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Financial Stability of Banks in Sudan: Assessment and Determinants

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Abstract: - This research aims to measure the financial stability of banks in Sudan and investigate its determinants. It focuses on 27 out of the 35 banks in Sudan's banking sector over a period of five years from 2017 to 2021. The balanced panel data statistical approach has been used for data analysis, using the Altman Z-score to measure the financial stability of the banking sector. Moreover, the research utilizes a multivariate regression model with financial stability (Z-score) as the response variable and various independent variables including inflation rate, GDP growth, political distress, bank efficiency, bank size, bank age, capitalization ratio, and capital adequacy ratio. The research results revealed that the banking sector in Sudan faces great vulnerability because of the high instability of banks. Ultimately, the multivariate regression analysis determined that size and capitalization have a significant positive impact on financial stability, whereas age and inflation have a significant negative impact on financial stability. Essentially, the stability of banks in Sudan is influenced by four determinants: size, capitalization, age, and inflation.

Keywords: Altman Z-score, Banks, Efficiency, Financial Stability.

I. INTRODUCTION

Sudan had witnessed economic and political changes since the end of the colonial era, but the scale of change has exacerbated since the fall of Omer El-Bashir regime in April 2019 as the inflation rate seemed to rise until it reached 358% in 2021 (African Development Bank, 2022). During these fluctuations in economic and political factors, the Sudanese banking sector is still playing an important role among Sudanese financial intermediaries, serve economy, find an optimal way to minimize the input investment or maximize the output production, financing the economic activities and maintaining the financial stability of the economic system, and as a nerve system of the country economy (Khan & Khattak, 2016), and failure of banking sector will lead to lag in economic growth (TATA CAPITAL, 2020), increase in rate of unemployment (Kandrac, 2014) and lead to economic collapse (Zhang, Zhang, & Tao, 2016).

Efficiency is elaborated as "the maximum potential ratio between the output and the input of the product development process, which shows the optimal distribution of available resources that would allow to achieve the maximum potential" (Cvilikas & Jurkonyte-Dumbliauskiene, 2016). Nowadays a well-functioning financial markets and banking institutions are most important indicators for economic growth (Roghaniana, Raslia, & Gheysari, 2012; Ferreira, 2012; Diallo & Koch, 2018). Banks efficiency highly affect the performance of banking sector; thus, it affects the macro and micro economics of countries (Ibrahim, Abdalla, & Eljelly, 2017; Nouaili, Abaoub, & Ochi, 2015).

Generally, the financial stability is the ability of a system to: (a) ease two main processes: the allocation of resources efficiently and effectiveness of economic process (such as wealth accumulation, economic growth and ultimately social prosperity); (b) measure finance risk, price it and give it proper allocation and (c) contain the ability of performing the previous functions by self-corrections (Schinasi, 2004). The financial stability is influenced by several determinants including the previous year indicator of financial stability, liquidity, profitability, bank size, uncertainty of giving credit, focus of banks and GDP growth rate (TSEGAYE, 2022).

This research aims to evaluate the impact of inflation and GDP on the Sudanese bank stability. And, investigate the political distress impact on the stability of banks in Sudan. Moreover, it targets to appraise the impact of efficiency on the stability of Sudanese banks. Furthermore, it will measure the Sudanese banks stability. In order to attain these objectives, the research will utilize various tools including Altman Z-score, Data Envelopment Analysis (DEA), Fragile State Index (FSI) and multivariate regression.

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II. Problem Statement And Questions

Sudan had experienced significant fluctuations in inflation rate and gross domestic product. According to the Central Bank of Sudan annual reports the average inflation rate for the year 2017 was 32.4% and the GDP growth rate was 5.2% (Central Bank of Sudan, 2017), the average inflation rate in 2018 increased to 63.3% while the GDP growth rate declined to 2.8% (Central Bank of Sudan, 2018), the average inflation rate decreased to 57% in 2019 in comparison with the preceding year while the GDP growth rate went down to reach -1.3% (Central Bank of Sudan, 2019), by the year 2020 the average inflation rate elevated to reach 163.3% and the GDP growth rate fell down to -1.6% (Central Bank of Sudan, 2020).

On the political front, a series of anti-government protests, uprisings came out through many Arabic countries, which have negative impact on economics as all and banks performance particularly (Jaara, 2021). Sudan had witnessed political distress since April 2019 when Al-Bashir regime - that governed the country for 30 years - was ended, then a transitional government was established in September 2019 and declared constitutionally in August 2019 (Bertelsmann Stiftung, 2022). According to the Fragile States Index, Sudan has been politically in the alert zone since 2016 until now, where the Fragile States Index was 110.6 in the year of 2016, then decrease slightly in 2017 to be 108.6, in the year of 2018 a negligibly dropped to 108, and declined sharply in year of 2019 to be 104.8, then raised starkly in 2020 to reach 107.1 (Messner, et al., FRAGILE STATES INDEX, 2019). Political stability and banks performance are interrelated (Jadah, Mohammed, Hasan, & Adeniran, 2020).

The rapid increase of inflation and the sharp decline of GDP create the need for scientific investigation of their impact on the stability of Sudan's banking sector. Moreover, the political change in Sudan led to instability in the Sudanese banking sector, as all Sudanese banks – during the years 2018 and 2019 - had a great probability to bankrupt (Taha, Bilal, Ibrahim, Abdallah, & Hussien, 2022). Accordingly, the research aims to answer the following questions:

1) Are banks in Sudan financially stable?
2) What are the determinants of financial stability of banks in Sudan?

III. Research Objectives

The core target of this research is to identify the impact of inflation rate spike, GDP growth rate diminish, performance efficiency and political distress on the stability of banks in Sudan. Thus, the research objectives encompass:

1) Assessment of the financial stability of banks in Sudan.
2) Investigate the determinants of financial stability of banks in Sudan.

IV. Research Methodology

The banking sector in Sudan composes of 35 banks, this research targets 77% of the whole working banks in Sudan.

In order to achieve its objectives, the research applies three analytical methods.

Altman Z score is used to assess banks financial stability, and data envelopment analysis is applied to evaluate banks efficiency. Moreover, multivariate regression is applied to investigate the determinants of banks financial stability in Sudan.

1) Population And Data Source:

Sudan's banking sector is composed of 35 operating banks (Central Bank of Sudan, 2022). Accordingly, the research targets 27 banks operating in Sudan (77% of total operating banks in Sudan).

The research depends on secondary data from the bank's annual reports, Central Bank of Sudan reports and Fund for Peace Organization reports.

2) Data Envelopment Analysis (DEA):

There are two common methods used to measure efficiency, the Parametric Stochastic Frontier Analysis and the Nonparametric Data Envelopment Analysis (DEA) (Antunes, Hadi-Vencheh, Jamshidi, Tan, & Wanke, 2022). Data Envelopment Analysis is a prominent technique for evaluating the relative efficiency of a set of entities called decision making units (DMUs) with homogeneous structures (CHARNES, COOPER, & RHODES, 1978). The major difference between the DEA and the parametric analysis is that DEA determines the highest point of data as the best performance point and all points below are worse, while the parametric analysis have central tendency to take the middle of the observed data as that above points are better and the lower points are worse-off (Cooper, Seiford, & Tone, 2006).

DEA contains two measure, Radial and Non-Radial model; the Radial model links each two inputs with one output (2:1), while the non-Radial model does not link specific number of inputs and outputs (meaning that inputs and outputs may change independently) (Kaoru & MikiT, 2009). This research will use the non-Radial measure, as unconstrained expansions or contractions of inputs and outputs can be implemented, in addition to the ability of comparison between different scenarios.

DEA model is implemented either through CRS (Constant Returns to Scale) or VRS (Variable Returns to Scale), CRS refers to the increase in inputs which leads to a slight increase in outputs, while VRS indicates that the increase in inputs does not lead to a slight change in outputs (Violeta & Cikovi´, Assessing the relative efficiency of commercial banks in the Republic, 2021)

The first DEA model was CCR (Charnes-Cooper-Rhodes) which had a defect that had been modified into BCC (Banker-Charnes-Cooper) which considers outputs shortfalls and input excess (Cooper, Seiford, & Tone, 2006; Othman, Mohd-Zamil, Vakibashi, & Mokhber, 2016). The research will depend on the BCC model.

$$\max_{u_j v_i} E_K = \frac{\sum_{j=1}^{q} uY_{kj} - u_0}{\sum_{i=1}^{p} vX_{ki}}$$

Subject to:

$$\frac{\sum_{j=1}^{q} u_j Y_{kj} - u_0}{\sum_{p=1}^{i} vX_{ki}}$$

Where:

Ek: Efficiency of k DMU.

Q: The output.

P: The input.

Uj: Weight of output.

V: Weight of input.

U0: Scaler free in sign (positive or negative or zero).

Two approaches in DEA can be followed to identify the model variables, which are production approach, and intermediation approach (Othman, Mohd-Zamil, Vakibashi, & Mokhber, 2016); Considering that: there are several decision-making units (DMUs) with their input and output data (Chiang, 2014), DMUs are always of the same type of institutions, DMUs operate within similar business conditions, the number of DMUs should be at least two or three times higher than the sum of inputs and outputs (Hosseini & Hosseini, 2021). This research will use labor cost, total deposits, and total assets as inputs; and total investments and total loans as outputs. The determination of inputs and outputs depends on the previous literature such as: (Kočišová, 2019), (Ibrahim, Abdalla, & Eljelly, 2017), (Othman, Mohd-Zamil, Vakibashi, & Mokhber, 2016), (Vesna & Klimentina, 2013) (Sufian, 2007), (Cooper, Seiford, & Tone, 2006).

This research use the DEA model to measure banks efficiency, Where many scholars and researches used it to reach the same purpose such as: (Antunes, Hadi-Vencheh, Jamshidi, Tan, & Wanke, 2022), (Jimoh, Ijaiya, Attah, Abdulmumin, & Etudaiye-Muhtar, 2022), (Cvetkoska & Cikovic, 2020), (Novickyt˙e & Droždz, 2018), (KOČIŠOVÁ, 2016), (Khan & Khattak, 2016).

3) Altman Z Score:

There are several models to measure banks stability such as Value at Risk, Stress Test and Altman Z-score which is being considered as the most effective model because it has the ability of expecting the probability of future insolvency of banks (Ghassan & Guendouz, 2019). Altman Z score is a measure to predict entities bankruptcy or financial soundness (Altman E. I., Financial Ratios: Discriminant Analysis and the Prediction of Corporate Bankruptcy, 1968), it started with a model for corporations or manufacturing companies with five ratios containing 'Working capital/ Total assets', 'Retained earnings/Total assets', 'EBIT/Total assets', 'Market value of equity/ Book value of total debts' and 'Sales/ Total assets' (Altman E. I., Financial Ratios: Discriminant Analysis and the Prediction of Corporate Bankruptcy, 1968); this model provides a more accurate financial assessment tool for risk analysts and lenders, it was applied until 2000 when it has been updated to be more accessible to other economic life conditions (Altman E. I., Predicting financial distress of companies: revisiting the Z-Score and ZETA models, 2013; Kittur, Harshavardhan, & Asha, 2019). The new model was modified to suit the nonmanufacturing sector as a result of the first model criticisms (Altman E. I., The Z-score bankruptcy model : past, present, and future, 1977;

ALTMAN & HOTCHKISS, 2006; Altman E. I., Predicting financial distress of companies: revisiting the Z-Score and ZETA models, 2013).

This research will utilize Z-score formula and variables for none manufacturing sectors.

Z = 6.56Xl + 3.26X2 + 6. 72X3 + 1.05X4

Where:

X1: liquidity Ratio (Working Capital / Total Assets).

X2: Solvency Ratio (Retained Earnings / Total Assets).

X3: Profitability Ratio (EBIT / Total Assets).

X4: Leverage Ratio (Book Value of Equity / Total Liabilities).

Source: (Cındık & Armutlulu, 2021)

The value of Z-score falls within 1of 3 zones: safe, gray or distress. Z falls in the safe zone when it is greater than or equal 2.6, and it falls in the distress zone when it is equal or less than 1.1 (Joshi, 2020; Kiemo, 2019). Table (1) below explains Z-score benchmark.

Altman z-score is a popular measure with many uses, it is one of credit scoring models. It is used by several researches to predict if banks would go bankrupt or suffer financial failure, for instance: (Taha, Bilal, Ibrahim, Abdallah, & Hussien, 2022), (Joshi, 2020), (Nath, Biswas, Rashid, & Biswas, 2020), (Kiemo, 2019), (Katuka, 2019), (Ghassan & Guendouz, 2019), (Kittur, Harshavardhan, & Asha, 2019), (Navila, Saha, & Rabeya, 2018), (Parvin, Rahman, & Nitu, 2016) (Badea & Matei, 2016).

Table (1): Altman Z-score Benchmark

Dimension	Z-score	Index	Comment
A	Higher than 2.6	Safe zone	Higher probability of stability
B	Between 1.1 and 2.26	Gray zone	Complex to judge
C	Below 1.1	Distress zone	Higher probability of bankrupt

Source: (Cındık & Armutlulu, 2021; Tung & Phung, 2019)

4) Fragile State Index:

Fragile State Index (FSI) is an annual ranking of 178 countries report, applies a comprehensive specialization parameter depending on 12 key indicators categorized as cohesion, political, social, economic and cross-cutting indicators to measure the national stability. Furthermore, FSI adopts over hundreds of proxies through social sciences experts to measure the stability of countries, and classify them into four area zones (alert, warning, stable and sustainability) (Fund for Pace, 2020). FSI is identified as alert zone when its value lies between 100 and 120 score and sustainable zone when the value lies between 10 and 39.9 score. Table (2) below explains the fragile state index benchmark.

Table (2): Fragile State Index Benchmark

Situation	FSI	Zone	Comment
1	100 – 120	Alert zone	High instability
2	70 - 99.9	Warning zone	Low instability
3	40 -69.9	Stable zone	Present stability
4	**10 - 39.9**	**Sustainable zone**	**Present and future stability**

Source: The Researchers

The fragile state index is a common metric used to evaluate the political distress, published by American Bimonthly Foreign Policy and The Fund for Peace (Xin, Alexandre, Hao, & Lu, 2022; Okeke, Ibem, & Akabuilo, 2020; Raza, Yan, Abbs, & Ullah, 2021). Thus, fragile state index will be used in this research as an indicator of the political distress in Sudan.

5) Multivariate Regression:

Multivariate regression applies more than one exogenous variable to interpret the variation in endogenous variable (Moore, McCabe, Alwan, Craig, & Duckworth, 2011); This research aims to measure the impact of GDP, inflation, political distress and efficiency on the financial stability of the Sudanese banks; consequently, this research will adopt the following multivariate regression equation:

$$Z = X_1 + X_2 + X_3 + X_4$$

Where:
Z: Altman Z-Score (Financial Stability of Banks).
X1: Average inflation rate.
X2: GDP growth rate.
X3: Fragile state index (Political distress of state).
X4: DEA score (Banks efficiency).

$Z = \beta 0 + AIRi + GDPGRi + FSIi + DEAi + BSi + BAi + CRi + CARi$

Where:

Z	Financial Stability of Banks Measured Using Altman Z-Score.
β0	Constant
AIRi	Average Inflation Rate.
GDPGRi	Gross Domestic Product Growth Rate.
FSIi	Fragile State Index (Political Distress of State).
DEAi	DEA Score (Banks Efficiency).
BSi	Bank Size
BAi	Bank Age
CRi	Capitalization Ratio
CARi	Capital Adequacy Ratio

Multivariate Regression is not vulnerable against outliers compared with other means of measuring the causal associations between variables, moreover it provides precise prediction and simulations with real data (Zhang, Liu, & Liu, 2020). The multivariate regression was used by many researchers to study the causal associations among distinct variables such as: (Bansal, 2021), (Guedhami, Knill, Megginson, & Senbet, 2022) and (Spilbergs, Fomins, & Krastins, 2022).

V. Data Analysis And Results

This chapter presents the financial stability assessment results and analyses of the determinants of financial stability of banks in Sudan.

1) Financial Stability Assessment:

Through the years from 2017 to 2019 banks facing high probability of bankruptcy ranged between two to three banks. Moreover, banks threatened to bankrupt (gray zone) increased among the years from 2017 to 2019. In parallel, financially stable banks declined from thirteen banks in 2017 to ten banks in 2019. In addition, banks witnessing high probability of bankruptcy increased dramatically during the last two years 2020 and 2021. Table (3) below indicates that most banks in Sudan are either alerted to bankruptcy (gray zone) or already have high probability of bankruptcy (distress zone) during the years from 2017 to 2021.

Table (3): Count of Banks by Index

Year	Distress Zone	Gray Zone	Safe Zone
2017	3	11	13
2018	2	11	14
2019	3	14	10
2020	7	9	11
2021	5	10	12
Average	4 (15%)	11 (41%)	12 (44%)

Source: The Researchers

Appendixes from (1) to (5) presents calculated Altman Z score for banks in Sudan during the period from 2017 to 2021.

2) Banks Efficiency:

During 2017 only nine banks were efficient (33% of banks), while the rest of eighteen banks were inefficient (67% of banks). Table (4) below presents banks technical efficiency for the year 2017.

Table (4): Technical Efficiency for 2017

Bank Name	Technical Efficiency	Pure Technical Efficiency	Scale Efficiency
Agricultural Bank	100%	100%	100%
Alsalam Bank	100%	100%	100%
Blue Nile Mashreq Bank	100%	100%	100%
Faisal Islamic Bank	100%	100%	100%
Family Bank	100%	100%	100%
Farmer's Commercial Bank	100%	100%	100%
Financial Investment Bank	100%	100%	100%
Sudanese Egyptian Bank	100%	100%	100%
Tadamon Islamic Bank	100%	100%	100%
ALKHALEEJ BANK	99%	100%	99%
United Capital Bank	98%	100%	98%
Sudanese French Bank	97%	100%	97%
Aljazeera Sudanese Jordanian Bank	93%	94%	99%
Saudi Sudanese Bank	92%	100%	92%
Bank of Khartoum	91%	100%	91%
Workers' National Bank	91%	92%	99%
Al Nile Bank for Commerce and Development	90%	100%	90%
Baraka Bank (Sudan)	90%	90%	100%
Balad Bank	89%	90%	98%
El -Nilien Bank	89%	100%	89%
Byblos Bank (Africa)	87%	100%	87%
Sudanese Islamic Bank	87%	89%	99%
Omdurman National Bank	81%	100%	81%
Export Development Bank	75%	76%	98%
Savings and Social Development Bank	67%	68%	99%
Animal Resources' Bank	50%	53%	95%
Arab Sudanese Bank	50%	88%	57%

Source: The Researchers

In 2018 the number of efficient banks decreased to seven banks (26% of banks). Five banks were efficient in 2017 but became inefficient in 2018, those include Blue Nile Mashreq Bank, Faisal Islamic Bank, Family Bank, Farmer's Commercial Bank, Financial Investment Bank, Sudanese Egyptian Bank and Tadamon Islamic Bank. Meanwhile, three banks were inefficient in 2017 and became efficient in 2018, which are El-Nilien Bank, Farmer's Commercial Bank, Financial Investment Bank Savings and Social Development Bank and Workers' National Bank. Table (5) below shows efficiency score for the year 2018.

Table (5): Technical Efficiency for 2018

Bank Name	Technical Efficiency	Pure Technical Efficiency	Scale Efficiency
Agricultural Bank	100%	100%	100%
Alsalam Bank	100%	100%	100%
El -Nilien Bank	100%	100%	100%
Farmer's Commercial Bank	100%	100%	100%
Financial Investment Bank	100%	100%	100%
Savings and Social Development Bank	100%	100%	100%
Workers' National Bank	100%	100%	100%
ALKHALEEJ BANK	93%	100%	93%
Faisal Islamic Bank	92%	100%	92%
Sudanese Islamic Bank	86%	89%	96%
Family Bank	85%	100%	85%
Bank of Khartoum	80%	100%	80%
United Capital Bank	78%	88%	89%
Sudanese Egyptian Bank	76%	100%	76%
Export Development Bank	74%	100%	74%
Baraka Bank (Sudan)	72%	73%	98%
Tadamon Islamic Bank	70%	82%	85%
Al Nile Bank for Commerce and Development	68%	69%	98%
Balad Bank	68%	76%	89%
Aljazeera Sudanese Jordanian Bank	66%	73%	90%
Omdurman National Bank	61%	100%	61%
Blue Nile Mashreq Bank	59%	66%	90%
Sudanese French Bank	54%	55%	97%
Saudi Sudanese Bank	53%	65%	83%
Byblos Bank (Africa)	47%	87%	54%
Animal Resources' Bank	17%	23%	73%
Arab Sudanese Bank	16%	39%	42%

Source: The Researchers

The number of efficient banks continues declining to reach six banks (22% of banks) in 2019 when compared to seven banks in 2018. In other words, efficiency of banking sector in Sudan had declined through the years from 2017 to 2019. Among the two years 2018 and 2019 five banks deteriorated to be inefficient, these banks are El-Nilien Bank, Farmer's Commercial Bank, Financial Investment Bank, Savings and Social Development Bank and Workers' National Bank. On the other hand, four banks enhanced to be efficient in 2019 after they were inefficient in 2018, they include Alkhaleej Bank, Alsalam Bank, Financial Investment Bank, Sudanese Egyptian Bank and United Capital Bank. These results are explained in table (6) below.

Table (6): Technical Efficiency for 2019

Bank Name	Technical Efficiency	Pure Technical Efficiency	Scale Efficiency
Agricultural Bank	100%	100%	100%
ALKHALEEJ BANK	100%	100%	100%
Alsalam Bank	100%	100%	100%
Financial Investment Bank	100%	100%	100%
Sudanese Egyptian Bank	100%	100%	100%
United Capital Bank	100%	100%	100%
El -Nilien Bank	98%	100%	98%
Balad Bank	94%	96%	99%
Farmer's Commercial Bank	94%	96%	98%
Baraka Bank (Sudan)	94%	95%	99%
Animal Resources' Bank	94%	94%	100%
Saudi Sudanese Bank	92%	95%	97%
Blue Nile Mashreq Bank	88%	100%	88%
Workers' National Bank	87%	87%	99%
Sudanese Islamic Bank	85%	86%	100%
Family Bank	85%	100%	85%
Savings and Social Development Bank	83%	84%	98%
Tadamon Islamic Bank	80%	89%	90%
Export Development Bank	78%	81%	96%
Faisal Islamic Bank	76%	100%	76%
Aljazeera Sudanese Jordanian Bank	76%	77%	99%
Sudanese French Bank	75%	76%	99%
Omdurman National Bank	71%	100%	71%
Al Nile Bank for Commerce and Development	67%	70%	96%
Byblos Bank (Africa)	65%	97%	67%
Bank of Khartoum	57%	100%	57%
Arab Sudanese Bank	45%	47%	95%

Source: The Researchers

The banking sector in Sudan witnessed a slight improvement in efficiency in 2020 as the number of efficient banks increased to eight bank (30% of banks), while as two banks - Saudi Sudanese Bank and Sudanese Islamic Bank - elevated to be efficient in 2020 in addition to the previous six efficient banks. Table (7) below shows banks efficiency in 2020.

Table (7): Technical Efficiency for 2020

Bank Name	Technical Efficiency	Pure Technical Efficiency	Scale Efficiency
Agricultural Bank	100%	100%	100%
ALKHALEEJ BANK	100%	100%	100%
Alsalam Bank	100%	100%	100%
Financial Investment Bank	100%	100%	100%

Bank Name	Technical Efficiency	Pure Technical Efficiency	Scale Efficiency
Saudi Sudanese Bank	100%	100%	100%
Sudanese Egyptian Bank	100%	100%	100%
Sudanese Islamic Bank	100%	100%	100%
United Capital Bank	100%	100%	100%
Byblos Bank (Africa)	93%	100%	93%
Blue Nile Mashreq Bank	92%	100%	92%
Farmer's Commercial Bank	85%	85%	100%
Workers' National Bank	83%	91%	91%
Animal Resources' Bank	80%	82%	98%
Tadamon Islamic Bank	80%	84%	95%
Omdurman National Bank	77%	100%	77%
Sudanese French Bank	76%	77%	98%
Balad Bank	73%	75%	97%
Baraka Bank (Sudan)	72%	76%	94%
Aljazeera Sudanese Jordanian Bank	71%	76%	93%
Al Nile Bank for Commerce and Development	70%	71%	99%
Family Bank	61%	100%	61%
Savings and Social Development Bank	60%	63%	95%
El -Nilien Bank	58%	100%	58%
Faisal Islamic Bank	55%	70%	79%
Bank of Khartoum	44%	100%	44%
Arab Sudanese Bank	39%	98%	39%
Export Development Bank	25%	45%	57%

Source: The Researchers

Table (8) below elaborates that in 2021 there were seven efficient banks (26% of banks) in contrast with 2020.

Table (8): Technical Efficiency for 2021

Bank Name	Technical Efficiency	Pure Technical Efficiency	Scale Efficiency
Agricultural Bank	100%	100%	100%
ALKHALEEJ BANK	100%	100%	100%
Alsalam Bank	100%	100%	100%
El -Nilien Bank	100%	100%	100%
Financial Investment Bank	100%	100%	100%
Saudi Sudanese Bank	100%	100%	100%
Sudanese Islamic Bank	100%	100%	100%
Savings and Social Development Bank	88%	92%	96%
Sudanese Egyptian Bank	83%	100%	83%
Farmer's Commercial Bank	82%	83%	100%
United Capital Bank	82%	84%	98%

Bank Name	Technical Efficiency	Pure Technical Efficiency	Scale Efficiency
Balad Bank	76%	78%	97%
Workers' National Bank	75%	86%	87%
Baraka Bank (Sudan)	73%	74%	99%
Aljazeera Sudanese Jordanian Bank	69%	71%	97%
Export Development Bank	65%	66%	98%
Bank of Khartoum	59%	100%	59%
Al Nile Bank for Commerce and Development	54%	58%	93%
Omdurman National Bank	50%	100%	50%
Family Bank	50%	100%	50%
Tadamon Islamic Bank	48%	50%	96%
Animal Resources' Bank	46%	48%	96%
Byblos Bank (Africa)	43%	100%	43%
Faisal Islamic Bank	39%	42%	94%
Sudanese French Bank	38%	41%	92%
Blue Nile Mashreq Bank	34%	91%	37%
Arab Sudanese Bank	19%	58%	33%

Source: The Researchers

The number of efficient banks in Sudan had not exceed seven banks during the five years from 2017 until 2021, i.e. only 26% of Sudanese banks were efficient while 74% were inefficient through the years from 2017 to 2021. This inference could be derived from table (9) and figure (1) below which presents efficiency scores for five years from 2017 to 2021.

Table (9): Efficiency for the Period from 2017 to 2021

Bank Name	Technical Efficiency	Pure Technical Efficiency	Scale Efficiency
Agricultural Bank	100%	100%	100%
ALKHALEEJ BANK	100%	100%	100%
Alsalam Bank	100%	100%	100%
El -Nilien Bank	100%	100%	100%
Financial Investment Bank	100%	100%	100%
Saudi Sudanese Bank	100%	100%	100%
Sudanese Islamic Bank	100%	100%	100%
Savings and Social Development Bank	88%	92%	96%
Sudanese Egyptian Bank	84%	100%	84%
Farmer's Commercial Bank	82%	83%	99%
United Capital Bank	82%	84%	97%
Balad Bank	77%	79%	98%
Workers' National Bank	73%	86%	85%
Baraka Bank (Sudan)	73%	74%	99%
Aljazeera Sudanese Jordanian Bank	68%	71%	96%

Bank Name	Technical Efficiency	Pure Technical Efficiency	Scale Efficiency
Bank of Khartoum	66%	100%	66%
Export Development Bank	66%	67%	98%
Al Nile Bank for Commerce and Development	55%	59%	94%
Family Bank	50%	100%	50%
Tadamon Islamic Bank	49%	50%	96%
Animal Resources' Bank	46%	49%	95%
Omdurman National Bank	45%	100%	45%
Byblos Bank (Africa)	41%	100%	41%
Faisal Islamic Bank	39%	41%	95%
Sudanese French Bank	37%	41%	92%
Blue Nile Mashreq Bank	32%	82%	40%
Arab Sudanese Bank	19%	64%	29%

Source: The Researchers

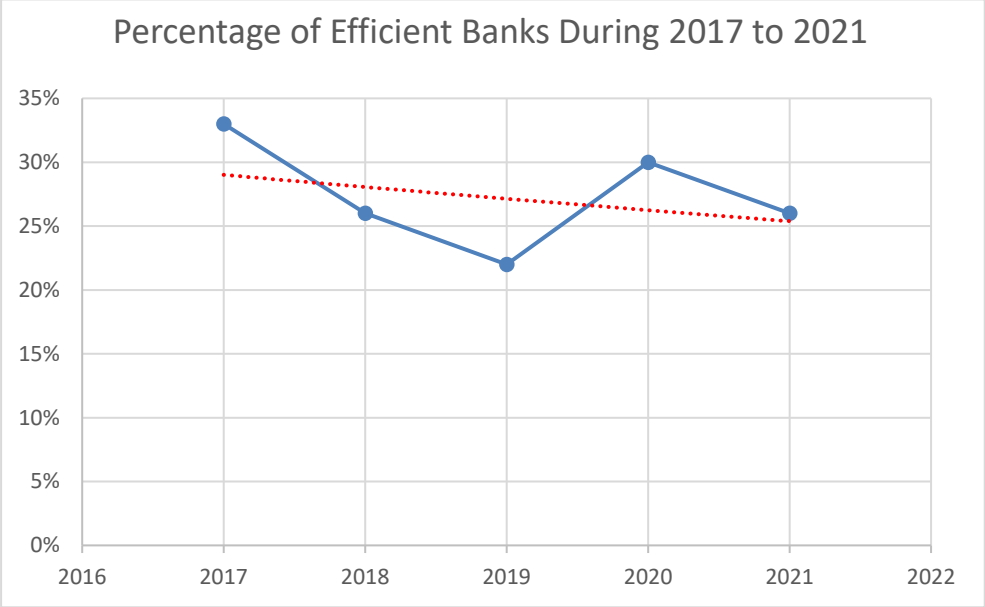

Figure (1): Percentage of Efficient Banks During 2017 to 2021

3) Multivariate Regression:

Multivariate regression model is used in this research to describe the factors that affect the financial stability of banks in Sudan. The results of the multivariate regression analysis are summarized in Table (10) below. The R value is 0.625, which demonstrates a direct positive correlation. While the R-squared value is 0.390, this means that 39% of the variation in the dependent variable (Financial Stability) can be explained by the independent variables (Efficiency, Size, Age, Capitalization, Capital Adequacy, Inflation, GDP Growth Rate and Fragile Index). Moreover, the adjusted R-squared value is 0.351, which means that the model explains 35% of the variation in the dependent variable after considering the number of independent variables.

Table (10): Regression Model Summary

Model	R	R2	Adjusted R2	Std. Error	Change Statistics		
					R2 change	F Change	Sig. F
1	.625	.390	.351	1.32	.390	10.075	.000

Source: The Researchers

The table below (11) shows the results of ANOVA analysis that tests the overall significance of the multiple regression model, and the p value is 0.000, which is smaller than 0.05, indicating that it is a statistically significant model.Top of Form.

Table (11): ANOVA

	Sum of Squares	df	Mean Square	F	Sig
Regression	141.040	8	17.630	10.075	.000
Residual	220.488	126	1.750		
Total	361.528	134			

Source: The Researchers

The table (12) below shows the regression coefficients, and it is clear that size, age, capitalization and inflation are statistically significant, implying that these variables have a significant impact on financial stability. On the other hand, no other variables have a statistically significant effect on financial stability at p-values less than 0.05. In other words, the factors that determine the financial stability of banks in Sudan are size, age, capitalization and inflation. Efficiency, capital adequacy, GDP growth and political distress are not considered as determinants of financial stability of banks in Sudan.

Table (12): Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	-13.994	13.596		-1.029	.305	-40.899	12.912
Efficiency	-.116	.583	-.015	-.199	.843	-1.269	1.037
Size	.559	.143	.483	3.917	.000	.277	.841
Age	-.021	.007	-.270	-2.904	.004	-.036	-.007
Equity/Assets	9.293	3.842	.646	2.419	.017	1.689	16.897
Equity/Debit	-.288	2.036	-.037	-.142	.888	-4.317	3.740
Inflation	-.450	.141	-.334	-3.186	.002	-.729	-.170
GDP	3.729	6.847	.065	.545	.587	-9.820	17.278
Fragile Index	.034	.121	.032	.284	.777	-.205	.274

Source: The Researchers

VI. Recommendations And Conclusion

1) Conclusion

This research aims to measure the financial stability of banks in Sudan and investigate its determinants. It focuses on 27 out of the 35 banks in Sudan's banking sector over a period of five years from 2017 to 2021.

The balanced panel data statistical approach has been used for data analysis, using the Altman Z-score to measure the financial stability of the banking sector. Moreover, the research utilizes a multivariate regression model with financial stability (Z-score) as the response variable and various independent variables including inflation rate, GDP growth, political distress, bank efficiency, bank size, bank age, capitalization ratio, and capital adequacy ratio.

The research results revealed that the banking sector in Sudan faces great vulnerability because of the high instability of banks. Ultimately, the multivariate regression analysis determined that size and capitalization have a significant positive impact on financial stability, whereas age and inflation have a significant negative impact on financial stability. Essentially, the stability of banks in Sudan is influenced by four determinants: size, capitalization, age, and inflation.

2) Recommendations

The research provides recommendations for future research on data accessibility and variable selection.

Collaborating with the banking sector and the Central Bank of Sudan can solve the problem of data accessibility that hindered the research by obtaining unpublished financial reports. Furthermore, the reliability of data in financial reports is in doubt because of unclear specification and classification of elements; therefore, it is suggested that future research consult with a knowledgeable Central Bank of Sudan member familiar with governmental regulations and bylaws impacting banking sector reports.

The research sought to explore various external and internal factors that impact the financial stability of banks, resulting in a complex and multifaceted research approach without previous literature utilizing a wide array of factors, leading to challenging multicollinearity analysis; hence, future research must understand the connections between the factors studied to prevent incorrect variable selection.

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