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The Impact of Risk Management Strategies on the Financial Performance of Yemeni Banks under Economic Turbulence: Evidence from 2014–2024

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ABSTRACT

The prolonged economic turbulence in Yemen has posed significant challenges to the stability and resilience of its banking sector, highlighting the critical need for effective risk governance mechanisms. In this context, the study examines how liquidity, market, credit, and operational risks the core dimensions of risk management affect return on assets (ROA). A balanced panel dataset was constructed from the annual reports of ten banks covering the period 2014 to 2024, selected based on data availability. The analysis employs pooled OLS, fixed-effects, and random-effects estimations, followed by Feasible Generalized Least Squares (FGLS) to ensure robustness. Correlation results indicate positive associations between all risk dimensions and ROA, with operational risk management showing the strongest relationship, followed by market and liquidity risk management, while credit risk exhibits a weaker link. Regression findings consistently confirm that operational, market, and liquidity risk management significantly enhance profitability, with operational risk management exerting the largest effect. Credit risk management demonstrates a positive but statistically insignificant influence, suggesting a more gradual or delayed impact on financial performance. Collectively, these findings highlight that integrated and well-coordinated risk management practices are essential for sustaining profitability in economically fragile environments.

Keywords: Risk Management Financial Performance, Banks, Economic Turbulence

INTRODUCTION

Yemen has experienced profound political, social, and economic upheaval since 2014, when severe political unrest disrupted state institutions, weakened governance structures, and initiated a prolonged period of instability. Consequently, the country has faced sustained disruption of trade flows, constrained production capacity, and weakened institutional effectiveness. These disruptions, compounded by external restrictions on commerce and sustained economic fragmentation, have precipitated a severe collapse of the national economy. Among the most severely affected sectors is banking, which serves as a cornerstone for financial stability and

economic continuity yet has faced a unique confluence of challenges, including sharp depreciation of the national currency, a severe liquidity crisis, and widespread closures of private and public businesses (Ministry of Planning & International Cooperation, 2016). Given that banking sector failures can trigger systemic economic collapse Bushashe (2023), Yemeni banks were thus forced to fundamentally reassess their risk management strategies in an effort to sustain operational continuity and ensure resilience under extreme macroeconomic duress. Yemen's banking system has been severely strained by both domestic and external shocks. Domestically, prolonged political instability and security crises have undermined institutional capacity, while globally, declining oil prices and escalating geopolitical tensions across the Middle East have intensified these pressures. Consequently, the combined effects of these factors triggered severe volatility in the Yemeni Riyal, driven by dwindling foreign currency inflows and depleted reserves. Although the authorities sought to inject liquidity and obtain external financing, such measures were insufficient, thereby exacerbating monetary pressures, accelerating currency depreciation, and deepening overall financial instability (Ministry of Planning & International Cooperation, 2016).

Within this context, banks have been compelled to reassess and adapt their risk management strategies to preserve operational continuity and financial resilience. However, despite the critical role of banking systems in maintaining economic stability, particularly in fragile and conflict-affected environments, existing literature has predominantly examined individual risk dimensions, such as liquidity, credit, market, or operational risk, in isolation. Consequently, there remains limited empirical evidence on how integrated risk management frameworks function in fragile economies like Yemen, especially during prolonged periods of economic turbulence. Moreover, insufficient attention has been given to the extent to which variations in banks' financial performance influence their capacity to implement comprehensive and effective risk management strategies under extreme uncertainty. This gap constrains both academic understanding and policy-oriented guidance on sustaining banking resilience in highly unstable environments.

Against this backdrop, the present study investigates the relationship between economic uncertainty, risk management strategies, and financial performance in the Yemeni banking sector over the period 2014–2024. Specifically, it examines how Yemeni banks have adjusted their risk management approaches in response to sustained political and economic shocks, with particular emphasis on the contrast between conservative risk responses and the adoption of integrated risk management frameworks. The study further explores whether banks with stronger financial performance are more capable of deploying comprehensive risk management strategies during periods of severe economic disruption. This study makes several important contributions to the banking and risk management literature. From a theoretical perspective, it extends the risk–return trade-off theory by examining its applicability under conditions of prolonged political and economic instability, where conventional assumptions regarding risk–reward dynamics may not hold. In addition, the study refines financial intermediation theory by demonstrating how banks adapt their intermediation function through the adoption of integrated risk management frameworks in fragile and conflict-affected economies, thereby highlighting the role of coordinated risk responses in sustaining financial intermediation under extreme uncertainty. From an empirical standpoint, the study provides rare and timely evidence from Yemen's banking sector over an extended period of economic turmoil, a context that remains largely underexplored in the banking and finance literature. By jointly analyzing multiple risk dimensions within an integrated framework, the findings offer novel insights into banks' heterogeneous risk management responses under sustained macroeconomic stress. From a practical and policy perspective, the results provide valuable guidance for bank managers in designing adaptive risk management strategies that enhance resilience and operational continuity, as well as for policymakers and regulators seeking to strengthen financial stability and mitigate systemic risk in fragile economic environments. Overall, the study underscores the importance of holistic risk management as a long-term mechanism for mitigating vulnerabilities, enhancing institutional resilience, and sustaining banking performance under extreme macroeconomic conditions. In the following section, we describe the sample, data, methodology, and variables. Section 4 presents the empirical results and discussion. Finally, Section 5 concludes the study and highlights its theoretical, empirical, and practical implications.

LITERATURE REVIEW

Liquidity risk has emerged as a cornerstone of risk management strategies, reflecting the acute financial instability and constrained cash flows that characterize the banking sector. Scholars emphasize that modern financial management frameworks must prioritize adaptability, resilience, and agility during periods of economic

turbulence (Bushashe, 2023). Accordingly, banks increasingly depend on comprehensive risk management systems that emphasize maintaining liquidity to ensure operational continuity and mitigate systemic disruptions (Soleymani & Yip, 2020). Liquidity management plays a decisive role during crises, safeguarding cash flows and enabling institutions to withstand extended instability(Kurniawan et al., 2023). Common mechanisms such as sustaining cash reserves, optimizing credit management, and accessing short-term borrowing—are essential to preserve liquidity positions (Luty, 2014). Conversely, weak credit and collection practices can severely undermine liquidity, thereby heightening insolvency risks (Hahn et al., 2023; Herring, 2017). Moreover, restructuring strategies, including debt renegotiation and cost rationalization, enhance organizational stability while balancing cash holdings with trade credit to support ongoing investment activities (Campello et al., 2019; Restrepo et al., 2019). The COVID-19 pandemic further reinforced these insights, revealing that institutions with robust liquidity systems avoided distressed asset sales, preserved reserves, and stabilized cash flows amid market shocks(C.-L. Chang et al., 2020; Feng & Wu, 2023). Within the banking sector, liquidity continuity directly shapes investment management strategies by enabling timely adjustments to crises and protecting long-term profitability (Susanti et al., 2023). Importantly, liquidity defined as the capacity to meet deposit withdrawals and short-term obligations depends heavily on the availability of liquid assets such as government bonds and central bank reserves (Abbas et al., 2019). For instance, Distinguin et al. (2023) found that European banks adapted liquidity strategies differently across crises: during the Global Financial Crisis (2008), reductions in lending and equity repurchases prevailed, whereas during the Sovereign Debt Crisis (2010–2012), banks increased deposits and reduced market debt. Moreover, comparative studies reveal a persistent gap between theoretical frameworks and actual practices, as firms often engage in hedge timing rather than consistent liquidity strategies (Kim & Chance, 2018). Taken together, this body of literature underscores that liquidity maintenance is not merely a technical requirement but a strategic necessity for banking stability. Ultimately, financial sustainability depends on effective liquidity management within an integrated risk management framework that includes credit, market, and operational dimensions (Idris, 2024).

Market risk is a fundamental component of financial stability. The Basel Committee (BCBS, 1993) defines it as the potential loss arising from fluctuations in interest rates, exchange rates, and equity values, later extending the definition to include credit spreads and commodity prices (Fahmee Ab Hamid et al., 2017). In this context, resilient market risk management emphasizes diversification across asset classes, sectors, and geographies to distribute exposures and enhance operational flexibility (J & Majid, 2020). In Yemen, banks have strengthened internal controls and redirected credit toward essential sectors such as food, pharmaceuticals, renewable energy, and MSMEs—while reducing exposure to high-risk activities. These measures align risk management with strategic objectives and promote operational sustainability(Duchin et al., 2010; Tong & Wei, 2008). Similarly, evidence from the COVID-19 period shows that resilience to market risk depends on diversification, effective mitigation strategies, and coordinated policy responses, as concentrated portfolios proved highly vulnerable to volatility and liquidity pressures(Acharya et al., 2017; Petighin, 2024; Chang et al., 2020; Feng & Wu, 2023). Therefore, robust diversification remains a cornerstone of market risk management, reducing exposure to systemic shocks and supporting long-term financial stability and growth(J & Majid, 2020). In particular, diversification across sectors, maturities, and credit quality combined with sound duration management enables investors to optimize risk-adjusted returns and mitigate market volatility (Bhuiyan et al., 2020; Tan & Mohamad Shafi, 2021). Collectively, the literature affirms that diversification reduces both idiosyncratic and systemic risks while fostering economies of scope(Berger et al., 2010; Meslier et al., 2014). Nonetheless, excessive diversification without adequate oversight can dilute managerial focus, introduce inefficiencies, and increase earnings volatility(Bliss & Rosen, 2005; Milbourn et al., 1999). Accordingly, effective market risk management requires a careful balance between diversification, liquidity buffers, and contingency planning to enhance resilience against both firm-specific and systemic shocks(Berger et al., 2010; Deyoung & Roland, 2001; Meslier et al., 2014).

Credit risk, the potential loss from borrowers' default, remains a central concern for banks, as high exposure can erode liquidity, profitability, and financial stability. Consequently, sound credit risk management is essential to ensuring operational stability and safeguarding bank performance (V. Chang et al., 2024). In the case of Yemeni banks, economic contraction, currency depreciation, and liquidity shortages have increased default risks and financial vulnerability, necessitating robust credit risk management through rigorous credit assessment, diversified portfolios, and ongoing monitoring of borrowers' financial health (Courage Oko-Odion & Omogbeme Angela, 2025). Within this framework, non-performing loans (NPLs) represent a critical manifestation of credit risk and play a decisive role in shaping overall credit exposure. NPLs not only increase systemic vulnerability but also underscore the necessity of maintaining strong asset quality standards(Sharma & Jain, 2025). Empirical studies

demonstrate that high NPL ratios erode financial health, undermine depositor and investor confidence, and, in extreme cases, trigger bank runs(Chaffai & Dietsch, 2015; Jafari, 2015). Specifically, NPL accumulation reduces profitability by increasing provisioning requirements and constraining liquidity(Joseph et al., 2012; MASSIMO Associate Professor et al., 2016). Moreover, factors such as cost per loan asset and default rates are key predictors of bank performance, reaffirming the centrality of credit risk management in determining financial outcomes (Boahene et al., 2012). Evidence from emerging markets reinforces these findings. For instance, research from Kenya highlights the importance of sophisticated risk assessment frameworks, stress testing, and governance mechanisms in identifying and mitigating default risk (Kimani & Kibera, 2023). Consequently, credit portfolio management has become a cornerstone of financial stability, particularly in systems characterized by high exposure to credit volatility (Kiseľáková & Kiseľák, 2013). Historically, inadequate credit risk management has been a significant contributor to banking crises, as evidenced in the early 2000s (Stanciu et al., 2009). The global financial crisis further exposed the limitations of conventional credit parameters in navigating complex and interconnected financial systems. Accordingly, robust credit risk management has emerged as a decisive factor for ensuring long-term sustainability, profitability, and systemic resilience (Musyoki, D., & Kadubo, 2012).

Overall, Effective credit risk management (CRM) is vital for bank resilience and financial stability. By mitigating exposure and safeguarding profitability, CRM enhances stakeholder confidence and serves as a strategic necessity for sustaining financial continuity in volatile economies such as Yemen (Amoa-Gyarteng et al., 2025).

Operational risk has emerged as a critical dimension of financial stability, reflecting its complexity, pervasiveness, and potential impact on banking performance. Early research by Wiseman and Catanach (1997) highlighted how regulatory reforms influence the classification and understanding of operational risks, while Power (2005) emphasized the institutionalization of OR, balancing quantitative modeling with governance-based approaches. Collectively, these studies underscore the trend to formalize operational risk management (ORM) as a central pillar of banking resilience. Large operational losses directly affect capital adequacy, emphasizing the need for precise risk measurement and robust capital buffers(de Fontnouvelle et al., 2011). Moreover, operational risk levels fluctuate with macroeconomic cycles, as observed by Bali et al., linking ORM to broader economic conditions. Governance and internal controls further shape risk exposure: disclosure regulations facilitate market assessment of OR(Brown et al., 2008), while internal control failures are the leading cause of losses, particularly in younger or complex institutions (Chernobai et al., 2011). Board composition and executive oversight have also been shown to mitigate operational failures (Wang & Hsu, 2013). Operational risk differs from credit and market risks in its ubiquity and resistance to simple quantification. It originates from process failures, human error, system disruptions, or external events, each capable of cascading through an institution(Barakat & Hussainey, 2013). Therefore, effective ORM requires integrating strategic planning, regulatory compliance, and advanced analytics. Adaptive frameworks, aligned with Basel standards, enable banks to anticipate losses from fraud, process deficiencies, and technological breakdowns(Arora & Agarwal, 2011; Nyström & Skoglund, 2002). Moreover, incorporating environmental, social, and governance (ESG) dimensions strengthens ORM by promoting sustainability and ethical responsibility. Operational failures can result in financial and reputational losses, as seen in the LIBOR scandal and the 2008 global financial crisis. In Islamic banking, OR extends to Sharia noncompliance and fiduciary breaches, posing reputational and liquidity risks. Similarly, in fragile economies like Yemen, prolonged instability magnifies operational vulnerabilities through disrupted payment systems, talent shortages, and limited technological infrastructure. In this context, operational risk management is not merely a regulatory requirement but a strategic necessity. Effective ORM combining governance, analytics, ESG integration, and moral hazard mitigation—enhances resilience, complements credit and market risk management, and sustains long-term performance under persistent uncertainty.

Collectively, the literature highlights that banking risk management plays a dual role both as a response to economic turbulence and as a strategic mechanism for resilience during crises. Therefore, understanding how prolonged economic turbulence shapes risk management decisions remains essential for sustaining financial stability, maintaining operational continuity, and ensuring the long-term viability of banks. Building on the existing literature, this study formulates two testable hypotheses. Prior research suggests that banks operating under prolonged economic and political instability tend to exhibit heterogeneous risk management responses. While some institutions adopt conservative risk management approaches in reaction to elevated uncertainty and heightened exposure, others strategically implement integrated risk management frameworks to preserve stability and maintain competitiveness. Accordingly, this study proposes the following hypothesis:

H1: Banks exhibit heterogeneous risk management responses to prolonged instability, reflected in the adoption of conservative versus integrated risk management approaches. Furthermore, previous studies indicate that financial performance plays a critical role in shaping banks' capacity to implement and sustain comprehensive risk management practices, particularly during periods of severe economic turbulence. Banks with stronger financial performance are generally better positioned to absorb shocks, invest in risk management systems, and maintain organizational resilience. Based on this theoretical and empirical foundation, the study advances the following hypothesis:

H2: Stronger financial performance enhances banks' ability to effectively adopt and sustain holistic risk management practices under turbulent conditions.

DATA AND METHODOLOGY

Data

This study examines the impact of risk management strategies on the financial performance of Yemeni banks under economic turbulence. The analysis focuses on a sample of 10 Yemeni banks, selected based on the availability and completeness of financial data, annual financial data covering the period 2014–2024. The primary dependent variable in this study is Financial Performance, measured by profitability indicators. The main independent variable is risk management strategies, reflecting the mechanisms through which banks identify, assess, and mitigate financial risks. The study incorporates four explanatory variables: liquidity risk, market risk, credit risk, and operational risk. These factors collectively represent the core dimensions of banks' risk exposure and management efficiency. A comprehensive summary of all variables and measurement details is provided in **Table 1**.

Table 1. Description of variables

Variable type	variable name	definitions
Dependent variables	Financial Performance	Bank performance is commonly measured using profitability indicators such as the Return on Assets (ROA) .
independent variable	Risk Management Strategies	reflecting the mechanisms through which banks identify, assess, and mitigate financial risks
explanatory variables	Liquidity Risk	Liquid Assets to Total Assets Ratio
	Market Risk	Risk Diversification Strategies (Financial Investments)
	Credit Risk	Non-Performing Loans Ratio
	Operational risks	Basic Indicator Approach – BIA

Note: This table lists and provides a brief description of the variables examined in this paper.

Methodology

The study employed descriptive statistics and panel regression modeling in EVIEWS to investigate the impact of risk management strategies on the financial performance of Yemeni banks under economic turbulence. Descriptive statistics summarized key measures of central tendency, dispersion, skewness, and kurtosis for the main financial and risk indicators, revealing deviations from normality and data asymmetries that may influence model specification. Correlation analysis was conducted to examine interdependencies among the variables and detect possible multicollinearity, ensuring that each risk dimension captured distinct aspects of financial performance. Subsequently, checks using alternative panel estimation techniques pooled OLS, fixed effects, and random effects. Finally, the Feasible Generalized Least Squares (FGLS) estimator was applied to correct for potential heteroscedasticity and cross-sectional dependence.

Econometric Model

The empirical model of this study is developed to examine how different risk management strategies influence the financial performance of Yemeni banks within an environment characterized by prolonged economic

uncertainty. In particular, the model aims to capture the extent to which key categories of financial risk, market risk, credit risk, liquidity risk, and operational risk affect profitability, as measured by the Return on Assets (ROA). Grounded in the principles of risk–return trade-off and financial intermediation theory, banks are expected to manage various forms of risk efficiently to maintain stability and sustain profitability. However, in economies exposed to persistent shocks and structural challenges, such as Yemen, the effectiveness of these risk management strategies may vary significantly across banks depending on their structural characteristics and governance frameworks.

Accordingly, the following econometric specification is formulated to empirically test the hypothesized relationships:

$$ROA_{it}=\beta 0+ \beta 1LR_{it}+ \beta 2MR_{it}+\beta 3CR_{it}+ \beta 4OR_{it}+ +\gamma' Xit+\alpha i+\varepsilon it \quad (1)$$

Where:

- ROA = Return on Assets (dependent variable)
- LR = Liquidity Risk
- MR = Market Risk
- CR = Credit Risk
- OR = Operational Risk
- X_{it}= vector of control
- α_i= bank-specific effect (fixed or random)
- ε_{it}= idiosyncratic error

RESULTS AND DISCUSSION

Descriptive and Exploratory Statistical Analysis

Descriptive statistics

Table 2 presents the descriptive statistics for five core banking variables. ROA shows a mean of 0.006 and a median of 0.005, ranging from –0.010 to 0.030 with a low standard deviation of 0.008. This pattern indicates that Yemeni banks generally achieve modest yet stable profitability. The distribution is slightly right-skewed (Skewness = 0.592) with near-normal kurtosis (2.922). However, the Jarque–Bera statistic (6.453, p = 0.040) reveals a mild departure from normality, suggesting some asymmetry in performance outcomes. Liquidity Risk has a mean of 0.668 and a median of 0.675, spanning 0.120–0.950 with moderate dispersion (SD = 0.192). The negative skewness (–0.725) implies that most banks maintain higher liquidity positions, while the kurtosis (3.118) remains close to normal. Nevertheless, the Jarque–Bera test (9.693, p = 0.008) indicates a statistically significant deviation from normality. Market Risk displays a relatively high mean of 0.782 and a median of 0.990 within a range of 0.140–1.000, with a standard deviation of 0.294, signifying moderate to high variability. The negative skew (–0.945) suggests that most banks face elevated market risk, whereas a few maintain lower exposure. Likewise, the kurtosis value (2.323) points to a slightly platykurtic shape, and the Jarque–Bera result (18.486, p = 0.000) confirms significant non-normality. Credit Risk records a mean of 0.108 and a median of 0.100, with a narrow range (0.000–0.280) and a small standard deviation (0.048), indicating limited variation across banks. The positive skew (1.001) and high kurtosis (4.901) show that while most banks maintain low credit risk, a few experience notably higher exposure. Furthermore, the Jarque–Bera statistic (34.939, p = 0.000) provides strong evidence against normality, highlighting disparities in credit portfolio quality. Operational Risk remains generally low, with a mean of 0.008 and a median of 0.007 within a narrow range (0.003–0.020) and low variability (SD = 0.004), reflecting high operational stability. However, the marked positive skew (1.770) and pronounced kurtosis (5.979) indicate the presence of extreme values. Similarly, the Jarque–Bera test (98.069, p = 0.000) confirms a heavily right-skewed distribution, suggesting that operational disruptions, while rare, can be severe.

Table 2. Summary statistics

Variables	Obs	Mean	Median	Max	Min	Std.Dev.	Skewness	Kurtosis	Jarque-Bera	P
Return on Assets	110	0.006	0.005	0.030	-0.010	0.008	0.592	2.922	6.453	0.040
Liquidity Risk	110	0.668	0.675	0.950	0.120	0.192	-0.725	3.118	9.693	0.008
Market Risk	110	0.782	0.990	1.000	0.140	0.294	-0.945	2.323	18.486	0.000
Credit Risk	110	0.108	0.100	0.280	0.000	0.048	1.001	4.901	34.939	0.000
Operational risks	110	0.008	0.007	0.020	0.003	0.004	1.770	5.979	98.069	0.000

Notes: Descriptive statistics are based on 110 panel observations for Yemeni banks (2014–2024). ROA denotes Return on Assets, and it measures profitability, while Liquidity Risk, Market Risk, Credit Risk, and Operational Risk represent key dimensions of risk management. Skewness and Kurtosis describe the shape of the variable distribution, while the Jarque–Bera (JB) statistic tests the null hypothesis of normality. A p-value below 0.05 indicates a statistically significant deviation from the normal distribution.

Correlation matrix of original Variables

Table 3 presents the correlation matrix illustrating the relationships between bank profitability, measured by Return on Assets (ROA), and the main dimensions of risk management, namely liquidity, market, credit, and operational risk management. The results show that all risk management indicators are positively correlated with ROA, indicating that stronger risk management practices contribute to improved financial performance. Among these, operational risk management exhibits the highest correlation with ROA (0.4982), suggesting that effective internal processes, technological efficiency, and control mechanisms play a crucial role in enhancing profitability. Market risk management also shows a relatively strong positive association with ROA (0.4707), implying that prudent handling of market exposures and investment diversification enhances returns while maintaining stability. Liquidity risk management has a moderate positive relationship with ROA (0.4398), reflecting that maintaining adequate liquidity and sound funding strategies supports profitability by reducing funding pressures and ensuring smooth operations. In contrast, credit risk management displays a weak positive correlation (0.1528), which suggests that improvements in credit risk control have a more gradual or indirect impact on profitability, possibly due to differences in loan portfolio structures or the delayed effect of credit quality on financial results. Regarding the interrelationships among the risk management variables, the results indicate generally weak to moderate positive correlations, suggesting that the different risk management dimensions complement each other but remain relatively independent. The positive relationship between liquidity and market risk management (0.2871) reflects that banks with disciplined market positions often maintain effective liquidity policies. Similarly, a modest association is observed between liquidity and credit risk management (0.1757), indicating that prudent credit practices can support better liquidity positions. The nearly zero correlation between liquidity and operational risk (−0.0430) implies that liquidity management operates independently from operational processes. The moderate positive correlation between market and operational risk management (0.3535) highlights that banks engaged in extensive market activities typically require stronger operational controls. Meanwhile, the weak positive relationships between credit risk management and both market risk (0.0540) and operational risk (0.1570) suggest limited interaction between these risk areas. Overall, the absence of strong correlations among the independent variables indicates low multicollinearity, reinforcing the reliability of the subsequent regression analysis. These findings emphasize that Yemeni banks with more effective, integrated, and balanced risk management frameworks tend to achieve higher financial performance even under challenging economic conditions.

Table 3. Correlation matrix of original Variables

	Return on Assets	Liquidity Risk	Market Risk	Credit Risk	Operational Risk
Return on Assets	1.0000				
Liquidity Risk	0.4398	1.0000			
Market Risk	0.4707	0.2871	1.0000		
Credit Risk	0.1528	0.1757	0.0540	1.0000	
Operational Risk	0.4982	-0.0430	0.3535	0.1570	1.0000

Notes: This table presents the pairwise Pearson correlation coefficients among the study variables. All coefficients measure the linear association between variables, with values closer to ±1 indicating stronger relationships

Panel Regression Estimates for ROA with Robustness Indicators

Table 4 presents the regression results examining the relationship between banks' financial performance, measured by Return on Assets (ROA), and four dimensions of risk management: liquidity, market, credit, and operational risk management. The findings consistently reveal positive relationships between ROA and all risk management variables, indicating that effective risk management practices enhance profitability. Among these, operational risk management exhibits the largest and most significant effect across all estimation models, suggesting that improvements in internal controls, technological efficiency, and compliance systems play a vital role in strengthening bank performance. This outcome concurs with the findings of (Wiseman & Catanach, 1997; Powe, 2005).

Table 4. Regression Coefficients

Variable	Pooled	Fixed	Random
Liquidity Risk (LR)	0.014*** (0.003)	0.020** (0.022)	0.014*** (0.003)
Market Risk (MR)	0.074** (0.052)	0.118*** (0.019)	0.074** (0.035)
Credit Risk (CR)	0.065 (0.018)	0.079 (0.020)	0.065(0.018)
Operational Risk (OR)	0.874*** (0.196)	0.790*** (0.142)	0.874*** (0.254)
Intercept	1.552 (1.511)	1.309** (0.444)	1.552* (0.912)

Note: Coefficients from pooled, fixed, and random effects regressions; standard errors in parentheses; significance: ***p<0.01, **p<0.05, p<0.1.

Market risk management also shows a significant positive impact, implying that prudent handling of market exposures and diversification strategies contributes to stable and enhanced returns. Liquidity risk management demonstrates a smaller but statistically significant positive relationship with ROA, which highlights the importance of maintaining sound liquidity positions to reduce funding pressures and support lending operations. This outcome concurs with the findings of (J & Majid, 2020; Berger et al., 2010). In contrast, credit risk management shows a positive but statistically insignificant effect, indicating that enhancements in credit control practices may influence profitability more gradually, possibly due to the delayed recognition of credit losses or differences in provisioning policies among banks. This outcome concurs with the findings of (Boahene et al., 2012; Musyoki, D., & Kadubo, 2012). The variation in coefficients across the pooled, fixed, and random effects models provides additional insights. The slightly higher coefficients for market and liquidity risk management in the fixed-effects model suggest that improvements within banks over time have a stronger influence on profitability than cross-bank differences. Meanwhile, the consistency of results between the pooled and random models indicates that both within- and between-bank variations play a role in determining financial performance. Overall, these results emphasize that operational, market, and liquidity risk management are key drivers of profitability in Yemeni banks, whereas the influence of credit risk management appears less direct or time-lagged. The generally positive and significant relationships among the risk management variables confirm that stronger, integrated, and well-coordinated risk management frameworks contribute to improved financial stability and higher returns, even amid prolonged economic challenges.

Table 5 summarizes the model fit statistics and diagnostic tests for the pooled OLS, fixed-effects, and random-effects estimations examining the relationship between risk management factors and bank financial performance, as measured by Return on Assets (ROA). The R-squared values of 0.613, 0.702, and 0.614 for the pooled, fixed, and random models, respectively, indicate that the independent variables collectively account for 61–70% of the variation in ROA. These results highlight the substantial explanatory power of integrated risk management practices, which aligns with previous studies emphasizing the strategic role of risk frameworks in enhancing bank performance (Idris, 2024; Bushashe, 2023). Across all models, the F-statistics are significant at the 1% level ($p < 0.01$), confirming the joint significance of liquidity, market, credit, and operational risks in explaining bank profitability. This finding corroborates earlier research suggesting that coordinated management of liquidity, market, credit, and operational risks is essential for sustaining financial performance, particularly under turbulent conditions (Soleymani & Yip, 2020; Acharya et al., 2017). Durbin–Watson statistics range from 1.061 to 1.367, indicating no serious concerns regarding serial correlation. The Jarque–Bera test suggests that residuals in the pooled and fixed-effects models approximate normality ($p > 0.05$), whereas the random-effects model exhibits slight deviations ($p < 0.01$), a common occurrence in large panel datasets. The Wald test detects heteroskedasticity

in the pooled and fixed-effects models ($p < 0.01$), while the Pesaran cross-sectional dependence (CD) test confirms no significant cross-sectional dependence among banks ($p > 0.05$).

Table 5. Model Fit and Diagnostics / Robustness Checks

Statistic	Pooled	Fixed	Random
R-squared	0.613	0.702	0.614
F-statistic	22.103	11.930	17.657
Prob(F)	0.000	0.000	0.000
Durbin–Watson	1.061	1.367	1.156
Normality (JB)	3.634 (p=0.163)	0.190 (p=0.909)	6.935 (p=0.000)
Heteroskedasticity (Wald)	222.237 (p=0.000)	239.919 (p=0.000)	–
Pesaran CD	1.367 (p=0.172)	0.351 (p=0.725)	0.872 (p=0.383)

Note: Values in parentheses indicate p-values. R^2 represents the proportion of variance in ROA explained by the independent variables. F-statistic and Prob(F) denote joint significance. Durbin–Watson tests for autocorrelation, JB for normality of residuals, Wald for heteroskedasticity, and Pesaran CD for cross-sectional dependence. Robust standard errors were applied to ensure consistent and unbiased estimates.

Interpretation of the Cross-Sectional Time-Series FGLS Regression Results for ROA

Table 6 presents the results of the cross-sectional time-series Feasible Generalized Least Squares (FGLS) regression, examining the relationship between risk management dimensions and the financial performance of Yemeni banks, measured by Return on Assets (ROA). The overall model is highly significant (Wald $\chi^2(4) = 432.16$, $p < 0.001$), indicating that liquidity, market, credit, and operational risk management collectively explain a substantial portion of the variation in bank profitability.

Table 6. Cross-Sectional Time-Series FGLS Regression

Cross-sectional time-series FGLS regression						
Coefficients: generalized least squares						
Panels: heteroskedastic with cross-sectional correlation						
Correlation: no autocorrelation						
Number of obs = 110 , Number of groups = 10 , Time periods =11						
Wald chi2(4) = 432.16						
Prob > chi2 = 0.0000						
Return on Assets	**Coefficient**	**Std.err.**	**z**	**P>|z|**	**[95%conf. interval]**	
Liquidity Risk	0.0149	0.001	10.330	0.000	0.012	0.018
Market Risk	0.0047	0.001	4.590	0.000	0.003	0.007
Credit Risk	0.0022	0.002	1.020	0.310	-0.002	0.006
Operational Risk	0.8397	0.051	16.350	0.000	0.739	0.940
_cons	-0.0146	0.001	-10.320	0.000	-0.017	-0.012
Model Coefficients: ROA = 0.0149*LR + 0.0047*MR + 0.0022*CR + 0.8397*OR -0.0146						

Note: This model was estimated using the Feasible Generalized Least Squares (FGLS) approach for cross-sectional time-series data. The estimation accounts for heteroskedasticity and cross-sectional correlation across panels while assuming no autocorrelation within individual banks.

The coefficient for liquidity risk management (0.0149, $z = 10.33$, $p < 0.001$; 95% CI [0.012, 0.018]) is positive and highly significant, confirming that stronger liquidity practices such as maintaining cash reserves, optimizing credit management, and accessing short-term borrowing enhance profitability. This finding is consistent with prior studies that emphasize liquidity as a cornerstone of financial stability, particularly in volatile contexts (Kurniawan et al., 2023; Luty, 2014). (Evidence from crises, including the COVID-19 pandemic, demonstrates that banks with robust liquidity systems avoid distressed asset sales, preserve reserves, and maintain operational continuity,

thereby protecting long-term profitability(C.-L. Chang et al., 2020; Feng & Wu, 2023; Susanti et al., 2023).

Market risk management has a smaller but significant positive effect (0.0047, z = 4.59, p < 0.001; 95% CI [0.003, 0.007]), suggesting that prudent management of market exposures and diversification strategies moderately improves bank returns. These results align with literature emphasizing the importance of diversification across asset classes, sectors, and geographies to reduce exposure to systemic shocks and support financial stability (Bhuiyan et al., 2020; Tan & Mohamad Shafi, 2021). Evidence from both developed and emerging markets indicates that well-diversified market strategies enhance resilience to interest rate, exchange rate, and equity fluctuations, thereby stabilizing profitability (Berger et al., 2010; Meslier et al., 2014; Petighin, 2024).

Operational risk management dominates the model, with a coefficient of 0.8397 (z = 16.35, p < 0.001; 95% CI [0.739, 0.940]), indicating that improvements in internal controls, processing efficiency, IT systems, and compliance substantially increase ROA. This strong effect reflects the critical role of operational risk management (ORM) in safeguarding bank performance, as highlighted in previous studies (de Fontnouvelle et al., 2011; Arora & Agarwal, 2011). Effective ORM reduces operational losses, strengthens capital adequacy, and ensures resilience against process failures, human error, system disruptions, and external shocks (Wang & Hsu, 2013; Barakat & Hussainey, 2013).

Credit risk management shows a small positive but statistically insignificant effect (0.0022, z = 1.02, p = 0.310; 95% CI [−0.002, 0.006]), suggesting that immediate variations in credit-risk controls have a limited detectable impact on ROA. This may reflect lagged recognition of loan losses, divergent provisioning policies, or constrained within-bank variation during the study period. Previous research similarly highlights that the influence of credit risk on profitability is often gradual and mediated by factors such as non-performing loans (NPLs), provisioning requirements, and asset quality (Sharma & Jain, 2025; Amoa-Gyarteng et al., 2025). The Wald χ^2 statistic confirms that all risk management variables jointly influence financial performance, and the FGLS methodology appropriately addresses heteroskedasticity and cross-sectional correlation, increasing confidence in the results. Consistent with prior studies, these findings demonstrate that holistic, integrated risk management, particularly operational and liquidity risk management, is crucial for sustaining profitability and resilience in banks operating under volatile and fragile economic conditions (Bushashe, 2023; Idris, 2024). While credit risk management shows a weaker contemporaneous effect, its strategic importance remains, as it safeguards long-term asset quality and supports financial stability in the medium to long term (Sharma & Jain, 2025; Amoa-Gyarteng et al., 2025; V. Chang et al., 2024).

CONCLUSION

This study examined the impact of risk management strategies on the financial performance of Yemeni banks over the period 2014–2024, using panel data models including pooled OLS, fixed-effects, random-effects, and Feasible Generalized Least Squares (FGLS) estimations. The results consistently demonstrate that effective risk management significantly enhances bank profitability, as measured by Return on Assets (ROA). Among the risk dimensions, operational risk management exerts the most substantial and statistically significant influence, highlighting the critical role of robust internal controls, technological efficiency, and compliance systems. Market and liquidity risk management also positively and significantly affect profitability, emphasizing the importance of prudent market exposure management and sound liquidity strategies. By contrast, credit risk management shows a positive but statistically insignificant effect, suggesting that its impact may be indirect or time-lagged due to differences in provisioning policies, loan portfolio structures, or delayed recognition of losses. The findings provide robust support for the study's hypotheses. Banks demonstrate heterogeneous responses to prolonged instability, adopting distinct strategies ranging from conservative to integrated approaches depending on their internal capacities and external pressures. Furthermore, stronger financial performance enhances banks' ability to implement and sustain holistic risk management practices, reinforcing resilience and operational continuity during periods of turbulence. The results underscore that integrated and well-coordinated risk management frameworks encompassing operational, market, liquidity, and credit dimensions are essential for mitigating financial shocks, improving efficiency, and sustaining profitability in fragile and volatile economic environments such as Yemen's banking sector.

This study has several important contributions, yet it is not without limitations. First, the analysis is based on a relatively small sample of ten banks, which may constrain the generalizability of the findings. Second, the study

focuses solely on the Yemeni banking sector, and thus the results may not fully capture variations in risk management practices across other fragile or conflict-affected economies. Finally, although care was taken in model specification, the potential for endogeneity between risk management practices and financial performance cannot be completely ruled out. Future research could address these limitations by conducting comparative studies across multiple fragile economies, incorporating additional macroeconomic control variables, applying dynamic panel data techniques to better capture time-dependent effects, and exploring alternative operationalizations of risk dimensions, including more granular or firm-level risk indicators. By acknowledging these limitations and identifying avenues for further investigation, the study provides a foundation for future research aimed at enhancing our understanding of risk management in fragile and conflict-affected banking environments.

DECLARATIONS

Ethic approval Not applicable. Consent to participate Not applicable. Consent for publication Not applicable. Competing interests The authors declare no competing interests.

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