Research Paper

Assessing the Resilience of the Banking System of Bangladesh: A Micro Stress Testing Approach

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ABSTRACT

Purpose: Recent phases of financial unrest, fraud and irregularities have raised questions on the stability of the banking sector of Bangladesh. This paper intends to find out the condition of banks in stressful situations at different levels to measure vulnerability to substantial risks. The paper also tries to find out the level of risk due to Revised Capital Adequacy Ratio (CAR) and fall in CAR, which would definitely help to augur and solve practical risk factors caused due to minor, moderate and major levels of shock.

Methodology: Micro stress testing has been used to predict the financial stability of banks under different shocks at different levels. 30 listed commercial banks of Dhaka Stock Exchange (DSE) have been taken as sample. The risk of the banking sector has been studied with the help of credit shock, equity price shock, exchange rate shock and liquidity shock in minor, moderate and major levels.

Results: This paper finds out that most of the banks can manage risks in minor and moderate levels of shock but could be in risk in terms of major shock. Nature of competition in collecting deposits may lead some banks to liquidity risk, whereas, exchange rate risk and equity risk may not hamper most of the banks due to lower amounts of foreign currency reserves and a very little exposure in the stock market. Diversification of loan portfolio can help the banks to mitigate their credit risk. The overall situation of the banking industry is quite satisfying; the problems can easily be solved by risky banks by following the footsteps of the secured banks.

Originality/Value: This paper contributes to the existing litrature by providing firm-specific risk identification and management using micro stress testing approach.

Practical implications: Findings of this study is directly relevant to the banking industry and can be used in different levels of shock to mitigate the highest chances of risk. Nonetheless this study gives proper comparison among banks, which may help risky banks to work with their risks and finally get away from the risk to be subsistent in the market.

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1. Introduction

A sound financial system is one of the prerequisites of sustainable economic development for any country as it substantially smoothens economic performance. The sound financial system includes banks, securities markets, pension, mutual funds and so on (IMF,2019). Banking sector is the most important as well as vulnerable elements of financial system as it deals with credit risk, liquidity risk and exchange rate risk mainly. These risks can hamper economic growth of a country. In this respect, strengthening financial institutions of an economy can be worked as a controlling mechanism to ensure financial stability. After the global financial turmoil in 2008, the importance of understanding the sustainability of financial institutions has become imperative (Singh, 2019). Nevertheless, banks are still facing problems due to Non-Performing loans (NPLs) which could result in a great failure of the financial system of Bangladesh. NPLs are increasing day by day and proper steps to stop this successive rate of problem loan are needed now, more than ever. For many reasons, banks' performance has declined in recent years, one of the reasons is an absolute increase in NPLs and the poor retrieval rate of classified loans (Bakht, 2019). In this case, State-Owned banks are more underperforming than private commercial banks.

Recently, Bangladesh has shifted from least developed country (LDC) to a developing country because of simultaneous progress in gross national income, human assets index, and economic vulnerability index. Besides, Bangladesh is enjoying an average gross domestic product (GDP) growth rate of 6.60% for last 10 years. For the FY 2018-2019, the GDP growth rate was 8.13%. It is expected that the GDP growth rate will be 8.20% in the FY 2019-2020 (Budget Speech 2019-20). To maintain such a balanced economic growth, financial stability is required since it contributes to the national output level (He 2017). Eventually, various approaches are used to make a vibrant banking industry. However, Bangladesh Bank published a regulation to report about the resilience of the banking sector which would robustly connect NPLs, equity price, foreign exchange and liquidity state of every bank (Bangladesh Bank, 2010). This guideline shows that there could be three phases of shocks that will unquestionably differentiate the risk. Credit shock, Equity price shock, exchange rate shock and liquidity shock could be introduced as the evolving variables, which could lead the banks to bankruptcy and bailout in the future. Because of these shocks, different banks around the world failed to continue their businesses in the past. So, the overall sustainability of the banking sector could be hampered in the presence of these shocks, that is why these variables have been taken (Bangladesh Bank, 2010).

This study objects to evaluate the financial stability de facto resilience of financial institutions to adverse economic impact with the help of micro stress testing analysis. Moreover, it can represent and explain the risks and causes of risks in this particular sector. Stress testing is a forward-looking assessment of the potential impact of various adverse events on the banking sector (Siddque and Hasan, 2013). It determines susceptibilities and points out the actions to be resilient to those adversities. Stress testing helps to find out the resilience of banking sector; what will happen if any financial turmoil hits this market and how the market will react to the turmoil. However, micro stress testing is a tool of assessing the potential impact of various adverse events on any

individual firm. This method of stress testing identifies firm-specific risks and helps the management to act promptly to reduce that risk.

To conduct the study, 30 listed commercial banks of DSE have been taken as samples. This study will contribute to the existing literature by providing firm-specific analysis of potential impact of adverse events including credit shock, equity price shock, foreign exchange shock and liquidity shock.

2. Literature review

2.1. What determines financial stress

According to The World Bank (2020), financial stability and stress can be defined from many different views, but the uniformity that can be found from these approaches is that, financial stress occurs when the financial system fails to perform due to various episodes affecting the whole financial system. Financial stability is about the financial system's strength against stress. The report suggests that the determinants of stress in a financial system include the systems ability to efficiently and effectively allocate resources, ability to properly assess and manage financial risks, ability to maintain employment levels as similar to the natural rate of the economy and the capacity to eliminate unconventional movements in price of assets that affect monetary solidity. The paper suggests that when a financial system is able to get rid of imbalances caused by events that are unforeseen and of significant adversity, it can be considered to be in range of stability. Now to determine this level of stability or risk, various measuring tools come into play.

2.2. Different methods used to measure financial stress

Various micro and macro level analysis tools can be found worldwide that are used to assess vulnerability of the banks and financial institutions of different countries. Stress can be measured in both firm-specific level and in a systemic level. Yi (2012); Dibley, Staehling, Nieburg, & Trowbridge (1987), Beck, Demirgüç-Kunt, Levine (2007); Demirgüç-Kunt, Detragiache, and Tressel (2008); Laeven and Levine (2009); Čihák and Hesse (2010) used the z-score method. The method is considered to be one of the most common measures at the firm-specific level. The z-score measures the solvency risk of a bank by specifically comparing return volatility (risk) with capitalization and returns (buffers). The method mainly gained popularity due to the fact that the score shares a direct negative relationship with insolvency; the higher the z-score, the probability of insolvency is lower. Another popular model to measure credit risk used by Hull, Nelken, & White (2005); Feng & Xiao (2009) is the Merton model. The assumption of the model is that the net asset value of the firm is the only source of equity price uncertainty. Also referred to as the Asset value model, the Merton model considers the equity of a firm to be like a contingent call option on the organization's assets. So, the model can presume credit default probability of the firm by setting thresholds for different levels of asset versus liability and measuring the organizations asset value at different volatility levels and the debtor's payment expectation scenario. Further modifications were made by different authors like Benos & Papanastasopoulos (2007) to catch a wider collection of financial activity. Various models derived from and the model is used include the KMV model and the Distance to Default model. Another new popular method is stress testing. (Adrian, Morsink, & Schumacher, 2020) stated stress testing to be a more dynamic and articulated tool of risk management.

2.3. The Stress Testing approach

Chattha & Archer (2016) stated stress testing to be one of the most widely accepted tools for measuring the inherent risks of a financial system. According to the Committee on the Global Financial System (2001), the term "stress testing" is used to define various methods and techniques adopted by financial institutions to measure the firm's exposure to events that are exceptional but possible. A worldwide survey done by the committee to identify the stress testing practices among prominent financial firms revealed the vital role of stress testing in risk management. It was found that a significant 45% of active international banks and 80% dealer banks active globally, use stress testing to construct contingency plans, determine liquidity risk and monitor allocation of capital.

Literature shows different methods and variables used in stress testing. Adesoji (2016) found that bank stress management in Nigeria is sensitive to total credit to the economy, NPLs and loan-to-deposit ratio because of their negative impact on banks' profitability; meaning that loan performance, cumulative effect of the volume of credit to the economy as well as loan to deposit ratio determine the profitability and the going concern of the financial sector. However, liquidity ratio and total asset constitute less concern as they are controllable. Lakstutiene et al., (2009) conducted macro stress testing on Lithuania Banks and found that in case the macroeconomics of the country develops the Lithuanian bank system would face deficit of capital for covering the probable losses; therefore, the banks of the country should accumulate more capital. The probability of default for the bank loan portfolio fluctuated very insignificantly, and consumer loans were the riskiest according to loan sectors. Loans to business clients were less risky and mortgage loans were the least risky. Van den End (2008) found that second-round shocks had more impact than the first-round effects and hit all types of banks, indicative of systematic risk. However, Wong et al., (2006) researched on framework for macro stress testing the credit risk of banks in Hong Kong and found that even for the Value-at-Risk (VaR) at the confidence level of 90%, banks would continue to make a profit in most of the stressed scenarios, suggesting the current credit risk of the banking sector to be moderate. In extreme cases of the VaR, at the confidence level of 99%, some banks could incur a material loss. Sarker and Nahar (2018) conducted a research on the vulnerability trends of the banking sector of Bangladesh and found that the credit concentration was very high where few numbers of borrowers affected the entire financial market and banks had very low bargain power and in extreme conditions, banks will fall in liquidity crisis. However, from the year 2011 to 2016, banks had enough liquid assets that could meet unwanted crisis. Uddin (2015) stressed that Sonali Bank showed changes in CAR due to different levels of shock and found that credit policy of the bank was not adequate because some industries could hamper the regulatory capital up to 1% fall in CAR, if they fail to pay 50% of their borrowings and 40.00% NPLs caused the total capital to become zero. Moreover, Hossain (2015) found that Prime Bank Limited had a strong capital base and CAR stood at 12.49% of the Risk-weighted asset (RWA). The research came to the conclusion that while in 2009 risk of all shocks was high, in 2010 risk levels dropped and only credit risk was high due to increase in NPLs. In 2011, exchange rate risk and credit risk increased due to further increase in NPLs. From the mentioned scholarly works, it can be stated that banks' resilience in handling any crisis moment depends on many factors including CAR, Shift in NPLs, exchange rate and liquidity risk.

2.4. Gap in the literature

There have been numerous researches conducted on understanding potential vulnerabilities in the financial markets and the importance of stress testing around the globe. In terms of Bangladesh, researches have been done on performance of specific institutions under specific levels of shocks. But a comprehensive comparison among institutions and the reaction of the financial market is an area yet to be researched on. A lack of research on how the banks of a country heavily dependent on exports are impacted by financial stress and why private banks are more efficient in managing NPLs than public banks is clearly visible.

3. Data and Method

3.1. Sample Selection

To conduct stress testing at firm-specific level, 30 listed commercial banks are selected. The research is based on secondary data collected from Annual reports and financial statements. Data is collected based on model which is described by authority. Year of 2018 is used to conduct the report.

Table 1 – Bank names and respective acronyms

Bank name	Acronym
Brac Bank Limited	Brac
City Bank Limited	City
Dhaka Bank Limited	Dhaka
Eastern Bank Limited	EBL
Export Import Bank of Bangladesh Limited	EXIM
International Finance Investment and Commerce Bank Limited	IFIC
National Bank Limited	NBL
One Bank Limited	One
Pubali Bank Limited	Pubali
Rupali Bank Limited	Rupali
Trust Bank Limited	TBL
AB Bank Limited	ABBL
Al-Arafah Islami Bank Limited	Al-Arafa
Bank Asia Limited	Bank Asia
Dutch Bangla Bank Limited	DBBL
Mutual Trust Bank Limited	MTB
Uttara Bank Limited	Uttara
Premier Bank Limited	Premier
Jamuna Bank Limited	Jamuna
First Security Islami Bank Limited	FSIBL

Islami Bank Bangladesh Limited	IBBL
Mercantile Bank Limited	Mercantile
Prime Bank Limited	Prime
Shahjalal Islami Bank Limited	SJIBL
Southeast Bank Limited	Southeast
Standard Bank Limited	Standard
United Commercial Bank Limited	UCB
National Credit and Commerce Bank Limited	NCC
Social Islami Bank Limited	SIBL

Source: Dhaka Stock Exchange

3.1.1. Model specification

Simple sensitivity analysis model advised by Bangladesh Bank is followed to carry out the micro stress testing. Moreover, the liquidity position of the institutions has also been stressed separately. Stress test was carried out assuming three different hypothetical scenarios:

i) *Minor level shocks:* Minor level shocks represent small shocks to the risk factors and can vary for different risk factors.
ii) *Moderate level shocks:* Moderate level shocks anticipate medium level shocks and the level is defined in each risk factor separately.
iii) *Major level shocks:* Major level shocks involve big shocks to all risk factors and is also defined separately.

Table 2 – Percentage of risks for each shock

	NPLs to loan	Shift of NPLs	Top borrowers default	Top 10 borrowers default	Extreme shock	Equity price	Foreign exchange	Revised liquid ratio
Minor	1%	1st	5%	5%	1st	10%	5%	10%
Moderate	2%	2nd	7.50%	7.50%	2nd	20%	10%	20%
Major	3%	3rd	10%	10%	3rd	40%	15%	30%

Source: Bangladesh Bank stress testing guidelines (2010)

3.1.2. Credit risk

Stress testing for credit risk assesses the impact of increase in the level of NPLs of the banks. Credit shock is calculated in 5 steps, the first deals with the increase in the NPLs and the respective provisioning. The second step deals with the negative shift in the NPLs categories and hence the increase in respective provisioning. The third deals with the increase of the NPLs in particular 1 or 2 sector and the respective provisioning. The fourth deals with the increase of the NPLs due to default of Top 10 large borrowers and the respective provisioning. The fifth deals with extreme events in which due to increase in the certain percentage of NPLs, the whole capitalposition of a bank will be wiped out. (Bangladesh Bank, 2010).

Calculating increase in NPLs:

- The amount of NPLs is calculated by cumulating the amounts of Special mention accounts (SMA), Substandard, Doubtful and loss accounts.
- Total Performing loan is calculated by deducting total NPLs from total loans.
- NPLs to loans is calculated by dividing total NPLs by total loans.
- In the next step, Increase in NPLs is calculated by applying the percentage of shock (1,2,3%) on the total performing loan. (Total performing loan * 1/2/3%).
- CAR is calculated by dividing total NPLs to loans by Increase in NPLs. (CAR= Total NPLs to loans / Increase in NPLs).
- Tax adjusted provision is calculated with the formula increase in NPLs * (1- tax).
- Revised capital is calculated by deducting Tax adjusted provision from the banks' capital.
- Revised RWA is calculated by deducting tax adjusted provision from the banques RWA.
- Revised CAR is calculated by dividing revised capital by revised RWA.
- Fall in CAR is calculated by deducting revised CAR from CAR
- Amount of revised NPLs is measured by adding total NPLs and Tax adjusted provision.
- Revised NPLs to Loans is calculated by dividing revised NPLs by total loans.

Table 3 - Increase in NPLs

Magnitude of Shock	1%	2%	3%
Total Loan			
Total Performing Loan			
Total NPLs			
NPLs to Loans (%)			
Increase in NPLs			
Increase in Provisions (after adjustment of eligible securities; if any)			
Tax adjusted provision (not yet applicable)			
Revised Capital			
Revised RWA			
Revised CAR (%)			
Revised NPLs			
Revised NPLs to Loans (%)			

Source: Bangladesh Bank stress testing guidelines (2010)

Table 4 - Formulae used in calculating shift in NPLs

Steps to Calculate	Formula	1st	2nd	3rd
CAR	= Capital / RWA			
Weighted amount of provision	= 20% of Substandard+50% of Doubtful + 100% of loss (of provision amount)			
Weighted amount of provision after shift categories	=NPLs in Substandard*50%20%+(NPLs in substandard*50%+NPLs in doubtful*50%) 50% + (NPLs in Doubtful * 50% + NPLs in Loss) * 100%			
Increase in provision	= Weighted amount of provision after shift categories - weighted amount of provision			
Tax adjusted provision	= Increase in provision * (1- tax)			
Revised capital	= Capital - tax adjusted provision			
Revised RWA	= RWA - tax adjusted provision			
Revised CAR	= Revised capital / Revised RWA			
Fall in CAR	= CAR – Revised CAR			

Source: Bangladesh Bank stress testing guidelines (2010)

Table 5 - Formulae used in calculating increase of NPLs in particular 1 or 2 sectors

Steps to Calculate	Formula	5%	7.5%	10%
CAR	= Capital / RWA			
Total loan in Large and medium scale industries	= Retrieved from financial statements			
Increase in NPLs under B/L category	= Total loan in Large and medium scale industries * shock percentage (5,7.5,10%)			
Tax adjusted provision	= Increase in provision * (1- tax)			
Revised capital	= Capital – tax adjusted provision			
Revised RWA	= RWA – tax adjusted provision			
Revised CAR	= Revised capital / Revised RWA			
Fall in CAR	= CAR – Revised CAR			

Source: Bangladesh Bank stress testing guidelines (2010)

Table 6 - Formulae used in calculating Increase of NPLs due to default of top 10 loan borrowers

Steps to Calculate	Formula	5%	7.5%	10%
Total loan to top 6 large borrowers	= Retrieved from financial statements			
Increase in NPLs under B/L category	= Total loan to top 6 large borrowers * shock percentage			
Tax adjusted provision	= Increase in provision * (1- tax)			
Revised capital	= Capital – tax adjusted provision			
Revised RWA	= RWA – tax adjusted provision			
Revised CAR	= Revised capital / Revised RWA			
Fall in CAR	= CAR – Revised CAR			

Source: Bangladesh Bank stress testing guidelines (2010)

Table 7 - Formulae used in calculating increase in NPLs up to that position in which whole capital will be wiped up

Steps to Calculate	Formula	1st	2nd	3rd
Total NPLs	= SMA+Substandard+Doubtful+Loss			
NPL/total loans	= Total NPLs / Total loans			
Total capital	= Retrieved from financial statements			
Increase in NPLs	= Total capital			
Increase in provision	= Increase in NPLs			
Revised capital	= Total Capital – increase in provision			
Revised RWA	= RWA – increase in provision			
Revised CAR	= Revised capital / Revised RWA			
Fall in CAR	= CAR – Revised CAR			
Revised NPLs	= Total NPLs + Increase in provision			
Revised NPLs%	= Revised NPLs / Total Loans			

Source: Bangladesh Bank stress testing guidelines (2010)

3.1.3. Exchange rate risk

Overall net open position of the bank including the on-balance sheet and off-balance sheet exposures is charged by different shock levels. The overall net open position is measured by aggregating the sum of net short positions or the sum of net long positions; whichever is greater. (Bangladesh Bank, 2010).

Table 8: Formulae used in calculating exchange rate risk

Steps to Calculate	Formula	5%	10%	15%
CAR	= Capital / RWA			
Net on balance sheet and off balance sheet currency exposure	= Retrieved from financial statements			
Exchange rate loss	= Net on balance sheet and off balance sheet currency exposure * shock percentage (5,10,15%)			
Tax adjusted loss	= Exchange rate loss * (1- tax)			
Revised capital	= Total Capital – tax adjusted loss			
Revised RWA	= RWA - tax adjusted loss			
Revised CAR	= Revised capital / Revised RWA			
Fall in CAR	= CAR – Revised CAR			

Source: Bangladesh Bank stress testing guidelines (2010)

3.1.4. Equity price risk

Shocks are applied on total exposure in the stock market and tax adjusted capital and fall in CAR is calculated for each scenario (Bangladesh Bank 2010).

Table 9: Formulae used in calculating equity price risk

Steps to Calculate	Formula	10%	20%	40%
CAR	= Capital / RWA			
Total exposure in stock market	= Retrieved from financial statements			
Fall in the stock price	= Total exposure in stock market * shock percentage (10,20,40%)			
Tax adjusted loss	= Fall in the stock price * (1- tax)			
Revised capital	= Total Capital – tax adjusted loss			
Revised RWA	= RWA - tax adjusted loss			
Revised CAR	= Revised capital / Revised RWA			
Fall in CAR	= CAR – Revised CAR			

Source: Bangladesh Bank stress testing guidelines (2010)

3.1.5. Liquidity risk

The liquidity ratio is calculated by dividing liquid assets by liquid liabilities. Shock levels are applied on liquid liability and the ratio is calculated under each scenario. (Bangladesh Bank, 2010).

Table 10: Formulae used in calculating liquidity risk

Steps to Calculate	Formula	10%	20%	30%
Liquid assets	= Cash + Balance with banks & Financial institutions + Money at call + Investments			
Liquid liabilities	= Retrieved from financial statements			
Liquid ratio	= Liquid assets / liquid liabilities			
Fall in liquid liabilities	= Liquid liabilities * shock percentage			
Revised liquid assets	= Liquid assets– fall in liquid liabilities			
Revised liquid liabilities	= Liquid liabilities – fall in liquid liabilities			
Revised liquid ratio	= Revised liquid assets / revised liquid liabilities			

Source: Bangladesh Bank stress testing guidelines (2010)

Figure 1 graphically represents the relation between risk and different level of shocks:

Figure 1: Relation between risks and shocks
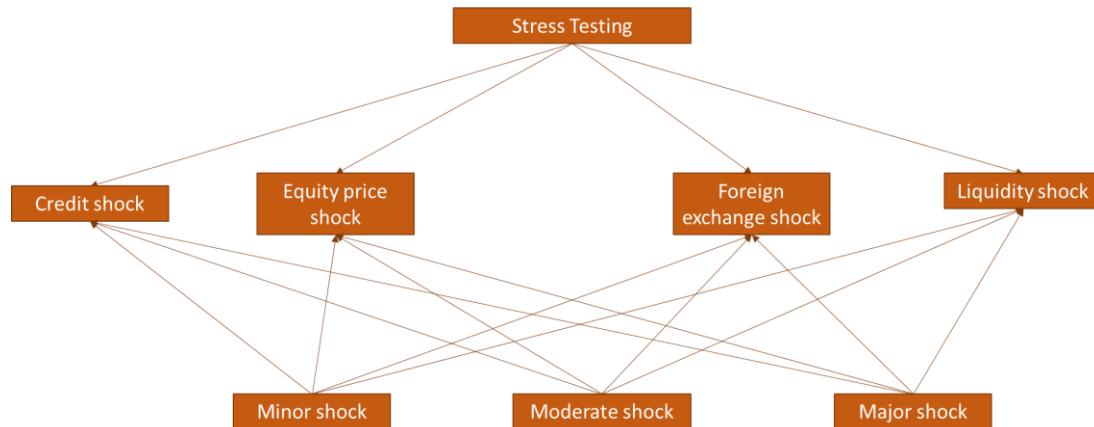
Source: Authors simulation of steps of stress testing

Table 11 represents reaction of CAR to levels of shock. Green represents fairly safe, yellow represents moderate safety and red represents problem areas outside parameters.

Table 11 – CAR reaction to levels of schock

	Shock	Increase in NPLs	Shift in NPLs	Top sector	Top 10 borrowers	Equity price shock	Exchange rate shock	Revised Liquid ratio
Brac Bank	Minor	14.93%	15.19%	15.66%	11.50%	15.35%	11.41%	110.31%
	Moderate	14.15%	15.19%	15.63%	9.24%	14.99%	6.65%	111.60%
	Major	13.34%	15.19%	15.61%	6.87%	14.27%	1.36%	113.25%
City Bank	Minor	11.47%	9.69%	11.98%	9.01%	12.13%	12.16%	95.87%
	Moderate	10.75%	9.69%	11.87%	7.33%	12.07%	12.14%	95.35%
	Major	10.01%	9.69%	11.76%	5.59%	11.94%	12.11%	94.69%
Dhaka Bank	Minor	11.19%	10.14%	10.82%	9.26%	11.87%	11.86%	81.31%
	Moderate	10.50%	10.14%	10.28%	7.89%	11.86%	11.85%	78.97%
	Major	9.80%	10.14%	9.73%	6.48%	11.84%	11.83%	75.96%
EBL	Minor	11.23%	11.71%	11.98%	11.92%	11.90%	11.99%	121.39%
	Moderate	10.42%	11.71%	11.96%	11.86%	11.77%	11.96%	124.06%
	Major	9.60%	11.71%	11.94%	11.81%	11.52%	11.93%	127.50%
Exim Bank	Minor	10.17%	8.76%	10.41%	9.83%	11.90%	10.89%	122.10%
	Moderate	9.42%	8.76%	10.16%	9.28%	11.77%	10.87%	124.86%
	Major	8.67%	8.76%	9.92%	8.72%	10.69%	10.86%	128.41%
IFIC Bank	Minor	11.91%	9.72%	11.90%	8.92%	12.60%	12.63%	93.57%
	Moderate	11.17%	9.72%	11.53%	6.94%	12.57%	12.62%	92.76%
	Major	10.42%	9.72%	11.16%	4.88%	12.50%	12.62%	91.73%
National Bank	Minor	13.35%	13.76%	13.90%	10.94%	13.83%	13.94%	74.41%
	Moderate	12.74%	13.76%	13.88%	9.35%	13.71%	13.94%	71.21%
	Major	12.11%	13.76%	13.86%	7.71%	13.47%	13.93%	67.09%
One Bank	Minor	11.10%	8.29%	11.20%	8.89%	11.91%	11.88%	101.68%
	Moderate	10.25%	8.29%	10.84%	7.29%	11.89%	11.83%	101.89%
	Major	9.39%	8.29%	10.47%	5.63%	11.85%	11.78%	102.16%
Pubali Bank	Minor	11.43%	10.42%	12.10%	10.62%	12.07%	12.17%	107.40%
	Moderate	10.68%	10.42%	12.06%	9.82%	11.96%	12.17%	108.32%
	Major	9.92%	10.42%	12.02%	9.01%	11.76%	12.17%	109.51%
Rupali Bank	Minor	9.27%	0.33%	8.96%	7.47%	9.93%	10.06%	76.76%
	Moderate	8.46%	0.33%	8.39%	6.13%	9.81%	10.06%	73.85%
	Major	7.65%	0.33%	7.83%	4.74%	9.56%	10.06%	70.12%
Trust Bank	Minor	13.18%	8.69%	13.55%	10.92%	14.03%	14.03%	66.28%
	Moderate	12.31%	8.69%	13.30%	9.28%	14.02%	14.01%	62.07%
	Major	11.41%	8.69%	13.05%	7.58%	14.01%	14.00%	56.65%
AB Bank	Minor	10.11%	-13.89%	9.56%	7.81%	10.41%	10.47%	100.90%
	Moderate	9.73%	-13.89%	9.10%	6.42%	10.35%	10.46%	101.01%
	Major	9.34%	-13.89%	8.62%	4.98%	10.21%	10.44%	101.15%
AlArafah Islami Bank	Minor	13.40%	11.30%	11.49%	8.68%	14.37%	14.27%	104.38%
	Moderate	12.39%	11.30%	9.97%	5.54%	14.36%	14.17%	104.93%
	Major	11.37%	11.30%	8.40%	2.18%	14.34%	14.06%	105.63%
Bank Asia	Minor	14.33%	13.32%	14.21%	11.51%	15.04%	15.02%	107.30%
	Moderate	13.59%	13.32%	12.96%	9.62%	15.02%	14.99%	108.21%
	Major	12.84%	13.32%	12.24%	7.65%	15.00%	14.97%	109.38%
DBBL	Minor	14.77%	13.72%	14.15%	12.53%	15.62%	15.61%	107.57%
	Moderate	13.91%	13.72%	13.39%	10.91%	15.39%	15.60%	108.52%
	Major	13.02%	13.72%	12.62%	9.22%	15.62%	15.59%	109.74%

Legend: ■ Very Safe / ■ Safe / ■ Problematic

|								
ICB Islamic Bank	Minor	-125.41%	-251.51%	-131.12%	-136.14%	-125.10%	-125.09%	104.96%
	Moderate	-125.74%	-251.51%	-474.72%	994.34%	-125.12%	-125.09%	105.58%
	Major	-126.07%	-251.51%	-1091.85%	436.50%	-125.15%	-125.09%	106.38%
MTB	Minor	12.02%	9.81%	12.14%	10.02%	12.78%	12.79%	101.02%
	Moderate	11.20%	9.81%	11.80%	8.55%	12.75%	12.76%	101.15%
	Major	10.37%	9.81%	11.45%	7.03%	12.69%	12.73%	101.32%
Uttara Bank	Minor	11.60%	8.01%	9.88%	6.59%	12.32%	12.41%	145.67%
	Moderate	10.73%	8.01%	8.53%	3.36%	12.19%	12.37%	151.38%
	Major	9.84%	8.01%	7.15%	-0.11%	11.92%	12.33%	158.72%
Premier Bank	Minor	16.39%	16.39%	16.61%	15.76%	17.03%	17.00%	61.36%
	Moderate	15.72%	14.31%	16.39%	15.11%	17.02%	16.96%	56.52%
	Major	15.05%	14.31%	16.17%	14.44%	17.00%	16.93%	50.31%
Jamuna Bank	Minor	12.91%	11.57%	12.47%	10.32%	13.47%	13.57%	110.42%
	Moderate	12.24%	11.57%	11.91%	8.59%	13.35%	13.55%	111.72%
	Major	11.55%	11.57%	11.33%	6.79%	13.12%	13.54%	113.39%
FSIBL	Minor	8.91%	8.23%	7.16%	5.05%	10.16%	10.16%	102.42%
	Moderate	7.60%	8.23%	5.57%	2.26%	10.15%	10.15%	102.72%
	Major	6.26%	8.23%	3.93%	-0.70%	10.12%	10.14%	103.11%
IBBL	Minor	11.07%	11.89%	10.38%	6.29%	11.78%	12.14%	109.62%
	Moderate	9.93%	11.89%	9.46%	3.04%	11.38%	12.11%	110.83%
	Major	8.77%	11.89%	8.51%	-0.45%	10.57%	12.08%	112.37%
Mercantile Bank	Minor	12.52%	10.98%	12.49%	10.26%	13.24%	13.26%	108.37%
	Moderate	11.74%	10.98%	12.09%	8.66%	13.20%	13.24%	109.41%
	Major	10.94%	10.98%	11.69%	7.01%	13.12%	13.22%	110.76%
Prime Bank	Minor	15.94%	13.91%	16.15%	15.33%	16.57%	16.54%	102.16%
	Moderate	15.29%	13.91%	15.94%	14.69%	16.56%	16.50%	102.43%
	Major	14.63%	13.91%	15.73%	14.04%	16.54%	16.46%	102.78%
SJIBL	Minor	14.82%	14.66%	14.94%	11.67%	15.58%	15.62%	102.71%
	Moderate	13.99%	14.66%	14.59%	9.54%	15.53%	15.62%	103.05%
	Major	13.15%	14.66%	14.23%	7.31%	15.42%	15.61%	103.49%
Southeast Bank	Minor	11.82%	10.07%	10.64%	8.90%	12.39%	12.45%	90.35%
	Moderate	11.17%	10.07%	9.70%	7.00%	12.32%	12.42%	89.14%
	Major	10.50%	10.07%	8.73%	5.02%	12.17%	12.40%	87.59%
Standard Bank	Minor	12.31%	8.25%	12.67%	11.67%	12.83%	12.99%	117.05%
	Moderate	11.61%	8.25%	12.50%	11.00%	12.67%	12.99%	119.18%
	Major	10.91%	8.25%	12.33%	10.31%	12.34%	12.99%	121.92%
UCB	Minor	12.12%	8.85%	11.81%	9.71%	12.67%	12.76%	75.70%
	Moderate	11.47%	8.85%	11.32%	8.10%	12.58%	12.75%	72.66%
	Major	10.80%	8.85%	10.82%	6.44%	12.39%	12.75%	68.75%
NCC Bank	Minor	11.88%	9.15%	12.34%	11.93%	12.56%	12.61%	102.49%
	Moderate	11.12%	9.15%	12.20%	11.59%	12.51%	12.60%	102.80%
	Major	10.35%	9.15%	12.06%	11.24%	12.39%	12.59%	103.20%
SIBL	Minor	13.27%	8.52%	12.81%	9.28%	14.15%	14.26%	102.53%
	Moderate	12.25%	8.52%	12.07%	6.56%	14.03%	14.26%	102.84%
	Major	11.20%	8.52%	11.31%	3.68%	13.80%	14.25%	103.25%

Source: Authors analysis on revised CAR in different shock levels

Graph 1 - Revised CAR due to NPLs to Loan in major shock
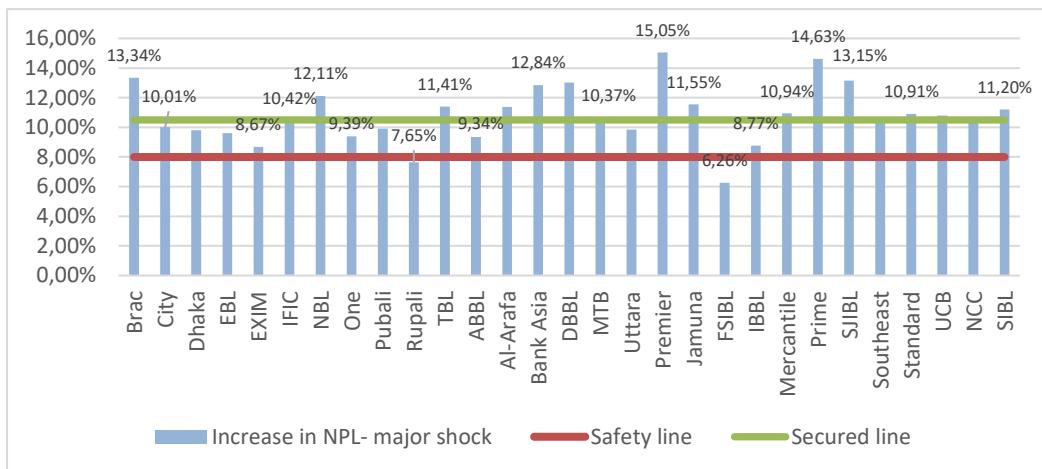

Source: Authors analysis of credit risk

Graph 2 - Revised CAR due to downward Shift in NPLs in major shock
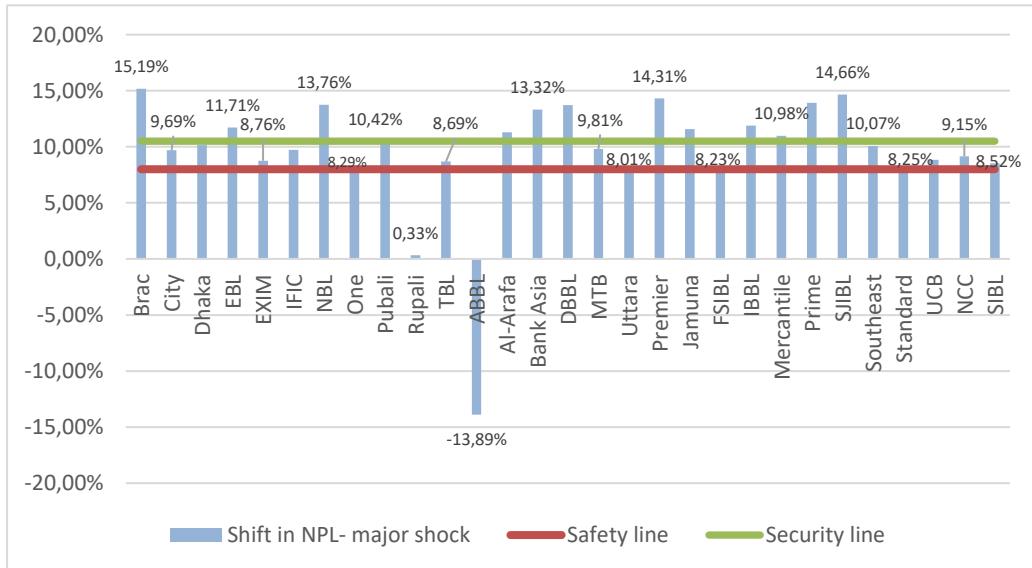

Source: Authors analysis of credit risk

**Graph 3 - Revised CAR due to default of Top borrowing sectors in major shock**
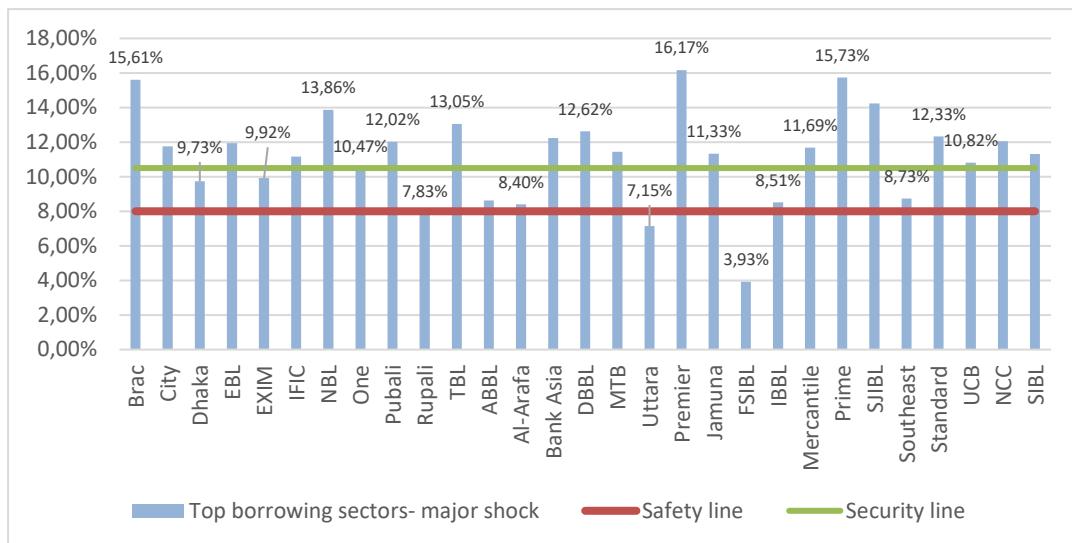
Source: Authors analysis of credit risk

**Graph 4 - Revised CAR due to default of Top 10 borrowers in major shock**
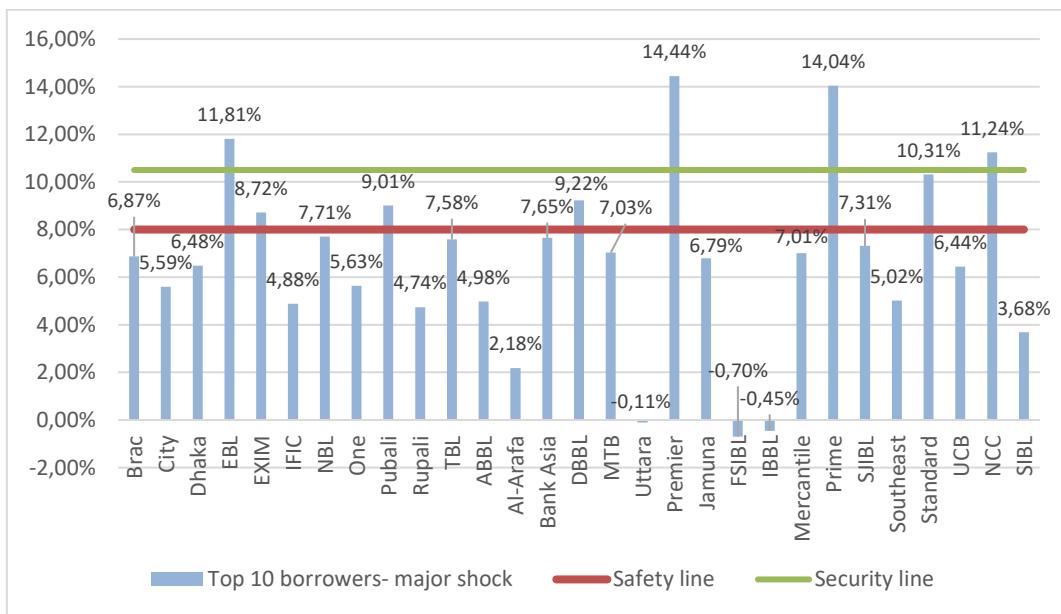
Source: Authors analysis of credit risk

Graph 5 - Fall in CAR due to Extreme Shock
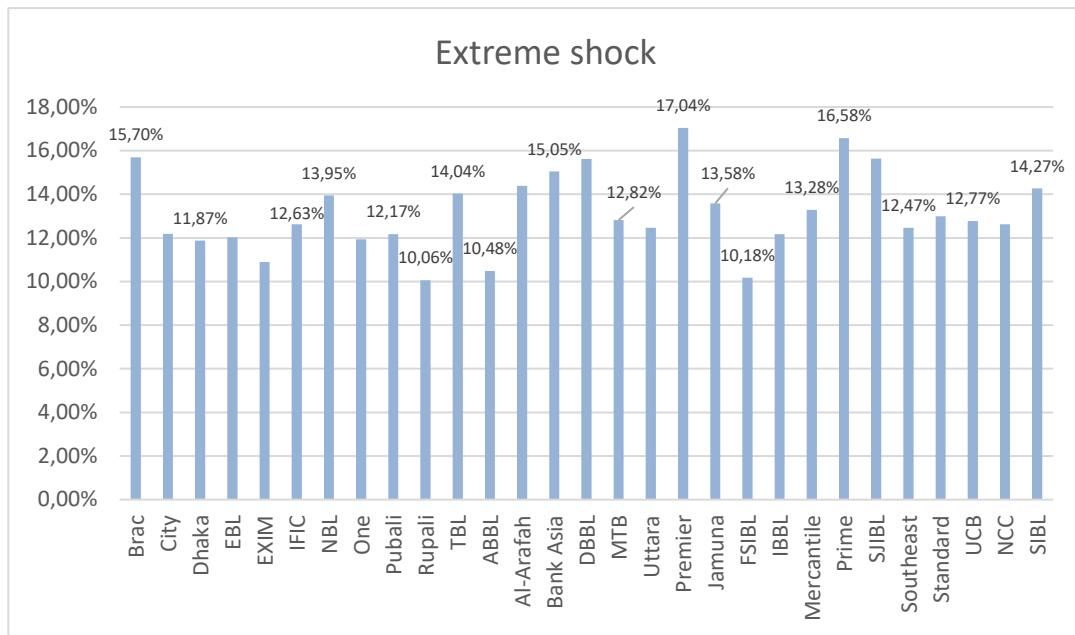
Source: Authors analysis of credit risk

**Graph 6 - Revised CAR due to decrease of Equity price in major shock**
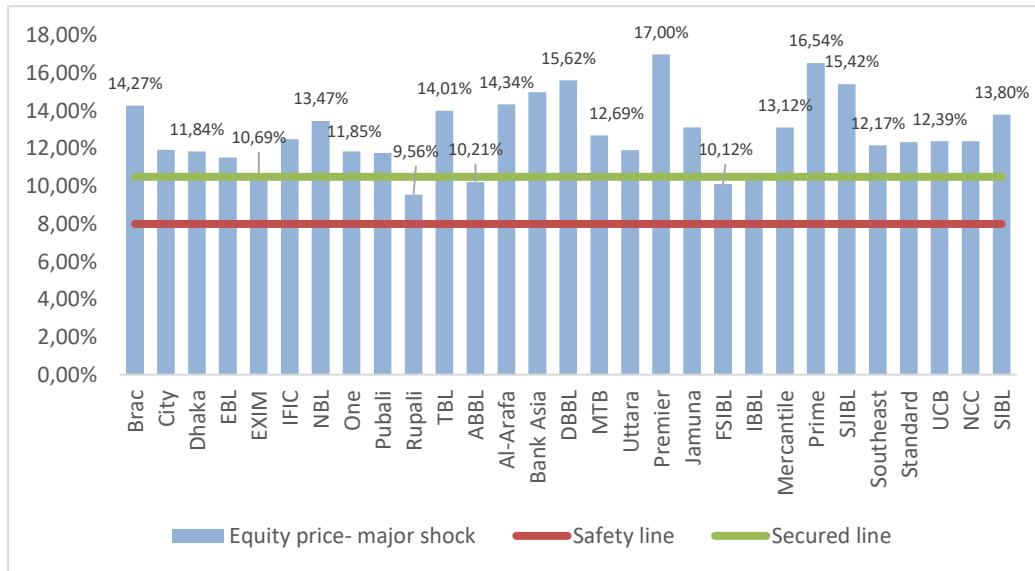
Source: Authors analysis of Equity Price risk

Graph 7 - Revised CAR due to adverse movement in foreign exchange rate in major shock
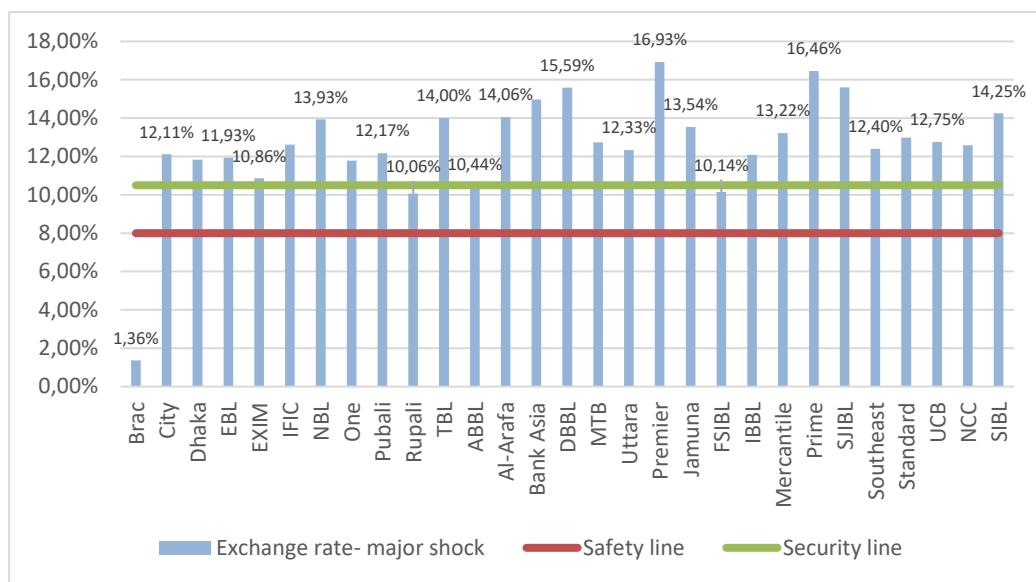
Source: Authors analysis of Foreign Exchange risk

Graph 8 - Revised liquidity ratio due to increase in liquid liabilities in major shock
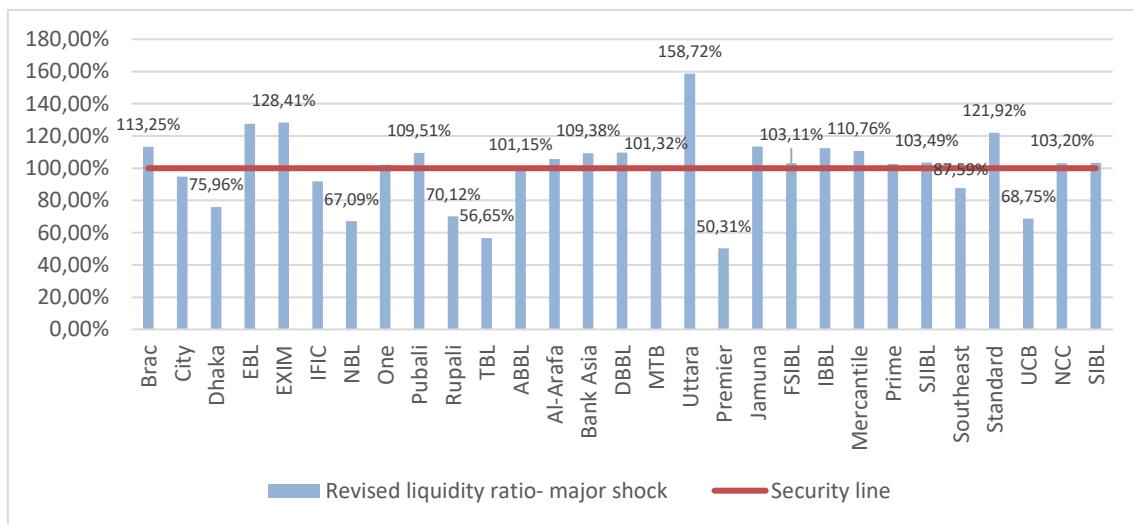
Source: Authors analysis of Liquidity risk

4. Results and discussion

Shocks of diverse levels can affect the banking industry and the whole economy as well. Nevertheless, there are some banks capable of recovering from the stressed circumstances and some may face difficulties. Bangladesh Bank's regulation stated that banks which have revised CAR more than 10.50 percent are at a sound state, and which are more than 8 percent but less than 10.50 percent are at safe state but they might need some improvement. There are some banks which have CAR less than 8 percent. They need to worry about their future whereas there would be a shock in the market (Bangladesh Bank, 2018). Nonetheless, for revised liquidity ratio, Bangladesh Bank advices the banks to maintain a ratio of more than 100% to ensure payment to debtors in case of a crisis. (Bangladesh Bank, 2015)

Taking these numbers as our basis, credit shock, liquidity shock, equity price shock and foreign exchange shock have been discussed.

4.1. Credit Shock

There are five types of criteria in credit shock which are similarly important for banking industry. In Bangladesh, credit shock is the most important one due to the nature of its economy. From Table 11, it's clear that there are a few banks which have problem due to NPLs to Loan. Rupali bank might get problem if major shock comes (Described in graph 1.1).

Nonetheless, FSIBL might face trouble if there is moderate or major shock. So, no bank should have trouble if there is minor shock. Economic shock might come rapidly, but we can forecast that before it strikes the economy. So, risky banks should work on their problematic sections to avoid the risk, besides, they can follow other banks that have controlled it successfully.

In shift on NPLs which is described in graph 2, NPLs hamper the company's portfolio to present the ability of NPLs to destroy any industry. But fortunately, this has little effect on some banks and others are again out of risk. Besides, Rupali bank's outcome in this section, could represent problematic output whereas its shift in NPLs in three levels of shock are same and that describes a bad situation of shift of NPLs. On the other hand, ABBL has a negative result in this section. Both banks should follow other banks to get rid of its current situation. But other banks such as Brac Bank, EBL, NBL, DBBL etc. have very good situation. Even, these banks will be strong if there would be any major shock in the economy.

In the top borrowers section which is described in graph 3, major shock could be risky for some banks. This scenario describes if the top borrowing sectors fall into deep trouble, what would happen to the banks. Rupali bank and Uttara bank could face risk when the major shock will be present in the economy. FSIBL could face trouble even if there are minor shocks (from graph 4). The other banks should be safe even if there are major shocks. So, overall situation is good and the risky banks could easily get rid of the problem, if they follow the secured banks.

In graph 4, it's clearly visible that many banks will face problem if their top ten borrowers do not give their payment timely. Bank gives loan to industries to continue and elevate their business. So, top ten is a huge number for most of the banks, and it's quite normal. Besides, banks should follow EBL, Premier Bank or NCC bank to understand how they have managed to enlarge their loan portfolio so big that their top ten borrowers also

couldn't hamper their operation even if in major shock. From table A1 (Appendix A), it could be easily understood that fall in CAR is more than NPLs to loan or shift of NPLs. It has fallen sharply due to its nature, but some banks are secured as they have higher revised CAR.

Extreme shock is a situation from table A1 which means that all the capital will be wiped out and it is the most dangerous situation that a bank can face. In graph 5, fall in CAR in extreme shock represents the worst situation of the banking sector of Bangladesh can face. This situation could put every bank in great trouble as every bank's Revised CAR will be zero. This situation could never be controlled by a single bank. In this case, every sector of the country should come forward to help the falling economy. But fortunately, this situation merely comes in a country if all the banks remain unconscious.

In credit shock, even in graphs, ICB Islami Bank is kept absent purposely. This bank has negative revised capital in calculating revised CAR. So, this bank has shown wondrous results throughout the study. In most of the cases, the graphs of ICB Islami Bank could barely be compared with other banks. But these results might not describe actual situation of ICBIB as this bank has faced different situation than others.

4.2. Equity price shock

From the Table 11, where equity price risk is being discussed, we can easily mark that there are no banks which have severe equity price risk for minor, moderate (from graph C5 and graph C12 in appendix C) and major shock as well. This is because of low immersion of banking sector in stock market. As total, exposure in stock market of these banks are relatively low, this shock might stir less in this particular sector.

ICB Islami Bank's result could be ignored here as their result is based on negative revised capital. For this particular reason, this result might impact meagre relatively. In the fall in CAR, from Table A1, the portion of fall is also insignificant. From graph 6, we can easily define this event as a non-risky section of banking sector.

4.3. Foreign exchange shock

Foreign exchange risk will be present for those banks that have more money on other currencies than BDT. In this case, about all the banks have good situation as they have controlled amount in other currency. So, if the rate of other currencies falls, it wouldn't be problem for them. The exception is Brac Bank here; they have some risk in major and moderate level (from graph C13) of shock which is described in graph 7. From table 11, it's evidently visible that other banks have no problem with this type of risk. From table A1, it's evidently visible that fall in CAR is also very low in this criteria. So, this is a good situation for the banking industry in exchange rate risk.

4.4. Liquidity shock

From graph 8, it is clearly visible that nine banks have problem related to their liquidity. These banks could face trouble in returning money to their depositors, if there has been a problematic situation, whereas the other 21 banks will be in adequate situation with their depositors. Those banks which could face trouble in minor shock (from graph C7 and C14) which is represented in table 11, should be more concerned about taking more deposits from their customers. As mentioned earlier, some banks want to take more

deposits to control their income and be profitable, they should also be concerned about their depositor's interest and risks. There will be risk in every business but some risk could easily be avoided by taking proper measures which already have been taken by the other 21 banks.

Overall situation of the banking industry in Bangladesh is satisfactory which is clear from this analysis. But there are some banks which might be in trouble, particularly in a major shock scenario. Obviously, there are some banks which could be in risk in minor and moderate level of shocks as well but the number are very low. Nevertheless, there should be some preventive measures taken by the authority of those banks as well as from the government to control the risk and financial stress. Financial stress could come in any economy anytime if that economy is not conscious about financial stress and its after effect situation. So, every industry should be concerned about financial stress and the banking industry should be more concerned as this industry is connected to all industries of a country. Besides, banking industry is dependable on their debtors and creditors at the same time, for this reason, this industry should have more focus about financial stress than other industries to safeguard the economy properly.

5. Conclusion and recommendations

This study objects to assess the resilience of banking system to any adverse economic events. Data have been collected from 30 listed commercial banks of DSE. Micro stress testing has been employed to analyze firm-specific risks associated with the vulnerabilities of financial institutions. Precisely, this study has been conducted based on a specific guideline on stress testing provided by Bangladesh Bank. Moreover, this study has covered a wide range of shocks, which basically describes risks at different level. These shocks may arise anytime if the banks neglect the risks. The study has covered three levels of shock which are, minor, moderate and major. On the other hand, it has taken base following the guidelines of the regulatory body to mention the positions of the banks as risky or as secured. Not only risky banks but also a fair number of secured banks have been identified through this study. As a whole, Revised CAR and fall in CAR have been used based on RWA, which have described and compared the banks in both micro and macro levels of analysis.

This paper finds out that about all the banks will survive in minor level of shock, even though there could be some cases of failure in terms of liquidity. The causes of failure in liquidity are due to competition of collecting deposits in the current market. Most of the private commercial banks, along with some public banks are very busy to collect deposits so that they can prove themselves as a successful one. But everything has its side effects as well. It has been confirmed that most of the banks are providing loan to the same industries repeatedly, which is a big concern for this industry. Though there are some banks who are free from this practice and they should be followed by the other banks. This risk could lead the banking industry into a failure even if they are performing well. In extreme shock, when all the capital could be wiped out and Revised CAR would be tending to zero, banks could face a deep trouble all together, which is typical because of extreme shock's nature. In equity price risk, all the banks are free from risk as they have less exposure in stock market. Nevertheless, most of the banks have less risk in exchange rate shock as they have little foreign currency respective to their size. Eventually, NPLs to Loan and shift of NPLs have some effects mostly in major shock on some of the banks which should be alarming for them.

Shocks are the risky situations which could affect the economy at any time. Every financial institution should be aware of shocks for sustainability as well as for keeping economic advancement. Those banks which have possible risk based on revised liquidity ratio should follow banks who are continuing their business without falling in risk parameters. Exchange rate risk should be avoided by converting the currency at a marginal level which depends on the type of operations bank does. On the other hand, banks should focus on diversifying their loan portfolio which is possibly most significant verdict of this paper. Without diversifying their portfolio, banks could face risk related to that sectors which occupy most of their loans and advancements. Nevertheless, NPLs is a serious issue which must be controlled with care, specifically for those banks, which already have a signal to face risk based on NPLs or shift of NPLs.

Several problems have been faced in data collection as banks' financial statements and annual reports did not contain all the information this research needed. Further research can be done on all the state-owned and private banks of Bangladesh which can broadly represent and compare the risk factors due to shock in banking sector. Comparison between private banks and state-owned banks can reveal empirical evidence to measure the micro level performance of banks.

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Appendix

Appendix A: Table representing changes in fall in CAR

	Shock	NPLs to loan	Shift of NPLs	Top borrowers	Top 10 borrowers	Extreme Shock	Equity price	Foreign exchange
Brac Bank	**Minor**	0.77%	0.52%	0.05%	4.20%		0.35%	4.29%
	Moderate	1.56%	0.52%	0.07%	6.46%		0.71%	9.05%
	Major	2.36%	0.52%	0.09%	8.84%	15.70%	1.43%	14.34%
City Bank	**Minor**	0.71%	2.49%	0.21%	3.18%		0.06%	0.02%
	Moderate	1.44%	2.49%	0.32%	4.86%		0.12%	0.05%
	Major	2.18%	2.49%	0.42%	6.60%	12.19%	0.24%	0.07%
Dhaka Bank	**Minor**	0.68%	1.74%	1.06%	2.62%		0.01%	0.01%
	Moderate	1.37%	1.74%	1.60%	3.99%		0.02%	0.03%
	Major	2.08%	1.74%	2.14%	5.40%	11.87%	0.03%	0.04%
EBL	**Minor**	0.79%	0.31%	0.06%	0.16%		0.12%	0.03%
	Moderate	1.60%	0.31%	0.06%	0.16%		0.25%	0.06%
	Major	2.42%	0.31%	0.08%	0.21%	12.02%	0.50%	0.09%
EXIM Bank	**Minor**	0.73%	2.14%	0.49%	1.08%		0.12%	0.01%
	Moderate	1.48%	2.14%	0.74%	1.62%		0.25%	0.03%
	Major	2.23%	2.14%	0.99%	2.18%	10.90%	0.32%	0.04%
IFIC Bank	**Minor**	0.72%	2.91%	0.73%	3.71%		0.03%	0.00%
	Moderate	1.46%	2.91%	1.10%	5.69%		0.06%	0.01%
	Major	2.21%	2.91%	1.47%	7.75%	12.63%	0.13%	0.01%
NBL	**Minor**	0.60%	0.19%	0.05%	3.01%		0.12%	0.01%
	Moderate	1.21%	0.19%	0.07%	4.60%		0.24%	0.01%
	Major	1.84%	0.19%	0.09%	6.24%	13.95%	0.47%	0.02%
One Bank	**Minor**	0.83%	3.64%	0.72%	3.04%		0.02%	0.05%
	Moderate	1.67%	3.64%	1.09%	4.64%		0.04%	0.09%
	Major	2.54%	3.64%	1.46%	6.30%	11.93%	0.07%	0.14%
Pubali Bank	**Minor**	0.74%	1.75%	0.08%	1.56%		0.10%	0.00%
	Moderate	1.49%	1.75%	0.11%	2.35%		0.21%	0.00%
	Major	2.25%	1.75%	0.15%	3.17%	12.17%	0.42%	0.00%
Rupali Bank	**Minor**	0.79%	9.73%	1.10%	2.58%		0.12%	0.00%
	Moderate	1.59%	9.73%	1.66%	3.93%		0.25%	0.00%
	Major	2.41%	9.73%	2.23%	5.32%	10.06%	0.50%	0.00%
Trust Bank	**Minor**	0.86%	5.35%	0.49%	3.11%		0.01%	0.01%
	Moderate	1.73%	5.35%	0.74%	4.76%		0.01%	0.02%
	Major	2.62%	5.35%	0.99%	6.46%	14.04%	0.03%	0.04%
AB Bank	**Minor**	0.38%	24.37%	0.92%	2.67%		0.07%	0.01%
	Moderate	0.76%	24.37%	1.39%	4.06%		0.14%	0.03%
	Major	1.14%	24.37%	1.86%	5.50%	10.48%	0.27%	0.04%
Al-Arafah Islami Bank	**Minor**	0.98%	3.08%	2.89%	5.69%		0.01%	0.10%
	Moderate	1.98%	3.08%	4.41%	8.84%		0.02%	0.21%
	Major	3.01%	3.08%	5.98%	12.20%	14.38%	0.04%	0.31%
Bank Asia	**Minor**	0.73%	1.74%	0.84%	3.54%		0.01%	0.03%
	Moderate	1.46%	1.74%	2.09%	5.43%		0.03%	0.06%
	Major	2.21%	1.74%	2.82%	7.40%	15.05%	0.05%	0.09%
DBBL	**Minor**	0.85%	1.90%	1.47%	3.08%		0.00%	0.01%
	Moderate	1.71%	1.90%	1.90%	4.71%		0.00%	0.02%
	Major	2.59%	1.90%	2.99%	6.40%	15.62%	0.00%	0.02%
ICB Islamic Bank	**Minor**	0.33%	126.42%	6.04%	11.06%	-	0.02%	0.00%
	Moderate	0.65%	126.42%	349.64%	-1119.42%	125.08%	0.03%	0.00%

Bank	Level							
	Major	0.98%	126.42%	966.77%	-561.58%		0.06%	0.01%
MTB	**Minor**	0.80%	3.01%	0.68%	2.80%		0.03%	0.03%
	Moderate	1.62%	3.01%	1.02%	4.27%		0.06%	0.06%
	Major	2.45%	3.01%	1.36%	5.79%	12.82%	0.13%	0.08%
Uttara Bank	**Minor**	0.85%	4.45%	2.58%	5.86%		0.13%	0.04%
	Moderate	1.73%	4.45%	3.92%	9.10%		0.27%	0.08%
	Major	2.61%	4.45%	5.31%	12.57%	12.46%	0.54%	0.13%
Premier Bank	**Minor**	0.65%	2.73%	0.43%	1.28%		0.01%	0.04%
	Moderate	1.32%	2.73%	0.65%	1.93%		0.02%	0.08%
	Major	1.99%	2.73%	0.87%	2.60%	17.04%	0.04%	0.12%
Jamuna Bank	**Minor**	0.67%	2.01%	1.11%	3.27%		0.11%	0.01%
	Moderate	1.35%	2.01%	1.68%	4.99%		0.23%	0.03%
	Major	2.04%	2.01%	2.25%	6.79%	13.58%	0.46%	0.04%
FSIBL	**Minor**	1.27%	1.95%	3.02%	5.13%		0.01%	0.01%
	Moderate	2.57%	1.95%	4.61%	7.92%		0.03%	0.03%
	Major	3.92%	1.95%	6.25%	10.88%	10.18%	0.06%	0.04%
IBBL	**Minor**	1.11%	0.29%	1.79%	5.89%		0.40%	0.03%
	Moderate	2.24%	0.29%	2.72%	9.14%		0.79%	0.06%
	Major	3.40%	0.29%	3.66%	12.62%	12.17%	1.60%	0.10%
Mercantile Bank	**Minor**	0.77%	2.30%	0.79%	3.03%		0.04%	0.02%
	Moderate	1.55%	2.30%	1.19%	4.62%		0.08%	0.04%
	Major	2.34%	2.30%	1.59%	6.27%	13.28%	0.17%	0.07%
Prime Bank	**Minor**	0.64%	2.67%	0.42%	1.25%		0.01%	0.04%
	Moderate	1.29%	2.67%	0.63%	1.89%		0.02%	0.08%
	Major	1.94%	2.67%	0.85%	2.53%	16.58%	0.04%	0.11%
SJIBL	**Minor**	0.81%	0.97%	0.69%	3.96%		0.05%	0.01%
	Moderate	1.64%	0.97%	1.04%	6.09%		0.10%	0.01%
	Major	2.48%	0.97%	1.40%	8.32%	15.63%	0.20%	0.02%
Southeast Bank	**Minor**	0.65%	2.39%	1.83%	3.57%		0.07%	0.02%
	Moderate	1.30%	2.39%	2.77%	5.47%		0.15%	0.04%
	Major	1.97%	2.39%	3.74%	7.45%	12.47%	0.29%	0.06%
Standard Bank	**Minor**	0.68%	4.75%	0.33%	1.32%		0.16%	0.00%
	Moderate	1.38%	4.75%	0.49%	2.00%		0.32%	0.00%
	Major	2.09%	4.75%	0.66%	2.68%	12.99%	0.65%	0.00%
UCB	**Minor**	0.65%	3.92%	0.96%	3.06%		0.09%	0.01%
	Moderate	1.30%	3.92%	1.45%	4.67%		0.19%	0.02%
	Major	1.97%	3.92%	1.95%	6.33%	12.77%	0.38%	0.02%
NCC	**Minor**	0.74%	3.48%	0.28%	0.69%		0.06%	0.01%
	Moderate	1.50%	3.48%	0.42%	1.04%		0.11%	0.02%
	Major	2.27%	3.48%	0.56%	1.39%	12.62%	0.23%	0.03%
SIBL	**Minor**	1.00%	5.75%	1.45%	4.99%		0.12%	0.01%
	Moderate	2.02%	5.75%	2.20%	7.70%		0.23%	0.01%
	Major	3.07%	5.75%	2.96%	10.59%	14.27%	0.47%	0.02%

Source: Authors analysis on fall in CAR in different shock levels

Appendix B – Detailed example of Stress Testing Analysis of Ducth Bangla Bank Limited (DBBL) as a representative of the other 29 banks

Table B1 - RWA & CAR

Regulatory Capital	34,077,442,810
RWA	218,204,862,362
CAR	0.156171785

Source: Authors calculation of DBBL credit shock

Table B2 - Calculation of Increase in NPLs

Increase in NPL	1%	2%	3%
Total loan	231553940339	231553940339	231553940339
Total performing loan	216780907138	216780907138	216780907138
Total NPLs	14773033201	14773033201	14773033201
NPLs to Loans	0.06	0.06	0.06
Increase in NPLs	2167809071.38	4335618142.76	6503427214.14
Increase in Provisions	2167809071.38	4335618142.76	6503427214.14
Tax adjusted provision	2167809071.38	4335618142.76	6503427214.14
Revised capital	31909633738.62	29741824667.24	27574015595.86
Revised RWA	216037053290.62	213869244219.24	211701435147.86
Revised CAR	14.77%	13.91%	13.02%
Fall in CAR	0.85%	1.71%	2.59%
Revised NPLs	16940842272.38	19108651343.76	21276460415.14
Revised NPLs to Loans	0.07	0.08	0.09

Source: Authors calculation of DBBL credit shock

Table B3 - Calculation of Shift in NPLs

Shift in NPLs categories	1st	2nd	3rd
Weighted amount of provision	4374819170	4374819170	4374819170
Weighted amount of provision after shift categories	9180908533	9180908533	9180908533
Increase in provision	4806089363	4806089363	4806089363
Tax adjusted provision	4806089363	4806089363	4806089363
Revised capital	29271353447	29271353447	29271353447
Revised RWA	213398772998.70	213398772998.70	213399000000.00
Revised CAR	13.72%	13.72%	13.72%
Fall in CAR	1.90%	1.90%	1.90%

Source: Authors calculation of DBBL credit shock

Table B4 - Calculation of Increase of NPLs due to default of top 10 loan borrowers

Increase of NPLs due to default of top 10 loan borrowers	5%	7.5%	10%
Total loan to top 10 large borrowers	153846619362	153846619362	153846619362
Increase in NPLs under B/L category	7692330968	11538496452	15384661936
Increase in provisions	7692330968	11538496452	15384661936
Tax adjusted provision	7692330968	11538496452	15384661936
Revised capital	26385111842	22538946358	18692780874
Revised RWA	210513000000.00	206666000000.00	202820000000.00
Revised CAR	0.125337488	0.109059577	0.092164295
Fall in CAR	3.08%	4.71%	6.40%

Source: Authors calculation of DBBL credit shock

Table B5 - Calculation of Increase in NPLs up to that position in which whole capital will be wiped up

Increase in NPLs up to that position in which whole capital will be wiped up	
Total NPLs	14773033201
NPLs/total loan	0.063799533
Total capital	34077442810
Increase in NPLs	34077442810
Increase in provision	34077442810
Revised capital	0
Revised RWA	184127419552.00
Revised CAR	0

Source: Authors calculation of DBBL credit shock

Table B6 - Calculation of Equity Price shock

Equity Price shock	10%	20%	40%
Total exposure in stock market	11,284,536	11,284,536	11,284,536
Fall in the stock price	1128453.6	2256907.2	4513814.4
Tax adjusted loss	705283.5	1410567	2821134
Revised capital	34076737527	34,076,032,243	34,074,621,676
Revised RWA	218204157078.50	218203451795.00	218,202,041,228.00
Revised CAR	15.62%	15.62%	15.62%
Fall in CAR	0.00%	0.00%	0.00%

Source: Authors calculation of DBBL equity price shock

Table B7 - Calculation of Exchange Rate Shock

Exchange Rate shock	5%	10%	15%
Net on balance sheet and off balance sheet currency exposure	656896195	656896195	656896195
Exchange rate loss	32844809.75	65689619.5	98534429.25
Tax adjusted loss	20528006.09	41056012.19	61584018.28
Revised capital	34056914804	34036386798	34015858792
Revised RWA	218184334356	218163806349.81	218143278343.72
Revised CAR	15.61%	15.60%	15.59%
Fall in CAR	0.01%	0.02%	0.02%

Source: Authors calculation of DBBL Exchange rate shock

Table:5.8: Calculation of Liquidity Shock

Liquidity Shock	10%	20%	30%
Liquid asset	216794053073	216794053073	216794053073
Liquid liability	202960514391	202960514391	202960514391
Liquid ratio	1.068158768	1.068158768	1.068158768
Fall in liquid liabilities	20296051439	40592102878	60888154317
Revised liquid assets	196498001634	176201950195	155905898756
Revised liquid liabilities	182664462952	162368411513	142072360074
Revised liquid ratio	107.57%	108.52%	109.74%

Source: Authors calculation of DBBL liquidity shock

Appendix C

Graph C1 - Revised CAR due to NPLs to Loan in moderate shock
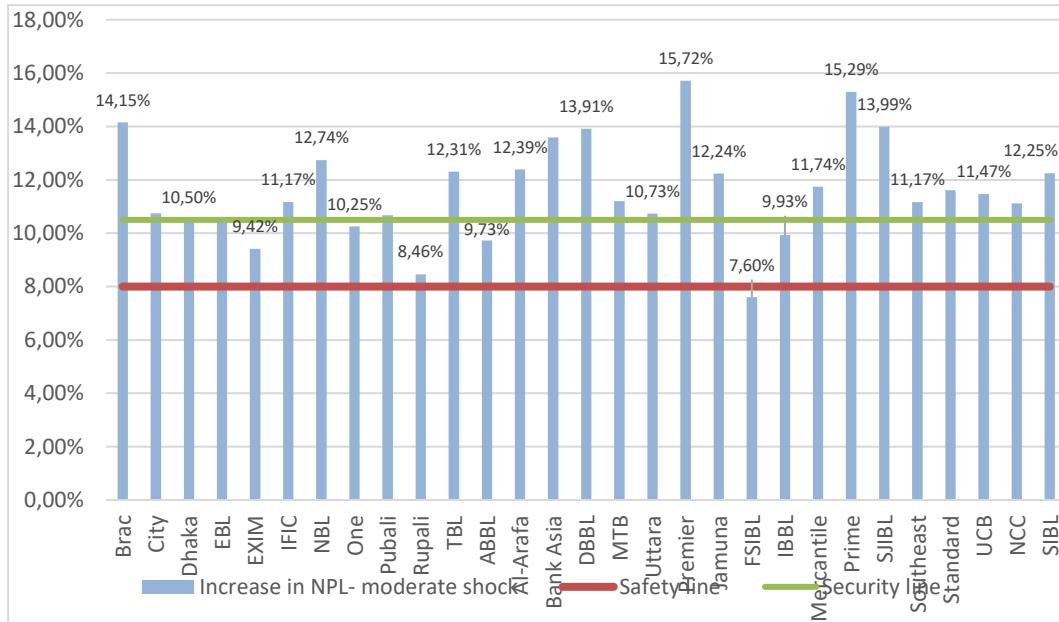
Source: Authors analysis

Graph C2 - Revised CAR due to downward Shift in NPLs in moderate shock
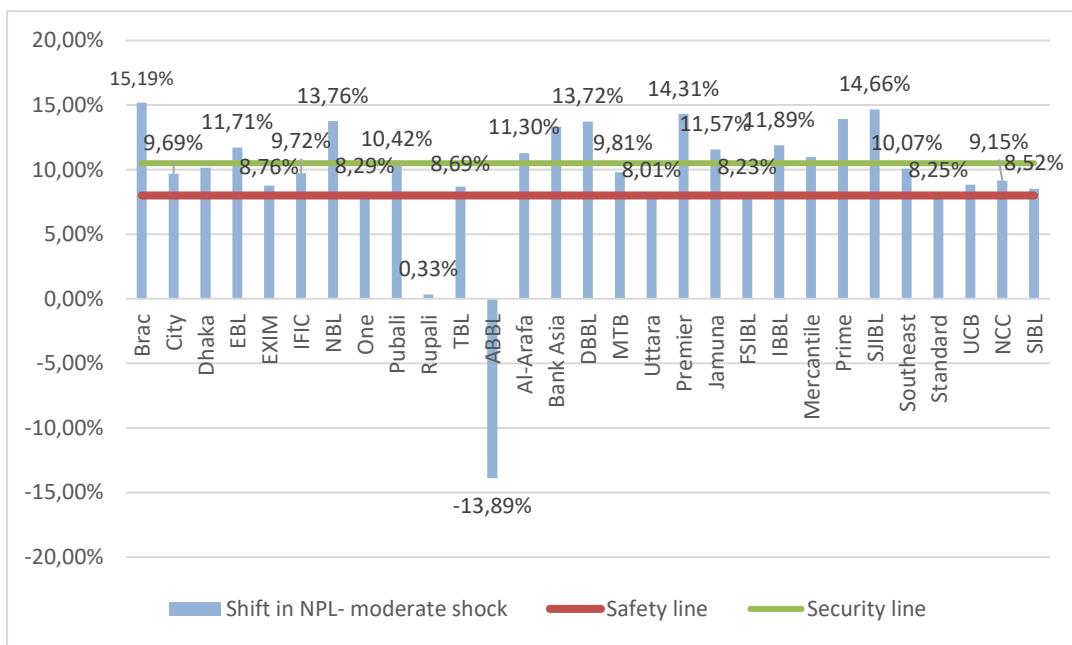
Source: Authors analysis

Graph C3 - Revised CAR due to default of Top borrowing sectors in moderate shock
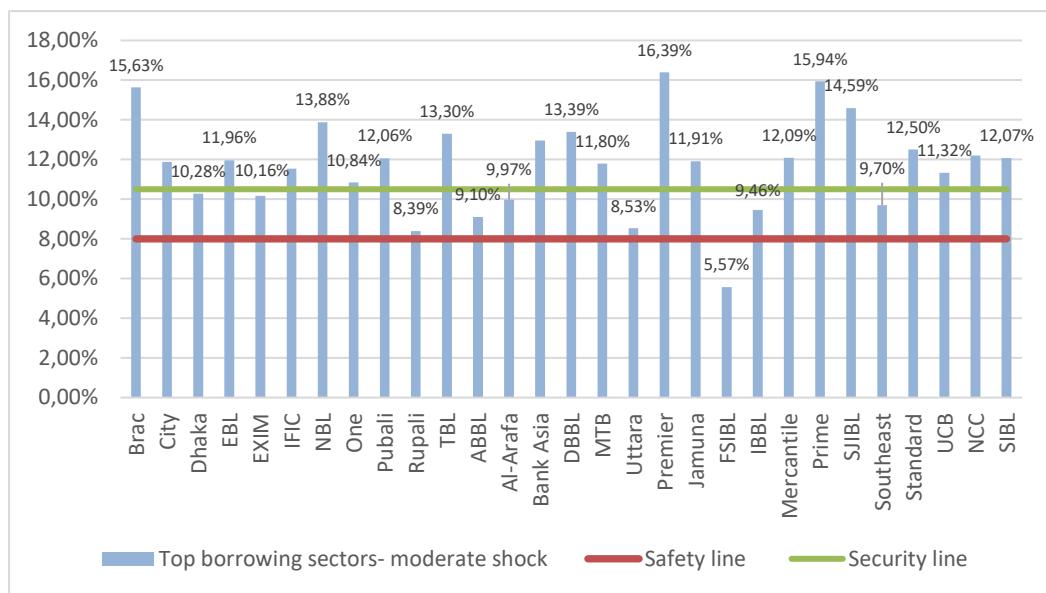
Source: Authors analysis

**Graph C4 - Revised CAR due to default of Top 10 borrowers in moderate shock**
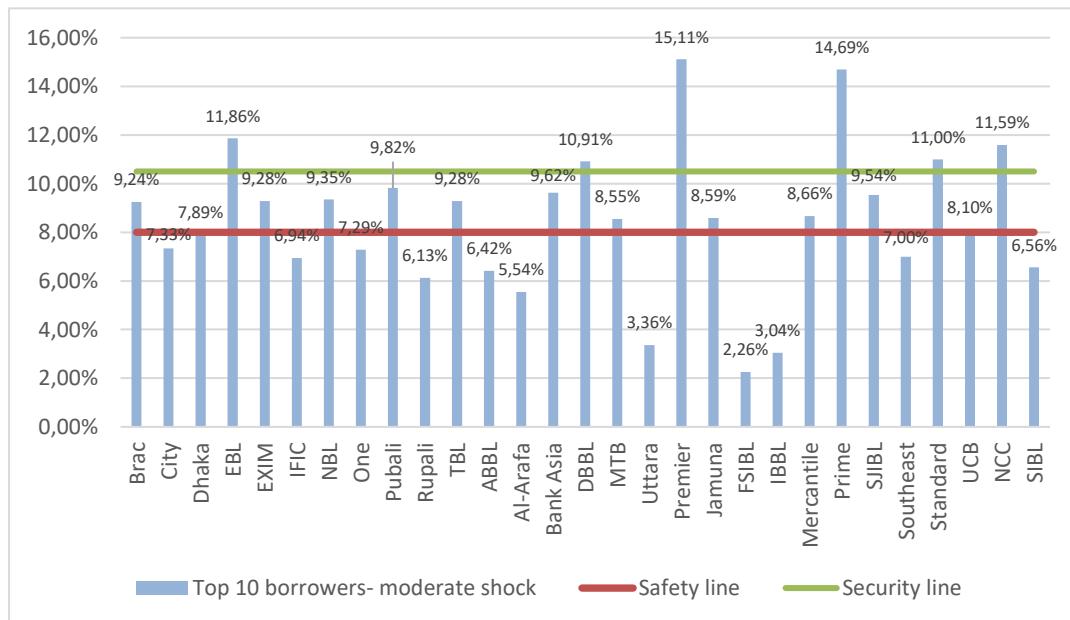
Source: Authors analysis

Graph C5 - Revised CAR due to decrease of Equity price in moderate shock
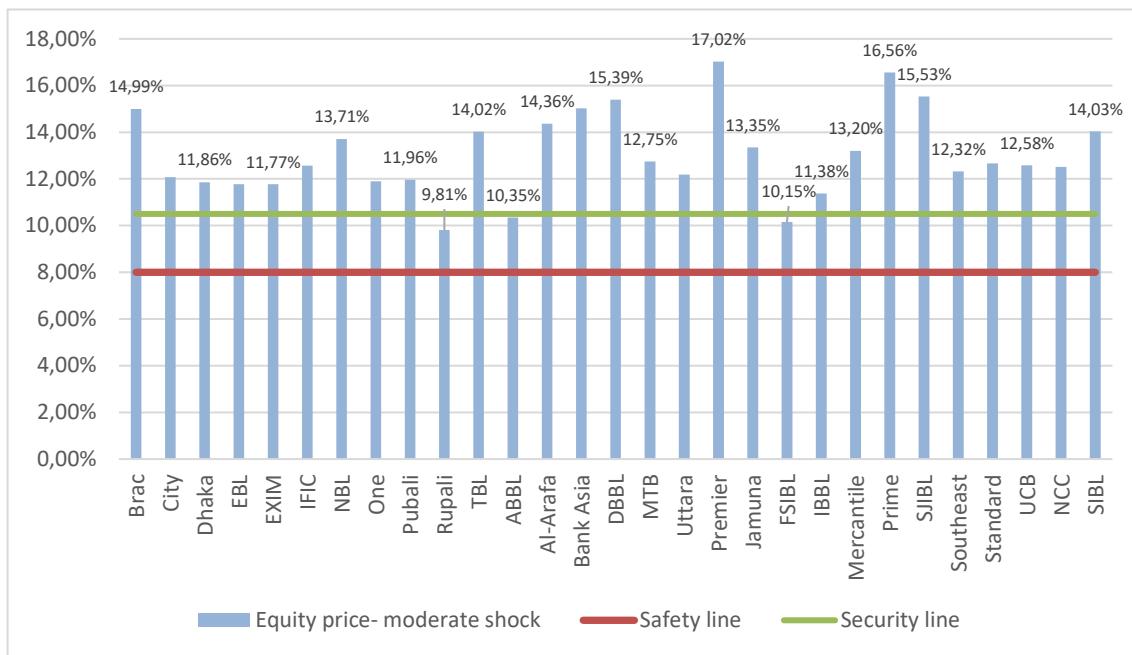
Source: Authors analysis

Graph C6 - Revised CAR due to adverse movement in foreign exchange rate in major shock moderate shock
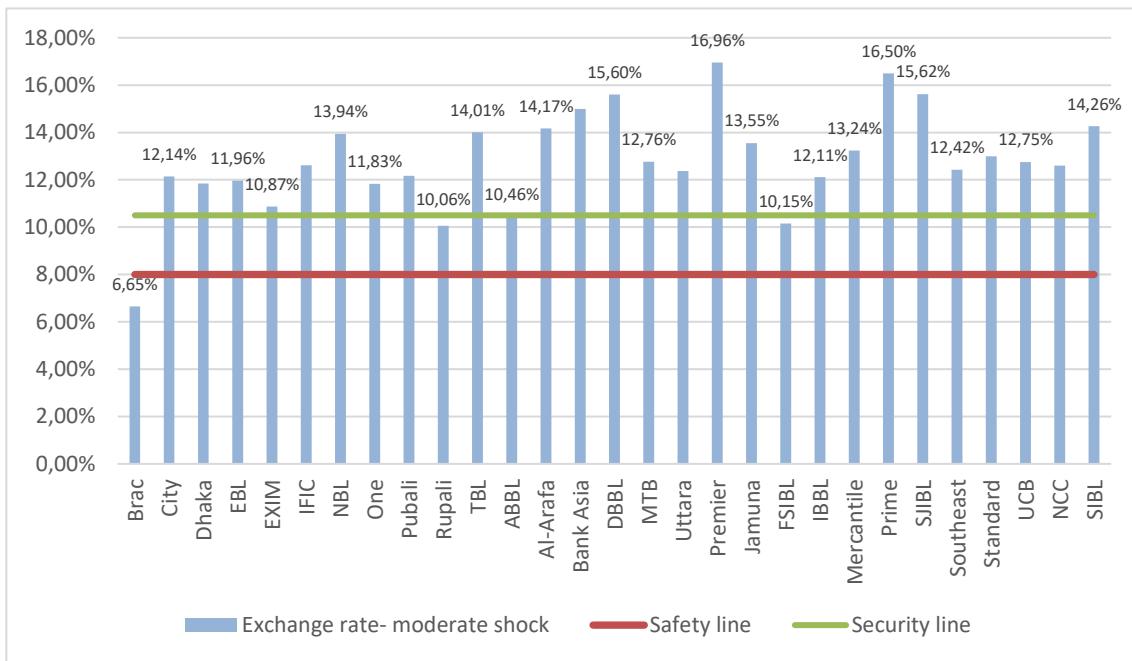
Source: Authors analysis

Graph C7 - Revised liquidity ratio due to increase in liquid liabilities in moderate shock
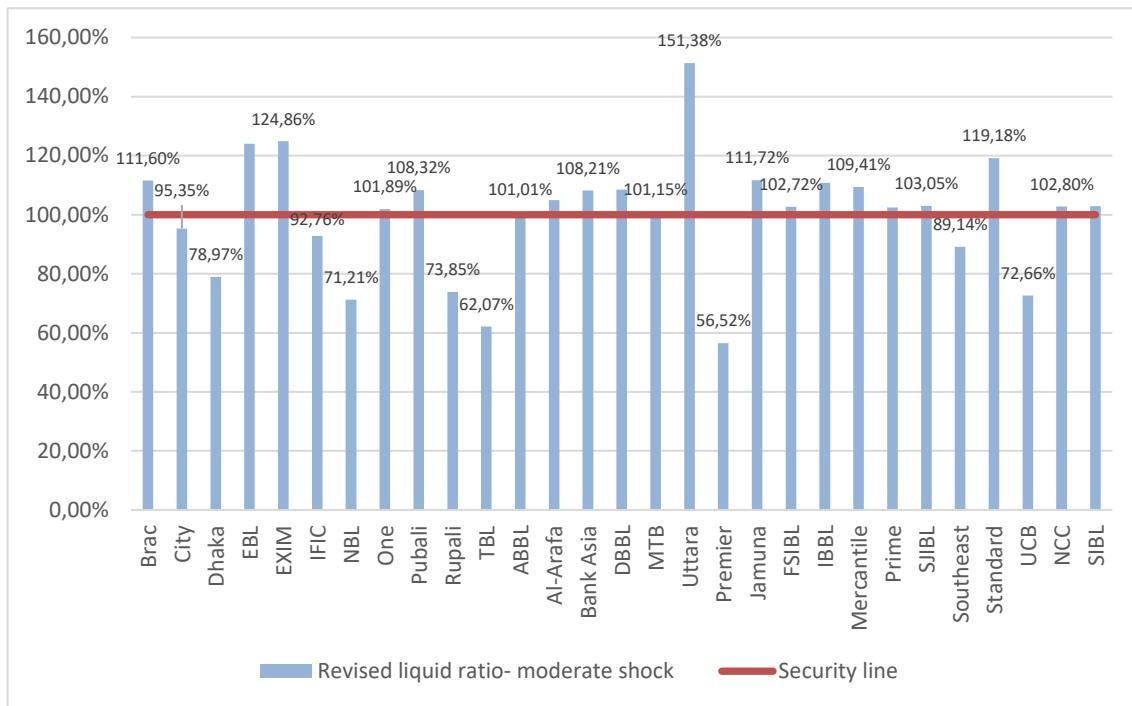
Source: Authors analysis

Graph C8 - Revised CAR due to NPLs to Loan in minor shock
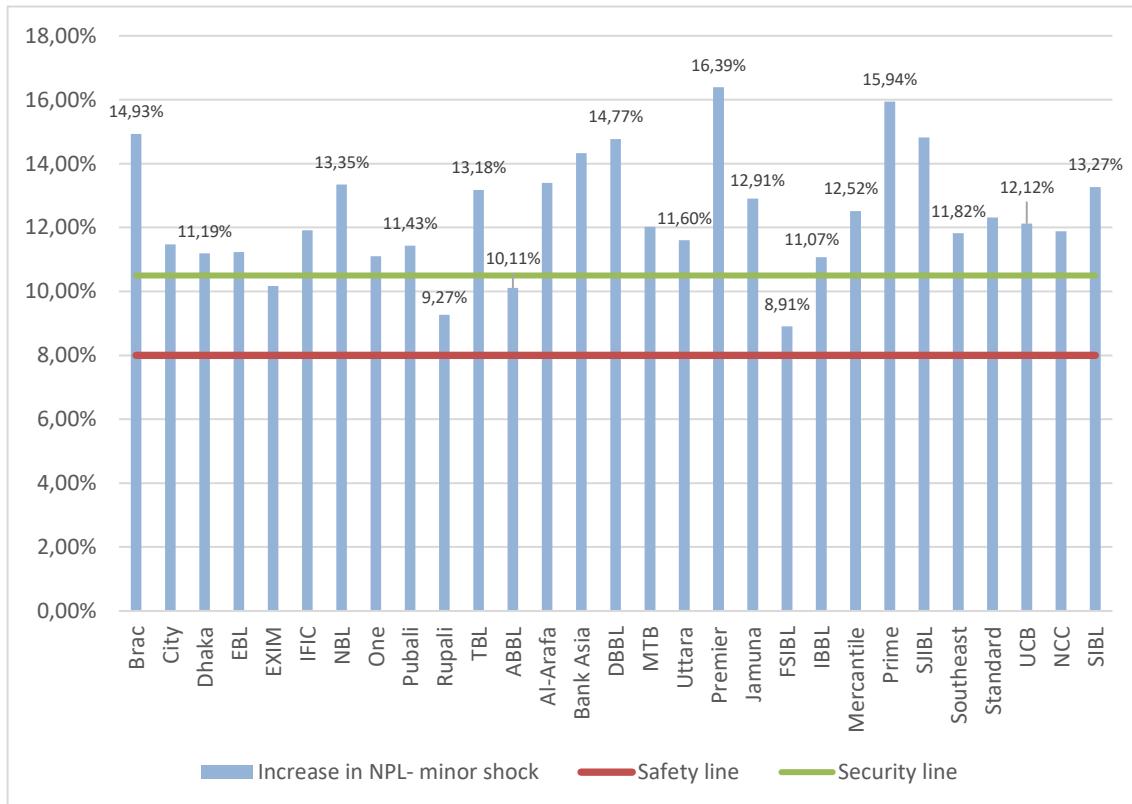
Source: Authors analysis

Graph C9 - Revised CAR due to downward Shift in NPLs in minor shock
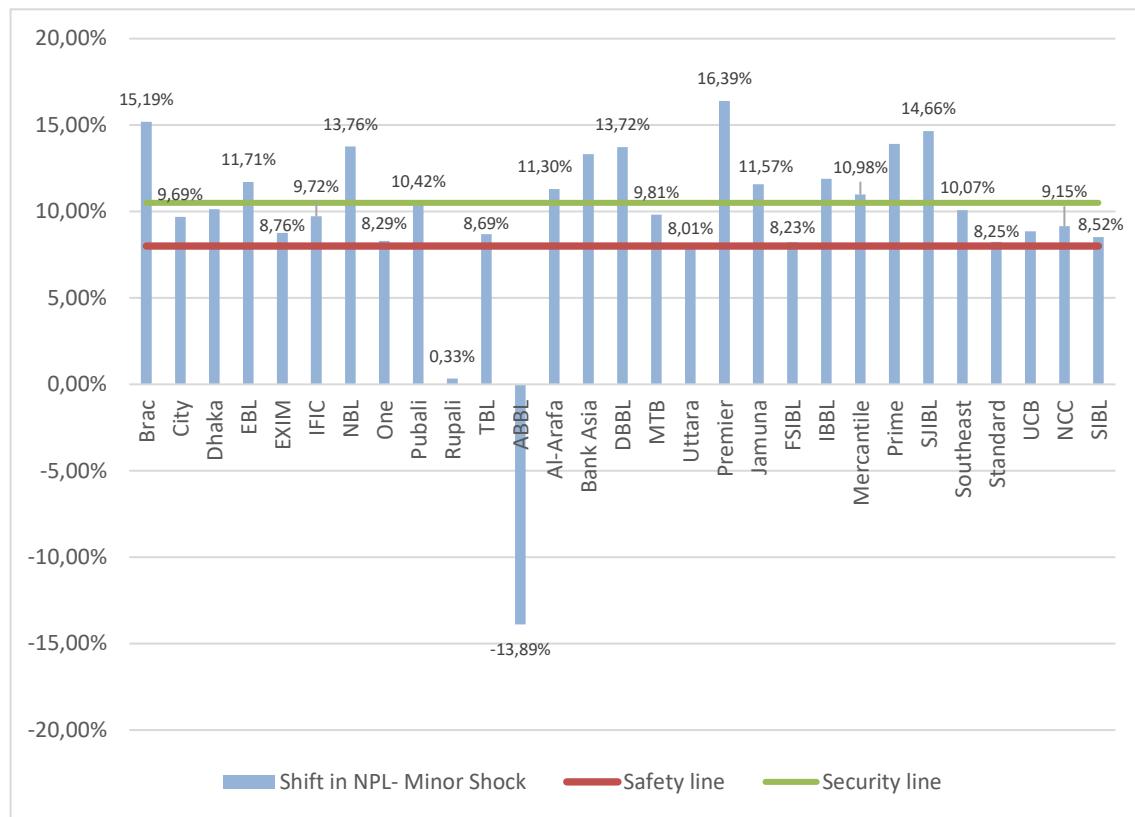
Source: Authors analysis

**Graph C10 - Revised CAR due to default of Top borrowing sectors in minor shock**
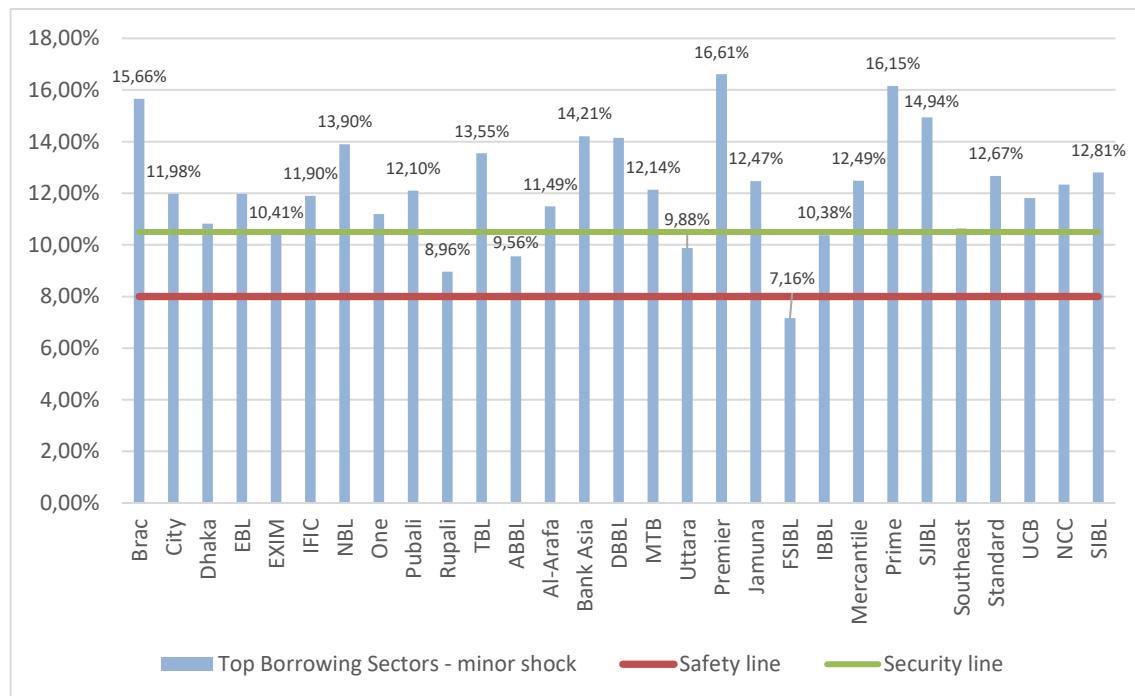
Source: Authors analysis

**Graph C11 - Revised CAR due to default of Top 10 borrowers in minor shock**
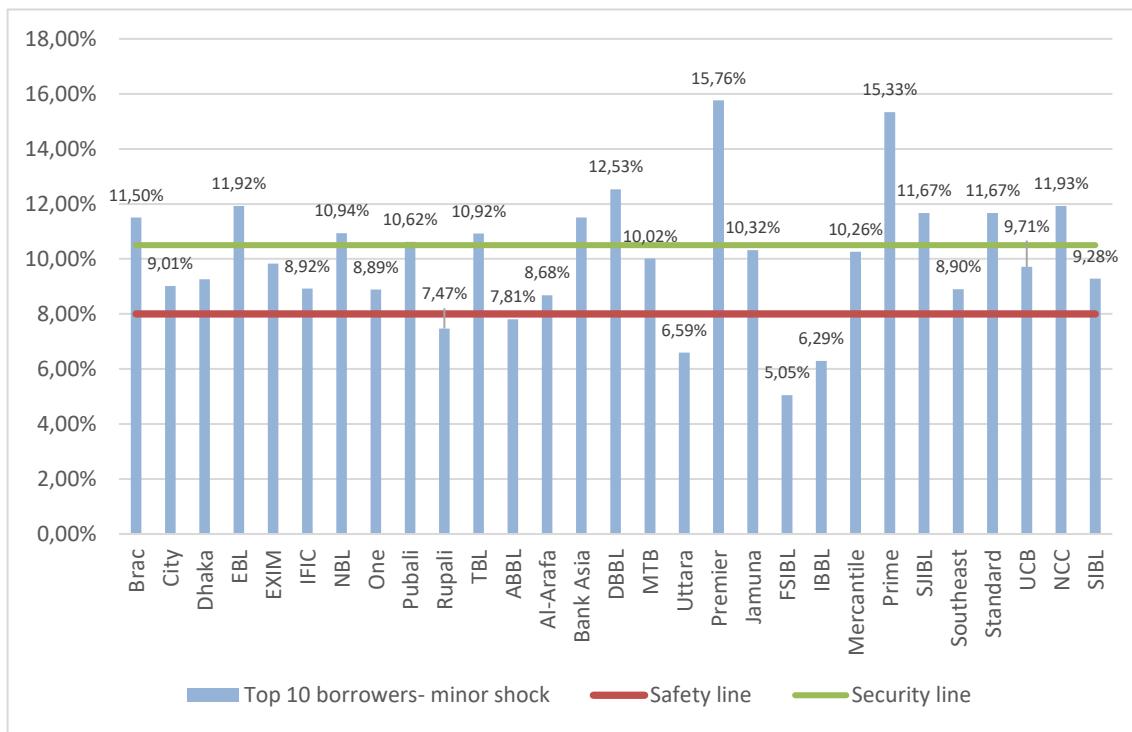
Source: Authors analysis

**Graph C12 - Revised CAR due to decrease of Equity price in minor shock**
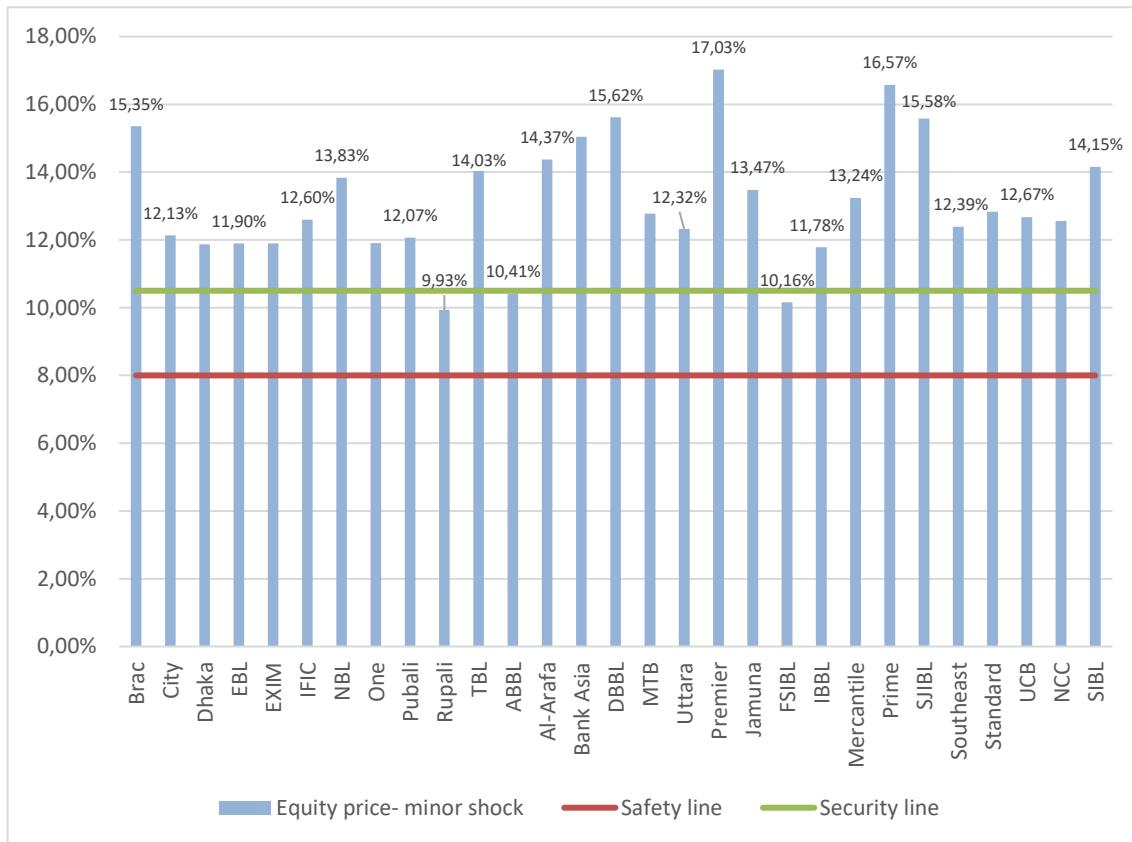
Source: Authors analysis

Graph C13 - Revised CAR due to adverse movement in foreign exchange rate in minor shock
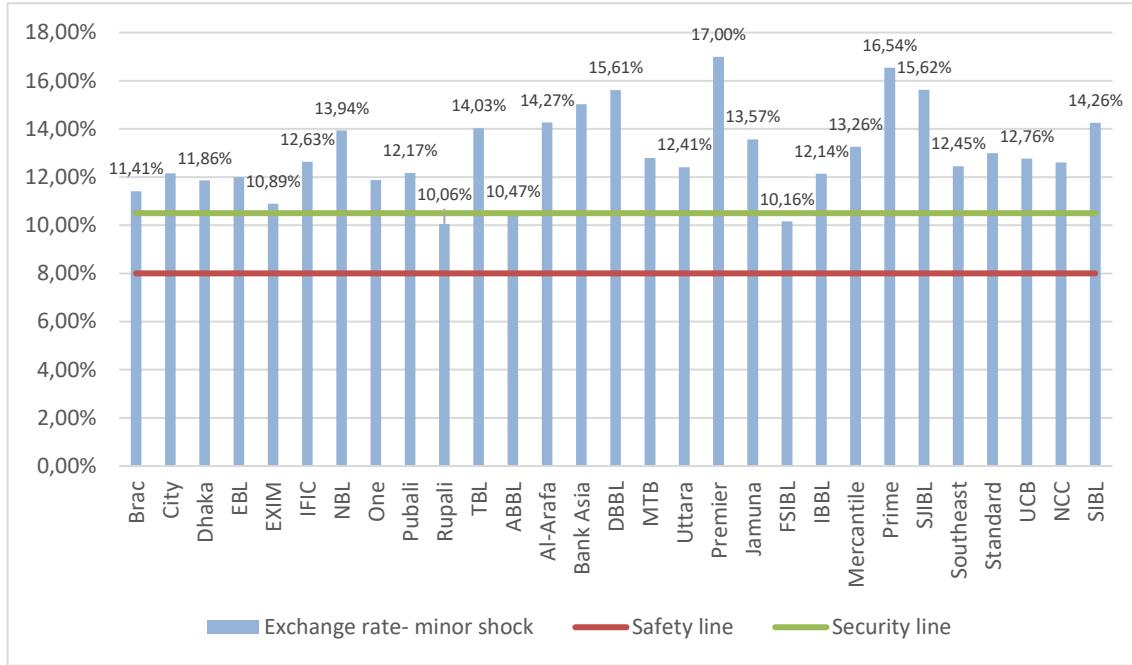
Source: Authors analysis

Graph C14 - Revised liquidity ratio due to increase in liquid liabilities in minor shock

Source: Authors analysis