

June 26, 2007

**The Chairman/ Chief Executive Officer
All Commercial Banks
(excluding RRBs & LABs)**

Dear Sir,

Guidelines on Stress Testing

Improvement in risk management practices has been in focus since the introduction of the financial sector liberalization process in the mid nineties. The process gained momentum with the issue of regulatory guidelines and guidance notes on asset liability management and management of credit risk, market risk and operational risk by the Reserve Bank since 1999. Further, the announcement of implementation of the revised capital adequacy framework in India has brought the risk management capabilities of banks into greater focus.

2. Globally, banks are increasingly relying on statistical models to measure and manage the financial risks to which they are exposed. These models are gaining credibility because they provide a framework for identifying, analysing, measuring, communicating and managing these risks. Since models cannot incorporate all possible risk outcomes and are generally not capable of capturing sudden and dramatic changes, banks supplement models with 'stress tests'. Internationally, stress testing has become an integral part of banks' risk management systems and is used to evaluate the potential vulnerability to some unlikely but plausible events or movements in financial variables. There are broadly two categories of stress tests used in banks viz. sensitivity tests and scenario tests. These may be used either separately or in conjunction with each other.

Sensitivity tests are normally used to assess the impact of change in *one variable* (for example, a high magnitude parallel shift in the yield curve, a significant movement in the foreign exchange rates, a large movement in the equity index etc.) on the bank's financial position.

Scenario tests include simultaneous moves in a *number of variables* (for example, equity prices, oil prices, foreign exchange rates, interest rates, liquidity etc.) based on a single event experienced in the past (i.e., *historical scenario* – for example, natural disasters, stock market crash, depletion of a country's foreign exchange reserves) or a plausible market event that has not yet happened (i.e., *hypothetical scenario* - for example, collapse of communication systems across the entire region/ country, sudden or prolonged severe economic downturn) and the assessment of their impact on the bank's financial position.

3. Banks in India are beginning to use statistical models to measure and manage risks. Stress tests are, therefore, relevant for these banks. Notwithstanding the use of statistical models, stress tests are a relevant and integral part of banks' risk management frameworks. Further, the supervisory review process under Pillar 2 of Basel II framework is intended not only to ensure that banks have adequate capital to support all the risks in their business, but also to encourage banks to develop and use better risk management techniques in monitoring and managing their risks. In the above background, the need for banks in India to adopt 'stress tests' as a risk management tool has been

emphasised in the Annual Policy Statement for 2006-07. Accordingly, the draft guidelines on stress testing were prepared and issued for feedback from banks. On the basis of the feedback received, the draft guidelines have been suitably revised and are furnished in the Annex . Guidelines on stress testing, as relevant for the Basel II framework, will be issued separately.

4. A copy of this circular may be placed before the Board of Directors at the next meeting for their information and appropriate guidance / advice. Banks shall put in place appropriate stress test policies and the relevant stress test framework for the various risk factors by September 30, 2007. As it is appreciated that banks may need to undertake the stress tests on a trial basis and use the results of these trial tests as a feedback to further refine the framework, it has been decided that banks be allowed some time to refine the stress testing frameworks. Banks are required to ensure that their formal stress testing frameworks, which are in accordance with the guidelines in Annex, are operational from March 31, 2008.

5. Please acknowledge receipt.

Yours faithfully,

(Prashant Saran)
Chief General Manager – in – Charge

Guidelines to banks on Stress Testing

Background

1. Internationally, stress testing has become an integral part of a bank's risk management system and is used to evaluate its potential vulnerability to certain unlikely but plausible events or movements in financial variables. The vulnerability is usually measured with reference to the bank's profitability or / and capital adequacy. This brings to fore the inadequacies of managing risks on the basis of 'normal' business conditions and emphasises the importance of robust risk management systems which factor-in a forward looking element and recognise the need to manage risks 'over the economic cycle'.

2. There are broadly two categories of stress tests used in banks viz. sensitivity tests and scenario tests. These may be used either separately or in conjunction with each other. The stress events and scenarios identified / developed by a bank should be plausible and relevant to its portfolio.

Sensitivity tests are normally used to assess the impact of change in *one variable* (for example, a high magnitude parallel shift in the yield curve, a significant movement in the foreign exchange rates, a large movement in the equity index etc.) on the bank's financial position.

Scenario tests include simultaneous moves in a *number of variables* (for example, equity prices, oil prices, foreign exchange rates, interest rates, liquidity etc.) based on a single event experienced in the past (i.e., *historical scenario* – for example, natural disasters, stock market crash, depletion of a country's foreign exchange reserves) or a plausible market event that has not yet happened (i.e., *hypothetical scenario* - for example, collapse of communication systems across the entire region/ country, sudden or prolonged severe economic downturn) and the assessment of their impact on the bank's financial position.

Utility

3. A well designed and implemented stress testing framework would supplement banks' risk management systems and help in making these systems more robust. The stress testing framework also helps banks to be better equipped to meet the stress situations as and when they arise and also overcome them such that they do not become a serious threat to themselves or to the banking systems in which they operate.

4. Stress tests should, as far as possible, be conducted on a bank-wide basis. While applying the stress tests on a bank-wide basis, due consideration should be given to country or market or portfolio specific factors. Stress tests should be adequately tailored to capture these factors. Stress tests undertaken on a bank-wide basis enable the Board and senior management to assess the potential impact of the stress situations on the bank's earnings and capital position, and enable them to develop or choose appropriate strategies for mitigating and managing the impact of those situations. The framework also helps bank managements in understanding the bank's risk profile and adjusting it in accordance with their risk appetites. The stress test results should be considered while establishing and reviewing various policies and limits.

5. The stress testing frameworks perform the dual role of being a diagnostic tool for improving a bank's understanding of its risk profile, for assessing the adequacy of internal capital, for

supplementing the internal capital models where paucity of historical data limits the predictive power of the models, and for introducing a forward looking element in the capital assessment process. Banks need to understand the likely impact of the stress situations and relate it to the capacity of the bank's profitability to absorb the shocks and the consequent impact on the bank's capital. Considering the range of possible options to tackle the stress situations, banks may decide to hold a capital buffer that would be aligned to the exceptional but plausible stress situations. The stress testing framework will serve as an important component of banks' Internal Capital Adequacy Process (ICAAP) under the Basel II framework. Guidelines on stress testing, as relevant for the Basel II framework, will be issued separately.

Framework requirements

6. Banks shall put in place a Board approved 'Stress Testing framework' to suit their individual requirements which would integrate into their risk management systems. The framework should satisfy the following essential requirements:

i) The Board approved 'stress testing policy' should detail (a) the frequency and procedure for identifying the principal risk factors which affect the bank's portfolio and should be stressed; (b) the methodology for constructing appropriate and plausible single factor and multi factor stress tests; (c) the procedure for setting the stress tolerance limits; (d) the process for monitoring the stress loss limits; (e) the remedial actions required to be taken at the relevant stages; (f) the authorities designated to activate the remedial actions; (g) the need for identification of the responsibilities assigned to various levels/ functional units; and (h) the need for specification of reporting lines.

ii) The senior management should be actively involved in identifying the principal risk factors; designing appropriate single factor/ multi factor stress tests; setting the stress tolerance limits; reviewing the stress test results and monitoring the stress loss limits; activating the appropriate remedial actions; periodically communicating the stress test results and the actions taken, if any, to the Board; reviewing the need to modify the stress testing framework with reference to certain elements like the risk factors, stress scenarios, levels of stress to be applied, the underlying assumptions, stress tolerance levels, remedial actions etc.; designing an appropriate MIS to support the stress tests to be conducted; and ensuring an appropriate and effective internal control mechanism to validate the stress tests and their findings;

iii) Board and senior management should regularly review the results of scenario analyses and stress tests, including the major assumptions that underpin them. Stress test results may be used for setting risk limits; allocating capital for various risks; managing risk exposures; and putting in place appropriate contingency plans for meeting the situations that may arise under adverse circumstances.

iv) Stress testing framework should be calibrated according to the complexity of each bank's business activities. The number of risk factors to be stressed would depend on the complexity of the portfolio and the risks the bank is exposed to. Banks should be able to justify their choice of stress

tests and the choice of risk factors that are stressed. Banks which have foreign operations, or/ and are active in derivatives markets, or/ and are operating an active trading portfolio should use a combination of scenario analysis and sensitivity tests. Other banks may confine themselves to sensitivity tests run relatively more frequently to assess the impact of the relevant principal risk factors on their financial condition.

v) Banks are free to choose the various assumptions underlying the stress tests and the basis for their assumptions. However, these should be well documented and available for verification by the supervisor / auditors. The assumptions underlying the stress tests should be reviewed periodically for assessing their validity. Banks should undertake fresh stress tests when there are significant modifications in the underlying assumptions. Such periodic reviews are necessary to ensure the integrity, accuracy, and reasonableness of the stress testing framework.

vi) Banks should use appropriate, accurate and complete data when performing stress tests. The IT resources should be commensurate with the complexity of the techniques and the coverage of the stress tests. Banks should have adequate MIS in place to support the stress testing framework. The systems should be able to support the conduct of stress tests on different risks at relevant levels (portfolios, regions, business units) and also aggregate the results for the bank as a whole.

vii) As the environment in which banks are operating is quite dynamic, there are changes in macroeconomic environment, banks' instruments, trading strategies and regulatory policies. The risk measurement methodologies and stress testing techniques in banks should, therefore, evolve to accommodate these changes. The stress testing framework should, therefore, be reviewed periodically to determine its efficacy and to consider the need for modifying any of the elements. The framework should be subjected to at least annual reviews which should cover, among others, the following aspects:

- (a) Adequacy of the documentation for various elements of the stress testing framework;
- (b) Integration of the stress testing framework in the day-to-day risk management processes;
- (c) Scope of coverage of the framework and the levels of stress applied;
- (d) Integrity of MIS and data feeding into the stress tests; and
- (e) Adequacy of the remedial actions and the efficiency of the systems for their activation;

Identification of risks

7. While traditionally stress tests are used in the context of managing *market risks*, these may also be employed in the management of *credit risks, operational risks and liquidity funding risk*. Banks should identify their major risks that should be subjected to stress tests. While identifying the major risks, banks should understand their exposures and the risks to which these are exposed as well as the correlation between these risks. An indicative list of the risks that banks, in general, are exposed to are credit risk, credit concentration risk, interest rate risk, price risk, foreign currency risk, impact of market movements on contingent credit risk, liquidity risk, operational risks, prepayment risk,

model risk, macro economic risk and political risk. The above is only an indicative list and banks should identify the risks to which they are exposed to with regard to their bank specific circumstances and portfolio.

Stress scenarios / levels

8. Banks should stress the relevant parameters at least at three levels of increasing adversity – minor, medium, and major – with reference to the normal situation and estimate the financial resources needed by it under each of the circumstances to

- a) meet the risk as it arises and for mitigating the impact of manifestation of that risk;
- b) meet the liabilities as they fall due; and
- c) meet the minimum CRAR requirements.

9. A scenario analysis measures the combined effect of adverse movements in more than one risk factor. Banks should determine the various risks that should be included in a scenario, take into account the linkages among the various risks without looking at each of them in isolation and assess the extent to which the stress would impact their financial position. Stress scenarios may be designed on the basis of either historical events or hypothetical events. An important element of scenario development will be the assessment and incorporation of the linkages between the various risk factors.

10. A few examples of stress factors / scenarios are as follows: domestic economic downturn, economic downturn of major economies to which the bank is directly exposed or to which the domestic economy is related; decline in the prospects of sectors to which the banks are having significant exposures; increase in level of NPAs and provisioning levels; increase in level of rating downgrades; failure of major counterparties; timing difference in interest rate changes (repricing risk); unfavourable differential changes in key interest rates (basis risk); parallel / non parallel yield curve shifts (yield curve risk); changes in the values of standalone and embedded options (option risk); adverse changes in exchange rates of major currencies; decline in market liquidity for financial instruments; stock market declines; tightening of market liquidity; significant operational risk events.

Frequency of stress testing

11. Banks may apply stress tests at varying frequencies dictated by their respective business requirements, relevance and cost. While some stress tests may be conducted daily or weekly – for example: trading book items for the various market risks; some others may be conducted at monthly or quarterly intervals – for example: those items which are less volatile in nature like credit risk in loans or HTM securities; interest rate risk in the banking book; and liquidity risk. Further, ad-hoc stress tests may be warranted when there are any special circumstances – for example: a rapidly deteriorating political / economic conditions in a country may warrant a quick assessment of the likely impact on the bank on account of its exposures to that country.

Interpretation of stress test results

12. The results of the various stress tests should be reviewed by the senior management and reported to the Board. These results should be an essential ingredient of bank's risk management systems.

13. Banks should be conscious of the fact that the stress tests only indicate the likely impact and do not indicate the likelihood of the occurrence of the stress events. Since stress testing is influenced by the judgment and experience of the people who design the stress tests, the effectiveness of the stress tests will depend upon whether banks have identified their major risks, whether they have chosen the right level of stress / stress scenarios, whether they have understood and interpreted the stress test results properly and whether they have initiated the necessary steps to address the situation presented by the stress test results. Hence, each of the above aspects need to be assigned their due importance.

14. Banks should document the stress tests undertaken by them, the underlying assumptions, the results and the outcomes. The documentation should be preserved *at least* for five years.

Remedial Actions

15. The remedial actions that banks may consider necessary to activate when the various stress tolerance levels are breached may include:

- a) Reduction of risk limits;
- b) Reduction of risks by enhancing collateral requirements, seeking higher level of risk mitigants, undertaking securitisation, and hedging;
- c) Amend pricing policies to reflect enhanced risks or previously unidentified risks;
- d) Augmenting the capital levels to enhance the buffer to absorb shocks;
- e) Enhancing sources of funds through credit lines, managing the liability structure, altering the liquid asset profile, etc.;

16. Banks should clearly identify the principles that they would be guided by while they decide on activation of the various remedial actions as appropriate to the stress event / level that may be reflected in the stress test results. The triggers for remedial actions may be identified clearly for example: with reference to the size of the potential loss or the impact on earnings and / or capital. In addition, the level of authority for determining the remedial action to be initiated should be clearly identified. The triggers, the remedial actions, the guiding principles for activation and the designated authorities should be properly documented and adopted/ applied as and when relevant.

17. As stress testing is an evolving area, a few *illustrative* examples of typical stress tests are presented in the Attachment purely with a view to aid in better perception of stress tests. Therefore, it would **not** be appropriate (i) to conclude that the levels of stress or the impacts mentioned in the illustrations are as perceived by the Reserve Bank or are recommended by the Reserve Bank and (ii) for banks to apply the illustrative stress tests as they are. Each bank should

ensure that the assumptions and the levels of stress are as determined by them and that the stress tests are suitably modified while designing their respective stress testing frameworks. The stress testing framework and methodology in each bank should be tailored to suit the size, complexity, risk philosophy, risk perceptions and skills in each bank.

Effective Date

18. Banks shall put in place appropriate stress test policies and the relevant stress test framework for the various risk factors by September 30, 2007. As it is appreciated that banks may need to undertake the stress tests on a trial basis and use the results of these trial tests as a feedback to further refine the framework, it has been decided that banks be allowed some time to refine the stress testing frameworks. Accordingly, banks may use the next 6 months to test and refine the stress testing framework and the underlying assumptions. At the same time, with a view to ensuring that stress testing frameworks for all relevant risk factors are formally operational in the Indian banking system without much delay, banks are required to ensure that their formal stress testing frameworks, which are in accordance with these guidelines, are operational from March 31, 2008.

Illustrative Examples of Stress Tests

As stress testing is an evolving area, a few illustrative examples of typical stress tests are presented below purely with a view to aid in better perception of stress tests among banks. Therefore, it would **not** be appropriate (i) to conclude that the levels of stress or the impacts mentioned in these illustrations are as perceived by the Reserve Bank or are recommended by the Reserve Bank and (ii) for banks to apply the illustrative stress tests as they are. Each bank should ensure that the assumptions and the levels of stress are as determined by them and that the stress tests are suitably modified while designing their respective stress testing frameworks in such a manner that it would be relevant to each bank's requirement. The stress testing framework and methodology in each bank should, however, be tailored to suit the size, complexity, risk philosophy, risk perceptions and skills in each bank. Banks should construct their own stress scenarios; ensure that appropriate risk factors are included; apply the appropriate levels of stress as they perceive to be plausible and ensure that the stress tests are economically meaningful.

Stress test illustration – 1 : Liquidity risk

1. The general sources of stress on liquidity in banks are seen to emerge from
 - a) Over-dependence on more volatile funding sources, such as wholesale funds and inter-bank funds;
 - b) Depositors' ability to switch funds among accounts by electronic means;
 - c) Bank's ratings downgrades or other negative news could cause, among others, reduced market access to unsecured borrowings from call money market; a reduction or cancellation of inter-bank credit lines; a reduction of deposits; and adversely affect a bank's capability of securitising its assets.
 - d) Off-balance sheet products that can give rise to sudden material demands for liquidity at banks include committed lending facilities to customers, committed backstop facilities, and committed back-up lines to special purpose vehicles.
 - e) Sharp and unanticipated market movements or defaults could cause demand for additional collateral calls from exchanges/ settlement platforms in connection with foreign exchange and securities transactions;

2. A primary liquidity risk is deposit run-offs in a bank-specific event. The assumptions that banks may utilise in the stress tests may be based on a combination of bank-specific historical data, industry data from prior stress events, and/or best guess estimates. When using bank-specific historical data, some banks may add an extra cushion to the assumed outflows to factor-in their perception that data largely based on stable historical periods may not adequately reflect depositor behaviour during a future stress event. The severity of deposit outflows in a bank's stress scenario depends upon factors including the strength of the bank's relationships with its customers, the proportion of deposits that is protected by deposit insurance, the composition of its balance sheet, and the duration of the crisis. Banks may reckon securitisation of the eligible assets as a potential source for liquidity after taking all relevant factors into account. While

considering stress scenarios, as a conservative measure, banks should not reckon the Reserve Bank as a contingent source for liquidity.

3. The broad assumptions that may be made on behaviour of liabilities during stress periods may be:
 - a) The percentage of retail deposits that may be withdrawn in a stress scenario is typically in the single digits, while a few banks may assume outflows in the low double digits. This reflects an assumption that retail depositors would be comforted by deposit insurance and so would not withdraw their deposits. Hence, retail for the purpose of stress tests would be those enjoying the protection of deposit insurance.
 - b) Corporate, bank and government deposits or other un-insured deposits may be assumed to reduce between 20 percent and 50 percent, typically over a one-month time span. Outflows may, sometimes, be assumed to be 100 percent for certain deposit types. Some banks may make finer distinction among different types of clients or on the basis of the bank's relationships with them.
 - c) Banks may recognise that disposal of assets to raise liquidity may entail application of haircuts (depending on the scenario) while arriving at their realisable value.
 - d) Banks may recognise that intra-group cash flows might be disrupted.
 - e) Banks may undertake the stress test where the stress scenario is expected to last over different time horizons say one month or less; two or three months; and six months or more.

4. A numerical illustration of a liquidity stress test when on account of an adverse rumour the bank's reputation for meeting its liabilities as and when they mature has been eroded is presented below. The broad assumptions are mentioned below:

(Rs. crore)

	1-7 days	8-14 days	15-28 days	29 days to 3 mths	> 3 to 6 mths	> 6 mths to 1 year	> 1 to 3 yrs	> 3 to 5 yrs	> 5 yrs	TOTAL
Normal										
Assets	50	50	150	200	200	300	350	250	250	1800
Wholesale deposits	12	18	40	50	40	50	10	10	0	230
Retail Deposits	40	50	140	200	310	300	190	140	200	1570
Total Liability	52	68	180	250	350	350	200	150	200	1800
Gap	-2	-18	-30	-50	-150	-50	150	100	50	0
Stress										
Assets	50	50	150	200	200	300	350	250	250	1800
Wholesale deposits	75	55	20	25	20	25	5	5	0	230
Retail Deposits	212	174	112	160	248	240	152	112	160	1570
Total Liability	287	229	132	185	268	265	157	117	160	1800
Gap	-237	-179	18	15	-68	35	193	133	90	0
Assumptions										
The stress scenario is expected to last three months										
1. Wholesale deposits - Fifty percent of these deposits are to be repaid in the first two buckets and the remaining fifty percent is re-deposited with a hike in interest rate by 1%.										
2. The retail deposits are fully covered by deposit insurance. However, 20% of the deposits in the third bucket onwards (i.e., 1570 – 90) are withdrawn in the first two buckets.										
3. Assets maturing beyond the first two buckets are sold at a discount of 10%, to the extent required, to meet the gap in the first two buckets. (i.e. Rs. 416 crore)										
Impact of stress on liquidity										
Loss on sale of assets										
46.22										
Higher Interest on -										
Wholesale deposits										
1.00										
Total cost										
47.22										

Stress test illustration – 2 : Interest rate risk – earnings perspective

Interest rate risk is the risk where changes in market interest rates might adversely affect a bank's financial condition. The immediate impact of changes in interest rates is on bank's earnings through changes in its Net Interest Income (NII). A long-term impact of changes in interest rates is on bank's Market Value of Equity (MVE) or Net worth through changes in the economic value of its assets, liabilities and off-balance sheet positions. The interest rate risk, when viewed from these two perspectives, is known as 'earnings perspective' and 'economic value' perspective, respectively. The present guidelines on asset liability management (BP.BC.8/21.04.098/99 dated February 10, 1999) to banks approach interest rate risk measurement from the 'earnings perspective' using the traditional Gap Analysis (TGA).

The following illustrations indicate a few methods of application of stress tests to assess the impact of interest rate risk from the earnings perspective.

(Rs. crore)

Time buckets ➔	1-14 days	15-28 days	29 days to 3 mths	> 3 to 6 mths	> 6 mths to 1 year	> 1 to 3 yrs	> 3 to 5 yrs	> 5 yrs	TOTAL
Particulars ↓									
RSA**	100	150	200	200	300	350	250	250	1800
RSL**	120	180	250	350	350	200	150	50	1650
Gap (RSA – RSL)	- 20	- 30	-50	-150	- 50	150	100	200	150

Annual Profit = Rs. 18 crore

** RSA – Rate sensitive assets; RSL – Rate sensitive liabilities

Example A : When interest rates increase by one percent across all time buckets both for assets and liabilities

	1-14 days	15-28 days	29 days to 3 mths	> 3 to 6 mths	> 6 mths to 1 year	> 1 to 3 yrs	> 3 to 5 yrs	> 5 yrs	TOTAL
RSA – Value	100	150	200	200	300	350	250	250	1800
RSL – Value	120	180	250	350	350	200	150	50	1650
Gap	-20	-30	-50	-150	-50	150	100	200	150
Intt. On RSA	1	1.5	2	2	3	3.5	2.5	2.5	18
Intt on RSL	-1.2	-1.8	-2.5	-3.5	-3.5	-2	-1.5	-0.5	-16.5
Impact on NII	-0.2	-0.3	-0.5	-1.5	-0.5	1.5	1	2	1.5
Impact on profit									8.33%

Assumptions: Where all assets and liabilities are linked to floating interest rates, any change in the interest rates would normally impact the interest rates pertaining to those assets and liabilities which are due for maturity/ re-pricing within the time horizon over which the stress is envisaged. In the Indian context, when there is a change in the prime lending rates (PLR) of banks, the change will impact the interest rates of all assets which are linked to the PLR, including those that are due for re-pricing/ maturity beyond the time horizon over which the stress is envisaged. Fixed interest rate exposures would be sensitive to interest rate changes with reference to the date of maturity and hence would not be affected by change in interest rates when these exposures are maturing beyond the time horizon over which the stress is envisaged. For the purpose of this illustration, the change in interest rates is assumed to immediately impact the interest rates pertaining to all assets and all liabilities, and, thus the NII.

- Increase in interest income on RSA = $1800 \times 0.01 =$ Rs. 18 crore
- Increase in interest expenditure on RSL = $1650 \times 0.01 =$ Rs. 16.50 crore
- Hence, NII has **increased** by Rs. 1.50 crore and the profits **increase** by 8.33%.
- The impact is equal to one percent of the Net gap between RSA and RSL (150×0.01)

Example B : When interest rates decrease by one percent across all time buckets both for assets and liabilities

	1-14 days	15-28 days	29 days to 3 mths	> 3 to 6 mths	> 6 mths to 1 year	> 1 to 3 yrs	> 3 to 5 yrs	> 5 yrs	TOTAL
RSA – Value	100	150	200	200	300	350	250	250	1800
RSL – Value	120	180	250	350	350	200	150	50	1650
Gap	-20	-30	-50	-150	-50	150	100	200	150
Intt. On RSA	-1	-1.5	-2	-2	-3	-3.5	-2.5	-2.5	-18
Intt on RSL	1.2	1.8	2.5	3.5	3.5	2	1.5	0.5	16.5
Impact on NII	0.2	0.3	0.5	1.5	0.5	-1.5	-1	-2	-1.5
Impact on profit									-8.33%

Assumptions: All assets and liabilities are linked to floating rate interest rates linked to benchmark rates. The change in interest rates immediately impacts the benchmark rates and thus the NII.

- Decrease in interest income on RSA = $1800 \times 0.01 =$ Rs. 18 crore
- Decrease in interest expenditure on RSL = $1650 \times 0.01 =$ Rs. 16.50 crore
- Hence, NII has **decreased** by Rs. 1.50 crore and the profits **decrease** by 8.33%.
- The impact is equal to one percent of the Net gap between RSA and RSL (150×0.01)

Example C : When interest rates increase by one percent for time buckets up to one year and decrease by one percent for time buckets beyond one year both for assets and liabilities

	1-14 days	15-28 days	29 days to 3 mths	> 3 to 6 mths	> 6 mths to 1 year	> 1 to 3 yrs	> 3 to 5 yrs	> 5 yrs	TOTAL
RSA – Value	100	150	200	200	300	350	250	250	1800
RSL – Value	120	180	250	350	350	200	150	50	1650
Gap	-20	-30	-50	-150	-50	150	100	200	150
Intt. On RSA	1	1.5	2	2	3	-3.5	-2.5	-2.5	1
Intt on RSL	-1.2	-1.8	-2.5	-3.5	-3.5	2	1.5	0.5	-8.5
Impact on NII	-0.2	-0.3	-0.5	-1.5	-0.5	-1.5	-1	-2	-7.5
Impact on profit									-41.67%

- RSA – RSL for time buckets up to one year = (-) 300. Hence, impact on NII for time buckets up to one year = $(-) 300 \times 0.01 = (-)$ Rs. 3 crore; i.e., a decrease in NII.

- RSA – RSL for time buckets beyond one year = (+) 450. Hence, impact on NII for time buckets beyond one year = 450 x (-) 0.01= (-) Rs. 4.50 crore; i.e., a decrease in NII.
- The aggregate **decrease** in NII is Rs. 7.50 crore and therefore the profits **decrease** by 41.67%.

Stress test illustration – 3 : Credit risk – Impact on capital adequacy

The stress tests for credit risk may assess the impact of an economic downturn on the bank's capital adequacy position especially under a Basel II scenario. An economic downturn could lead to a downgrade in the credit ratings awarded to a bank's counterparties by rating agencies. This might lead to a consequent increase in the risk weights for these exposures which will have an impact on the bank's capital adequacy position. This is a likely situation under a Basel II scenario where the risk weights will be related to the credit rating enjoyed by the counterparty exposures. A similar stress test may also be undertaken with reference to the internal rating grades awarded to the counterparties. The impact in this situation would be on the economic capital maintained by a bank.

The following two examples illustrate this impact on capital adequacy arising out of an economic downturn, under two assumptions (a) a uniform level of downgrade for all rating grades; and (b) a different level of downgrade for different rating grades.

Example A:

						Rs.crore
		Normal situation		Stress situation		
Rating scale	Risk weight	Exposure	RWA	Extent of down-grade (%)	Exposure	RWA
AAA	20	300	60.00	15	255	51.00
AA	50	200	100.00	15	215	107.50
A	50	100	50.00	15	115	57.50
BBB	100	300	300.00	15	270	270.00
BB & below	150	100	150.00		145	217.50
		1000	660.00		1000	703.50
Minimum Capital			59.40			63.32
Capital funds*	65					
CRAR			9.85			9.24

* Assumed capital funds.

- **Example B :**

						Rs.crore
		Normal situation		Stress situation		
Rating scale	Risk weight	Exposure	RWA	Extent of down-grade (%)	Exposure	RWA
AAA	20	300	60.00	15	255	51.00
AA	50	200	100.00	20	205	102.50
A	50	100	50.00	25	115	57.50
BBB	100	300	300.00	30	235	235.00
BB & below	150	100	150.00		190	285.00
		1000	660.00		1000	731.00
Minimum Capital			59.40			65.79
Capital funds*	65					
CRAR			9.85			8.89

* Assumed capital funds

Stress test illustration – 4 : Credit risk

The stress tests for credit risk may also assess the impact of an increase in the level of non performing loans (NPLs). This could have a two way impact – one on the bank's NPA levels as well as on the additional provisioning requirements which would have a consequent impact on the bank's profits and the CRAR. Banks may also conduct stress tests with reference to the extent of provisioning that may be required by the regulator for various asset categories.

Example A: The regulatory provisioning requirement under a stress situation is assumed as 1% for all Standard (S); 25% for Substandard (SS), and 100% for all Doubtful categories.

					Rs. Crore
		Normal situation		Stress situation *	
Asset Classification	Rate of Provisioning (%)	Exposure	Provision	Revised rate of provisioning (%)	Provision
S	1	900	9.00	1.00	9.00
SS	10	40	4.00	25	10.00
D1	20	10	2.00	100	10.00
D2	30	15	4.50	100	15.00
D3	100	35	35.00	100	35.00
		1000	54.50		79.00
Profit		18		-6.50	
Addl. Provisions					24.50
Impact on profits (%)				-136.11	
ROA		1.80		-0.65	
Capital funds		95		70.50	
RWA		954.50		930.00	
CRAR		9.95		7.58	

* Assumed capital funds – Rs. 95 crore

Note:

1. **Profit** under stress situation = $18 - 24.50 = (-) 6.50$
2. **Capital funds** under stress situation = $95 - 24.50 = 70.50$
3. **RWA** under normal situation = $1000 - (4.00+2.00+4.50+35.00) = 954.50$
4. **RWA** under stress situation = $1000 - (10.00 + 10.00 + 15.00 + 35.00) = 930$

Example B: The downgrade from Standard to NPA (sub standard) is assumed to be 10% (i.e., the extent of present level of gross NPAs) and the provisioning requirements under stress situation are assumed as in example A above:

		Rs. Crore					
		Normal situation			Stress situation *		
Asset Classification	Rate of Provisioning (%)	Exposure	Provision	Extent of downgrade (%)	Exposure	Revised rate of provisioning (%)	Provision
S	1.00	900	9.00	10	810	1	8.10
SS	10	40	4.00		130	25	32.50
D1	20	10	2.00		10	100	10.00
D2	30	15	4.50		15	100	15.00
D3	100	35	35.00		35	100	35.00
		1000	54.50		1000		100.60
Profit		18				-28.10	
Add. Provisions							46.10
Impact on profits						-256.11	
ROA		1.80				-2.81	
Capital funds		95				48.00	
RWA		954.50				907.50	
CRAR		9.95				5.29	

Note:

1. **Profit** under stress situation = $18 - 46.10 = (-) 28.10$
2. **Capital funds** under stress situation = $[95 - (9.00 - 8.10)] - 46.10 = 48.00$
3. **RWA** under stress situation = $1000 - (32.50 + 10.00 + 15.00 + 35.00) = 907.50$

Stress test illustration – 5 : Foreign exchange risk

The stress test for exchange rate may assess the impact of change in exchange rate on the bank's open positions and consequently its capital requirements. To model direct foreign exchange risk only the overall net open position of the bank may be given an adverse shocks (say 5%, 10% and 15%). The overall net open position is measured by aggregating the sum of short positions or the sum of long positions; whichever is greater regardless of sign. Banks may adopt a more conservative method for computing open positions. The impact of the stress event could be measured with reference to

- a) the additional capital that may be required to be maintained; and
- b) the loss on account of change in value

Example A:

Foreign exchange open positions				
Currency		Limits (in millions)	Rupee equivalent (Rs. Crore)	
USD		5	22.50	
EURO		4	23.20	
GBP		3	24.00	
Sw. Franc		7	26.60	
Jap Yen		500	22.50	
Total			118.80	
Stress (%)			Rupee equivalent (Rs. Crore)	Additional capital required (Rs. Crore)
5			1247.4	0.53
10			1306.8	1.07
15			1366.2	1.60
	Normal	5% stress	10% stress	15% stress
Capital funds	65*	65	65	65
Risk weighted assets	660*	665.84	671.78	677.72
CRAR	9.85	9.76	9.68	9.59

* Assumed

Example B :

(Rs. Crore)						
Currency	Rate (in Rs.)	OB/ OS	Position	Rupee equivalent		
USD	45	OS	3	13.50		
EURO	58	OS	4	23.20		
GBP	80	OB	2	16.00		
Sw. Franc	38	OS	5	19.00		
Jap Yen	0.45	OB	450	20.25		
Annual profits				18.00		
Currency	Rupee equivalent 5 % stress	Net impact on P/L account	Rupee equivalent 10% stress	Net impact on P/L account	Rupee equivalent 15% stress	Net impact on P/L account
USD	14.18	-0.68	14.85	-1.35	15.53	-2.03
EURO	24.36	-1.16	25.52	-2.32	26.68	-3.48
GBP	16.80	0.80	17.60	1.60	18.40	2.40
Sw. Franc	19.95	-0.95	20.90	-1.90	21.85	-2.85
Jap Yen	21.26	1.01	22.28	2.03	23.29	3.04
		-0.97		-1.95		-2.92
% of profits		5.4		10.8		16.2

Note:

- a) The Rupee has depreciated against all currencies by 5%, 10% and 15%.
- b) Since Rupee has depreciated, the bank incurs a loss on oversold positions and makes a gain on the overbought positions.