International Journal of Management and Commerce
www.managementjournal.in
Online ISSN: 2664-6854
Received: 17-04-2026, Accepted: 18-05-2026, Published: 02-06-2026
Volume 8, Issue 2, 2026, Page No. 30-36

Does mobile banking affect bank liquidity? Evidence from State-Owned Banks in Indonesia

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DOI: https://doi.org/10.66856/ijmc.2026.8.2.8041

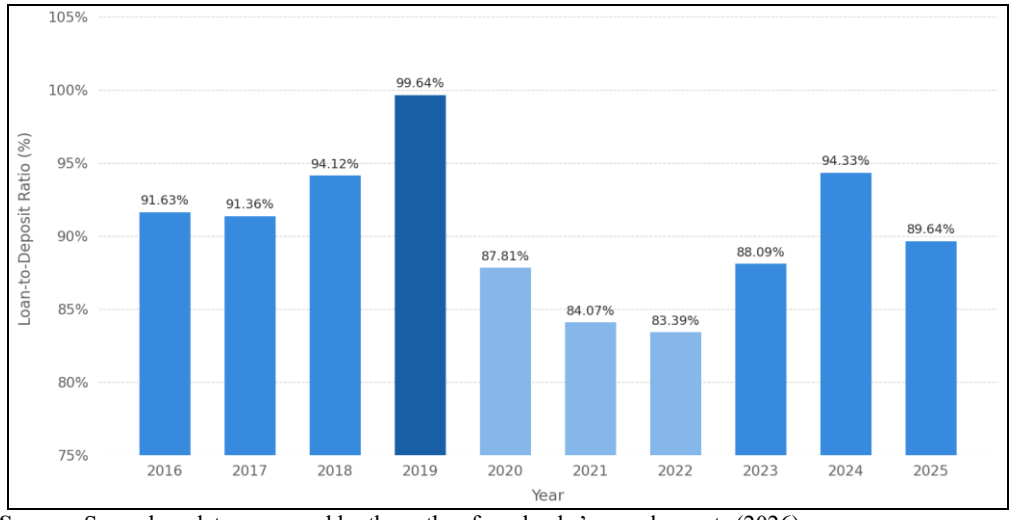
Abstract
The link between mobile banking adoption and bank liquidity is not well-defined, particularly in state-owned banks in emerging markets. This study delves into the impact of mobile banking on the loan-to-deposit ratio (LDR) of Indonesian state-owned banks, referred as BUMN banks. It evaluates mobile banking intensity by analyzing registered users, transaction volume, and transaction value to assess the scope of adoption, transaction frequency, and financial depth. Utilizing a panel data regression analysis, the study finds that only transaction value has a significant and positive effect on LDR, while user adoption and transaction volume have positive but not significant effects. This finding aligns with a credit-facilitation mechanism, indicating the role of high-value digital interactions. This is particular when supported by integrated loan products and extensive financial activities on mobile platforms can enhance credit demand and intermediation ratios. These results suggest that the effect of mobile banking on liquidity is dependent on digital intensity, with the financial depth of engagement being the key driver of liquidity dynamics in the BUMN banking sector.

Keywords: Mobile Banking, Digital Banking, Bank Liquidity, Financial Intermediation, State-Owned Bank, Indonesia

Introduction

Bank liquidity is a vital component of financial stability, representing a bank's ability to meet short-term obligations while continuing its primary role in financial intermediation [1–3]. The loan-to-deposit ratio (LDR), which compares total loans to total third-party deposits, is the most prevalent metric for evaluating bank liquidity [4–6]. It functions as both a regulatory benchmark and a strategic performance indicator. An appropriately balanced LDR indicates effective credit intermediation, but both excessively high and low levels present distinct risks [5, 7, 8]. A high LDR can result in liquidity shortages during periods of increased deposit withdrawals [9], whereas a low LDR indicates underutilized funds and lost intermediation income [7]. The task of maintaining this balance for bank stability has become more intricate with the advent of digital financial services [10], as new transaction channels modify the speed, volume, and nature of deposit inflows and credit demand.

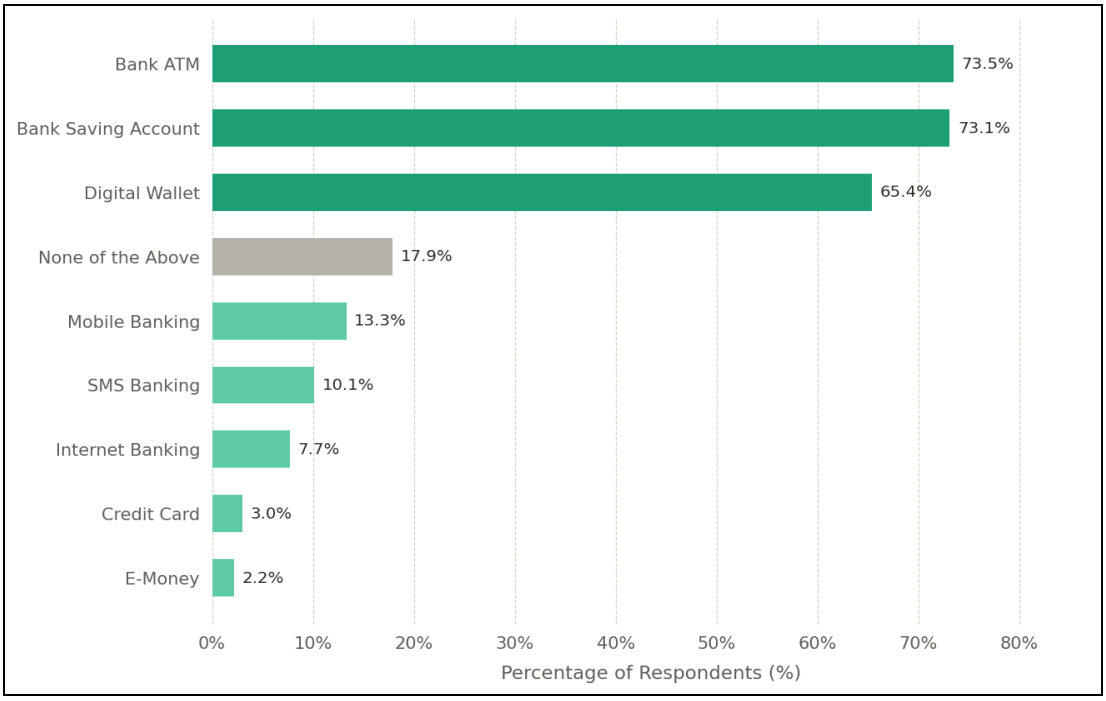
While there is no universally defined "ideal" percentage, banks with LDRs exceeding 95% are more susceptible to increased liquidity risks and potential instability [11–13]. Although Indonesian state-owned banks (hereafter referred to as BUMN banks) generally keep their LDRs within a safe range, there have been occasions of less favorable ratios. For instance, Bank Mandiris LDR fell from 80.04% in 2021 to 77.61% in 2022, and Bank BTN's LDR varied between 102.66% and 113.50% from 2016 to 2019. In addition, the past ten years have seen significant fluctuations, which may be attributed to external influences like cyclical credit growth and government-imposed lending requirements, along with internal financial strategies [14–16]. The variations in trends among comparable banks operating under the same regulatory conditions highlight the importance of understanding the factors that lead to differences in liquidity positions. Despite the rapid progress, the differences in speed and extent of mobile banking adoption among these institutions have not been thoroughly explored.



Source: Secondary data processed by the author from banks' annual reports (2026)

Fig 1: Loan-to-Deposit Ratio Trends of Indonesian State-Owned Banks (2016–2025)

From 2016 to 2025, the evolution of mobile banking in Indonesian BUMN banks was characterized by a complete developmental cycle rather than a simple growth pattern. The initial phase was marked by limited user adoption and frequent system disruptions. It wasn't until around 2020 that fully functional applications became widely available, coinciding with the COVID-19 pandemic, which unexpectedly accelerated the transition to digital platforms due to limited access to physical banking services [17–19]. Despite this shift, the adoption rate remained relatively low. The 2021 Digital Literacy Status Report by the Ministry of Communication and Digital Affairs indicated that only 13.3% of Indonesians regularly used mobile banking, placing it fourth with visible difference behind ATMs (73.5%), traditional bank accounts (73.1%), and digital wallets (65.4%) [20]. This multi-phase development provides variation in digital channel usage intensity over the period and is essential for understanding how mobile banking's relationship with the LDR evolves at different stages of digital maturity.



Source: The 2021 Digital Literacy Status Report by the Ministry of Communication and Digital Affairs (2021)

Fig 2: Digital Banking & Financial Services Used and Frequency of Use in Indonesia in 2021

Although there is growing academic interest in digital banking and financial performance [21–24], the specific impact of mobile banking on bank liquidity, remains underexplored and inconsistent. Most existing studies focus on profitability or efficiency, some use diverse bank samples that obscure institutional characteristics. There is limited evidence using a longitudinal panel of Indonesian BUMN banks with various proxies for mobile banking intensity to study LDR outcomes, which this study seeks to address. This study addresses an ongoing debate in digital banking literature on whether mobile banking adoption affects bank liquidity, with evidence varying by context. Focusing on Indonesian BUMN banks over 10 years, it explores a state-owned banking context distinct from private banks, where dual mandates and policy-driven digital adoption influence intermediation dynamics differently. By using three indicators for mobile banking intensity, which are registered users, transaction volume, and value, this study allows a more nuanced evaluation of digital channel expansion's impact on liquidity. The primary inquiry is, "What impact does the use of mobile banking have on the liquidity of Indonesian state-owned banks, and does this impact differ based on the various dimensions of mobile banking intensity?"

Literature Review and Hypothesis Development

Financial intermediation theory views banks as specialized intermediaries that help minimize information asymmetries and transaction costs when transferring funds from depositors to borrowers [25–28]. The LDR serves as an indicator of the effectiveness and intensity of this intermediation process: a higher LDR suggests that a larger share of collected deposits has been allocated as loans. Digital transformation in banking has been found to boost liquidity creation by optimizing loan loss provisions, enhancing risk tolerance, and reducing financial disintermediation, which is consistent with the essence of financial intermediation theory [29, 30]. Within this context, mobile banking acts as an innovative channel that impacts both sides of the intermediation equation, lowering the cost and increasing the ease of deposit transactions while also reducing obstacles to loan applications and credit uptake [31, 32]. Its overall impact on the LDR is influenced by the relative strengths of responses on the deposit and credit sides, forming a proposition that can be empirically tested.

The extensive empirical research on digital banking and financial performance presents a complex and sometimes contradictory picture. Many studies indicate that mobile and internet banking enhance bank efficiency and profitability. For example, higher volumes of digital transactions are linked to improved cost efficiency in emerging markets, depending on factors such as the economic conditions of the region [33–35]. In Indonesia, the adoption of digital banking enhances financial performance, especially in terms of efficiency and profitability [36–38]. However, not all evidence

supports this view. Some studies find that digital transformation can reduce short-term profitability due to substantial initial investments in infrastructure and skilled labor [39, 40]. Meanwhile, digital banking has no significant effect on the financial performance of smaller rural banks, likely due to limited adoption and operational scale [41]. These discrepancies highlight variations in sample composition, measurement methods, and digital maturity stage across banking systems, emphasizing the importance of institution-specific, longitudinal studies. Studies specifically examining the mobile banking–liquidity connection is more limited.

Some studies suggest that mobile banking enhances deposit mobilization by expanding access to banking services among underserved populations, thus increasing the deposit base and reducing LDR [42, 43]. This mechanism is particularly plausible in emerging markets with significant financial inclusion gaps. Conversely, another line argues mobile banking primarily facilitates credit product uptake by lowering application barriers, increasing loan volumes, and possible impact on raising LDR [44, 45]. Notably, limited study in the available literature has exclusively examined this relationship within BUMN banks over a long panel period, leaving open the question of whether the relationship consistently holds across user adoption, transactional frequency, and monetary volume dimensions.

The institutional framework of BUMN introduces contextual considerations. In Indonesia, state-owned banks are expected to balance financial inclusion and credit expansion with their commercial objectives [46]. Government-endorsed digital financial infrastructure initiatives have accelerated the adoption of mobile banking in BUMN banks beyond what market forces alone might have achieved [47, 48]. This policy-driven expansion shows that mobile banking growth in BUMN banks aims to increase retail deposits and broaden credit access for underserved populations. This dual strategy is expected to raise the LDR, as digital credit expansion increasingly outweighs deposit growth during the observation period. The increasing scale of BUMN mobile banking transactions provides initial evidence of an expanding intermediation footprint due to the growth of digital channels.

Building on this theoretical foundation and previous evidence, this study suggests that mobile banking usage is positively associated with the LDR of Indonesian BUMN banks across all three dimensions of digital intensity. The fundamental mechanism is that mobile banking enhances the efficiency of matching deposit supply with credit demand, enabling banks to allocate a larger portion of mobilized deposits as loans without compromising liquidity safety, consistent with the intermediation efficiency argument. The following directional hypotheses are proposed:

H1: Mobile banking user adoption is positively associated with the loan-to-deposit ratio of Indonesian BUMN banks.

H2: Mobile banking transaction value is positively associated with the loan-to-deposit ratio of Indonesian BUMN banks.

H3: Mobile banking transaction volume is positively associated with the loan-to-deposit ratio of Indonesian BUMN banks.

Methods

This study uses an unbalanced panel dataset including four BUMN banks in Indonesia, which include Bank Mandiri, Bank BRI, Bank BNI, and Bank BTN covering 2016 to 2025, totaling up to 40 bank-year observations. Bank BSI, an Islamic state-owned bank, is excluded as it was formed in beginning of 2021 after a government merger and lacks consistent historical data. These banks are key in Indonesia's state-owned banking sector, holding most of the system's banking assets, deposits, and credit allocations. Data were sourced from Refinitiv Eikon for standardized financial statements and ratio data, and official annual reports on each bank's website.

This study examines bank liquidity using the loan-to-deposit ratio (LDR) as the dependent variable. The LDR is calculated by dividing total loans by total deposits or third-party funds. Recognized by the OJK as the main measure of liquidity for Indonesian banks, it is often cited in the country's banking research. This study uses three independent variables, each reflecting a different aspect of mobile banking intensity across various model specifications: (H1) USER, the natural logarithm of registered mobile banking users; (H2) TRANS, the natural logarithm of annual mobile banking transactions; and (H3) VOL, the natural logarithm of the annual value of mobile banking transactions in IDR. Logarithmic transformation manages significant scale differences across sections and periods. To isolate the mobile banking effects on LDR, five control variables are included: firm size (SIZE), the natural logarithm of total assets, to account for scale economies in intermediation; capital adequacy ratio (CAR), addressing regulatory capital constraints on lending; current account saving account (CS), which represents the proportion of a bank's total deposits held; and leverage ratio (LVG), reflecting core financial strength and its ability to absorb unexpected losses.

the panel data regression analysis is used to address unobserved bank-specific heterogeneity, which could bias coefficient estimates in pooled OLS. Three models are evaluated: common effects model (CEM), fixed effects model (FEM), and random effects model (REM). Classical assumption diagnostics, including tests for normality, multicollinearity, heteroskedasticity, and autocorrelation, ensure estimator validity. Separate regressions for each mobile banking proxy allow direct comparison of effects across digital intensity dimensions. The baseline regression model is specified as follows

$$LDR_{it} = \alpha + \beta_1 MBU_{it} + \beta_2 SIZE_{it} + \beta_3 CAR_{it} + \beta_4 CS_{it} + \beta_5 LVG_{it} + \varepsilon_{it} \quad (1)$$

Where i indexes the individual bank and t indexes the year. MBU_{it} represents $USER_{it}$, $TRANS_{it}$, and VOL_{it} across three specifications corresponding to H1, H2, and H3 respectively. The term ε_{it} refers to the error component, which accounts for the unique variations not explained by the included variables.

Results and Discussion

Table 1 presents descriptive statistics for variables across 40 bank-year observations. The average LDR is 0.897,

indicating high credit deployment, aligning with BUMN banks' intermediation role. The LDR ranges from 0.771 to 1.128, showing variation, including cases where loans exceed deposits. The three mobile banking proxies show different dispersion patterns, which are USER has low variance, implying consistent user base growth over time. In contrast, TRANS and VOL show higher dispersion, indicating differences in transaction intensity and monetary scale. This variation supports a multi-proxy approach, as user count, transaction frequency, and value each capture unique mobile banking behavior aspects.

Table 1: Summary of Statistics

Variable	Mean	Std. Dev.	Min	Max
LDR	0.897	0.082	0.771	1.128
USER	6.612	0.518	5.724	7.601
TRANS	3.185	1.947	1.231	6.658
VOL	8.031	1.342	4.523	9.762
SIZE	1.648	0.224	0.493	2.063
CAR	0.207	0.019	0.171	0.248
LVG	0.829	0.041	0.758	0.924
CSA	0.608	0.097	0.403	0.812

Source: Secondary data, processed by the author (2026)

Before hypothesis testing, model selection and assumption diagnostics were conducted. The Chow test yielded a p-value of 0.422, greater than 0.05, suggesting the null hypothesis of common slopes cannot be dismissed, favoring the CEM over the fixed effects model. The Breusch–Pagan Lagrange Multiplier test further validated the preference for CEM over the random effects model, with a p-value of 1.000, indicating no significant bank-specific random components in this small-N panel. Classical assumption diagnostics showed no multicollinearity, as all VIF values were below 10 with a mean of 4.47, and no heteroskedasticity was detected (Breusch–Pagan/Cook–Weisberg: $x^2(1) = 0.16$, $p = 0.685$), meeting the requirements for unbiased OLS inference.

Table 2 presents the regression results based on the chosen CEM specification. The model as a whole is statistically significant (Prob > F = 0.011) and accounts for approximately 27.8% of the variance in LDR. The relatively lower adjusted R^2 compared to the gross R^2 indicates the panel's limited cross-sectional scope and the presence of several control variables that, although directionally relevant, do not achieve significance in this specification. However, the partial coefficient estimates for the three mobile banking proxies reveal varied insights across the different aspects of digital intensity.

Table 2: Hypothesis Test Results

Variable	Coeff	Std. Error	t-stat	p-value
USER	0.041	0.057	0.72	0.476
TRANS	0.006	0.013	0.46	0.651
VOL	0.034**	0.013	2.62	0.013
SIZE	0.051**	0.029	1.76	0.022
CAR	-0.905	0.571	-1.58	0.123
LVG	-0.418	0.384	-1.09	0.284
CSA	0.381**	0.172	2.22	0.033
Constant	1.683***	0.359	4.69	0.000
R^2	0.412	F-stat	0.011	
Adjusted R^2	0.278	N	40	

Source: Secondary data, processed by the author (2026); Note: ** p-value < 0.05; *** p-value < 0.01

The coefficient for USER was positive ($\beta = 0.041$) but not statistically significant ($p = 0.476$), leading to the rejection of H1. This suggests that an increase in registered users does not significantly change the LDR of BUMN banks. Likely, mobile banking onboarding in the Indonesian BUMN context involves existing clients moving from branch or ATM channels to mobile banking, not new depositors or borrowers. Thus, user growth here is a channel shift, not increased intermediation, leaving the loan-to-deposit ratio largely unchanged. The low variation in USER (SD = 0.518) across the sample supports this: differences in the number of users across banks and years are small, offering limited variation to identify an LDR effect.

The coefficient for TRANS is positive ($\beta = 0.006$) but not statistically significant ($p = 0.651$), leading to the rejection of H2. This aligns with Indonesian mobile banking's transaction structure, where main activities like paying utility bills, topping up e-wallets, and routine fund transfers are primarily fund-routing operations that don't directly increase the loan portfolio or net deposit stock. Thus, frequent mobile transactions indicate convenience rather than deeper intermediation. The impact on LDR is neutralized by simultaneous inflow and outflow transactions, implying no net credit demand or deposit accumulation. The wide variation in TRANS (SD = 1.947) shows significant transaction frequency differences across banks and years, yet this doesn't lead to different LDR outcomes, further suggesting frequency alone isn't a sufficient driver of liquidity dynamics.

The most informative finding pertains to VOL, which has a positive, statistically significant coefficient ($\beta = 0.034$, $p = 0.013$), supporting H3. Banks with higher mobile banking transaction values show increased LDR, aligning with the credit-facilitation mechanism in financial intermediation theory. Unlike transaction frequency, which reflects routine, low-value activities, transaction value is influenced by significant actions like digital loan applications, large transfers for investments, and embedded credit products in mobile banking apps. As BUMN banks have incorporated consumer loan, mortgage pre-approval, and small-business credit features into their platforms the financial scale of digital engagement mirrors credit uptake rather than payment behavior. This suggests it is not the frequency of mobile banking use, but the financial value transacted, that drives credit demand and elevates the loan portfolio, and consequently LDR. This aligns with prior studies [33, 34, 36, 49] who found that digitally enabled credit channels boost loan demand, and with evidence that the income-generating potential of digital banking becomes apparent when the monetary depth of usage is assessed rather than adoption breadth.

Among control variables, CSA is positive and significant, indicating banks with more low-cost current and savings accounts extend more credit (50). A stable, inexpensive liability base reduces costs, enabling aggressive loan expansion, significant in the BUMN context, with CSA ratios from 40.3% to 81.2%. Bank size is also significant, showing larger banks maintain higher credit deployment ratios [51, 52], which might be consistent with scale benefits in credit origination and risk diversification. LVG and CAR are statistically insignificant, likely due to uniform regulatory capital maintenance above OJK minimums, resulting in insufficient variation to detect an independent effect on LDR. Overall, findings present a cohesive narrative: mobile banking intensity, as assessed by

transaction value, and a robust CSA base and larger institutional scale enable BUMN banks to sustain higher intermediation ratios.

Conclusion

This study examined mobile banking's effect on Indonesian BUMN banks' liquidity, indicated by the LDR for 10 years. It evaluated mobile banking intensity through user adoption, transaction volume, and value using an annual panel of four BUMN banks under the common effects model. Only transaction value significantly affects LDR. Banks with higher transaction values have higher LDR, supporting a credit-facilitation mechanism where digital engagement boosts credit demand via integrated loan products and high-value activities. User adoption and transaction frequency positively but insignificantly affect LDR, suggesting channel migration and regular payments don't significantly alter BUMN banks' intermediation balance.

The study's results have multiple implications. For bank management, the value intensity in mobile banking, not the number of users, drives digital engagement relevant to the LDR. Enhancing users' financial engagement through integrated credit offerings, high-value investments, savings options, and digital loan features is likely to affect LDR outcomes more than acquiring new users. The effects of current account savings and bank size suggest that mature digital channels, stable low-cost funding, and institutional scale are key to the advantages of larger state-owned banks. Regulators should focus on transaction values, not user rates, to gain insights into the impact of digital banking on credit growth and liquidity risk. Academically, this study shows that the link between mobile banking and liquidity is sensitive to how digital intensity is measured, and using a single proxy may overlook variations in adoption, frequency, and value dimensions.

Several limitations exist in this study. The sample is limited to four state-owned banks in one categorized as emerging country, which restricts generalization. The use of annual data prevents the examination of short-term liquidity changes influenced by mobile banking. The study does not differentiate transaction values by product type, rather distinguishing between credit and savings activities could improve the understanding of the credit-facilitation mechanism. Future studies could include private or regional banks to determine whether the observed value intensity is unique to state-owned banks. They could also add digital banking metrics, such as mobile loan volumes, fee income, and digital product penetration, to offer a comprehensive view of fintech's impact on banking efficiency.

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