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Balancing Liquidity and Profitability: An Empirical Analysis of Saudi Commercial Banks (2020–2024)

Amina Hamdouni[1]

Abstract

This study investigates the impact of liquidity risk on the financial performance of 10 Saudi banks over the period 2020 to 2024 using dynamic Generalized Method of Moments (GMM) models. Liquidity risk is primarily measured by the Loan-to-Deposit Ratio (LDR), while additional liquidity indicators include Liquid Assets to Total Assets (LATA) and Cash and Cash Equivalents (CCE). Firm performance is assessed through Return on Assets (ROA), Return on Equity (ROE), and Tobin's Q, capturing both accounting profitability and market valuation. The results indicate that higher LDR significantly diminishes bank profitability and market value. In contrast, greater liquid assets relative to total assets (LATA) positively affect performance across all measures. Cash and cash equivalents (CCE) do not show a significant impact. Model diagnostics confirm the validity of instruments and the absence of second-order autocorrelation, supporting the robustness of the findings. These insights emphasize the critical importance of liquidity management for banking performance in Saudi Arabia, offering valuable guidance for regulators and bank managers.

Keywords: *Return on Assets (ROA), Return on Equity (ROE), Tobin's Q (TBQ), Loan-to-Deposit Ratio, Liquid Assets to Total Assets, Cash and Cash Equivalents, Dynamic Generalized Method of Moments.*

Introduction

Liquidity risk is a critical challenge faced by commercial banks, particularly during periods of financial uncertainty and economic disruption. It arises when a bank is unable to meet its short-term obligations due to insufficient liquid assets, thereby threatening both operational continuity and stakeholder confidence. Effective liquidity management is essential not only for preserving bank solvency but also for maintaining profitability and ensuring broader financial system stability.

The period 2020–2024 has been marked by significant economic and financial shocks, most notably the global COVID-19 pandemic, which tested the resilience of banking systems worldwide. In Saudi Arabia, this period also coincided with volatile oil prices, heightened geopolitical tensions, and major structural reforms introduced under Vision 2030. These conditions placed considerable strain on the liquidity positions of Saudi banks and highlighted the need for strong and adaptive risk management frameworks.

In response, Saudi banks adopted more conservative liquidity strategies, shaped by both internal policy adjustments and external regulatory pressures—particularly those stemming from the Basel III liquidity standards and the Saudi Central Bank (SAMA). While these measures have strengthened liquidity buffers, they may have introduced a trade-off by limiting banks' ability

[1] Imam Mohammad Ibn Saud Islamic University (IMSIU), Email: amhomoduai@imamu.edu.sa, Department of Finance, College of Business, Imam Mohammad Ibn Saud Islamic University (IMSIU), Riyadh, Saudi Arabia, (Correspomding Author)

to engage in higher-yield investments, potentially affecting profitability. This tension between maintaining adequate liquidity and maximizing performance lies at the heart of this research.

Prior studies have produced mixed findings on the relationship between liquidity risk and bank performance. For example, Bourke (1989) and Molyneux and Thornton (1992) found a positive relationship between liquidity and profitability, suggesting that more liquid banks are better positioned to absorb shocks and seize investment opportunities. Conversely, other studies, such as those by Kosmidou et al. (2008) and Vodová (2011), report a negative association, arguing that holding excessive liquid assets can reduce profitability due to lower returns compared to illiquid but higher-yielding investments. In the context of emerging markets, including the GCC region, Almazari (2014) observed that liquidity ratios significantly influenced bank performance in Saudi Arabia, though the direction and magnitude varied depending on the indicator used.

Despite this growing body of literature, there is a notable lack of empirical research focused specifically on Saudi-listed commercial banks during the post-pandemic recovery period. Given the Kingdom's rapid digital transformation, financial innovation, and evolving regulatory environment, there is a pressing need for updated, context-specific analyses.

This study aims to fill that gap by investigating the impact of liquidity risk on the financial performance of commercial banks listed on the Saudi Stock Exchange over the period 2020–2024. The analysis employs key financial indicators—Return on Assets (ROA), Return on Equity (ROE), and Tobin's Q—to capture both accounting-based and market-based dimensions of performance. Using panel data techniques, particularly the dynamic Generalized Method of Moments (GMM), the study assesses both short-term effects and long-run dynamics.

This paper is structured as follows: Section 2 reviews the relevant literature and formulates the research hypotheses. Section 3 describes the methodology and data employed in the empirical analysis. Section 4 presents and interprets the results. Section 5 concludes with key findings and provides policy recommendations. The insights derived from this study are expected to assist banking executives, financial analysts, and policymakers in balancing liquidity risk management with profitability goals in the context of Saudi Arabia's transforming financial sector.

Literature Review

Liquidity risk remains a critical area of concern for banking institutions, especially in the wake of economic disruptions caused by the COVID-19 pandemic, fluctuating oil prices, and global financial volatility. This section explores the theoretical foundations and empirical studies—both classical and recent—that address the relationship between liquidity risk and bank profitability, with a focus on Saudi commercial banks.

Theoretical Framework

The Liquidity-Profitability Trade-off Theory explains that holding more liquid assets enhances a bank's ability to meet short-term obligations but typically results in reduced profitability due to lower returns on these assets. Conversely, holding fewer liquid assets may increase profitability but heightens the risk of insolvency. Diamond and Dybvig (1983) proposed that banks face inherent liquidity risks due to the mismatch between short-term deposits and long-term lending.

This trade-off has influenced regulatory frameworks globally, including the Basel III liquidity coverage ratio (LCR) and net stable funding ratio (NSFR), which aim to enhance liquidity resilience without severely hampering profitability.

Global Empirical Evidence

Early research by Bourke (1989) and Molyneux and Thornton (1992) found a negative correlation between liquidity and profitability. These findings were reaffirmed by Kosmidou et al. (2008), especially during times of crisis.

More recent international studies present mixed results. Abdulazeez et al. (2021), in a study of Nigerian banks, found that liquidity risk significantly reduced profitability as measured by ROA. In contrast, Chen et al. (2022) found a non-linear relationship between liquidity and performance in Asian banks, where moderate liquidity levels enhanced performance, but excessive liquidity reduced efficiency. Eltweri et al. (2024) examined major commercial banks in the UK and found that liquidity risk had a statistically significant negative effect on financial performance, emphasizing the cost implications of maintaining large liquidity buffers. Similarly, Al-Nimer et al. (2024) investigated Jordanian banks and confirmed that liquidity risk plays a mediating role in the relationship between capital structure and financial performance, highlighting the complexity of liquidity's influence within broader financial strategies. On a broader theoretical level, Rauch et al. (2010) highlighted the institutional and structural determinants of bank liquidity creation, emphasizing how bank size, capital structure, and regulation influence liquidity supply and indirectly affect performance.

Recent Evidence from Saudi Arabia and the GCC

In addition to global and regional insights, several studies have specifically explored liquidity risk and bank performance in the Middle East and Gulf Cooperation Council (GCC) contexts. The GCC region—and Saudi Arabia in particular—has witnessed significant financial reforms under Vision 2030, making recent evidence particularly valuable.

Al-Homaidi et al. (2021) analyzed commercial banks in the GCC and found that liquidity risk, measured through loan-to-deposit ratios and liquid assets to total assets, had a statistically significant negative impact on ROA and ROE. Saudi banks were specifically noted for their conservative liquidity management practices. Khamis and Al Shammari (2022) examined Saudi banks during the COVID-19 pandemic and found that while short-term liquidity buffers were increased, this negatively impacted profitability in the short run. However, they highlighted that this effect diminished post-2021 as economic activity resumed. Alshehri and Abuzayed (2023) used panel data for 11 Saudi-listed banks from 2015 to 2022 and employed a dynamic GMM approach. Their findings indicated that lagged liquidity risk had a significant negative impact on profitability, suggesting delayed effects of liquidity decisions. They also noted that regulatory compliance (Basel III) moderated this relationship. Almughaiseeb (2024) extended the analysis to consider environmental factors and geopolitical risks. The study concluded that during periods of oil price volatility, Saudi banks tend to over-accumulate liquidity, resulting in a dampening effect on profitability metrics such as ROE. Alabdullah et al. (2019) examined Saudi banks and found that liquidity risk had a statistically significant and negative effect on financial performance, underscoring the importance of effective liquidity management in sustaining profitability. Similarly, Al-Khouri (2012) analyzed the UAE banking sector and concluded that both bank-specific characteristics and macroeconomic variables-including liquidity-were key determinants of bank profitability. In a comparative study of Middle Eastern banks, Zeitun (2012) identified liquidity, credit risk, and macroeconomic conditions as critical performance drivers, suggesting that liquidity management should be aligned with broader financial and economic dynamics. Collectively, these studies contribute to a growing consensus that liquidity risk is a central determinant of financial outcomes in both advanced and emerging banking

systems.

Identified Gaps and Contribution

The literature suggests a complex, context-dependent relationship between liquidity risk and bank profitability. While many studies confirm a negative relationship, recent evidence from Saudi Arabia highlights both direct and lagged effects, moderated by policy reforms and macroeconomic factors. This study contributes by using updated data and a dynamic methodology to provide a nuanced understanding of how liquidity risk affects the profitability of Saudi commercial banks.

Despite a growing body of regional studies, several gaps remain:

Most existing studies do not consider dynamic effects using techniques such as system GMM.

There is limited post-pandemic analysis, especially covering 2022–2023, a period marked by recovery and accelerated digital transformation in Saudi banks.

Few studies isolate the role of liquidity risk in the presence of regulatory or ESG compliance factors, which are increasingly relevant in the Saudi context.

This study addresses these gaps by employing a dynamic panel analysis of Saudi-listed commercial banks over a five-year period (2020–2024), offering insights into both the immediate and delayed effects of liquidity risk on profitability.

Hypotheses Development

Based on the empirical findings from prior studies examining the relationship between liquidity risk and bank profitability—such as those by Bordeleau and Graham (2010), Alamri and Almazari, 2021, the following hypotheses are formulated:

Main Hypotheses

- **H_{01}**: Liquidity risk, measured by the Loan-to-Deposit Ratio (LDR), has no significant effect on the profitability of Saudi commercial banks.
- **H_{11}**: Liquidity risk, measured by the Loan-to-Deposit Ratio (LDR), has a significant negative effect on the profitability of Saudi commercial banks.
- **H_{02}**: The ratio of Liquid Assets to Total Assets (LATA) has no significant impact on bank profitability.
- **H_{12}**: A higher Liquid Assets to Total Assets ratio (LATA) is positively associated with bank profitability.
- **H_{03}**: Cash and Cash Equivalents (CCE) have no significant influence on bank profitability.
- **H_{13}**: Higher levels of Cash and Cash Equivalents (CCE) have a significant positive effect on bank profitability.

Control Variable Hypotheses

- **H_{04}**: Bank size (SIZE) does not significantly affect profitability.
- **H_{14}**: Larger bank size (SIZE) is associated with improved profitability.

- **H_{05}**: Capital Adequacy Ratio (CAR) has no significant impact on profitability.
- **H_{15}**: A higher Capital Adequacy Ratio (CAR) is positively related to profitability.
- **H_{06}**: Non-Performing Loans (NPL) have no effect on profitability.
- **H_{16}**: A higher NPL ratio negatively affects profitability.
- **H_{07}**: Operational Efficiency (OEFF) does not influence profitability.
- **H_{17}**: Improved operational efficiency is positively associated with profitability.
- **H_{08}**: Macroeconomic factors such as Inflation (INF) and GDP Growth Rate (GDPGR) have no significant effect on profitability.
- **H_{18}**: Inflation and GDP Growth Rate significantly influence bank profitability.

Methodology

Data, Sample and Sources

To investigate the relationship between liquidity risk and the profitability of commercial banks in Saudi Arabia, the study focuses on institutions listed on the Saudi Stock Exchange that operate within the core financial sector. These banks are of particular interest due to their critical role in credit intermediation, their exposure to liquidity fluctuations, and the regulatory emphasis placed on their risk management practices. As banking profitability is often influenced by internal financial structures—such as capital adequacy and loan portfolio quality—as well as external macroeconomic factors like inflation and economic growth, commercial banks provide an ideal setting for evaluating how liquidity conditions affect financial performance. Moreover, Saudi Arabia's financial sector has undergone significant regulatory evolution in recent years, aligning more closely with Basel III standards, which further heightens the relevance of liquidity risk as a determinant of bank performance.

The sample in this study comprises 10 commercial banks listed on the Saudi Stock Exchange, selected based on the availability of consistent and complete data. The study covers a five-year period from 2020 to 2024, which captures both pre- and post-COVID-19 dynamics in bank performance and liquidity management. Financial data—such as Return on Assets (ROA), Return on Equity (ROE), and Tobin's Q—are collected from each bank's annual reports, audited financial statements, and disclosures available on the Saudi Exchange (Tadawul) and bank websites. This approach aligns with recent empirical studies by Hamdouni (2025) and Hamdouni (2025b), who utilized similar financial performance metrics to analyze the impact of ESG disclosure on corporate performance in Saudi Arabia's heavy-polluting companies, as well as the relationship between corporate governance improvements, corporate investment, and value creation in Shariah-compliant firms. These studies demonstrate the relevance and robustness of such financial indicators in assessing firm performance in the Saudi context.Liquidity-related variables, including the Loan-to-Deposit Ratio (LDR), Liquid Assets to Total Assets (LATA), and Cash and Cash Equivalents (CCE), are sourced from the same documents. Control variables like bank size (SIZE), Capital Adequacy Ratio (CAR), Non-Performing Loans (NPL), and Operational Efficiency (OEFF) are derived from financial ratios and supplementary notes in the banks' annual filings. Macroeconomic indicators, such as Inflation (INF) and GDP Growth Rate (GDPGR), are obtained from the Saudi Central Bank (SAMA) and the World Bank. The panel dataset is balanced, and missing data are handled using mean imputation when necessary,

ensuring the consistency and reliability of the estimation sample for econometric analysis. All measurements of variables in this study were detailed and summarized in Table 1.

Estimation Models

This study employs a dynamic panel data approach using the two-step System Generalized Method of Moments (GMM) estimator to investigate the impact of liquidity risk on the profitability of 10 commercial banks listed on the Saudi Stock Exchange over the five-year period 2020–2024. This method is chosen to address endogeneity, autocorrelation, and unobserved heterogeneity commonly found in banking panel datasets. Following recent empirical applications in the Saudi context, such as Hamdouni and Smaoui (2025), which emphasize the importance of controlling for systemic risks and dynamic relationships in financial performance analysis, the use of dynamic GMM allows for robust estimation of both short-term and long-term effects of liquidity risk on bank profitability.

Model Specification

The general dynamic panel model is specified as follows:

$$y_{i,t} = \alpha y_{i,t-1} + \beta_1 LiquidityRisk_{i,t} + \beta_1 X_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t}$$

Where:

- $y_{i,t}$: Bank profitability (ROA, ROE, or Tobin's Q) for bank i at time t
- $y_{i,t-1}$: Lagged profitability
- $LiquidityRisk_{i,t}$: Measures such as LDR, LATA, or CCE
- $X_{i,t}$: Control variables (SIZE, CAR, NPL, OEFF, INF, GDPGR)
- μ_i: Bank-specific fixed effects
- λ_t: Time fixed effects
- $\varepsilon_{i,t}$: Error term

Estimation Method

The Arellano-Bover/Blundell-Bond two-step System GMM estimator is used. This approach is appropriate given the dynamic nature of the model and the short time dimension (T=5) and a moderate number of banks (N=10). It allows for controlling endogeneity by using lagged levels and differences as instruments.

Diagnostic Tests

To ensure the robustness of the model estimates, the following diagnostic tests will be conducted AR(1) and AR(2) tests for serial correlation, Hansen and Sargan tests for overidentifying restrictions and Instrument validity terts.

Variables	**Symbols**	**Description**
Return on Assets	**ROA**	**Net income divided by total assets; measures overall profitability.**

Return on Equity	**ROE**	**Net income divided by shareholders' equity; measures return to owners.**
Tobin's Q	**TBQ**	**Market value of firm divided by the book value of total assets.**
Loan-to-Deposit Ratio	**LDR**	**Total loans divided by customer deposits; higher values indicate higher liquidity risk.**
Liquid Assets to Total Assets	**LATA**	**Proportion of liquid assets over total assets.**
Cash and Cash Equivalents	**CCE**	**Cash holdings as a proportion of total assets.**
Bank Size	**SIZE**	**Natural logarithm of total assets.**
Capital Adequacy Ratio	**CAR**	**Total capital divided by risk-weighted assets.**
Non-Performing Loans Ratio	**NPL**	**Non-performing loans divided by total loans.**
Operational Efficiency	**OEFF**	**Operating expenses divided by operating income.**
Inflation Rate	**INF**	**Annual inflation rate of Saudi Arabia.**
GDP Growth Rate	**GDPGR**	**Annual percentage change in real GDP.**

Table 1. Variables Definitions

Results and Discussion

Descriptive Statistics

Table 2 presents the descriptive statistics for the key variables used in the study, based on data from 10 commercial banks listed on the Saudi Stock Exchange over the 2020–2024 period. The profitability indicators show that the average Return on Assets (ROA) is 1.39%, with a standard deviation of 0.47%, indicating moderate variation across banks and time. Return on Equity (ROE) averages 12.05%, suggesting a healthy return to shareholders, though the relatively wide range—from 4.14% to 16.69%—reflects performance disparities among the sampled banks. Tobin's Q, with a mean of 1.19, indicates that most banks are valued above the replacement cost of their assets, a sign of positive investor expectations.

Regarding liquidity risk, the Loan-to-Deposit Ratio (LDR) has a mean value of 85.4%, with some banks reaching levels close to 99%, indicating higher liquidity exposure in certain cases. In contrast, the mean ratios for Liquid Assets to Total Assets (22.6%) and Cash and Cash Equivalents (9.96%) suggest that banks maintain relatively strong short-term liquidity buffers. These findings highlight the balance banks must strike between profitability and liquidity risk.

Bank size, proxied by the natural logarithm of total assets (SIZE), averages 15.02, suggesting a sample that includes a mix of medium and large banks. The Capital Adequacy Ratio (CAR) shows a healthy average of 18.36%, well above regulatory requirements, which reinforces the financial strength of the sector. Asset quality, as measured by the Non-Performing Loans (NPL) ratio, remains low on average (2.95%), though some banks experience levels above 5%, potentially impacting profitability. Operational Efficiency (OEFF) has a mean of 54.68%, indicating moderate cost control, with some variation across the sample.

Finally, the macroeconomic variables—Inflation (2.37%) and GDP Growth Rate (2.53%)—display reasonable stability, reflecting the relatively controlled economic environment in Saudi Arabia during the study period. Overall, the descriptive statistics suggest a well-capitalized and moderately profitable banking sector, but one that faces notable variability in liquidity risk and cost efficiency—both of which are key determinants of performance.

	Mean	Std. Dev.	Min	25th %ile	Median	75th %ile	Max
ROA	**0.0139**	**0.0047**	**0.0052**	**0.0107**	**0.0138**	**0.0167**	**0.0243**
ROE	**0.1205**	**0.0262**	**0.0414**	**0.1051**	**0.1214**	**0.1376**	**0.1669**
TBQ	**1.1921**	**0.2031**	**0.8162**	**1.0235**	**1.2034**	**1.302**	**1.6926**
LDR	**0.8542**	**0.0447**	**0.7743**	**0.8128**	**0.8597**	**0.8795**	**0.986**
LATA	**0.226**	**0.0437**	**0.139**	**0.1939**	**0.2281**	**0.2474**	**0.3741**
CCE	**0.0996**	**0.0216**	**0.0352**	**0.0865**	**0.1008**	**0.1149**	**0.1427**
SIZE	**15.0161**	**0.3869**	**14.276**	**14.7186**	**15.0022**	**15.3103**	**16.0462**
CAR	**0.1836**	**0.0197**	**0.1375**	**0.1687**	**0.1825**	**0.1974**	**0.2238**
NPL	**0.0295**	**0.0107**	**0.0093**	**0.0204**	**0.0303**	**0.0368**	**0.0506**
OEFF	**0.5468**	**0.0534**	**0.4349**	**0.5078**	**0.542**	**0.5784**	**0.7039**
INF	**0.0237**	**0.0045**	**0.0126**	**0.0207**	**0.0234**	**0.0276**	**0.0345**
GDPGR	**0.0253**	**0.0093**	**0.0029**	**0.0206**	**0.0258**	**0.0296**	**0.0477**

Table 2. Descriptive Statistics

Correlation Matrix

The Pearson correlation matrix provides insight into the linear relationships between profitability measures, liquidity indicators, and control variables. Table 3 reveals the correlations between the dependent variables (ROA, ROE, TBQ), independent variables (LDR, LATA, CCE), and control variables (SIZE, CAR, NPL, OEFF, INF, GDPGR). The correlation analysis reveals several important relationships between profitability, liquidity risk, and control variables among Saudi commercial banks during the period 2020–2024. Notably, Return on Assets (ROA) shows a positive and statistically significant correlation with Liquid Assets to Total Assets (LATA) ($r = 0.333$, $p < 0.05$), indicating that banks maintaining higher liquidity buffers tend to achieve greater asset efficiency. Cash and Cash Equivalents (CCE) also exhibit a positive, though statistically insignificant, correlation with ROA ($r = 0.227$), suggesting a potentially favorable but weak effect of holding cash on bank performance. The Loan-to-Deposit Ratio (LDR), another liquidity risk measure, shows only a weak positive association with ROA ($r = 0.107$), reflecting that increased lending relative to deposits does not necessarily compromise short-term profitability.

With respect to Return on Equity (ROE), the results are mixed. ROE has a negative correlation with LDR ($r = -0.173$) and LATA ($r = -0.159$), and a weak positive correlation with CCE ($r = 0.065$), implying that liquidity management may have nuanced implications for shareholder returns. Tobin's Q, a market-based performance indicator, presents a weak positive relationship with LATA ($r = 0.173$) and a significant negative correlation with inflation ($r = -0.279$, $p < 0.05$), suggesting that market valuation of banks is sensitive to macroeconomic pressures, particularly price instability.

Among the control variables, Capital Adequacy Ratio (CAR) demonstrates a significant negative correlation with ROA ($r = -0.290$, $p < 0.05$), which may reflect the trade-off between regulatory capital buffers and return-generating activities. Operational Efficiency (OEFF) is negatively correlated with ROE ($r = -0.264$, $p < 0.10$), confirming that higher operational costs relative to income tend to erode returns to shareholders. Bank Size (SIZE) shows a negative but insignificant correlation with both ROA and TBQ, suggesting that scale does not automatically translate into higher profitability or market valuation. Lastly, GDP Growth Rate (GDPGR) is negatively associated with ROE ($r = -0.251$, $p < 0.10$), a counterintuitive finding that may be influenced by lagged effects or cyclical adjustments in banking margins. Overall, the matrix underscores that liquidity management, cost efficiency, and macroeconomic stability play critical roles in shaping the financial performance of Saudi banks.

	ROA	ROE	TBQ	LDR	LATA	CCE	SIZE	CAR	NPL	OEFF	INF	GDPGR
ROA	1											
ROE	0.110	1										
TBQ	-0.126	-0.231	1									
LDR	0.107	-0.173	0.054	1								
LATA	0.333**	-0.159	0.173	-0.027	1							
CCE	0.227	0.065	-0.008	-0.267*	0.300**	1						
SIZE	-0.206	-0.007	-0.012	0.215	-0.012	0.017	1					
CAR	-0.290**	-0.170	0.118	-0.034	-0.147	0.022	0.096	1				
NPL	-0.018	0.203	0.173	-0.166	-0.088	0.088	0.086	-0.037	1			
OEFF	-0.168	-0.264*	-0.085	0.214	-0.216	-0.126	0.189	0.321**	-0.007	1		
INF	-0.106	0.069	-0.279**	-0.161	-0.113	-0.040	0.033	0.038	-0.078	0.013	1	

GDPGR	-0.108	-0.251*	-0.185	0.009	-0.040	-0.170	0.225	0.082	-0.256*	-0.100	-0.018	1

Table 3. Pearson Correlation Matrix

Notes: *p <0.10; **p <0.05; ***p <0.01.

Unit Root Tests

Unit root tests in panel data are performed to check whether our variables are stationary-a critical requirement in many types of econometric analyses. It's necessary: To avoid spurious regressions, to ensure valid inference in panel regressions (methods like OLS, GMM, and Fixed Effects assume that the variables are stationary, or at least cointegrated if non-stationary. if variables are non-stationary and not cointegrated, our model may produce biased or inconsistent estimates.) and to decide on model specification. Without testing for unit roots, our panel regression results may be unreliable, misleading, or even invalid.

The test's null hypothesis is that there is all panels contain unit roots (all series are non-stationary), while the alternative hypothesis suggests that some panels are stationary.

Table 4 reports the results of panel unit root tests using the Levin–Lin–Chu (LLC) and Im–Pesaran–Shin (IPS) methods to assess the stationarity of the variables used in the analysis. Both the LLC and IPS tests reject the null hypothesis of a unit root (non-stationarity) at the 5% significance level for all variables, indicating that the panel data series are stationary at level. This supports the appropriateness of proceeding with dynamic panel estimations like the System GMM model. Since both LLC and IPS tests reject the null hypothesis of a unit root (with p-values < 0.05) for all variables in level form, we conclude that all variables are integrated of order zero, I(0). This means they are stationary in level, and no differencing is required before estimation.

	Levin–Lin–Chu unit root test (LLC)		**Im–Pesaran–Shin unit root test (IPS)**		**Stationarity**	
Variables	**I(0)**	**I(1)**	**I(0)**	**I(1)**	**Stationarity**	**Integration Order**
ROA	**-2.247****	**-5.377*****	**-1.227*****	**-6.712*****	**Stationary**	**I(0)**
ROE	**-3.349*****	**-4.794*****	**-3.873**	**-7.12*****	**Stationary**	**I(0)**
TBQ	**-9.816****	**-4.02*****	**-1.349*****	**-5.177*****	**Stationary**	**I(0)**
LDR	**-4.359****	**-4.898*****	**-2.561*****	**-6.984*****	**Stationary**	**I(0)**
LATA	**-7.843****	**-8.879*****	**-1.846****	**-2.853*****	**Stationary**	**I(0)**
CCE	**-6.436****	**-8.977*****	**-1.455****	**-4.6*****	**Stationary**	**I(0)**
SIZE	**-4.47****	**-2.698*****	**-0.655****	**-6.745*****	**Stationary**	**I(0)**

CAR	**-6.727****	**-6.086*****	**-3.688****	**-6.92*****	**Stationary**	**I(0)**
NPL	**-7.742****	**-9.684*****	**-2.556****	**-7.037*****	**Stationary**	**I(0)**
OEFF	**-9.541****	**-7.833*****	**-2.634****	**-3.35*****	**Stationary**	**I(0)**

Table 4. Panel Unit Root Results.

Notes: *p <0.10; **p <0.05; ***p <0.01.

Panel Cross-Sectional Dependence Tests

Panel cross-sectional dependence tests are conducted to determine whether there are correlations across cross-sectional units (e.g., firms, countries, industries) in a panel dataset. This is important because many panel data models assume cross-sectional independence, and violating this assumption can lead to biased standard errors, invalid test statistics, and inconsistent estimators.

Table 5 provide Panel Cross-Sectional Dependence Tests applied to 10 banks over 2020–2024. All tests indicate significant cross-sectional dependence ($p < 0.05$). The consistent significance across all tests and all models confirms the presence of cross-sectional dependence on the data. This justifies the use of System GMM estimation, which is well-suited for handling panel data characterized by interdependence, endogeneity, and dynamic relationships. Ignoring such dependence would lead to biased and inefficient estimates in traditional panel regression models.

Model	**ROA**		**ROE**		**TBQ**	
	Statistic	**p-Value**	**Statistic**	**p-Value**	**Statistic**	**p-Value**
Breusch-Pagan LM	**29.104**	**0.001**	**26.532**	**0.003**	**32.817**	**0.000**
Pesaran scaled LM	**6.021**	**0.000**	**5.487**	**0.000**	**6.894**	**0.000**
Bias-corrected scaled LM	**5.405**	**0.000**	**4.923**	**0.001**	**6.21**	**0.000**
Pesaran CD	**3.589**	**0.000**	**3.109**	**0.002**	**3.998**	**0.000**

Table 5. Panel Cross-Sectional Dependence Tests

Slope Heterogeneity Test

Table 6 presents the results of the Pesaran and Yamagata (2008) slope homogeneity test for the ROA, ROE, and Tobin's Q (TBQ) models over the 2020–2024 period. The test examines whether slope coefficients are homogeneous across panel units—in this case, commercial banks listed on the Saudi Stock Exchange. The results indicate that for all three models, both the Delta and adjusted Delta statistics are statistically significant at the 5% level. Specifically, the adjusted Delta statistic for the ROA model is 2.891 ($p = 0.008$), for the ROE model is 3.562 ($p = 0.011$), and for the TBQ model is 1.912 ($p = 0.025$). These findings lead to the rejection of the null hypothesis of slope homogeneity, confirming the presence of slope heterogeneity across banks. This suggests that the relationship between liquidity risk and financial performance varies across institutions. Consequently, the use of dynamic panel estimation techniques such as the System GMM model is justified, as it accommodates heterogeneity and unobserved firm-level effects while providing consistent estimates.

	Delta	p-Value	adj. Delta	p-Value
ROA	**2.466**	**0.031**	**2.891**	**0.008**
ROE	**3.53**	**0.009**	**3.562**	**0.011**
TBQ	**2.021**	**0.004**	**1.912**	**0.025**

Table 6. Pesaran and Yamagata Test

Multicollinearity test and Normality Test

Table 7 presents the results of the multicollinearity test conducted using the Variance Inflation Factor (VIF) for all independent and control variables across the ROA, ROE, and Tobin's Q (TBQ) models. In all three models, the VIF values for the variables remain below the commonly accepted threshold of 5, indicating the absence of serious multicollinearity. For example, in the ROA model, VIF values range from 1.48 (OEFF) to 4.02 (NPL), while similar ranges are observed in the ROE and TBQ models. These results suggest that no single variable is excessively correlated with others, which implies that the estimated regression coefficients are likely to be stable and reliable. The lack of multicollinearity ensures that the individual effects of liquidity risk and control variables on financial performance can be accurately identified without distortion. Therefore, all variables are retained in the GMM regression models without the need for elimination or transformation due to multicollinearity concerns.

Regarding the normality test, skewness and kurtosis values are presented to evaluate the distributional properties of each variable. The skewness values for most variables lie within the acceptable range of –1 to +1, indicating relatively symmetric distributions. For example, ROA (0.136), TBQ (0.345), and LDR (0.495) show mild positive skewness, while ROE (–0.505) and CCE (–0.297) exhibit slight negative skewness. Kurtosis values for all variables are also close to the normal value of 3, with LATA being slightly leptokurtic (4.432), indicating heavier tails, and NPL being slightly platykurtic (2.155), indicating lighter tails. Overall, the data approximates normality reasonably well, especially given that panel estimation techniques like System GMM are robust to minor deviations from normality.

	Multicollinearity test			**Normality test**	
Variables	**ROA**	**ROE**	**TBQ**	**Skewness**	**Kurtosis**
ROA	**-**	**-**	**-**	**0.136**	**2.547**
ROE	**-**	**-**	**-**	**-0.505**	**3.569**
TBQ	**-**	**-**	**-**	**0.345**	**2.722**
LDR	**2.12**	**2.45**	**1.87**	**0.495**	**3.261**
LATA	**3.1**	**2.89**	**3.44**	**0.631**	**4.432**
CCE	**2.61**	**2.73**	**2.15**	**-0.297**	**3.292**
SIZE	**3.5**	**4.05**	**3.11**	**0.216**	**2.648**
CAR	**2.81**	**2.97**	**3.09**	**0.097**	**2.606**
NPL	**4.02**	**3.66**	**4.31**	**-0.067**	**2.155**
OEFF	**1.48**	**1.65**	**1.39**	**0.579**	**3.250**

Table 7. Multicollinearity test and Normality test

Estimation Results

Table 8 presents the results of the dynamic GMM models estimating the impact of various financial variables on firm performance measured by ROA, ROE, and Tobin's Q. The Loan to Deposit Ratio (LDR) shows a consistently negative and statistically significant effect across all three models, indicating that higher liquidity risk adversely affects both accounting profitability and market valuation. Long-term assets (LATA) have a positive and significant impact on ROA, ROE, and Tobin's Q, suggesting that investment in long-term productive assets enhances firm performance. Cash and cash equivalents (CCE) do not exhibit a significant relationship with firm performance in any model. Firm size (SIZE) positively influences ROE at a highly significant level but is not significant for ROA or Tobin's Q, implying that larger firms tend to have better equity returns. The Capital Adequacy Ratio (CAR) is only positively and significantly associated with Tobin's Q, reflecting its importance for market valuation but not for accounting profitability measures. Non-performing loans (NPL) and operating efficiency (OEFF) show limited significance, with OEFF negatively affecting ROE but not other performance measures.

All models are jointly significant with p-values of 0.000, confirming the overall relevance of the explanatory variables. The AR(1) test is expected to be significant ($p < 0.05$) in first-differenced GMM models, and this is confirmed for all three models, indicating first-order autocorrelation as expected. The AR(2) test should not be significant, as second-order autocorrelation would invalidate the GMM instruments. In all three models, AR(2) p-values are greater than 0.10, confirming no second-order serial correlation. These results support the validity of the GMM specification and suggest that the models are correctly specified with respect to autocorrelation structure.

The Hansen test results, with p-values greater than 0.14, support the validity of the instruments used, confirming that the moment conditions are appropriate. Overall, the results highlight the critical role of liquidity management and asset investment in determining firm profitability and market valuation, while also confirming the robustness of the GMM approach in this context.

	ROA	**ROE**	**TBQ**
Variables	**Coefficient**	**Coefficient**	**Coefficient**
LDR	**-0.034***	**-0.039***	**-0.132***
LATA	**0.021****	**0.199***	**1.037****
CCE	**0.036**	**0.074**	**1.044**
SIZE	**-0.003**	**0.021*****	**0.058**
CAR	**-0.049**	**-0.113**	**2.976***
NPL	**-0.008**	**0.179**	**1.005**
OEFF	**-0.010**	**-0.165***	**-0.112**
C	**0.031**	**-0.023**	**0.025**
Prob>chi2	**0.000**	**0.000**	**0.000**
AR(1) Statistic	**–2.842**	**–3.015**	**–2.615**
AR(1) p-value	**0.004**	**0.002**	**0.009**
AR(2) Statistic	**–1.126**	**–0.987**	**–1.204**
AR(2) p-value	**0.26**	**0.324**	**0.229**

Hansen test	**2.454**	**3.443**	**7.665**
P-value	**0.145**	**0.166**	**0.183**

Table 8. The GMM Model Results

Notes: *p <0.10; **p <0.05; ***p <0.01.

Discussion

The primary objective of this study was to examine the impact of liquidity risk on the profitability of Saudi commercial banks using a two-step System Generalized Method of Moments (GMM) approach. The results presented in Table 8 provide strong empirical evidence supporting several of the formulated hypotheses and align with both global and regional literature on banking performance.

Liquidity Risk and Bank Profitability

The Loan-to-Deposit Ratio (LDR), a core measure of liquidity risk, demonstrated a consistently negative and statistically significant relationship with all three performance indicators—ROA, ROE, and Tobin's Q. This supports H_{11}, rejecting the null hypothesis (H_{01}) and confirming that higher liquidity risk adversely affects both accounting profitability and market valuation. These finding echoes prior studies such as Eltweri et al. (2024) on UK banks and Alabdullah et al. (2019) in the Saudi context, which both documented the detrimental effects of liquidity pressure on bank performance. It also aligns with Alshehri and Abuzayed (2023), who noted that Saudi banks' liquidity risk, particularly when elevated post-crisis, significantly reduced profitability.

Liquid Asset Holdings

The ratio of Liquid Assets to Total Assets (LATA) showed a positive and statistically significant impact on all three-performance metrics. This outcome confirms H_{12} and refutes H_{02}, suggesting that maintaining an adequate level of liquid assets contributes to financial stability and supports profitability. The result is consistent with the findings of Al-Homaidi et al. (2021), who emphasized the positive role of conservative liquidity strategies in the GCC region. Furthermore, it complements earlier international research by Chen et al. (2022), who found that moderate levels of liquidity enhance bank performance by ensuring sufficient buffers during periods of financial stress.

Cash and Cash Equivalents

Contrary to expectations, Cash and Cash Equivalents (CCE) did not exhibit a statistically significant impact on ROA, ROE, or Tobin's Q. As such, the results do not support H_{13}, and the null hypothesis (H_{03}) cannot be rejected. This may reflect the low-yield nature of idle cash holdings in a low-interest environment or indicate that CCE alone does not sufficiently capture liquidity efficiency. This is consistent with the observations of Khamis and Al Shammari (2022), who noted that while Saudi banks increased liquidity buffers during the COVID-19 period, this did not translate into enhanced profitability.

Control Variables

Firm Size (SIZE) was found to be significantly and positively related to ROE but insignificant for ROA and Tobin's Q. This partial support for H_{14} suggests that larger banks may benefit from economies of scale or better access to equity financing, aligning with the findings of Rauch et al. (2010) and Zeitun (2012).

Capital Adequacy Ratio (CAR) showed a significant positive impact only on Tobin's Q, supporting H_{15} in terms of market valuation but not accounting returns. This indicates that investors view well-capitalized banks as more resilient, a point also emphasized in Almughaiseeb's (2024) work on the intersection of financial and geopolitical risks.

Non-Performing Loans (NPL) had no statistically significant relationship with performance in this dataset, leading to a failure to reject H_{06}. This diverges from Zeitun (2012) but could be attributed to relatively stable credit quality among Saudi banks in the study period.

Operational Efficiency (OEFF) negatively and significantly impacted ROE only, providing partial support for H_{17}. This suggests inefficiencies in cost management directly affect equity-based profitability, a result also observed by Al-Nimer et al. (2024) who noted that liquidity interacts with internal efficiency measures in shaping performance.

Interpretation within the Saudi Context

These findings confirm much of the recent literature on Saudi and regional banking sectors. The negative relationship between LDR and profitability supports earlier findings by Alshehri and Abuzayed (2023), Alabdullah et al. (2019), and Khamis and Al Shammari (2022), all of whom emphasized that elevated liquidity risk—especially under crisis conditions—undermines profitability. Furthermore, the positive role of LATA reinforces the idea that prudently managed liquidity contributes positively to performance, particularly in economies undergoing structural transformation like Saudi Arabia under Vision 2030.

Conclusion and Implications

This study investigated the impact of liquidity risk on the financial performance of ten commercial banks listed on the Saudi Stock Exchange over the period 2020–2024, using a two-step System GMM estimation approach. The empirical results revealed a consistently negative and statistically significant relationship between the Loan-to-Deposit Ratio (LDR) and firm performance across all measures—Return on Assets (ROA), Return on Equity (ROE), and Tobin's Q. This confirms that higher liquidity risk undermines both accounting-based profitability and market valuation, highlighting the critical role of prudent liquidity management in maintaining financial stability.

Additionally, the positive and significant impact of Liquid Assets to Total Assets (LATA) on all performance indicators suggests that long-term investments in liquid, productive assets contribute positively to bank profitability and resilience. In contrast, Cash and Cash Equivalents (CCE) showed no significant influence, indicating that idle cash holdings alone are insufficient to drive financial performance. Among the control variables, firm size (SIZE) enhanced ROE, while Capital Adequacy Ratio (CAR) contributed only to market-based valuation (Tobin's Q). Other factors, such as Non-Performing Loans (NPL) and Operational Efficiency (OEFF), demonstrated limited and inconsistent effects.

These findings are consistent with both global literature and recent regional studies from Saudi Arabia and the broader GCC region, including those by Alabdullah et al. (2019), Alshehri and Abuzayed (2023), and Khamis and Al Shammari (2022), who all reported that elevated liquidity risk impairs profitability, particularly during periods of macroeconomic stress and regulatory transition.

The findings of this study carry several important implications for banking practitioners, regulators, and researchers. For bank managers, the consistent negative impact of the Loan-to-

Deposit Ratio (LDR) on profitability highlights the need for careful liquidity risk management. While maintaining liquidity is essential for regulatory compliance and operational stability, excessive reliance on customer deposits to fund loans may erode profitability. Managers should seek a balanced approach that aligns liquidity levels with productive investment opportunities and improved operational efficiency, particularly given the significance of ROE as influenced by bank size. For policymakers and regulators, such as the Saudi Central Bank (SAMA), the results support the continuation of liquidity oversight under Basel III while encouraging a regulatory environment that also fosters innovation and risk-adjusted profitability. The positive association between capital adequacy and market valuation (Tobin's Q) further validates the emphasis on strong capital buffers in enhancing investor confidence. Lastly, for academic researchers, these results open avenues for future inquiry into how liquidity risk interacts with emerging variables such as climate risk, ESG disclosure, and digital transformation—factors increasingly relevant in the evolving Saudi banking landscape, as shown by recent studies like Hamdouni and Smaoui (2025). Overall, this study emphasizes the strategic importance of liquidity decisions in shaping financial performance in Saudi Arabia's banking sector.

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