# Managing Stress Test for Banks: A Case Study on Ten Commercial Banks In Bangladesh

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**Abstract:** *The Economic globalization and diversification have increased the vulnerability of financial markets towards difficult to predictable phenomena, and the collapse of financial systems, composed of interconnectedness of financial institutions (mainly, commercial banks), in one country causes negative consequences in other parts of the world. These do create financial crises both in domestic and global financial markets creating financial instability. Stress testing is one of the effective and popular ways to alert bank management with regard to adverse unexpected outcomes related to variety of risks and provides an indication how much capital might be needed to absorb losses should large shocks occur. In this paper, we have studied stress test first from theoretical standpoint and then conducted stress testing of credit, equity and liquidity shocks of ten (10) commercial banks of Bangladesh as per the guidelines of Bangladesh Bank drafted in 2010.The study finds that the large number of banks (8 out of 10) are capable of withstanding liquidity shocks while a half of the banks under study (5 of 10) are resilient to defend the equity shocks. The credit shocks were varied under different categories. The study has also pointed out some additional CAR that the banks to collect to absorb the shocks. Finally, the researchers have submitted some interesting implications of the study might help the senior managements, policy makers, depositors, owners, and all other stakeholders of the banks.*
**Key Words**: *Stress Testing, Credit, Equity and Liquidity Shocks, CAR and Capital Buffer*

## I. Introduction

The international financial turmoil of the 1990s, the Asian crisis, and the recent worldwide economic meltdown, originated in the US, prompted the development of new frameworks, tools, and techniques to assess the stability of financial system [1].These shocking to the economy has augmented the importance of better understanding of potential vulnerabilities in the financial system and the measures to assess these vulnerabilities for both the regulators and the bankers. The regulators and managers of the financial system around the globe have developed a number of quantitative techniques to assess the potential risks to the individual institutions as well as financial system. A range of quantitative techniques that could serve the purpose is widely known as 'stress testing' [2]. IMF and Basel Committee on banking supervision have also suggested for conducting stress tests on the financial sector. At system level, stress tests are primarily designed to quantify the impact of possible changes in economic environment on the financial system [1]. At institutional level, stress testing techniques provide a way to quantify the impact of changes in a number of risk factors on the assets and liabilities portfolio of the institution.

In view of the above stands point, the central bank of Bangladesh, Bangladesh Bank, has ordered all banks and other financial institutions to undergo stress tests to check whether they are strong enough to hold up in the face of more difficulties and risks. Taking the above as essence of stress testing, this study seeks to establish stress testing of some selected commercial banks along with a theoretical snapshot of stress testing.

## II. Rationale of the Study

For recent economic meltdown, about 140 banks had to shutdown only in the US during 2009 and the total number of bank failure already stands at 86[3]. Bangladesh economy, having very low exposure to the world market, has also been affected to some extent. Amidst a lack of confidence in existing projections and risk metrics, the recent global market turmoil has raised unprecedented levels of interest from industry and regulators in stress testing methods and results for the following reasons [4]:

i. The size of losses incurred by banks and the succession of new write-downs each quarter has obliged financial institutions to drop their usual business forecasting and in some cases, to assess whether they would still be going concerns once the crisis bottomed out.

ii. Other risk measurement tools, such as value at risk and economic capital, which were based on assumptions of distributions, have proven to be too optimistic and inaccurate until significant calibration is performed.

Earlier, Bangladesh Bank, the central bank of Bangladesh, has issued core risk management guidelines so that banks can develop a sound risk management practice while carrying out their day-to-day activities. But,

this present risk management culture, based on normal business conditions and historical trends, is not enough to cope with the disorders that have happened in the financial system globally. Financial institutions around the world are increasingly employing stress testing to determine the impact of financial institutions under a set of exceptional but plausible assumptions through a series of test.

Under the above perspective, this study has been taken to conduct stress testing of some 10 selected commercial banks of Bangladesh which will make well cautious the policy makers, senior management, investors and all stratums of stakeholders with regard to financial sector of the country in general and banking sector in particular

## III. Objectives of the Study

The principal objective of the study is to conduct stress testing of some selected commercial banks. To achieve this principal objective, the following specific objectives have been outlined:
  i.   To give a theoretical insight of Stress Testing
 ii.   To conduct stress testing of the sample commercial banks with a view to simulate the effects of large financial shocks on the normal functioning of the sample banks and to determine  the impact of the potential event of deteriorations on mandatory capital requirements as suggested by  Basel 2.
iii.   To highlight some implications of the study

## IV. Literature Review

To [5], the first step in stress testing is usually to determine what risks will be stressed and specifying the scenarios, as this will assist in determining the methodology to be used and data requirements. In most instances historical data is employed to measure the sensitivity of commercial banks' balance sheet to various shocks. Three broad techniques have been used to implement the stress testing approach :( 1) time series analysis; (2) panel data regressions, and, (3) structural models [6]

The committee on the Global Financial System (CGFS) initiated a census of stress test scenario of 43 banks (commercial and investment banks) of 10 courtiers constituting 293stress test (stress test of potential market event, such as a stock market crash) and 131 sensitivity Stress test (stress test based on standardized moves in closely linked market risk factors, such as parallel yield curve shift) in early 2000 [7]. The census also reported that all the banks under study used stress test to understand the firm's risk profile and communicate with senior management. Just over half use stress test to set limits, one fifth use stress for capital allocation Two thirds of banks said that stress test result had directly led them to hedge their position. The report also pointed out that most banks run their stress test at high frequency (daily or weekly).

In France, during the 1$^{st}$ quarter of 2004, the General Secretariat of the Commission Bancaire (GSCB) and the Directorate General Economics and International Relations (DGEI)  of the Banque deFrance conducted an assessment of the stability of the French banking system  and its capacity to withstand a set of financial shocks through stress testing [8]. The result of the assessment, on the basis of 2003 reports and predicted performance in 2004 and 2005, indicated that the French banking system is currently is in a position to withstand major economic shocks.

In India, the committee of Financial Sector Assessment (CFSA) carried out single-factor stress  tests for the commercial banking sector covering credit risk, market/interest rate risk and liquidity risk [9].These stress tests for credit, market and liquidity risk show that Indian banks are generally resilient.

In the United States, stress tests were conducted on America's 19 largest bank holding companies (BHCs) [10]. These results revealed that nine (9) of the nineteen (19) banks tested already hold sufficient capital to operate through 2010 under the projected adverse scenario; those banks will not e required to raise additional capital. Ten (10) of the nineteen banks were found to need additional capital totaling $75 billion in order to weather a more adverse economic scenario.

In Switzerland, the Financial Market Supervisory Authority, FINMA, had been conducting the various stress tests on Swiss banks since 2008, designed to assess the impact that a sharp deterioration in economic conditions might have on Swiss banks [11].  Since the beginning of 2009, FINMA has stepped up these stress tests at the two large banks, Credit Suisse and UBS, which identified that even after the effect of a severe stress event the banks, would still maintain a stable capital base with a Tier 1 capital ratio over 8%

In Bangladesh, Stress tests were conducted by the staff team of the IMF and the World Bank  in 2009 to  assess the resilience of the banking sector covering the entire 48 banks operating in the country as of December 2008[12].The analysis depicts that credit risk continues to have a larger impact than any other single factor. The banking sector CAR declined by 1.4 % ad would require TK29 billion to meet the regulatory minimum of 10%.Five bank including two state owned are currently below the CAR. All nine foreign banks operating in Bangladesh were resilient. Exchange rate risk does not preset a major risk in Bangladesh because the net open position of many banks is minimal. The key results of the test have been show in the 'Table 1'

Table1: Banking Sector Stress Test of Bangladesh

| Shocks | System | SOBs* | PCBs** | FBI * | DFI * |
|---|---|---|---|---|---|
| *Initial Capital Adequacy Ratio(CAR)* | 10.10% | 7.8% | 11.2% | 23.8% | -3.3% |
| *CAR aftershocks:* | 7.7 | 2.2 | 10.2 | 23.9 | -11.5 |
| NPLs increase | 6.6 | 3.8 | 8.0 | 20.9 | -1.1 |
| Category shift from watch to substandard | 10.1 | 7.9 | 11.3 | 24.1 | -3.3 |
| Appreciation of Taka | 9.9 | 7.5 | 11.1 | 23.6 | -3.3 |
| Depreciation Taka | 9.7 | 7.2 | 11.1 | 22.9 | -3.8 |
| Upward parallel shift of yield curve | 10.4 | 8.4 | 11.4 | 24.8 | -2.9 |
| Downward parallel shift of yield curve | 8.4 | 0.7 | 10.7 | 22.2 | -2.5 |
| *Scenario Analysis* | 23.7 | 30.0 | 19.9 | 35.0 | 11.4 |
| *Initial Liquidity Ratios:* | 94.8 | 82.4 | 100.3 | 114.5 | 76.9 |
| SLR Ratio | | | | | |
| Liquid Assets/ Liquid Liabilities(LA/LL) Ratio | 89.2 | 77.5 | 94.4 | 107.8 | 72.4 |
| *Liquidity Ratios aftershocks:* | 19.8 | 23.7 | 17.2 | 30.8 | 9.7 |
| Run on deposit on (LA/LL) Ratio | | | | | |
| Run on deposit on SLR Ratio | | | | | |

Source: IMF Country Report on the Financial Stability Assessment on Bangladesh, 2010
* SOBs = state owned banks, PCBs =Private commercial banks, FBI=Foreign banking
Institutions, DFI= Development financial institutions

**4.1. Research Gap**

Though the issue "Stress Test" has got impressive attentions in the last few decades as to measure the level of economic resistance and to alert bankruptcy threat warning of the financial institutions in general, and the commercial banks in particular had the stress test scenario of a deepening economic and financial crises came truth, there is mere doubt that most of the studies related to the issue were done in the context of developed countries of the world and they are performed either by the domestic financial supervisory authority or by the IMF. Very few studies were done in the context developing countries, from academic research standpoints, especially in Bangladesh. There are lacks of sufficient academic research regarding the stress testing of the banking sector of Bangladesh excepting the study done by the IMF as mentioned earlier. In light of the above background, this study seeks to conduct stress testing of some selected commercial banks which is expected to flourish the conceptual, operational know how and the managerial implications of stress test in institutional level to the academicians and practitioners.

# V. Data &Research Methodology of the Study

The study has applied sensitivity and scenario analysis of stress testing as per the guidelines of Bangladesh Bank in order to predict the plausible vulnerabilities regarding interest rate shocks, credit shocks, liquidity shocks, equity price shocks and the foreign exchange shocks of ten (10) sample commercial banks. A list of the name of the sample 10 banks, taken random basis, has been appended (Appendix 1) in appendices. The calculation procedures to stress test have also been attached in appendix

The required data inputs to the conduct the study have been collected from the annual reports for the year 2009 of the ten (10) sample banks of the study. The available research papers, journals, working papers, different guidelines, relevant books and websites on this particular study have been used by the researchers to collect information associated with the study.

**5.1. Explanations of the Methodologies Used**

The study uses the mechanics of stress testing as developed by Bangladesh Bank, in 2010.The key points of the mechanics as under:

### 5.1.1 Three Hypothetical Scenarios of Stress Test

The Stress test of the sample banks would be operated under three hypothetical scenarios:

i. **Scenario 1(Minor Level Shocks)**: it is a situation which means that all risk elements of the sample banks will plausibly encounter small level of shocks at varied level for each risk factor.

ii. **Scenario 2(Moderate Level Shocks)**: it is a situation which means that all risk elements of the sample banks will plausibly encounter medium level of shocks at varied level for each risk factor.

iii. **Scenario 3(Major Level Shocks)**: it is a situation which means that all the risk elements of the banks will plausibly encounter medium level of shocks at varied level for each risk factor.

### 5.1.2. Other Methodological Issues: Risks that are covered under this stress Test

The guideline of Bangladesh Bank for stress testing, 2010 covers the following categories of risk under stress test:

a)     **Credit Risk:** The stress test for credit risk assesses the impact of increase in the level of nonperforming loans of the bank/FI. This involves six types of shocks:

i. **Increase in NPLs**: The three scenarios shall explain the impact of 1%, 2% and 3% of the total performing loans directly downgraded to bad/loss category having 100% provisioning requirement. The impact of resultant loss will be calibrated on CAR

ii. **Shift in NPLs Categories**: The three scenarios shall explain the impact of 50%, 80% and 100% downward shift in the NPL categories. The impact of resultant loss will be calibrated on CAR

iii. **Fall in Forced Sale Value (FSV) of Mortgaged collatera**l: The forced sale values of the collateral shall be given shocks of 10%, 20% and 40% decline in the forced sale value of mortgaged collateral. The impact of resultant loss will be calibrated in the CAR.

iv. **Increase in NPLs in particular one or two sector.** *e. garments & Textiles* and the respective provisioning*. The three scenarios shall explain the impact of 5%, 7.5% and 10% performing loans of particular 1 or 2 sectors directly downgraded to bad/loss category having 100% provisioning requirement. The impact of resultant loss will be calibrated in the CAR.

v. **Increase in NPLs due to default of Top 10 large borrowers**. The three scenarios shall explain the impact of 5%, 7.5%and 10% performing loans of Top 10 large borrowers directly downgraded to bad/los category having 100% provisioning requirement. The impact of resultant loss will be calibrated in the CAR.

b)     **Interest Rate Risk:** Interest rate risk is the potential that the value of the on-balance sheet and the off balance sheet positions of the bank/DFI would be negatively affected with the change in the interest rates. The vulnerability of an institution towards the adverse movements of the interest rate can be gauged by using duration GAP analysis

c)     **Equity Price Risk:** The stress test for equity price risk assesses the impact of the fall in the stock market index. Appropriate shocks will have to be absorbed to the respective securities if the current market value of all the on balance sheet and off balance sheet securities listed on the stock exchanges including shares, NIT units, mutual funds etc. exchanges including shares, NIT units, mutual funds etc falls at the rate of 10%, 20% and 30%respectively. The impact of resultant loss will be calibrated in the CAR.

d)     **Liquidity Risk:** The stress test for liquidity risk evaluates the resilience of the banks towards the fall in liquid liabilities. The ratio "liquid assets to liquid liabilities" shall be calculated before and after the application of shocks by dividing the liquid assets with liquid liabilities. Appropriate shocks will have to be absorbed to the liquid liabilities if the current liquidity position falls at the rate of 10%, 20% and 30% respectively.

The key input variables and the resultant output of the stress test of commercial banks     in Bangladesh has been summarized in 'Table 2"

## VI.       Why to Simulate the CAR?

In this study, the notion of stress is understood as a threat, and its existence has a negative effect on the "system" of banks, in particular the financial outcome which charges directly on capital adequacy ratio (CAR), and hence the value assigned to the owners. Such an assumption should be regarded as legitimate, because the owners are responsible for the nature and scale of the risk undertaken by the bank regardless of whether the source of risk is the environment (for example, a crisis), or    whether this is due to bad decisions of the owners[13]. This follows from the fact that banks are institutions of public trust believed to be given a special supervision and special rules in protecting deposits and other liabilities from any possible inability. Hence, depositors and other creditors of the bank should not be charged off for any negative effects.

**Table 2**: **Stress Testing components along with their Magnitude and impacts**

| Components of Shocks | Magnitude of Shocks | | | Final Impact on |
|---|---|---|---|---|
| | Scenario1 (minor) | Scenario2 (moderate) | Scenario3 (major) | |
| **Credit Shocks:** | | | | |
| 1.            Increase in NPLs | 1% | 2% | 3% | CAR% |
| 2.            Shift in NPLs Categories | 50% | 80% | 100% | CAR |
| 3.            Fall in FSV) of Mortgaged collateral | 10% | 20% | 40% | CAR |
| 4.            Increase in NPLs in particular one or two sector. | 5% | 7.5% | 10% | CAR |
| 5.            Increase in NPLs due to default of 10 large borrowers | 5% | 7.5% | 10% | CAR |
| **Interest Rate Shocks:** Increase in interest rate | 1% | 2% | 3% | CAR |
| **Exchange Rate Shocks:** Adverse moment of exchange rate | 5% | 10% | 15% | CAR |
| **Liquidity Shocks:** Fall in liquid liabilities | 10% | 20% | 30% | Liquidity ratio |
| **Equity Price Risk:** Fall in stock prices | 10% | 20% | 40% | CAR |

**Source:** Bangladesh Bank Stress Testing Guidelines, 2010, tabulated by authors

## VII.        Theoretical Basis of Stress Testing

### 7.1. Concept Stress Testing

[14] has defined stress testing as a series of analytical techniques, which measure the sensitivity of the "system" of financial institutions on risk factors. The term "system" is understood most commonly as a balance, and the stress-testing refers the various risk factors, such as price (impairment), which causes certain economic consequences. The Basel Committee on Banking Supervisions defines a stress test "as the evaluation of a bank's financial position under a severe but plausible scenario to assist in decision-making within the bank. The term 'stress testing' is also used to refer not only to the mechanics of applying specific individual tests, but also to the wider environment within which the tests are developed, evaluated and used within the decision-making process[15].

### 7.2 Basic Criteria for the Conduct of Stress Testing

From the viewpoint of the examination and presentation of analysis, stress tests can be divided into two groups: sensitivity tests and scenarios testing (Figure 1).

Sensitivity test assesses the impact of one or more risk variables on the financial situation of a bank. Scenarios tests are characterized by a more complicated structure and include a simulation of several variables at the same time, while such an analysis is more valuable than the previous one, because it takes into account the possible inverse correlation between the impacts of individual risks [13]. Both the scenarios test and sensitivity test may be subject to the same mathematical model, which generally can be divided into two types: deterministic models and stochastic models [16]. ***Deterministic models*** allow an analysis without taking into account the probabilities of events that shape the score size. ***Stochastic models*** are more sophisticated, are they take into account the likelihood of occurrence of certain risk factors. The data and parameters to conduct the sensitivity and scenario test are collected through historical analysis and hypothetically respectively. It is necessary to carry stress testing for short-term forecasts (for example, up to 1 year) and long-term (i.e. 1 to 5 years).

**Figure: Criteria for the conduct of stress Test.**



Source: own study based on (Basel Committee, 2009).
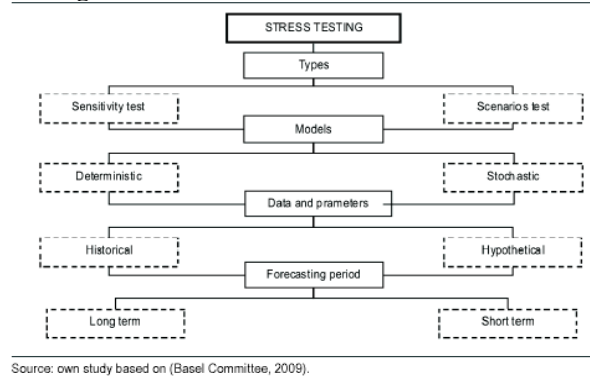
### 7.3. Critical Questions to include in Stress Testing

Stress testing can involve complex models and infrastructure, is frequently dependent on expert judgment, and yet it must be transparent, replicable and reliably able to support strategic business, capital-planning and management processes. To ensure its relevance, senior management is to make sure some key considerations as addressed below [4]:

   i.   What are the most significant risk types that could materially damage the firm?
  ii.   What techniques are presently in place that can already be used for stress testing purposes?
 iii.   What should the target stress testing framework be and how does it match present and evolving market practices?
  iv.   Is the target framework's sophistication proportionate to the size and complexity of the firm?
   v.   What meaningful scenarios adequately reflect the bank's activity and risk profile?
  vi.   Are calculation techniques reasonably sophisticated but straightforward enough that they can be understood by the management and practitioners?
 vii.   Have experienced experts such as line managers been sufficiently integrated into the stress testing process in order to question the validity of the calculated results?

### 7.4. Disclosure Issue of Stress Test Result

There is a consensus in Europe on the importance of stress testing but not on the release of results. Whereas US agencies released results of individual institutions, Switzerland and the EU have not disclosed the names of the banks that were tested [13]. Other issues like, choice of scenarios, information on the methods and measures of impact and the reliability of the calculation should be clearly explained by the conducting authority to avoid any misinterpretation by the users.

## VIII.    Results of Stress Testing Analysis of the Study and their Interpretations

### 8.1. Credit Shocks: Increase in Non Performing Loans, NPLs

Of the ten (10) sample banks tested for the credit shocks, increase in NPLs ad thus the impact on capital adequacy ratio at three plausible scenarios, four (4) banks namely EBL, IFIC, NBL and NCCBL are seemed to be well protected if the hypothetical scenarios of potential stress came truth and thus they would be in need of no additional capital as sown in (**Appendix4**).On contrary the resistance power of the other three(3) banks in the study seems to be poor and hence additional capital to absorb the potential loss is required up to 1.47%,2.6% 0.1%,2.31%3.7% and, 1.69% of RWA by DBL, SBL, SIBL, MBL, CBL, and OBL respectively. The researchers have replicated the calculation sample shown in appendix *3* for all the banks under study to get the stress test results of this shock factor.

### 8.2. Credit Shocks: Increase in Non Performing Loans of the loan given to top 10 large borrowers by the banks under study

Out of the ten (10) sample banks assessed through stress testing in this category, three (3) banks namely NBL, SBL, and OBL were found that they are required to make a provision of additional regulatory capital at a percentage (%) of 2.25,1.89. and 0.91 respectively (**appendix6**) to avoid any troublesome situations in the midst of stress considered. The researchers have not been able to gather requisite data from the annual reports of four (4) banks, EBL, DBL, MBL, and CBL, and hence no decision can be drawn over their capital vulnerability. However, all of these banks are holding a sound capital as per the Basel 2. Two (2) of the ten (10) banks under study have been proved as sound at any level of shocks and thus they are not needed to keep additional capital over minimum standard of 10%. The stress test result of this type threat factor for all the banks has been worked out as in the same way as the estimation shown in *appendix 5*.

**8.3 Credit Shocks: Increase in Non Performing Loans of the loan given to top 10 large borrowers by the banks under the study.**

Three (3) banks, IFIC, NBL, and SIBL, which has been examined from the credit shocks perspective for increasing in NPLs due to falling in bankruptcy of top ten (10) borrowers of respective banks, can be said to be resilient at every scenarios conducted as their capital adequacy ratios are well above of the minimum ratio (appendix 8) .The other seven (7) banks supposing EBL, NCCBL, DBL,SBL, MBL, CBL, and OBL would be expected to collect additional capital by the percentage (%) of 3.18,0.56,0.46,1.33,1.16,5, and 0.59 respectively (appendix 8) to consume any shocks to possibly occur. The researchers have estimated the revised CAR of all the banks at this type of shock by taking the procedure as shown in ***appendix 7***.

**8.4. The stress test for equity price risk due to fall in the stock market index**

The potential fall in stock market index by three scenarios ,10% fall,20% fall and 30% fall , don't create any negative pressure on the required level of capital adequacy of five (5) banks namely EBL, IFIC, NCCBL, NBL, and SIBL and thus it is not necessary for them to collect additional capital over minimum ratio (appendix10).On the other hand, the other five (5) banks will be struggling with their capital strength if the potential threat becomes true .Therefore ,it is recommended that the banks DBL, SIBL, MBL, CBL, and OBL should collect additional capital by the percentage of (%) 0.24,1.85,0.93,3.38,and 0.57 (appendix10) respectively to make cushion against any losses to potentially occur. The sample shown in appendix 9 has been used to work out all the results of this test.

**8.5. The stress test for Liquidity Shocks due to fall in liquid liabilities**

As per as the liquidity issue is concerned, the resilience of almost all, eight (8) banks, the banks under study are observed not to be fading in the hypothetical scenarios of shocks considered ( appendix12) while the liquidity ratio of two (2) other banks namely EBL and SBL will be weakening as soon as the mythical shocks becomes active. The sample module shown in *appendix 11* has been used to figure out all the results of this test summarized in appendix 12.

## IX.      Implications of Stress Test Result of the Study

Having summarized the main results of the study, the researchers would like to suggest some implications of the study that might help the senior managements, policy makers, depositors, owners, and all other stakeholders of the banks. The implications are: first, that it can be said that devising stress test the bank risk managers can identify and recognize the character of firm's exposure as well as the relative strengths and weaknesses of stress test analysis and other techniques to better simulate the risks at different hypothetical economic crises. Second, by interpreting the results the banks can assess their relative capital strength in terms of other banks in the banking sector. Third, the banks would be in a position to establish a capital buffer (shock absorbers on capital) to defend their risk appetite under stress conditions.

## X.      Scope for Further Research

The study has been conducted only taking ten (10) commercial banks of Bangladesh to assess the power of resilience, as per as the liquidity shocks ,equity and credit shock are concerned, using guidelines of Bangladesh Bank. But the interest rate shocks and foreign exchange shocks of these banks have not been conducted which can be topics of further research. Moreover, the stress test of contagion shocks, the shock that an initial (bank) failure may spill over to the rest of the (banking) industry and cause further (bank) failure, of the banks may also be a crucial research. Apart from these, potential researches of this field may also emphasize on the stress test of total financial institutions of Bangladesh, determining the capital buffer, examining the fitness of stress testing models practiced in developed financial markets, cost benefits analysis of stress test and the correlations of institutional level of stress test with macroeconomic label of stress test can be much impressive issues of stress test.

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**Appendix 1** Annual Reports, EBL,DBL,SBL,SIBL,MBL,OBL,IFIC,NBL,NCCBL,CBL,2009
**List of the banks selected for conducting stress testing as of 2009**

| SI.NO | Names Of the Banks |
|---|---|
| 1 | Eastern Bank Ltd ( EBL) |
| 2 | IFIC Bank Ltd. (IFIBL) |
| 3 | National Bank Ltd.(NBL) |
| 4 | NCC Bank Ltd (NCCBL) |
| 5 | Dhaka Bank Ltd.(DBL) |
| 6 | Shajalal Islami Bank Ltd.(SBL) |
| 7 | Social Islami Bank Ltd.(SIBL) |
| 8 | Mercantile Bank Ltd.(MBL) |
| 9 | The City Bank Ltd.(CBL) |
| 10 | One Bank Ltd.(OBL) |

**Appendix2**:
Key Information for stress testing of the sample banks (Figures in TK, core)

| Banks Items | EBL | DBL | OBL | SIBL | CBL | NBL | NCCBL | MBL | IFIC | SBL |
|---|---|---|---|---|---|---|---|---|---|---|
| Regulatory Capital (as per Basel 2) | 831.65 | 563.37 | 357.32 | 391.46 | 562.49 | 9123.99 | 632.24 | 499.54 | 492.88 | 543 |
| RWA ( as per Basel 2) | 4937.50 | 4932.93 | 3277.65 | 3224.31 | 6962.17 | 67281.91 | 4665.2 | 4768.57 | 3652.16 | 5704.47 |
| Liquid Assets | 1122.67 | 2197.08 | 958.73 | 1013.65 | 2376.19 | 1228.83 | 4227.38 | 1498.37 | 2083.81 | 731.24 |
| Liquid Liabilities | 1342.06 | 1119.39 | 615.25 | 494.74 | 950.02 | 1127.66 | 786.08 | 1005.70 | 909.86 | 881.79 |
| Total Loans | 4766.79 | 5290.98 | 32533 | 2658.06 | 43486 | 65129.29 | 4853.02 | 48295.55 | 3779.39 | 4395.83 |
| NPLs | 117.27 | 249.61 | 1756.782 | 84.9 | 2117.76 | 3881.706 | 142.05 | 261.24 | 232.0545 | 41.32 |
| Loan to top 10 large borrower | n/a | n/a | 774.59 | 294.48 | n/a | 1265.92 | 882.37 | n/a | 761.93 | 873.7 |
| Loan to garments/textile/large industry sector | 5638.83 | 972.90 | 538.89 | 170.40 | 2223.87 | 1031.79 | 2108.15 | 851.09 | 616.34 | 527.5 |
| Total exposure in stock market | 843.41 | 496.67 | 306.85 | 355.58 | 586.42 | 819.68 | 603.44 | 429.63 | 419.75 | 492.66 |

Source:  authors own study from Annual Reports of 10 Sample Commercial Banks, 2009

**Appendix3:**

The credit shocks that arises due to the increase of NPL ratio and thereby the impact on CAR ratio of all the sample banks under the study, after a 1%,2% and 3% increase of NPL of the total performing loan ,have been calculated as: taking following sample calculation of Shajalal Islami bank Ltd. as a replica

| SI. NO. | Magnitude of Shock | *Scenario 1* *1%* | *Scenario 2* *2%* | *Scenario3* *3%* |
|---|---|---|---|---|
| A | Total Loan | 4395.83 | 4395.83 | 4395.83 |
| B | Non Performing Loan | 41.32 | 41.32 | 41.32 |
| C | Total Performing Loan (A-B) | 4354.51 | 4354.51 | 4354.51 |
| D | Increase in NPL (C*% of shocks | 43.5451 | 87.0902 | 130.6353 |
| E | Increase in provision (D-0) | 43.5451 | 87.0902 | 130.6353 |
| F | Tax adjusted provision D-(1-0) | 43.5451 | 87.0902 | 130.6353 |
| G | Revised Regulatory capital(Capital-D) | 499.4549 | 455.9098 | 412.3647 |
| H | Revised Risk Weighted Assets RWA,(RWA-D) | 5660.925 | 5617.38 | 5573.835 |
| I | Revised CAR(G/H) | 8.82% | 8.11% | 7.39% |

Source: authors own study from Annual Reports of Sample Commercial Banks, 2009

**Appendix4:**
**Stress Test Result of the Credit Shocks (Increase in Non Performing Loans, NPLs) of all the banks under study**

| Names Of the Banks | Without Stress CAR (Minimum, CAR as per Basel2 =10%) | With Stress: Revised Capital Adequacy Ratio in % (CAR) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Scenario 1 1% | Fall in potential threat if revised CAR <10% | Scenario 2 2% | Fall in potential threat if revised CAR <10% | Scenario3 3% | Fall in potential threat if revised CAR <10% | Need of additional capital (Minimum , CAR-CAR At Scenario3) |
| Eastern Bank Ltd | 16.84 | 16.06 | ×* | 15.24 | × | 14.42 | × | No |
| IFIC Bank Ltd. | 13.50 | 12.65 | × | 11.78 | × | 10.90 | × | N0 |
| National Bank Ltd. | 13.56 | 12.77 | × | 11.96 | × | 11.13 | × | NO |
| NCC Bank Ltd | 13.55 | 12.67 | × | 11.77 | × | 10.88 | × | NO |
| Dhaka Bank Ltd. | 11.31 | 10.40 | × | 9.48 | √ | 8.53 | √ | Yes,1.47% |
| Shajalal Islami Bank Ltd. | 9.52 | 8.82 | √* | 8.12 | √ | 7.40 | √ | Yes,2.6% |
| Social Islami Bank Ltd. | 12.00 | 11.43 | × | 10.78 | × | 9.99 | √ | Yes,0.1% |
| Mercantile Bank Ltd. | 10.48 | 9.57 | √ | 8.63 | √ | 7.69 | √ | Yes,2.31% |
| The City Bank Ltd. | 11.29 | 7.41 | √ | 6.86 | √ | 6.30 | √ | Yes,3.7% |
| One Bank Ltd | 10.90 | 10.05 | × | 9.19 | √ | 8.31 | √ | Yes,1.69% |

**Source:** Calculation done by the authors on the basis of data taken from annual report of 2009 of the respective banks, *×= No chance to fall in threat, *√= Chance to fall in threat

**Appendix5:**

The credit shocks that arises due to increase in NPLs of the loan disbursed to top 10 large loan borrower and thereby the impact on CAR ratio of all the sample banks under the study, after a 5%, 7.5% and 10% increase of NPLs under this category, have been calculated as: taking   following sample calculation of Shajalal Islami bank Ltd. as a replica

| SI. NO. | Magnitude of Shock | *Scenario 1 5%* | *Scenario 2 7.5%* | *Scenario3 3%* |
|---|---|---|---|---|
| A | Loan to Top 10 large loan borrower | 873.7 | 873.7 | 873.7 |
| B | Increase in NPL (A*% of shocks | 43.68 | 65.52 | 87.37 |
| C | Increase in provision (B-0) | 43.68 | 65.52 | 87.37 |
| D | Tax adjusted provision B-(1-0) | 43.68 | 65.52 | 87.37 |
| E | Revised     Regulatory capital(Capital-B) | 499.32 | 477.48 | 455.63 |
| F | Revised  Risk  Weighted Assets RWA,(RWA-B) | 5660.79 | 5638.95 | 5617.1 |
| G | Revised CAR(E/H) | 8.82 | 8.46 | 8.11 |

Source:  authors own study from Annual Reports of Sample Commercial Banks

**Appendix6:**

Stress Test Result of the Credit Shocks of all  the banks under study due to  increase in NPLs of the loan disburdes to Top 10 Large Loan *Borrower*

| Names   Of the Banks | Without Stress CAR (Minimum, CAR as per Basel2 =10%) | With Stress: Revised Capital Adequacy Ratio in %  (CAR) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Scenario 1 5% | Fall in potential threat if revised CAR <10% | Scenario 2 7.5% | Fall in potential threat if revised CAR <10%% | Scenario3 10% | Fall in potential threat if revised CAR <10% | Need of additional capital (Minimum, CAR-CAR At Scenario3 |
| Eastern    Bank Ltd | 16.84 | n/a * | n/a* | n/a* | n/a* | n/a* | n/a* | n/a* |
| IFIC Bank Ltd. | 13.50 | 12.65 | × | 12.12 | × | 11.65 | × | No |
| National   Bank Ltd. | 13.56 | 8.487 | √ | 7.78 | √ | 7.75 | √ | Yes,2.25% |
| NCC Bank Ltd | 13.55 | 12.72 | ------ | 12.30 | ------ | 11.88 | ----- | No |
| Dhaka     Bank Ltd. | 11.31 | n/a* | n/a* | n/a* | n/a* | n/a* | | n/a* |
| Shajalal  Islami Bank Ltd. | 9.52 | 8.82 | √ | 8.46 | √ | 8.11 | √ | Yes,1.89% |
| Social    Islami Bank Ltd. | 12.00 | 11.58 | × | 11.01 | × | 10.44 | × | No |
| Mercantile Bank Ltd. | 10.48 | n/a* | n/a* | n/a* | n/a* | n/a* | n/a* | n/a* |
| The City Bank Ltd. | 11.29 | n/a* | n/a* | n/a* | n/a* | n/a* | n/a* | n/a* |
| One Bank Ltd | 10.90 | 9.83 | √ | 9.29 | √ | 9.09 | √ | Yes,0.91% |

Source: authors own study from Annual Reports of Sample Commercial Banks, * N/A *= calculation was not done due to data unavailability

**Appendix7:**

The credit shocks that arises due to increase in NPLs of the loan disbursed to garments/ textile /large industrial sector and thereby the impact on CAR ratio of all the sample banks under the study, after a 5%,7.5% and 10% increase of NPLs under this category ,have been calculated as: taking   following sample calculation of Shajalal Islami bank Ltd. as a replica

| SI. NO. | Magnitude of Shock | *Scenario 1 5%* | *Scenario 2 7.5%* | *Scenario3 3%* |
|---|---|---|---|---|
| A | Loan to Garments Sector | 527.5 | 527.5 | 527.5 |
| B | Increase in NPL (A*% of  shocks | 26.375 | 39.5625 | 52.75 |
| C | Increase in provision (B-0) | 26.375 | 39.5625 | 52.75 |
| D | Tax adjusted provision B-(1-0) | 26.375 | 39.5625 | 52.75 |
| E | Revised Regulatory capital(Capital-B) | 516.625 | 503.4375 | 490.25 |
| H | Revised Risk Weighted Assets RWA,(RWA-B) | 5678.095 | 5664.908 | 5651.72 |
| I | Revised CAR(E/H) | 9.09% | 8.88% | 8.67% |

Source: authors own study from Annual Reports of Sample Commercial Banks

**Appendix8:**

Stress Test Result of the Credit Shocks due to increase in  Non Performing Loans, NPLs,  of the loan disbursed to garments/ textile /large industrial sector by  all  the banks under study

| Names  Of the Banks | Without Stress CAR (Minimum, CAR as per Basel2 =10%) | With Stress: Revised Capital Adequacy Ratio in %  (CAR) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Scenario 1 5% | Fall in potential threat if revised CAR <10% | Scenario 2 7.5% | Fall in potential threat if revised CAR <10% | Scenario3 10% | Fall in potential threat if revised CAR <10% | Need of additional capital (Minimum, CAR-CAR At Scenario3 |
| **Eastern  Bank Ltd** | 16.84 | 11.80 | × | 9.05 | √ | 6.12 | √ | Yes,3.18% |
| **IFIC     Bank Ltd.** | 13.50 | 12.75 | × | 12.38 | × | 12.01 | × | No |
| **National Bank Ltd.** | 13.56 | 13.49 | × | 13.36 | × | 13.42 | × | No |
| **NCC     Bank Ltd** | 13.55 | 11.55 | × | 10.51% | × | 9.46 | √ | Yes,0.56% |
| **Dhaka   Bank Ltd.** | 11.31 | 10.43 | × | 9.99 | √ | 9.54 | √ | Yes,0.46% |
| **Shajalal Islami   Bank Ltd.** | 9.52 | 9.09 | √ | 8.88 | √ | 8.67 | √ | Yes,1.33% |
| **Social   Islami Bank Ltd.** | 12.00 | 11.83 | × | 11.79 | × | 10.44 | × | No |
| **Mercantile Bank Ltd.** | 10.48 | 9.66 | √ | 9.26 | √ | 8.84 | √ | Yes,1.16% |
| **The       City Bank Ltd.** | 11.29 | 6.47 | √ | 5.71 | √ | 5.00 | √ | Yes,5% |
| **One Bank Ltd** | 10.90 | 10.16 | × | 9.7 | √ | 9.41 | √ | Yes,0.59% |

Source: authors own study from Annual Reports of Sample Commercial Banks

**Appendix9:**

The stress test for equity price risk due to fall in the stock market index and thereby the impact on CAR ratio of all the sample banks under the study, after a 10%,20% and30% increase of NPLs under this category ,have been calculated as: taking following sample calculation of Shajalal Islami bank Ltd. as a replica

| SI. NO. | Magnitude of Shock | *Scenario 1* *10%* | *Scenario 2* *20%* | *Scenario3* *30%* |
|---------|--------------------|--------------------|--------------------|--------------------|
| A | Total exposure in stock market | 492.66 | 492.66 | 492.66 |
| B | Fall in stock price (A*% of shocks | 49.266 | 98.532 | 147.798 |
| C | Tax adjusted loss( B-(1-42.50% of B) | 28.32795 | 56.6559 | 84.98385 |
| D | Revised Regulatory capital(Capital-C) | 514.6721 | 486.3441 | 458.0162 |
| E | Revised Risk Weighted Assets RWA,(RWA-C) | 5676.142 | 5647.814 | 5619.486 |
| F | Revised CAR(D/E) | 9.06% | 8.61% | 8.15% |

Source: authors own study from Annual Reports of Sample Commercial Banks

**Appendix10:**

Stress Test Result of the Test of Equity Shocks: Shocks due to threat in exposures of stock market

| Names Of the Banks | Without Stress CAR (Minimum, CAR as per Basel2 =10%) | With Stress: Revised Capital Adequacy Ratio in %  (CAR) | | | | | | |
|--------------------|------------------------------------------------------|---------------------------------------------------------|---|---|---|---|---|---|
| | | Scenario 1 10% | Fall in potential threat if revised CAR <10% | Scenario 2 20% | Fall in potential threat if revised CAR <10% | Scenario 3 30% | Fall in potential threat if revised CAR <10%% | Need of additional capital (Minimum, CAR-CAR At Scenario3 |
| **Eastern Bank Ltd** | 16.84 | 16.02 | × | 15.18 | × | 14.32 | × | NO |
| **IFIC Bank Ltd.** | 13.50 | 12.92 | × | 12.37 | × | 11.75 | × | No |
| **National Bank Ltd.** | 13.56 | 12.86 | × | 12.33 | × | 11.70 | × | No |
| **NCC Bank Ltd** | 13.55 | 12.90 | × | 12.55 | × | 11.58 | × | No |
| **Dhaka Bank Ltd.** | 11.31 | 10.81 | × | 10.28 | × | 9.76 | √ | Yes,0.24% |
| **Shajalal Islami Bank Ltd.** | 9.52 | 9.07 | √ | 8.61 | √ | 8.15 | √ | Yes,1.85% |
| **Social Islami Bank Ltd.** | 12.00 | 11.58 | × | 11.01 | × | 10.44 | × | No |
| **Mercantile Bank Ltd.** | 10.48 | 10.01 | × | 9.54 | √ | 9.07 | √ | Yes,0.93% |
| **The City Bank Ltd.** | 11.29 | 7.51 | √ | 7.07 | √ | 6.62 | √ | Yes.3.38% |
| **One Bank Ltd** | 10.90 | 10.42 | × | 9.93 | √ | 9.43 | √ | Yes,0.57% |

Source: authors own study from Annual Reports of Sample Commercial Banks

**Appendix11:**

The liquidity shock that results from the revised liquid ratio of all the 10 banks under the study, after a 10%, 20% and 30% fall in liquid liability, has been calculated taking  following sample calculation of Shajalal Islami bank Ltd. as a replica

| SI. NO. | Magnitude of Shock | *Scenario 1 10%* | *Scenario 2 20%* | *Scenario3 30%* |
|---|---|---|---|---|
| A | Liquid Assets(L A) | 7312497077 | 7312497077 | 7312497077 |
| B | Liquid Liabilities(LL) | 8817958379 | 8817958379 | 8817958379 |
| C | Liquidity Ratio (%) (A/B) | 0.829273258 | 0.829273258 | 0.829273258 |
| D | Fall in liquid liabilities (B*% of shocks) | 881795837.9 | 1763591676 | 2645387514 |
| E | Revised Liquid Assets(A-D) | 6430701239 | 5548905401 | 4667109563 |
| F | Revised Liquid Liabilities(B-D) | 7936162541 | 7054366703 | 6172570865 |
| G | Revised Liquid Ratio (%)(E/F) | 0.81030362 | 0.786591573 | 0.756104655 |

Source:  authors own study from Annual Reports of Sample Commercial Banks, 2009

**Appedix12:**

Stress Test Result of Liquidity Shocks of the banks under study

| Names Of the Banks | Without Stress CAR (Minimum, CAR as per Basel2=10%) | With Stress: Revised Liquidity Ratio | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Scenario 1 10% | Fall in Liquidity Ratio | Scenario 2 20% | Fall in Liquidity Ratio | Scenario 3 30% | Fall in Liquidity Ratio % | Threat On liquidity |
| **Eastern BankLtd** | 0.83 | 0.81 | √ | 0.79 | × | 0.76 | × | yes |
| **IFIC Bank Ltd.** | 2.29 | 2.43 | × | 2.61 | × | 2.84 | × | no |
| **National Bank Ltd.** | 1.08 | 1.09 | × | | × | 1.12 | × | no |
| **NCC Bank Ltd** | 5.37 | 5.86 | × | 6.74 | × | 7.25 | × | no |
| **Dhaka Bank Ltd.** | 1.96 | 0.11 | × | 2.20 | × | 2.37 | √ | no |
| **Shajalal Islami Bank Ltd.** | 0.82 | 0.81 | √ | 0.78 | √ | 0.75 | √ | yes |
| **Social Islami Bank Ltd.** | 2.05 | 2.16 | × | 2.30 | × | 2.49 | × | no |
| **Mercantile Bank Ltd.** | 1.48 | 1.54 | | 1.61 | √ | 1.69 | √ | no |
| **The City Bank Ltd.** | 2.50 | 2.66 | √ | 2.87 | √ | 3.14 | √ | no |
| **One Bank Ltd** | 1.55 | 1.62 | × | 1.69 | √ | 1.79 | √ | no |

Source:  authors own study from Annual Reports