdings shows that seven banks comprising 0.5 percent of system assets would have a capital deficit of RUB 0.9 billion. Two interest rate shocks to banks' trading portfolio were also considered. The first assumes an increase of 1,000 basis points in corporate sector spreads and an increase of 400 basis point in government bond spreads. In this case, 13 banks comprising 6.7 percent of system assets would have an aggregate capital deficit of RUB 20 billion. If only corporate sector spreads were to increase by 1,000 basis points (with no increase in government bond spreads), four banks comprising 1 percent of system assets would have an aggregate capital deficit of RUB 6.7 billion.

39. Single factor tests related to credit risk point to a significant concentration risk in lending. Other single factor tests of market risk showed relatively minor effects, owing to the small size of securities portfolios.

LIQUIDITY STRESS TESTS

40. CBR carried out liquidity stress tests for the banking system as a whole (Table 8). A key assumption was that banks would not have access to CBR financing or interbank inflows. Three liquidity scenarios were considered: mild, severe, and very severe. The mild and severe scenarios were calibrated based on historical outflow rates during periods of stress in Russia. The very severe scenario covers additional stress, mainly in the interbank market, as seen in some advanced and emerging economies.

41. The results of CBR's liquidity stress tests show minor liquidity deficits for the mild scenario and substantial but manageable liquidity deficits for the strict and very strict scenarios. Under the mild scenario, only 36 banks (1.7 percent of system assets) show liquidity deficits, with a total shortage of less than 0.1 percent of GDP. These indicators increase to 111 banks (11 percent of system assets) with a shortage of 0.4 percent of GDP in the strict scenario and 181 banks (41.8 percent of system assets) with a shortage of 2.9 percent of GDP in the very strict scenario.

42. The three largest state-owned banks have a special position regarding liquidity. Specifically, they are significant players in the corporate (state-related) and retail deposit markets, and along with other large banks, hold large stocks of high quality assets and have access to

unsecured funding. (This said, sanctions continue to restrict the access of large banks to term external funding.) Lower-rated small and medium sized banks do not have access to the same low-cost sources of funding, and instead rely on higher yielding collateral, short-term secured markets, and CBR.

STRESS TESTING RECOMMENDATIONS

43. CBR has significantly upgraded its stress testing practices in recent years, but some further improvements are possible. Key priorities are: (i) implementation of modern, comprehensive, and integrated TD and BU methodologies covering not just banks but also affiliated entities; (ii) development of an “expected loss approach” for credit risk using probability of default, loss given default, and exposure at default; (iii) development of a credit registry, also to provide additional data; (iv) expanded use of the results of TD bank-by-bank stress tests in the bank supervision process, including for capital planning and dividend policy; (v) possible publication of aggregate TD stress test results in the Financial Stability Review; and (vi) enhanced system-wide stress tests for all banks, beginning with the large and medium-sized banks, using macro scenarios and key bank stress test parameter assumptions over a three-year horizon.

44. It would be advisable to also conduct stress tests on a consolidated basis, and liquidity stress test by currency. The current stress tests on a solo basis may miss downstreaming of problematic assets by D-SIBs (which are subject to stricter regulatory requirements) to unconsolidated subsidiaries. Similarly, liquidity stress tests based on aggregate asset and liability categories may overlook liquidity shortages in particular currencies.

45. An asset quality review is recommended to assess risks stemming from uncertainty about asset quality, concentrated lending, and related party lending. Stress tests should be supplemented by a granular and comprehensive review of banks’ asset portfolios to gauge capitalization needs.²³

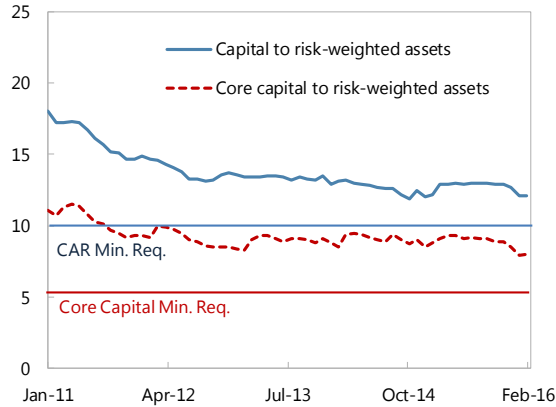
²³ The Bank of Russia has already begun to implement the recommendations of FSAP mission: as part of banking supervision improvement the Risk Analysis Service has been organized. The Service is expected to assess assets and transactions of credit institutions on ongoing basis.

Figure 1. Bank Capital and Liquidity, 2008–15

Capital ratios remained stable due to capital injection ...

Capital Adequacy

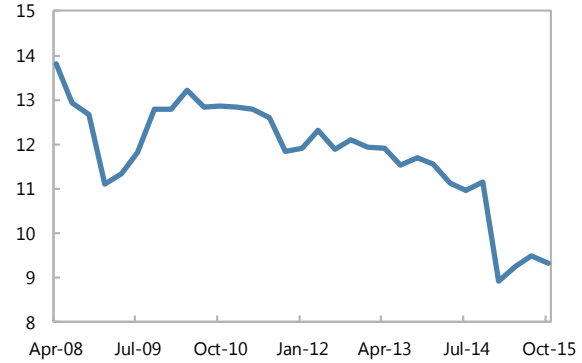
(In percent)



... and the use of regulatory forbearance to shield risk weighted assets from the impact of the depreciation.

Equity to Total Assets of Russian Banks

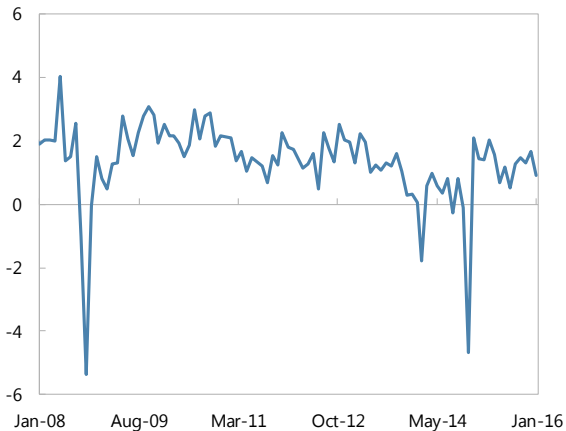
(In percent)



Liquidity dried up following a strong outflow of retail deposits in December 2014...

Retail Deposits

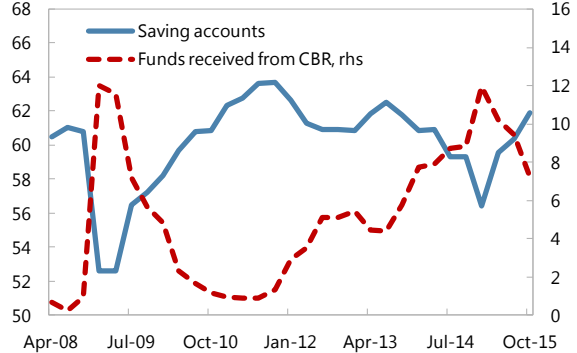
(Percent change, M-o-m, SA)



...which was compensated by CBR stepping in to support liquidity of the banking system.

Main Funding Sources

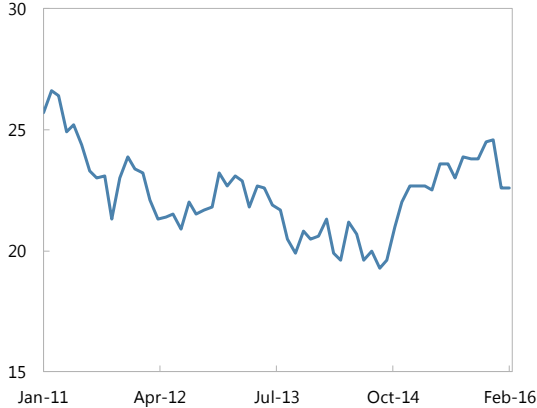
(In percent of total liabilities)



Since then, confidence returned and the liquidity situation has improved

Liquidity Assets to Total Assets

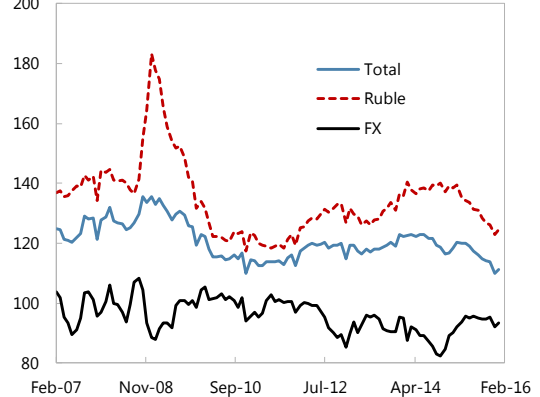
(In percent)



... amid declining loan-to-deposit ratios.

Loan-to-Deposit Ratio

(In percent)

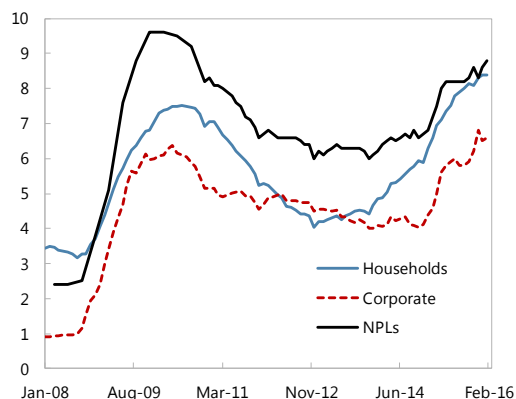


Sources: Central Bank of Russia and IMF staff calculations.

Figure 2. Bank Asset Quality, 2008–15

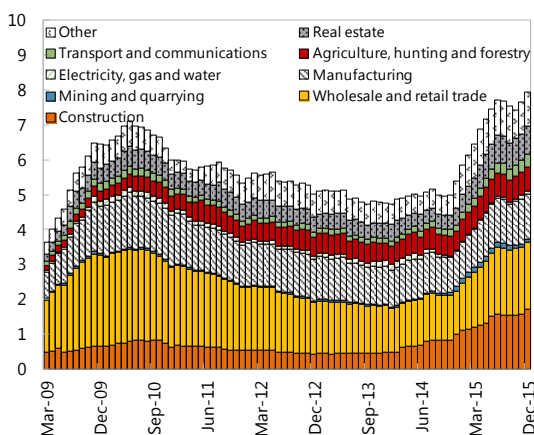
NPLs remain lower than their 2008 peak ...

Overdue Loans and NPLs
(In percent of total loans)



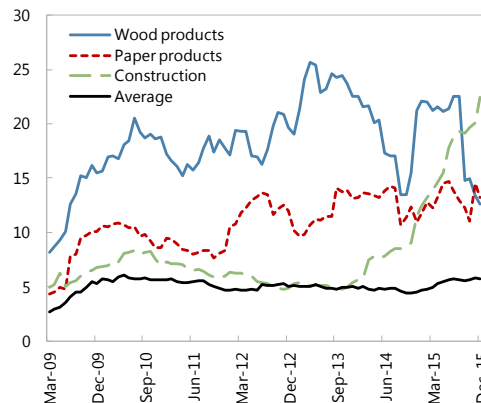
Overdue loans in rubles have increased primarily in the construction and retail trade sectors...

Ruble Overdue Loans to Total Loans by Sector



Nearly 25 percent of the construction portfolio is overdue...

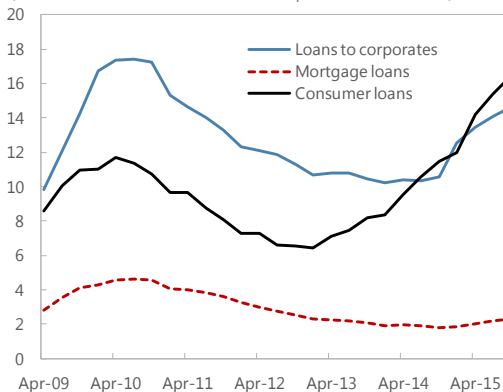
Ruble Overdue Loans by Portfolio
(In percent)



... although provisions are higher once FX loans, loans to FIs and governmental institutions are excluded.

Provisions

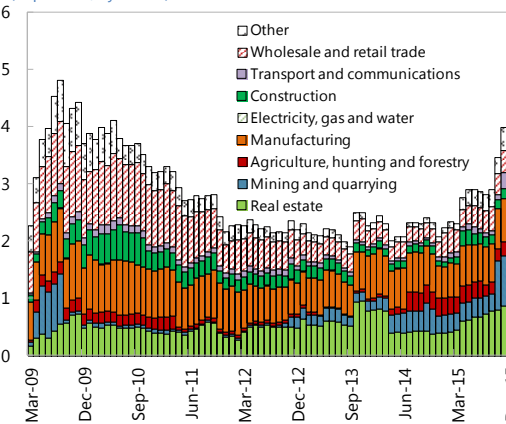
(In Russian ruble denominated loans; in percent of total loans)



... while overdue loans in FX have risen primarily in the real estate, agriculture, and mining sectors.

Foreign Exchange Overdue Loans to Total Loans

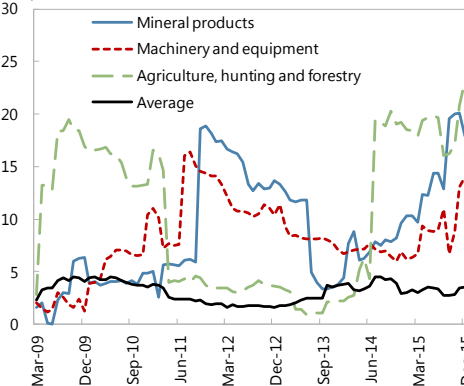
(In percent, by sector)



... while loans in FX show weak performance in agriculture, mining, and machinery and equipment.

Foreign Exchange Overdue Loans by Portfolio

(In percent)



Sources: Central Bank of Russia and IMF staff calculations.

Figure 3. Staff Stress Testing Framework

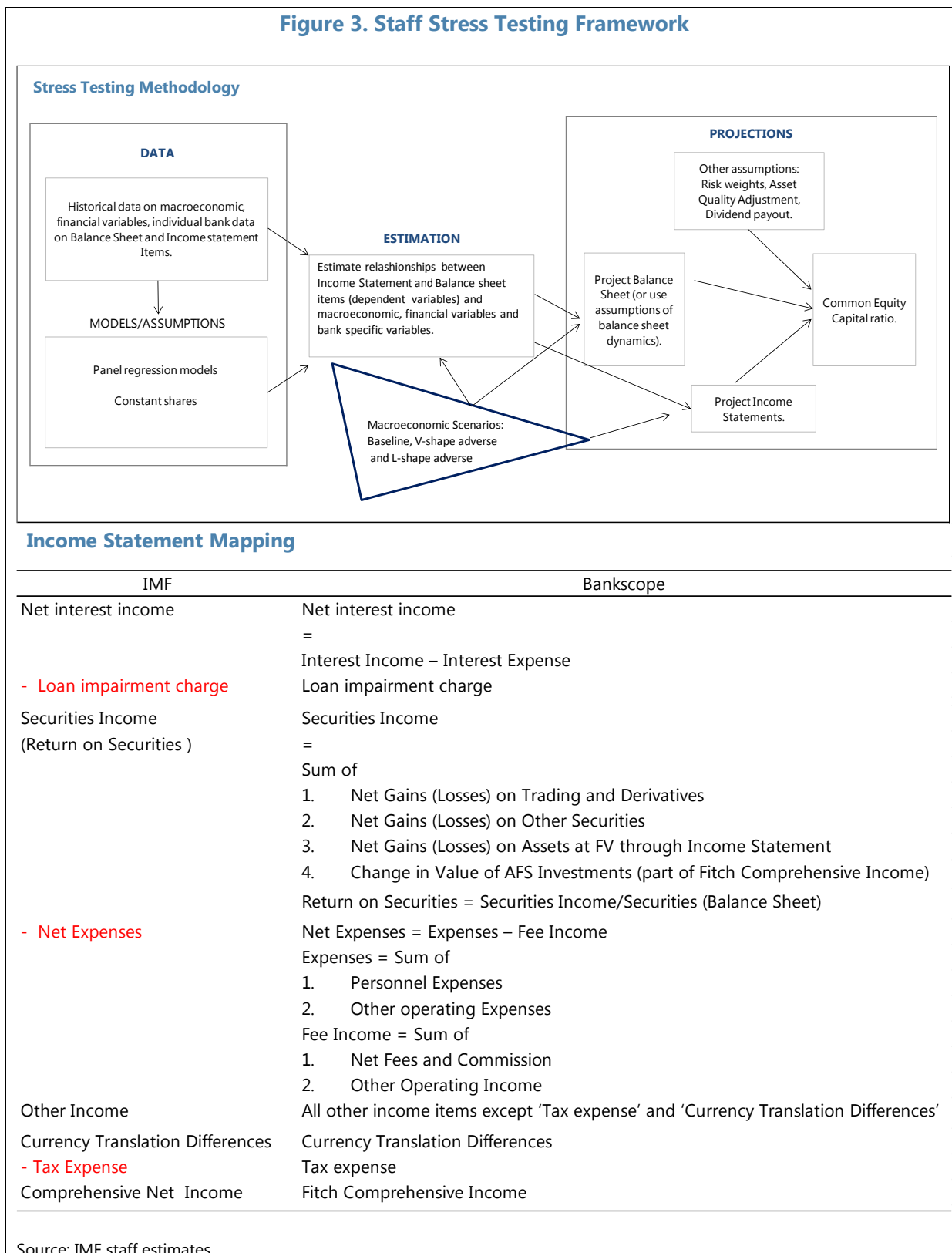
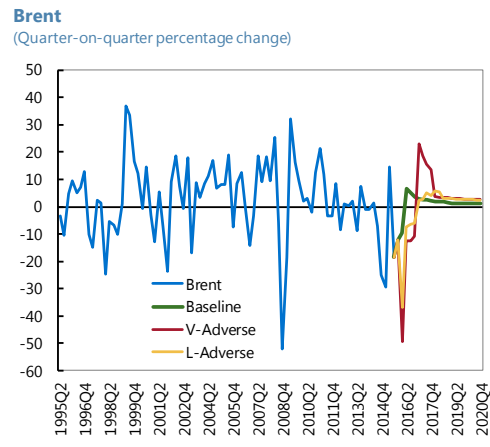
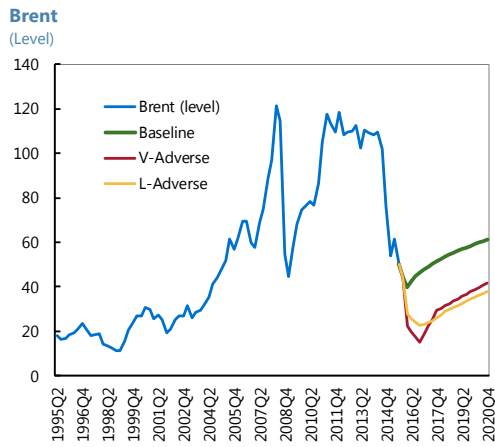


Figure 4. Macroeconomic Scenarios: Main Variables

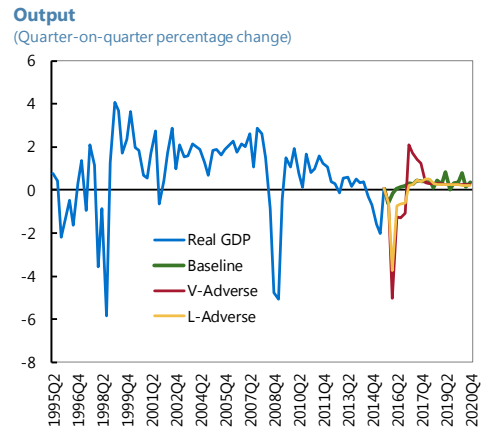
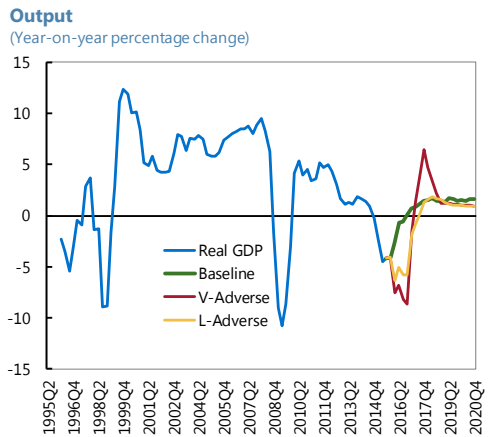
Staff designed three scenarios...

...based on option implied oil price scenarios.



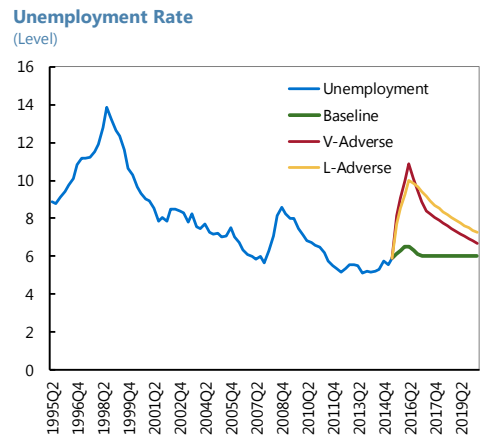
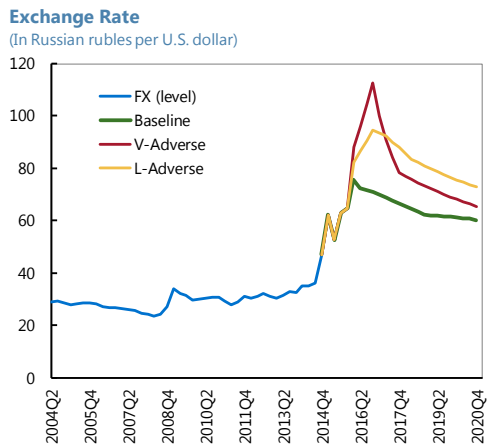
Output responds according to oil price changes.

Decline in GDP would be similar to previous recessions.



The ruble depreciates ...

...and unemployment rises.

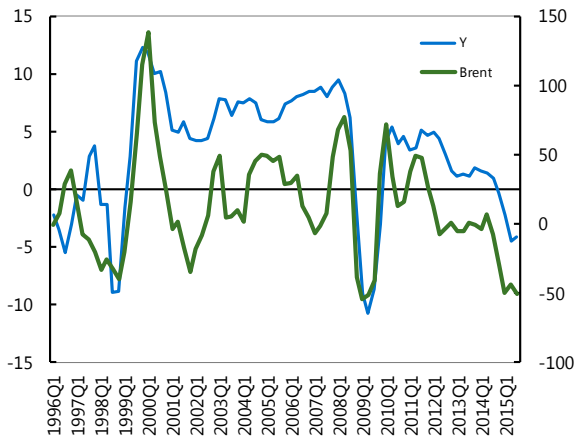


Source: IMF staff estimates.

Figure 5. Oil, GDP Growth, FX, Inflation, and Interest Rates

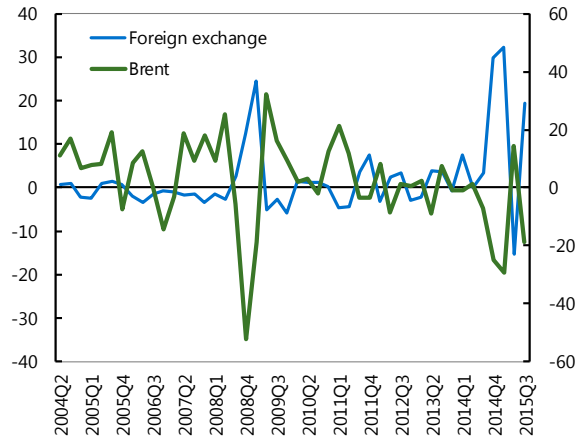
GDP growth is highly correlated with changes in oil prices....

Output and Oil Price
(Year-on-year percentage change)



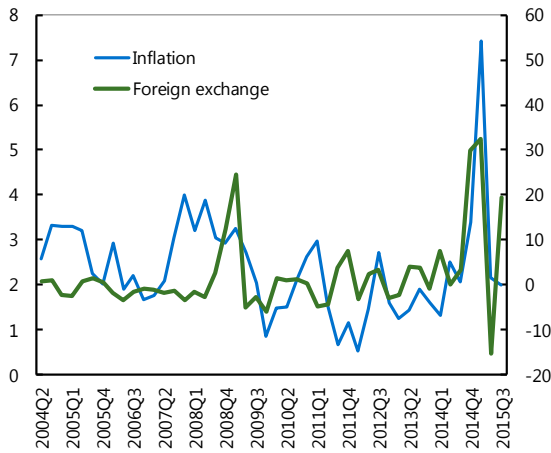
Ruble seems to depreciate strongly when oil prices fall, especially after 2008....

Foreign Exchange and Oil Price
(Quarter-on-quarter percentage change)



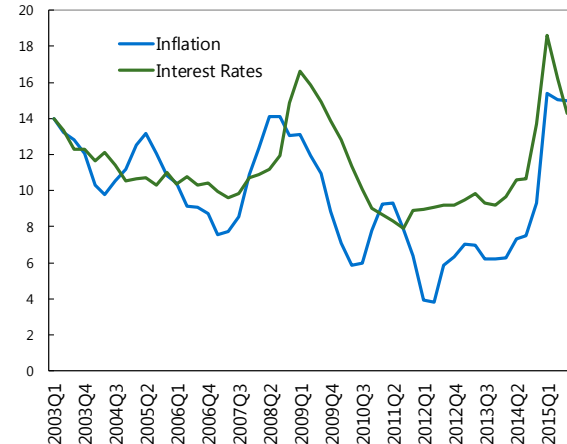
The inflation pass-through is high...

Foreign Exchange and Inflation
(Quarter-on-quarter percentage change)



Higher inflation is accommodated by higher interest rates, in line with CBR's objective....

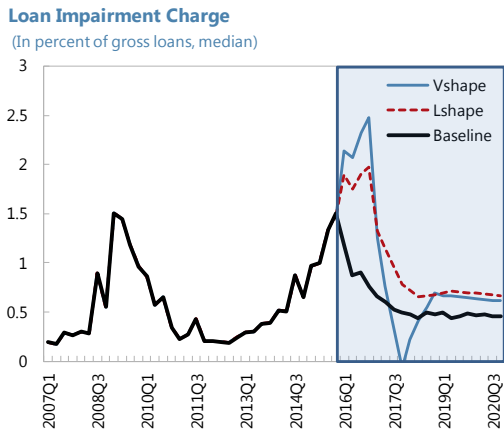
Inflation and Interest Rates
(Levels, percentage points)



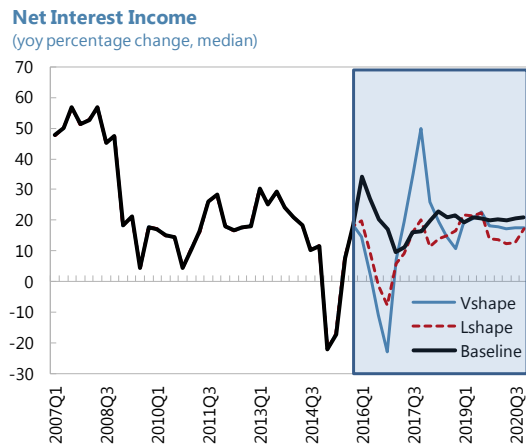
Sources: IMF staff calculations.

Figure 6. Stress Test Scenarios and Restructured Loans, 2013–16

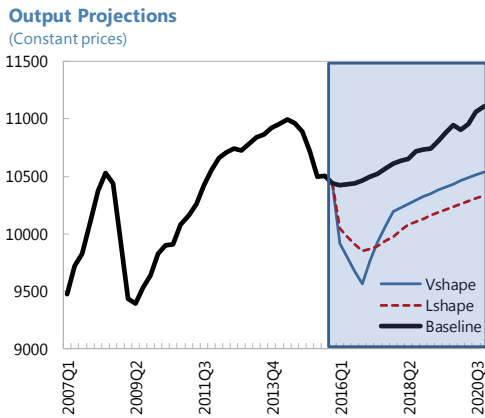
Loan impairment charge increases as loan quality deteriorates...



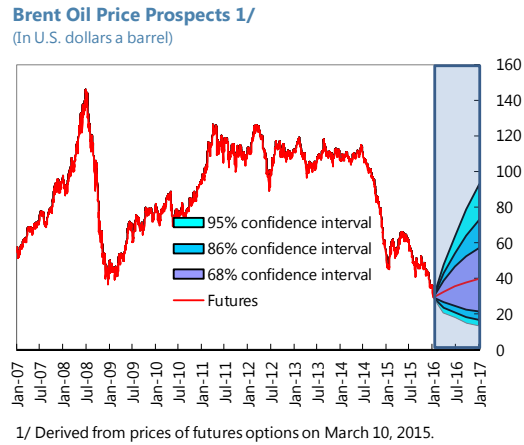
... and interest income decreases due to shrinking margins.



Output declines sharply, long-run growth is modest...

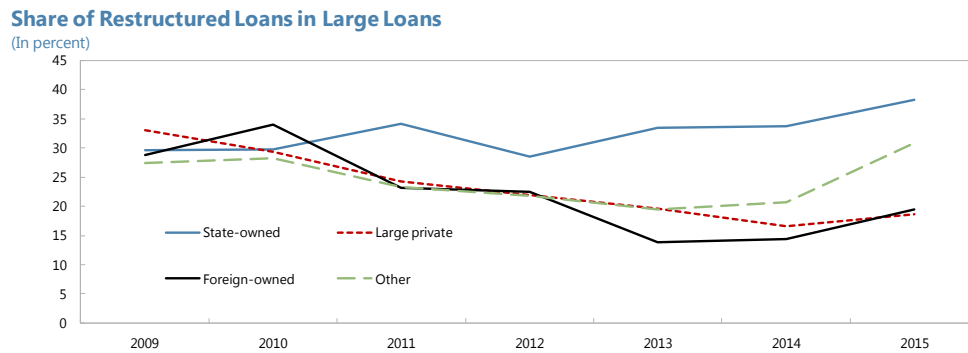


...reflecting the outlook for oil prices.



1/ Derived from prices of futures options on March 10, 2015.

The share of restructured loans has been increasing during the last two years.



Sources: Authorities, Bloomberg, and IMF staff estimates.

Figure 7. Asset Quality Adjustment

Asset quality adjustments were based on aggregate loan portfolio.

Loan Quality of Russian Banking System (01/01/2016)

	Current LP	Prov. Ratio	Current Prov.
Standard	26,254		
Substandard	22,237	2%	400
Doubtful	4,769	18%	858
Problem	1,409	41%	579
Loss	3,442	77%	2,654
	58,111		4,492

Higher provisioning, and lower collateralization rates ...

	CBR Regulation (Min/Max)	Mid Point
	1% / 20%	11%
	21% / 50%	36%
	51% / 100%	76%
	100%	100%

	Current LP	Relative Shares (excl. standard)	Collateralized
Standard	26,254		
Substandard	22,237	70%	69%
Doubtful	4,769	15%	40%
Problem	1,409	4%	35%
Loss	3,442	11%	5%
	58,111	100%	56%

Discussions with banking analysts, rating agencies, banks and CBR resulted in an estimate of weak restructured loans of 30 percent of restructured loans.

Migration of Bad Restructured Loans

Downgraded Loans	Adjusted LP	Prov. Ratio	Adjusted Prov.
	23,836		
2,418	22,607	2%	407
2,048	6,378	18%	1,148
439	1,718	41%	706
130	3,572	77%	2,754
	58,111		5,015

Restructured Loans:	30.7%	Loan Imp. Charge
Bad Loans:	30.0%	0.9%

... result in higher provisions.

Provisioning Adjustment

	Current LP	Adj. Prov. Ratio	Adjusted Prov.
Standard	26,254		
Substandard	22,237	3%	758
Doubtful	4,769	21%	1,022
Problem	1,409	49%	696
Loss	3,442	95%	3,279
	58,111		5,755

Loan Imp. Charge	2.2%
------------------	------

The combined effect of loan migration and higher provisioning results in loan impairment charge of 3.3 percentage points.

Migration of Restructured Loans and Provisioning Adjustment

Adjusted LP	Adjusted Prov.
23,836	
22,607	3%
6,378	21%
1,718	49%
3,572	95%
58,111	6,389

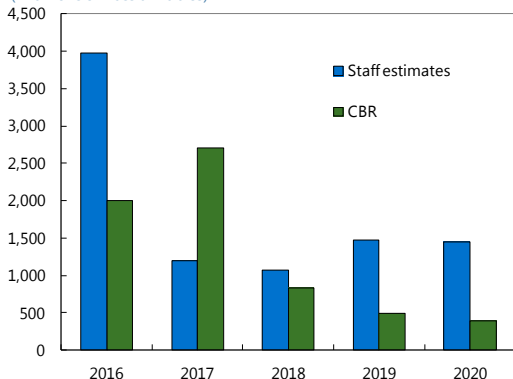
Loan Imp. Charge	3.3%
------------------	------

Source: IMF staff calculations.

Figure 8. Stress Test Results (V-Shape Scenario)

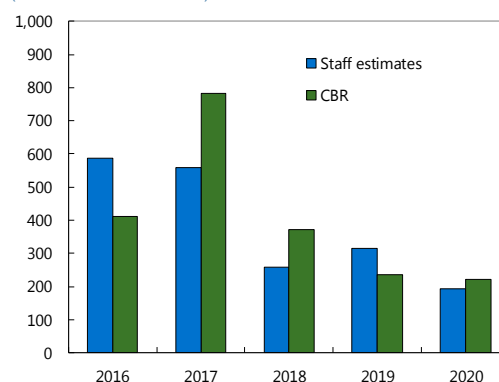
Credit losses peak in the first two years.

Credit Losses
(In billions of Russian rubles)



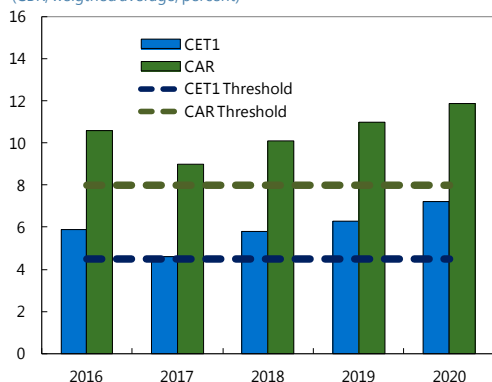
Capital deficits increases are similar in CBR's and staff's stress tests.

Capital Deficit Increase
(In billions of Russian rubles)



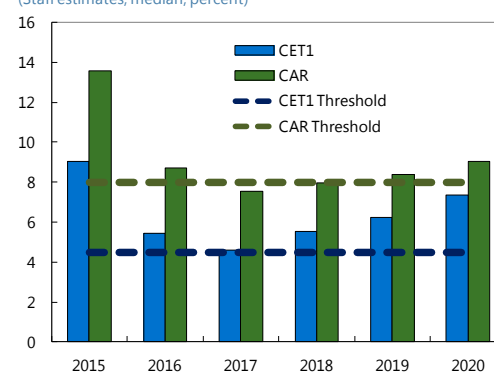
Average capital ratios (CBR) bottom out in 2017 and recover by 2020.

Capital Ratios
(CBR, weighed average, percent)



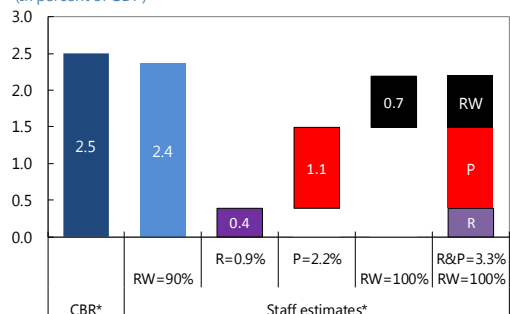
Median capital ratios (staff) breach total capital ratio threshold (CAR Threshold) in 2017, and recover slightly above by 2020.

Capital Ratios—Without Asset Quality Adjustments
(Staff estimates, median, percent)



Total capital deficit is about 2½ percent of GDP (CBR and staff), with additional capital charge of about 2 percent of GDP (staff) due to asset quality adjustments.

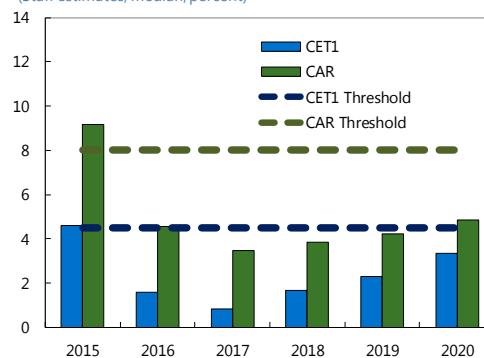
Total Capital Deficit
(In percent of GDP)



Note: R=Restructuring; P=Provisioning; RW=Risk Weight.
*Includes credit, market, interest, and liquidity risk.
**Covers about 80% of total banking assets.

When adjusting for forbearance, median capital ratios (Staff) are more affected

Capital Ratios—With Asset Quality Adjustments
(Staff estimates, median, percent)



Sources: Authorities and IMF staff estimates.

Table 1. Financial Soundness Indicators, 2013–16
(In percent)

	2013	2014	2015	2016 March
Financial Soundness Indicators				
Capital adequacy				
Capital to risk-weighted assets	13.5	12.5	12.7	12.4
Core capital to risk-weighted assets	9.1	9.0	8.5	8.4
Credit risk				
NPLs to total loans	6.0	6.7	8.3	9.2
Loan loss provisions to total loans	5.9	6.5	7.8	8.4
Large credit risks to capital	204.3	245.5	254.4	248.1
Distribution of loans provided by credit institutions				
Agriculture, hunting and forestry	4.3	3.5	3.5	3.6
Mining	3.1	4.2	4.9	5.5
Manufacturing	13.6	15.5	17.1	16.9
Production and distribution of energy, gas and water	2.5	2.5	2.5	2.5
Construction	5.6	5.3	4.8	4.8
Wholesale and retail trade	13.7	13.3	11.3	11.0
Transport and communication	4.2	4.4	4.2	4.3
Other economic activities	21.1	21.2	24.1	23.9
Individuals	32.0	30.1	27.5	27.6
<i>Of which: mortgage loans</i>	8.5	9.4	10.1	12.5
Geographical distribution of interbank loans and deposits				
Russian Federation	39.7	53.6	54.0	58.9
United Kingdom	23.8	13.9	12.3	11.1
United States	6.8	4.9	4.5	4.7
Germany	0.6	0.4	0.8	1.0
Austria	7.3	7.3	4.9	4.1
France	1.9	1.8	1.8	2.4
Italy	0.1	0.0	0.0	0.1
Cyprus	4.7	4.9	9.2	6.2
Netherlands	1.5	1.3	0.8	0.4
Other	13.6	11.8	11.8	11.0
Liquidity				
Highly liquid assets to total assets	9.9	10.4	10.6	11.6
Liquid assets to total assets	20.5	22.0	24.6	22.8
Liquid assets to short-term liabilities	78.7	80.4	139.3	121.8
Ratio of client's funds to total loans	98.7	92.8	59.0	59.4
Return on assets	1.9	0.9	0.3	0.4
Return on equity	15.2	7.9	2.3	3.4
Balance Sheet Structure, in percent of assets				
Total asset growth rate	16.0	35.2	6.9	9.0
Asset side				
Accounts with CBR and other central banks	3.9	4.2	3.0	3.6
Interbank lending	8.9	8.9	10.4	10.7
Securities holdings	13.6	12.5	14.2	14.6
Liability side				
Funds from CBR	7.7	12.0	6.5	5.0
Interbank liabilities	8.4	8.5	8.5	9.5
Individual deposits	29.5	23.9	28.0	27.8

Sources: Authorities and IMF staff calculations.

Table 2. Macroeconomic Scenarios: Projections 2015–20

	Actual		Projections			
	2015	2016	2017	2018	2019	2020
A. Baseline Scenario						
Real GDP (%)	-3.7	-1.0	1.0	1.5	1.5	1.5
Brent price (USD/bbl, avg.)	53	43	50	54	57	60
Exchange Rate (RUB/USD, avg.)	61	73	68	64	62	61
Inflation (% , avg.)	15.5	8.3	7.0	5.0	4.0	4.0
Short-term Interest Rates (% , avg.)	11.0	8.5	5.5	5.5	5.5	5.5
Unemployment (% , avg.)	5.6	6.4	6.1	6.0	6.0	6.0
B. V-Shape Scenario						
Real GDP (%)	-3.7	-7.8	2.6	2.9	1.1	1.0
Brent price (USD/bbl, avg.)	53	19	24	32	36	40
Exchange Rate (RUB/USD, avg.)	61	100	88	75	71	67
Inflation (% , avg.)	15.5	15.9	6.1	4.0	4.2	4.2
Short-term Interest Rates (% , avg.)	11.0	17.7	7.6	5.4	5.7	5.7
Unemployment (% , avg.)	5.6	9.5	9.2	8.0	7.4	6.9
C. L-Shape Scenario						
Real GDP (%)	-3.7	-5.7	-0.3	1.7	1.1	1.0
Brent price (USD/bbl, avg.)	53	25	25	29	33	37
Exchange Rate (RUB/USD, avg.)	61	88	91	83	78	74
Inflation (% , avg.)	15.5	13.3	5.4	4.1	4.2	4.2
Short-term Interest Rates (% , avg.)	11.0	15.2	6.9	5.5	5.7	5.7
Unemployment (% , avg.)	5.6	8.9	9.5	8.6	8.0	7.4

Source: IMF staff calculations.

Table 3. Regression Results

A: Balance Sheet Items			
Variables	(1)	(2)	(3)
	Gross Loans (yoy %)	Total Assets (yoy %)	Net Charge Offs (% Gross Loans)
Gross loans (yoy %) = L,	0.382*** (0.0310)		
Gross loans (yoy %)		0.853*** (0.0113)	-0.0158*** (0.00215)
Real GDP (yoy %)			-0.125*** (0.0306)
Real GDP (yoy %) if g>0	3.820*** (0.410)		
Real GDP (yoy %) if RETAIL or OTHER	0.643* (0.357)		
Lending Rate			0.00434 (0.0603)
Term Premium			0.412*** (0.131)
Real Housing Index (yoy %)			-0.0207*** (0.00679)
Rouble/USD			0.0478*** (0.0178)
Constant	9.938*** (1.461)	4.236*** (0.460)	3.715*** (0.968)
Observations	1,487	1,504	1,502
R-squared	0.361	0.884	0.512
Firm FE	YES	YES	YES
YEAR>2007			

Robust standard errors in parentheses

B: Income Statement Items						
Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Net interest income (yoy)	Trading Inc. (%TA)	Non-interest Expense (yoy)	Net Fees and Commissions	Other Net Inc. (%TA)	Loan Impairment
Loans * Lending Rate (yoy %) = L,	0.445*** (0.0342)					
Deposits * Deposit Rate (yoy %) = L,	-0.168*** (0.0264)					
Total Assets (yoy %)			0.387*** (0.0277)	0.272*** (0.0511)		
Real GDP (yoy %)	4.149*** (0.212)	-0.0290*** (0.00314)				-0.0508*** (0.00407)
RIX		-0.00466 (0.0132)				
InflationRate_yoy	0.611* (0.355)					
Unemployment						0.101*** (0.0207)
TermPremium		0.0446*** (0.0133)			-0.0659*** (0.0136)	-0.115*** (0.0186)
RHI_yoy_g		0.00589*** (0.000722)			-0.00190* (0.00105)	
Constant	3.323 (3.100)	0.156*** (0.0422)	15.22*** (1.211)	18.44*** (2.007)	0.275*** (0.0280)	0.619*** (0.123)
Observations	1,481	1,554	1,497	1,136	1,554	1,554
R-squared	0.354	0.152	0.232	0.132	0.412	0.559
Firm FE	YES	YES	YES	YES	YES	YES
YEAR>2007				YES		

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Source: IMF staff calculations.

Table 4. Detailed Stress Test Results

	2016	2017	2018	2019	2020	2016	2017	2018	2019	2020	2016	2017	2018	2019	2020		
	Baseline					Stress Scenario (V-shaped)					Stress Scenario (L-shaped)						
Top-down, CBR 1/																	
<i>without asset quality adjustment</i>																	
CET1 capital ratio 2/	7.9	8.1	8.1	8.3	8.3	5.9	4.6	5.8	6.3	7.2	6.3	5.2	5.6	6.1	6.7		
Total capital ratio 2/	12.3	12.5	12.6	12.7	12.8	10.6	9.0	10.1	11.0	11.9	11.0	10.2	10.7	11.3	11.8		
Top-down, Staff 3/																	
<i>without asset quality adjustment</i>																	
CET1 capital ratio 4/	9.0	8.4	10.1	12.4	14.8	5.4	4.6	5.5	6.2	7.4	6.5	4.8	5.2	5.9	6.5		
Total capital ratio 4/	12.5	12.8	13.3	14.2	16.2	8.7	7.5	8.0	8.4	9.0	9.7	8.1	7.8	8.4	8.8		
Top-down, Staff 3/																	
<i>with asset quality adjustment</i>																	
CET1 capital ratio 4/	6.0	5.5	7.2	9.5	11.8	1.6	0.8	1.7	2.3	3.3	2.5	1.0	1.4	2.0	2.6		
Total capital ratio 4/	9.5	9.9	10.3	11.2	13.2	4.5	3.5	3.9	4.2	4.8	5.5	3.9	3.8	4.2	4.7		
Top-down, CBR 1/						Sum						Sum					
<i>without asset quality adjustment</i>																	
Credit losses 5/	1.2	1.7	0.8	0.6	0.5	4.8	3.4	4.7	1.4	0.9	0.7	11.1	2.8	3.7	1.5	0.9	0.7
Total capital deficit 6/ 7/	0.1	0.2	0.2	0.2	0.3		0.5	1.5	1.9	2.2	2.5		0.4	1.2	1.6	1.9	2.1
Top-down, Staff 3/																	
<i>without asset quality adjustment</i>																	
Credit losses 5/	2.9	1.9	1.7	1.8	1.8	10.2	6.8	2.1	1.8	2.5	2.5	15.8	5.8	3.5	2.4	2.6	2.5
Total capital deficit 6/	0.1	0.2	0.3	0.4	0.4		0.7	1.4	1.7	2.1	2.4		0.4	1.3	1.8	2.3	2.7
Top-down, Staff 3/																	
<i>with asset quality adjustment</i>																	
Credit losses 5/	6.2	1.9	1.7	1.8	1.8	13.5	10.1	2.1	1.8	2.5	2.5	19.1	9.1	3.5	2.4	2.6	2.5
Total capital deficit 6/	0.5	0.8	0.9	1.0	1.0		3.8	4.6	4.4	4.3	4.2		3.0	4.0	4.3	4.4	4.4
Top-down, CBR 1/																	
<i>without asset quality adjustment</i>																	
No. of banks with capital deficit 1/	34	36	27	23	19		72	140	76	34	29		62	108	67	35	19
Share of banks with capital deficit /8	6.8	7.0	6.2	6.1	5.7		19.1	29.7	18.7	5.8	5.4		17.2	28.9	15.5	6.4	4.9
Top-down, Staff 3/																	
<i>without asset quality adjustment</i>																	
No. of banks with capital deficit 3/	7	7	9	9	9		16	20	19	18	16		13	18	19	18	17
Share of banks with capital deficit /8	8.4	11.8	15.0	15.0	15.0		37.0	40.0	40.0	39.4	38.1		34.8	38.4	39.4	39.4	39.0
Top-down, Staff 3/																	
<i>with asset quality adjustment</i>																	
No. of banks with capital deficit 3/	15	15	15	14	12		27	28	26	25	23		27	25	26	25	24
Share of banks with capital deficit /8	37.0	37.0	37.7	37.5	18.7		86.5	86.8	83.5	83.3	44.3		86.5	83.2	83.4	83.3	44.3
Source: IMF staff calculations.																	
1/ Based on a sample of 681 banks.						5/ In percent of total loans.											
2/ Asset weighted mean.						6/ In percent of GDP.											
3/ Based on a sample of largest 37 banks.						7/ Includes also market and liquidity risk.											
4/ Median						8/ In percent of sample total assets.											

Table 5. Banks' Bottom-Up Results for 12 Banks in 2016

Main Results	Baseline Scenario	V-Shape Scenario	L-Shape Scenario
Total losses, bn RUB	947	2, 882	2,122
Losses on credit risk, bn RUB	786	1,978	1,536
Including losses on:			
Corporate portfolio, bn RUB	561	1,572	1,215
Retail portfolio, bn RUB	225	407	322
Losses on market risk, bn RUB	1	146	90
Including losses on:			
Interest rate risk on trade portfolio, bn RUB	0	17	10
Equity risk, bn RUB	0	76	49
FX risk, bn RUB	0	54	31
Losses on Interest rate risk on banking book, bn RUB	25	404	224
Losses on liquidity risk, bn RUB	135	254	225
Financial result, bn RUB	730	-1,159	-466
Aggregate capital deficit, bn RUB	3	199	70
Number of banks with capital deficit	1	6	2

Source: CBR estimates.

Table 6. CBR's Top-Down Results for the Same 12 Banks in 2016

Main Results	Baseline Scenario	V-Shape Scenario	L-Shape Scenario
Total losses, bn RUB	1,687	3,746	3,425
Losses on credit risk, bn RUB	1,277	2,221	2,031
Including losses on:			
Corporate portfolio, bn RUB	1,031	1,807	1,659
Retail portfolio, bn RUB	247	414	372
Losses on market risk, bn RUB	197	749	678
Including losses on:			
Interest rate risk on trade portfolio, bn RUB	108	412	376
Equity risk, bn RUB	59	225	204
FX risk, bn RUB	30	112	98
Losses on Interest rate risk on banking book, bn RUB	189	720	671
Losses on liquidity risk, bn RUB	24	56	45
Financial result, bn RUB	334	-680	-505
Aggregate capital deficit, bn RUB	65	522	426
Number of banks with capital deficit	1	7	6

Source: CBR estimates.

Table 7. Results of Single-Factor Tests (at the end of 2015)

	Credit Risk	Market Risk			
	Default of top five bank borrowers	Exchange rate depreciation of 20 percent	Equity decline of 30 percent	Interest Rate Risk in the Trading Book	
				Corporate sector +1000bps government bonds +400 bps	Corporate sector +1000bps government bonds +0 bps
Number of banks with capital deficit	338	5	7	13	4
Share of total banking assets (in percent)	82.5	0.1	0.5	6.7	1.0
Aggregated capital deficit, bn RUB	1,519	0.2	0.9	20	6.7

Source: CBR estimates.

Table 8. Assumptions of Liquidity Tests

Parameters	Mild Scenario	Severe Scenario	Very Severe Scenario
<i>Outflows, in percent</i>			
Individual deposits	20 (10 for largest bank)	30 (10 for largest bank)	30 (10 for largest bank)
Deposits of legal entities	10	10	30
Funds of legal entities in settlement and other accounts	20	30	40 (20 for largest bank)
Interbank loans from non-residents	30	50	50
Interbank loans from residents	0	0	40 (20 for largest bank)
<i>Fire Sales with Discounts, in percent</i>			
Cash and correspondent accounts with the CRB	0	0	0
Highly liquid assets	5	5	5
Liquid assets	20	20	20
Securities not included in liquid assets	30	40	65
Source: CBR estimates.			

Appendix I. Banking Sector Stress Testing Matrix (STeM)

Domain		Assumptions		
		Top-Down by FSAP Team	Top-Down by Authorities	Bottom-Up by Authorities
Banking Sector: Solvency Risk				
1. Institutional Perimeter	Institutions included	<ul style="list-style-type: none"> • Top 37 	<ul style="list-style-type: none"> • 681 	<ul style="list-style-type: none"> • 12 large banks (including 10 systemically important banks)
	Market share	<ul style="list-style-type: none"> • 81.5 percent 	<ul style="list-style-type: none"> • 99.7 percent 	<ul style="list-style-type: none"> • 66 percent
	Data and baseline date	<ul style="list-style-type: none"> • Institutions' public data, up to 3rd Q 2015 • Consolidated banking group, and stand-alone basis 	<ul style="list-style-type: none"> • Public data and other data, up to 4th Q 2015 • Stand-alone basis 	<ul style="list-style-type: none"> • Institutions' own data; up to 4th Q 2015 • Stand-alone basis
2. Channels of Risk Propagation	Methodology	<ul style="list-style-type: none"> • Balance-sheet model (loan impairment charge/provisions/NPLs) • Supplemental balance sheet analysis of impact of restructuring and under-provisioning 	<ul style="list-style-type: none"> • Balance-sheet model (NPLs/provisions) 	<ul style="list-style-type: none"> • Banks' internal models
	Satellite Models for Macrofinancial linkages	<ul style="list-style-type: none"> • Models for credit losses, NPLs, loan impairment charge, pre-impairment income • Satellite model bank by bank using IFRS data 	<ul style="list-style-type: none"> • Models for credit losses, NPLs, provisions, pre-impairment income • CBR macro model has second round effects related to the dependency between credit growth and growth of fixed capital investments 	<ul style="list-style-type: none"> • Own models
	Stress test horizon	<ul style="list-style-type: none"> • Five years, 2016–20 	<ul style="list-style-type: none"> • Five years, 2016–20 	<ul style="list-style-type: none"> • One year

		Assumptions		
		Top-Down by FSAP Team	Top-Down by Authorities	Bottom-Up by Authorities
3. Tail shocks	Scenario analysis	<ul style="list-style-type: none"> Macro scenarios are shocks conditioned upon oil price, GDP, exchange rate, inflation, interest rates, unemployment Baseline, adverse V-shaped scenario, adverse L-shaped scenario (magnitude of shocks derived from adverse oil price scenario plus macro model) 	<ul style="list-style-type: none"> Macro scenarios are shocks conditioned upon oil price, GDP, exchange rate, inflation, interest rates, unemployment Baseline, adverse V-shaped scenario, adverse L-shaped scenario 	<ul style="list-style-type: none"> Macro scenarios are shocks conditioned upon oil price, GDP, exchange rate, inflation, interest rates, unemployment. Baseline, adverse V-shaped scenario, adverse L-shaped scenario
	Sensitivity analysis	<ul style="list-style-type: none"> Not performed by staff 	<ul style="list-style-type: none"> Single-factor shocks are applied; concentration risk: default of top five borrowers; market risks: FX 20 percent depreciation, equity 30 percent decline, interest rate +1000 bps corporate bonds and +400 bps, government bonds 	<ul style="list-style-type: none"> Not performed by banks
4. Risks and Buffers	Risks/factors assessed (how each element is derived, assumptions)	<ul style="list-style-type: none"> Credit losses, profitability, income after tax, funding costs, exchange rate 	<ul style="list-style-type: none"> Credit losses, profitability, income after tax, funding costs, market risk, fixed income holdings of banks/sovereigns, exchange rate 	<ul style="list-style-type: none"> Same as authorities' TD stress tests
	Behavioral adjustments	<ul style="list-style-type: none"> Dividend payout can be restricted by CBR. 	<ul style="list-style-type: none"> Dividend payout can be restricted by CBR. 	<ul style="list-style-type: none"> Banks' internal models

Domain		Assumptions		
		Top-Down by FSAP Team	Top-Down by Authorities	Bottom-Up by Authorities
5. Regulatory and Market-Based Standards and Parameters	Calibration of risk parameters	<ul style="list-style-type: none"> • NPLs/provisions • RWA according to standardized approach • Risk weights increase from 90 percent to 100 percent in the prudent approach 	<ul style="list-style-type: none"> • NPLs/provisions • RWA according to standardized approach 	<ul style="list-style-type: none"> • Own methodologies • RWA similar to authorities' stress tests
	Regulatory/Accounting and Market-Based Standards	<ul style="list-style-type: none"> • Hurdle rate: Basel III schedule, local regulatory requirements 	<ul style="list-style-type: none"> • Hurdle rate: Basel III schedule, local regulatory requirements 	<ul style="list-style-type: none"> • Hurdle rate: Basel III schedule, local regulatory requirements
		<ul style="list-style-type: none"> • CET1 of 4.5 percent, CAR of 8 percent 	<ul style="list-style-type: none"> • CET1 of 4.5 percent, CAR of 8 percent 	<ul style="list-style-type: none"> • CET1 of 4.5 percent, T1 of 6 percent, CAR of 8 percent
6. Reporting Format for Results	Output presentation	<ul style="list-style-type: none"> • Dispersion of capital ratios: median • Capital deficit, system wide • Pass or fail; percentage of assets that fail • Number of banks undercapitalized 	<ul style="list-style-type: none"> • Distributions by capital ratio: weighted average • Capital deficit, system wide • Pass or fail; percentage of assets that fail • Number of undercapitalized banks 	<ul style="list-style-type: none"> • Capital shortfall, system wide. • Pass or fail; percentage of assets that fail • Number of banks undercapitalized
7. Asset quality adjustment	Stress testing methodology	<ul style="list-style-type: none"> • Adjustment for weak restructured loans and underprovisioning lead to one-off increase in provisions at beginning of stress testing period 	<ul style="list-style-type: none"> • Not performed by authorities 	<ul style="list-style-type: none"> • Not performed by banks

Domain		Assumptions		
		Top-Down by FSAP Team	Top-Down by Authorities	Bottom-Up by Authorities
BANKING SECTOR: LIQUIDITY RISK				
1. Institutional Perimeter	Institutions included	<ul style="list-style-type: none"> Carried out by authorities with agreed scenarios 	<ul style="list-style-type: none"> 681 	<ul style="list-style-type: none"> Banks included in authorities' liquidity scenarios
	Market share	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> 99.7 percent 	<ul style="list-style-type: none"> N/A
	Data and baseline date	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> Institutions' public data and other data up to 4th Q 2015 Stand-alone basis 	<ul style="list-style-type: none"> N/A
2. Channels of Risk Propagation	Methodology	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> Cash outflow asset discounts and sensitivity analysis for liquidity risk 	<ul style="list-style-type: none"> N/A
3. Risks and Buffers	Risks	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> Outflows from liabilities liquidity shock Discounts on assets Market liquidity shock 	<ul style="list-style-type: none"> N/A
	Buffers	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> Counterbalancing capacity stand-alone 	<ul style="list-style-type: none"> N/A
4. Tail shocks	Size of the shock (one period, i.e., one-off shock to most recent balance sheet).	<ul style="list-style-type: none"> N/A 	<ul style="list-style-type: none"> Bank run and dry up of wholesale funding markets, taking into account haircuts to liquid assets 	<ul style="list-style-type: none"> N/A

Domain		Assumptions		
		Top-Down by FSAP Team	Top-Down by Authorities	Bottom-Up by Authorities
			<ul style="list-style-type: none"> • Outflows: household deposits-30 percent (10 percent largest bank); legal entities 30 percent; corporate settlement and other accounts-40 percent (20 for largest bank); interbank loans non-resident 50 percent; interbank loans resident 40 percent (20 for largest bank) • Haircut: highly liquid asset, 5 percent; liquid asset 20 percent; low-liquid asset 65 percent 	
5. Regulatory and Market-Based Standards and Parameters	Regulatory standards	N/A	Amount of liquidity deficit and number of banks with liquidity deficit	N/A
6. Reporting Format for Results	Output presentation	N/A	Amount of liquidity deficit and number of banks with liquidity deficit	N/A