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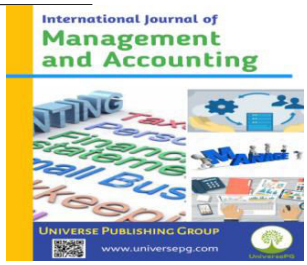

Using the Z-score to analyze the Financial Stability of Conventional Commercial Banks in Bangladesh

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ABSTRACT

This paper aims to measure and identify the determinants of financial stability of conventional commercial banks of Bangladesh listed on the Dhaka Stock Exchange. In the first step, the researcher calculates an accounting-based Z-score to measure the financial stability of the 23 sample banks over the period 2013-2022. In the second phase of the study, panel data regression analysis is conducted to identify the bank-specific determinants of financial stability. The exogenous variables include return on asset, income diversity, bank size, non-performing loan liquidity, capital adequacy, and management efficiency. The endogenous variable is the financial stability measured by z-score. The study provides empirical evidence of the bank-specific factors affecting the solvency of conventional commercial banks in Bangladesh.

Keywords: Z-score, Financial stability, Income diversity, Commercial banks, and Panel data regression.

INTRODUCTION:

The banking sector is the lifeblood of the economy of Bangladesh contributing significantly to the development of the country. No sooner had the COVID-19 pandemic ended, the Russian-Ukraine war poses new challenges to the world economy. Bangladesh is not an exception. Rising inflation can hurt the stability of the banking sector (Paul, 2023). Failures in the banking sector have contagious effects (Pasiouras and Gaganis, 2013) and can lead to the collapse of the financial system. Financial Stability Report 2021 published by the Financial Stability Department of Bangladesh Bank stated that banks and financial institutions have a moderate level of resiliency to possible unforeseen shocks. The report stated that increasing non-performing loans and high loan concentration is a matter of concern for many banks. In modern times bank failure is a common affair. So measuring the financial stability of banks is urgent to stakeholders (e.g. depositors, borrowers, employees, regulators, policymakers). Besides market-based methods such as the Capital Asset Pricing Model (CAPM), Value-at-Risk (VAR) model, and Merton distance to default model, several accounting data-based methods like the Z-score model and non-performing loan ratio are widely used as complementary especially when the bank is not listed. The accounting ratio-based Z-score model developed by Boyd and Graham, (1986) is an important contribution and is extensively used by academicians and practitioners. In a study conducted using U.S banks by Chiaramonte *et al.* (2016), it was found that the Z-score model can predict 76% of bank failure and the predictive power of the model remains constant over a three-year forward period. The basic idea behind the Z-score model is to link a bank's equity capital to its variability of return to measure how much variability

of return a bank can tolerate without becoming insolvent. The banking sector is going through digital transformation constantly and new financial securities are emerging. It is necessary to identify the factors that show early signs of financial distress to show the need for increased regulation (Sysoyeva, 2020). In this paper, the author tries to investigate empirically the effects of some crucial bank-specific variables on the financial stability of conventional commercial banks of Bangladesh measured by the Z-score model.

The bank-specific endogenous variables include profitability measured by return on asset, income diversity measured by the ratio of non-interest income to total operating income, bank size measured by the natural logarithm of total assets, asset quality measured by the ratio of non-performing loans to total loans, liquidity measured by total credit to deposit ratio, capital adequacy measured by total capital to risk-weighted assets, and management efficiency measured by total cost to total income ratio. Although there are lots of studies conducted on measuring credit risk of Islamic and conventional banks using market data-based methods and accounting data-based methods. There is no such empirical study of measuring the financial stability of conventional banks using Z-score using such a comprehensive sample in Bangladesh. This study attempts to fill this gap in the literature.

Review of Literature

Researchers from both developed & developing economies have used the Z-score to measure the default risk of financial institutions and contributed to the literature on the financial stability of banks (Anjom and Faruq, 2023). According to Joudar *et al*. (2023), liquidity and the ratio of capital adequacy have a positive impact on stability while governance, bank size, and level of concentration harm stability. The study conducted in the MENA region also states that financing-to-assets ratio, profitability ratio, cost-to-income ratio, inflation rate, and GDP have no significant impact on financial stability as estimated by the Z-Score. The study suggested improving liquidity and capital adequacy position as well as increasing the bank size cautiously with improvement in governance and encouraging new entries to decrease the level of concentration for improving the stability of Islamic banks. Silveira & Rani, (2021) used the Merton model of measuring the probability of default to investigate and compare the financial distress condition of conventional banks and Shariah banks of Indonesia over the period from 2011 to 2017. The researchers employed a t-test to whether the distance to default and probability of default differ significantly between these two categories of banks. They found the probability of default is significantly lower for Islamic banks. Therefore the researcher suggested Shariah-based banking instead of conventional to avoid financial instability. Supiyadi, (2021) studied to identify the determinants of financial performance and stability of Islamic banks in Indonesia for the period 2010-2017. The study reveals that Capital Adequacy, Bank Size, Asset quality, Management Efficiency, and GDP had a significant negative impact, while liquidity position, financial stability measured by z-score, and inflation had a significant positive impact on the profitability of Islamic banks in Indonesia. The researcher also found that return on assets and credits are the factors that significantly affect the financial stability of Indonesian banks. Ardiansyah *et al.* (2014) investigated the financial stability of Shariah-based banks and the factors that affect the stability. For this purpose, the authors used the Merton model of distance to default to measure default probability. They found that the default probability of Islamic banks is high as it is greater than 0.5. The authors also found that the amount of assets Islamic banks hold signifycantly and negatively affect default probability while the interest rate of Bank Indonesia significantly and positively affects default probability. This indicates that Islamic banks don't use interest rates but are influenced by interest rates. Čihák and Hesse, (2010) empirically investigated the impact of Islamic banking on the financial stability of conventional banks and used Z-score to measure stability. The researchers found that small Islamic banks are more financially stable than large Islamic and conventional banks while large conventional banks are more financially stable than large Islamic banks. They also found that the existence of Islamic banking has no impact on the financial stability of conventional banks. They mentioned as a possible cause for the low financial stability of Islamic banks is the weak credit risk management and monitoring system resulting in adverse selection and moral hazards when it's become bigger. Rajhi and Hassairi, (2013) compared Islamic banks and conventional

banks in terms of financial stability using Z-score in MENA and Southeast Asian countries where both categories of banks coexist and found that Islamic banks are more stable than conventional banks. This result is inconsistent with Čihák and Hesse, (2010). The researcher identified income diversity and credit risk as the common cause of financial distress for Islamic banks. As Islamic banks concentrate their focus on non-lending activities, their chance of bankruptcy increases. The results indicate that with the increase in LIBOR rate, the financial stability of Islamic banks in Southeast Asian countries decreases.

The researchers also found that Islamic banks and conventional banks crowd out each other in Southeast Asian countries. Jacob Muvingi *et al.* (2015) sought to compare the predictability of an accounting-based Z-score and a market-based KMV Merton model and found that an accounting-based Z-score is more accurate in predicting financial distress. According to the analysis, the Z-score model shows a .959 accuracy ratio against a .509 accuracy ratio of the market-based model. The study infers that the company that goes bankrupt exhibited poor financial performance in previous years. The study concluded that the ratio of EBIT to current liabilities and the market value of equity and long-term liabilities can be used to predict distress in advance in Zimbabwe. The empirical study of Bourkhis and Nabi, (2013) provided evidence that Islamic banks were not in a better position than conventional banks in terms of financial stability during the financial crisis of 2008-09. Their study indicated that Islamic banks are gradually switching from the theoretical practices that protected them even during the crisis. Kabir *et al.* (2015) empirically compared the credit risk of Islamic banks and conventional banks using the market-based Merton distance to default model and accounting-based Z-score. The researcher also calculated the NPL ratio to compare credit risk.

The finding as reported by Bourkhis and Nabi, (2013) that Islamic and conventional banks have no signify-cant difference in financial crisis during the financial crisis. The researcher also found that the method used in measuring financial stability has an important impact on the level of stability. According to Merton's distance to default model, Islamic banks have higher financial stability than conventional banks while conventional banks have higher financial stability when measured with Z score and NPL ratio.

METHODOLOGY:

The accounting ratio-based z-score model developed by Boyd and Graham, (1986) is used to measure the financial stability of conventional commercial banks in Bangladesh. Z-score is one of the widely used accounting data-based credit risk measurement methods among practitioners and academicians. Z-score is popular because of its ease of use as few accounting ratios are needed for calculation and its good predictability (Čihák and Hesse, 2010; Hossain *et al*., 2023).

Measurement of Financial Stability

The procedure for z-score calculation is as follows:

$$Z\text{- Score} = (ROA + E/A) / S.D \text{ of } ROA$$

Where, ROA = Return on Assets, E/A= is the ratio of total equity to total assets, S.D of ROA = Standard deviation of ROA over the whole sample period. S.D of ROA is also calculated in some studies over a three-year window including the current year and the preceding two years (Kabir *et al.*, 2015; Pasiouras and Gaganis, 2013; Chiaramonte *et al*., 2016; Cummins *et al*., 2017). The Z-score indicates how many standard deviations of a bank's ROA must fall to run out of equity capital and be forced into bankruptcy (Čihák and Hesse, 2010; Pasiouras and Gaganis, 2013). A higher z-score means higher financial stability while a lower z-score indicates lower financial stability. Along with assessing the status of financial stability with the help of the Z-Score Model, an econometric analysis is adopted to establish some form of relationship between the outcomes and selected bank-specific repressors. The econometric model is illustrated below:

$$Z\text{-SCORE}it = \alpha + \beta 1ROAit + \beta 2IDit + \beta 3CIRt + \beta 4LIQit + \beta 5CARit + \beta 6BSit + \varepsilon it$$

Hypotheses

The following hypothesis will be tested in the study

H1: Income diversity has a significant effect on financial stability of conventional commercial banks in Bangladesh.

H2: ROA significantly affect the financial stability of conventional commercial banks in Bangladesh

H3: Management efficiency significantly impact on financial stability of conventional commercial banks in Bangladesh

H4: Liquidity has significant effect on financial stability of conventional commercial banks in Bangladesh

H5: Capital Adequacy has significant effect on financial stability of conventional commercial banks in Bangladesh

H6: Bank Size has significant impact on financial stability of conventional commercial banks in Bangladesh

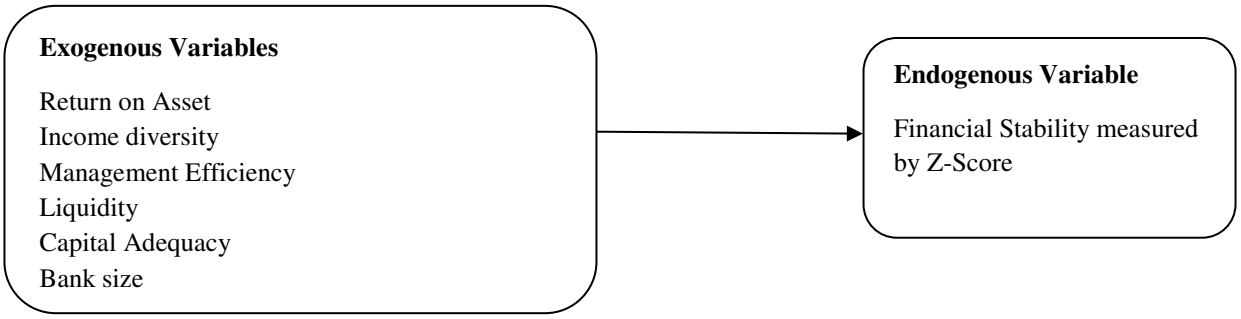

Fig. 1: Regression Model.

Table 1: Variable Codes and Formulas.

Variables	Measurement	Formulae
Endogenous Variable		
Financial Stability	Z-Score	(ROA + E/A) / S.D of ROA
Exogenous Variables		
Income diversity	ID	Non-interest Income/ Total Operating Income
Return on asset	ROA	Net Income / Total Assets
Management Efficiency	CIR	Ratio of Total Cost to Total Income
Liquidity	LIQ	Ratio of Total Credit to Total Deposit
Capital Adequacy	CAR	Ratio of Total Capital to Total Risk-Weighted Assets
Bank size	BS	Natural Logarithm of Total Assets

Sampling technique

Collection of data is based on the financial statements of selected banks. In total, 230 observations of 23 banks over the period from 2013 to 2022. The sample technique used is purposive sampling technique based on whether bank is listed in Dhaka Stock Exchange and the required data is available over the sample period. The sampling technique is illustrated below:

Industry	Total state-owned and private commercial banks	Listed with DSE	Listed conventional banks with DSE	No. of banks taken as a sample	No. of Years of each sampled bank
Bank	49	35	27	23	10

Empirical results and analyses

Descriptive statistics of Z-scores of sample banks

The descriptive statistics of the Z-scores of sample banks show the maximum, minimum, and average Z-scores of each sample bank with its ranking among all the sample banks. Southeast Bank Ltd. has the highest average Z-score of 10.8568 with a maximum score of 20.75491 and a minimum score of 6.4141. This indicates Southeast Bank Ltd showed the highest level of stability over the study period among the sample banks. Rupali Bank Ltd. is the only state-owned bank included in the sample and has the lowest average Z-score of 0.70378 with a maximum score of 1.433163 and the lowest score of -0.83112. Therefore, Rupali Bank Ltd. has the lowest level of financial stability. Southeast Bank Ltd., Eastern Bank Ltd., NCC Bank Ltd., Jamuna Bank Ltd., and Dutch-Bangla Bank Ltd. make up the list best five banks, and Rupali Bank Ltd., AB Bank Ltd., One Bank Ltd., Midland Bank Ltd., South-Bangla Agricultural Bank Ltd., make up the list of worst five banks among the sample banks in terms financial stability measured by Z-scores.

Table 2: Descriptive statistics of Z-scores of sample banks.

Bank Name	Max	Min	Average	Rankings
Trust Bank Ltd.	5.029258	2.776737	3.842029	**8**
Pubali Bank Ltd.	3.906306	1.677064	2.623029	**15**
Mutual Trust Bank Ltd.	4.790225	1.822899	3.70861	**9**
Mercantile Bank Ltd.	5.953955	3.182452	4.704428	**6**
City Bank Ltd.	4.921423	2.096001	3.366255	**11**
Dutch-Bangla Bank Ltd.	6.541617	3.523655	5.525816	**5**
Premier Bank Ltd.	5.284079	1.919778	2.975768	**13**
Dhaka Bank Ltd.	3.764716	2.324383	2.962105	**14**
United Commercial Bank Ltd.	4.189993	1.93771	2.384574	**18**
AB Bank Ltd.	2.603086	0.339094	1.137389	**22**
Brac Bank Ltd.	4.999985	2.9737	4.027574	**7**
IFIC Bank Ltd.	3.548372	0.951132	2.603657	**16**
Bank Asia Ltd.	5.225454	2.532163	3.300876	**12**
Southeast Bank Ltd.	20.75491	6.414159	10.8568	**1**
One Bank Ltd.	2.780725	0.644484	1.632885	**21**
Prime Bank Ltd.	5.792447	2.385004	3.690405	**10**
Eastern Bank Ltd.	8.206344	6.175168	7.625307	**2**
Rupali Bank Ltd.	1.433163	-0.83112	0.70378	**23**
NRBC Bank Ltd.	3.657489	1.157551	2.590821	**17**
South-Bangla Agricultural Bank Ltd.	3.897432	1.092243	2.227925	**19**
Midland Bank Ltd.	3.532834	1.238387	2.222636	**20**
NCC Bank Ltd.	9.467853	6.104462	7.064158	**3**
Jamuna Bank Ltd.	7.532994	3.852183	6.636392	**4**

Financial stability of banks of Bangladesh

Fig. 2 shows the average financial stability of the sample banks over the study period. This figure clearly indicates that the average financial stability of comercial banks is deteriorating. In 2014, the average Z-score was 4.97 and gradually falls to 3.07 in 2022.

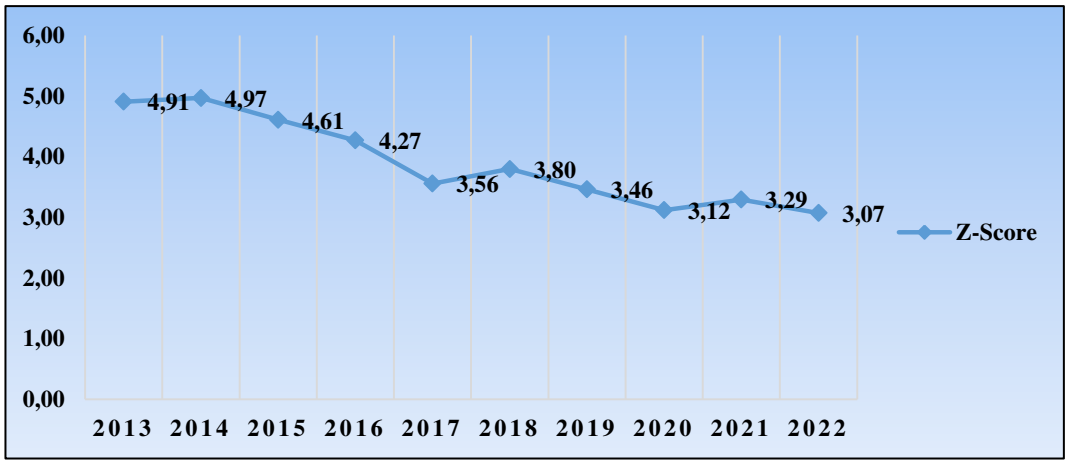

Fig. 2: Average Financial Stability of the Sample Banks (2013-2022).

Descriptive statistics

The descriptive statistics of the Z-score in **Table 3** show that it has a mean value of 4.112, a minimum value of -.831, and a maximum value of 27.589 with a standard deviation of 3.366. This verifies that there is no such presence of outliers that need treatments for regression analysis. The mean Z-score of 4.112 also indicates the average level of financial stability of conventional commercial banks in Bangladesh. The average return on assets is .893 whereas the average

cost to income ratio is 53.105. The average income diversity is 40.452 which indicate a high proportion of non-interest income. The average capital adequacy ratio is 14.465 which are greater than the minimum capital adequacy requirement.

Table 3: Descriptive Statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
Z-Score	230	4.112	3.366	-.831	27.589
ROA	230	.893	.451	-.1	2.31
ID	230	40.452	18.55	3.349	89.307
CIR	230	52.105	12.172	28.64	104.11
LIQ	230	80.558	6.471	56.15	96.8
CAR	230	14.465	8.535	4.92	97.06
BS	230	12.289	.79	8.927	13.477

RESULTS:

The cross-sectional time-series FGLS regression method is employed to check the problem of heteroskedasticity, autocorrelation, and cross-sectional dependence. The result shows that return on asset, income diversity, cost-to-income ratio, and bank size significantly impact financial stability. Banks with higher profitability will have higher financial stability as they have better credit risk management capacity. ROA has a strong positive impact on the level of financial stability measured by the Z-score. Income diversity has a significant negative relation with the Z-score indicating that banks that are highly dependent on non-interest earnings have lower financial stability. Čihák and Hesse, (2010) and Kabir *et al.* (2015) found similar evidence of a significant negative relationship between income diversity and financial stability. The cost-to-income ratio has a significant negative impact on bank stability as expected. That means the higher the ratio of total cost to total income lower will be the financial stability. The bank size is statistically significant at a 5% level of significance. Bank size has negative effect on Z-score and is consistent with (Joudar *et al.,* 2023; Čihák and Hesse, 2010). This result is inconsistent with the result of Kabir *et al.* (2015) as they found that with the increase in bank size, financial stability also increases. However, the larger size of banks can also create management inefficiency.

Table 4: Cross-sectional time-series FGLS regression.

Z-score	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
ROA	2.604	.14	18.62	0	2.33	2.879	***
ID	-.008	.002	-4.29	0	-.012	-.005	***
CIR	-.025	.008	-3.29	.001	-.04	-.01	***
LIQ	-.01	.008	-1.20	.228	-.027	.006	
CAR	-.007	.011	-0.58	.559	-.029	.016	
BS	-.377	.151	-2.50	.012	-.672	-.081	**
Constant	8.926	1.953	4.57	0	5.098	12.754	***
Mean dependent var		4.112		SD dependent var		3.366	
Number of obs		230		Chi-square		519.245	
*** $p<.01$, ** $p<.05$, * $p<.1$							

CONCLUSION:

This paper aimed to investigate the financial stability of conventional commercial banks of Bangladesh using the Z-score method and also identify the bank-specific variables that affect a bank's financial stability. Z-score is a widely used accounting information-based credit risk measurement method. The Z-score shows how many standard deviations of ROA of a firm must fall to completely deplete its equity and eventually fall to distress. The average Z-scores shows that commercial banks of Bangladesh have low to medium level of financial stability. The average Z-score has a declining trend over the study period that indicates the financial stability of banks is decreasing

gradually. In addition, the study tries to identify the bank-specific determinants of the financial stability of conventional commercial banks in Bangladesh. The author finds that management efficiency measured by the total cost to total income ratio, income diversity measured by the proportion of the non-interest income of total operating income, and bank size measured by the natural logarithm of the total asset has a significant negative impact while return on the asset has strong positive on Z-scores. Therefore, to improve financial stability banks must take necessary actions to increase their profitability, & management efficiency & strengthen the source of lending-based interest income besides fees & commissions. Banks need to keep their credit risk management efficient while increasing size.

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CONFLICTS OF INTEREST:

The author declares no conflict of interest with anybody regarding this research work.

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