International Journal of Applied Research in Business and Management (ISSN: 2700-8983)
an Open Access journal by Wohllebe & Ross Publishing, Germany.
Volume: 06 Issue: 05 Year: 2025
https://doi.org/10.51137/wrp.ijarbm.457

Disentangling Liquidity-Performance Dynamics: Firm Size as a Strategic Moderator Among Listed Healthcare and Pharmaceutical Industry in Emerging Economies

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Abstract:

This study investigates the moderating role of firm size in the relationship between liquidity and financial performance among Nigeria's listed healthcare and pharmaceutical manufacturing firms over the period 2014 to 2023. Using a balanced panel dataset of 10 publicly traded firms, the study employs Generalized Least Squares (GLS) estimation to account for panel-level heteroscedasticity and individual effects. The analysis evaluates the influence of three core liquidity indicators, including current ratio, quick ratio, and cash ratio, on return on assets (ROA), with firm size introduced as a moderating variable. Descriptive statistics and correlation diagnostics reveal significant variation in liquidity levels, while normality and multicollinearity tests confirm the robustness of the regression. Findings indicate that the current ratio exerts a significant negative influence on ROA, and firm size positively moderates this relationship. However, quick ratio and cash ratio exhibit no significant direct effects or interaction effects with firm size. These outcomes suggest that optimal liquidity management is critical for profitability, particularly in firms of varying operational scales. The study extends liquidity-performance literature by emphasizing firm characteristics, and it offers implications for liquidity governance, firm scalability, and sectoral competitiveness.

Keywords:

Liquidity Management, Firm Size, Financial Performance, Return on Assets, Healthcare Sector, Nigeria

Submitted: 2025-11-22. Revised: 2025-12-21. Accepted: 2025-12-30.

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Introduction

Liquidity management remains a fundamental pillar in the financial health and operational sustainability of firms, particularly within capital-intensive sectors such as healthcare and pharmaceuticals. In the context of emerging economies like Nigeria, the efficient deployment of liquid assets is especially crucial given the macroeconomic volatility, fluctuating exchange rates, and persistent infrastructural bottlenecks that impair firm performance (Akinleye & Ogunmuyiwa, 2020). Liquidity ratios such as the current ratio, quick ratio, and cash ratio are essential indicators that determine the ability of a firm to meet short-term obligations, thereby influencing profitability metrics like return on assets (ROA). However, while much of the extant literature has explored the direct relationship between liquidity and performance, the potential moderating role of firm size in this nexus remains underexplored in sector-specific contexts.

The healthcare and pharmaceutical manufacturing sector in Nigeria presents a unique context for examining this relationship. These firms often grapple with longer cash conversion cycles, heavy dependency on foreign exchange for inputs, and regulatory compliance burdens—all of which heighten the importance of liquidity strategies (Ogunbiyi & Iheanacho, 2021). Larger firms, by virtue of economies of scale, better access to credit, and diversified revenue streams, are often more resilient to liquidity shocks, suggesting that firm size may amplify or attenuate the effect of liquidity on performance. Conversely, smaller firms may face liquidity constraints that more directly impair profitability. This study thus considers whether firm size significantly moderates the relationship between liquidity indicators and firm performance among Nigeria's listed healthcare and pharmaceutical manufacturing firms.

From a theoretical standpoint, this study is anchored in the resource-based view (RBV) and pecking order theory. The RBV posits that internal resources, such as liquidity, serve as critical assets that can offer competitive advantage when deployed efficiently (Barney, 1991). Simultaneously, the pecking order theory suggests that firms prioritize internal financing (retained earnings and liquid assets) over external sources due to asymmetric information and cost implications (Myers & Majluf, 1984). In this framework, the ability of firms to leverage liquidity effectively is likely influenced by structural characteristics such as firm size, which may determine access to resources and strategic decision-making capacities.

Empirical studies have yielded mixed results regarding the liquidity-performance relationship. For instance, Adegbite et al. (2023) found a positive relationship between the quick ratio and ROA among Nigerian consumer goods firms, while Uwuigbe et al. (2021) reported an insignificant impact of the current ratio on profitability in the industrial sector. However, there is limited consensus on the role of firm size as a moderator, especially in specialized sectors like healthcare and pharmaceuticals. Some scholars argue that larger firms possess operational buffers that help them absorb liquidity shocks more efficiently (Khan et al., 2022), while others suggest that size could lead to bureaucratic inefficiencies, diluting the benefits of high liquidity levels (Al-Homaidi et al., 2021).

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Given the contextual gaps and sectoral nuances, this study investigates the moderating role of firm size in the relationship between liquidity and profitability among ten listed healthcare and pharmaceutical manufacturing firms in Nigeria, using data from 2014 to 2023. By employing a random effect generalized least squares (GLS) panel regression model, this study aims to isolate both direct and interaction effects of liquidity ratios and firm size on ROA. This methodological approach offers robust control for unobservable heterogeneity across firms while acknowledging time-invariant firm characteristics that could affect the dependent variable.

The research contributes to the broader discourse on financial management and firm performance in emerging markets by offering evidence on how firm size conditions the effectiveness of liquidity strategies. The findings are expected to inform policymakers, investors, and corporate managers on the importance of firm-specific characteristics in strategic liquidity decisions. Furthermore, the results may aid regulatory bodies such as the Financial Reporting Council of Nigeria (FRCN) and the Securities and Exchange Commission (SEC) in formulating size-sensitive financial disclosure and risk management policies. The remainder of the paper is structured as follows. Section 2 reviews relevant literature and theoretical foundations, Section 3 outlines the methodology and data sources, Section 4 presents the results and discussion, and Section 5 concludes with policy implications, limitations, and recommendations for future research.

Literature and Hypotheses

Theoretical Review

The investigation of the liquidity-performance nexus, particularly under the moderating influence of firm size, is well-grounded in several prominent theoretical frameworks within corporate finance. This section discusses the Resource-Based View (RBV), Trade-Off Theory, and Pecking Order Theory as the foundational theories guiding this study. The Resource-Based View (RBV) conceptualizes firms as bundles of unique resources and capabilities that provide competitive advantage when effectively managed (Barney, 1991). Liquidity, within this framework, is seen as a strategic resource that firms can leverage to enhance operational flexibility and innovation capacity. Larger firms, by virtue of more substantial resource endowments and managerial competencies, are better positioned to optimize liquidity for sustained profitability (Wang & Barney, 2021). RBV thus predicts that firm size may condition the liquidity-performance relationship by amplifying the benefits of liquid assets as valuable, rare, and inimitable resources.

Trade-Off Theory offers an alternative perspective focusing on the balance firms strike between the benefits and costs of holding liquid assets (Myers, 2001; Huang & Ritter, 2020). According to this theory, liquidity reduces bankruptcy risk and transaction costs associated with external financing, which

positively affects firm value and profitability. However, excessive liquidity entails an opportunity cost by tying up funds that could otherwise be invested in profitable projects, potentially decreasing returns. Firm size is relevant here as larger firms often have better access to capital markets and lower financing costs, enabling them to hold less precautionary liquidity, while smaller firms may need to maintain higher liquidity buffers, thus altering the liquidity-profitability dynamics (Kim & Santoso, 2018).

The Pecking Order Theory (Myers & Majluf, 1984) complements these views by emphasizing firms' financing preferences. It suggests that firms prioritize internal financing (retained earnings and liquid assets) over external debt or equity to avoid asymmetric information problems and issuance costs. Liquidity, therefore, serves as a proxy for internal funds availability, which can influence investment and profitability. Firm size can moderate this relationship, as larger firms typically have more retained earnings and easier access to external financing, diminishing their reliance on liquidity compared to smaller firms that are more financially constrained (Florou et al., 2019).

Complementing these core theories, the Behavioral Theory of the Firm (Cyert & March, 1963) also provides insights into managerial decision-making regarding liquidity. Larger firms tend to have more complex decision hierarchies and risk management processes, which may affect how liquidity impacts performance. This theory suggests that firm size shapes the internal routines and risk tolerance that govern liquidity policies and ultimately influence profitability outcomes (Grafton et al., 2019).

Recent empirical studies affirm the relevance of these theories in emerging markets. For example, Ismail and Almutairi (2022) confirm the RBV in their study of Gulf Cooperation Council firms, showing firm size positively moderates the impact of liquidity on profitability. Similarly, Kinyua et al. (2023) apply the Trade-Off Theory to Kenyan manufacturing firms, finding that larger firms optimize liquidity holding better, leading to enhanced returns. However, other studies reveal divergent findings; Alqahtani and Mayowa (2021) observe in Saudi Arabia that the Pecking Order Theory's predictions hold predominantly for smaller firms due to financing constraints, underscoring the context-dependency of these theoretical perspectives.

Empirical Review

The empirical literature examining the liquidity-performance relationship, particularly with firm size as a moderating variable, is extensive and provides a nuanced understanding across various contexts, industries, and methodologies. A significant body of research confirms a positive and statistically significant association between liquidity measures - such as current ratio, quick ratio, and cash ratio - and firm profitability, proxied by return on assets (ROA) or return on equity (ROE). For instance, Chen et al. (2016) found that firms maintaining adequate liquidity levels in Chinese manufacturing sectors exhibited superior profitability, emphasizing liquidity's role in reducing transaction costs and financial

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distress. Likewise, Akbas et al. (2019) demonstrated that liquidity positively affects firm performance in Turkish listed companies, with results robust across multiple liquidity proxies.

Conversely, several studies report a nonlinear or threshold effect where excessive liquidity harms profitability by inducing opportunity costs. Al-Matari et al. (2014) observed that while moderate liquidity improved firm returns in Saudi firms, excessive cash holdings reduced profitability due to underutilized resources. This trade-off underscores the necessity of optimal liquidity management, which aligns with the trade-off theory discussed previously.

The moderating effect of firm size has been increasingly explored, with emerging consensus that size influences the liquidity-profitability nexus. Larger firms typically benefit from economies of scale, better risk management, and diversified resource bases, enabling them to optimize liquidity for enhanced profitability. For example, Saeed and Sameer (2021) studied Pakistani textile firms and found that firm size significantly strengthened the positive impact of liquidity on profitability, suggesting that larger firms leverage liquidity more efficiently. Similarly, Abor and Biekpe (2010) showed that firm size moderates liquidity-performance relations in Ghanaian firms, attributing the effect to improved access to capital and managerial sophistication in larger entities.

However, contrasting findings exist in specific emerging markets and industries. Mwewa and Sakala (2020) reported that in Zambian manufacturing firms, liquidity's impact on profitability was stronger among smaller firms, attributed to their greater dependence on liquid assets for operational continuity due to limited external financing. This suggests that contextual factors such as capital market development, industry characteristics, and firm-specific constraints can influence the moderating role of size. Methodologically, most studies utilize panel data techniques, including fixed effects, random effects, and generalized least squares (GLS), to control for unobserved heterogeneity and serial correlation. Studies like Okafor and Chinedu (2022) employed GLS to analyze Nigerian manufacturing firms, confirming liquidity's positive effect on profitability, moderated by firm size. These approaches enhance the robustness and reliability of findings across diverse datasets and time horizons.

Recent research also incorporates advanced measures of liquidity and firm performance, such as cash conversion cycle and Tobin's Q, broadening the conceptualization beyond traditional ratios. For example, Sharma and Kumar (2023) linked liquidity efficiency with market valuation in Indian pharmaceutical firms, highlighting the importance of liquidity management in capital-intensive sectors. This aligns with the increasing emphasis on healthcare and pharmaceutical industries, which require liquidity to fund R&D and manage supply chain risks.

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Hypotheses Development

Theoretical frameworks such as the trade-off theory and pecking order theory suggest that adequate liquidity minimizes the risk of financial distress, thereby facilitating operational continuity and enhancing profitability (Deloof, 2003; Nazir & Afza, 2009). Empirically, numerous studies have established a positive relationship between liquidity and profitability, especially in manufacturing and healthcare sectors where working capital management is crucial for sustaining operations (Chen et al., 2016; García-Teruel & Martínez-Solano, 2007). However, an excessive accumulation of current assets may lead to suboptimal profitability due to opportunity costs associated with idle funds (Shin & Soenen, 1998; Raheman & Nasr, 2007). This trade-off indicates that liquidity must be maintained at an optimal level to maximize firm performance. In emerging economies such as Nigeria, liquidity constraints often exacerbate operational risks, making liquidity management even more vital (Akinlo & Emmanuel, 2021). Thus, it is hypothesized (**H1**) that: *current liquidity significantly influences profitability in listed healthcare and pharmaceutical firms in Nigeria.*

The quality of liquidity, reflected by more liquid assets excluding inventory, offers a refined perspective on how short-term financial health affects profitability. The quick ratio, which filters out less liquid inventory, is often considered a better indicator of immediate solvency than the broader current ratio (Deloof, 2003; Aktas et al., 2015). Studies have demonstrated that firms with strong quick liquidity positions are better positioned to respond to short-term obligations and investment opportunities, thereby fostering improved profitability (Raheman & Nasr, 2007; Akbar et al., 2020). The relationship may be contingent on firm-specific factors such as industry, operational cycles, and financial strategies. In capital-intensive industries like pharmaceuticals, where inventory turnover rates and receivables play critical roles, maintaining an optimal quick ratio is crucial (Akinlo & Emmanuel, 2021; Sharma & Kumar, 2023). Empirical investigations in developing markets suggest a positive, though sometimes non-linear, impact of quick liquidity on profitability, emphasizing the need for careful liquidity management (Shin & Soenen, 1998; Abbas & Nisar, 2019). Therefore, the hypothesis (**H2**) *posits a significant effect of quality liquidity on profitability.*

Cash holdings represent the most liquid asset form and serve as a buffer against liquidity shocks, directly impacting firm performance (Opler et al., 1999). The cash ratio, which measures the capacity to cover liabilities solely with cash and cash equivalents, provides a stringent test of liquidity's impact on profitability (Lamberson, 1995). Prior research highlights that adequate cash reserves facilitate investment flexibility, reduce transaction costs, and shield firms during economic downturns, thereby enhancing profitability (Harford et al., 2008; Han & Qiu, 2007). Excessive cash holdings may indicate inefficient capital allocation and a lack of profitable investment opportunities, negatively affecting returns (Jin & Jorion, 2006; Ozkan & Ozkan, 2004). In sectors such as healthcare and pharmaceuticals, where

timely R&D investment and supply chain management are essential, balancing cash reserves against investment needs is critical (Sharma & Kumar, 2023; Akinlo & Emmanuel, 2021). Hence, it is hypothesized (**H3**) that *cash liquidity exerts a significant effect on firm profitability.*

Firm size is a salient contextual factor that influences how liquidity translates into profitability. Larger firms tend to benefit from economies of scale, greater market power, and enhanced access to external finance, which may strengthen the positive effects of liquidity on profitability (Abor & Biekpe, 2010; Saeed & Sameer, 2021). Additionally, larger firms often possess more sophisticated financial management practices, allowing them to optimize liquidity levels better than smaller firms (Mwewa & Sakala, 2020). Empirical evidence suggests that firm size moderates the liquidity-profitability nexus, with larger firms deriving more significant profitability benefits from liquidity management (Abbas & Nisar, 2019; Okafor & Chinedu, 2022). In the Nigerian context, where access to credit is often constrained, firm size may be particularly crucial in determining how liquidity impacts financial performance (Akinlo & Emmanuel, 2021). Accordingly, it is hypothesized (H4) that firm size significantly moderates the relationship between liquidity and profitability as measured by the current ratio.

The interaction between firm size and quality liquidity is similarly important. Larger firms are more capable of leveraging quick assets effectively due to their resource endowment and market reach (Saeed & Sameer, 2021; Abor & Biekpe, 2010). This capacity potentially amplifies the impact of quick liquidity on profitability by facilitating smoother operations and timely investment (Mwewa & Sakala, 2020; Okafor & Chinedu, 2022). Conversely, smaller firms may struggle to realize such benefits due to scale inefficiencies and limited financial flexibility (Abbas & Nisar, 2019). This differential effect underscores the necessity of considering firm size as a moderator in liquidity studies, particularly in complex sectors such as healthcare and pharmaceuticals (Sharma & Kumar, 2023). Therefore, the hypothesis (**H5**) *posits a significant moderating effect of firm size on the relationship between liquidity quality and profitability.*

Firm size also potentially moderates the impact of cash holdings on profitability. Larger firms generally have better access to capital markets and may hold less cash relative to their size without compromising operational flexibility, possibly diluting the direct impact of cash liquidity on profitability (Harford et al., 2008; Jin & Jorion, 2006). Conversely, smaller firms often maintain higher cash ratios as a precautionary measure due to greater financing constraints (Ozkan & Ozkan, 2004; Mwewa & Sakala, 2020). In the Nigerian healthcare and pharmaceutical sector, where financial markets remain developing, this moderating role is particularly salient (Akinlo & Emmanuel, 2021; Sharma & Kumar, 2023). Larger firms' superior resource management and investment capabilities may either amplify or attenuate the liquidity-profitability link related to cash holdings. Hence, it is hypothesized (**H6**) that *firm size significantly moderates the effect of cash liquidity on profitability.*

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Methods and Data

This study employs a balanced panel dataset comprising 10 healthcare and pharmaceutical manufacturing firms listed on the Nigerian Exchange Group (NXG) spanning the period 2014 to 2023. The selection of these 10 firms is justified by the requirement for continuous listing over the entire period and the availability of consistent, audited financial data, which ensures the reliability and completeness of the panel dataset. While the sample size is constrained, it represents all firms in the sector meeting these criteria, capturing the full spectrum of listed healthcare and pharmaceutical firms in Nigeria during the study period. The selected period offers a comprehensive view of firm performance dynamics and liquidity management within a decade characterized by evolving economic conditions and sector-specific challenges (Akinlo & Emmanuel, 2021). The healthcare and pharmaceutical sector is particularly relevant given its critical role in national health outcomes and economic development (Sharma & Kumar, 2023).

It is acknowledged that the small sample size may limit statistical power and the generalizability of the findings to other sectors or unlisted firms. However, the use of panel data across a ten-year period increases the number of observations, improving the efficiency of parameter estimates and allowing for robust longitudinal analysis (Baltagi, 2021).

The dataset is sourced from audited annual reports, NSE official disclosures, and Thomson Reuters Eikon financial database. Panel data structure enables control for unobserved heterogeneity across firms and over time, improving estimation efficiency and consistency (Baltagi, 2021).

The empirical analysis employs two linear regression models to investigate the direct effects of liquidity indicators on firm profitability and the moderating role of firm size on these relationships. The dependent variable is return on assets ($\text{ROA}_{i,t}$) for firm i in year t. The key independent variables are the current ratio ($\text{CURR}_{i,t}$), quick ratio ($\text{QUIR}_{i,t}$), and cash ratio ($\text{CASH}_{i,t}$), while firm size ($\text{FSIZ}_{i,t}$) is included as a control and moderator. The baseline model is specified as:

$$\text{ROA}_{i,t} = \alpha + \beta_1 \text{CURR}_{i,t} + \beta_2 \text{QUIR}_{i,t} + \beta_3 \text{CASH}_{i,t} + \beta_4 \text{FSIZ}_{i,t} + \varepsilon_{i,t} \quad (1)$$

Table 1 presents detailed variable descriptions, measurements, and data sources. Also, α is the intercept, β_1 to β_4 are the coefficients for each explanatory variable, and $\varepsilon_{i,t}$ is the error term. The extended interaction model incorporates interaction terms between firm size and each liquidity measure to capture moderation effects:

$$\begin{aligned}\text{ROA}_{i,t} = \alpha &+ \beta_1 \text{CURR}_{i,t} + \beta_2 \text{QUIR}_{i,t} + \beta_3 \text{CASH}_{i,t} + \beta_4 \text{FSIZ}_{i,t} \\ &+ \beta_5(\text{CURR}_{i,t} \times \text{FSIZ}_{i,t}) + \beta_6(\text{QUIR}_{i,t} \times \text{FSIZ}_{i,t}) + \beta_7(\text{CASH}_{i,t} \times \text{FSIZ}_{i,t}) + \varepsilon_{i,t}\end{aligned} \quad (2)$$

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The inclusion of interaction terms aligns with prior studies emphasizing that firm size may condition the liquidity-profitability relationship through resource access and operational scale (Abor & Biekpe, 2010; Saeed & Sameer, 2021). Control variables are incorporated to mitigate omitted variable bias (Deloof, 2003). Table 1 shows the variable justification and the apriori are discuss. The ROA is a widely used profitability measure reflecting overall firm efficiency in generating earnings from assets (Chen et al., 2016). It is sensitive to operational and financial management decisions, making it suitable for this investigation. Liquidity Ratios, such as urrent, quick, and cash ratios, capture varying degrees of liquidity, reflecting the firm's ability to meet short-term obligations (Deloof, 2003). Current ratio includes all current assets, quick ratio excludes inventory, while cash ratio focuses strictly on cash and equivalents, providing a nuanced assessment of liquidity's role in profitability. The Firm Size, proxied by the logarithm of total assets, is theorized to affect liquidity management due to economies of scale, market power, and financing flexibility (Abor & Biekpe, 2010). Larger firms may leverage liquidity more effectively, warranting the examination of its moderating role. The Leverage controls for financial risk associated with debt financing, which may impact profitability through interest costs and financial distress (Nazir & Afza, 2009). Sales Growth captures firm expansion dynamics that potentially influence working capital needs and profitability (Shin & Soenen, 1998). Firm Age is included as a proxy for experience and market reputation, which could affect financial performance (Akinlo & Emmanuel, 2021).

The Breusch–Pagan Lagrange Multiplier (LM) test would validate the presence of panel effects, further justifying the use of GLS. Afterward, the Hausman test is conducted to decide between fixed effects and random effects models, ensuring correct specification of unobserved heterogeneity (Hausman, 1978). Given the likely presence of firm-specific effects correlated with regressors, fixed effects is the preferred baseline, with GLS used to correct heteroskedasticity and autocorrelation issues. The GLS estimation technique is employed for panel regression analysis. GLS is efficient in handling panel-specific heteroskedasticity and serial correlation, making it suitable for datasets with firm-level unobserved heterogeneity and unbalanced error structures (Baltagi, 2021). Unlike Ordinary Least Squares (OLS), GLS efficiently handles non-spherical error variance, producing unbiased, consistent, and efficient estimates (Greene, 2018). A The selection of the random effects GLS model was based on the results of the Hausman test, which failed to reject the null hypothesis, suggesting that the random effects estimator is consistent and efficient relative to the fixed effects estimator (Wooldridge, 2019). The generic GLS estimator is mathematically expressed as:

$$\mathbf{y} = \mathbf{X}\boldsymbol{\beta} + \boldsymbol{\mu} + \boldsymbol{\epsilon}, \quad \text{Var}(\boldsymbol{\epsilon}) = \sigma_{\epsilon}^2\mathbf{I}, \quad \text{Var}(\boldsymbol{\mu}) = \sigma_{\mu}^2\mathbf{I} \tag{3}$$

Where $\mathbf{y}$ is the $N \times 1$ vector of the dependent variable (ROA), $\mathbf{X}$ is the matrix of explanatory and interaction variables, $\boldsymbol{\beta}$ is the parameter vector, and $\boldsymbol{\mu}$ and $\boldsymbol{\epsilon}$ represent firm-specific and idiosyncratic error components, respectively. To address endogeneity concerns such as reverse causality between

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governance and performance, all explanatory variables are lagged by one year (Adams & Ferreira, 2009). Moreover, robust standard errors clustered at the firm level are applied to mitigate issues of heteroskedasticity and serial correlation across panels.

Variables	Nature	Measurement	References	Data Source	Expected Sign
Return on Assets $ROA_{i,t}$	Dependent	$ROA_{i,t} = \frac{\text{Net Income}_{i,t}}{\text{Total Assets}_{i,t}}$	Al-Swidi et al. (2021), Iqbal et al. (2020), Olowookere et al. (2023)	Nigerian Stock Exchange (2014–2023)	+
Current Ratio $CURR_{i,t}$	Independent	$CURR_{i,t} = \frac{\text{Current Assets}_{i,t}}{\text{Current Liabilities}_{i,t}}$	Olawale & Garba (2022), Adegbie & Adeniran (2021), Usman et al. (2024)	Annual Financial Reports (2014–2023)	±
Working Capital $WKCP_{i,t}$	Independent	$WKCP_{i,t} = \text{Current Assets}_{i,t} - \text{Current Liabilities}_{i,t}$	Ibrahim et al. (2021), Ojo & Adebayo (2020), Adeola (2023)	Audited Financial Statements (2014–2023)	±
Quick Ratio $QUIR_{i,t}$	Independent	$QUIR_{i,t} = \frac{\text{Current Assets}_{i,t} - \text{Inventory}_{i,t}}{\text{Current Liabilities}_{i,t}}$	Nwankwo & Okeke (2021), Lawal & Akinola (2023), Eze et al. (2024)	Annual Reports and Financial Databases (2014–2023)	±

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Variables	Nature	Measurement	References	Data Source	Expected Sign
Cash Conversion Cycle $CCC_{i,t}$	Independent	$CCC_{i,t}$ $= \text{Inventory Period}_{i,t}$ $+ \text{Receivables Period}_{i,t}$ $- \text{Payables Period}_{i,t}$	Emeka & Udeh (2020), Onwumere (2022), Bello & Yusuf (2024)	Company Disclosures and Industry Reports (2014–2023)	+/−
Firm Size $FSIZ_{i,t}$	Moderator	$FSIZ_{i,t} = \ln(\text{Total Assets}_{i,t})$	Adeyemi et al. (2022), Okafor & Onwuka (2023), Chukwu (2021)	Financial Statements & NSE Database (2014–2023)	−

Table 1: Variable Measurement Table

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Results and Implications

Result Interpretation

The descriptive statistics (Table 2) offer initial insights into the central tendencies and dispersion levels of the study variables. The mean return on assets (ROA) stands at 0.089, indicating moderate profitability in a sector grappling with regulatory pressures, import dependence, and foreign exchange volatility. The current ratio exhibits a mean of 1.596, suggesting that on average, firms maintain an acceptable liquidity buffer above the conventional benchmark of 1.5. However, the standard deviation of 0.783 for the current ratio and 0.641 for ROA indicates considerable inter-firm variability, potentially reflective of operational inefficiencies and disparate capital structures.

The correlation matrix (Table 3) highlights significant associations between key variables. Notably, the current ratio exhibits a statistically significant negative correlation with ROA ($r = -0.295$, $p < 0.1$), suggesting a potential trade-off between liquidity and profitability. Quick ratio and cash ratio show weaker and statistically insignificant associations with ROA, hinting at less influence of highly liquid assets or cash holdings on firm-level profitability. Firm size (proxied by the natural logarithm of total assets) positively correlates with ROA ($r = 0.338$), reinforcing the notion that scale economies may enhance resource utilization and profitability, consistent with resource-based perspectives (Barney et al., 2021).

Diagnostic tests (Table 4) confirm that the model assumptions are reasonably satisfied. Variance inflation factors (VIFs) fall below the threshold of 5, indicating no serious multicollinearity among the explanatory variables. The Shapiro-Wilk test for normality yields p-values above 0.05 for most variables, supporting the assumption of normal distribution required for efficient GLS estimation. Furthermore, the Breusch-Pagan test rejects the null hypothesis of homoscedasticity ($p < 0.05$), justifying the application of Generalized Least Squares (GLS), which is robust to heteroscedasticity. Table 5 (Hausman Specification Test) indicates that the random effects model is appropriate and preferred for the analysis, as it is consistent and more efficient than the fixed effects model.

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Variable	Mean	Std. Dev.	Min	Max
$ROA_{i,t}$	0.089	0.164	-0.192	1.315
$CURR_{i,t}$	1.596	0.396	0.030	3.559
$QUIR_{i,t}$	1.426	1.013	0.099	7.190
$CASH_{i,t}$	-12.890	174.522	-622.000	539.000
$FSIZ_{i,t}$	10.064	0.346	9.193	10.993

Table 2: Descriptive Statistics

Variables	(1) $ROA_{i,t}$	(2) $CURR_{i,t}$	(3) $QUIR_{i,t}$	(4) $CASH_{i,t}$	(5) $FSIZ_{i,t}$
(1) $ROA_{i,t}$	1.000				
(2) $CURR_{i,t}$	-0.295* (0.003)	1.000			
(3) $QUIR_{i,t}$	-0.098 (0.334)	-0.180 (0.074)	1.000		
(4) $CASH_{i,t}$	-0.073 (0.469)	0.025 (0.805)	0.029 (0.777)	1.000	
(5) $FSIZ_{i,t}$	-0.213* (0.033)	0.073 (0.471)	0.110 (0.276)	-0.133 (0.186)	1.000

Table 3: Pairwise Correlations (Panel Variables)

Note: *** p<0.01, ** p<0.05, * p<0.1

	Normality (Shapiro-Wilk W)				Multicollinearity (VIF)	
Variable	**W**	**V**	**z**	**Prob > z**	**VIF**	**1/VIF**
$ROA_{i,t}$	0.684	26.064	7.233	0.000	—	—
$CURR_{i,t}$	0.879	9.961	5.099	0.000	1.050	0.952
$QUIR_{i,t}$	0.597	33.246	7.773	0.000	1.040	0.962
$CASH_{i,t}$	0.933	5.540	3.798	0.000	1.040	0.962
$FSIZ_{i,t}$	0.972	2.316	1.863	0.031	1.020	0.980

Table 4: Normality (Shapiro-Wilk W) and VIF Tests

Statistic	Value
Chi-square test	2.458
P-value	0.652

Table 5: Hausman Specification Test

International Journal of Applied Research in Business and Management (ISSN: 2700-8983)
an Open Access journal by Wohllebe & Ross Publishing, Germany.
Volume: 06 Issue: 05 Year: 2025
https://doi.org/10.51137/wrp.ijarbm.457

Tables 6 and 7 report GLS regression results, with Table 7 incorporating firm size as a moderator. To streamline the discussion, the key findings from both tables are integrated here.

The current ratio exhibits a statistically significant negative effect on ROA (β_1 = -4.633, p = 0.001), suggesting that higher levels of current assets relative to liabilities may reduce profitability, potentially due to inefficient capital allocation or excessive liquidity, in line with agency theory (Jensen & Meckling, 1976; Fosu et al., 2021). The quick ratio and cash ratio do not have significant direct effects on ROA (β_2 = 0.717, p = 0.400; β_3 = 0.000, p = 0.871), nor do their interactions with firm size yield significant results (β_6 = -0.072, p = 0.393; β_7 = 0.000, p = 0.893) (Jensen & Meckling, 1976; Fosu et al., 2021). The interaction term between current ratio and firm size (β_5 = 0.448, p = 0.002) is positive and significant, indicating that larger firms can leverage their liquidity more efficiently, transforming potential inefficiencies into profitability gains (Ozkan et al., 2021; Al-Najjar & Kilincarslan, 2019).

The quick ratio and cash ratio do not have significant direct effects on ROA (β_2 = 0.717, p = 0.400; β_3 = 0.000, p = 0.871), nor do their interactions with firm size yield significant results (β_6 = -0.072, p = 0.393; β_7 = 0.000, p = 0.893). This suggests that excluding inventory or focusing solely on cash holdings does not substantially impact profitability in the Nigerian pharmaceutical sector, consistent with evidence from inventory-intensive industries (Anser et al., 2022; Adusei & Alagidede, 2020; Zimon & Tarighi, 2021).

Firm size, as an independent regressor, negatively affects ROA (β_4 = -0.762, p = 0.007), implying potential diseconomies of scale or bureaucratic inefficiencies in larger firms, which may offset the benefits of scale (Chen et al., 2020; George & Kabir, 2021).

Overall, the model explains 25.1% of the variation in ROA (R^2 = 0.251, F = 4.404, p < 0.01), indicating a modest but statistically significant fit. These results highlight that firm size significantly moderates the liquidity-profitability relationship, particularly for the current ratio, emphasizing the strategic importance of scale in liquidity management.

$ROA_{i,t} = \alpha + \beta_1 CURR_{i,t} + \beta_2 QUIR_{i,t} + \beta_3 CASH_{i,t} + \beta_4 FSIZ_{i,t} + \varepsilon_{i,t}$

Variable	Parameter Symbol	Coef.	St.Err.	t-value	p-value
$CURR_{i,t}$	β_1	-0.125*	0.040	-3.120	0.002
$QUIR_{i,t}$	β_2	-0.021	0.016	-1.320	0.189
$CASH_{i,t}$	β_3	0.000	0.000	-0.910	0.365
$FSIZ_{i,t}$	β_4	-0.089	0.046	-1.950	0.054
Constant	α	1.217*	0.457	2.660	0.009
Statistics:					
R-squared		0.148			
F-test		4.139			

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$ROA_{i,t} = \alpha + \beta_1 CURR_{i,t} + \beta_2 QUIR_{i,t} + \beta_3 CASH_{i,t} + \beta_4 FSIZ_{i,t} + \varepsilon_{i,t}$

Variable	Parameter Symbol	Coef.	St.Err.	t-value	p-value
Prob > F		0.004			

Table 6: GLS Regression of ROA

Note: *Significant at 5% or below (p < 0.05)

Variable	Parameter	Coef.	St.Err.	t-value	p-value
$CURR_{i,t}$	β_1	-4.633*	1.388	-3.340	0.001
$QUIR_{i,t}$	β_2	0.717	0.848	0.850	0.400
$CASH_{i,t}$	β_3	0.000	0.003	-0.160	0.871
$FSIZ_{i,t}$	β_4	-0.762*	0.275	-2.770	0.007
$CURR_{i,t} \times FSIZ_{i,t}$	β_5	0.448*	0.138	3.240	0.002
$QUIR_{i,t} \times FSIZ_{i,t}$	β_6	-0.072	0.084	-0.860	0.393
$CASH_{i,t} \times FSIZ_{i,t}$	β_7	0.000	0.000	0.130	0.893
Constant	α	7.962*	2.757	2.890	0.005
Statistics:					
R-squared	0.251				
F-test	4.404				
Prob > F	0.000				

Table 7: GLS Regression Results with Interaction Terms

Note: *Significant at 5% or below (p < 0.05)

Hypotheses Evaluation

The results facilitate a systematic evaluation of the null hypotheses. H_{01}, which posits that the current ratio has no significant effect on ROA, is rejected based on the statistically significant negative coefficient (p = 0.002). This aligns with the theoretical argument that excessive liquidity may reflect underutilized assets and suboptimal financial planning (Gitman et al., 2022). The result also corroborates prior empirical studies in Nigeria (Oseghale & Akinmulegun, 2021) and Kenya (Okiro et al., 2021), which found that higher liquidity does not always enhance profitability in capital-intensive industries.

H2 and H3, concerning the quick and cash ratios respectively, cannot be rejected, as their coefficients are statistically insignificant (p > 0.1). This suggests that while liquidity is necessary for operational continuity, not all forms of liquidity uniformly influence firm performance. The finding reflects recent

evidence from sub-Saharan African firms, where idle cash holdings and overly conservative liquidity practices sometimes dampen returns (Boateng et al., 2020).

H4, which proposes that firm size does not significantly moderate the current ratio–ROA relationship, is decisively rejected due to the positive and significant interaction term ($p = 0.002$). This supports contingency theory and the resource-based view, which suggest that organizational context, including firm size, modifies the effectiveness of financial policies (Barney et al., 2021; Bhunia & Roy, 2022). Larger firms may be better positioned to invest excess liquidity into profitable ventures or to negotiate favorable credit terms, thereby neutralizing the adverse effect of high current ratios on performance.

In contrast, H5 and H6 concerning the moderating role of firm size on the quick and cash ratio–ROA relationships are not rejected, as the interaction terms are insignificant. This result implies that while firm size matters in the context of broader liquidity management (i.e., current ratio), it may not substantially alter the impact of more restrictive liquidity measures on profitability. This nuance reflects operational realities in the Nigerian context, where cash constraints and working capital cycles vary significantly between large and small firms (Musa & Ogundeji, 2023).

Discussion and Implications

First, the negative impact of current ratio on profitability suggests that corporate managers in healthcare manufacturing firms should avoid maintaining excessively high liquidity buffers. Instead, they should consider investing surplus current assets into short-term productive activities or flexible financing instruments to enhance returns, as emphasized by Gitman et al. (2022). This finding aligns with Adegbie and Adeniran (2021) and Adeola (2023), who also reported that overly conservative liquidity management can reduce firm profitability in Nigerian manufacturing and pharmaceutical firms. However, it contrasts with Fosu et al. (2021), who observed a positive relationship between liquidity and performance in other African contexts, suggesting that sectoral and contextual differences may influence liquidity outcomes.

Second, the significant moderating role of firm size highlights the need for targeted liquidity strategies based on firm-specific characteristics. Policymakers and financial advisors should provide differentiated liquidity management guidelines for small and large firms, recognizing that large firms can better absorb liquidity shocks without sacrificing profitability (Bhunia & Roy, 2022). This corroborates findings by Agyemang et al. (2023), Alqahtani and Mayowa (2021), and Ismail and Almutairi (2022), who demonstrated that firm size enhances the ability to leverage liquidity for superior financial performance, reinforcing the moderating role of size in liquidity-profitability relationships.

Third, the finding that quick and cash ratios do not significantly influence performance calls for a re-evaluation of traditional liquidity metrics in performance assessments. Regulatory bodies and financial

analysts should consider incorporating broader working capital efficiency indicators, especially in highly regulated sectors like pharmaceuticals (Boateng et al., 2020). This result is consistent with Olalekan et al. (2022), who argued that not all liquidity ratios equally predict performance and that sector-specific dynamics may diminish the influence of cash and quick ratios.

Fourth, the government and capital market regulators should design incentive structures that support growth-oriented liquidity management, particularly for smaller firms. For instance, tax incentives for reinvestment of idle cash or subsidized credit lines for working capital improvements may help bridge the performance gap associated with firm size disparities (Okiro et al., 2021). This recommendation is in line with the policy-oriented suggestions of Adeyemi et al. (2022) and Bassey et al. (2021), who emphasized that regulatory and fiscal support can strengthen the performance of smaller firms in the Nigerian manufacturing sector.

Lastly, the evidence underscores the importance of capacity-building programs in financial planning and treasury management, particularly for mid-sized firms in the healthcare sector. Institutions such as the Financial Reporting Council of Nigeria and the Institute of Chartered Accountants of Nigeria (ICAN) can develop sector-specific financial training programs to enhance liquidity utilization and profitability (Nwakoby et al., 2023). This aligns with the resource-based perspective, as suggested by Barney (1991) and reinforced in recent empirical studies (Atta & Mensah, 2023), indicating that developing firm-specific capabilities in liquidity management can create sustained competitive advantage.

Conclusion

This study investigated the moderating role of firm size in the relationship between liquidity indicators and financial performance (proxied by ROA) of listed healthcare and pharmaceutical manufacturing firms in Nigeria, using panel data spanning 2014 to 2023. Drawing on agency theory and resource-based perspectives, the analysis applied panel regression techniques to assess both direct and interaction effects of liquidity metrics on profitability. The findings reveal that only the current ratio has a statistically significant direct effect on ROA, while the quick ratio and cash ratio do not significantly affect profitability. Importantly, firm size significantly moderates the effect of the current ratio on ROA, suggesting that larger firms are better able to transform liquidity into higher profitability. These results indicate that larger firms may leverage liquidity for superior operational performance due to economies of scale, stronger governance structures, and improved access to financing (Agyemang et al., 2023; Enekwe et al., 2020).

Despite the study's robustness and contribution to firm-level financial research in Nigeria's healthcare and pharmaceutical manufacturing sector, certain limitations are noteworthy. First, the study's sample was limited to ten firms due to data availability, which may limit generalizability across other sectors or

sub-industries. Second, the exclusive reliance on accounting-based performance metrics such as ROA may not fully capture market-based evaluations or investor perceptions of performance. Third, potential omitted variables, such as inflation volatility, policy shifts, or macroeconomic shocks (e.g., COVID-19 pandemic), were not explicitly controlled for but could influence the liquidity-performance dynamics observed. These constraints, though mitigated using diagnostic checks and robustness analysis, imply that the results should be interpreted within the context of these limitations.

Based on the findings, the following actionable recommendations are proposed for practitioners in the healthcare and pharmaceutical sector:

Tailored liquidity management: Firms should adopt liquidity practices aligned with their size and operational complexity. Larger firms should prioritize optimizing current and quick assets to enhance profitability, while smaller firms may need to balance liquidity with investments in productive assets (Atta & Mensah, 2023; Bassey et al., 2021).

Board oversight of liquidity strategies: Corporate boards should periodically review liquidity strategies and integrate them into broader financial performance objectives, particularly during periods of economic uncertainty. Regulatory guidance: Financial regulators, such as the Financial Reporting Council of Nigeria (FRCN) and the Securities and Exchange Commission (SEC), should promote industry-specific liquidity benchmarking standards for health-critical sectors. Policy support for smaller firms: Policymakers should provide targeted support for liquidity enhancement, through tax incentives or working capital credit schemes, to strengthen the resilience and performance of smaller pharmaceutical firms. Incorporating firm size in strategy: Firm managers should consider firm size as a key contextual variable in liquidity-performance decision-making, ensuring strategies are informed by empirical evidence and theoretical frameworks (Agyemang et al., 2023; Atta & Mensah, 2023).

The study contributes to financial theory and suggests avenues for future research:

Theoretical contributions: By demonstrating the moderating role of firm size in the liquidity-profitability nexus, the study reinforces the relevance of agency theory and resource-based perspectives in understanding firm performance heterogeneity (Barney, 1991; Jensen & Meckling, 1976). It highlights that liquidity management alone is insufficient to explain profitability without considering firm-specific contextual factors such as size and governance.

Future research directions:

- Expanding the scope to market-based performance measures, such as Tobin's Q or earnings per share (EPS), to capture investor sentiment and stock valuation impacts.

- Conducting cross-country comparative studies involving Sub-Saharan African nations to explore how institutional and regulatory contexts affect the liquidity-performance relationship.
- Exploring sectoral variations in liquidity strategy effectiveness across healthcare, manufacturing, and technology sectors.
- Applying dynamic panel models or structural equation modeling (SEM) to strengthen causal inference and examine complex mediating and moderating relationships (Ali & Anwar, 2022; Andoh & Obeng, 2020).

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International Journal of Applied Research in Business and Management (ISSN: 2700-8983)
an Open Access journal by Wohllebe & Ross Publishing, Germany.
Volume: 06 Issue: 05 Year: 2025
https://doi.org/10.51137/wrp.ijarbm.457

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