

Are The Sudanese Banks Financially Sound?

Nawal Hussein Abbas Elhussein¹ & Ahmed Ali Eldawaha²

¹ School of Management Studies, University of Khartoum, Khartoum, Sudan

² Ellie Industries, Khartoum, Sudan

Correspondence: Nawal Hussein Abbas Elhussein, North York, Ontario, M2J 4E7, Canada. Tel: 1-64-7783-4489.

E-mail: nawalelhussein80@gmail.com

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Abstract

This study attempts to investigate whether the banks operating in Sudan are solvent and financially sound as well as to examine whether there are roots for a banking panic. The research is also intended to determine whether there are candidate bankrupt banks. The study employs quantitative and qualitative research methods and utilizes both secondary and primary data and covers the eight-year period 2013-2020. The annual audited financial reports of banks published for the period under study represent the source of the secondary data and the primary data is collected through questionnaires distributed to depositors. The sample comprises 30 banks out of a total population of 37 banks. Also, responses from 416 participants in the questionnaire are considered for constructing the depositors' confidence index. To test the hypotheses a number of quantitative models, namely, univariate financial ratios models, Ahmed (2003) Z-score model, Altman (2002) emergent markets Z-score model, and depositor's confidence index (DCI) model are utilized. The statistical results of three out of the four models, namely, the univariate financial ratios model, Ahmed (2003) Z-score model, and depositor's confidence index, document that banks operating in Sudan are financially unsound and financially distressed and none of those banks is thoroughly healthy. However, the results of EM Z-score model show that banks operating in Sudan can be categorized as healthy and financially sound and that there are no roots for a banking panic in the country.

Keywords: banks, financial health, financial distress, financial ratios, Z-score models, confidence index

1. Introduction

To ensure that the banks are well-functioning, a regular diagnostic financial check has to be performed by the regulators and policy makers. The most important manifestation that need to be examined is the financial health of banks. To accurately assess the financial health of banks, four main areas of financial health must be examined. These areas include liquidity, solvency, profitability and operating efficiency. Among the most efficient diagnostic tools of a business's financial health are the financial ratios and Z-score model.

Banks came into existence in Sudan in the early 20th century during the British Egyptian colonialism with the first bank being established in 1913. Since then and until the mid-1970s all banks operating in Sudan were conventional. From mid-1970 until 1983 Sudan experienced dual banking with conventional and Islamic banks operating together. In 1983 the Central Bank of Sudan (CBOS) announced the Islamization of the entire banking system mandating all financial institutions operating in Sudan to fully comply with the Islamic laws. Currently, there are 37 banks operating in Sudan. This study attempts to investigate whether the banks operating in Sudan are financially healthy by calculating the financial ratios and Z-scores of two Multivariate Discriminants Analysis (MDA) for the seven successive years following the secession of South Sudan. This is the period from 2013 to 2019 which is selected on the basis that the secession of South Sudan hardly hit the Sudanese economy in general and banking sector in particular. The study also endeavors to construct a Sudanese depositor's confidence index to be used as one of the predictors of bank's financial distress. Six hypotheses are set by the study: Banks operating in Sudan are financially sound and are able to pay off depositors, There are no roots for a banking crisis, There is no bank that is likely to go out of business, The privately-owned banks are not significantly different from the government-owned ones in terms of their financial health levels, The specialized banks are as financially sound as the nonspecialized ones, The foreign banks operating in Sudan achieve the same scores of financial health as the national banks. The rest of this paper is outlined as follows: Section two provides a review of the literature that explains the concept of financial health and

presents findings of the previous studies on the financial health of banks. Section three describes the methodology employed. In section four the empirical results are presented. Section five thoroughly discusses the findings of the study. Section six presents the conclusions and recommendations of the paper.

2. Literature Review

The financial health of a business is not explicitly defined in the business's literature. However; generally speaking, there is a consensus that good financial health means less worries and stress because a financially sound entity is always resilient and able to pursue profitable business opportunities. Thus, one can simply define financial health as a term used to describe the state of a business financial situation. Further, financial health can be viewed as the opposite of financial distress. All definitions agree that financial distress is a condition in which a company cannot generate sufficient revenue or income to meet its financial obligations as they come due and may eventually go into bankruptcy. Over the last five decades, several models have been developed and used to predict the financial distress of businesses. These models are divided into two main groups: Statistical analysis techniques and Computer based analysis techniques. Statistical models include Univariate Financial Ratio Models, Multivariate Financial Ratio Models, and Market Models. The Univariate Financial Ratio Models, are initiated by Beaver (1966), Tamari (1966) and Wilcox (1971) to predict enterprises failure by observing the behavior of financial ratios. According to Beaver (1966) cash flow to total debt and net income to total assets are the two best predictors of failure. Eljelly and Mansour (2001) find that out of many financial ratios 18 financial ratios are practical and effective variables for developing their models that predict private companies' failure in the Sudan. They classified these ratios into four major categories; Liquidity measures, Profitability measures, Activity and turnover measures, and Indebtedness measures. Ahmed (2003) advocates that 13 out of 41 financial ratios as relevant variables for building up models predicting the financial distress of Sudanese commercial banks. He categorized these ratios as Indebtedness Measures, Liquidity measures, and Profitability measures. More recent studies document that gearing ratio is the best ratio for predicting payment difficulty; Stenback (2013) and Lundqvist and Strand (2013).

It is worthwhile to mention that financial ratios suffer from major shortcomings. That is, financial ratios are subject to manipulation and that one ratio cannot fit to give a clear picture of a firm financial health. Moreover, there is no general agreement among the scholars on specific ratios that can be harnessed to gauge the financial health of enterprises.

In the multivariate models the combination of a number of financial ratios is utilized. Altman (1968) extended the work of Beaver (1966) by employing Multiple Discriminant Analysis (MDA) to identify a group of distress prediction ratios. His work opened the door widely to researchers and academicians to apply the MDA approach to coin different models; Deakin (1972), Grice and Ingram (2001), Eljelly and Mansour (2001), and Ahmed (2003). Although the MDA models are beneficial tools in predicting financial distress and examining financial viability of organizations, they are sharply criticized because of their restrictive assumptions about multivariate normality and independence of explanatory variables. These limitations, motivated Ohlson (1980) to introduce a new model based on logit analysis with a set of nine accounting ratios and Zmijewski (1984) to use probit analysis to build a three-variable distress prediction model. Ohlson (1980) study is followed by many studies which used the logit analysis to develop models that predicting financial distress of businesses; Kim and Gu (2010), Hassani and Parsadmehr (2012), and Zaghoudi, (2013). Some studies combined both the logit and probit techniques to tailor business failure prediction models. In this respect, Zavgran (1983) presented a logit and probit model to estimate the probability of failure. However, the results obtained by the probit and logit models are less accurate in predicting failure than the MDA models. Additionally, both the MDA and the probit and logit-based models use accounting ratios only as explanatory variables. As a result, researchers started to look for models that eliminate the disadvantages of both discriminant analysis and logit and probit prediction models. For instance, Shumway (2001) develops a discrete hazard model that uses both accounting ratios and market-driven variables to estimate the probability of failure.

Market - based models came into existence in 1970s when Black and Scholes (1973) present their famous option-pricing model is further developed by Merton model (Merton, 1974). The model basically implies that if the market value of assets lies below the face value of debt in one year's time the firm faces default situation. Further modifications are made by researchers, including Vasicek (1977) and Collin-Dufresne and Goldstein (2001). In addition to those models, few studies attempt to incorporate the viewpoints of depositors in models developed to address trust in banks. These studies primarily examine the determinants of confidence in banks using logit models; Mosch and Prast (2008), Lebedyef (2011), and Fungacova, et.al. (2016). Though many of the statistical models reported proved to have high predictive power for their ratios, a unique perfect combination of financial ratios has

not yet been found. It is well known that models' composition and precision depend on data availability, data quality, sample selection and methods of analysis.

To overcome the problems of the statistical prediction models, several artificial intelligence modeling techniques, including support vector machines, genetic algorithms, decision trees, and neural networks, have been largely developed in the recent years. However recent studies found that the two types, and more specifically the MDA and neural networks models, perform similarly and sometimes the MDA performs better than the neural networks (Eljelly and Mansour, 2001).

It is well noted that the accounting-based financial ratio models and the Altman Z-score models are widely used in financial distress area of research despite their cited criticisms because of their popularity and easy-to-use feature, Al Zaabi (2011), Chieng (2013), Lundqvist and Strand (2013), Priya and Rengarajan (2016), Liang and Pathak (2016), Sreekala, Santhi, & Kumar, (2016).

Based on the literature review this paper uses multi models to assess the financial health of banks in order to eliminate disadvantages of individual models when used separately. Further the depositor's confidence index model is coined by this study as an additional model for assessing the financial health of banks by incorporating the opinions of depositors.

3. Material and Methods

The problem researched is centered on assessing the financial health of the banks operating in Sudan and their ability to pay off the depositors, determining banks that are more likely to go bankrupt and comparing the privately-owned and government-owned banks, the specialized and nonspecialized banks and foreign and national banks in terms of financial health scores. The period covered by the study is 2011-2020. The sample of the study includes 30 banks and the depositors who hold demand deposit, saving deposit, and/or investment deposits in those banks. The thirty banks are composed of twenty commercial banks, five specialized banks, four foreign banks, and one governmental bank. The depositors' confidence index is developed using the Simple random sampling method. To determine the sample size, the Andrew Fisher's formula is used, and the targeted sample size is 385. The data needed for constructing the depositor's confidence index is collected via a questionnaire. The financial data needed to calculate the financial ratios and Z-scores are gathered from the annual audited financial reports of the banks, banks' websites, Central Bank of Sudan (CBOS), Sudanese Banks Union, Khartoum Stock Exchange and Sudan Academy for Banking Studies. Since there is no one model that fits all situations and cases and, in an attempt, to have a thorough evaluation, the study uses four models of data analysis to attain its stated objectives. The multi models are also adopted to obtain a complete picture and in order to eliminate disadvantages of these models when used individually. These models include univariate financial ratios model, two models of multiple discriminant analysis (MDA), namely, the model formulated by Ahmed (2003) and the Emerging Market (EM) Z-score introduced by Altman (2002) and depositor's confidence index (DCI). All of the four models are used to evaluate the financial health of sampled banks collectively. More specifically, these models are used to examine the first hypothesis of this study. The other hypotheses are tested using mainly the EM Z-score. The t-test and the multivariate Hotelling (T2) test, as hypothesis tests, are employed to test the significance of the results obtained from the application of both EM Z-score and Ahmed (2003) models. The depositor confidence index is adopted to incorporate the view point of depositors. The Index is reported on a 0 to 100 scale where the 100 points are distributed to the four group of determinants in a way that reflect the degree of influence of each group of variables on the index. And then within each group of variables, the responses of the participants are equally weighted. Following these assumptions, the construction of the index per depositor involves the distribution of the 100-point index to the bank- specific factors, regulatory environment factors, political factors and economic factors. The bank- specific factors are considered the most influential factors on the confidence index and thus a higher weight of 30 points is attached to this group of factors whereas the regulatory environment factors and political factors are assumed to be equally important and hence each one of these are given a weight of 25 points. The economic factors are assumed to have relatively lowest strength of effect on the index and therefore are assigned a weight of 20 points.

These assumptions are summarized in Table 1 below.

Table 1. Allocation of Weights to the Variables and Responses

Factors	Factors Weight	Number of Questions	Question Weight	Response Weight (W _{ij})	Scale Weight				
					0	1	2	3	4
Bank- specific factors (A)	30	6	5	1.25	0	1.25	2.5	3.75	5
Regulatory environment factors (B)	25	7	3.57	0.89	0	0.89	1.79	2.68	3.57
Political factors (C)	25	4	6.25	1.56	0	1.56	3.13	4.69	6.25
Economic factors (D)	20	1	20	5.00	0	5.00	10.0	15.00	20.00
Total Points (Index)	100	18			0	25	50	75	100

Researcher’s calculations

Hence, total index (DCI) is an accumulation of all points and if X_{i1}, X_{i2}, X_{i3} and X_{i4} as well as W_{i1}, W_{i2}, W_{i3} and W_{i4} are used to denote for the bank- specific variables, regulatory environment variables, political variables and economic variables and their weights respectively, the index model can be represented by the following equation:

$$DCI = \sum_{i=1}^6 w_{i1}X_{i1} + \sum_{i=1}^7 w_{i2}X_{i2} + \sum_{i=1}^4 w_{i3}X_{i3} + w_{i4}X_{i4} \tag{1}$$

Based on the calculation of the weights, W_{i1}, W_{i2}, W_{i3} and W_{i4} can be replaced by the weights 1.25, 0.89, 1.56 and 5 respectively. Thus, the model can be rewritten as follows:

$$DCI = 1.25\sum_{i=1}^6 X_{i1} + 0.89\sum_{i=1}^7 X_{i2} + 1.56\sum_{i=1}^4 X_{i3} + 5X_{i4} \tag{2}$$

Subsequent to the development of this simple model, a grading system which is composed of five criteria is adopted; do not trust at all, slightly trust, moderately trust, highly trust, and fully trust. The interval value of the index for every criterion is subjectively determined; the depositors are classified as they “do not trust at all” if the index score is 0. They are graded as they “slightly trust” if index lies between 0 and 50; “moderately trust” if it lies within the range 50 and 75; “highly trust” if it is between 75 and 99; and “fully trust” if it is exactly 100. In order to evaluate and interpret the overall index; the resulting value of the overall index needs to be hypothetically tested. So, it is essential to test that the mean index of the depositors’ population (μ) lies within one of these grades which in turn is determined by the computed value of the index. That is to test that the mean index of the depositors’ population (μ) is not less than the lower limit (X) of a specified grade. As a consequence, the null and alternative hypothesis can be formulated as follows:

$$H_0: \mu = X \text{ and } H_1: \mu < X. \tag{3}$$

In addition to these models, the profile analysis is used to test the flatness and parallelism of the profiles of the statistical results obtained from the application of the univariate financial ratios and multiple discriminant analysis models.

4. Results

The financial health of banks operating in Sudan is critically examined using the four models: univariate financial ratios, Emerging Market (EM) Z-score, Ahmed (2003) Z- score, and the Depositors’ Confidence Index (DCI).

4.1 Assessing the Financial Health of Banks Using Univariate Financial Ratios Model

Table 2 below, shows the means of the selected financial ratios that measure liquidity, profitability, efficiency and solvency of the sampled banks throughout the time period 2011 – 2018.

Table 2. Univariate Financial Ratios

Ratio	2013	2014	2015	2016	2017	2018	2019	2020	Average	CompT	CriticalT
Liquidity Measures:											
Current Ratio	1.24	1.18	1.20	1.17	1.19	1.21	1.15	1.09	1.13	21.16	21.56
Capital Asset Ratio	0.15	0.12	0.12	0.10	0.11	0.11	0.09	0.05	0.09	21.13	21.56
Profitability Measures:											
ROA	0.02	0.03	0.02	0.03	0.03	0.03	0.03	0.04	0.03	15.62	21.56
ROE	0.12	0.16	0.15	0.30	0.12	0.25	0.41	0.12	0.23	41.01	21.56
Operating profit to Assets	0.03	0.04	0.03	0.03	0.04	0.04	0.03	0.05	0.04	16.11	21.56
Retained Earnings to Assets	0.04	0.05	0.06	0.06	0.07	0.08	0.08	0.08	0.07	26.40	21.56
Indebtedness Measures:											
Debt Ratio	0.78	0.81	0.80	0.80	0.80	0.79	0.82	0.86	0.83	29.05	21.56
Equity Ratio	0.35	0.28	0.31	0.30	0.33	0.35	0.28	0.20	0.25	24.69	21.56
Deposit Ratio	0.67	0.64	0.64	0.61	0.63	0.61	0.65	0.65	0.64	11.25	21.56
Cash Flow Ratio	0.07	0.11	0.00	0.00	0.02	0.07	0.06	0.01	0.07	30.19	21.56
Efficiency Measures:											
Revenue Turnover	0.56	0.52	0.52	0.54	0.52	0.50	0.53	0.43	0.48	19.04	21.56
Capital Turnover	1.73	1.25	1.20	1.02	0.93	0.88	0.60	(0.13)	0.57	18.36	21.56
Asset usage	0.09	0.09	0.09	0.10	0.11	0.11	0.10	0.10	0.10	34.15	21.56

Researcher's calculations

Table 2 shows that both the current and capital-assets ratios of the banks are very low and are decreasing over time. It is also observable that the current ratio over the entire period is typically below the conventional norm, which is 2:1. These two ratios indicate that there has been deterioration in the liquidity position of the banking industry in Sudan. The profitability ratios indicate that banks do not generate sufficient profits from their operations. The operating profit to assets ratio is also very low and averaged 4% with a flat trend. The shareholders' profit ratio exhibits a similar magnitude and behavior. Likewise, the retained earnings ratio reveals that banks in total use a very low portion of their retained earnings to finance their capital expenditure. It is clearly revealed that less than 10% of the assets acquisition is financed by the retained earnings. Similarly, the indebtedness measures reveal unfavorable results. Both the debt and equity ratios indicate that the banks have inadequate capital and therefore are highly Indebted and thus are of high risk. When it comes to the deposits structure, which is determined by dividing demand deposits by total deposits, it can be clearly noticed that the majority of deposits are demand ones and the average ratio is 64%. The cash flow to debt ratio is very low and has varied substantially from year to year. The measures of the operating efficiency do not depict a different picture from the one reflected by the abovementioned group of metrics. The assets usage ratio is low and shows that the revenue is just 10% of the total asset at average. The capital turnover ratio discloses an average of 57%, which means that the management of banks are inefficient in employing

their working capital to generate revenues. It is generally accepted that an efficiency ratio of 50% or under is considered optimal.

4.2 Assessing the Financial Health of Banks Using Ahmed (2003) Z- score

Table 3 and Table 4 display the overall mean scores calculated from individual and consolidated financial statements of the banks, respectively. These tables also present the statistics and results of the statistical T- test and Hotelling (T2) Test.

Table 3. Ahmed (2003) Z- score for Individual Banks

Bank Name	2013	2014	2015	2016	2017	2018	2019	2020	Average
Animal Resources' Bank	(5.22)	(5.14)	(5.17)	(4.51)	(5.34)	(4.73)	(4.78)	(5.66)	(4.96)
Blue Nile Mashreq Bank	(5.04)	(5.04)	(5.06)	(5.05)	(5.04)	(5.04)	(5.04)	(5.00)	(5.03)
Financial Investment Bank	(5.06)	(5.06)	(5.05)	(5.06)	(5.05)	(5.04)	(5.06)	(5.08)	(5.06)
Sudanese Egyptian Bank	(5.10)	(5.06)	(5.09)	(5.08)	(5.08)	(5.09)	(5.08)	(5.03)	(5.07)
United Capital Bank	(5.09)	(5.08)	(5.09)	(5.09)	(5.09)	(5.11)	(5.10)	(5.05)	(5.07)
Arab Sudanese Bank	(5.10)	(5.07)	(5.10)	(5.10)	(5.10)	(5.09)	(5.07)	(5.04)	(5.07)
Faisal Islamic Bank	(5.07)	(5.07)	(5.07)	(5.09)	(5.10)	(5.10)	(5.08)	(5.05)	(5.08)
Tadamon Islamic Bank	(5.09)	(5.09)	(5.10)	(5.10)	(5.09)	(5.07)	(5.08)	(5.06)	(5.08)
Alsalam Bank	(5.11)	(5.07)	(5.10)	(5.10)	(5.10)	(5.09)	(5.09)	(5.03)	(5.08)
Qatar National Bank	(5.08)	(5.09)	(5.09)	(5.08)	(5.06)	(5.08)	(5.08)	(5.08)	(5.08)
Baraka Bank (Sudan)	(5.11)	(5.11)	(5.09)	(5.10)	(5.10)	(5.10)	(5.08)	(5.06)	(5.08)
Family Bank	(5.09)	(5.08)	(5.07)	(5.08)	(5.08)	(5.07)	(5.08)	(5.11)	(5.09)
Workers' National Bank	(5.08)	(5.08)	(5.09)	(5.09)	(5.09)	(5.08)	(5.09)	(5.08)	(5.09)
Omdurman National Bank	(5.07)	(5.11)	(5.11)	(5.10)	(5.09)	(5.08)	(5.09)	(5.07)	(5.09)
Sudanese Islamic Bank	(5.10)	(5.12)	(5.10)	(5.11)	(5.10)	(5.10)	(5.09)	(5.07)	(5.09)
Saving and Social Development Bank	(5.11)	(5.11)	(5.08)	(5.09)	(5.09)	(5.08)	(5.09)	(5.09)	(5.09)
Aljazeera Sudanese Jordanian Bank	(5.10)	(5.10)	(5.10)	(5.09)	(5.09)	(5.09)	(5.09)	(5.09)	(5.09)
National Bank of Abu Dhabi	(5.09)	(5.11)	(5.13)	(5.09)	(5.08)	(5.09)	(5.08)	(5.10)	(5.10)
Industrial Development Bank	(5.11)	(5.11)	(5.11)	(5.11)	(5.08)	(5.07)	(5.09)	(5.10)	(5.10)
Saudi Sudanese Bank	(5.11)	(5.11)	(5.11)	(5.10)	(5.10)	(5.08)	(5.09)	(5.09)	(5.10)
Al -Shamal Islamic Bank	(5.11)	(5.12)	(5.10)	(5.09)	(5.10)	(5.10)	(5.11)	(5.08)	(5.10)
Farmer's Commercial Bank	(5.11)	(5.12)	(5.11)	(5.10)	(5.11)	(5.11)	(5.11)	(5.09)	(5.10)
Bank of Khartoum	(5.13)	(5.11)	(5.12)	(5.11)	(5.10)	(5.10)	(5.10)	(5.10)	(5.10)
Sudanese French Bank	(5.11)	(5.11)	(5.09)	(5.09)	(5.10)	(5.12)	(5.13)	(5.11)	(5.11)
Al Nile Bank for Commerce and Development	(5.12)	(5.11)	(5.12)	(5.11)	(5.12)	(5.11)	(5.11)	(5.11)	(5.11)
Byblos Bank (Africa)	(5.11)	(5.11)	(5.10)	(5.10)	(5.13)	(5.11)	(5.11)	(5.13)	(5.11)
Agricultural bank of Sudan	(5.11)	(5.12)	(5.12)	(5.12)	(5.12)	(5.11)	(5.12)	(5.11)	(5.12)
Sahelo Saharinne Bank	(5.07)	(5.09)	(5.06)	(5.10)	(5.10)	(5.10)	(5.12)	(5.18)	(5.13)
Elnilein Bank	(5.11)	(5.11)	(5.11)	(5.14)	(5.15)	(5.15)	(5.16)	(5.19)	(5.17)
Export Development Bank	(5.12)	(5.13)	(5.13)	(5.14)	(5.16)	(5.22)	(4.54)	(5.34)	(5.18)
Overall Mean Ahmed (2003) Z-score	(5.10)	(5.10)	(5.10)	(5.08)	(5.10)	(5.08)	(5.06)	(5.11)	(5.09)
Overall Mean Ahmed (2003) Z-score from Consolidated FS	(5.12)	(5.11)	(5.12)	(5.11)	(5.11)	(5.11)	(5.11)	(5.09)	(5.10)

Table 4. Ahmed (2003) Z- score for Consolidated Banks

Statistic	2013	2014	2015	2016	2017	2018	2019	2020	Average
Mean of Ahmed (2003) Z-score	(5.10)	(5.10)	(5.10)	(5.08)	(5.10)	(5.08)	(5.06)	(5.11)	(5.09)
Overall Mean of Ahmed (2003) Z-score from Consolidated FS	(5.12)	(5.11)	(5.12)	(5.11)	(5.11)	(5.11)	(5.11)	(5.09)	(5.10)
Standard Error	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.01	0.00
Sample size (n)	30	30	30	30	30	30	30	30	30
T-test:									
Ho: $\mu = 26.647$									
H1: $\mu < 26.647$									
t-test Statistic (Computed Value)	(125,109)	(218,625)	(208,155)	(10,040)	(46,855)	(21,648)	(8,664)	(8,252)	(82,569)
Critical Value	(1.7)	(1.7)	(1.7)	(1.7)	(1.7)	(1.7)	(1.7)	(1.7)	(1.7)
$\alpha = .05$	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.00
Ho: $\mu = 26.647$									
H1: $\mu < 26.647$									
Hotelling T2 Statistic	109,040,581								
Hotelling T2 Critical Value at $\alpha = .05$	25								
Decision: Reject Ho									

As shown in Table 3 and Table 4 all the banks, individually and collectively, demonstrate scores lower than the threshold of 21.791 of Ahmed (2003) Z-score, which means that all the banks are falling in the distressed area of the scale. It clearly observable that throughout the period of the study all the Z-scores of banks and the period average score are negative and significantly far behind the cut-off value of the scale. These results indicate that none of the banks is financially sound. Further, the statistical results of both univariate T-test and multivariate Hotelling (T2) test indicate that the banks are quietly unhealthy. The results of Ahmed (2003) Z-score model are thoroughly consistent with the ones obtained by applying the univariate financial ratios model. This consistency in results is highly anticipated as Ahmed (2003) Z-score model is built from the ratios utilized by the financial ratios model.

4.3 Assessing the Financial Health of Banks Using Emerging Market (EM) Z-score

Tables 5 and 6 display the mean scores calculated for individual and consolidated banks respectively. Table 6 also presents the statistics and results of the statistical T- test and Hotelling (T2) Test.

Table 5. Emerging Market (EM) Z- score results for Individual Banks

Bank Name	2013	2014	2015	2016	2017	2018	2019	2020	Average
Alsalam Bank	5.06	6.87	6.95	8.08	8.21	9.03	8.65	11.04	8.54
Financial Investment Bank	7.91	7.80	8.45	8.74	9.62	11.21	8.59	6.36	8.13
Blue Nile Mashreq Bank	7.03	6.71	6.97	7.22	7.34	7.77	7.37	7.80	7.46
Industrial Development Bank	5.97	5.60	5.38	6.06	8.46	9.54	9.55	7.21	7.36
United Capital Bank	6.24	5.92	5.89	5.72	5.76	5.26	5.54	8.30	6.46
Family Bank	6.65	7.22	7.66	7.24	7.24	7.41	6.63	4.77	6.21
Aljazeera Sudanese Jordanian Bank	6.10	5.89	5.75	5.57	5.48	4.76	4.98	5.59	5.39
Sudanese Egyptian Bank	5.04	5.54	5.40	5.49	4.97	4.69	5.02	5.67	5.28
Workers' National Bank	5.96	5.77	5.87	5.64	5.40	5.56	4.71	4.69	5.10
National Bank of Abu Dhabi	4.95	4.23	3.68	4.61	5.63	5.52	6.13	4.78	4.94
Arab Sudanese Bank	5.46	5.66	5.05	4.90	4.77	5.00	4.99	4.54	4.79
Byblos Bank (Africa)	5.10	4.49	4.75	5.15	4.83	5.16	5.36	4.02	4.66
Sahelo Saharinne Bank	9.22	7.12	10.57	6.58	6.66	6.51	5.06	1.49	4.65
Qatar National Bank	5.23	4.56	4.01	4.71	5.49	5.01	4.81	4.27	4.60
Tadamon Islamic Bank	4.84	4.63	4.53	3.96	4.45	4.61	4.71	4.68	4.59
Baraka Bank (Sudan)	4.23	3.94	4.05	4.21	4.22	4.10	4.41	4.40	4.28
Sudanese Islamic Bank	4.55	4.02	4.35	4.26	4.35	4.39	4.31	4.21	4.27
Saudi Sudanese Bank	4.15	3.87	3.94	4.63	4.56	4.26	4.45	4.17	4.24
Farmer's Commercial Bank	3.79	3.68	4.17	4.40	4.26	4.50	4.09	4.02	4.13
Saving and Social Development Bank	4.42	4.01	4.48	3.95	4.22	4.27	4.22	3.97	4.13
Al -Shamal Islamic Bank	4.57	4.13	4.30	4.54	4.10	4.45	3.97	3.86	4.12
Agricultural bank of Sudan	5.25	4.65	4.75	4.30	4.09	4.34	3.93	3.77	4.12
Omdurman National Bank	3.68	4.42	4.39	4.28	4.42	4.51	4.12	3.87	4.10
Sudanese French Bank	3.96	3.88	4.01	4.19	4.22	4.12	4.05	3.94	4.03
Faisal Islamic Bank	4.42	4.25	4.18	4.11	3.89	3.68	3.72	3.96	3.92
Bank of Khartoum	3.88	4.18	3.96	4.15	4.24	4.08	4.07	3.65	3.88
Al Nile Bank for Commerce and Development	3.73	3.73	3.60	3.82	3.65	3.72	3.70	3.65	3.68
Export Development Bank	3.88	3.65	3.52	3.34	3.07	2.45	1.47	2.65	2.82
Animal Resources' Bank	2.32	2.60	0.05	(0.42)	0.50	1.83	2.00	3.03	2.58
Elnilein Bank	4.82	3.92	3.85	1.80	1.82	2.39	1.74	0.01	1.07
Overall Mean EM Z-score	5.08	4.90	4.95	4.84	5.00	5.14	4.88	4.61	4.78
Overall Mean EM Z-score from Consolidated FS	3.92	3.96	3.96	3.99	4.03	4.06	3.96	3.88	3.94

Table 6. Emerging Market (EM) Z- score results for Consolidated Banks

Statistic	2013	2014	2015	2016	2017	2018	2019	2020	Average
Overall Mean of EM Z-score	5.08	4.90	4.95	4.84	5.00	5.14	4.88	4.61	4.78
Overall Mean of EM Z-score from Consolidated FS	3.92	3.96	3.96	3.99	4.03	4.06	3.96	3.88	3.94
Standard Error	1.93	1.66	3.45	3.07	3.50	4.26	3.42	4.15	2.54
Sample size (n)	30	30	30	30	30	30	30	30	30
T-test:									
H ₀ : $\mu = 2.6$									
H ₁ : $\mu > 2.6$									
t-test Statistic (Computed Value)	7	8	4	4	4	3	4	3	5
Critical Value	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70
$\alpha = .05$	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
ρ -value	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00
Decision: Reject H ₀									
Hotelling (T ²) Test:									
H ₀ : $\mu = 2.6$									
H ₁ : $\mu > 2.6$									
Hotelling T ² Statistic	185								
Hotelling T ² Critical Value at $\alpha = .05$	25								
Decision: Reject H ₀									

As Table 5 and Table 6 clearly divulge, in a sharp contrast to the univariate financial ratios and Ahmed (2003) models, the results of EM Z-score model show that banks operating in Sudan can be categorized as healthy and financially sound because EM Z-scores, both for individual and consolidated banks, substantially surpass the cut-off value of 2.60 and thus locating them in the healthy zone of the scale. The results of both the T-test and Hotelling (T²) test led to the rejection of the null hypothesis emphasizing that the banks are financially viable.

4.4 Assessing the Financial Health of Banks Using Depositors' Confidence Index

The statistical results of the analysis of the depositor's confidence index model, which is coined by this study as the first model for assessing the financial health of banks are shown in Table 7 below.

Table 7. Depositors' Confidence Index

Description	Value
Standard Depositors' Confidence Index	100
Ordinary Average Depositors' Confidence Index	44
Weighted Average Depositors' Confidence Index	47
Standard Error	21
Sample size (n)	416
t-test:	
H ₀ : $\mu = 50$	
H ₁ : $\mu < 50$	

t-test Statistic (Computed Value)	(3.41)
Critical Value	(1.65)
α	0.05
ρ -value	0.00
Decision: Reject H_0	

The statistical results in the table above show a significant statistical depositor confidence index of 47. This low level of the index indicates that the depositors slightly trust the banks operating in Sudan.

4.5 Assessing the Possibility of Banks That Are Likely to Go out of Business

The Emerging Market (EM) Z-score is employed to determine banks that are potential for bankruptcy. Out of the 30 sampled banks, two banks, namely Elnilein Bank and Animal Resources Bank, are indicated by the (EM) Z-score are distressed banks and thus are most probable to go bankrupt. Table 8 and Table 9 display the statistical results of the (EM) Z-score for Elnilein Bank and Animal Resources Bank respectively.

Table 8. Elnilein Bank Statistics

Statistics	2013	2014	2015	2016	2017	2018	2019	2020	Average
EM Z- score	4.82	3.92	3.85	1.80	1.82	2.39	1.74	0.01	1.07
X1. Working Capital/Total Assets	0.18	0.08	0.07	(0.18)	(0.19)	(0.17)	(0.27)	(0.54)	(0.36)
X2. Retained Earnings/Total Assets	(0.02)	(0.05)	(0.04)	(0.12)	(0.08)	0.02	0.01	0.04	0.01
X3. Return/Total Assets	0.02	0.02	0.02	0.01	0.01	0.02	0.01	0.01	0.01
X4. Stockholders Equity /Total Assets	0.31	0.15	0.14	0.05	0.04	0.14	0.09	0.08	0.09

Table 9. Animal Resources' Bank Statistics

Statistics	2013	2014	2015	2016	2017	2018	2019	2020	Average
EM Z- score	2.32	2.60	0.05	(0.42)	0.50	1.83	2.00	3.03	2.58
X1. Working Capital/Total Assets	(0.08)	(0.11)	(0.37)	(0.38)	(0.34)	(0.23)	(0.17)	(0.03)	(0.09)
X2. Retained Earnings/Total Assets	(0.09)	(0.05)	(0.30)	(0.30)	(0.20)	(0.11)	(0.09)	(0.01)	(0.05)
X3. Return/Total Assets	(0.02)	0.02	0.02	(0.03)	0.02	0.06	0.02	0.00	0.01
X4. Stockholders Equity /Total Assets	0.04	0.09	0.10	0.01	(0.02)	0.02	0.00	(0.00)	0.01

As Table 8 shows, the average Z-score of Elnilein Bank is just 1.07 which is less than 1.1 and thus is located in the distress zone. Similarly, the Animal Resources Bank, as table (9) reveals achieves an average Z-score of 2.58 which is lower than the cut-off value and therefore is positioned in the gray area. Further, the results demonstrate that the Z-scores of the two banks are decreasing over time.

4.6 Comparing the Financial Health of Different Groups of Banks

The financial health of three groups of banks is compared using the Emerging Market (EM) Z-score supplemented with the statistical t-test for the difference in means and profile analysis. These groups are the privately-owned versus government-owned banks, the specialized versus nonspecialized (commercial) banks, and the foreign versus national banks. The statistical results are reported in Tables 10, 11 and 12 below.

Table 10. Performance of Privately-owned Banks versus Government-owned Banks

	2013	2014	2015	2016	2017	2018	2019	2020	Average
EM Z-score Government-Owned	5.12	4.55	4.62	4.03	4.65	5.14	4.86	3.74	4.17
EM Z-score Private Banks	4.87	4.87	4.85	4.92	4.94	5.07	4.82	4.92	4.90
Standard Error (S12)	1.73	1.89	3.05	3.52	3.55	4.43	3.07	3.78	2.47
Standard Error (S22)	0.44	0.60	0.40	3.05	7.65	9.45	11.01	8.67	6.58
Pooled Standard Error (Sp2)	1.57	1.73	2.72	3.46	4.06	5.06	4.07	4.39	2.99
Sample size (n1)	22	22	22	22	22	22	22	22	22
Sample size (n2)	4	4	4	4	4	4	4	4	4

T-test:

Ho: $\mu_1 = \mu_2$

H1: $\mu_1 \neq \mu_2$

t-test Statistic (Computed Value)	(0.37)	0.45	0.26	0.89	0.27	(0.05)	(0.04)	1.04	0.78
Critical Value	2.06	2.06	2.06	2.06	2.06	2.06	2.06	2.06	2.06
$\alpha = .05$	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
p-value	0.36	0.67	0.60	0.81	0.61	0.48	0.48	0.85	0.78

Decision: Don't reject Ho at SL .05

Hotelling (T2) Test:

Ho1: $\mu_{1j} - \mu_{1,j-1} = \mu_{2j} - \mu_{2,j-1}$ for $j = 2, 3, \dots, 8$, the two profiles are parallel

Ho1: $\mu_{1j} - \mu_{1,j-1} \neq \mu_{2j} - \mu_{2,j-1}$ for $j = 2, 3, \dots, 8$, the two profiles are not parallel

Hotelling T2 Statistic 49.73

Hotelling T2 Critical Value at $\alpha = .05$ 24.05

Decision: Reject Ho at .05 SL, the two profiles are not parallel

Ho2: $(\mu_{11} + \mu_{12} + \mu_{13} + \dots + \mu_{18})/8 = (\mu_{21} + \mu_{22} + \mu_{23} + \dots + \mu_{28})/8$, the two groups are at the same level

H12: $(\mu_{11} + \mu_{12} + \mu_{13} + \dots + \mu_{18})/8 \neq (\mu_{21} + \mu_{22} + \mu_{23} + \dots + \mu_{28})/8$, the two groups are not at the same level

t-test Statistic (Computed Value) (0.35)

Critical Value 2.06

$\alpha = .05$

Decision: Don't reject Ho at .05 SL, the two groups are at the same level

When comparing the performance of the privately-owned banks with the performance of government-owned banks, as Table 10 reveals, the Hotelling T2 leads to rejecting the parallelism hypothesis and the profile analysis indicates that the two groups of banks are not performing in a parallel way. This means that the privately-owned banks are not significantly different from their government-owned counterparts in terms of their financial health levels.

Table 11. Performance of Commercial Banks versus Specialized Banks

	2013	2014	2015	2016	2017	2018	2019	2020	Average
EM Commercial Banks	Z-score 4.89	4.71	4.71	4.60	4.65	4.70	4.54	4.49	4.54
EM Specialized Banks	Z-score 6.04	5.86	6.14	6.06	6.72	7.35	6.59	5.22	5.99
Standard Error (S12)	1.80	1.33	3.28	2.67	2.44	2.32	2.35	4.55	2.14
Standard Error (S22)	1.77	2.64	3.22	4.04	6.21	9.57	6.36	2.28	3.37
Pooled Standard Error (Sp2)	1.80	1.52	3.27	2.86	2.98	3.36	2.92	4.22	2.32
Sample size (n1)	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Sample size (n2)	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
T-test:									
Ho: $\mu_1 = \mu_2$									
H1: $\mu_1 \neq \mu_2$									
t-test Statistic (Computed Value)	(1.75)	(1.90)	(1.62)	(1.76)	(2.45)	(2.96)	(2.45)	(0.72)	(1.94)
Critical Value	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05
$\alpha = .05$	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
p-value	0.05	0.03	0.06	0.05	0.01	0.00	0.01	0.24	0.03
Decision: Don't reject Ho at SL .05									
Hotelling (T2) Test:									
Ho1: $\mu_{1j} - \mu_{1, j-1} = \mu_{2j} - \mu_{2, j-1}$ for $j = 2, 3, \dots, 8$, the two profiles are parallel									
Ho1: $\mu_{1j} - \mu_{1, j-1} \neq \mu_{2j} - \mu_{2, j-1}$ for $j = 2, 3, \dots, 8$, the two profiles are not parallel									
Hotelling T2 Statistic 15.29									
Hotelling T2 Critical Value at $\alpha = .05$ 21.95									
Decision: Don't reject Ho at .05 SL, the two profiles are parallel									

The statistical results in Table 11 indicate significant statistical differences between the specialized and nonspecialized banks. The profiles of the two categories show that the specialized banks are uniformly performing better than the commercial banks over the time period examined and it is concluded that there is a significant difference between the two groups of banks. The specialized banks experience higher Z-scores, and therefore a lower risk of bankruptcy than their nonspecialized counterparts.

Table 12. Performance of Foreign Banks versus National Banks

	2013	2014	2015	2016	2017	2018	2019	2020	Average
EM Z-score National Banks	4.64	4.58	4.50	4.48	4.46	4.54	4.40	4.63	4.51
EM Z-score Foreign Banks	6.21	5.39	5.83	5.20	5.64	5.51	5.25	3.77	4.74
Standard Error (S_1^2)	1.14	1.23	2.08	2.98	2.61	2.55	2.65	4.98	2.56
Standard Error (S_2^2)	4.05	1.70	10.36	0.86	0.60	0.50	0.36	2.35	0.02
Pooled Standard Error (Sp^2)	1.52	1.29	3.16	2.71	2.35	2.29	2.35	4.64	2.23
Sample size (n_1)	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00
Sample size (n_2)	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
T-test:									
$H_0: \mu_1 = \mu_2$									
$H_1: \mu_1 \neq \mu_2$									
t-test Statistic (Computed Value)	(2.35)	(1.32)	(1.37)	(0.80)	(1.40)	(1.18)	(1.01)	0.73	(0.29)
Critical Value	2.07	2.07	2.07	2.07	2.07	2.07	2.07	2.07	2.07
$\alpha = .05$	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
ρ -value	0.01	0.10	0.09	0.22	0.09	0.13	0.16	0.76	0.39
Decision: Don't reject H_0 at SL .05									
Hotelling (T^2) Test:									
$H_0: \mu_{1j} - \mu_{1,j-1} = \mu_{2j} - \mu_{2,j-1}$ for $j = 2, 3, \dots, 8$, the two profiles are parallel									
$H_1: \mu_{1j} - \mu_{1,j-1} \neq \mu_{2j} - \mu_{2,j-1}$ for $j = 2, 3, \dots, 8$, the two profiles are not parallel									
Hotelling T^2 Statistic									
Hotelling T2 Critical Value at $\alpha = .05$									24.76
Decision: Don't reject H_0 at .05 SL, the two profiles are parallel									
$H_{02}: (\mu_{11} + \mu_{12} + \mu_{13} + \dots + \mu_{18})/8 = (\mu_{21} + \mu_{22} + \mu_{23} + \dots + \mu_{28})/8$, the two groups are at the same level									
$H_{12}: (\mu_{11} + \mu_{12} + \mu_{13} + \dots + \mu_{18})/8 \neq (\mu_{21} + \mu_{22} + \mu_{23} + \dots + \mu_{28})/8$, the two groups are not at the same level									
t-test Statistic (Computed Value)									1.09
Critical Value									2.07
$\alpha = .05$									
Decision: Don't reject H_0 at .05 SL, the two groups are at the same level									

As revealed by Table 12, the statistical test shows that the foreign banks are not consistently performing better than the national banks. The statistical results clearly demonstrate that the financial health of the foreign banks is not significantly different from the one of the national banks.

5. Discussion

The analysis of the statistical results obtained from the univariate financial ratios model and Ahmed (2003) model indicate that the Sudanese banks are not financially sound. The liquidity ratios show that there has been deterioration in the liquidity position of the banking industry in Sudan. Since banks depend heavily on lending to generate revenues, the shortage in liquidity weakens their financing capability, which in turn negatively affects their earnings. Furthermore, the lack of liquidity may force banks either to sell assets or pay a premium on borrowed funds. The indebtedness measures reveal that banks are highly leveraged and thus are of high risk. This asserts that the banks will find it hard to get further financing from both national and international financial markets. This high credit risk also suggests that the bank is no longer attractive for the depositors. This is confirmed by the deposits structure of

banks, which are mainly demand ones. This result is expected because the Marabaha margin, which indicates the return on investment deposits, almost remains fixed at 12% over the period examined and this percentage is far below inflation levels. This explains the shrinkage in investment deposits through time and signals the inability of banks to earn satisfactory profits. Additionally, the profitability measures indicate that banks do generate sufficient profits from their operations. Due to the high level of inflation, the bank's managements find it difficult to pay dividends and also secure internal fund to sustain any growth strategy. The turnover financial metrics indicate that the management of banks are inefficient in employing their working capital to generate revenues and are generally not optimizing the utilization of assets. This inefficient use of assets justifies the low level of profitability realized by those banks.

The results obtained from the analysis of the depositors' confidence index indicate that the depositors slightly trust the banks operating in Sudan. This finding is highly expected as the previous studies provide evidence that factors such as slumping economy, turbulent political climate, high inflation, inconsistent policies and regulations, weak transparency, undercapitalization of banks, which are all prevailing in Sudan, negatively affect the confidence of depositors in their banks. This weak trust implies that the depositors are not sure that their banks can safely secure their deposits and thus are skeptical that their banks are able to pay them back their money. The low confidence in banks also indicates that the depositors are doubtful about the competency, integrity and transparency of their banks' management. Further, the undercapitalization of banks triggers a fear of banks failure and thus loss of depositors' money. Additionally, the inconsistent and ever-changing government policies, especially the monetary and credit ones, the weak legal and regulatory systems and laws, the deteriorating economic conditions of the country and the political instability and erratic country foreign relationships, signal that banks will suffer from financial difficulties in the near future and initiate a strong tendency towards cash withdrawal from banks.

The analysis also shows that the privately-owned banks do not perform better than the government-owned ones. This result may be attributed to the fact that the government-owned banks are supported by the government. That is to say, the government usually injects funds in those banks that are in bad need for financing. The same logic applies for the better performance of the specialized banks as compared to the nonspecialized ones. The specialized banks are highly propped by the government. For instance, the Central bank has decreased the legal monetary reserve required for the banks that provide finance to agricultural, industrial and mineral mining projects, in an attempt to boost exports. With regards to the comparison of the financial health of the foreign banks with that of the national banks, the analysis indicates that the financial health of both groups is similar, which led to the reasoning that the foreign banks have not benefited from their developed expertise, overseas existence and access the international financial market to strengthen their financial positions.

The contrary conclusion arrived at by the employment of EM Z-score model that banks operating in Sudan are generally healthy and financially viable may be in the context that, though the banking sector in Sudan is not financially sound, within the near future of two years most of the banks will not be bankrupt.

Several practical implications can be derived from the results of this study. To enhance the financial health of banks and boost the level of confidence in them a number of corrective actions need to be taken by banks management as well as regulatory bodies. Enhancing transparency through adopting enforceable comprehensive disclosure measures, imposing corporate governance, strengthening banks' capitals and lowering operating costs are some suggested corrective actions. Regulators also need to set rules that protect depositors and safeguard their money.

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Authors' contributions

Dr. Nawal Elhussein is responsible for conceiving and designing the analysis. Dr Ahmed Eldawaha is responsible for data collection and performed the analysis. Dr. Nawal contributed most to the work, including writing the manuscript and revising it. The two authors read and approved the final manuscript

Competing interests

The authors declare that they have no competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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