Chapter II

Financial Institutions: Soundness and Resilience

The overall risks to the banking sector remained elevated due to asset quality concerns. Between March and September 2017, the gross non-performing advances (GNPA) ratio of scheduled commercial banks (SCBs) increased from 9.6 per cent to 10.2 per cent and the stressed advances ratio marginally increased from 12.1 per cent to 12.2 per cent. Public sector banks (PSBs) registered GNPA ratio at 13.5 per cent and stressed advances ratio at 16.2 per cent in September 2017.

The macro stress test for credit risk indicates that under the baseline macro scenario, the GNPA ratio may increase to 10.8 per cent by March 2018 and further to 11.1 per cent by September 2018.

The network analysis indicates that the degree of interconnectedness in the banking system has decreased gradually since 2012. The joint solvency-liquidity contagion analysis shows that losses due to default of a bank have declined.

Section I

Scheduled commercial banks

2.1   In this section, the soundness and resilience of scheduled commercial banks (SCBs) is discussed under two broad sub-heads: i) performance and ii) resilience, the latter using macro stress tests through scenarios and single factor sensitivity analyses[1].

Performance

Credit and deposit growth

2.2   Credit growth of SCBs, on a y-o-y basis, increased from 4.4 per cent to 6.2 per cent between March and September 2017. The public sector banks' (PSBs) credit growth increased from 0.7 per cent to 2.2 per cent during the same period reversing the declining trend observed during past two years. Emerging risks due to muted credit growth have been discussed in Chapter 1 (para 1.10). On the other hand, deposit growth of SCBs, on a y-o-y basis, decelerated from 11.1 per cent to 7.8 per cent between March and September 2017. The decline in deposit growth is observed across all bank groups (Chart 2.1).

Soundness – Capital adequacy and leverage ratio

2.3   Capital to risk-weighted asset ratio (CRAR) of SCBs increased from 13.6 per cent to 13.9 per cent between March and September 2017 largely due to an improvement for private sector banks (PVBs). Common equity tier (CET) 1 leverage ratio[2] of SCBs

Chart 2.1: Credit and deposit growth: y-o-y basis
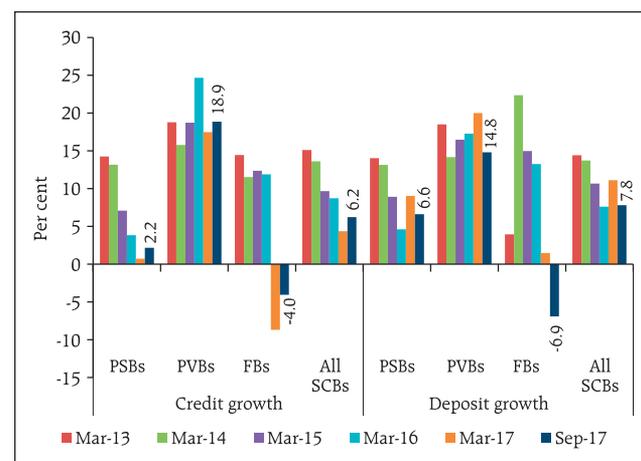
Note: PSBs=Public sector banks, PVBs=Private sector banks and FBs=Foreign banks.
Source: RBI supervisory returns.

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[1]   Analyses are based on supervisory returns and cover only domestic operations of SCBs, except in the case of data on large borrowers, which is based on banks' global operations. SCBs include public sector, private sector and foreign banks.

[2]   CET 1 leverage ratio is defined as the ratio of CET 1 capital to total assets. Total assets include the credit equivalent of off-balance sheet items.

also improved from 6.0 per cent to 6.2 per cent during the same period (Chart 2.2).

Asset quality

2.4   The gross non-performing advances (GNPA) ratio[3] of SCBs increased from 9.6 per cent to 10.2 per cent between March and September 2017, whereas, their restructured standard advances (RSA) ratio declined from 2.5 per cent to 2.0 per cent. The stressed advances (SA) ratio[4] rose marginally from 12.1 per cent to 12.2 per cent during the same period. GNPA ratio of PSBs increased from 12.5 per cent to 13.5 per cent between March and September 2017. Stressed advances ratio of PSBs rose from 15.6 per cent to 16.2 per cent during the period (Chart 2.3a).

2.5   The net non-performing advances (NNPA) as a percentage of total net advances increased from 5.5 per cent to 5.7 per cent between March and September 2017. PSBs recorded distinctly higher NNPA ratio of 7.9 per cent (Chart 2.3b).

2.6   The GNPAs of all SCBs increased by 18.5 per cent on a y-o-y basis in September 2017. PVBs registered a higher increase in GNPAs (40.8 per cent) as compared to their public sector counterparts (17.0

Chart 2.2: Capital adequacy
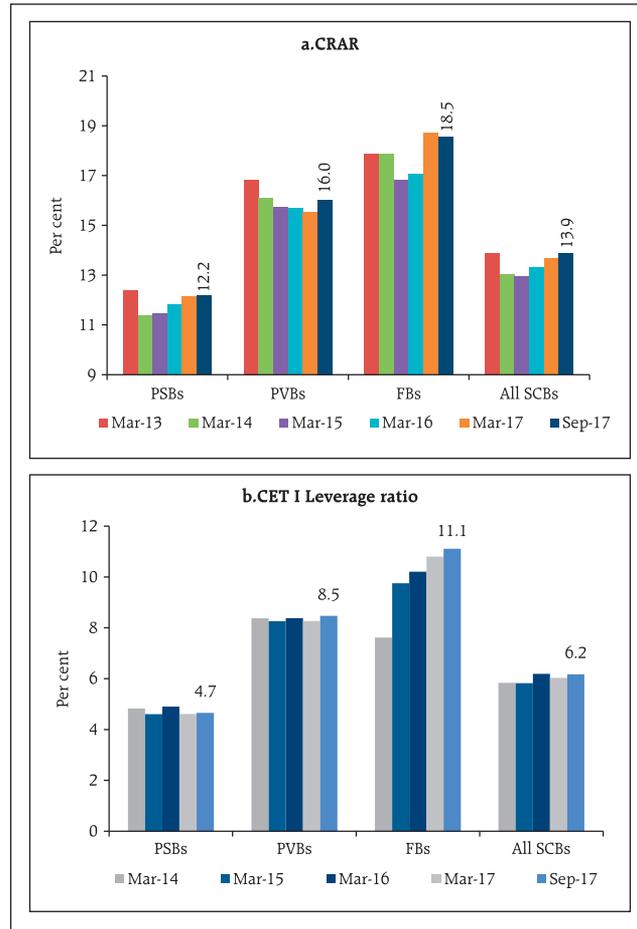
Source: RBI supervisory returns.

**Chart 2.3: Asset quality**
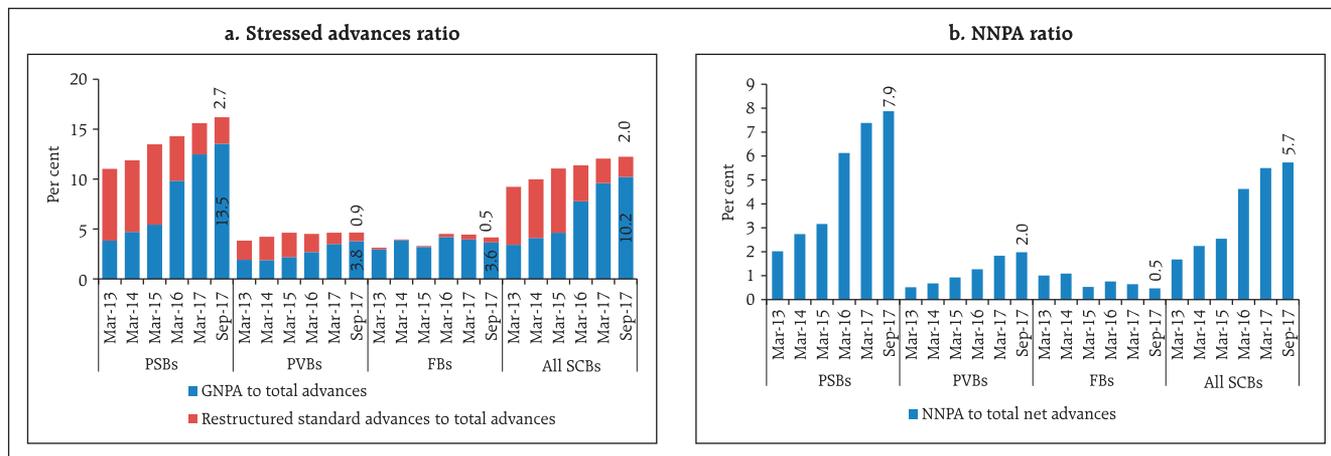
Source: RBI supervisory returns.

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[3] GNPA, RSA and SA ratios have been calculated as a percentage of total gross advances.

[4] For the purpose of analysing the asset quality, stressed advances are defined as GNPAs plus RSAs.

Chart 2.4: Change in asset quality

a. GNPAs: y-o-y variation

b. NNPAs: y-o-y variation
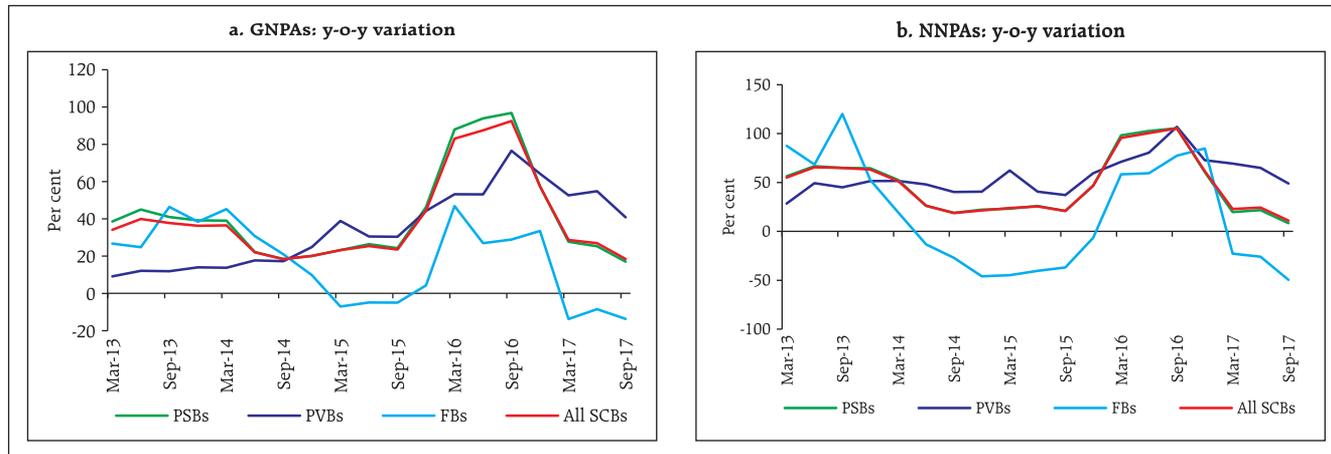
Source: RBI supervisory returns.

per cent) (Chart 2.4a). NNPAs of all SCBs increased by 11.1 per cent on a y-o-y basis in September 2017 (Chart 2.4b).

2.7 From an analysis of the slippage ratio[5] of 27 banks (accounting for about 87 per cent of the total assets of the banking system), the median as well as the tails are showing signs of moderation. The right tail observations (indicating a high conversion to NPAs) mostly pertain to PSBs (Chart 2.5).

2.8 The asset quality of SCBs deteriorated across broad sectors between March and September 2017 with the industrial sector leading this cohort (Chart 2.6).

Chart 2.5: Slippage from standard assets portfolio
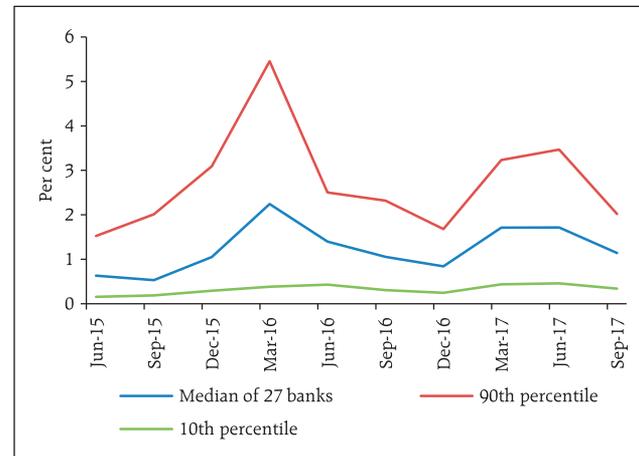
Source: RBI supervisory returns.

Chart 2.6: Stressed advances in broad sectors

(per cent to total advances of the respective sector)
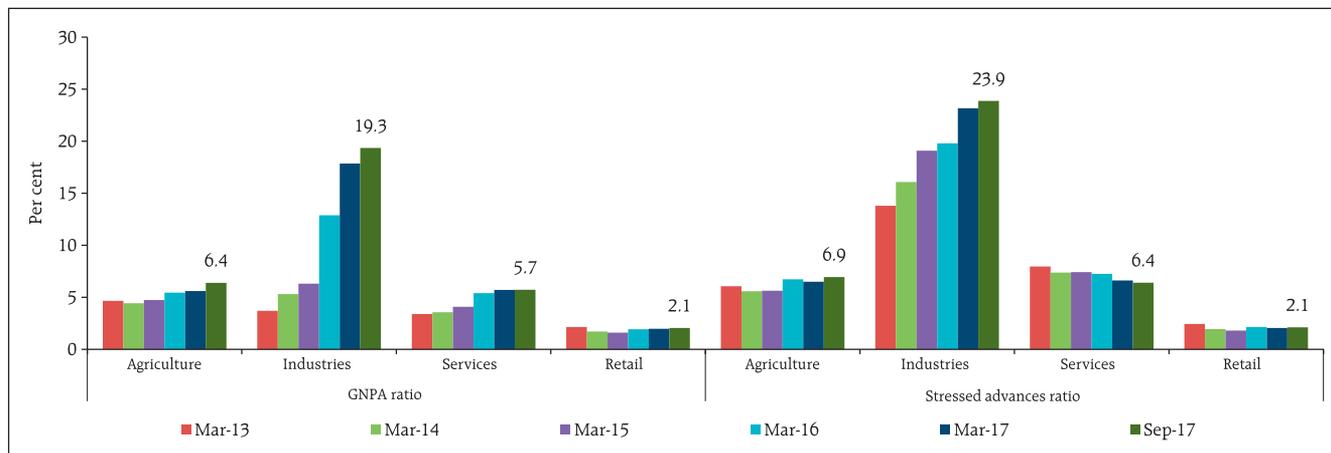

Source: RBI supervisory returns.

[5] Slippage ratio in this context represents the slippages from the standard advances to NPA status (excluding slippages from the restructured standard advances) as a ratio of the standard advances (net of restructured standard advances).

Chart 2.7: Stressed advances ratios of major sub-sectors within industry

(per cent of advances of their respective sector)
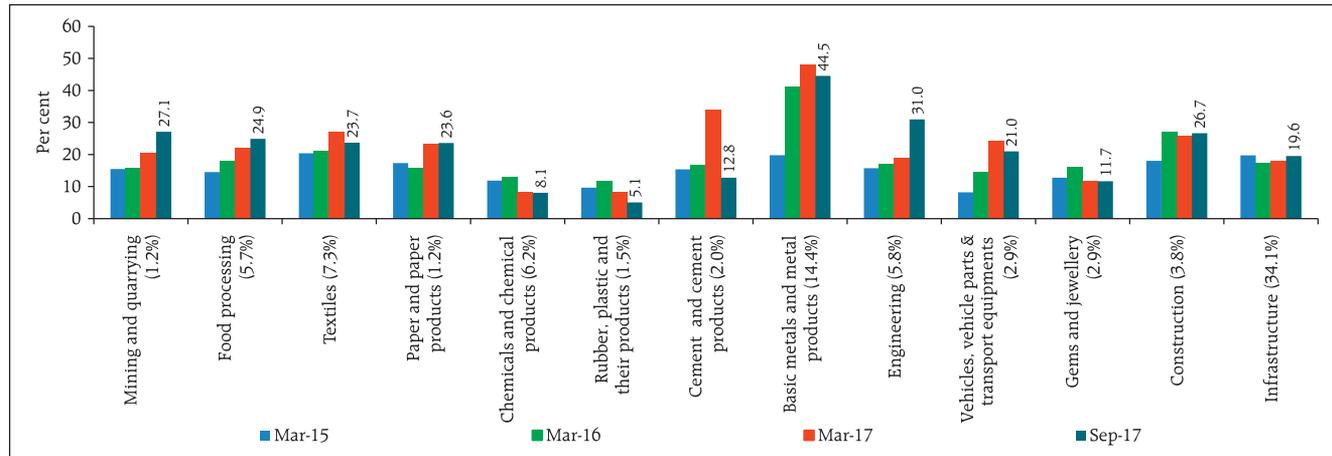
Note: Number given in parenthesis with the legend is share of the respective sub-sector's credit in total credit to industry.
**Source:** RBI supervisory returns.

2.9   Among the major industry sub-sectors, mining and quarrying, food processing, engineering, construction and infrastructure registered increase in their stressed advances ratios between March and September 2017. The asset quality of sub-sectors such as textiles, rubber, cement, basic metals and vehicles, however, improved during the same period (Chart 2.7).

Credit quality of large borrowers[6]

2.10   The share of large borrowers both in total SCBs' loans as well as GNPAs declined between March and September 2017 (Chart 2.8).

2.11   The total stressed advances of large borrowers increased by 2.4 per cent between March and September 2017. Advances to large borrowers classified as special mention accounts-2[7] (SMA-2) also increased sharply by 56.5 per cent during the same period (Chart 2.9).

Chart 2.8: Share of large borrowers in SCBs' loan portfolio
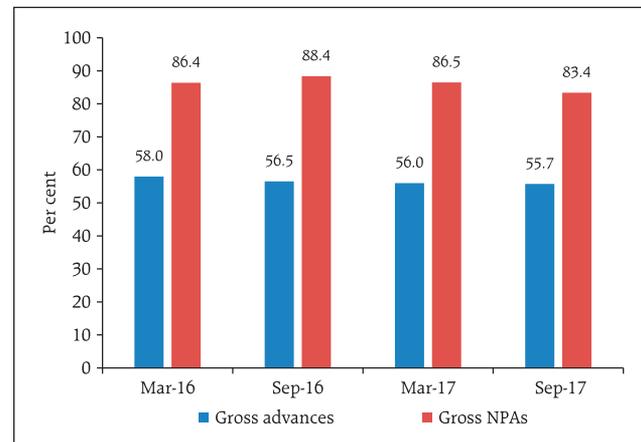
Source: RBI supervisory returns.

Chart 2.9: Percentage change in the asset quality of large borrowers between March and September 2017
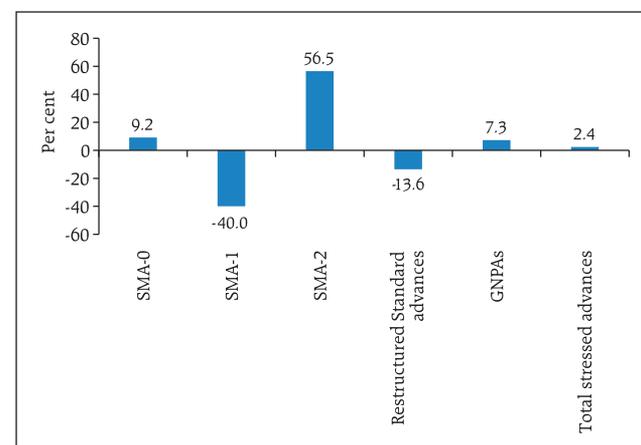
Source: RBI supervisory returns.

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[6] A large borrower is defined as a borrower that has aggregate fund-based and non-fund based exposure of ₹50 million and more for the SCBs.

[7] Before a loan account turns into a NPA, banks are required to identify incipient stress in the account by creating three sub-asset categories of SMAs: i) SMA-0: Principal or interest payment not overdue for more than 30 days but account showing signs of incipient stress, ii) SMA-1: Principal or interest payment overdue between 31-60 days, and iii) SMA-2: Principal or interest payment overdue between 61-90 days.

Chart 2.10: GNPA and SMA-2 ratios of large borrowers

(per cent of gross advances)


a. GNPA ratio

b. SMA-2 ratio
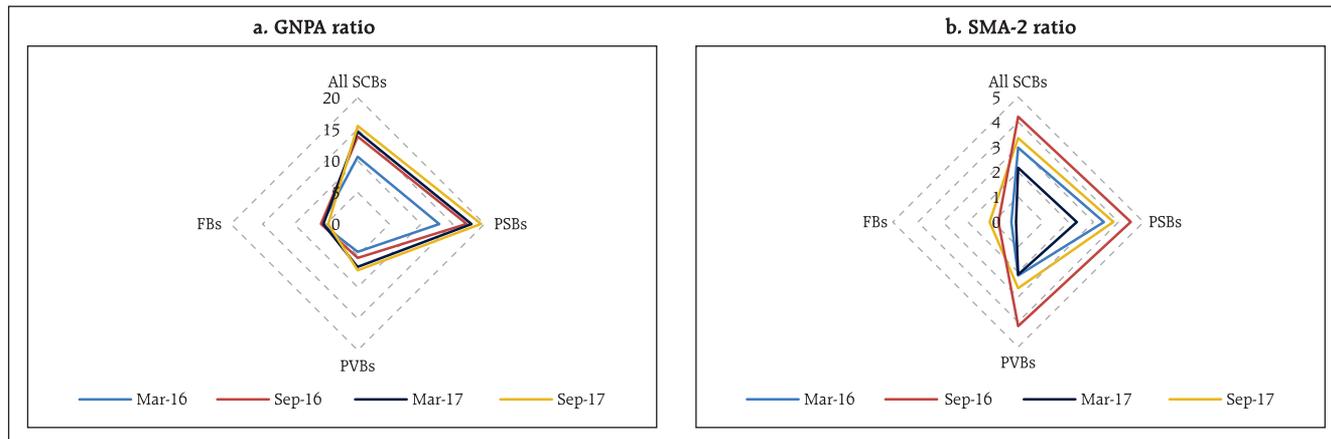
Source: RBI supervisory returns.

2.12   The GNPA ratio of large borrowers increased from 14.6 per cent to 15.5 per cent between March and September 2017. The GNPA ratios went up for both PSBs and PVBs, whereas, the same came down for foreign banks (FBs) (Chart 2.10).

2.13   The share of standard advances (excluding restructured standard advances) in total funded amount outstanding of large borrowers declined from 80.9 per cent to 80.6 per cent between March and September 2017. The top 100 large borrowers (in terms of outstanding funded amounts) accounted for 15.5 per cent of credit and 25.0 per cent of GNPAs of SCBs (Chart 2.11 and 2.12).

Chart 2.11: Composition of total funded amount outstanding of large borrowers
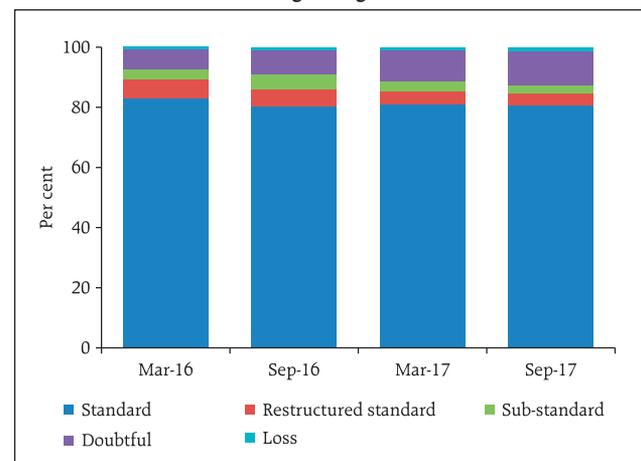
Source: RBI supervisory returns.

Chart 2.12: Fund based exposure of SCBs to large borrowers (LBs)-Share of top 100
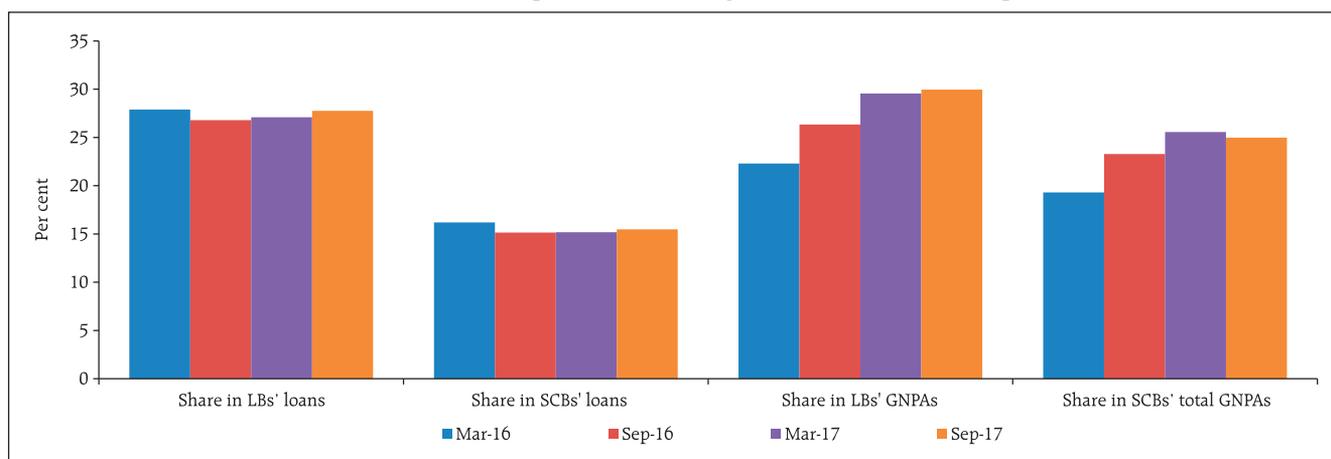
Source: RBI supervisory returns.

Asset quality vis-à-vis capital adequacy of SCBs

2.14   Banks which have relatively lower asset quality, also tend to have lower capital adequacy as shown by the negative correlation between CRAR and the stressed advances ratio. This negative association between asset quality and capital adequacy which

was low at (-)0.18 in March 2011 increased sharply to (-)0.74 by September 2017 (Chart 2.13).

2.15   While assessing the risk absorbing capacity of banks, it was found that all PSBs and some PVBs had a negative provisioning gap assuming a benchmark provision coverage (PC) at 50 per cent.[8]

Chart 2.13: Asset quality and capital adequacy
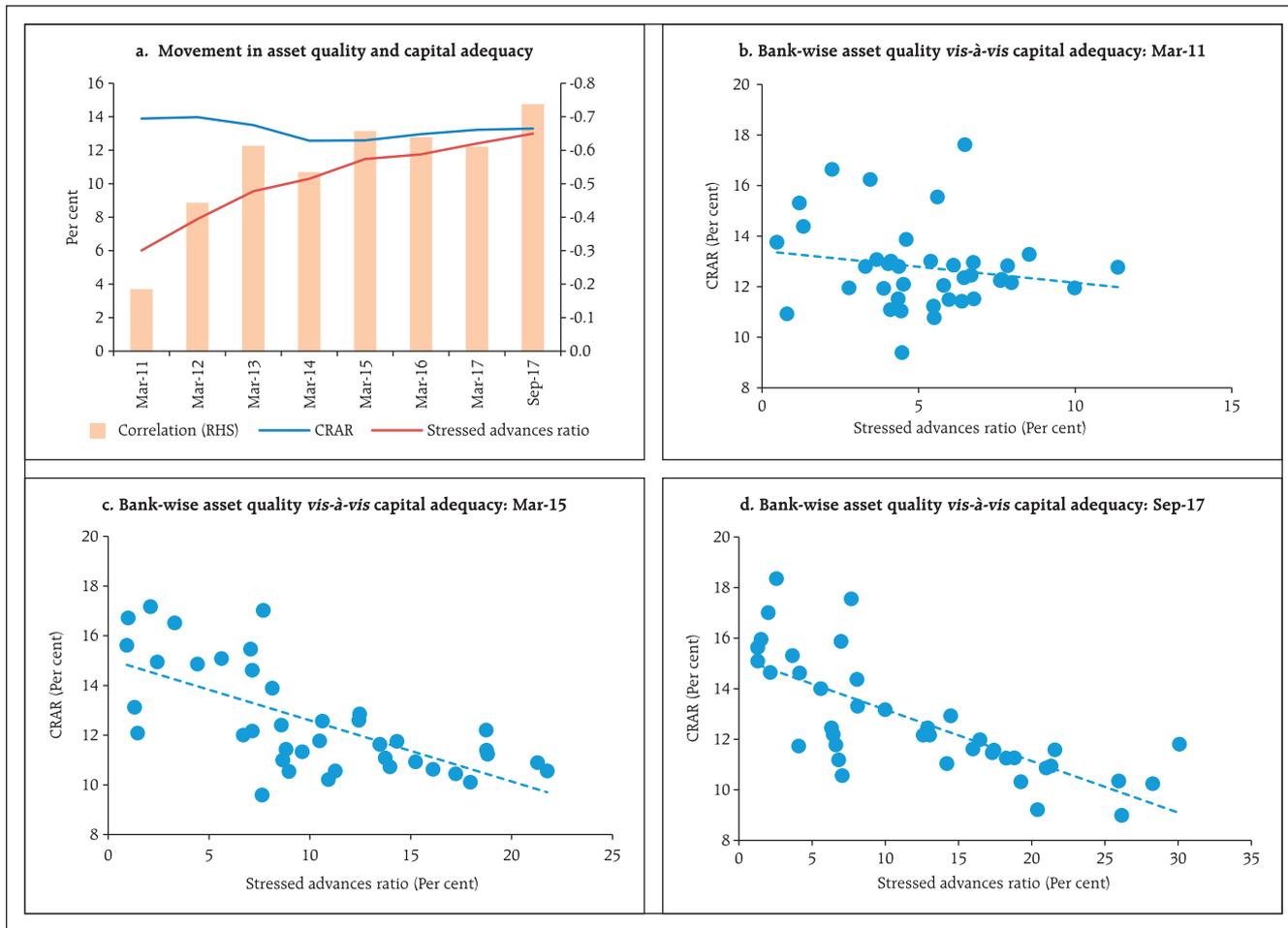
Note: 1)   Based on public and private sector banks only.
        2)   Correlation is calculated between bank-wise stressed advances ratio and CRAR.
Source: RBI supervisory returns.

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[8] Provisioning gap is defined as actual PC minus target PC. The actual PC is calculated as the ratio of (GNPAs minus NNPAs) to stressed advances. Target (benchmark) PC is assumed to be 50 per cent. The negative gap for a bank indicates that the actual provision maintained by the bank is less than the target provisions, *i.e.*, the bank will require to increase its provisioning levels.

In addition, negative returns on the assets of under-provisioned PSBs may hinder their ability to further build-up their loss absorption capacity (Chart 2.14).

Profitability

2.16   SCBs' return on assets (RoA) remained unchanged at 0.4 per cent between March and September 2017 while their return on equity (RoE) declined from 4.3 per cent to 4.2 per cent. PSBs have continued to record negative profitability ratios since March 2016 (Chart 2.15).

Risks

Banking stability indicator

2.17   The banking stability indicator (BSI)[9] shows that the risks to the banking sector remain at an

Chart 2.14: Provisioning gap and profitability – September 2017
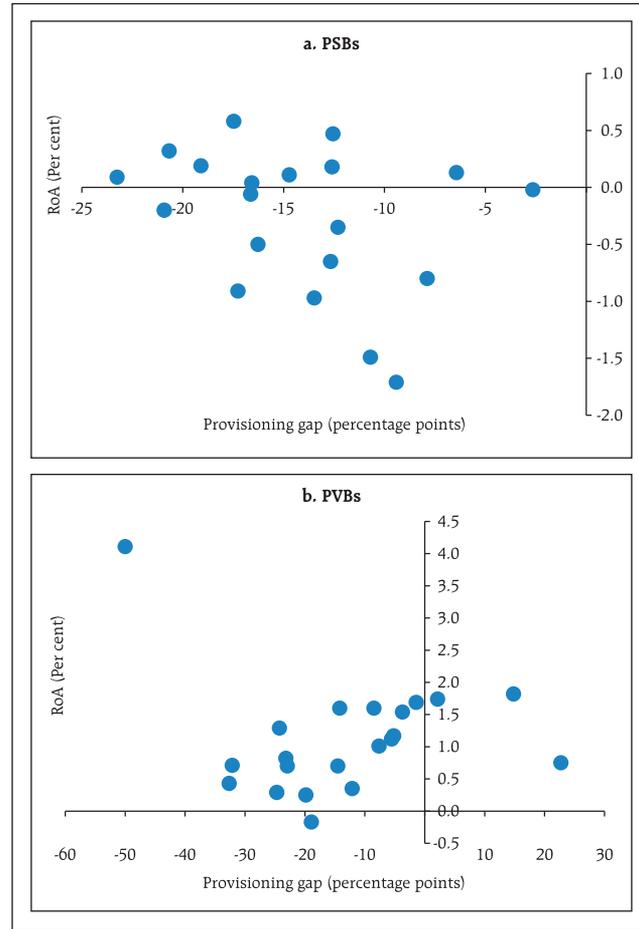
Source: RBI supervisory returns.

Chart 2.15: Profitability
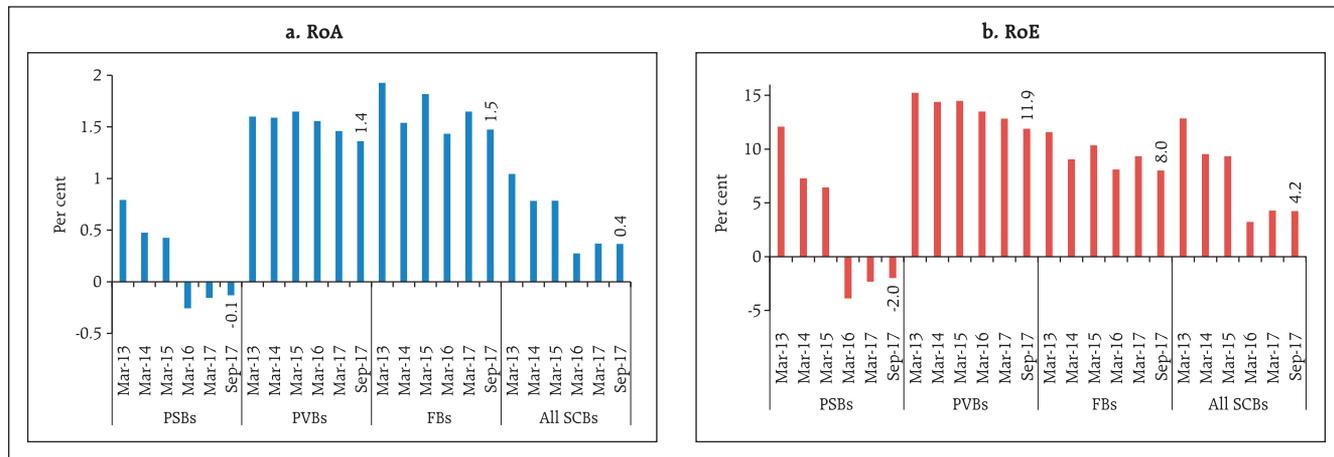
Note: RoA and RoE are annual/annualised number.
Source: RBI supervisory returns.

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[9] The detailed methodology and basic indicators used under different BSI dimensions are given in Annex-2.

elevated level weighed down by further asset quality deterioration (Charts 2.16 and 2.17).

Resilience – Stress tests

Macro stress test – Credit risk

2.18   The Indian banking system's resilience to macroeconomic shocks was tested through a macro stress test for credit risk. This test assumed baseline and two (medium and severe) adverse macroeconomic risk scenarios (Chart 2.18). The adverse scenarios were derived based on standard deviations in the historical values of the macroeconomic variables: up to 1 standard deviation (SD) for medium risk and 1.25 to 2 SD for severe risk (10-year historical data).

2.19   The stress test indicated that under the baseline scenario, the GNPA ratio of all SCBs may increase from 10.2 per cent in September 2017 to 10.8 per cent by March 2018 and further to 11.1 per cent by September 2018. However, if the macroeconomic conditions deteriorate, the GNPA ratio may increase

Chart 2.16: Banking stability indicator
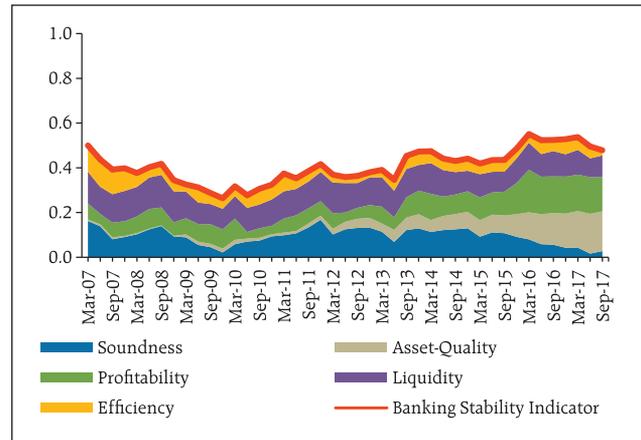
Note: Increase in indicator value shows lower stability. The width of each dimension signifies its contribution towards risk.
Source: RBI supervisory returns and staff calculations.

Chart 2.17: Banking stability map
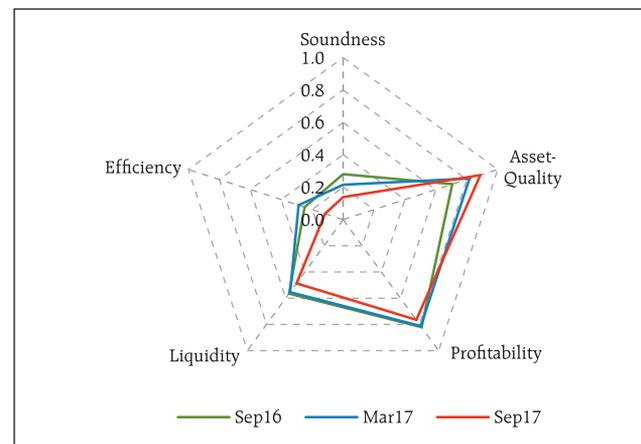
Note: Away from the centre signifies increase in risk. **Source**: RBI supervisory returns and staff calculations.

Chart 2.18: Macroeconomic scenario assumptions[10] **(2017-18 and 2018-19)**
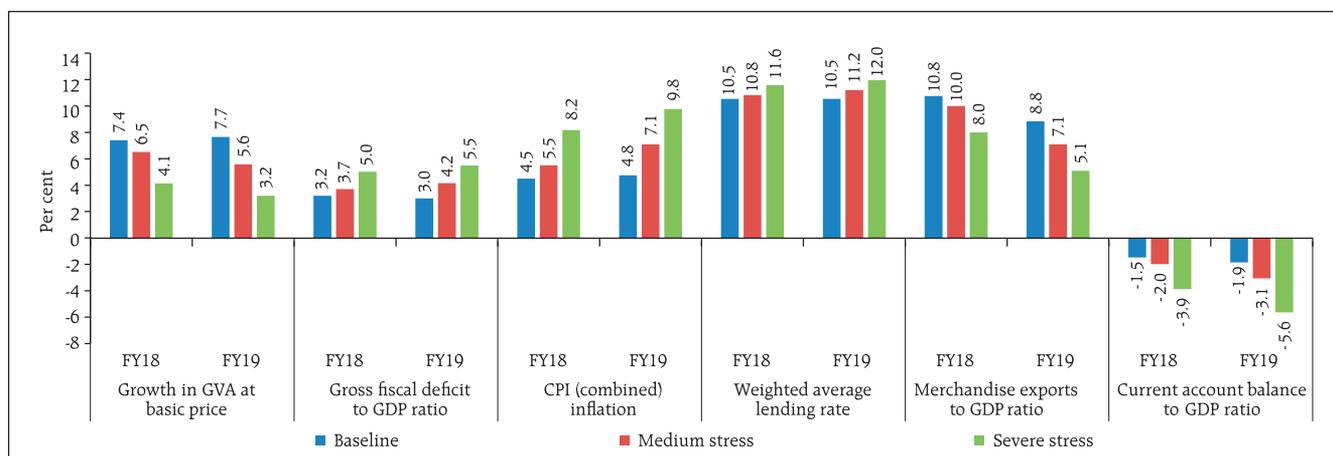
[10] These stress scenarios are stringent and conservative assessments under hypothetical-severely adverse economic conditions and should not be interpreted as forecasts or expected outcomes. For financial year 2017-18 (FY18) the numbers correspond to the last two quarters. For financial year 2018-19 (FY19) the numbers correspond to the first two quarters.

Chart 2.19: Projection of GNPA ratio of SCBs
(under various scenarios)
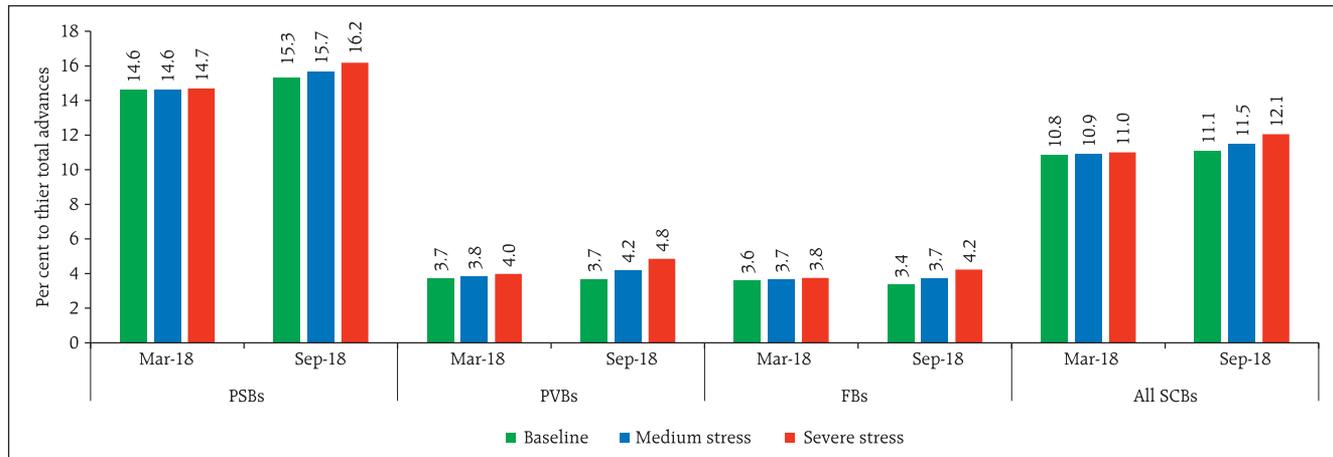
Note: The projection of system level GNPA ratio (55 select banks) has been done using three different, but complementary econometric models: multivariate regression, vector autoregression (VAR) and quantile regression (which can deal with tail risks and takes into account the non-linear impact of macroeconomic shocks). The average GNPA ratio of these three models is given in the chart. However, in the case of bank groups, two models – multivariate regression and VAR are used.
Source: RBI supervisory returns and staff calculations.

further under such consequential stress scenarios (Chart 2.19).

2.20 Under the assumed baseline macro scenario, six banks have CRAR below the minimum regulatory level of 9 per cent by September 2018. However, if the macro conditions deteriorate, CRAR of more banks in the stress test goes below the minimum

regulatory requirements. Under the severe stress scenario, the system level CRAR declines from 13.5 per cent in September 2017 to 11.5 per cent by September 2018. The recent capitalisation plan announced by the GoI for PSBs is expected to significantly augment capital buffers of affected banks as also the credit growth (Chart 2.20).

Chart 2.20: CRAR projections
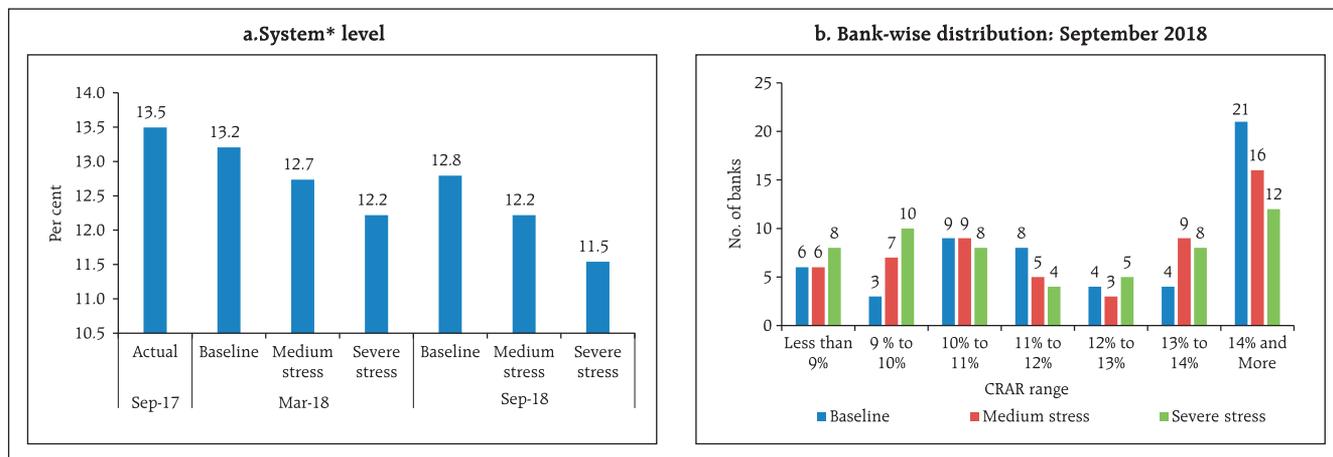
* System of 55 select banks.
Note: The capital projection is made under a conservative assumption of minimum profit transfer to capital reserves at 25 per cent. It does not take into account any capital infusion by stake holders.
Source: RBI supervisory returns and staff calculations.

2.21   Under the severe stress scenario, seven banks have common equity tier (CET) 1 capital to risk-weighted assets ratio below the minimum regulatory required level of 5.5 per cent by September 2018. The system level CET 1 capital ratio declines from 10.2 per cent in September 2017 to 8.7 per cent by September 2018 (Chart 2.21).

Sensitivity analysis: Bank level[11]

2.22   A number of single factor sensitivity stress tests[12] (top-down) were carried out on SCBs[13] to assess their vulnerabilities and resilience under various scenarios[14]. The resilience of SCBs with respect to credit, interest rate, equity prices and liquidity risks was studied through the top-down sensitivity analysis by imparting extreme but plausible shocks. The results are based on September 2017 data.

Credit risk

2.23   A severe credit shock is likely to impact the capital adequacy and profitability of a significant number of banks, mostly PSBs. The impact of various static credit shocks for banks showed that the system level CRAR will remain above the required minimum of 9 per cent. Under a severe shock of 3 SD[15] (that is, if the average GNPA ratio of select SCBs moves up to 16.6 per cent from 10.6 per cent), the system level CRAR and tier-1 CRAR will decline to 10.6 per cent and 8.1 per cent respectively. The capital losses at the system level could be about 23.6 per cent. Reverse stress tests results show that a shock of 4.54 SD would bring down the system level CRAR to 9 per cent. On the other hand, the SCBs would lose their entire profit if the GNPA ratio moves up by 0.77

Chart 2.21: Projection of CET 1 capital ratio
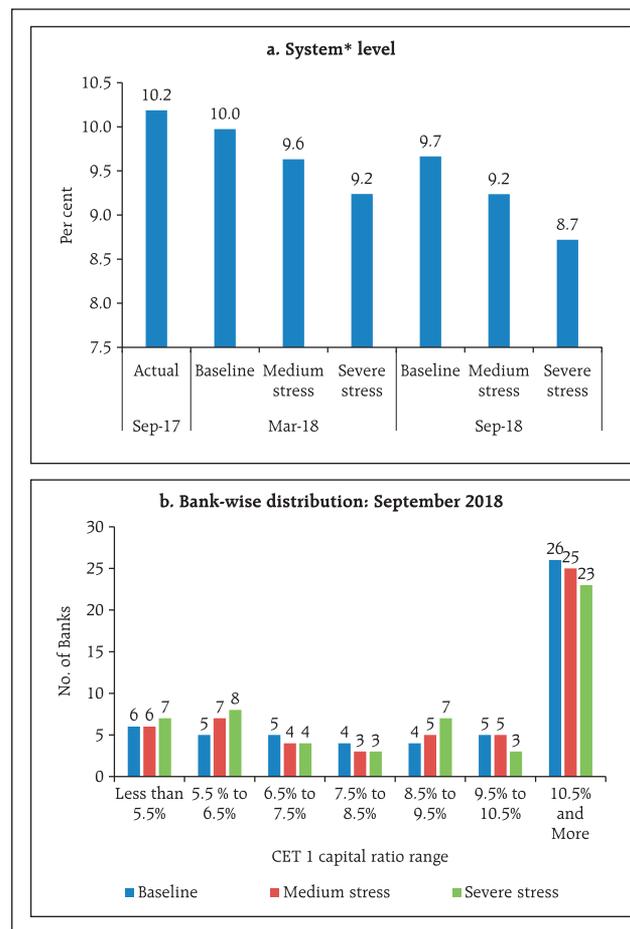
* System of 55 select banks.
Note: The capital projection is made under a conservative assumption of minimum profit transfer to capital reserves at 25 per cent. It does not take into account any capital infusion by stake holders.
Source: RBI supervisory returns and staff calculations.

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[11] The sensitivity analysis was undertaken in addition to macro stress tests for credit risk. While in the former, shocks were given directly to asset quality (GNPAs), in the latter the shocks were in terms of adverse macroeconomic conditions. While the focus of the macro stress tests is credit risk, the sensitivity analysis covered credit, market and liquidity risks.

[12] For details of the stress tests, see Annex-2.

[13] Single factor sensitivity analysis stress tests were conducted for a sample of 54 SCBs (consequent to the merger of State Bank Associates into State Bank of India effective from April 1, 2017) accounting for 99 per cent assets of the total banking sector.

[14] The shocks designed under various hypothetical scenarios are extreme but plausible.

[15] The standard deviation (SD) of the GNPA ratio is estimated using quarterly data since 2004. One SD shock approximates a 19 per cent increase in GNPAs in one quarter.

Chart 2.22: Credit risk – shocks and impacts

a. System Level

b. Bank Level
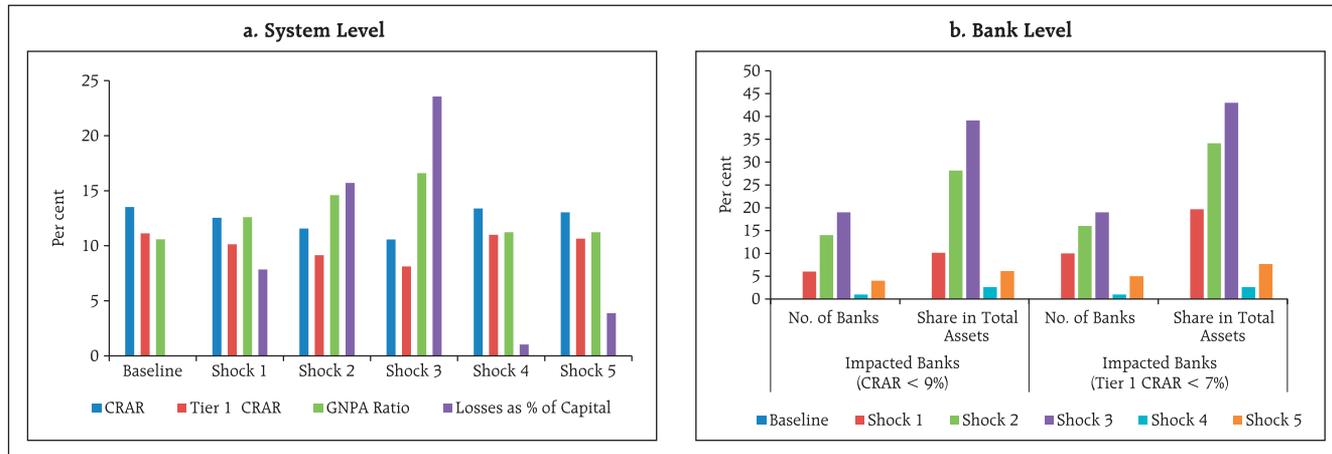
Shock 1: 1 SD shock on GNPAs
Shock 2: 2 SD shock on GNPAs
Shock 3: 3 SD shock on GNPAs
Shock 4: 30 per cent of restructured advances turn into GNPAs (sub-standard category)
Shock 5: 30 per cent of restructured advances turn into GNPAs (loss category) – written off
Note: System of select 54 SCBs.
Source: RBI supervisory returns and staff calculations.

SD to 12.1 per cent. At the individual bank-level, the stress test results show that 19 banks having a share of 39.1 per cent of SCBs' total assets fail to maintain the required CRAR under the shock of a 3 SD increase in GNPAs. PSBs were found to be severely impacted with the CRAR of 17 PSBs going down below 9 per cent (Charts 2.22 and 2.23).

Credit concentration risk

2.24   Stress tests on banks' credit concentration risks, considering top individual borrowers according to their stressed advances showed that the impact[16] (under three different scenarios) was significant for nine banks, comprising about 15 per cent of the assets. These banks fail to maintain a 9 per cent CRAR in at least one of the scenarios. The impact could be 87 per cent of the profit before tax (PBT) under the scenario of a default by the topmost stressed borrower. The impact[17] on CRAR at the system level under the assumed scenarios of failure

Chart 2.23: CRAR-wise distribution of banks
(under a 3 SD shock on the GNPA ratio)
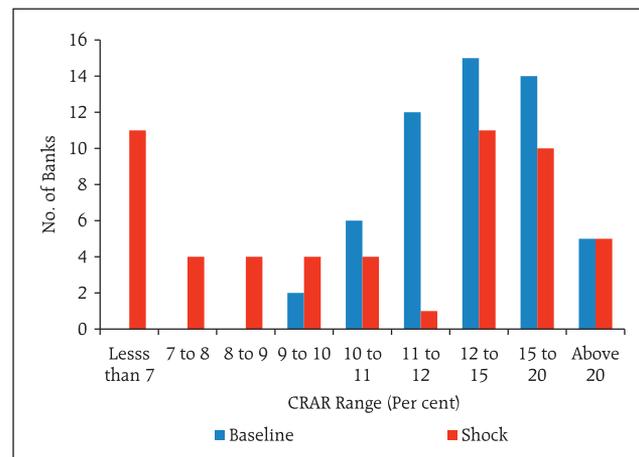
Note: System of select 54 SCBs.
Source: RBI Supervisory returns and staff calculations.

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[16] In case of failure, the borrower is considered to move into the loss category. Please see Annex-2 for details.

[17] Impact is calculated as the difference between baseline CRAR and the stressed CRAR under assumed shock scenarios.

Chart 2.24: Credit concentration risk: Individual borrowers – Stressed advances
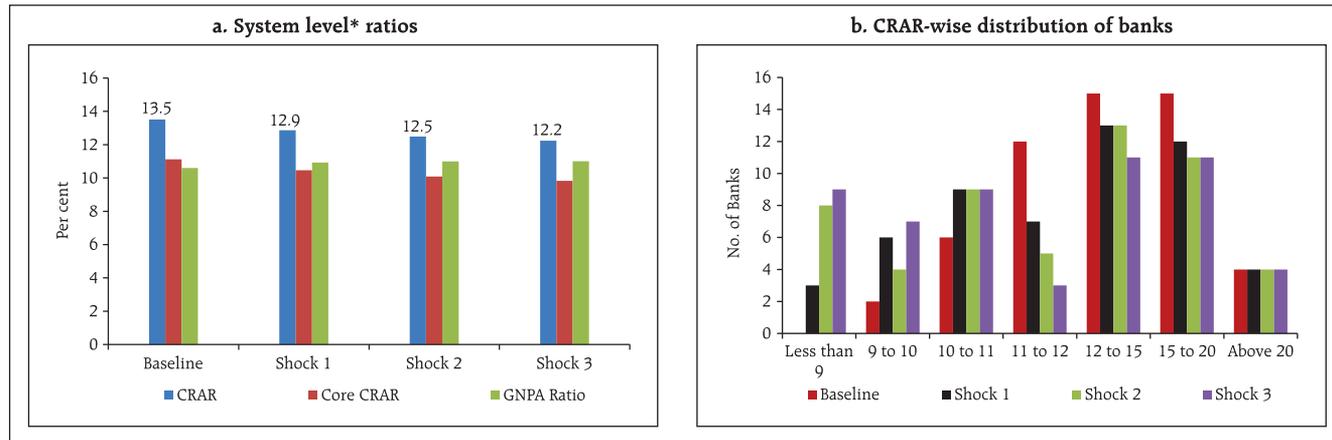
Shock 1: Top stressed individual borrower defaults
Shock 2: Top two stressed individual borrowers default
Shock 3: Top three stressed individual borrowers default
Note: * System of select 54 SCBs.
Source: RBI supervisory returns and staff calculations.

of the top one, two and three stressed borrowers will be 64, 102 and 127 basis points (Chart 2.24).

2.25 Stress tests on banks' credit concentration risks, considering top individual borrowers according to their exposure, showed that the impact[18] (under three different scenarios) was significant for one bank, accounting for about 2.6 per cent of total assets, which fail to maintain the mandated 9 per cent CRAR. The losses could be 45 per cent of PBT under the scenario of a default by the topmost

individual borrower of each bank. There will be a complete erosion of the profits of the banking sector under the scenario of a default by the topmost 3 borrowers of each bank. The impact on CRAR at the system level under the assumed scenario of default by the top three individual borrowers of each bank (shock 3) will be around 77 basis points (Chart 2.25).

2.26 Stress tests on credit concentration risks on account of assumed failure of group borrowers show that the losses could be around 6 per cent of

Chart 2.25: Credit concentration risk: Individual borrowers – Exposure
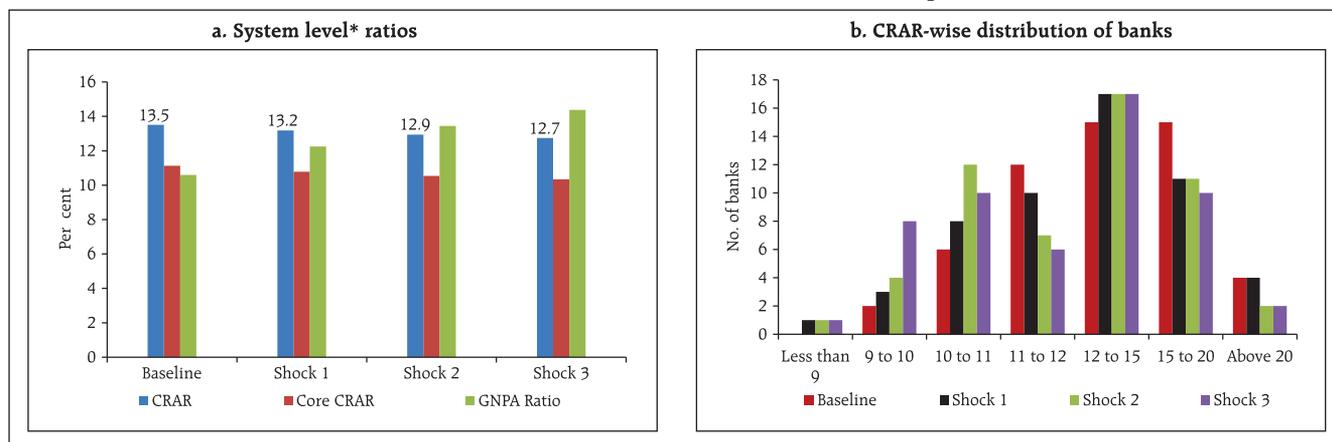
Shock 1: Top individual borrower defaults
Shock 2: Top two individual borrowers default
Shock 3: Top three individual borrowers default
Note: * System of select 54 SCBs.
**Source:** RBI supervisory returns and staff calculations.

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[18] In case of default, the borrower is considered to move into the sub-standard category. Please see Annex-2 for details.

Table 2.1: Credit concentration risk: Group borrowers – Exposure

Shocks	System level*				Bank level	
	CRAR	Core CRAR	GNPA ratio	Losses as % of Capital	Impacted Banks (CRAR < 9%)	
Baseline (Before shock)	13.5	11.1	10.6	---	No. of Banks	Share in Total Assets of SCBs (in %)
Shock 1 The top 1 group borrower defaults	12.7	10.3	14.4	6.3	2	4.2
Shock 2 The top 2 group borrowers default	12.1	9.7	17.3	11.1	4	7.1
Shock 3 The top 3 group borrowers default	11.6	9.2	19.8	15.1	6	11.4

Note: * System of select 52 SCBs.
**Source:** RBI supervisory returns and staff calculations

the aggregated capital of banks under the assumed scenarios of default[19] by the top group borrower. The losses could be about 11 per cent in case of default by the top 2 group borrowers. As many as six banks will not be able to maintain their CRAR at 9 per cent if top 3 group borrowers of each individual bank default (Table 2.1).

Sectoral credit risk

2.27   Credit risk arising from exposure to the infrastructure sector (specifically power, transport and telecommunications) was examined through a sectoral credit stress test where the GNPA ratio of the sector was assumed to increase by a fixed percentage point impacting the overall GNPA ratio of the banking system. The results show that shocks to the infrastructure segment will considerably impact the profitability of banks, with the most severe shocks (15 per cent of restructured standard advances and 10 per cent of standard advances becoming NPAs and moving to the sub-standard category) wiping out about 87 per cent of the profits. The most significant effect of the single factor shock appears to be on the power sector (Chart 2.26).

Chart 2.26: Sectoral credit risk: Infrastructure – shocks and impacts
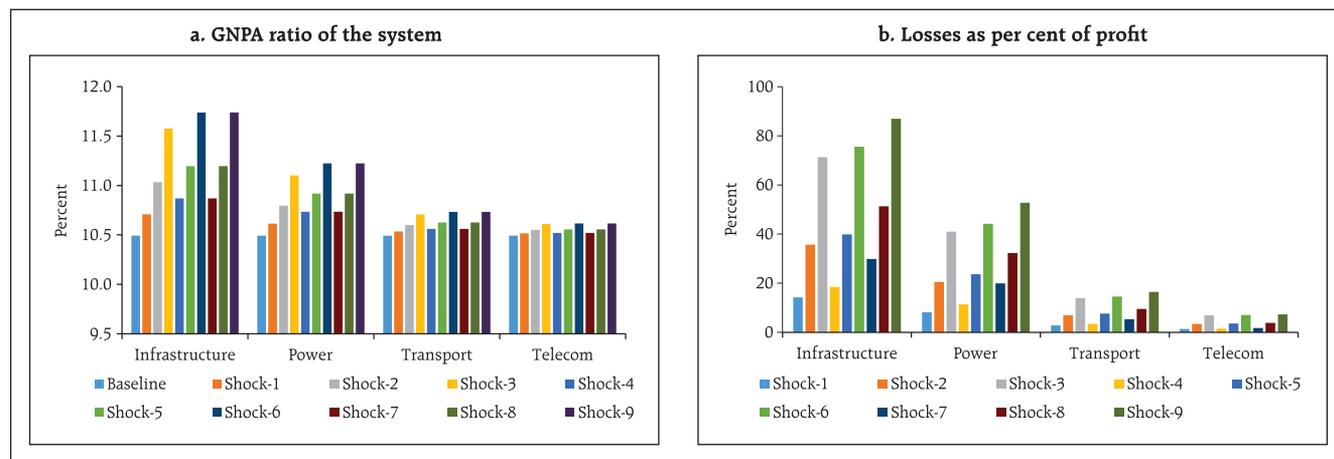
Note: 1. A system of select 54 SCBs.
2. Shock assumes percentage increase in the sectoral NPA ratio and conversion of a portion of restructured standard advances into NPAs.

Shocks	Shock-1	Shock-2	Shock-3	Shock-4	Shock-5	Shock-6	Shock-7	Shock-8	Shock-9
Shock on Restructured Standard Advances &	0			15			15		
Shock on other Standard Advances #	2	5	10	2	5	10	2	5	10

& Shocks 1-3: No shock on restructured standard advances,
Shocks 4-6: Restructured standard advances to sub-standard category,
Shocks 7-9: Restructured standard advances to loss category.
The new NPAs arising out of standard advances (other than restructured standard advances) are assumed to be distributed among different asset classes (following the existing pattern) in the shock scenario.
Source: RBI supervisory returns and staff calculations.

[19] In case of default, the borrower is considered to move into the sub-standard category. Please see Annex-2 for details.

Interest rate risk

2.28   For investments under available for sale (AFS) and held for trading (HFT) categories (direct impact) a parallel upward shift of 2.5 percentage points in the yield curve will lower CRAR by about 123 basis points at the system level (Table 2.2). At the disaggregated level, four banks accounting for 5.3 per cent of the total assets were impacted adversely and their CRAR fell below 9 per cent. The total loss of capital at the system level is estimated to be about 10.3 per cent. The assumed shock of a 2.5 percentage points parallel upward shift of the yield curve on the held to maturity (HTM) portfolios of banks, *if marked-to-market*, reduces the CRAR by about 280 basis points resulting in 19 banks' CRAR falling below 9 per cent.

Equity price risk

2.29   Under the equity price risk, the impact of a shock due to fall in the equity prices on bank capital and profit was examined. The system-wide CRAR declines by 41 basis points from the baseline under the scenario of 55 per cent drop in equity prices (Chart 2.27). At the individual bank-level, CRAR of only one bank falls marginally below 9 per cent, while two banks, accounting for 4.4 per cent of the total assets, have their tier 1 CRAR below the regulatory mandate of 7 per cent. Stressed profit of five banks turns negative.

Liquidity risk: Impact of deposit run-off on liquid stocks

2.30   The liquidity risk analysis captured the impact of deposit run-off and increased demand for the unutilised portions of credit lines which were sanctioned/committed/guaranteed. Banks, in general, are in a position to withstand liquidity shocks with their high quality liquid assets (HQLA)[20]. In assumed

Table 2.2: Interest rate risk – Bank groups – shocks and impacts
(under a shock of 250 basis points parallel
upward shift of the INR yield curve)

(per cent)

	Public sector banks		Private sector banks		Foreign banks		All SCBs	
	AFS	HFT	AFS	HFT	AFS	HFT	AFS	HFT
Modified duration	3.5	6.1	2.0	1.6	1.4	2.0	1.4	2.0
Share in total investments	41.9	0.3	32.6	5.1	91.0	9.8	42.5	2.1
Reduction in CRAR (bps)	165		53		116		123	

Source: RBI supervisory returns and staff calculations.

Chart 2.27: Equity price risk
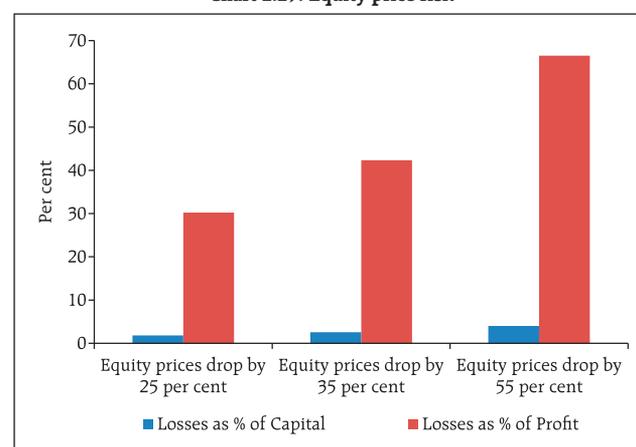
Note: A system of select 54 SCBs.
Source: RBI supervisory returns and staff calculations.

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[20] In view of the implementation of the liquidity coverage ratio (LCR) with effect from January 1, 2015 in India, the definition of liquid assets was revised for stress testing. For this stress testing exercise, HQLAs were computed as cash reserves in excess of required CRR, excess SLR investments, SLR investments at 2 per cent of NDTL (under MSF) and additional SLR investments at 9 per cent of NDTL (following the circular DBR.BP.BC 52/21.04.098/2014-15 dated November 28, 2014 and DBR.BP.BC.No. 2/21.04.098/2016-17 dated July 21, 2016).

scenarios, there will be increased withdrawals of un-insured deposits[21]. Simultaneously, there will also be increased demand for credit resulting in an attempt to withdraw unutilised portions of sanctioned working capital limits as well as utilisation of credit commitments and guarantees extended by banks to their customers.

2.31   Using their HQLAs required for meeting day-to-day liquidity requirements, most banks (49 out of the 54 banks in the sample) remain resilient in a scenario of assumed sudden and unexpected withdrawals of around 12 per cent of deposits along with the utilisation of 75 per cent of their committed credit lines (Chart 2.28).

**Stress testing the derivatives portfolio of banks:
Bottom-up stress tests**

2.32   A series of bottom-up stress tests (sensitivity analysis) on derivative portfolios were conducted for select sample banks[22] with the reference date as September 30, 2017. The shocks on interest rates ranged from 100 to 250 basis points, while 20 per cent appreciation/depreciation shocks were assumed for foreign exchange rates. The stress tests were carried out for individual shocks on a stand-alone basis.

2.33   In the sample, the derivatives portfolio for most of the PSBs and PVBs (barring one bank) registered small marked-to-market (MTM) values, while FBs had a relatively large positive as well as negative MTM. Most of the PSBs and PVBs had positive net MTM, while most of the FBs recorded negative net MTM (Chart 2.29).

Chart 2.28: Liquidity risk – Shocks and impacts
(using HQLAs for liquidity support)

- Liquid assets available to the system (per cent of total assets)
- Share of assets of failed banks in stress scenario to total assets of SCBs
- Number of banks which failed the test (Out of select 54)
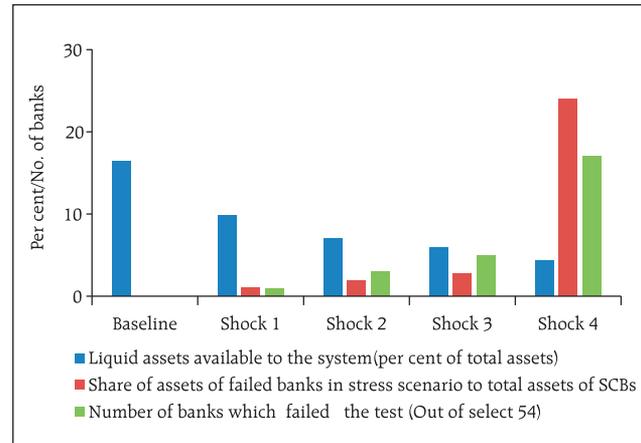
Note: 1. A bank was considered 'failed' in the test when it was unable to meet the requirements under stress scenarios (on imparting shocks) with the help of its liquid assets (stock of liquid assets turned negative under stress conditions).
2. Shocks: Liquidity shocks include a demand for 75 per cent of the committed credit lines (comprising unutilised portions of sanctioned working capital limits as well as credit commitments towards their customers) and also a withdrawal of a portion of un-insured deposits as given below:

Shock	1	2	3	4
Per cent withdrawal of un-insured deposits	5	10	12	15

Source: RBI supervisory returns and staff calculations.

Chart 2.29: MTM of total derivatives- Select banks – September 2017

- Positive MTM   - Negative MTM   - Net MTM (RHS)
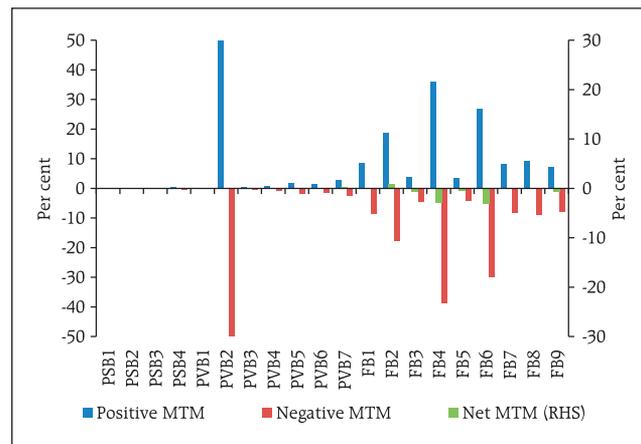
Note: PSB: Public sector bank, PVB: Private sector bank, FB: Foreign bank.
Source: Sample banks (Bottom-up stress tests on derivatives portfolio).

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[21] Presently un-insured deposits are about 70 per cent of total deposits (Source: DICGC, *Handbook of Statistics on the Indian Economy*).

[22] Stress tests on derivatives portfolios were conducted for a sample of 20 banks. Details are given in Annex-2.

2.34 The stress test results show that the average net impact of interest rate shocks on sample banks was negligible. The results of foreign exchange shock scenarios show that the effect of a shock seemed to be normalising in September 2017 after a previous spike (Chart 2.30).

Section II

Scheduled urban co-operative banks

Performance

2.35 At the system level,[23] the CRAR of scheduled urban co-operative banks (SUCBs) declined maginally from 13.7 per cent in March 2017 to 13.6 per cent in September 2017. However, at a disaggregated level, CRAR of five banks was below the minimum required level of 9 per cent. GNPAs of SUCBs as a percentage of gross advances increased from 6.9 per cent to 8.5 per cent. Their provision coverage ratio[24] (PCR) decreased from 55.3 per cent to 47.1 per cent. RoA increased from 0.7 per cent to 0.9 per cent. Liquidity ratio[25] declined marginally from 35.9 per cent to 35.7 per cent (Table 2.3).

Resilience – Stress tests

Credit risk

2.36 The impact of credit risk shocks on the CRAR of SUCBs was observed under four different scenarios.[26] The results show that under a severe shock, which assumes increase in GNPAs by 2 SD (and turning into loss advances), the system level CRAR of SUCBs comes down below the minimum regulatory requirement. At an individual level, a larger number of banks (39 out of 54) are not able to maintain the minimum CRAR.

Chart 2.30: Stress tests – Impact of shocks on derivative portfolio of select banks
(change in net MTM on application of a shock)
(per cent to capital funds)
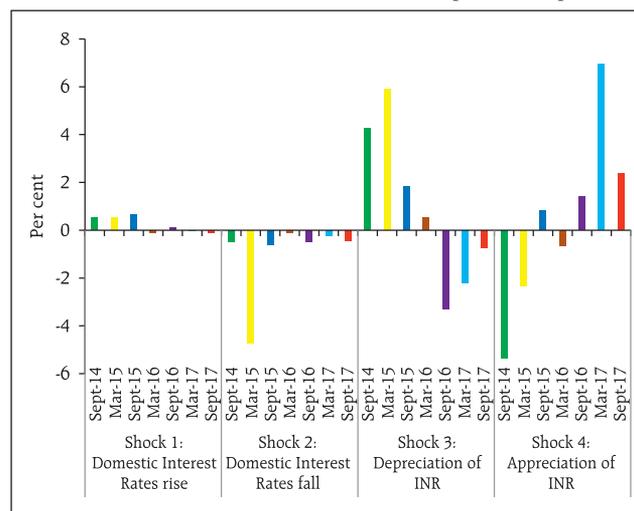
Note: Change in net MTM due to an applied shock with respect to the baseline.
Source: Sample banks (Bottom-up stress tests on derivative portfolio).

Table 2.3: Select financial soundness indicators of SUCBs
(per cent)

Financial soundness indicators	Mar 2017	Sep 2017
1. CRAR	13.7	13.6
2. Gross NPAs to gross advances	6.9	8.5
3. Return on assets (annualised)	0.7	0.9
4. Liquidity ratio	35.9	35.7
5. PCR	55.3	47.1

Source: RBI supervisory returns.

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[23] System of 54 SUCBs.

[24] PCR is compiled as "NPA provisions held as % of Gross NPAs".

[25] Liquidity ratio = 100 * (Cash + due from banks + SLR investments) / Total assets.

[26] The four scenarios are: i) 1 SD shock on GNPAs (classified into sub-standard advances), ii) 2 SD shock on GNPAs (classified into sub-standard advances), iii) 1 SD shock on GNPAs (classified into loss advances), and iv) 2 SD shock on GNPAs (classified into loss advances). SD was estimated using 10 years data. For details of the stress tests, see Annex-2.

Liquidity risk

2.37   A stress test on liquidity risk was carried out for 54 SUCBs using two different scenarios: i) 50 per cent and ii) 100 per cent increase in cash outflows, in one to 28 days' time bucket. It was further assumed that there was no change in cash inflows under both the scenarios. The stress test results indicate that 22 banks in the first scenario and 40 banks in the second scenario are significantly impacted.

Section III

Non-banking financial companies

2.38   As of September 2017, there were 11,469 non-banking financial companies (NBFCs) registered with the Reserve Bank, of which 172 were deposit-accepting (NBFCs-D). There were 220 systemically important non-deposit accepting NBFCs (NBFCs-ND-SI).[27] All NBFCs-D and NBFCs-ND-SI are subjected to prudential regulations such as capital adequacy requirements and provisioning norms along with reporting requirements.

Performance

2.39   The aggregate balance sheet size of the NBFC[28] sector was at ₹13.8 trillion in September 2017, expanding by 15.6 per cent, as compared to ₹11.9 trillion in September 2016. Loans and advances increased by 15.7 per cent, whereas, investments increased by 15.8 per cent (Table 2.4).

2.40   Net profit increased by 4.7 per cent in September 2017 (y-o-y). RoA was at 1.9 per cent in September 2017 (Table 2.5).

Asset quality and capital adequacy

2.41   GNPAs of the NBFC sector as a percentage of total advances increased from 4.4 per cent in March 2017 to 4.9 per cent in September 2017. NNPAs as a percentage of net advances also increased from 2.2 per cent to 2.4 per cent between March and September 2017 (Chart 2.31).

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[27] NBFCs-ND-SIs are NBFCs-ND with assets of ₹5 billion and above.

[28] Excluding Government owned NBFCs.

Table 2.4: Aggregated balance sheet of NBFC sector: y-o-y growth

(per cent)

	Mar-17	Sep -17
1. Share capital	15.2	8.8
2. Reserves and surplus	12.2	18.1
3. Total borrowings	15.0	15.1
4. Current liabilities and provisions	16.0	26.7
Total Liabilities / Assets	**14.5**	**15.6**
1. Loans and advances	16.4	15.7
2. Investments	11.9	15.8
3. Others	7.9	15.2
Income/Expenditure		
1. Total income	8.9	15.3
2. Total expenditure	9.6	18.1
3. Net profit	-2.9	4.7

Source: RBI supervisory returns.

Table 2.5: Select ratios of NBFC sector

(per cent)

	Mar-17	Sep-17
1. Capital market exposure (CME) to total assets	7.8	10.8
2. Real Estate Exposure (REE) to total assets	5.6	9.0
3. Leverage ratio	2.8	3.0
4. Net Profit to total income	14.0	14.8
5. RoA	1.8	1.9
6. RoE	6.8	7.6

Source: RBI supervisory returns.

Chart 2.31: Asset quality and capital adequacy of the NBFC sector

Source: RBI supervisory returns.

2.42   As per extant guidelines, NBFCs[29] are required to maintain a minimum capital consisting of tier 1[30] and tier 2 capital, of not less than 15 per cent of their aggregate risk-weighted assets. CRAR of NBFCs decreased from 22.8 per cent in March 2017 to 22.5 per cent in September 2017 (Chart 2.31).

Resilience – Stress tests

System level

2.43   Stress test on credit risk for NBFCs[31] is carried out for the period ended September 2017 under three scenarios: increase in GNPAs by (i) 0.5 SD, (ii) 1 SD and (iii) 3 SD. The results indicate that in the first scenario, the sector's CRAR declines marginally to 22.4 per cent from 22.5 per cent. In the second scenario, the CRAR goes down to 22.3 per cent and in the third scenario, it declines to 21.9 per cent.

Individual NBFCs

2.44   The stress test results for individual NBFCs indicate that under scenarios (i) and (ii), around 7 per cent of the companies are not able to comply with the minimum regulatory capital requirements of 15 per cent. Around 10 per cent of the companies are not able to comply with the minimum regulatory CRAR norm under the third scenario.

Section IV

Interconnectedness[32]

Inter-bank[33] **market**

2.45   The inter-bank market is a major source of funding for banking institutions, though its size decreased from around ₹8 trillion in March 2017 to ₹7 trillion in September 2017. The inter-bank market continued to be predominantly fund-based (close to 86 per cent of total exposure) and constituted nearly 5.3 per cent of the total assets of the banking system in September 2017 (Chart 2.32).

Chart 2.32: Inter-bank market
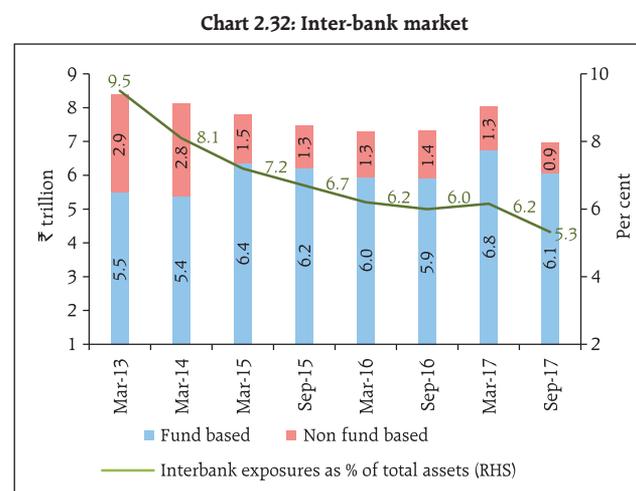
Source: RBI supervisory returns and staff calculations.

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[29] Deposit taking NBFCs and non-deposit taking NBFCs having asset size of ₹ 5 billion and above are included.

[30] As per the revised guidelines issued on November 10, 2014, minimum tier 1 capital for NBFCs-ND-SI (having asset size of ₹ 5 billion and above) and all deposit taking NBFCs was revised up to 10 per cent (earlier tier 1 capital could not be less than 7.5 per cent) and these entities were required to meet compliance in a phased manner: 8.5 per cent by end-March 2016 and 10 per cent by end-March 2017).

[31] NBFCs-D and NBFCs-ND-SI are considered for the stress tests.

[32] The network model used in the analysis has been developed by Professor Sheri Markose (University of Essex) and Dr. Simone Giansante (Bath University) in collaboration with the Financial Stability Unit, Reserve Bank of India.

[33] The analysis is restricted to 80 SCBs for data pertaining to end-September 2017.The inter-bank as connoted in the current analysis is a total of all outstanding exposures, short-term plus long-term between banks.

2.46   PSBs continued to be the biggest player in the inter-bank market with a share of 62 per cent followed by PVBs at 26 per cent and FBs at 12 per cent (Chart 2.33).

2.47   A substantial portion of fund based exposure in the inter-bank[34] market is short-term in nature. The composition of short-term (ST) fund based inter-bank exposure shows that the highest share was of short-term deposits followed by short-term loans in September 2017. Similarly, composition of long-term (LT) fund based inter-bank exposure shows highest share of loans and advances followed by long-term deposits and long-term debt instruments (Chart 2.34).

Chart 2.33: Share of different bank groups in the inter-bank market

Source: RBI supervisory returns and staff calculations.

Network structure and connectivity

2.48   The network structure[35] of the banking system[36], which is tiered in nature, reveals that the number of dominant banks declined from nine to
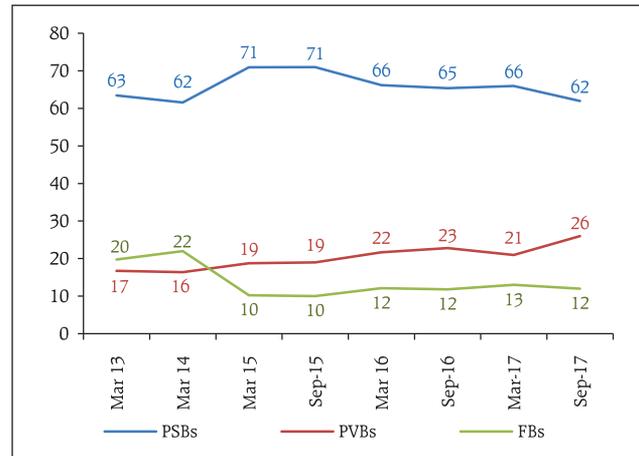
**Chart 2.34: Composition of the fund based inter-bank market – September 2017**
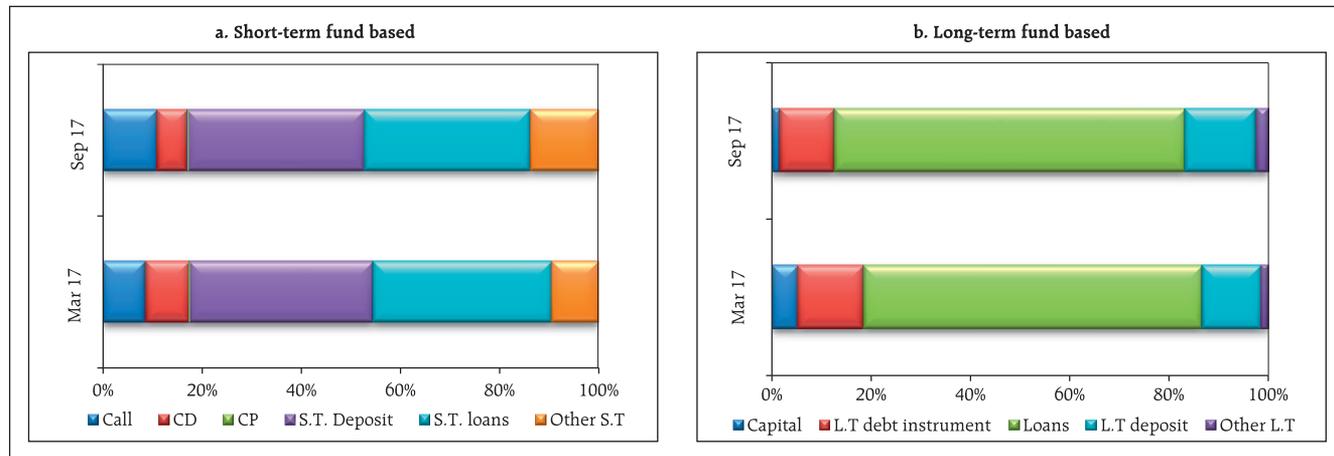
Source: RBI supervisory returns and staff calculations

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[34] A revised data reporting format was introduced in December 2016 to capture more granular information on fund based activities and reducing the others categories. Therefore, the September 2017 data classification is not strictly comparable with the period earlier than December 2016.

[35] The diagrammatic representation of the network of the banking system is that of a tiered structure, where different banks have different degrees or levels of connectivity with others in the network. In the present analysis, the most connected banks are in the inner most core (at the centre of the network diagram). Banks are then placed in the mid core, outer core and the periphery (the respective concentric circles around the centre in the diagram), based on their level of relative connectivity. The colour coding of the links in the tiered network diagram represents the borrowing from different tiers in the network (for example, the green links represent borrowings from the banks in the inner core). Each ball represents a bank and they are weighted according to their net positions vis-à-vis all other banks in the system. The lines linking each bank are weighted on the basis of outstanding exposures.

[36] SUCBs have been included along with SCBs in the network diagram for the first time.

Chart 2.35: Network structure of the Indian banking system (SCBs + SUCBs)
**(September 2017)**
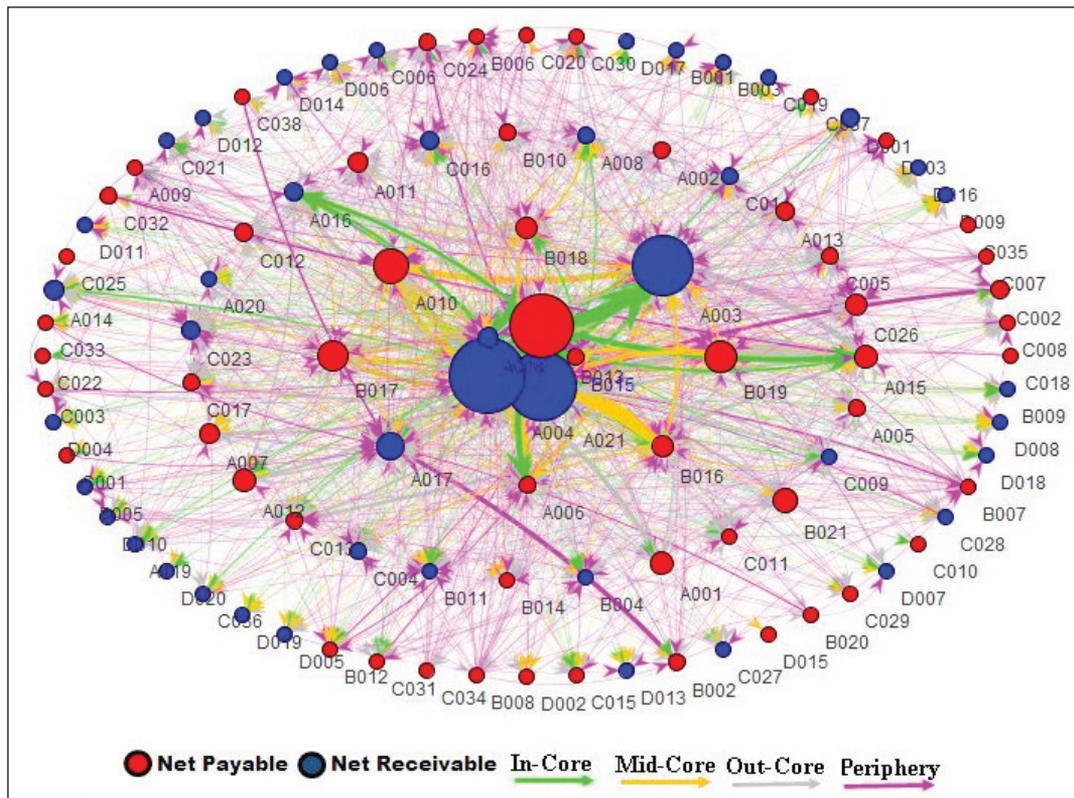
Note: Includes all scheduled commercial banks (SCBs) and select scheduled urban cooperative banks (SUCBs).
Source: RBI supervisory returns and staff calculations.

five during the period from March 2012 to September 2017 (Chart 2.35).

2.49   The degree of interconnectedness in the banking system (SCBs), measured by the connectivity ratio[37], has decreased gradually since 2012 indicating that the links/ connections between the banks have reduced over time. The cluster coefficient[38] which depicts local interconnectedness, however, remained consistent during the period from March 2012 to September 2017 indicating that clustering/ grouping within the banking network has not changed much over time (Chart 2.36).

Chart 2.36: Connectivity statistics of the banking system (SCBs)
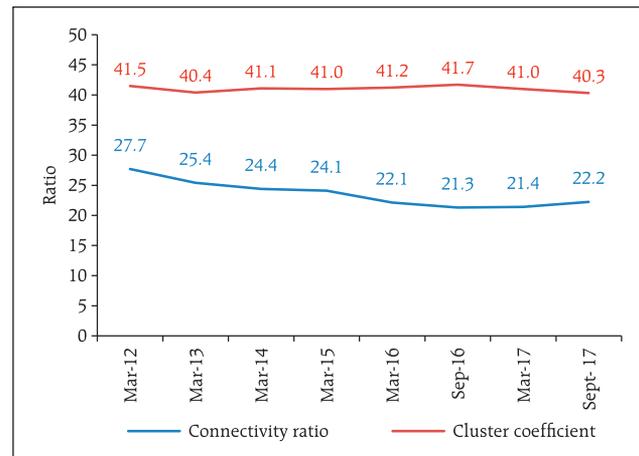
Source: RBI supervisory returns and staff calculations.

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[37] *Connectivity ratio:* This is a statistic that measures the extent of links between the nodes relative to all possible links in a complete graph.

[38] *Cluster coefficient:* Clustering in networks measures how interconnected each node is. Specifically, there should be an increased probability that two of a node's neighbours (banks' counterparties in case of the financial network) are also neighbours themselves. A high cluster coefficient for the network corresponds with high local interconnectedness prevailing in the system.

Network of the financial system

2.50   SCBs are the dominant players in the entire financial system,[39] accounting for nearly 47 per cent of the bilateral exposure, followed by asset management companies managing mutual funds (AMC-MFs) at around 15 per cent. Non-banking financial companies (NBFCs) had bilateral exposure of 12 per cent, whereas, insurance companies as well as housing finance companies (HFCs) each had around 9 per cent exposure. All-India financial institutions (AIFIs) accounted for 7 per cent exposure. SUCBs and pension funds (PFs) together accounted for nearly one per cent of the bilateral exposure in the financial system.

2.51   In inter-sectoral[40] exposure, AMC-MFs followed by the insurance companies were the biggest fund providers in the system, while NBFCs followed by HFCs and SCBs were the biggest receiver of funds. Within SCBs, however, both PVBs and FBs had a net payable position *vis-à-vis* the entire financial sector, whereas PSBs had a net receivable position (Chart 2.37 and Table 2.6).

2.52   Among the lenders (*i.e.* those who have a net receivable position against the rest of the financial system), the funds lent by AMC-MFs, SUCBs, PFs and PSBs increased, whereas, for insurance companies it decreased in September 2017 as compared to March 2017. Among the borrowers, the funds borrowed by AIFIs (NABARD, EXIM, NHB and SIDBI) and FBs

Chart 2.37: Network plot of the financial system (September 2017)
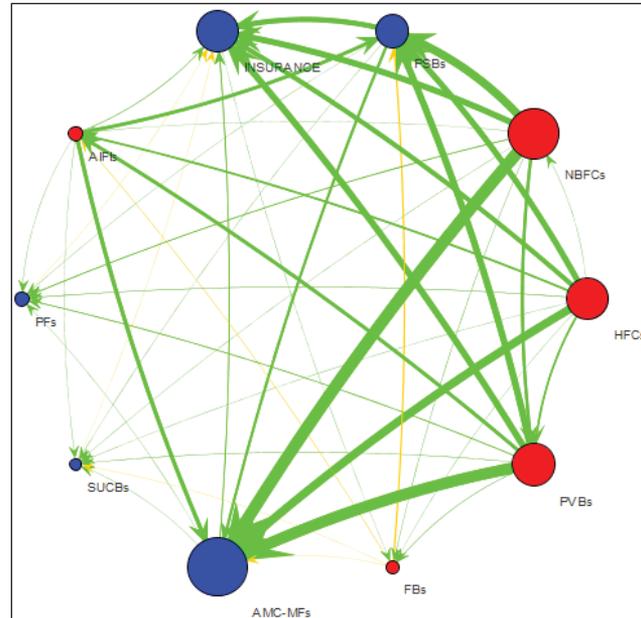
Note: Based on a sample. The receivable and payable amounts do not include transactions among entities of the same group. Red circles are net payable institutions and blue are net receivable institutions.
Source: RBI supervisory returns and staff calculations.

Table 2.6: Inter-sector assets and liabilities – September 2017

(₹ billion)

Fin. Entity	Receivables	Payables
PSBs	6163.2	2798.1
PVBs	2633.4	7328.8
FBs	802.5	1000.9
AMC-MFs[41]	7723.6	629.6
Insurance companies[42]	4684.2	158.7
NBFCs[43]	453.5	6321.1
SUCBs[44]	143.8	28.8
AIFIs (NABARD, EXIM, NHB, SIDBI)	1906.3	2266.6
PFs	491.0	8.2
HFCs[45]	368.2	4827.2

Note: Based on a sample. The receivable and payable amounts do not include transactions among entities of same group.
Source: RBI supervisory returns and staff calculations.

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[39] Larger financial system analysis also includes exposure between entities of same group.

[40] Inter- sector exposure does not include transactions among entities of the same group.

[41] The sample includes 22 AMC-MFs which cover more than 90 per cent of the AUMs of the mutual fund sector.

[42] The sample includes 21 insurance companies that cover more than 90 per cent of the assets of the insurance companies.

[43] This is a representative sample of the NBFC sector and it includes 34 companies (both deposit taking and non-deposit taking systemically important companies).

[44] The sample includes 20 SUCBs. The inter-sector sample also includes 7 PFs.

[45] Sample for HFCs includes 15 entities.

decreased, whereas, those by NBFCs, PVBs and HFCs increased (Chart 2.38).

Interaction among SCBs, AMC-MFs and insurance companies[46]

2.53   As at the end of September 2017, the gross receivables of AMC-MFs from the financial system were around 38.2 per cent of their average assets under management (AUM), while the gross receivables of the banking system were around 9.8 per cent of their total assets.

2.54   The banking sector had a gross exposure (receivables) of nearly ₹238 billion in September 2017 towards the insurance and mutual fund sectors taken together (as against ₹154 billion in March 2017). At the same time, the combined exposure (gross receivables) of AMC-MFs and insurance companies towards the banking sector was nearly ₹5.12 trillion (as against ₹4.8 trillion in March 2017).

Exposure to NBFCs

2.55   NBFCs were the largest net borrowers of funds from the financial system with highest funds received from SCBs (40 per cent), followed by AMC-MFs (at 37 per cent) and insurance companies (at 19 per cent). SUCBs, AIFIs, HFCs and PFs together accounted for 4 per cent of the borrowings by NBFCs within the financial system[47] (chart 2.39).

Exposure to HFCs

2.56   HFCs were net borrower of funds from the financial system. AMC-MFs (36 per cent), SCBs (35 per cent), insurance sector (19 per cent) and AIFIs (8 per cent) largely contributed to the funds raised by

Chart 2.38: Net lending (+ve) / borrowing (-ve) by the institutions
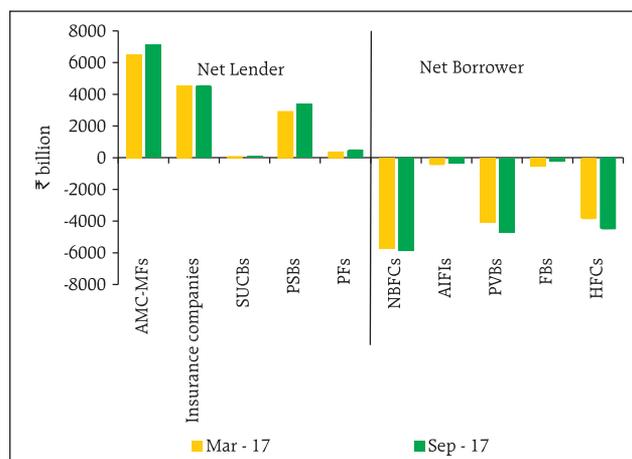
Note: Based on a sample.
Source: RBI supervisory returns and staff calculations

**Chart 2.39: Exposure to NBFCs**
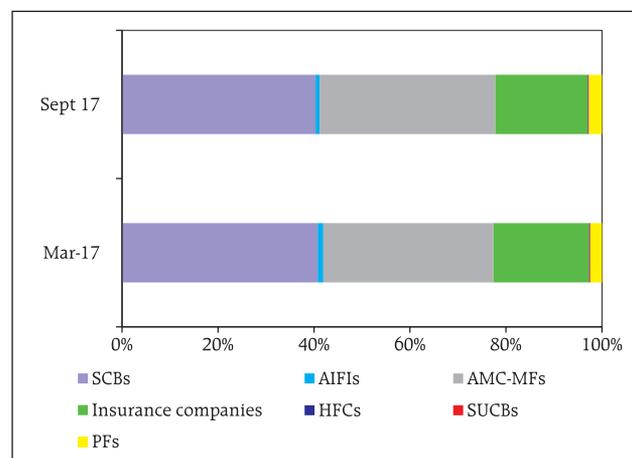
Note: Based on a sample.
Source: RBI supervisory returns and staff calculations

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[46] This analysis is confined to bilateral exposure (both fund and non-fund based) among 80 SCBs and a select sample of AMC-MFs and insurance companies.

[47] The numbers quoted in this paragraph are confined to a select sample of NBFCs which are significant from a contagion perspective and their bilateral exposure with a sample of regulated financial institutions.

Chart 2.40: Exposure to HFCs

Note: Based on a sample.
Source: RBI supervisory returns and staff calculations

Chart 2.41: Gross exposure (receivables) of pension funds
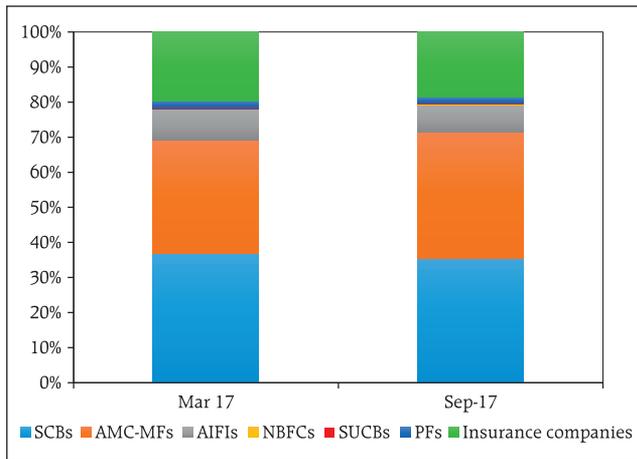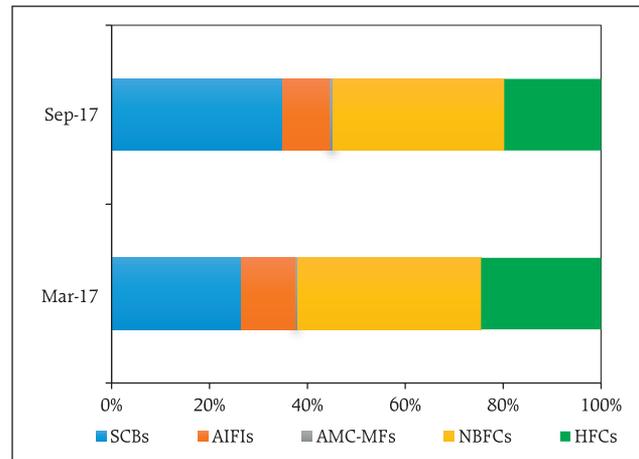
Note: These exposures are not on the balance sheet of the pension funds but on the balance sheet of the NPS schemes managed by pension funds. The analysis is confined to bilateral exposure (both fund and non-fund based) among a select sample of regulated entities. Based on a sample.
Source: RBI supervisory returns and staff calculations

HFCs. SUCBs, NBFCs and PFs together accounted for 2 per cent of the borrowings by HFCs (Chart 2.40).

Exposure of pension funds[48]

2.57   Pension funds were net lenders in the financial system. Within the financial system, nearly 35 per cent of the pension funds' exposure (gross receivables) was to NBFCs and 35 per cent to SCBs, followed by HFCs (20 per cent) and AIFIs (10 per cent) (Chart 2.41).[49]

Contagion analysis

SCBs and SUCBs

2.58   A contagion analysis using network tools was used to estimate potential losses in the event of failure of one or more banks due to solvency and liquidity risks in the banking system (Chart 2.42).[50] The assessment of impact of joint solvency[51]-liquidity[52] contagion was carried out for a system of combined SCBs and SUCBs.[53]

Chart 2.42: Contagion plot – Impact of failure of a bank
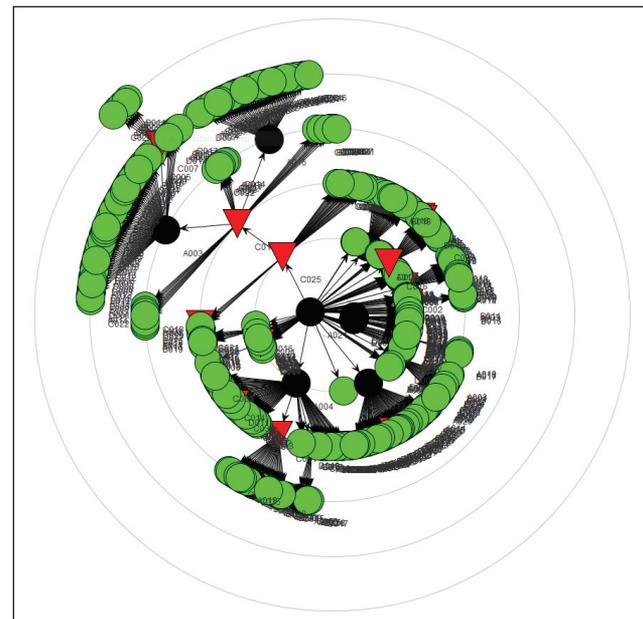
Source: RBI supervisory returns and staff calculations
Note: The Contagion propogation from failure of a 'trigger' institution (centre most black node) is displayed. The green nodes represent healthy institutions while the black nodes have failed. The red nodes specify the institutions that fail because of liquidity problems.

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[48] Data pertains to exposure of the schemes managed by the seven pension funds and regulated/ administered by PFRDA.

[49] Exposure of pension funds to SUCBs and insurance companies (in the selected sample) was nil.

[50] This is a pictorial representation of contagion in a banking system. For methodology refer Annex-2. SUCBs are included for the contagion analysis for the first time along with SCBs.

[51] Failure criteria for the contagion analysis taken as: tier 1 CRAR falling below 7 per cent.

[52] Liquid assets taken as: Excess SLR + excess CRR + 11 per cent of NDTL.

[53] Same definition and criterion for failure have been taken for SUCBs as applicable for SCBs assuming uniform regulation across the various types of banks going forward.

2.59   The analysis shows that the failure of a SCB (trigger bank) would not only cause further distress to other SCBs but also to SUCBs, whereas, the impact of failure of a SUCB is contained within SUCBs[54] (Table 2.7). A further analysis shows that the impact of solvency is more critical for SUCBs and the impact of liquidity contagion is low.

Contagion impact after macroeconomic shocks to SCBs

2.60   The contagion impact of the failure of a bank is likely to be magnified if macroeconomic shocks result in distress in the banking system in a situation of a generalised downturn in the economy. To assess the contagion impact[55], the initial impact of macroeconomic shocks on individual banks was taken from the macro stress tests, where a baseline and two (medium and severe) adverse scenarios were considered (ref. Chart 2.18).[56]

2.61   Contagion impact on the outcome of macro stress test reveals that additional solvency losses due to the contagion (excluding initial loss of the macro shock) to the banking system in terms of tier 1 capital would be limited to 5.5 per cent in the baseline, 8.1 per cent in medium stress and 8.8 per cent in severe stress scenarios. The number of default banks after the contagion (including the initially default banks

Table 2.7: Top 5 banks with maximum contagion impact – September 2017
(joint solvency-liquidity contagion)

Trigger bank (SCB)	Number of default banks		Solvency losses (% of tier-1 capital)	Liquidity losses (% of liquid assets)
	SCBs + SUCBs	SUCBs		
Bank 1	17	1	10.45	10.93
Bank 2	10	0	4.45	9.55
Bank 3	9	0	5.12	9.59
Bank 4	6	0	3.17	6.51
Bank 5	2	0	4.49	5.58

Note: 1. Capital loss is shown as % of tier 1 capital of the system (SCBs+SUCBs)

2. Liquidity loss is shown as % of total liquid assets of the system (SCBs+SUCBs)

3. Top five banks have been selected on the basis of number of default banks in contagion.

Source: RBI supervisory returns and staff calculations

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[54] Five SUCBs failed the solvency criteria at the beginning before the initiation of contagion. However, there was no further failure of banks due to contagion on account of these banks. The number of default banks shown in Table 2.7 excludes these five banks.

[55] Criteria for default is taken as: tier 1 CRAR falling below 7 per cent.

[56] The results of macro-stress tests have been used as an input for contagion analysis. Followings assumptions have been made:

a)   The projected balance sheet structure used for macro stress test has been applied on network structure proportionately.

b)   The projected losses under a macro scenario (calculated as reduction in projected tier 1 CRAR, in percentage terms, in September 2018 with respect to actual value in September 2017) have been applied to the September 2017 capital position assuming proportionally similar balance sheet structure for both September 2017 and September 2018.

c)   Bilateral exposures structure between financial entities remain similar in both September 2017 and September 2018.

due to macro shocks) would be 8 in baseline, 16 in medium stress and 18 in severe stress scenarios (Chart 2.43).

Chart 2.43: Contagion impact after macroeconomic shocks – September 2018 (solvency contagion)
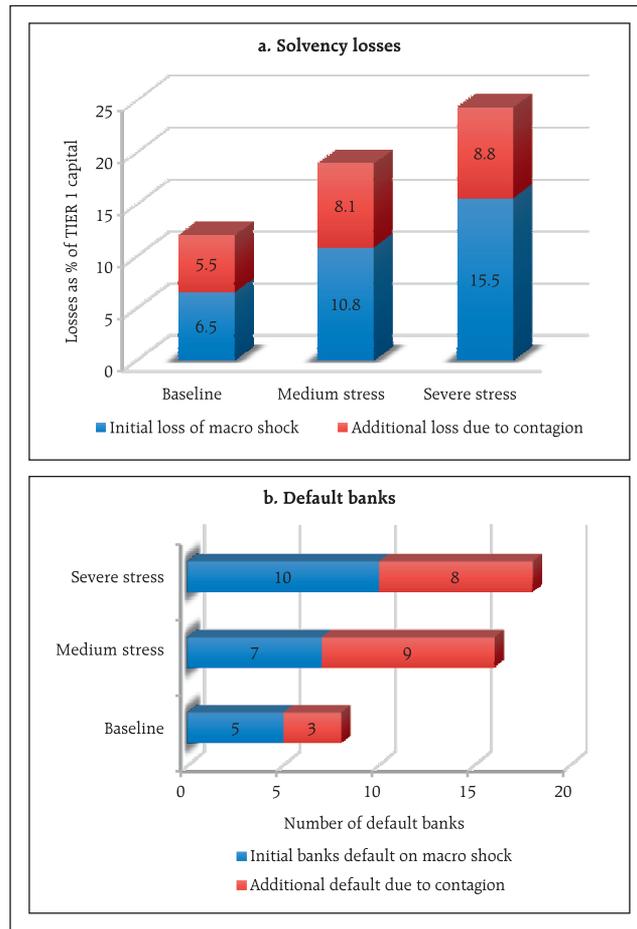
Note: The projected capital in September 2018 does not take into account any capital infusion by stake holders. A conservative assumption of minimum profit transfer to capital reserves at 25 per cent is also made while estimating the projections.
Source: RBI supervisory returns and staff calculations.