THE ROLE OF BANK SIZE IN LIQUIDITY MANAGEMENT: INSIGHTS FROM EMERGING MARKETS

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Abstract

Liquidity management is a critical function for banks, particularly in emerging market economies (EMEs), where financial markets are less developed and more volatile (Tan & Tuluca, 2024; Umar et al., 2023). However, the extent to which bank size influences liquidity management strategies in EMEs remains insufficiently explored. This study investigated the relationship between bank size and liquidity management practices using a sample of 40 commercial banks from 11 EMEs. Employing the system generalised method of moments (GMM) estimator, the study analysed how bank size affects liquidity buffers and funding strategies. The findings reveal significant differences in liquidity management between small and large banks. Large banks maintain lower liquidity reserves, leveraging better access to external funding and capital markets, whereas small banks hold higher liquidity buffers due to limited funding options and greater financial constraints. Risk aversion and prudence emerge as key factors shaping liquidity strategies across bank sizes. These insights contribute to the broader understanding of liquidity dynamics in EMEs, with implications for financial stability, banking regulation, and policy design. The study provides valuable guidance for regulators, practitioners, and academics, highlighting the need for tailored liquidity regulations that consider the distinct challenges faced by banks of varying sizes in EMEs.

Keywords: Bank Size, Bank Liquidity Management, Commercial Banks, Emerging Markets, System GMM

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1. INTRODUCTION

Effective liquidity management is a critical imperative for banks, particularly in the context of emerging market economies (EMEs), where financial markets are often characterised by heightened volatility and imperfections (Tan & Tuluca, 2024; Umar et al., 2023). The multifaceted nature of liquidity management is linked to several key determinants, including the size of the bank, its business model, regulatory environment, and the prevailing macroeconomic conditions (Bhati et al., 2021; Eyalsalman et al., 2024; Mashamba, 2021; Yitayaw, 2021). This study examined the crucial role played by bank size in shaping the liquidity management practices of banking institutions operating within EMEs.

Large banks have a specific trend, as evidenced by their inclination to maintain minimal liquidity reserves. This can be attributed to a variety of factors that distinguish them from their smaller counterparts. Firstly, large banks enjoy access to a more extensive array of liquidity solutions, such as negotiable certificates of deposits and brokered deposits, providing them with a distinct advantage in navigating liquidity challenges (DeYoung & Jang, 2016). Additionally, their elevated reputation and perceived lower risk in capital markets afford large banks superior access to funding sources, including capital markets and liability funding. Secondly, the loan portfolios of these banking giants are strategically endowed with more liquid assets, including syndicated loans that can be readily liquidated in times of heightened liquidity demands (DeYoung & Jang, 2016). Thirdly, the reliance of large banks on capital markets for funding diminishes their imperative to maintain high liquidity buffers (Distinguin et al., 2013). This strategic approach aligns with the contours of the "too big to fail" (TBTF) theory, postulating that large and complex banks, owing to their systemic importance, are more likely to receive government bailouts during times of crisis (Kaufman, 2013). Consequently, the expectation of external support from the lender of last resort diminishes the incentive for large banks to hold large liquidity buffers (Antoun et al., 2021; Aspachs et al., 2005; Repullo, 2004). This strategic behaviour is further corroborated by Bai et al. (2018), who empirically demonstrate that large banks face the largest liquidity shortfalls, indicating a calculated reliance on the TBTF safeguard.

In contrast to their larger counterparts, small banks operate within a different risk paradigm, where the prospect of failure is perceived as more acceptable due to their limited potential to trigger systemic disturbances. Consequently, small banks adopt a strategic approach by prioritising the maintenance of substantial liquidity buffers, recognising their restricted access to government bailouts and external liquidity support (Kashyap et al., 2002; Kostyuk et al., 2013; Kostyuk & Ivanyi, 2015). Moreover, Delechat et al. (2012) contend that smaller banks that confront heightened financial constraints encounter difficulties in accessing funding from capital markets. This constraint prompts small banks to proactively uphold elevated levels of liquidity buffers, driven by a precautionary motive. Thus, the financial landscape for small banks, characterised by a scarcity of external financial support, underscores the imperative for self-reliance in liquidity management. This reliance on internal resources further highlights the divergence in liquidity management strategies between large and small banks. While large banks predominantly lean on capital markets for their liquidity needs, small banks, constrained by their financial limitations, find themselves compelled to depend on their internal reserves for effective liquidity management.

This dichotomy in liquidity management strategies not only reflects the differing risk profiles of large and small banks but also has profound implications for their overall business models. Large banks, buoyed by their reliance on capital markets, are inclined to pursue wholesale-oriented business models. In contrast, small banks, driven by the need for self-sufficiency, often lean towards a retail business model that emphasises traditional financial intermediation (Hasan & Soula, 2017). This distinctive approach to liquidity management and business models underscores the dynamics at play, shedding light on the strategic choices made by banks of varying sizes in their liquidity management. The study explored whether liquidity management practices among banks in EMEs exhibit variations based on their asset sizes.

While studies have examined liquidity management strategies in developed economies (Arzevitin et al., 2019; Berger & Bouwman, 2017; DeYoung & Jang, 2016), less is known about how bank size influences liquidity practices in emerging markets. Key differences suggest these practices may diverge. Emerging markets often lack the market structures and diverse funding sources of advanced economies (Ediagbonya & Tioluwani, 2023), compelling banks to maintain larger liquidity buffers as a precautionary measure. Regulatory frameworks also prioritise stability over efficiency, imposing high liquidity requirements that may reduce the TBTF effect (Subhanij, 2010). Additionally, emerging markets have fewer instances of large-scale bank bailouts (Joseph, 2013), creating uncertainty around government intervention and encouraging even large banks to adopt conservative liquidity strategies. Understanding these dynamics is essential for assessing liquidity management in emerging markets.

Examining how bank size influences liquidity management in emerging markets is crucial. These economies are prone to financial crises, and bank failures can amplify instability. Large banks with lower liquidity buffers may face higher liquidity risks, posing systemic threats. Investors and depositors rely on banks to manage liquidity effectively, making it essential to assess how bank size affects liquidity risk. Understanding these dynamics can strengthen depositor confidence and financial stability. Additionally, insights into liquidity practices support risk mitigation and crisis preparedness (Bonfin & Kim, 2012), helping banks to navigate economic shocks in emerging markets. Through this analysis, the study makes a significant contribution by exploring a specific aspect of banking behaviour in emerging markets. It adds to the academic knowledge, providing insights that can be used for further research and academic discourse. Besides, policymakers and regulators rely heavily on insights into financial institution behaviour to formulate effective policies and regulatory frameworks. The study's examination of how bank size influences liquidity management is instrumental in developing targeted policies that address the specific needs and challenges faced by banks operating in emerging markets.

The study is structured as follows. Section 2 reviews relevant literature. Section 3 details the methodology. Section 4 presents results and discussion, and Section 5 concludes with key insights and policy recommendations.

2. LITERATURE REVIEW

2.1. Theoretical foundations

The theoretical foundations underpinning the relationship between bank size and liquidity management provide essential frameworks for understanding the dynamics within financial institutions. These theories elucidate how the size of a bank may influence its liquidity management strategies and risk preferences (Kaufman, 2013; Williamson, 1967). One prominent theoretical lens is the TBTF theory, suggesting that larger banks, deemed systemically important, are more likely to receive government bailouts in times of distress (Kaufman, 2013). Consequently, these banks may exhibit a lower inclination to maintain large liquidity buffers, anticipating external support in the face of crises. The TBTF theory underscores the interplay between a bank's size, its systemic significance, and the corresponding implications for liquidity management.

Additionally, the organisational control theory posits that, as banks grow in size and geographical reach, the hierarchical control over successive levels diminishes (Williamson, 1967). Large banks, with extensive branch networks and operational complexity, may face challenges in monitoring employees effectively. This theory implies that large banks tend to adopt standardised operational procedures, including lending policies based on readily available "hard information" from financial statements. Consequently, this may influence their liquidity management practices, emphasising the reliance on quantifiable data. Moreover, the information asymmetry theory sheds light on how banks of different sizes handle informational challenges for lending decisions. Small banks, with closer and more personal relationships with clients, are posited to have a comparative advantage in accessing "soft information" such as character and reliability, gathered through personal interactions (Berger & Udell, 2002). This theory implies that small banks may place a higher emphasis on qualitative factors in their lending decisions, influencing their liquidity management strategies. These theoretical frameworks collectively contribute to our understanding of the intricate relationship between bank size and liquidity management. The TBTF theory highlights the systemic implications, the organisational control theory addresses operational procedures, and the information asymmetry theory delves into the qualitative aspects of information handling (Berger & Udell, 2002; Kaufman, 2013; Williamson, 1967). These foundational theories provide a conceptual lens through which to interpret and contextualise the findings in the subsequent sections.

2.2. Review of related literature

Amaral (2021) analysed the liquidity positions of Portuguese and Spanish commercial banks from 2002 to 2015 to test whether bank size affects liquidity management. The results support the hypothesis that liquidity management practices differ by size, especially in Spain, where smaller banks have more stability and higher liquidity than larger banks. This is consistent with the view that small banks hold large liquidity buffers due to limited access to external financing (Kashyap et al., 2002). The study also confirms that large banks are less liquid, in line with the TBTF theory.

Ardekani et al. (2020) explored the relationship between bank size, network position, and liquidity management in the context of European financial markets. They used a sample of banks from different sectors (commercial, investment, real estate, and mortgage) and countries (28 in total) to examine how their liquidity ratios varied according to their network centrality and access to external funding. They discovered that large and medium-sized banks, which occupied more central positions in the interbank network, tended to have lower liquidity ratios than smaller banks, which were more peripheral. They attributed this difference to two main factors: first, large and medium-sized banks had superior access to external funding from the interbank market, which reduced their dependence on holding liquid assets; second, they benefited from perceived safety nets from the government, such as the lender-of-last-resort facility, which lowered their liquidity risk. On the other hand, smaller banks faced several obstacles that constrained their liquidity flexibility: first, they suffered from asymmetric information and creditworthiness issues, which made it harder for them to obtain external funding; and second, they had limited network connections, which narrowed their options for borrowing liquidity from other banks. These factors forced smaller banks to operate with higher liquidity levels and larger buffer stocks than their larger counterparts.

Multiple studies highlight the relationship between bank size and liquidity management, with size influencing both stability and liquidity levels. For example, Ma and Li (2020) and Khan et al. (2017) show that large banks in China and the US, respectively, exhibit greater stability and capital buffers when less reliant on deposits (low deposit-to-asset ratio). This suggests that large banks might hold higher liquidity reserves. Pham et al. (2021) further support this with Vietnamese data, finding that larger banks hold more liquid assets. However, Lastuvkova (2016) cautions against oversimplification. Their study in Czech, Slovak, and Slovenian markets reveals that the size-liquidity relationship is nuanced, with different sizes and asset types impacting various liquidity ratios in diverse ways. This underscores the importance of considering bank size and type when designing macroprudential policies, as the size-liquidity link varies across subgroups and sectors. Therefore, while larger banks may generally hold higher liquidity buffers and exhibit greater stability, the influence of size on liquidity management is complex and requires careful consideration of bank-specific characteristics and market context.

On the other hand, Bonner et al. (2015) challenge the linear assumption about bank size and liquidity buffers by analysing data from reporting banks in 30 Organisation for Economic Co-operation and Development (OECD) countries. The surprising finding reveals a non-linear pattern: medium-sized banks hold the least liquid assets, while the largest banks maintain the most. This counterintuitive result is attributed to the heightened scrutiny faced by large, systemically important banks, leading to the necessity for larger liquidity buffers to ensure regulatory compliance and overall financial stability. Additionally, Awad (2020) suggests that large banks may use their extensive branch networks to improve their liquidity position.

Discussing the precautionary motive for banks to hold liquidity buffers, Delechat et al. (2012) emphasise that small banks face difficulties in accessing external financing, creating incentives for them to maintain substantial liquidity buffers. This evidence aligns with Dinger's (2009) findings of a non-linear relationship, where smaller banks in Europe tend to hold more liquidity. In a study on UK banks, Aspachs et al. (2005) did not find evidence supporting the idea that large banks hold liquidity buffers. This contradicts Kashyap et al.'s (2002) earlier research, which suggests a strong impact of bank size on liquid asset holdings.

This literature review synthesises diverse empirical findings, revealing the intricate interplay between bank size and liquidity management. Non-linear patterns, varying influences across bank sizes and sectors, and the impact of external financing constraints underscore the need for detailed considerations when formulating policies aimed at enhancing liquidity management within the banking sector.

3. METHODOLOGY

3.1. Data and sample

The sample included 40 commercial banks from 11 EMEs: Hong Kong, India, Mexico, Saudi Arabia, South Africa, Argentina, Indonesia, Korea, Russia, Singapore, and Turkey. From a population of 91 banks, the study applied the screening criteria of Bruno et al. (2016) and Berger and Bouwman (2009) to exclude non-"pure" commercial banks. Exclusion criteria included zero deposits, no outstanding loans, no commercial real estate or industrial loans, zero or negative equity, or resembling a building society (home loans exceeding 50% of gross total loans). The study period covered January 2011 to December 2016. Bank-level data were sourced from Income Statements and Balance Sheets via the Bureau van Dijk Orbis Financial Information Service, while macro-financial data came from the World Bank Economic Indicators. Due to data constraints in emerging markets, year-end data were used, reflecting slow portfolio changes (Berger & Bouwman, 2009). Missing data were supplemented from individual bank websites. All financial statements were consolidated and converted to USD to ensure comparability.

3.2. Variables description and hypotheses

3.2.1. Dependent variable: Liquidity ratio

The study followed Chen et al. (2022), Al-Qudah (2020), and Polizzi et al. (2020) in using the liquid asset ratio (*LIQ*) as a measure of bank liquidity. *LIQ* is computed by dividing a bank's total liquid assets by its total assets. A heightened *LIQ* ratio signifies an increased capacity of a bank to weather liquidity shocks, indicating a robust liquidity position. This approach aligns with established practices in the literature and facilitates a comprehensive evaluation of a bank's resilience in the face of potential liquidity challenges.

3.2.2. Explanatory variables

The bank-specific factors are described by the following variables:

- Lagged dependent variable ($LIQ_{jc,\,t-1}$): To account for the inertia inherent in liquidity management, the study incorporated the lagged dependent variable (previous period's liquidity ratio) as one of the explanatory variables. This recognises that adjusting liquidity levels is not instantaneous, often due to frictions in capital markets that create adjustment costs (DeYoung & Jang, 2016). These costs, in turn, disincentivise frequent adjustments and incentivise banks to hold larger buffers of readily available assets. Therefore, the study hypothesises that the presence of adjustment costs motivates banks to maintain higher liquidity buffers as a strategic safeguard against unexpected shocks.
- Bank capital (*CAP*): Two theories explain the relationship between bank capital and liquidity: risk absorption and financial fragility. The risk absorption theory suggests that higher capital absorbs losses, enabling greater risk-taking and reducing liquidity buffers, as banks rely less on liquid assets (Carney, 2013; Repullo, 2004; Von Thadden, 2004). Strong capital buffers also boost investor and depositor confidence, allowing well-capitalised banks to hold fewer liquid assets without risking funding access (Bonner & Hilbers, 2015). Conversely, the financial fragility theory (Diamond & Rajan, 2000, 2001) predicts a positive link between capital and liquidity. It argues that high capital leads banks to hold more liquid assets to reassure depositors and mitigate losses (Levine & Sarkar, 2019). Given these conflicting views, this study anticipated either a positive or a negative coefficient for capital. Bank capital is measured as the tier 1 and tier 2 capital ratios to risk-weighted assets.
- Bank size (*SIZE*): The TBTF theory posits that regulators are likely to intervene and prevent the collapse of large banks due to their interconnectedness and potential systemic impact. This may incentivise mega banks to target lower liquidity buffers based on the belief that government bailouts will protect them in case of trouble. Additionally, large banks often exhibit stable cash flows, superior access to capital markets and investment opportunities, diverse business lines, and loan portfolios rich in highly liquid assets such as syndicated loans (DeYoung & Jang, 2016; Kochubey & Kowalczyk, 2014). Furthermore, their dominant market share and market power (Awad, 2020; Gautam, 2016) might further entice them to hold lower liquidity reserves. Therefore, the study expected a negative relationship between size and liquidity.
- Profitability (return on equity — *ROE*): The relationship between bank profitability and liquidity is unclear, with recent research painting opposing pictures. On one hand, higher profitability might dampen a bank's need for hefty liquidity buffers, as argued by Konovalova (2019) and Bonner and Eijffinger (2012). Their view rests on the improved access to debt markets that profitable banks enjoy due to their stronger creditworthiness (Berger & Udell, 1998). This enhanced debt-funding capacity makes them less constrained by liquidity shortfalls, potentially leading them to hold lower levels of readily available assets (Berger & Bouwman, 2009). However, a contrasting perspective, championed by Deans and Stewart (2012) and Debelle (2012), suggests that profitability can boost liquidity levels. Their reasoning hinges on the idea that substantial profits tend to translate into robust cash holdings (Dang, 2023). This abundance of internal funds can provide profitable banks with the luxury of maintaining larger liquidity buffers, acting as a safety net against unforeseen shocks. Given these divergent perspectives and ambiguous empirical evidence, a clear expected relationship is difficult to formulate.
- Loan growth (*LG*): Lending constitutes the core activity of commercial banks, generating interest income and driving their profitability (Yhip & Alagheband, 2020). Consequently, loan demand plays a crucial role in shaping banks' liquidity management strategies (Irani & Meisenzahl, 2017). When loan demand is low, banks tend to accumulate larger liquidity buffers as a safety net against potential shocks (Adrian & Shin, 2010). Conversely, strong loan demand periods incentivise banks to allocate more resources towards loans, potentially leading to lower liquidity holdings. Therefore, this study hypothesised that loan growth will negatively influence bank liquidity. The study estimated loan growth as the percentage change in gross loans from the previous year.

• Loan loss reserves ratio (*LLOSS*): The asset quality signalling hypothesis proposes that a bank's loan portfolio risk directly influences its liquidity management strategies (Lucas & McDonald, 1992). This study examined this link by focusing on the loan loss reserves ratio, measured as the proportion of loan loss reserves to gross loans. Higher reserves reflect a bank's anticipation of increased credit losses, potentially signalling financial distress to external funding sources (Ambarchian, 2017; Mattingly & Abou-Zaid, 2015). Consequently, banks with deteriorating asset quality might face reduced access to external financing and the subsequent risk of declining loan repayments (Tabak et al., 2013). To mitigate these risks, banks experiencing high loan losses are expected to maintain larger liquidity buffers. Therefore, based on the aforementioned theoretical insights, this study expected a positive association between loan loss provisions and bank liquidity holdings.

• Deposit-loan synergy (*DLS*): Banks play a crucial role in providing liquidity services to depositors and borrowers through offerings such as checking accounts for depositors and credit lines for borrowers. In the process of delivering these services, banks expose themselves to liquidity risk, a challenge that can be mitigated through effective risk management strategies. Kashyap et al. (2002) propose a risk-hedging approach wherein banks combine transaction/demand deposits (DD) with loan demands. Gatev et al. (2007) emphasise that, when cash demands from depositors are not correlated with credit line drawdowns by borrowers, banks can leverage cash inflows from DD to fulfil loan commitment requests. This operational synergy, known as the deposit-loan synergy, enables banks to concurrently reduce cash holdings and cater to the needs of both depositors and borrowers. This study posited that the deposit-loan synergy is inversely associated with banks' liquidity buffers, aligning with insights from Fungáčová et al. (2017). The variable representing this synergy, denoted as *DLS*, is calculated by multiplying loan commitments by DD.

• Transaction deposits (*TD*): One of the primary roles of commercial banks in an economy is to offer maturity transformation services to economic agents, that is, to accept short-term deposits and issue long-term loans (Yhip & Alagheband, 2020). Consequently, the principal source of liquidity for commercial banks tends to be transaction (demand) deposits. As such, banks with high levels of DD are expected to be highly liquid. Likewise, given that the withdrawal of transaction deposits is unpredictable, DD carries a high risk of unexpected withdrawals; hence, as transaction deposits increase, banks should invest more in liquid assets to ameliorate liquidity risk (Chen & Phuong, 2014). This study, therefore, predicted that banks with large transaction deposits target low liquidity. The value of total DD is taken as the proxy variable for transaction deposits.

• Deposit insurance (*DEP*): Beyond bank-specific factors, this study also investigated the influence of deposit insurance on liquidity holdings. Its presence mitigates depositor anxiety and curbs the threat of bank runs, essentially externalising liquidity risk from individual banks to a broader collective (Anginer & Demirgüç-Kunt, 2018). This reduces individual banks' incentive to hold large precautionary buffers as the collective insurance scheme acts as a safety net against potential deposit outflows (Ngo et al., 2016). However, the effectiveness of deposit insurance in lowering liquidity buffers is not clear-cut. Moral hazard concerns and potential design flaws within the scheme can incentivise banks to engage in riskier behaviour, potentially offsetting the initial reduction in precautionary liquidity holding (Howarth & Quaglia, 2020). Therefore, this study expected a negative, but potentially weaker association between deposit insurance and bank liquidity holdings. While deposit insurance should initially decrease liquidity buffers, its effectiveness might be dampened by moral hazard and other design features. The study captured deposit insurance presence using a dummy variable (*DEPINS*) that equals one for countries with coverage and zero otherwise.

• Business cycles (gross domestic product — *GDP*): In environments marked by capital market frictions, the liquidity buffers of banks tend to exhibit countercyclical behaviour (Aspachs et al., 2005; Delechat et al., 2012). Countercyclical patterns manifest as banks accumulating liquidity reserves during periods of economic weakness, possibly attributed to heightened default risk and subdued loan demand. Conversely, these buffers are drawn down during economic upswings, reflecting increased lending opportunities and reduced default risk. Accordingly, the study hypothesised that business cycles exert a negative influence on banks' liquidity buffers. In line with Plakalovic and Alihodzic (2015), this study utilised the annual growth in real GDP as a proxy for business cycles.

• Savings (*SR*): The availability of liquid assets for banks is an important factor that affects their ability to meet their obligations and provide credit to the economy. One of the sources of liquidity for banks is the savings of the corporate and household sectors, which are deposited into banks or invested in their debt products. Therefore, the level of savings in a country may have a significant impact on the liquidity of its banking system. This study examined the role of savings in influencing the adjustments of bank liquidity in different countries. It is hypothesised that higher savings levels lead to higher liquidity levels for banks, as they increase the inflow of funds and reduce the need for external borrowing. To test this hypothesis, the study used the savings ratio as the main explanatory variable, which measures the proportion of gross national savings to the total gross national product (GNP). The savings ratio reflects the aggregate saving behaviour of the economy and its potential contribution to bank liquidity. The study followed the approach taken by Ma and Yi (2010), who used the same variable to analyse the determinants of bank liquidity in China.

• Monetary policy (*CBR*): Worldwide, central banks wield a range of tools, including short-term interest rate adjustments, to influence economic activity through their impact on bank behaviour (Bahaj & Reis, 2023). These adjustments, known as central bank rates or policy rates, directly affect banks' liquidity management due to the transmission mechanisms of monetary policy (Acharya & Rajan, 2022). Research suggests that banks respond to interest rate changes by strategically adjusting their holdings of liquid securities relative to total assets (Xiao & Krause, 2022). When central banks lower rates (easing policy), banks tend to hold more liquid assets in anticipation of increased lending and investment activity (Aspachs et al., 2005). Conversely, policy tightening through rate hikes prompts banks to reduce their liquid holdings to offset higher borrowing costs (Chen & Phuong, 2014; Xiao & Krause, 2022). Therefore, this study posited a negative relationship between bank liquidity and policy rates, aligned with prior findings (Aspachs et al., 2005; Chen & Phuong, 2014). The study employed the central bank rate as a proxy for monetary policy, consistent with established practice.

3.3. Empirical model

This study examined whether liquidity management practices pursued by banks operating in EMEs vary according to bank size. To achieve this objective, the study first assumed that banks have an unobservable internal target liquidity ratio, which they consider to be the optimal level of liquidity, that balances the benefits and costs of maintaining liquid assets. The study further assumed that the internal target liquidity ratio is driven by a set of observable characteristics. Therefore, in line with DeYoung and Jang (2016), the banks' desired liquidity ratio (LIQ_{ict}^*) is modelled as a function of the banks' observable characteristics as follows:

$$LIQ_{ict}^* = \beta X_{ict} + \eta_t + \nu_{it} + \varepsilon_{it} \tag{1}$$

where,

- LIQ_{ict}^*: target liquidity ratio for i at time t in country c, which is perceived to vary across banks and over time;
- β: vector of coefficients to be determined;
- X_{ict}: vector of bank-specific characteristics as well as macroeconomic fundamentals that influence the liquidity ratio setting;
- η_t: time effects;
- ν_{it}: bank fixed effects (FE);
- ε_{it}: idiosyncratic error term.

The study employed a dynamic panel framework, where bank liquidity (LIQ_{ict}) adjusts gradually toward its target level due to market frictions. The speed of adjustment (λ) reflects how quickly banks close the gap between actual and target liquidity. The model (see Eq. (1)) incorporates bank-specific factors (capital, size, loan growth, loan losses, profitability, deposit structure) and macroeconomic variables (GDP, interest rates, monetary policy). It is estimated using the system generalised method of moments (GMM) to control for endogeneity and unobserved heterogeneity.

$$\begin{aligned} LIQ_{ict} = \alpha + \lambda LIQ_{ic,t-1} + \beta_1 CAP_{ict} + \beta_2 SIZE_{ict} + \beta_3 LG_{ict} + \beta_4 LLOSS_{ict} + \beta_5 ROE_{ict} + \beta_6 DLS_{ict} + \beta_7 TD_{ict} \\ + \theta DEPINS_{ct} + \gamma_1 GDP_{ct} + \gamma_2 SR_{ct} + \gamma_3 MP_{ct} + \eta_t + \nu_{it} + \varepsilon_{it} \end{aligned} \tag{2}$$

where,

- LIQ_{ict}: liquidity ratio;
- $LIQ_{ic,t-1}$: lagged liquidity ratio;
- CAP_{ict}: bank capital;
- $SIZE_{ict}$: bank size;
- LG_{ict}: loan growth;
- $LLOSS_{ict}$: loan loss;
- ROE_{ict}: return on equity;
- DLS_{ict}: deposit loan synergy;
- TD_{ict}: transaction deposits;
- $DEPINS_{ct}$: dummy variable;
- GDP_{ct}: real gross domestic product growth;
- SR_{ct}: savings ratio;
- MP_{ct}: monetary policy proxied by central bank rate;
- η_t: time effects;
- ν_{it}: bank FE;
- ε_{it}: idiosyncratic error term.

To test whether liquidity management practices vary by asset size, the study employed a sample-splitting approach, classifying banks as small or large based on the median asset size (50%). Banks below the median are categorised as small, while those above are classified as large. Two dummy variables, *SMALL* and *LARGE*, are introduced into the baseline model (Eq. (3)), leading to the following modified equations:

For small banks:

$$\begin{aligned} LIQ_{ict} = \alpha + \lambda LIQ_{ic,t-1} + \beta_1 CAP_{ict} + \beta_2 SMALL_{ict} + \beta_3 LG_{ict} + \beta_4 LLOSS_{ict} + \beta_5 ROE_{ict} + \beta_6 DLS_{ict} + \beta_7 TD_{ict} \\ + \theta DEPINS_{ct} + \gamma_1 GDP_{ct} + \gamma_2 SR_{ct} + \gamma_3 MP_{ct} + \eta_t + \nu_{it} + \varepsilon_{it} \end{aligned} \tag{3}$$

For large banks:

$$\begin{aligned} LIQ_{ict} = \alpha + \lambda LIQ_{ic,t-1} + \beta_1 CAP_{ict} + \beta_2 LARGE_{ict} + \beta_3 LG_{ict} + \beta_4 LLOSS_{ict} + \beta_5 ROE_{ict} + \beta_6 DLS_{ict} + \beta_7 TD_{ict} \\ + \theta DEPINS_{ct} + \gamma_1 GDP_{ct} + \gamma_2 SR_{ct} + \gamma_3 MP_{ct} + \eta_t + \nu_{it} + \varepsilon_{it} \end{aligned} \tag{4}$$

The study examined whether liquidity management strategies differ by bank size using a sample-splitting approach. Recognising that small and large banks face different constraints and opportunities, this method accounts for potential heterogeneity in liquidity practices. The median asset size (50%) was used to divide banks into two groups, ensuring balanced observations and a meaningful size distinction. This approach was based on the theoretical argument that bank size influences liquidity costs, benefits, and access to alternative funding sources. Splitting into three groups (small, medium, and large) would reduce statistical power, introduce arbitrariness, and complicate result interpretation. The two-group classification provides a clear and efficient test of the research hypothesis.

3.4. Estimation technique

The dynamic nature of Eqs. (2), (3), and (4) raise endogeneity concerns, making static panel regression models, such as ordinary least squares (OLS), FE, and random effect (RE), unsuitable. Endogeneity arises from the correlation between explanatory variables and unobserved FE, as well as the correlation between the lagged dependent variable and the error term. While the FE and RE estimators address FE, they introduce bias in dynamic panels. To overcome these limitations, the study employed the two-step system GMM estimator (Blundell & Bond, 1998), which effectively handles persistence, dynamic panel bias, endogeneity, heteroscedasticity, and autocorrelation. This method is well-suited for panel data with a large number of banks and a short time frame. While the two-stage least squares (2SLS) or instrument variables techniques could be employed for analysis, their effectiveness relies on the availability of valid and strong instruments, which could be challenging in the context of this study. Moreover, system GMM was considered the most appropriate estimator given the small *N* and large *T* of the dataset.

4. RESULTS AND DISCUSSION

4.1. Descriptive statistics

The study provided descriptive statistics to offer a comprehensive overview of bank-specific characteristics. This included a detailed examination and summary of key quantitative measures and features that define and distinguish individual banks within the study. The descriptive statistics serve as a valuable tool for understanding the central tendencies, variations, and distributions of these characteristics, providing readers with a clear and insightful snapshot of the diverse attributes exhibited by the banks under investigation.

Table 1. Descriptive statistics

Variables	*Mean*		*Standard deviation*		*Minimum*		*Maximum*	
	Small (1)	*Large (2)*	*Small (3)*	*Large (4)*	*Small (5)*	*Large (6)*	*Small (7)*	*Large (8)*
Bank liquidity (*LIQ*)	38.60	29.88	21.61	25.24	4.17	2.43	76.34	74.91
Bank capital (*CAP*)	14.36	17.57	14.36	5.52	9.66	9.41	18.91	45.75
Loan growth (*LG*)	7.76	19.13	7.76	34.01	-13.13	-29.53	46.58	196.35
Loan loss (*LLOSS*)	2.58	2.06	2.58	1.73	0.114	0.08	18.56	9.02
Return on equity (*ROE*)	10.21	9.30	10.21	16.65	-21.73	-86.75	23.45	32.58
Transaction deposits (*TD*)	6.19	8.55	6.19	1.07	4.01	7.00	7.65	10.47

Source: Authors' elaboration based on data from Bureau van Dijk Orbis Financial Information Service.

Table 1 above presents descriptive statistics for the period January 2011 to December 2016. The sample was divided into two groups based on balance sheet size. Small banks hold an average of 38.60% of their assets in liquid securities, compared to 29.88% for large banks, indicating a greater reliance on liquidity buffers due to limited access to external funding (Berger & Bouwman, 2009). Large banks maintain 17.57 cents in tier 1 and tier 2 capital per dollar of risk-weighted assets, while small banks hold 14.36 cents. This contradicts the TBTF theory, suggesting that large banks in emerging markets remain well-capitalised (Hasan & Soula, 2017).

Loan growth differs significantly, with large banks expanding their portfolios at an average rate of 19.13%, while small banks grow at 7.76%. This supports the view that larger banks create more liquidity through lending (Berger & Sedunov, 2017). In contrast, small banks outperform large banks in profitability, achieving an average *ROE* of 10.21 cents per dollar of equity, compared to 9.30 cents for large banks. The higher *ROE* may result from small banks' focus on traditional intermediation, which tends to be more profitable than the diversified activities of larger banks (Hasan & Soula, 2017).

4.2. Empirical results

The results of estimating Eqs. (2), (3), and (4) using the two-step system GMM estimator are reported in Table 2. Columns 2, 3, and 4 of Table 2 correspond, respectively, to the whole sample (Model 1), the small banks subsample (Model 2), and the large banks subsample (Model 3).

Table 2. Empirical results

Variables	*Whole sample*	*Small banks*	*Large banks*
Lagged liquid asset ratio ($LIQ_{ic,\,t-1}$)	0.5467*** (0.1508)	0.8382*** (0.2721)	0.6927*** (0.1660)
Bank capital (*CAP*)	5.8783** (2.9607)	2.2815*** (0.4931)	-0.1588 (0.3139)
Bank size (*SIZE*)	-0.0917 (0.2373)	-	-
Loan growth (*LG*)	0.0513*** (0.0148)	0.0433** (0.0222)	0.0584*** (0.1135)
Asset quality (*LLOSS*)	-2.283*** (0.5783)	2.0690 (1.4027)	-2.1115** (0.8373)
Profitability (*ROE*)	-0.1947*** (0.0286)	0.1952*** (0.0603)	-0.1760*** (0.0452)
Deposit-loan synergy (*DLS*)	-0.2321*** (0.0390)	0.1834*** (0.0521)	-0.0623 (0.0679)
Transaction deposits (*TD*)	11.9923** (5.6294)	4.0565 (3.5735)	17.3825*** (5.7208)
Deposit insurance coverage (*DEPINS*)	63.4001 (97.4963)	95.3926** (40.2759)	-205.1127*** (48.7456)
Business cycle (*GDP*)	1.8842** (0.8626)	-2.4793*** (0.8361)	1.9277** (0.8473)
Savings ratio (*SR*)	-1.3611*** (0.4114)	0.0407 (0.5627)	-0.9750 (0.4493)
Monetary policy (*CBR*)	-0.4843 (0.5559)	-0.4296 (0.2744)	0.4642 (0.4262)
Sargan test	0.6190	0.5345	0.3492
Arellano Bond (2) test	0.5911	0.8638	0.4713
Wald test	914.68***	11800.63***	6043.16***

*Note: ***, **, * indicate statistical significance at 1%, 5% and 10%, respectively. Standard errors are shown in parentheses (brackets).*
Source: Authors' elaboration based on data from Bureau van Dijk Orbis Financial Information Service.

4.2.1. Lagged dependent variable

The positive and statistically significant coefficient of the lagged liquidity ratio (*LIQ*) confirms that banks in emerging markets follow a partial adjustment model. Liquidity ratios exhibit persistence, indicating that banks actively manage their liquidity but adjust slowly due to adjustment costs. The speed of adjustment, calculated as 1 minus the coefficient of the *LIQ*, is 0.1618 for small banks and 0.3073 for large banks. At these rates, small banks take approximately 6.18 years to close their liquidity gap, while large banks take 3.25 years. This slow adjustment aligns with the hypothesis that adjustment costs incentivise banks to maintain liquidity buffers (Drobetz et al., 2015). Large banks adjust their liquidity more quickly than small banks, likely due to fewer financial frictions. Their greater access to capital markets, stronger bargaining power, and diverse funding sources reduce financial constraints, allowing for faster liquidity adjustments (Amaral, 2021; Ardekani et al., 2020).

4.2.2. Bank capital

The results in Table 2 show that capital adequacy influences liquidity differently across bank sizes. For small banks, the positive and statistically significant coefficient (2.28) of *CAP* in column 2 suggests that higher capital levels lead to greater liquidity buffers. This supports the financial fragility theory, which posits that weaker capital structures drive banks to hold more liquid assets as a precautionary measure. In contrast, the negative but statistically insignificant coefficient (-0.16) of *CAP* in column 3 suggests that the effect of capital on liquidity for large banks is inconclusive. Large, well-capitalised banks in emerging markets likely rely more on wholesale funding to manage liquidity, similar to trends observed in advanced markets (Berger & Bouwman, 2009; Kochubey & Kowalczyk, 2014). This suggests that, while capital growth prompts large banks to hold lower liquidity levels, small banks maintain higher liquidity due to financial constraints.

4.2.3. Loan growth

Loan growth positively influences liquidity holdings of small and large banks in emerging markets, as the coefficient of the parameter is both positive and statistically significant in both estimates. The coefficient for small banks is 0.0433 (column 2, Table 2) while the coefficient for large banks is 0.0584 (column 3, Table 2). The impact of loan growth appears to have a similar effect (in terms of statistical and economic significance) on liquidity adjustments for banks of all sizes in emerging markets since the coefficients are not significantly different. This result implies that banks in emerging markets tend to increase their liquidity buffers when they expand their lending activities, regardless of their size. This may reflect the precautionary motive of banks to cope with the uncertainty and volatility of funding markets in developing countries (Nguyen & Nguyen, 2022). Alternatively, this may indicate the regulatory pressure of banks to comply with the minimum liquidity requirements imposed by the Basel III framework. According to the literature, loan growth and liquidity holdings of banks are influenced by various factors, such as funding liquidity, bank capital, macroeconomic conditions, and institutional environment (Acharya & Rajan, 2022; Agoraki et al., 2011; Nguyen & Nguyen, 2022).

4.2.4. Asset quality

The results in Table 2, column 1, show that deteriorating asset quality leads to reductions in bank liquidity, as fund providers withdraw support from banks experiencing higher loan defaults. This effect is more pronounced in large banks, where the positive and statistically significant coefficient of *LLOSS* supports the signalling hypothesis of asset quality (Lucas & McDonald, 1992). For large banks, the significant negative coefficient (-2.11) of *LLOSS* (column 3) indicates that worsening asset quality corresponds to liquidity losses, likely due to increased credit risk, making them less attractive to depositors and creditors. In contrast, for small banks, the positive coefficient (2.07) of *LLOSS* (column 2) is statistically insignificant, suggesting that the study did not find strong evidence of a consistent positive relationship between *LLOSS* and liquidity. These findings highlight differences in liquidity management between small and large banks, emphasising how asset quality signals affect funding availability and risk perception across bank sizes.

4.2.5. Profitability

The findings presented in columns 2 and 3 of Table 2 indicate a positive impact (0.2) of profitability on liquidity adjustments for small banks, whereas this relationship is negative (-0.18) for large banks. These results imply that small banks tend to allocate a portion of their profits to liquid securities, contributing to the augmentation of their liquidity reserves. Conversely, akin to the overall sample outcomes, it seems that a surge in profits prompts large banks to reduce their investments in liquid assets. This behaviour of large banks may stem from the capacity of high profits to facilitate debt servicing, leading them to invest less in liquid securities, given their ease of accessing external funding in EMEs (Roman & Sargu, 2015).

4.2.6. Deposit loan synergy

The empirical results from columns 2 and 3 of Table 2 reveal insights into the relationship between the *DLS* variable and the liquid assets ratio for both small and large banks. For small banks, a positive association (0.18) is observed between the *DLS* variable and the liquid assets ratio. This implies that small banks, capitalising on the synergy between deposits and loans, tend to hold higher levels of liquid assets. The positive coefficient indicates that an increase in the *DLS* variable is associated with a higher liquid assets ratio for small banks. In contrast, for large banks, the relationship is negative (-0.06) but statistically insignificant. This suggests that changes in the *DLS* variable do not have a statistically significant impact on the liquid assets ratio for large banks. It seems that the positive association between *DLS* and liquid assets for small banks reflects a cautious liquidity management strategy. However, the non-significant relationship for large banks suggests that factors beyond the deposit loan synergy play a more prominent role in shaping their liquidity decisions. Further investigation into the operational and strategic dynamics of small and large banks is warranted for a deeper understanding of observed patterns.

4.2.7. Transaction deposits

The positive and statistically significant coefficient (17.38) associated with transaction deposits in the large banks model (column 3) underscores a compelling association between changes in transaction deposits and shifts in liquidity ratios for large banks in emerging markets. This suggests that large banks rely significantly on transaction deposits as a determinant of their liquidity positions. Interestingly, this finding diverges from the results of Distinguin et al. (2013) in the US, who reported that small banks tend to allocate a higher proportion of total assets to loans and deposits due to their greater inclination toward traditional financial intermediation. Conversely, the statistically insignificant impact of DD on liquidity holdings for small banks implies that changes in DD do not play a substantial role in determining the liquidity positions of small banks. The insignificant impact of transaction deposits on changes in liquidity for small banks implies that these institutions may adopt alternative strategies, such as leveraging capital and utilising profits, to fortify their liquidity reserves.

4.2.8. Deposit insurance

Deposit insurance aims to prevent bank runs by reassuring depositors, thereby stabilising liquidity (Howarth & Quaglia, 2020). The empirical results indicate that this effect varies by bank size.

For small banks, the significantly positive coefficient (95.39) of *DEPINS* in column 2 of Table 2 suggests that deposit insurance strengthens liquidity by boosting depositor confidence. In contrast, the negative and statistically significant coefficient (-205.11) in the large bank model indicates that deposit insurance encourages risk-taking behaviour in large banks. This aligns with the moral hazard theory, which suggests that guaranteed protection may lead banks to invest in riskier assets rather than maintain liquidity (Demirgüç-Kunt & Detragiache, 2002; Ngalawa et al., 2016). The findings highlight the different liquidity management strategies of small and large banks in emerging markets, emphasising the need to consider bank size when designing deposit insurance policies.

4.2.9. Business cycle

The results show that real domestic output (*GDP*) negatively affects liquidity adjustments in small banks but positively affects large banks. The negative coefficient (-2.48) in the small banks model indicates a countercyclical pattern, with liquidity buffers decreasing in expansions and increasing in contractions. In contrast, the positive coefficient (1.93) for large banks suggests pro-cyclical behaviour, as liquidity rises during expansions and falls in downturns. This may reflect large banks' strategic response to increased credit demand and investment opportunities during economic growth. These findings highlight differing liquidity management strategies between small and large banks in emerging markets.

4.2.10. Savings ratio

The regression results show a significant effect of the savings variable on liquidity for the full sample, but this impact varies by bank size. For small banks, the positive but insignificant coefficient (0.04) suggests that savings fluctuations do not drive liquidity adjustments. Similarly, the negative but insignificant coefficient (-0.98) for large banks indicates that savings changes do not significantly influence their liquidity positions either. These findings suggest that savings patterns are not a consistent driver of liquidity changes across bank sizes in emerging markets.

4.2.11. Monetary policy

The insignificant effect of the central bank rate on liquidity adjustments in emerging markets, as indicated by results in columns 2 and 3, suggests that changes in the central bank rate do not have a statistically significant impact on influencing liquidity positions of banks in these markets, all else being equal. These results suggest that the traditional interest rate transmission mechanism, where changes in the central bank rate affect lending and borrowing activities, may not be operating strongly in the observed emerging markets. Other factors, such as market structure, financial regulations, or alternative sources of funding, might be influencing banks' liquidity more than the central bank rate.

5. CONCLUSION

This study examined how balance sheet size influences liquidity management in emerging market banks. The findings show that banks maintain target liquidity ratios, adjusting gradually amid market frictions. Large banks adjust liquidity faster, suggesting fewer financial constraints. Capital significantly drives liquidity in small banks, but has an unclear effect on large banks. Deposit insurance boosts liquidity for large banks but reduces it for small ones. Liquidity buffers are countercyclical for small banks and procyclical for large ones. These results highlight distinct liquidity strategies based on bank size, contributing to the understanding of liquidity dynamics in emerging markets.

The implications of these findings are far-reaching. Banks, particularly smaller ones, should tailor risk management strategies based on their unique characteristics. Robust capital structures are crucial for small banks, and regulatory bodies may consider initiatives to promote adequate capitalisation. Policymakers need to evaluate deposit insurance policies carefully, striking a balance to ensure stability without encouraging moral hazard. Acknowledging the gradual adjustment of liquidity due to market frictions is vital, and strategies should be developed to navigate these frictions effectively, especially for larger banks. Considering the countercyclical and procyclical nature of liquidity buffers, banks, regulators, and policymakers should adopt proactive measures to maintain financial stability during economic expansions and contractions. Tailoring regulatory measures to account for the diverse liquidity management needs of banks, based on their size, could enhance the effectiveness of regulatory frameworks. Prudent deposit and funding practices, particularly during economic uncertainty, may benefit banks, contributing to stable liquidity positions. Continuous monitoring of liquidity management practices, considering the evolving dynamics of financial markets and economic conditions, is crucial for fostering adaptability. In essence, the study underscores the need for a tailored and dynamic approach to liquidity management practices, considering the distinctive characteristics and challenges faced by banks of different sizes. Policymakers, regulators, and banks themselves should collaborate to create an environment that encourages prudent risk management and contributes to the overall stability of the financial system.

While the two-category split provides valuable insights, it does not account for medium-sized banks. Future research could adopt a three-category approach for a more detailed analysis of liquidity management across bank sizes. The two-category split was a strategic choice aligned with this study's objectives, but different research questions may require alternative categorisations. Additionally, regulatory changes can influence liquidity management, and this study did not capture future shifts. Future research could use dynamic modelling, such as simulations, to assess how banks adjust liquidity practices in response to evolving regulations.

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