

EXPLORING THE INFLUENCE OF RISK MANAGEMENT ON COMMERCIAL BANK PERFORMANCE IN SUDAN: AN EMPIRICAL STUDY

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Abstract:

This study aims to examine the impact of operational, credit, and liquidity risks on the financial performance of Sudanese commercial banks and then to make recommendations that improve risk management practices. The study sample consists of 27 banks for the period 2017-2021, and the data were collected from the annual reports of these banks. The study used the fixed effects model to test the hypotheses of the study. The results of the study showed that the operating risks are represented by managerial weakness, fraud, and the underuse of technology. Credit risks arising from non-performing loans and inadequate risk assessment practices, and Liquidity risks all have a significant negative impact on the financial performance of commercial banks in Sudan, especially during periods of recession and economic instability. These significant and critical outcomes necessitate effective risk management strategies to mitigate these negative effects. Strengthening the regulatory framework to better align with international banking standards, modernizing banking infrastructure to improve operational efficiency, and strengthening the legal and institutional environment to support sustainable financial practices, and consequently, contributing to the flexibility and upgrading the overall profitability of Sudanese banks.

Keywords: Operational Risk Management, Credit Risk Mitigation, Liquidity Management, Bank Profitability, Sudanese Banking Sector, Risk Assessment Models.

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1. Introduction:

The activity of commercial banks is essential for economic stability and growth in all countries because they play an important and essential role in pooling and mobilizing savings, providing credit, and promoting financial inclusion. All the above activities are considered vital functions required for the development of small and medium-sized enterprises (SMEs), encouraging entrepreneurship, and creating jobs, and this makes banks major drivers of sustainable economic growth (Youssef, 2024). In addition, Banks have an important and pivotal role in creating liquidity by converting illiquid assets into liquid liabilities, thereby supporting economic growth and investment and driving GDP growth (Berger & Bouwman, 2009).

In recent years, effective risk management in commercial banks has become a top priority globally, due to the fact that operational, credit, and liquidity risks have become increasingly overlapping and complex in nature. According to the Basel Committee on Banking Supervision (2011), operational risk refers to potential losses resulting from internal process failures or as a result of system failures or human error or external events. This type of risk can significantly disrupt a bank's operations and undermine its financial performance, as evidenced by fraud incidents, cyberattacks, and global compliance failures (Hogan et al. 2017). Credit risk, on the other hand, stems from the possibility of borrower defaulting, which in turn directly and negatively affects asset quality and profitability. During recessions and economic downturns, high levels of non-performing loans (NPLs) can erode banks' capital and increase operating costs (Altman & Saunders, 1998). Liquidity risk arises if a bank is unable to meet its short-term obligations due to a lack of available funds, and this may entail the necessity of selling part of its Assets, which may be forcibly incurred as well as high emergency financing costs, and the bank may reach the insolvency stage (Diamond & Rajan, 2001).

The overlap and interdependence of the different types of risks facing commercial banks necessarily require a holistic approach to effectively managing these risks rather than individually addressing one type in isolation from other types of risk. For example, system failure can give rise to operating risks, and this in turn exacerbates the resulting credit risk by disrupting loan processing, loan defaults and high non-performing loan ratios can lead to high liquidity risk. This case clearly illustrates the importance of developing a coordinated risk management strategy, such as Integrated Risk Management (IRM), which emphasizes the management of multiple risks comprehensively and collectively in order to enhance resilience and ensure financial stability (Fayed & El Masri, 2021). Similarly, risk diversification theory suggests that the distribution of risk across a variety of assets and sectors can help mitigate the negative effects of recessions and economic shocks (Srairi, 2022).

The banking sector in Sudan operates under a number of constraints and challenges, represented by political instability, economic sanctions imposed from abroad, and macroeconomic volatility. These challenges thus lead to an increase in the impact of operational, credit, and liquidity risks and their implications on the performance and financial stability of the banking sector. Persistent problems resulting from weak operations, high non-performing loan ratios, and frequent liquidity shortages are leaving the sector facing financial turmoil and declining profitability. In addition, gaps and weaknesses in risk management practices make banks vulnerable to cascading risk events, reducing their resilience, continuity, and sustainability of performance as desired. Understanding how operating, credit, and liquidity risks interact and impact the banking sector is critical to developing strategies that enhance resilience to challenges and contribute to long-term economic recovery and development.

Despite the availability and potential to use and apply integrated risk management approaches and risk diversification tools to enhance banks' ability to address and counteract the negative effects of the various risks they face, the level of implementation of these approaches by Sudanese banks is still limited. Often, current practices for addressing and managing different risks are done in isolation rather than a comprehensive approach, which exacerbates the crisis and increases vulnerability to cascading risk events. Failure to implement effective risk management undermines the sector's ability to adapt to external pressures and impedes sustainable economic development. A literature review indicated a gap and a lack of applied research on how operating, credit, and liquidity risks affect the financial performance of Sudanese banks. Moreover, the practical application of integrated and diverse risk management strategies in this context remains underexplored. Closing this gap and addressing the shortfalls is critical to strengthening the financial position of banks and ensuring that they can support the Sudanese economy.

The present study attempts to answer two main research questions: First, which type of risk has the greatest impact on banks' financial performance? Second, how can banks enhance risk management practices to overcome and mitigate the negative effects of operational, credit, and liquidity risks? To answer these questions, the present study seeks to achieve three objectives: first, to identify the main risks faced by Sudanese banks. Second, to analyze the relationship between these risks and key financial performance indicators, such as return on assets. Third, to explore the role of integrated risk management and risk diversification practices in reducing these risks and enhancing the resilience of the bank, and to face obstacles and risks. This research paper also aims to provide some practical suggestions and recommendations that can guide the authorities responsible for the banking system in developing policies, and promoting risk management practices based on the data and the context in which Sudanese banks operate, as the ultimate goal is to enhance the financial performance of this important economic sector and achieve stability and thus contribute to the long-term economic growth in Sudan.

The research paper is divided into five sections. The second section provides a review of the most important literature that addresses the various types of risks faced by financial institutions in general and commercial banks in particular, with a focus on applied studies and research on these different types of risks. The third section deals with research methodology, which includes research hypotheses and data and their sources, in addition to the description of the modeling used in the process of data analysis and hypothesis testing. The focus in the fourth section is directed to analyzing the data, extracting various statistics, and discussing the results produced by the model, considering the reality of the Sudanese economy. Finally, the research

paper is concerned with presenting a summary of the results with an explanation of the implications of these results, in addition to providing some recommendations that can contribute to addressing and managing the different types of risks that hinder the performance of banks in Sudan.

Literature Review

Financial institutions in general, and commercial banks in particular, play a crucial role in driving and sustaining economic growth by exercising a number of functions, such as mobilizing savings and providing bank credit to various productive projects and sectors. Practicing these functions promotes innovation, entrepreneurship, job creation, and infrastructure development, which effectively contribute to supporting the economy and maintaining its stability, especially during periods of recession and financial crises (Levine, 1997; Berger & Bouwman, 2009). On the other hand, banks also act as an intermediary and mechanism for implementing the country's monetary policies, adjusting lending practices, and setting interest rates in accordance with the policies and procedures of the central bank (Mishkin, 2001). Despite the importance of exercising these vital functions, banks face significantly increased risks that can hinder their ability to sustain and maintain their expected financial performance, particularly in economies as fragile as Sudan. Some of the main risks faced by banks are operational, credit, and liquidity risks, which present challenges for these banks and affect their profitability, stability, and resilience in multiple ways.

The emergence and exacerbation of operational risks due to the collapse of processes or systems or due to external events have made them a key and pivotal point in the overall framework of risk management, as in the case of the settlement made by the Basel Committee on Banking Supervision (2011). Some studies and research have indicated and shown that laxity and mismanagement of operational risks can result in serious and catastrophic consequences and can result in significant financial losses, discrediting the organization and deteriorating overall performance (Chernobai et al., 2010; Hogan et al., 2017). In this regard, for example, Aebi and Schmid (2012) noted that banks with well-established and robust operational risk management practices and methods achieved good performance indicators through high return on assets (ROA) and return on equity (ROE), especially during financial crises and turmoil. For emerging markets, some studies and research have indicated that poor management of operational risks has resulted in higher costs, lower efficiency, and lower productivity and profitability (Baselga & Sanchis, 2022; Akinola & Egbunike, 2023). In the case of Sudan's economy, which is the focus of this study, operational risk management is a clear challenge due to weak and eroded infrastructure, weak regulatory oversight, and limited adoption of advanced technological systems. These challenges to operational risk management pose a threat to banks' efficiency and poor financial performance.

Credit risk refers to the potential loss arising from borrowers' inability to meet their obligations to banks and financial institutions. The more borrowers are unable or default on time, the higher the proportion of non-performing loans, which has become a component and an essential component of banking risk management. High levels of non-performing loans will undoubtedly lead to reduced profitability and lower efficiency of banks, as banks are forced to allocate additional resources to offset loan losses instead of engaging in serious income-generating activities (Al-Khouri, 2020). Studies and research in emerging markets in Africa and Asia indicate that there is a strong negative correlation between non-performing loans and bank

performance (Kargi, 2011; Kasim & Obaiomi, 2021). In the case of Sudan, economic instability and limited access to effective credit assessment tools may further increase and exacerbate credit risk, making it very difficult for Sudanese banks to maintain sound and productive loan portfolios, which means that their profitability is low. In order to mitigate and reduce the negative effects of credit risk, credit diversification across different productive sectors can be resorted to as advocated by risk diversification theory, especially in unstable economies (Srairi, 2022).

One of the risks facing banks is liquidity risk, which means that banks are unable to meet their short-term financial obligations, and this is a critical challenge for banks. Effective liquidity management is one of the prerequisites to ensure the stability of banks, as it avoids the need to resort to selling assets on an emergency basis and thus reduces their profitability (Diamond & Rajan, 2001; Ahmed et al., 2021). Studies and research conducted in some developing countries and emerging markets indicate and emphasize the utmost importance of maintaining acceptable levels of liquidity to cope with economic challenges and volatility in these markets (Rahman & Hasan, 2023). For Sudan, the situation is more difficult and complicated due to frequent cash shortages and limited interbank exchanges and transactions. This would lead to increased liquidity constraints and weakened financial stability. The trend towards diversifying funding sources and developing liquidity forecasting tools and strategies may mitigate the negative effects of these risks.

The interconnected and interrelated nature of these different types of risks facing banks further complicates the situation, making risk management more challenging. For example, failures related to poor credit assessment may lead to a higher ratio of non-performing loans, and as a result, higher credit risk. In contrast, high levels of credit risk can lead to negative outcomes as they deplete liquidity reserves, thereby increasing liquidity risk. To address this interconnected and overlapping nature of operational, credit, and liquidity risks, it is necessary to adopt the perspective and support of the theory of integrated risk management (IRM) as a holistic approach to managing these risks in order to enhance resilience and profitability (Fayed & El Masry, 2021). In the case of Sudan, the implementation of this comprehensive framework by Sudanese banks may often face validation challenges, reflecting and highlighting a significant gap in current risk management practice.

Published research on risk management clearly indicates the importance of adopting effective practices to maintain good performance for banks. For example, Baselga and Sanchis (2022) have found that operational risks in developing country markets have a significant impact on the efficiency of commercial banks with fragile and weak regulatory environments. Similarly, Ahmed and Safdar (2022) have clarified that the negative effects of liquidity risk affect the profitability of banks in emerging economies. However, there are still shortcomings and scarcity, and there is a lack of scientific research on the banking sector in Sudan.

This study attempts to bridge this gap by studying and analyzing the impact of operational, credit, and liquidity risks on Sudanese banks and proposing some strategies based on investment risk management and risk diversification to enhance their financial performance. Based on a review of previous conceptual and empirical literature related to risk management, the theoretical framework of this study was developed, and the hypothetical relationships between the variables were formulated. dependent and independent variables, as shown in Figure 1.

The study is based on theoretical insights and empirical results, and proposes the following hypotheses:

Macro Hypothesis

H1: There is a negative relationship between financial risk and the financial performance of the bank, measured by return on assets (ROA).

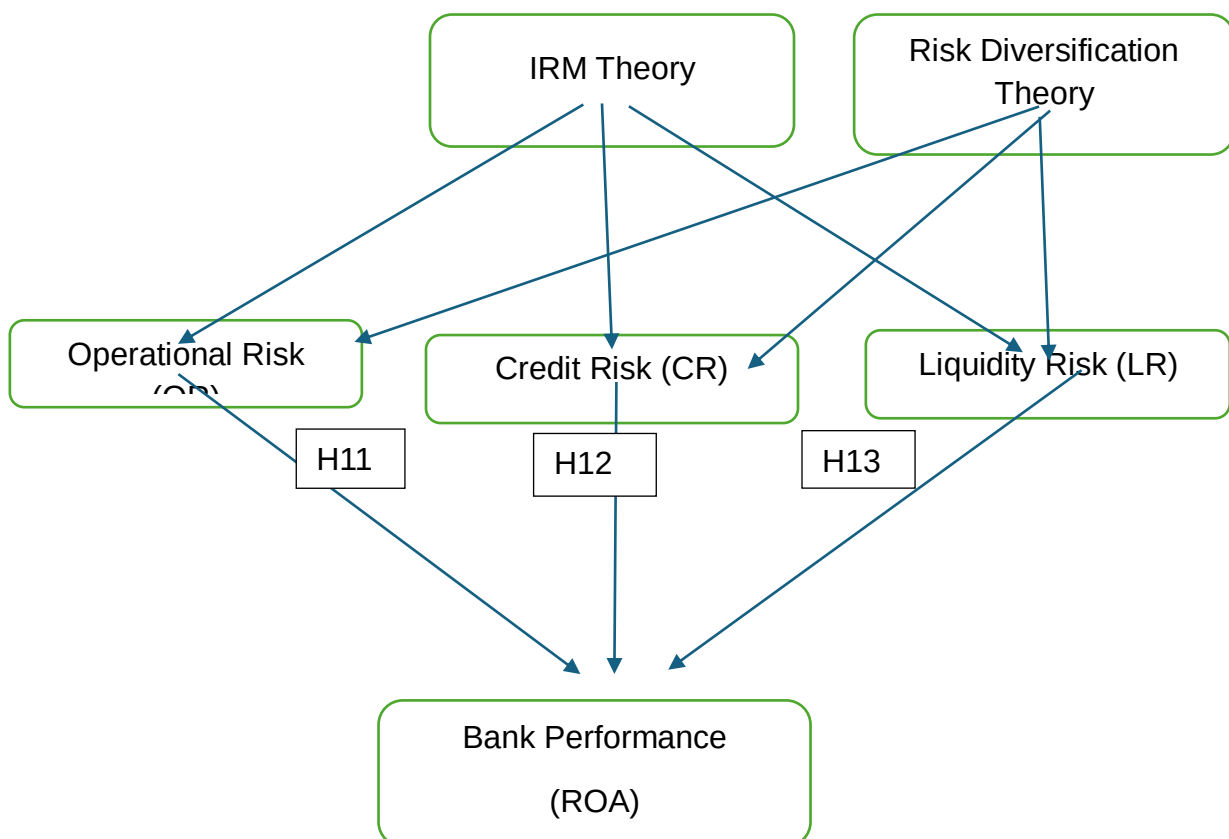
Micro Hypotheses

H11: There is a statistically significant negative relationship between the bank's operational risk and financial performance, measured by the return on assets.

H12: There is a statistically significant negative relationship between credit risk and the bank's financial performance, measured by return on assets.

H13: There is a statistically significant negative relationship between liquidity risk and the bank's financial performance, measured by return on assets.

Figure 1: Proposed Research Framework



3- Methodology:

3.1 Theoretical Model:

This study is premised on evaluating the effect of the financial risk management on the financial performance of commercial banks in Sudan. Yearly panel data from the years 2017 to 2021 was collected from the financial statements, regulatory reports, and publications of the 27 Sudanese commercial banks including Agricultural Bank, Al Nile Bank, Al Jazeera Bank, Al Khaleej Bank, Animal Resource Bank, Al Salam Bank, Al Balad Bank, Arab Sudanese Bank, Al Baraka Bank, Khartoum Bank, Blue Nile Bank, Byblos African Bank, Export Development Bank, El Nilien

Bank, Family Bank, Faisal Islamic Bank, Farmers Commercial Bank, Financial Investment Bank, Saudi Sudanese Bank, Omdorman National Bank, Sudanese Egyptian Bank, Savings and Social Development Ba, Sudanese Islamic Bank, Sudanese France Bank, United Capital Bank and Workers National Bank, Tadamon Islamic Bank

Here, we will depict the operational definition of the study variables employed in this paper. The variables have been largely discussed and frequently mentioned in previous research studies.

Theoretically, greater exposure to financial risks is typically accompanied by a decline in the profitability of banks; hence, a priori expectation from the model is that credit risk, operational risk, and liquidity risk are expected to adversely affect bank performance as captured by Return on Asset (ROA).

Here, the dependent variable is financial performance (or bank performance), and it is measured in terms of its capacity to generate sustainable profitability. It is the gauge of the efficiency and effectiveness with which a bank performs, as captured by earnings, measures of efficiency, and management performance. Various steps are taken to measure bank performance, of which traditional performance indicators like those applied in other industries are Return on Assets (ROA), Return on Equity (ROE), or cost-to-income ratio as the most prevailing. Return on Assets (ROA) is utilized in this research as a financial performance indicator. ROA is computed by dividing banks' net income by their total assets.

The independent variables include variables that capture the impact of financial risks, which are credit risk, operational risk, and liquidity risk.

Credit risk is an internal determinant of bank performance. Credit risk is the possibility of losing a lender's hold due to a risk of default on a debt that is possibly initiated by bank borrowers not paying as expected or meeting their contractual terms. The higher the banks' exposure to credit risk, the higher the possibility of the banks experiencing a financial crisis. Gross loans to total assets ratios are utilized as a measure of credit risk, whereby banks with a larger proportion of non-performing loans are less profitable compared to others. Other research confirms the fact that higher levels of credit risk are responsible for decreasing banks' profitability levels.

Operational risk, as defined by Basel II, is the risk of loss due to inadequate or failed internal processes, people, systems, or external events that cause loss of the company's ability to conduct business in a normal way. Operational risk is the risk of loss caused by various normal attributes of business activities. This includes the risk of loss due to ineffective processes, inept staff members, inappropriate systems, or external events. Operational risk is measured by the operating costs to operating income ratio. The ratio indicates the efficiency of management. The greater this ratio, the less bank profitability is likely to be. Several studies have found operational risk to have a negative correlation with the profitability of a bank.

Liquidity risk refers to the bank's inability to settle its financial obligations as they become due. This is due to insufficient cash or failure to convert assets into cash at reasonable losses. The risk is a critical aspect of banks' business and financial performance. The difficulty in raising sufficient cash from the sale of assets to meet the demand of depositors and the failure to raise new money to meet contingent expenses and withdrawals will result in liquidity risk and adversely affect the operation and financial performance of the bank. Sathyamurthy et al (2020), Mardiana and Dianaata (2018), Hamza S. M (2017), and Yousfi (2015) studies established that

liquidity risk adversely affects financial performance. Liquidity risk is measured by liquid assets to deposits and short-term funding ratio.

Similarly, in this paper, we empirically tried to examine the effect of credit risk, operational risk, and liquidity risk on the performance of 27 Sudanese banks over the period (2017-2021).

To investigate the above relationship, we form the following estimable models:

$$ROA = f(CR, OR, LR) \quad (1)$$

Where:

ROA: Return on Assets

CR: Credit Risk

OR: Operational Risk

LR: Liquidity Risk

3.2 Analytical Methods:

A common panel data regression model looks like

$$Y_{it} = \alpha + \beta X_{it} + \mu_{it} \quad (2)$$

where Y is the dependent variable, X is the explanatory variable, α and β are coefficients, "i" denotes cross sections, and "t" denotes the time dimension of panel data, while " μ_{it} " denotes the unobservable factors affecting the panel data modelling stated above.

Panel data was analyzed using either the fixed effect or the random effect model. The fixed effect model assumes that there is one true effect size, which underlies all the studies in the analysis, and that all differences in observed effects are due to sampling error. In a fixed-effect model, the unobserved variables can have any associations whatsoever with the observed variables. Fixed effects model control for the effects of time-invariant variables with time-invariant effects. This is true whether the variable is explicitly measured or not.

Accordingly, the fixed effect model is as follows:

$$Y_{it} = (\alpha + \mu_i) + X_{it} \beta + v_{it} \quad (3)$$

where α and β are constant parameters; " μ_i " is also a parameter but assumed to be fixed and is estimated for inference in the panel data. The remaining unobservable factors are stochastic with " v_{it} ", which are distributed identically as IID $(0, \sigma_v^2)$ and change with individual banks and time invariants. Also, it is assumed that under the fixed effect model and for all "i" and "t", the explanatory variable (" X_{it} ") does not depend on " v_{it} " for inference.

We can convert our model into a fixed effect as follows:

$$ROA_{it} = (\beta_0 + \mu_i) + \beta_1 CR_{it} + \beta_2 OR_{it} + \beta_3 LR_{it} + v_{it} \quad (4)$$

In a random effect model, the unobserved variables are assumed to be uncorrelated with all the observed variables. Random effect model can be estimated by Generalized Least Squares (GLS) method, which is used in case of heteroskedasticity or autocorrelation problems. According to Baltagi (2005), the random effect model is appropriate in a situation where the researcher intends

to draw individuals randomly from a large population. In this case, the term μ_{it} assumed to be random.

Then the random effect model looks like:

$$Y_{it} = \alpha + X_{it} \beta + (\mu_{it} + v_{it}) \quad (5)$$

Where μ_{it} is distributed identically as IID $(0, \sigma_{\mu}^2)$, v_{it} is also distributed identically as IID $(0, \sigma_v^2)$, and the values of μ_{it} and v_{it} are independent. Also, there is no relationship between the values of X_{it} and the values of μ_{it} and v_{it} .

Our model can be converted into a random effect as follows:

$$ROA_{it} = \beta_0 + \beta_1 CR_{it} + \beta_2 OR_{it} + \beta_3 LR_{it} + (\mu_{it} + v_{it}) \quad (6)$$

In deciding whether to use one of the models (fixed effect or random effect), the Hausman specification test (1978) is conducted. The test between the fixed and the random effects under the null hypothesis that the individual effects are not correlated with the order regressors in the model. After estimating the said fixed effect model in (4) and the random effect model in (6), we will identify which of the two is better to be accepted according to the Hausman test. When we get a statistically significant p-value, we will adopt the fixed effect model, otherwise, we will adopt the random effect model.

4. Data Analysis and Discussion

Table 1 reports the descriptive statistics of Return on Assets (ROA), Credit Risk (CR), Operational Risk (OR), and Liquidity Risk (LR).

Table 1: Descriptive Statistics

	ROA	OR	CR	LR
Mean	0.036	0.713	0.833	1.694
Medium	0.025	0.600	0.780	1.310
Maximum	0.201	7.800	7.800	14.49
Minimum	0.000	0.010	0.210	0.420
Std. Dev	0.039	0.732	0.771	1.450
Skewness	2.192	7.441	7.725	5.731
Kurtosis	7.688	70.670	65.070	47.665
Jarque-Bera Probability	27003 0.000	232 0.000	23012 0.000	11960 0.000
Observations	135	135	135	135
Cross Sections	27	27	27	27

Source: Authors' calculations.

The descriptive statistics presented in Table 1 reveal that Sudanese banks are struggling with low profitability, as indicated by an average Return on Assets (ROA) of just 3.6%. This suggests that the banks face significant challenges in efficiently converting assets into earnings. According to Hawkins and Mihaljek (2001), a ROA below 20% is considered low, further emphasizing the underperformance of these banks. Liquidity risk emerges as the most significant concern, with a

mean value of 169%, signaling severe difficulties in managing liquidity. Credit risk (mean of 83%) and operational risk (mean of 71%) also present notable vulnerabilities, reflecting the systemic issues created by Sudan's ongoing economic instability and political uncertainty. These findings underscore that Sudanese banks are highly exposed to various risks that could undermine their profitability and long-term sustainability. This aligns with previous research, which highlights the prevalence of high credit risk and operational inefficiencies in economies grappling with instability.

The skewness values for all variables are positive, suggesting that a larger number of banks experience higher values for each variable than the mean value reported for the sample period. Additionally, the Jarque-Bera (J-B) test results for all variables are highly significant, indicating that the probability distributions of these variables are not normally distributed. This suggests that the data within the study period exhibit heterogeneity in their patterns.

To determine the appropriate model for our panel data analysis, we applied the Hausman Specification test (1978) to decide between a fixed effects or random effects model. After estimating the random effects model in equation (6) and conducting the Hausman test, we found that the Chi-square statistic for the model is significant at the 5% level. Therefore, a fixed effects model is more suitable for analyzing the ROA data.

For our analysis, we employed pooled EGLS (cross-section weight) to estimate the Fixed Effects Model, allowing for different intercepts across individual banks. The estimation results from these fixed effects model, as outlined in equation (4), are presented in Table 2 below.

Table 2. Results of Fixed Effect Model for ROA

Regressor	Coefficient	t-ratio	Prob.	R ²	AdjustedR ²	CalculatedF	Prob.
OR	-0.0080	-3.965	0.0001	0.87	0.83	24.17	0.000
CR	-0.0020	-2.618	0.0100				
LR	-0.0015	-1.897	0.0605				
Constant	0.046	21.477	0.0000				

Source: Authors' calculations.

Table 2 presents the results from the Fixed Effects Model, showing that all three risk factors—credit risk, operational risk, and liquidity risk—have a significant negative impact on bank performance in Sudan. Specifically, credit risk has a coefficient of -0.0020, indicating that a 1-unit increase in credit risk leads to a decrease in ROA by 0.002. Similarly, operational risk has a coefficient of -0.0080, meaning that an increase in operational risk results in a 0.008 decrease in ROA. Liquidity risk also negatively impacts ROA, with a coefficient of -0.0015, though it is only statistically significant at the 10% level.

The F-statistic of 24.17 and an R² value of 0.83 suggest that credit risk, operational risk, and liquidity risk account for 83% of the variation in ROA. This indicates a strong model fit, reinforcing the importance of these risk factors in explaining the performance of Sudanese banks. The analysis indicates that operational risk has the most significant impact on the financial performance of Sudanese banks. The negative coefficient for operational risk (-0.0080) suggests that a one-unit increase in operational risk results in a 0.008 decrease in ROA. This finding is particularly meaningful given Sudan's underdeveloped banking infrastructure, inconsistent regulatory environment, and limited access to modern banking technologies. Common operational inefficiencies in Sudanese banks, such as outdated systems, poor cybersecurity measures, and insufficient staff training, contribute to high operational costs and missed revenue

opportunities. This result aligns with previous studies (e.g., Gadzo et al., 2019; Al-Tamimi et al., 2015), which found a strong negative relationship between operational risk and profitability in economies facing similar challenges. However, this finding contrasts with the work of Abu Hussain and Al-Ajmi (2012), who reported a significant positive relationship between operational risk and bank performance.

Credit risk also has a significant impact on profitability. The negative relationship between credit risk and ROA (with a coefficient of -0.0020) reflects the economic instability in Sudan, which results in higher default rates and increased uncertainty in loan repayments. The country's volatile political and economic conditions, including high inflation, currency devaluation, and government instability, further heighten the risk of defaults. This finding is consistent with the work of Ruziqa (2013) and Abbas & Ullah (2023), who observed similar negative effects of credit risk on bank performance in other unstable economies.

Although still significant, liquidity risk has a smaller impact on ROA compared to operational and credit risks. The coefficient of -0.0015 indicates that while liquidity issues are important, they are less impactful than the other risks. This can be attributed to Sudan's liquidity constraints, such as foreign exchange shortages and economic policies that limit banks' ability to raise funds at reasonable rates. As a result, banks are often forced to rely on expensive borrowing or liquidate assets at unfavorable prices, which reduces profitability. This finding is consistent with studies by Tabari et al. (2013) and Distinguin et al. (2013), which reported similar results in other emerging markets.

The ongoing political instability and economic challenges in Sudan significantly influence these results. The high levels of credit and operational risk can be attributed to the fragile political climate, where frequent policy changes and economic uncertainty discourage long-term investment and increase the likelihood of defaults. While liquidity risk is also significant, it is likely worsened by the foreign exchange crisis and limited access to international capital markets, which hinder banks' ability to meet short-term obligations efficiently.

Furthermore, the economic sanctions imposed on Sudan in recent years have restricted banks' access to international financial systems and technology, likely exacerbating operational and liquidity risks. Sudanese banks face significant barriers in upgrading their systems, limiting their ability to adopt modern risk management practices and increasing their exposure to operational and liquidity challenges.

The combination of economic instability, political uncertainty, and sanctions has created a unique environment for Sudanese banks, where traditional risk management strategies may fall short. The findings highlight the need for comprehensive risk management reforms, including investments in technology, improvements to operational systems, and stronger regulatory oversight, to mitigate the adverse effects of these risks on financial performance.

5- Conclusion, policy implications, and future research

This study investigates the impact of credit, operational, and liquidity risks on the return on assets (ROA) of banks operating in Sudan. By understanding these key risk factors, Sudanese banks can better refine their strategies to boost financial performance. Using pooled EGLS (cross-section weight), we estimate the Fixed Effects Model with varying intercepts for individual banks. Our empirical results reveal that credit, operational, and liquidity risks significantly negatively affect the financial performance of Sudanese banks. Among these, operational risk exerts the greatest impact, followed by credit risk and liquidity risk. These

findings highlight the importance for Sudanese banks to improve their risk management practices, particularly by addressing operational inefficiencies and managing credit exposure. Strengthening financial infrastructure, modernizing operational systems, and optimizing liquidity management are essential steps for enhancing profitability and ensuring the long-term stability of the banking sector in Sudan.

To reduce credit risk, banks should implement advanced data analytics and credit scoring systems, improve loan monitoring tools to detect early signs of distress and diversify loan portfolios across different industries, regions, and borrower types. Minimizing operational risk requires investment in modern banking infrastructure, including core banking systems, robust cybersecurity measures, and automation. Additionally, banks should focus on employee training and capacity-building programs, while strengthening regulatory compliance with international banking standards to reduce fraud and operational errors. To effectively manage liquidity risk, banks need to maintain optimal liquidity ratios by balancing short- and long-term asset investments, diversifying funding sources, and enhancing forecasting and stress-testing capabilities to anticipate potential liquidity shortages.

The study emphasizes the need for a robust regulatory framework to address operational and liquidity risks in Sudan's banking sector. Policymakers, particularly the Central Bank of Sudan (CBOS), should enforce stricter regulations aligned with international standards like Basel III and ensure that banks adopt comprehensive risk management frameworks. Support from international financial institutions for training would further strengthen these efforts. Monitoring capital adequacy is essential to help banks withstand economic shocks. Policy initiatives to develop banking infrastructure, including access to modern technologies like mobile banking and fintech solutions, are critical for reducing operational risk, enhancing liquidity management, and promoting financial inclusion. Strengthening governance structures within banks is also vital for minimizing fraud and operational failures. The government should encourage the use of risk-sharing mechanisms, such as loan guarantees, to mitigate credit and liquidity risks, while improving anti-money laundering (AML) and know-your-customer (KYC) practices to enhance transparency and risk management.

Acknowledging the limitations of this study is crucial for a balanced interpretation of the findings. While focusing on Sudan as a single-country case study and examining firm-specific factors provides valuable insights, it may limit the broader applicability of the results. Future research should explore the influence of macroeconomic variables on bank performance, the role of government policies in risk mitigation, and the effectiveness of risk management tools. Comparative studies with other conflict-affected countries could also offer further valuable insights.

Declarations

The author declares that there are no conflicts of interest. During the preparation of this manuscript, the author used Scholar GPT to check grammar and enhance readability. All content was subsequently reviewed and edited by the authors, who take full responsibility for the final version of the publication.

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