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Stress Testing on Private Commercial Banks in Bangladesh

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Abstract: One of the most reliable and well-liked methods for signaling bank management of negative repercussions associated to possible threats is stress testing. It also depicts how much capital adequacy ratio (CAR) may be required to absorb losses if any substantial shocks occur. As per Bangladesh Bank standards, researchers conducted load testing on 10 Bangladeshi private commercial banks' non-performing loans (NPL), non-performing loans in two key sectors, equity price risk, liquidity shocks, and interest rate shocks in this article. Data from the annual reports of the chosen banks for the years 2016, 2017, and 2018 were used in this analysis. According to the study, all 10 banks in the years 2016, 2017, and 2018 need more capital due to the indicator NPL. In 2016, 2017, and 2018, Prime Bank was able to withstand NPL shocks in two crucial industries. Bank Asia and Jamuna bank were also able to do so in those years. In 2016, 2017, and 2018, four out of ten banks were able to surpass the shock threshold when it comes to equity price risk. Under the liquidity indicator, none of them can sustain operations in three years without additional financing. Finally, out of 10 banks, six banks do not need any more capital when the indicator interest rate is taken into account. The study also highlights certain extra CAR that the banks might enhance to withstand shocks. Finally, several intriguing study implications are demonstrated in this paper, which may be useful to senior management, decision-makers, depositors, owners, and other bank stakeholders.

Keywords: Stress Test, Credit Risk, Non-performing Loan, Equity Price Risk, Liquidity Shock, Interest Rate Shock

1. Introduction

Carefully considering the financial crisis of recent decades including the world economic crisis of 2008, 2012 and post years the decision makers like to know about the vulnerabilities of the financial system and the probable solutions to the problems. And for that instance stress testing is one of the most effective methods for quantifying financial sector vulnerabilities. The key element of the stress testing definition is the notion of an exceptional but possible event. This article represents the outcome from the stress testing on 10 PCB banks operating in Bangladesh. Here, five indicators have been used for analysing three years of data of those 10 banks for this test such as increase in Non-performing loan (NPL) to all sectors, increase in NPL to two major sectors, fall the price of stock, fall the value of liquid liabilities and changes in equity due to change increase in interest rate. Much importance has been given on stress testing because to

analyse financial sector, the term stress testing refers to a range of techniques used to help measure the vulnerability of financial institution and financial system. Stress test were developed for use at the portfolio level, to understand how the value of a portfolio changes if there are large changes to its different risk factors such as credit risk, interest rate. On the other hand stress testing is one of the most widely used risk management tools for financial institutions to know whether financial institutions are financially capable enough to defend losses that could occur in various unfavourable scenarios. Because of the financial crisis of the recent years not only the developed countries were affected badly but also developing country like Bangladesh had to go though financial trouble. World Bank, International Monetary Fund (IMF) is trying to encourage each central bank so that local bank of particular country can do stress test. Here Only 10 banks have been considered to understand the overall banking industry and to justify the scenario, and five

indicators have been used. It would be better if more indicators could be used. Exchange rate was originally intended to be taken into consideration, but in the end, this indicator could not be because Bangladesh's exchange rate is handled floating and is supervised by Bangladesh Bank (Central Bank of Bangladesh). In this paper there are six parts such as Introduction, Literature Review, Research and Data Methodology, Interpretation, Conclusion and Findings. This paper will help senior management of the banks, policy makers, depositors, owners and all other stakeholders of the banks. By interpreting the results banks can assess their relative capital strength in terms of other banks in the banking sector.

1.1. Rationale of the Study

There are many reasons for proposing this study. Some of them are briefly discussed below. Because of the economic instability of recent years many developed countries including the USA, UK, France Germany and so on affected too much but at the same time developing countries like Bangladesh also got affected. Still United States is the major player in world economics and our foreign remittance mainly depend on readymade garments, textile and United States is the big market for our readymade garments and textile industry so, if the economic condition of the USA becomes worse than somehow it will create negative impact in Bangladesh. In addition, most of the Bangladeshi schedule banks gave huge amount of money as loan in garments and textile industry. Since, most of the banks had huge investment in the stock market so; they had to face huge loss because of that crisis. During the stock market crisis all schedule banks had to calculate further how much money they require to operate their business properly subsequently they could not figure out the right amount because of continuous crisis in the stock market at the same time Bangladesh Bank changed the rules which was regarding stock market investment for schedule banks as a result they were forced to sell out some of the share at minimum price. So, after completing this study it is desired to find out how much money banks require operating their business properly. This study will further be beneficial to know about Bangladeshi banking sector as well as relevant sector. Besides that, this paper is being prepared to publish so that readers get benefited. It is hoped that this paper will be an asset for the future.

1.2. Objectives of the Study

By doing this study it is desired to find out
1) To provide a brief overview of stress testing theoretically.
2) To carry out stress testing on a sample of commercial banks in order to assess the effects of possible deteriorations on Basel II's specified necessary capital requirements.
3) To assess Bangladesh's overall banking situation.
4) To assess Bangladesh's overall banking environment in the wake of the share market crisis and mismanagement in the credit sector.
5) To determine each bank's specific position in the context of an economic crisis.

1.3. Scope of the Study

Finding the set of pertinent financial institutions for the study of stress tests is the key issue here. The scope of the stress testing exercise should be broad enough to reflect a major critical mass of the financial system while keeping the number of financial institutions covered at a reasonable level. They suggest setting up a cut off criterion based on the combined market share of the participating institutions. If there are substantial connections between bank and non-bank financial organizations, leaving them out of the research would prevent us from finding a number of systemic weaknesses.

Concerning risk exposure, there is another another conundrum. Measuring risk exposure is a difficult undertaking, even once the scope of the research has been defined in terms of a particular set of institutions and asset classes. In actuality, portfolios change continuously over time in accordance with the unique investing and hedging strategies employed by various institutions. This makes it much more challenging to assess risk exposure. It is preferable to take the maturity length of inter-sensitive assets into account when calculating interest rate risk for the financial institution. However, financial institutions may choose not to share it out of concern for their clients' privacy. In addition, data limitations make it difficult to pinpoint the pertinent portfolio. Due to these limitations, the majority of the work to date has concentrated on creating fictitious portfolios whose compositions approximate the distribution of asset and risk exposure in a system. Contrarily, in studies that make use of actual data, the analysis is frequently limited to a small number of significant major banks, which also reflects the limited availability of public market data on these institutions. When it comes to the asset classes that should be considered for the study, stress tests have so far mostly focused on the banking industries, paying particular attention to interbank loans, consumer and business loans, and corporate loans. The corporate exposure by industrial sector has only been broken out in a few studies.

1.4. Limitation of the Study

Not all private commercial banks doing business in Bangladesh have been taken into account. Additionally, it would be preferable if it could be taken into account some public commercial banks and non-banking financial institutions (NBFI). Here, financial soundness has been assessed and supported using five metrics. However, it would be great if additional indications could be used. But we were only able to apply a maximum of five criteria because of a lack of information and time. However, we have initially just commenced to obtain information on six indicators. However, after a given period of time, we were unable to collect data

on a particular criterion, like "loan to top 10 major borrowers," because some banks only included total loans and advances in their annual reports, rather than this specific information. We first planned to evaluate another indicator, the exchange rate, but eventually opted against doing so because Bangladesh Bank, the Central Bank of Bangladesh, keeps close eye on the country's floating exchange rate. This study excludes other variables including market risk, value at risk, and commodity price risk.

2. Literature Review

The use of stress tests to gauge economic resilience and warn financial institutions of the potential of bankruptcy has gained significant attention in recent years. Commercial banks in particular have used stress tests to simulate varying economic circumstances. There are three broad types of stress tests: sensitivity analysis, scenario analysis, and contagion analysis. Sensitivity analysis scrutinizes the effects of changes in important economic variables (such as interest rates and exchange rates), scenario analysis evaluates the effects of exceptional but plausible scenarios, and contagion analysis attempts to account for the transmission of shocks from individual exposure to the system as a whole [1]. The soundness of the financial system must be measured with high-quality quantitative inputs. And financial soundness indicators (FSI) are gauges of a nation's financial institutions' existing soundness and health. There is no debate that the preponderance of research on the subject were conducted in the setting of industrialized nations and were either carried out by local regulatory authorities like the Central Bank or the International Monetary Fund (IMF). From an academic study standpoint, few studies have been conducted in the setting of developing nations, particularly in Bangladesh. With the exception of the IMF report, there is not enough scholarly research on the stress testing of Bangladesh's banking system. In light of the aforementioned context, this study aims to perform stress tests on a few picked private commercial banks (PCB), with the intention that it would advance academics' and practitioners' operational expertise and management implications of stress tests at the institutional level. New frameworks, tools, and techniques to evaluate the stability of the financial system have been developed in response to the international financial turmoil of the 1990s, the Asian Crisis, and the most recent global economic recession, all of which had their origins in the United States of America (USA) [2]. The shock to the economy has increased the need for regulators and bankers to have a better awareness of possible exposures in the financial system and actions to address these exposures. A number of quantitative techniques have been developed by financial system managers and regulators around the world for the purpose of what is commonly referred to as "stress testing." Stress tests for the financial industry have also been endorsed by the IMF and Basel Committee on Banking Supervision. At the system level, stress tests are generally made to estimate how potential changes in the economic environment may affect the financial system [3]. At the institutional level, stress testing methods offer a mechanism to calculate the consequence of changes in a variety of risk variables on the institution's asset and liability portfolio. These tests concentrate on identifying portfolio exchange rate, interest rate, and credit risk as well as possible interbank contagion effects. Credit risk is used to gauge the quality of upcoming portfolios [4]. The European insurance sector's stress tests focused on the solvency position, the capital that was available before and after the tests, what-if scenarios, the value of corporate bonds and stocks, movements of assets and liabilities, and five account risks, including interest rates, equity risk, property, credit spread, and fall risk [5]. Different risks have been addressed by Financial Sector Assessment Programs (FSAPs) in stress tests, including those related to credit risk, market risk (including interest rate, exchange rate, equity, and volatility risks), real estate, and other asset price risks, liquidity risk, and contagion risk [6, 7]. Capital sufficiency, asset quality, profits and profitability, liquidity, and susceptibility to market risk are all hallmarks of financial soundness [8]. There are several stress test signals, such as credit risk owing to NPL [9, 10], liquidity risk, stock price risk, and credit risk resulting from NPLs in two sectors [11]. NPL, a growth in NPL in two sectors, a decline in the value of eligible securities, the bank's top ten debtors, interest rate output, and liquidity output are among the indicators used by the Bangladesh Bank when providing guidelines for stress tests (Bangladesh Bank). Following the computation, such institutions should increase the capital needed to comply with regulatory requirements [12]. The stability of the Italian banking system is tested under stress using a variety of measures, including the macroeconomic (output and inflation) ratio, the capital-to-loan ratio, the default rate, the NPL-to-loan ratio, and the interest margin to total intermediated funds ratio [13]. Different modeling approaches have been introduced thus far, largely relying on the availability of data [14]. Two types of approaches may be distinguished: those that rely on information on loan performance, such as NPL, loan loss provisions (LLPs), and historical default rates, and those that rely on micro-level information about the default risk of the household and/or business sectors. The central bank keeps an eye on certain approaches for examining possible indicators of financial system instability. Since the early 1990s, banks have used stress testing extensively, and today's authorities mandate them for tracking credit and market risks in banks' portfolios [15]. These approaches seek to give a comprehensive assessment of the bank's risk-bearing capability.

3. Methodology of the Study

The study used a stress testing scenario in accordance with Bangladesh Bank rules to identify the likely vulnerabilities of 10 banks with relation to credit shocks, liquidity shocks, stock price shocks, and interest rate shocks. The 10 sample banks' annual reports for the years 2016, 2017, and 2018 provided the necessary data inputs for conducting the study. We gathered information for the study by consulting the

available research papers, journals, working papers, guidelines from various central banks, pertinent books, newspapers, and websites. We did not need to employ a questionnaire because we had data from the annual report, and Excel software was used to compute each indicator.

Other Methodological Issues: Risks that are considered under this stress test and their calculation format:

a) Credit risk due to increase in NPL's (Format 1): The

following format has been used to compute the stress test of credit risk caused by the study's rising level of NPLs. Eight factors were taken into account in this computation, such as the total loan to the economy, the bank's NPL, and the amount of performing loans. To evaluate this indicator, we introduced three level shocks: 2%, 5%, and 10% increases in NPLs will result in updated Capital Adequacy Ratios (CAR).

Table 1. *NPL at different level shocks.*

SL No.	Magnitude of the shock	Scenario 1, (2%)	Scenario 2, (5%)	Scenario 3, (10%)
A	Total Loan			
B	Nonperforming loan (A-B)			
C	Total Performing Loan			
D	Increase in NPL (% of shocks)			
E	Increase in provision (D-0)			
F	Tax adjusted provision D-(1-0)			
G	Revised regulatory capital (Capital-D)			
H	Revised Risk Weighted Assets (RWA-D)			
I	Revised CAR (G/H)			

b) Credit risk due to Increase in NPL's in major investment in two sector (Format 2) ex. Garments, Textile and Housing. For this calculation, we took into account seven different factors, such as the provision of loans to two important investment sectors. By

performing the calculations, we can determine how the CAR will change if the NPL rises as a result of increasing shock levels of 5%, 10%, and 15% respectively.

Table 2. *NPL in two major sectors at different level shocks.*

SL No.	Magnitude of the shock	Scenario 1, (5%)	Scenario 2, (10%)	Scenario 3, (15%)
A	Loan to top 2 sector			
B	Increase in NPL (% of shock)			
C	Increase in provision (B-0)			
D	Tax adjusted provision B-(1-0)			
E	Revised regulatory capital (Capital-B)			
F	Revised RWA (RWA-B)			
G	Revised CAR (E/F)			

c) Equity price risk (Format 3): The stress test for equity price risk evaluates the effects of a decline in stock price. If the current market value of all on- and off-balance sheet assets listed on the stock exchange, including shares and mutual funds, falls at the rate of

three shock levels—10%, 25%, and 50%—respectively, appropriate shocks will need to be absorbed by the various securities. We took six factors into account while doing the computations to determine the updated CAR after each shock.

Table 3. *Equity Price risk at different level Shocks.*

SL No.	Magnitude of the stock	Scenario 1, (10%)	Scenario 2, (25%)	Scenario 3, (50%)
A	Total exposure in stock market			
B	Fall in stock price (% of shock)			
C	Tax adjusted loss (B+(1-42.5% of B)			
D	Revised regulatory capital (Capital-C)			
E	Revised RWA (RWA-C)			
F	Revised CAR (D/E)			

d) Liquidity risk (Format 4): The flexibility of the banks toward unfavorable changes in the influx and outflow of liquid assets is assessed by the stress test for liquidity risk. Assumed shock scenarios include liquid asset outflow claims for liabilities appearing significantly earlier displaying claims from all buckets moving in the previous by the standard rates but liquid asset inflow claims for assets in anticipated buckets are being

postponed by a standard rates to the next buckets. The bank's ability to balance its books is also being tested by applying the usual shocks under the assumption that the market would continue to decline. 10%, 20%, and 30% shock situations are the norm. To do this calculations we have considered seven particulars as well as by doing this calculations we want to found what will be revised CAR after each shock level.

Table 4. Liquidity risk at different level shocks.

SL No	Magnitude of the stock	Scenario 1, (10%)	Scenario 2, (20%)	Scenario 3, (30%)
A	Liquid Asset (LA)			
B	Liquid Liabilities (LL)			
C	Liquid ratio (%) (A/B)			
D	Fall in liquid Liabilities (% of shock)			
E	Revised liquid Asset (A-D)			
F	Revised liquid Liabilities (B-D)			
G	Revised liquid Ratio (%) (E/F)			

e) Appropriate shocks due to increase in interest rate in the economy (Format 5). The value of the bank's on- and off-balance-sheet investments might be negatively impacted by interest rates if they shift. Simple sensitivity analysis and duration GAP analysis may both be used to assess the banks' susceptibility to interest rate increases. The typical scenarios of shock levels are an increase in interest rates of 1%, 2%, and 3%. These shocks will be expressed simply as a stress on the cumulative GAP of rate-sensitive assets (RSA) and liabilities (RSA) (RSL).

Table 5. Interest rate risk at different level shocks.

SL No.	Particulars			
1	Market value of Assets			
2	Market value of Liabilities			
3	Gap of Amount			
4	Magnitude of interest rate change	1%	2%	3%
5	Fall in the market value of equity			
6	Revised regulatory capital			
7	Revised RWA			
8	Capital adequacy ratio (CAR)			

We have calculated each indicator for three years however, for the simplicity here only one year calculation of a single bank is shown as an example. Example (AB bank 2016).

Table 6. NPL at Different level shocks of AB bank 2016.

Amount in Million

SL No.	Magnitude of the stock	Scenario 1, (2%)	Scenario 2, (5%)	Scenario 3, (10%)
A	Total Loan	88299	88298.8	88298.8
B	Nonperforming loan (A-B)	1852.49	1852.49	1852.49
C	Total Performing Loan	86446	86446	86446
D	Increase in NPL (% of shocks)	1728.9268	4322.317	8644.634
E	Increase in provision (D-0)	1728.9268	4322.317	8644.634
F	Tax adjusted provision D-(1-0)	1728.9268	4322.317	8644.634
G	Revised regulatory capital (Capital-D)	12931.3632	10337.973	6015.656
H	Revised Risk Weighted Assets (RWA-D)	146219.7132	143626.323	139304.006
I	Revised CAR (G/H)	0.088437892	0.071978261	0.043183654

Table 7. NPL in two major sectors at Different level shocks of AB bank 2016.

Amount in Million

SL No.	Magnitude of the stock	Scenario 1, (5%)	Scenario 2, (10%)	Scenario 3, (15%)
A	Loan to top 2 sector	52060.8	52060.8	52060.8
B	Increase in NPL (% of shock)	2603.04	5206.08	7809.12
C	Increase in provision (B-0)	2603.04	5206.08	7809.12
D	Tax adjusted provision B-(1-0)	2603.04	5206.08	7809.12
E	Revised regulatory capital (Capital-B)	12057.25	9454.21	6851.17
F	Revised RWA (RWA-B)	145345.6	142742.56	140139.52
G	Revised CAR (E/F)	0.082955728	0.066232594	0.048888208

Table 8. Equity Price risk at different level Shocks in AB Bank 2016.

Amount in Million

SL No.	Magnitude of the stock	Scenario 1, (10%)	Scenario 2, (25%)	Scenario 3, (50%)
A	Total exposure in stock market	2591.272762	2591.272762	2591.272762
B	Fall in stock price (% of shock)	259.1272762	647.8181905	1295.636381
C	Tax adjusted loss (B+(1-42.5% of B)	149.9981838	373.4954595	745.9909191

SL No.	Magnitude of the stock	Scenario 1, (10%)	Scenario 2, (25%)	Scenario 3, (50%)
D	Revised regulatory capital (Capital-C)	14510.29182	14286.79454	13914.29908
E	Revised RWA (RWA-C)	147798.6418	147575.1445	147202.6491
F	Revised CAR (D/E)	0.098176084	0.096810304	0.094524787

Table 9. Liquidity risk at different level shocks in AB Bank 2016.

Amount in Million

SL No	Magnitude of the stock	Scenario 1, (10%)	Scenario 2, (20%)	Scenario 3, (30%)
A	Liquid Asset (LA)	20290.61062	20290.61062	20290.61062
B	Liquid Liabilities (LL)	108980.64	108980.6371	108980.6371
C	Liquid ratio (%) (A/B)	0.186185465	0.186185465	0.186185465
D	Fall in liquid Liabilities (% of shock)	10898.06371	21796.12742	32694.19113
E	Revised liquid Asset (A-D)	9392.54691	-1505.516798	-12403.58051
F	Revised liquid Liabilities (B-D)	98082.57338	87184.50967	76286.44596
G	Revised liquid Ratio (%) (E/F)	0.095761628	-0.017268168	-0.162592193

Table 10. Interest rate risk at different level shocks in AB Bank 2016.

Amount in Million

SL No.	Particulars			
1	Market value of Assets	111861.9583		
2	Market value of Liabilities	108980.6371		
3	Gap of Amount	2881.32121		
4	Magnitude of interest rate change	1%	2%	3%
5	Fall in the market value of equity	14118.06414	14089.25093	14060.43772
6	Revised regulatory capital	14631.47679	14602.66358	14573.85036
7	Revised RWA	147919.8268	147891.0136	147862.2004
8	Capital adequacy ratio (CAR)	0.098914913	0.098739357	0.098563733

4. Analysis and Interpretation of the Data

Summary of overall calculation, year 2016. CAR without stress and CAR after stress at each level:

Table 11. Indicator: NPL.

Category	Name of the Bank	Without Stress CAR (Minimum CAR as per Basel2=10%)	With Stress: Revised Capital Adequacy Ratio in% (CAR)						Need Additional Capital
			Scenario 1, 2% %	Fall in potential threat if revised CAR<10%	Scenario 2, 5% %	Fall in potential threat if revised CAR<10%	Scenario 3, 10% %	Fall in potential threat if revised CAR<10%	
Private Commercial Banks	AB	9.90	8.84	x	7.19	x	4.31	x	Yes
	BA	8.11	6.82	x	4.83	x	1.31	x	Yes
	CBL	11.14	10.21		8.77	x	6.28	x	Yes
	DBL	10.09	8.84	x	6.91	x	3.49	x	Yes
	JBL	9.50	8.15	x	6.06	x	2.36	x	Yes
	MTB	11.49	10.2		8.2	x	4.66	x	Yes
	PREMIER	10.00	8.83	x	7.0	x	3.8	x	Yes
	PRIME	11.69	10.57		8.84	x	5.81	x	Yes
	SOUTH	11.31	10.27		8.65	x	5.83	x	Yes
	TRUST	9.05	7.93	x	6.21	x	3.18	x	Yes

Table 12. Indicator: NPL in two major sectors.

Category	Name of the Bank	Without Stress CAR (Minimum CAR as per Basel2=10%)	With Stress: Revised Capital Adequacy Ratio in% (CAR)						Need Additional Capital
			Scenario 1, 1% %	Fall in potential threat if revised CAR<10%	Scenario 2, 2% %	Fall in potential threat if revised CAR<10%	Scenario 3, 5% %	Fall in potential threat if revised CAR<10%	
Private Commercial Banks	AB		8.29	x	6.62	X	4.88	x	Yes
	BA		7.65	x	7.19	X	6.72	x	Yes
	CBL		9.71	x	8.22	X	6.69	x	Yes
	DBL		8.20	x	6.72	X	5.19	x	Yes
	JBL		7.66	x	5.74	X	3.75	x	Yes
	MTB		10.59		9.67	X	8.74	x	Yes
	PREMIER		8.51	x	6.96	X	5.36	x	Yes
	PRIME		11.28		10.88		10.47		No
	SOUTH		10.51		9.70	X	8.87	x	Yes
	TRUST		8.23	x	7.40	X	6.55	x	Yes

Table 13. Indicator: Equity price Risk.

Category	Name of the Bank	Without Stress CAR (Minimum CAR as per Basel2=10%)	With Stress: Revised Capital Adequacy Ratio in% (CAR)						Need Additional Capital
			Scenario 1, 1% %	Fall in potential threat if revised CAR<10%	Scenario 2, 2% %	Fall in potential threat if revised CAR<10%	Scenario 3, 5% %	Fall in potential threat if revised CAR<10%	
Private Commercial Banks	AB	9.90	9.81	x	9.68	x	9.45	x	Yes
	BA	8.11	8.09	x	8.06	x	8.0	x	Yes
	CBL	11.14	11.06		10.93		10.73		No
	DBL	10.09	10.03		9.94	x	9.80	x	Yes
	JBL	9.50	9.48	x	9.45	x	9.42	x	Yes
	MTB	11.49	11.45		11.39		11.31		No
	PREMIER	10.00	9.82	x	9.55	x	9.10	x	Yes
	PRIME	11.69	11.69		11.69		11.69		No
	SOUTH	11.31	11.27		11.22		11.13		No
	TRUST	9.05	8.99	x	8.90	x	8.73	x	Yes

Table 14. Indicator: Liquidity.

Category	Name of the Bank	Without Stress CAR (Minimum CAR as per Basel2=10%)	With Stress: Revised Capital Adequacy Ratio in% (CAR)						Need Additional Capital
			Scenario 1, 1% %	Fall in potential threat if revised CAR<10%	Scenario 2, 2% %	Fall in potential threat if revised CAR<10%	Scenario 3, 5% %	Fall in potential threat if revised CAR<10%	
Private Commercial Banks	AB	9.90	9.58	x	-1.73	x	-16.26	x	Yes
	BA	8.11	12.72		1.80	x	-12.22	x	Yes
	CBL	11.14	23.01		13.39		1.02	x	Yes
	DBL	10.09	22.12		12.38		-0.14	x	Yes
	JBL	9.50	19.37		9.29	x	-3.67	x	Yes
	MTB	11.49	23.63		14.08		1.81	x	Yes
	PREMIER	10.00	26.65		17.48		5.70	x	Yes
	PRIME	11.69	17.05		6.68	x	-6.65	x	Yes
	SOUTH	11.31	19.39		9.31	x	-3.65	x	Yes
	TRUST	9.05	19.38		9.30	x	-3.67	x	Yes

Table 15. Indicator: Interest rate.

Category	Name of the Bank	Without Stress CAR (Minimum CAR as per Basel2=10%)	With Stress: Revised Capital Adequacy Ratio in% (CAR)						Need Additional Capital
			Scenario 1, 1% %	Fall in potential threat if revised CAR < 10%	Scenario 2, 2% %	Fall in potential threat if revised CAR < 10%	Scenario 3, 5% %	Fall in potential threat if revised CAR <10%	
Private Commercial Banks	AB	9.90	9.89	x	9.87	x	9.85	x	Yes
	BA	8.11	8.08	x	8.06	x	8.03	x	Yes
	CBL	11.14	11.11		11.09		11.06		No
	DBL	10.09	10.11		10.12		10.14		No
	JBL	9.50	9.50	x	9.51	x	9.51	x	Yes
	MTB	11.49	11.51		11.54		11.57		No
	PREMIER	10.00	9.98	x	9.96	x	9.94	x	Yes
	PRIME	11.69	11.63		11.58		11.52		No
	SOUTH	11.31	11.29		11.26		11.23		No
	TRUST	9.05	10.28		10.35		10.42		No

Comparison among three years data of each bank and average of each bank:
Calculation of AB bank is given below as example:

Table 16. Comparison of NPL among three years data of AB Bank at Different shocks level.

NPL	Shock @ 2%	Shock @ 5%	Shock @ 10%
Y16	8.84	7.19	4.31
Y17	10.19	8.37	5.15
Y18	10.36	8.39	4.9
Sum	29.39	23.95	14.36
Average.	9.796667	7.983333	4.786667

Table 17. *Comparison of NPL in Two sectors among three years data of AB Bank at Different shocks level.*

NPL in 2 sectors	Shock @ 5%	Shock @ 10%	Shock @ 15%
Y16	8.29	6.62	4.88
Y17	9.91	8.4	6.84
Y18	11.09	9.82	7.61
Sum	29.29	24.84	19.33
Average.	9.763333	8.28	6.443333

Table 18. *Comparison of Equity Price Risk among three years data of AB Bank at Different shocks level.*

Equity Price Risk	Shock @ 10%	Shock @ 25%	Shock @ 50%
Y16	9.81	9.68	9.45
Y17	11.22	11	10.65
Y18	11.46	11.2	10.78
Sum	32.49	31.88	30.88
Average.	10.83	10.62667	10.29333

Table 19. *Comparison of Liquidity Risk among three years data of AB Bank at Different shocks level.*

Liquidity	Shock @ 10%	Shock @ 20%	Shock @ 30%
Y16	9.58	-1.73	-16.26
Y17	23.32	13.73	1.41
Y18	25.7	16.41	4.47
Sum	58.6	28.41	-10.38
Average.	19.53333	9.47	-3.46

Table 20. *Comparison of Interest rate Risk among three years data of AB Bank at Different shocks level.*

Interest Rate	Shock @ 1%	Shock @ 2%	Shock @ 3%
Y16	9.89	9.87	9.85
Y17	11.37	11.38	11.38
Y18	11.69	11.76	11.82
Sum	32.95	33.01	33.05
Average.	10.98333	11.00333	11.01667

Average of each category:

Table 21. *Indicator: NPL.*

Bank	Shock @ 2%	Shock @ 5%	Shock @ 10%
AB	9.796667	7.983333	4.786667
BA	10.12667	7.93	4.003333
City	11.81333	9.88	6.84
Dhaka	9.26	7.33	3.926667
Jamuna	9.633333	7.516667	3.756667
MTB	9.973333	7.783333	3.87667
Premier	9.296667	7.37	3.986667
Prime	11.03333	9.11	5.713333
Southeast	10.203333	8.346667	5.283333
Trust	9.906667	7.996667	4.623333
Sum	101.04333	81.246667	46.79667
Average.	10.104333	8.1246667	4.679667

Table 22. *Indicator: NPL in two major sectors.*

Bank	Shock @ 5%	Shock @ 10%	Shock 15 @%
AB	9.763333	8.28	6.45
BA	11.55	11.09	10.62
City	10.86667	8.813333	7.143333
Dhaka	9.166667	7.943333	6.69
Jamuna	9.53	8.003333	6.406667
MTB	10.34333	9.28	8.2
Premier	8.96	7.333333	5.65
Prime	11.74	11.20667	11.66667
Southeast	10.46333	9.693333	8.913333
Trust	10.20333	9.256667	8.29
Sum	102.58666	90.900002	80.030003
Average.	10.258666	9.0900002	8.0030003

Table 23. *Indicator: Equity Price Risk.*

Bank	Shock @ 10%	Shock @ 25%	Shock @ 50%
AB	10.83	10.63	10.29
BA	11.98667	11.95	11.88333
City	12.21	11.97333	11.64667
Dhaka	10.46333	10.4	10.29
Jamuna	10.97333	10.93333	10.88333
MTB	11.34	11.28	11.18
Premier	10.29333	10.05333	9.68
Prime	12.26333	12.26	12.25
Southeast	11.15333	11.04667	10.86667
Trust	11.07	10.96667	10.79
Sum	112.5833	111.4933	109.76
Average.	11.25833	11.14933	10.976

Table 24. *Indicator: Liquidity.*

Bank (liquidity)	Shock @ 10%	Shock @ 20%	Shock @ 30%
AB	19.53333	9.47	-3.46
BA	17.90333	7.64	-5.55
City	24.04667	14.97333	3.726667
Dhaka	21.22333	11.37667	-1.29
Jamuna	31.76333	23.23333	12.26667
MTB	42.95333	35.82333	26.66
Premier	26.71	17.54667	5.773333
Prime	19.12667	9.016667	-3.98
Southeast	22.94	13.30667	0.92
Trust	25.58333	16.28	4.313333
Sum	251.7833	158.6667	39.38
Average.	25.17833	15.86667	3.938

Table 25. *Indicator: Interest Rate.*

Bank	Shock @ 1%	Shock @ 2%	Shock @ 3%
AB	10.983333	11.00333	11.01667
BA	10.59667	10.55	10.49667
City	12.56	12.51333	12.46
Dhaka	10.53333	10.55333	10.58333
Jamuna	11.00667	11.01	11.03
MTB	11.25333	11.13667	10.98
Premier	11.00667	11.02	11.03
Prime	12.22	12.17667	12.13
Southeast	11.19333	11.16	11.13
Trust	11.56667	11.60667	11.64667
Sum	112.92	112.73	112.50334
Average.	11.292	11.273	11.250334

Analysis:

Here, 10 banks—AB, BA, City, Dhaka, Jamuna, MTB, Premier, Prime, Southeast, and Trust—have been taken into account. To get the average for the sector, we first averaged each indicator over the course of three years, then we averaged each indicator again, and last we averaged the average of other banks. Subsequently, we determined the category's average. AB (9.80 percent, 7.99 percent, and 4.79 percent), BA (10.12 percent, 7.94 percent, and 4.00 percent), City (11.82 percent, 9.89 percent, and 6.85 percent), Dhaka (9.26 percent, 7.33 percent, and 3.93 percent), Jamuna (9.64 percent, 7.52 percent, and 3.76 percent), MTB (9.98 percent, 7.79 percent, and 3.88 percent), and Premier (9.30 percent, 7.38 percent) are the ten banks with (9.90 percent, 8.00 percent and 4.62 percent). The three shock levels (2 percent, 5 percent, and 10 percent) of this indicator's industry average are 10.10 percent, 8.13 percent, and 4.68 percent,

respectively. At a shock level of 2 percent, four of the ten banks don't require additional capital, and another six banks are close to the safe zone because their CAR is above 9 percent. Ten banks require additional capital because all banks' CAR is below 10%, and the shock level at 5 and 10 percent. AB (9.77 percent, 8.29 percent, and 6.25 percent), BA (11.55 percent, 11.09 percent, and 10.62 percent), City (10.87 percent, 8.82 percent, and 7.15 percent), Dhaka (9.16 percent, 7.95 percent, and 6.70 percent), Jamuna (9.53 percent, 8.00 percent, and 6.40 percent), MTB (10.34 percent, 9.28 percent, and 8.20 percent), and Premier (10.34 percent, 9.28 percent, and 8.20 percent) are (10.20 percent, 9.25 percent and 8.29 percent). The industry average for this metric is 10.25 percent, 9.09 percent, and 8.00 percent for the three shock levels (percent, percent, and percent), respectively. Six banks out of ten are in the safe zone and do not require extra capital at a shock level of 5% (scenario 1),

while another four banks are very near to the safe zone since their CAR is close to 9%. Eight banks also require extra capital if the shock level is 10% (scenario 2), 10% (scenario 3), or 15% (scenario 3) since the CAR for these eight banks is below 10%. AB (10.83 percent, 10.63 percent, and 10.29 percent), BA (11.99 percent, 11.95 percent, and 11.89 percent), City (12.21 percent, 11.96 percent, and 11.89 percent), Dhaka (10.46 percent, 10.40 percent, and 10.29 percent), Jamuna (10.98 percent, 10.93 percent, and 10.89 percent), and MTB (11.35 percent, 11.28 percent, and 11.18 percent) are the ten banks with the average result for this indicator (Equity (11.07 percent, 10.97 percent and 10.80 percent). The three shock levels (10%, 25%, and 50%) in the industry average for this indicator are 11.25%, 11.14%, and 10.97%, respectively. At shock level 10% (scenario 1), out of ten banks, ten banks are in safe zone in three shock level because at any shock level all banks revised CAR is above 10%.

The average result for ten banks in each shock level (10 percent, 20 percent, and 30 percent) for this indicator (liquidity) is AB (19.54 percent, 9.48 percent, and -3.46 percent), BA (17.90 percent, 7.64 percent, and -5.55 percent), City (24.04 percent, 14.98 percent, and 3.73 percent), Dhaka (21.23 percent, 11.38 percent, and -1.29 percent), Jamuna (31.77 percent, 23.23 percent (25.58 percent, 16.28 percent and 4.32 percent). The industry average for this indicator for the three different shock levels (10%, 20%, and 30%) is 25, 17%, 15, 87%, and 3, 94%, respectively. At shock level 10% (scenario 1), out of ten banks, ten banks are in safe position they don't need additional capital. And shock levels at 20% (scenario 2) seven banks are in safe zone. And shock level at 30% (scenario 3) only two banks revised CAR is above 10% and rest of the other banks needs additional capital because these banks revised CAR is below 10%.

Average result of this indicator (interest rate) for ten banks in each shock level (1%, 2% and 3%) is AB (10.98%, 11.00% and 11.01%), BA (10.59%, 10.55% and 10.49%), City (12.56%, 12.51% and 12.46%), Dhaka (10.53%, 10.55% and 10.58%), Jamuna (11.00%, 11.01% and 11.03%), MTB (11.25%, 11.13% and 10.98%), Premier (11.00%, 11.02% and 11.03%), Prime (12.22%, 12.17% and 12.13%), Southeast (11.19%, 11.16% and 11.13%), Trust (11.56%, 11.60% and 11.64%). Industry average of this indicator in three shock level (1%, 2% and 3%) is 11.29%, 11.27% and 11.25% respectively. Out of ten banks, every bank's updated CAR is greater than 10% in any shock level. That implies that all of these banks are doing well according to this measure.

5. Findings and Suggestions of Study

5.1. Findings

The survey's key conclusions are presented in this part. Based on the calculation of all 10 banks' 2016 NPLs, it was determined that all banks needed more capital. In addition, all banks, with the exception of Prime Bank, need extra

capital based on a different indication (NPLs in two important industries). When another indicator (Equity Price Risk) is taken into account, however, CBL, MTB, Prime, and South East Bank need not. On the other hand, all banks need more capital when we take into account another indication (liquidity). Additionally, CBL, DBL, MTB, Prime, South, and Trust Bank do not need any extra capital when another signal (increase in interest rates) is taken into account. Accordingly, 4 out of 10 banks need more capital. In conclusion, an analysis of 2016 shows that banks are performing well in two areas (Equity Price Risk and Increase in Interest Rate).

All banks need extra capital when the data from all 10 banks in 2017 is analyzed using the indicator NPL. In addition, when the indicator investment is computed for the top two sectors, all banks need additional capital with the exception of BA, JBL, and Prime. In addition, AB, BA, CBL, DBL, JBL, MTB, Prime, South East, and Trust banks do not need any more capital when we take into account another indication of investment in the stock market. Therefore, nine banks out of ten don't need any more capital because they are doing so well in 2017, according to this indication. Additionally, MTB doesn't need any additional capital when another indication (liquidity) is taken into account. Another factor (increase in interest rates) has also been taken into account, although no banks need any more capital. By examining the year 2017, it can be concluded that banks are performing well in three areas, including stock market investment, liquidity, and an increase in interest rates.

All ten banks' data were calculated in 2018 using the indicator NPL, which results in all ten banks needing additional capital. However, when we calculated using the indicator investment to the top two sectors, all banks needed additional capital, with the exception of BA and Prime. Additionally, when another indicator was taken into account and considered investment to the stock market at that time, none of the ten banks did. In addition, JBL, MTB, and Trust do not need any more capital when another indication (Liquidity) has been taken into account. When another signal (an increase in interest rates) has been taken into account, MTB will need more funding. That indicates that just one bank out of the ten banks needs more capital. According to an analysis of the 2018 calendar year, all banks are doing well in terms of three indicators: stock market investment, liquidity, and increase in interest rates.

As a result of the foregoing summary, we can state that certain banks can manage stress based on three signs (Equity Price Risk, Liquidity and Interest rate). In order for those banks to be able to handle stress, they need concentrate on the remaining two signs. Additionally, those banks' financial situation is so dire that they need to increase paid-up capital.

5.2. Suggestions

Indicators of equity price and interest rate risk are doing well for these 10 banks. Due to their management effectiveness, they are skilled at creating stock market portfolios, therefore it won't be an issue if the price of the

stock drops by up to 50%. However, all banks should exercise extreme caution when making loans since if the shock level is merely 5%, all banks will require more capital. Additionally, all banks—aside from Bank Asia and Prime Bank—need greater capital in the event of a nonperforming loan. Therefore, if any undesirable events occur in liquid asset indicators, all banks, with the exception of Jamuna Bank, require more capital.

6. Conclusions

The stress-testing models and their effects on Bangladeshi private commercial banks were the main topics of this essay. In this study, a comparative analysis of the performance of the banking sector is reviewed along with a more thorough explanation of how to create, implement, and standardize stress testing scenarios. To improve the comparability of outcomes in this regard, an effort to standardize stress scenarios throughout the banking sector would be beneficial. The paper's main goals, such as providing an overview of the framework for stress testing, have all been covered in depth. What conditions must be satisfied in order to be shocked? and other issues were addressed in this section. What kinds of dangers ought to be examined? Which indices of financial soundness are most appropriate for my analysis? In order to assess whether financial institutions are financially adaptable enough to absorb losses that could arise in a variety of unfavorable circumstances, supervisors often use a fundamental management technique called stress testing. The banking sector's post-test CAR as a result was above 8%. By conducting stress tests, senior management of financial organizations will be able to determine how to reduce risk, what combination of assets a bank should hold, where a bank may be more flexible, and where a bank should spend as little as possible. Comparatively, first generation banks do much better across the board, while second generation banks also perform better across a few measures thanks to their RWA. These two indicators, "liquid asset" and "interest rate," perform better than the other three. To reduce risk, all banks should diversify their lending and investing across several industries.

Appendix

Table 26. List of the Banks selected for conducting stress testing.

Serial No.	Acronyms	Name of the Bank
1	AB	Arab Bangladesh Bank limited
2	BA	Bank Asia
3	CBL	City Bank limited
4	DBL	Dhaka Bank limited
5	JBL	Jamuna Bank limited
6	MTB	Mutual Trust Bank limited

Serial No.	Acronyms	Name of the Bank
7	PREMIER	Premier Bank limited
8	PRIME	Prime Bank limited
9	SOUTH	Southeast Bank limited
10	TRUST	Trust Bank limited

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