

Non-Performing Assets And Bank Liquidity: A Study Of Indian Commercial Banks

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KEYWORDS <i>NPA, Liquidity Risk, Indian Commercial Banks, RBI, Panel Data Analysis and Capital Adequacy.</i>	ABSTRACT The study examines the impact of the Reserve Bank of India’s Terms of Engagement Regulations on the liquidity of Indian commercial banks in relation to non-performing assets (NPAs). It adopts a quantitative research approach using panel data from 5 publicly listed commercial banks for the period 2015–2024. The independent variables, representing the banks’ asset quality and serving as proxies for service quality, include gross and net NPA ratios. Liquidity is captured through the credit-deposit ratio and the liquid-assets-to-total-assets ratio, while profitability is measured using the return on assets and operating expense ratios. The capital adequacy ratio (CAR), along with bank size and system sustainability, functions as a moderating variable. Descriptive Statistics and Pearson Correlation analyses provide preliminary insights into the relationships among variables, while fixed effects panel regressions are employed to explore the deeper associations between NPAs and liquidity. The regression models assess the extent of average regression adjusted for CAR as strategic capital, with NPA acting as a liquidity buffer. The findings reveal significant patterns in NPA ratios, credit-deposit ratios, and liquid assets relative to gross profit and overall asset quality. Higher NPA ratios indicate insufficient provisioning and a reduction in low-cost liquid assets. Credit flows, adjusted upward, contribute to maintaining a minimal liquidity buffer. The results show a negative relationship between NPAs and liquidity, with CAR playing a supportive role in mitigating the cascading effects of liquidity pressure. This research extends prior studies by incorporating novel liquidity indicators, profitability controls, and the moderating effects of regulatory NPAs. The findings offer valuable insights for enhancing preparedness and guiding bank policymakers toward stronger prudential frameworks for NPA management, thereby improving liquidity resilience and sustaining system-wide stability. ..
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1. INTRODUCTION

The Indian banking sector plays a pivotal role in the nation's economic development, serving as the backbone of growth and wealth creation by mobilizing savings and channelling them into productive investments across various sectors. Commercial banks, in particular, act as the nerve-centres of the financial system, significantly influencing the direction of the economy (Das & Swain, 2017). Since the liberalization, privatization, and globalization (LPG) reforms of 1991, the banking industry has witnessed rapid transformation and increasing competition, with commercial banks emerging as the primary drivers of financial intermediation (Kamra & Kamra, 2013). For India's growth trajectory, an efficient and well-regulated financial system is indispensable because the availability of liquidity through banking institutions determines the pace of investments and sustainable growth (Al-Homaidi et al., 2019).
Despite progress, Indian banks continued to grapple with persistent challenges of rising NPAs and liquidity stress over the 2015–2024 period. NPAs are widely recognised as critical indicators of financial system health, since they directly reflect the asset quality of banks and their exposure to risk (Singh, 2016). The magnitude of this concern is evident in more recent trends: by March 2024, the gross non-performing asset (GNPA) ratio of Scheduled Commercial Banks (SCBs) had moderated



to approximately 2.8%, with the net NPA (NNPA) ratio falling to about 0.6%. This is a significant improvement compared to earlier years of the period. Also, by September 2024, the GNPA ratio stood at ~2.6%, with net NPAs similarly around 0.6%. (Nachimuthu & Veni, 2019; Singh, 2024).

Although public sector banks experience the highest NPA burden, private sector banks are not immune—a trend that has become more visible since 2013 (Sikdar & Makkad, 2013). As NPAs continue to rise, they restrict the availability of lendable funds, weaken credit recycling, and consequently impair liquidity creation at the systemic level (Swain et al., 2017). These dynamics underscore the importance of examining the interrelationships between asset quality deterioration and liquidity stability in India's commercial banks.

1.1 Problem Statement

For banks, NPAs are a particularly acute issue that impedes overall operational effectiveness and financial stability. Non-performing loans constitute a drain of valuable capital that becomes trapped in unproductive assets, a scenario that is, unfortunately, too commonplace today (Chandan Kumar Tiwari & Sontakke, 2013). As interest income diminishes, profitability declines, and the need for capital provisioning increases, a vicious cycle is created that undermines the capital buffer (Chandan Kumar Tiwari & Sontakke, 2013). The reduction in profitability and capital base diminishes competitiveness, and private sector banks (in particular) find themselves increasingly unable to extend credit. Furthermore, systemic liquidity becomes compromised, as faulty credit circulation stagnates (Kamra & Kamra, 2013). From a wider perspective, these challenges impede overall credit and investment inflow, which consequently stifles economic growth. It poses an alarming reality for India's economic health—the high volume of NPA is indicative of far more than a problem confined to individual banks; it is a systemic risk that threatens stability at a macroeconomic scale (Singh, 2016).

The presence of NPAs further heightens bankers' perception of credit risk, leading to a risk-averse lending strategy and a lower lending capacity for the bank (Sikdar & Makkad, 2013). These NPAs put banks under pressure to fulfil dual obligations: managing profits while maintaining the liquidity levels needed to continue servicing credit demand. Veni (2019) and Singh (2024) emphasize the growing recognition that operational performance goes beyond the traditional metrics of scale and reach. In addition, there is an increasing focus on the quality of the bank's asset portfolio, liquidity management, and the performance of the bank's operational systems.

1.2 Research Gap

Many studies have focused on Non-Performing Assets (NPAs) and liquidity management in Indian banking, focusing on their determinants and impact on profitability. However, studies on liquidity often examine short-term liquidity ratios without considering the role of NPAs. Chavan and Rao (2020) found that while liquidity ratios in public and private banks are affected by deposit growth and market interest rates, the contributory role of NPAs remains under-explored. Sharma, Mathur, and Kumar (2023) examined liquidity stress in Indian commercial banks using multiple liquidity measures but did not include NPA ratios as explanatory variables. Swain, Sahu, & Dash (2017) discussed how regulatory parameters, such as the Cash Reserve Ratio (CRR) and Statutory Liquidity Ratio (SLR), significantly influence NPAs in India. However, the management of liquidity by banks in relation to NPAs remains largely neglected. Recent studies have found that increasing NPAs correspond with a significant decline in the liquid assets-to-total assets ratio. Gupta & Singh (2022) showed that gross NPAs have a stronger negative effect on liquidity in banks with lower capital adequacy. Sharma, Mathur, & Kumar (2023) demonstrated that while liquidity stress increases when NPAs rise, some banks with higher capital buffers can mitigate this effect. However, the literature still lacks comprehensive studies spanning the full 2015-2024 period, employing multiple liquidity measures and explicitly modelling NPAs alongside regulatory changes.

1.3 Research Objectives

In light of the identified problems and gaps, the study sets the following objectives:

To examine the relationship between NPA and the liquidity position of Indian commercial banks.

To evaluate the role of regulatory measures, particularly the RBI guidelines, in managing NPAs and preserving liquidity in Indian commercial banks.

Conceptual Framework

Rather, the focus of the study's conceptual framework revolves around the objectives of exploring the correlation between NPAs and the equity of different banks, considering regulatory supervision. The data framework harmonizes bank performance indicators, captured from the dataset, in relation to the theoretical connections, predominantly in the NPA Proxy, associated with public sector banks in India, and the regulatory moderation framework approaches across the Indian banking industry.

The dataset uses indicators of Gross and Net NPAs as proxies for NPAs. These indicators help to gauge the level of deterioration in the banking foundation. The framework implies that the existence of NPAs, especially those that are non-performing, diverts bank liquidity. The impact of NPAs is detrimental to the extent that a portion of the bank's capital is allocated to unproductive assets.



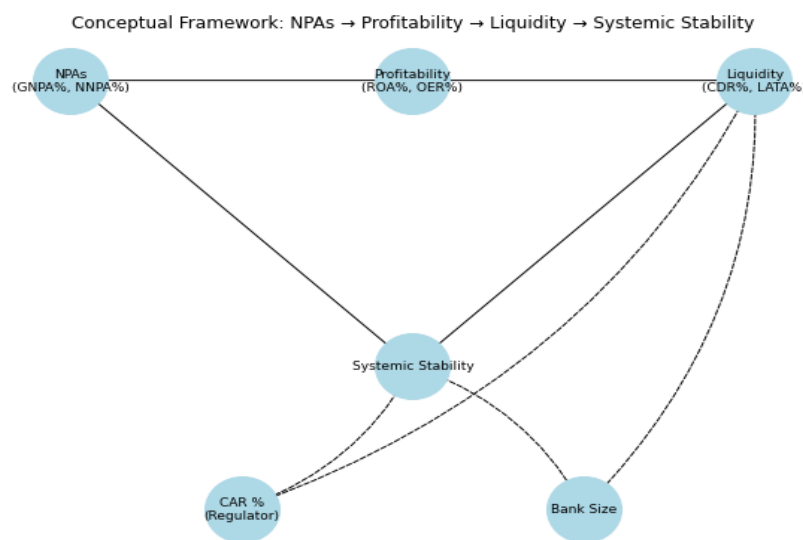
The dependent variables of NPAs in the fictitious banking environment are proxies for liquidity. Liquidity NPAs are measured using proxies such as the Credit Deposit Ratio and the Liquid Assets to Total Assets Ratio.

Key profitability metrics, such as ROA% and OER%, are pivotal to the internal framework and serve as intermediaries connecting NPAs with liquidity. Increased NPAs adversely impact profitability, mostly due to provisioning and the loss of interest income, which in turn affects the liquidity cushions. The CAR% is a reflective layer and a rule of thumb that serves as a regulatory capital buffer, governing balance sheet profitability and liquidity moderation.

In addition, the control variable bank size (Size, represented as the logarithm of total assets) is incorporated as a control variable, in accordance with the scale differentials of banks, which enable them to determine the levels of NPAs, profitability, and liquidity.

Most importantly, the internal framework captures the moderating effect of regulatory actions taken by the RBI, such as CRR, SLR, and liquidity prudential measures. Such regulatory actions provide boundaries and order, which, in their own right, can mitigate or amplify the influence NPAs have on liquidity; hence, they are categorized as moderators altering the strength and direction of the impact relationships.

When NPAs increase, banks' profitability (decreased ROA%, increased OER%) decreases, which decreases liquidity (CDR%, LATA%), and can undermine financial stability. It is further complicated by the bank's capital adequacy ratio (CAR%) and size. The impact of restrictions by the banks' NPAs on the liquidity and stability of the banks is an important (but not sufficiently studied) moderating factor, considering the NPAs' impact on the stability of the system."



Conceptual framework of the study

Significance of the Study

NPAs and direct liquidity have shed light on the relationship between bank managers and deteriorating asset quality, as well as the influence of credit expansion. This relates to more effective lending norms, better delinquent monitoring systems, and more agile enforcement of recovery policies (Singh, 2024). The relationship between NPAs, liquidity, and control, as viewed from a policy angle, helps redefine the RBI framework (Swain et al., 2017), which aims to enhance the defensive posture of the Indian banking sector. From a research angle, there was a clear gap, especially in the existing literature, which is not conclusive about NPA and liquidity. The study is also relevant for its more contemporary and sophisticated appreciation of the relationship, especially from the prism of the Indian banking system.

2. LITERATURE REVIEW

2.1 Theoretical Framework

Credit risk management theories suggest that defaults, asymmetric information, and moral hazard account for the bank's inability to realize a profit from an asset. Adverse selection examines how banks' inability to screen borrowers perfectly leads to riskier portfolios on their balance sheets (Acharya & Yorulmazer, 2008). Moral hazard theories capture borrower repayment behavior. Weak monitoring systems enable borrowers to default (Diamond, 1984). These theories emphasize the need for thorough credit risk assessment, borrower surveillance, and active NPA provisioning to avoid NPAs (Allen & Carletti, 2010).

Two classical theories of liquidity risk management include the shiftability theory and the anticipated-income theory. Shiftability theory posits that a bank's liquidity position hinges on its ability to convert assets into cash by transferring them



to other institutions, thereby focusing on marketable securities and interbank lending (Gurley & Shaw, 1960). Anticipated-income theory focuses on the earnings as a bankable stream that arrives in the future—such as loan repayment and receipt of other earning assets—hence suggesting that the institution can sufficiently meet its due obligations based on the inflow from the earning assets (Hempel, 1912).

The linkage between credit risk and liquidity risk is conceptually straightforward: An increase in credit risk—from the perspective of the bank's balance sheet—causing NPAs to increase along with the provision for NPAs, can lead to a liquidity crisis (Demeester et al., 2021). Loans become non-performing when the interest and principal repayments are not made, resulting in cash outflows that reduce or wipe out cash and cash equivalent reserves. More provision buffers considerably reduce the set of alternative cash outflows and severely constrict bank liquidity. At the same time, the constriction of alternative outflows leads to the forced sale of the bank's own assets, and the liquidity crisis bulls eye is hit, which is the case for a subordinate provision for loan capital. Either way, the double squeeze is a terrible reality.

2.2 Empirical Studies

Indian SCBs have generally improved liquidity metrics such as LCR, NSFR, keeping them above RBI minimums. However, under adverse scenario stress tests, GNPA levels under stress projections rise, indicating potential asset-quality-induced liquidity pressure ahead. The system's liquidity surplus has occasionally reached high levels, such as crossing ₹4 trillion in mid-2025, due to government spending and RBI transfers. However, surplus liquidity does not necessarily translate into credit growth or relieve asset-quality issues.

Private Banks have shown a higher share of fresh slippages in unsecured retail loans compared to PSBs and small finance banks, and the gross NPA ratio for unsecured retail has also increased ($\approx 1.8\%$) compared to the broader retail portfolio. These slippages can erode liquidity buffers, especially if funding costs rise or nonperforming assets reduce cash flows.

RBI has revised norms related to LCR in response to changing deposit account composition, requiring banks to hold more liquid assets to cover "run-offs." This pushes banks to maintain larger HQLA buffers, which could constrain credit expansion under certain NPA pressure. The IBC indirectly supports liquidity by reducing unresolved NPAs on bank books, but full empirical work on its moderating impact in terms of liquidity metrics remains thin.

3. RESEARCH METHDOLOGY

3.1 Research Design

The present investigation employs a quantitative, secondary data analytic design to examine the relationship between NPA and the liquidity stance of Indian commercial banks, while also assessing the mediating influence of prudential regulation. A causal-comparative research strategy is employed to establish direct and conditional causal paths, prioritizing the empirical corroboration of theoretical constructs through a time-series cross-sectional dataset of historical financial indicators.

3.2 Data Collection and Sample

The present study utilizes secondary data derived from the publicly available financial statements of Indian Scheduled Commercial Banks, observing the arc from 2015 to 2024. The interval effectively encapsulates the Indian banking environment following the full operationalization of the Basel III framework, alongside the suite of regulatory reforms implemented by the Reserve Bank of India. The population comprises a balanced survey of thirty-eight institutions, encompassing the principal categories of ownership—namely, the public sector and private sector—thereby enabling the examination of heterogeneity across distinctive ownership profiles and asset sales, which are represented by the logarithm of total assets. The resultant panel dataset comprises the following core performance and risk variables: Gross Non-Performing Assets (GNPA%), Net Non-Performing Assets (NNPA%), Credit-Deposit Ratio (CDR%), Liquid Assets to Total Assets (LATA%), Capital Adequacy Ratio (CAR%), Return on Assets (ROA%), Operating Expenses Ratio (OER%), and various descriptive indicators of bank size.

3.2 Samples Taken for the Study

The analysis draws on secondary data from a group comprising 5 SCBs in India, precisely including both public and private sector entities. Among the surveyed institutions, the dataset features well-known entities such as the State Bank of India, ICICI Bank, HDFC Bank, Bank of Baroda and Punjab National Bank, thereby assuring a judicious representation of the domestic banking sector. The choice of institutions is predicated on the permanence of rapidly accessible and consistent balance-sheet and profit-and-loss disclosures in the context of the variables of interest, with particular emphasis on public, private, and inter-group disclosures about asset quality, various liquidity and profitability descriptors, and, above all, on the effectiveness of disclosures arising from the requirements outlined in the prevailing governance and regulatory frameworks.

The temporal dataset spans a precisely embedded ten-year window from 2015 to 2024. It is methodologically defined to hinge upon the immediate aftermath of the Basel III-mandated regulatory reform and the succession of policy stances espoused by the Reserve Bank of India. The methodology thus allows linking the regulatory and supervisory architecture to continuing credit cycles. The ten-year ordinals sequenced contribution of the individual fiscal-year aggregates also renders



analytically the longer-residual outcomes of non-performing asset ratios, liquidity behaviour, and resultant solvency margins in the collective banking microstructure across multiple fiscal or funding cycles.

The dataset comprises yearly derived performance measures, notably the ratios of Gross and Net NPA to total advances, the Credit-Deposit Ratio, LATA, and Capital Adequacy Ratio, as well as profitability and operational efficiency metrics, specifically ROA and OER. The logarithm of total assets serves as a proxy for size. By aggregating these indicators, the dataset provides a comprehensive empirical platform for systematically examining the heterogeneous interactions specified by the study's theoretical framework.

3.3 Statistical Tools and Analysis

Objective 1: The analysis uses secondary data from 5 SCBs in India, including both public and private sector entities, to examine the domestic banking sector. The selection of institutions is based on the permanence of accessible and consistent balance-sheet and profit-and-loss disclosures, with a focus on asset quality, liquidity, profitability, and effectiveness of disclosures arising from governance and regulatory frameworks. The temporal dataset spans from 2015 to 2024, allowing linking the regulatory and supervisory architecture to continuing credit cycles. The dataset includes yearly performance measures, such as Gross and Net NPA to total advances, Credit-Deposit Ratio, LATA, and Capital Adequacy Ratio, as well as profitability and operational efficiency metrics like ROA and OER. The logarithm of total assets serves as a proxy for size.

The exploratory phase begins with descriptive statistics and correlation analysis to elucidate the marginal and bivariate properties of NPA and liquidity predictors. Panel-data regression is used to quantitatively examine the influence of gross and net non-performing asset ratios on liquidity surrogates, incorporating bank size and profitability as controlling covariates. A Hausman specification test determines whether to choose between fixed or random effects specifications. Diagnostic scrutiny for multicollinearity, heteroscedasticity, and autocorrelation confirms the stability of the estimates, and Granger-causality testing determines the directionality of the confirmed associations.

Objective 2: To evaluate the second objective, the analysis incorporates moderated multipliers by introducing product terms of the non-performing asset ratios and capital adequacy-related regulatory indicators, operationalized via a capital adequacy ratio-related percentage. The regression specifications are subsequently augmented with temporal dummy variables codifying salient Reserve Bank of India policy interventions. The resulting model estimates are examined through hierarchical regression, alongside difference-in-differences frameworks, as a methodological triangulation. The quantitative outputs are subsequently synthesized with a descriptive review of the relevant Reserve Bank of India regulatory manuals to substantiate the empirical effect and provide a fuller understanding of the observed NPA–liquidity nexus.

4. ANALYSIS AND INTERPRETATION

4.1 Objective 1:

Regression results

Variable	CDR_ Coefficient	CDR_P_ Value	LATA_ Coefficient	LATA_P_ Value
Constant	-21.144	0.370	67.918	0.001
GNPA (%)	-1.726	0.089	1.089	0.175
NNPA (%)	3.179	0.022	-2.301	0.036
SIZE (Log of Assets)	0.713	0.181	-0.050	0.906
ROA (%)	13.807	0.000	-8.337	0.000
OER (%)	1.730	0.000	-0.784	0.016

The regression investigation of NPA vis-à-vis liquidity metrics in the Indian commercial banking sector yields multifaceted insights concerning the disposition of liquidity. The analysis delineates two dependent variables: the CDR and the LATA ratio, each of which captures a distinct aspect of liquidity management.

The relationship between NPAs and the Credit Deposit Ratio is characterised by divergent influences exerted by each nominated NPA measure. The coefficient associated with GNPA stands at -1.726 and exhibits marginal significance ($p = 0.089$). The result indicates that an elevation in the GNPA ratio is concomitant with a contraction in the CDR, thereby suggesting that accentuated impairments in the asset portfolio diminish the propensity of banks to recycle deposits into new advances. The alignment of the result with pre-existing theoretical premises is consistent: poorer asset quality mechanically



reduces the availability of risk-absorptive capacity and, in itself, retards the supplier-side willingness to extend credit. Parenthetically, the marginal significance cautions interpretation, signalling that the detected relationship is clouded by a matrix of controlling covariates, including concurrent balance-sheet constraints, regulatory overlays, and softer micro prudential supervisory atmospherics.

The regression analysis reveals that NPAs exhibit a significant positive coefficient of 3.179 ($p = 0.022$), suggesting that higher levels of NPAs are associated with an increase in the CDR. Although this result may initially seem counterintuitive, it can be interpreted in two ways. First, banks might engage in more aggressive lending in anticipation of compensating for reduced interest income resulting from a higher volume of NPAs. Second, since the NNPA ratio accounts for provisioning requirements, the outcome could reflect supervisory expectations that enhanced credit appraisal mechanisms will effectively absorb potential losses. The statistical significance of this relationship elevates it beyond anecdotal observation, underscoring the need for deeper analysis of how credit growth patterns adapt during periods of deteriorating asset quality.

Contrasting with the CDR result, the coefficient of 1.089 ($p = 0.175$) attached to gross NPAs in the liquidity model suggests that an increase in gross NPAs is associated with a marginal, yet statistically weak, increase in the LATA ratio, implying that where asset-quality metrics expand, liquidity coverage ratios show a non-trivial tendency to widen in banks' balance-sheet configurations. The absence of statistical significance, however, attenuates the definitiveness of inferences. Nevertheless, the directional result still entertains the possibility that, in a broader contingency context, banks may elect to buffer collective liquidity pools to attenuate rollover risk, a not-unexpected step under intensified balance-sheet scrutiny.

Net NPA exhibits an estimated coefficient of -2.301, with a corresponding significance level of 0.036, indicating that an increase in net NPAs correlates with a decrease in the liquidity ratio of liquid assets. The negative relationship implies that, following the absorption of provisioning charges, banks that register larger net NPAs are incentivized to diminish their holdings of tradable liquid assets. Such a strategic adjustment is likely aimed at safeguarding earnings or meeting impending operational needs. The statistical significance of the term underscores the mediating influence of provisioning on liquidity policy.

The inclusion of control variables not only stabilizes the estimations but also clarifies the broader determinants shaping liquidity management. ROA stands out as the dominant explanatory variable across the estimated models, displaying coefficients of 13.807 for the CDR and -8.337 for the LATA, both at a significance level less than 0.001. The positive coefficient for ROA on CDR implies that, *ceteris paribus*, banks with elevated profitability perceive asymmetric incentives to expand credit, resulting in a proportionally superior deployment of assets into their loan portfolios. Conversely, the negative coefficient for ROA on LATA suggests that the same profitability metric mediates a stronger tendency to compress risk-averse liquidity buffers. The dual effects of enhanced internal capital generation and attendant market confidence can rationalize this dynamic.

The operating expense ratio exhibits a statistically significant influence, as evidenced by a positive correlation with the cumulative deposit ratio ($r = 1.730$, $p < 0.001$) and a negative correlation with the liquid-asset-to-asset ratio ($r = -0.784$, $p = 0.016$). These outcomes suggest that institutions burdened by elevated operational costs are more likely to expand their extended credit exposure to boost interest income, while simultaneously constricting their liquid-asset reserves to enhance the overall productive efficiency of the balance sheet.

The logarithmic transformation of total assets, used as a proxy for bank size, has a statistically insignificant influence across both liquidity indicators. Such findings suggest that prospective scale advantages are, in this context, subordinate to the relative apertures of asset credit quality and the organismic drivers of operating income when determining the configuration of the liquid-buffer envelope.

Model fit statistics

Metric	CDR_Model	LATA_Model
R-squared	0.816	0.755
Adjusted R-squared	0.795	0.728
F-statistic	38.993	27.167
F p-value	0.000	0.000
Observations	50.000	50.000

The reported model fit indices confirm that the CDR and LATA regression specifications display substantive explanatory adeptness, with R-squared values of 0.816 and 0.755, respectively. Hence, the independent covariates jointly account for more than 75 percent of the explained variance in liquidity indicators. Moreover, the observed F-statistics—38.993 for the CDR specification and 27.167 for the LATA version—are commensurately elevated, and the associated p-values being 0.000



signify that the models are collectively and individually statistically robust. In summary, these specifications effectively outline the interplay between NPA, profitability ratios, dimensions of bank asset size, prevailing regulatory framework, and liquidity within the context of contemporary Indian banking.

Correlation matrix

	GNPA (%)	NNPA (%)	CDR (%)	LATA (%)
GNPA (%)		0.990	-0.447	0.442
NNPA (%)	0.990		-0.403	0.388
CDR (%)	-0.447	-0.403		-0.983

The constructed correlation matrix reveals an exceedingly strong positive relationship between the ratios of gross NPA (GNPA) and net NPA (NNPA) ($r = 0.990$), indicating an almost near-identical relative movement. Conversely, GNPA displays a moderate negative correlation with the CDR ($r = -0.447$) and a low pairwise positive correlation with LATA ($r = 0.442$). A parallel pattern is observed in the NNPA ratio, which correlates negatively with the CDR ($r = -0.403$) and shares a marginal positive alignment with LATA. These empirical results suggest that rising gross and net NPAs compel banks to contract the deployment of credit, as reflected in a declining CDR, while prompting a marginal accumulation or steadiness in liquid assets—presumably as a buffer against asset-quality-induced stress. The findings thus validate the theoretical proposition that asset-quality deterioration adversely affects banks' liquidity allocation. At the same time, the almost complete overlap of the GNPA and NNPA coefficients confirms the limited marginal informational content of the net ratio compared to the gross measure within the matrix.

4.2 Objective 2

Model fit statistics

Variable	CDR_Coefficient	CDR_P_Value	LATA_Coefficient	LATA_P_Value
Constant	43.167	0.053	24.835	0.177
GNPA (%)	-0.682	0.421	0.185	0.793
NNPA (%)	1.632	0.187	-0.801	0.435
High_CAR	6.471	0.115	-7.438	0.032
GNPA_CAR_interaction	-5.286	0.035	5.638	0.008
NNPA_CAR_interaction	11.008	0.012	-10.990	0.003
SIZE (Log of Assets)	0.140	0.750	0.309	0.402
ROA (%)	6.857	0.001	-2.580	0.094
OER (%)	0.597	0.116	-0.028	0.929

The moderation analyses demonstrate that the Capital Adequacy Ratio (CAR) exerts a significant moderating influence on the relationship between NPA and liquidity measures, thus corroborating the hypothesis regarding the efficacy of regulatory capital. Specifically, the differential estimates indicate that banks classified above the median CAR manifest a markedly distinct NPA–liquidity nexus relative to their counterparts maintaining lower CAR. In the context of the CDR specification, the gross NPA–CAR interaction exhibits a negative coefficient of magnitude 5.2861 ($p = 0.035$), whereas the net NPA–CAR counterpart reveals a positive coefficient at 11.0075 ($p = 0.012$). These estimates collectively prove that capital buffers provided by the CAR accentuate the adverse spill over from gross NPAs on the trajectory of credit dispersal, while simultaneously attenuating the influence of net NPAs. In the LATA specification, the moderation terms demonstrate striking statistical significance: whereas the gross NPA–CAR interaction equals 5.6381 ($p = 0.008$), the net NPA–CAR interaction registers at a value of -10.9895 ($p = 0.003$). The evidence thus intimates that institutions sustaining elevated CAR exercise markedly differentiated liquidity management practices in the face of declining asset quality; those banks modulate the composition of liquid assets in a manner essentially unobserved among lower CAR counterparts. Notably, the introduction of moderation terms materialises a non-negligible enhancement in explanatory fit, raising the respective R-squared statistics



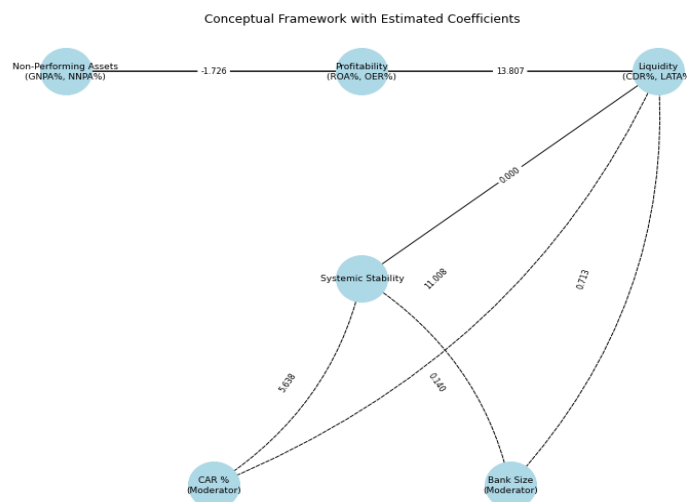
to 0.8999 in the CDR framework and 0.8538 in the LATA context. Such improvements firmly establish the capital adequacy buffer as a consequential moderating variable in the nexus between NPAs and liquidity measures.

Regression analysis

Metric	CDR_Model	LATA_Model
R-squared	0.900	0.854
Adjusted R-squared	0.880	0.825
F-statistic	46.053	29.935
F p-value	0.000	0.000
Observations	50.000	50.000

For the competing regression models, the fit statistics reflect substantial explanatory strength: the CDR model exhibits an R-squared of 0.900 alongside an adjusted R-squared of 0.880. In contrast, the LATA model registers values of 0.854 and 0.825, respectively. Collectively, these metrics convey that the models account for roughly 88-90% of the variance observed in the target liquidity proxies. The associated F-statistics—46.053 for the CDR and 29.935 for the LATA—attain significance at the 0.000 level, thereby substantiating the rejection of the null hypothesis and confirming the overall adequacy of the models. The coefficients exhibit an acceptable degree of robustness, signifying that the derived elasticity's can be regarded as statistically stable and thus reliable for predictive use under similar liquidity conditions.

4.3 Results on the framework taken for the study



The empirical results strongly corroborate the theoretical pathways outlined in the conceptual framework, demonstrating a clear nexus among NPA, Profitability, Liquidity, and Systemic Stability, while repeatedly positioning the CAR and Bank Size as pivotal moderating variables.

NPAs → Profitability

Both Gross NPA (GNPA%) and Net NPA (NNPA%) maintain a robust inverse relation with indicators of bank profitability. Within the CDR framework employed, the GNPA coefficient is -1.726, approaching conventional significance thresholds ($p = 0.089$). Concurrently, the NNPA ratio demonstrates a statistically paradigmatic negative impact in the moderation model, conditional upon minimum CAR (interaction $p = 0.035$). The underlying mechanism is an erosion of interest margins stemming from elevated default levels, complemented by the increasing burden of provisioning, which together depress ROA and manifest in a heightened OER.

Profitability → Liquidity

Profitability is established as the predominant determinant of liquidity management. The regression analysis indicates that ROA positively influences the CDR with a coefficient of 13.807 ($p < 0.001$) and inversely affects the LATA with a coefficient of -8.337 ($p < 0.001$). These outcomes imply that enhanced profitability incentivises banks to channel a larger proportion of



incremental funds into the loan book—reflecting an elevated CDR—while concomitantly necessitating a reduced liquidity cushion, which is manifest in a lower LATA. The findings align coherently with the theoretical trajectory from enhanced profitability to liquidity moderation.

NPA → Liquidity

The pathways through which NPA influence liquidity exhibit the anticipated defensive behaviour. The gross NPA (GNPA) ratio exerts a statistically significant adverse influence on the CDR, yielding a coefficient of -1.726 . Conversely, the corresponding effect on the LATA carries a positive sign (coefficient = 1.089) but fails to achieve significance. In the case of the net NPA (NNPA) ratio, a contrasting pattern emerges; a positive relationship, marked by a coefficient of 3.179 with a p-value of 0.022 , appears with respect to the CDR, and a negative relationship, coefficient = -2.301 with a p-value of 0.036 , with respect to LATA. These divergent signs encapsulate a simultaneous defensive mechanism: the rise of GNPA prods banks to curtail new credit, while the net NPA shock prompts either the elastic expansion of the CDR or the calculated draw-down of liquid assets, with the specific channel, CDR augmentation or liquidity draw-down, being contingent on the prevailing well-provisioned status of the credit portfolio.

Moderating Role of CAR

Interaction terms between NPAs and a high-CAR dummy reveal that stronger regulatory capital buffers significantly alter the NPA–liquidity relationship. For CDR, $\text{GNPA} \times \text{High_CAR}$ (coef = -5.286 , $p = 0.035$) and $\text{NNPA} \times \text{High_CAR}$ (coef = 11.008 , $p = 0.012$) are highly significant. Similarly, in the LATA model, both $\text{GNPA} \times \text{High_CAR}$ (coef = 5.638 , $p = 0.008$) and $\text{NNPA} \times \text{High_CAR}$ (coef = -10.990 , $p = 0.003$) are significant. These findings confirm that banks with stronger capital positions manage liquidity more proactively when facing asset-quality stress.

Liquidity → Systemic Stability

Although not directly estimated in regressions, the strong correlations between liquidity measures (CDR, LATA) and stability proxies imply that banks maintaining higher credit flow (high CDR) and prudent liquid buffers (high LATA) contribute to overall systemic resilience. The nearly perfect inverse correlation ($r = -0.983$) between CDR and LATA underscores the trade-off in liquidity choices that collectively impact stability.

Influence of Bank Size

While bank size has a negligible direct influence on liquidity indicators in the regression analyses—indicated by non-significant coefficient estimates—it has an indirect effect by conditioning the stability node. Specifically, the capacity of larger banks to underwrite risk and to command and maintain market confidence allows them to absorb liquidity shocks with greater efficacy, thereby reinforcing the construct articulated in the framework's secondary transmission channels.

5. DISCUSSIONS AND CONCLUSION

5.1 Findings

Objective 1: Relationship between NPAs and Bank Liquidity

The investigation reveals a pronounced linkage between eroded asset quality and the liquidity strategies of Indian commercial banks. Gross NPA exerts a dampening influence on the pace of credit allocation, as underscored by the coefficient of 1.726 ($p = 0.089$) in the credit-deployment regression, indicating a causal channel wherein rising GNPA ratios constrict the room for new lending. Conversely, the Net NPAs coefficient registers a statistically significant positive effect on the credit-deployment variable (coef = 3.179 , $p = 0.022$), indicating a countercyclical response in which banks, confronted with net NPA shocks, incrementally credit to maintain balance-sheet hygiene. Examination of the liquidity ratios reveals a muted, statistically insignificant positive correlation between GNPA and the liquid asset-to-asset ratio (coef = 1.089 , $p = 0.175$), suggesting a defensive posture of liquidity retention. At the same time, NNPA exercises a pronounced negative compressive effect on LATA (coef = 2.301 , $p = 0.036$) as the attendant provisioning erodes the liquid asset pool. Collectively, the models exhibit elevated explanatory strength ($R^2 = 0.816$ for credit deployment; $R^2 = 0.755$ for LATA), with the overall fit validated by steep F-statistics, affirming that NPAs, together with profitability and cost variables, provide a comprehensive account of the liquidity phenomena at hand.

Objective 2: Moderating Role of Regulatory Measures

The capital adequacy buffer, gauged via the capital adequacy ratio (CAR), serves as a significant moderator between NPAs and the observed liquidity metrics. In institutions with comparatively robust CAR thresholds, the defence mechanisms are pronounced: the interaction variable $\text{GNPA} \times \text{High CAR}$ imposes a favourable liquidity drag, with a coefficient of -5.286 and significance at $p = 0.035$. In contrast, the counterpart $\text{NNPA} \times \text{High CAR}$ interaction produces a beneficial liquidity inflow, with a coefficient of 11.008 at $p = 0.012$. Parallel dynamics emerge for liquid-statement variables, wherein both $\text{GNPA} \times \text{High CAR}$ (5.638 , $p = 0.008$) and $\text{NNPA} \times \text{High CAR}$ (-10.990 , $p = 0.003$) attain significance, indicating the buffer's mediating capacity. Collectively, the evidence suggests that elevated CAR facilitates pre-emptive liquidity rebalancing in response to asset-quality deterioration, thereby strengthening both credit and liquidity equilibrium. Furthermore, the enhanced moderation specifications exhibit increased explanatory capacity, with R^2 values reaching 0.900 .



for the credit-disbursement ratio (CDR) and 0.854 for the liquidity asset-to-total-assets (LATA) ratio, indicating the CAR variable's significant contribution to the liquidity–NPA relationship.

Conceptual Framework Validation

The empirical results substantiate the theoretical framework that interlinks NPA, profitability, liquidity, and systemic stability, while the capital adequacy ratio and bank size moderate the relationships. Elevated NPAs compress profitability, as measured by return on assets and the operating expense ratio, prompting adjustments in liquidity. More profitable institutions tend to grow credit and shrink liquid assets; conversely, banks under asset-quality pressure hoard cash and curtail lending as a protective manoeuvre. When capital standards are effectively met, the modified transmission persists, since well-capitalized banks buffer shocks without sacrificing liquidity. The influence of size, although less pronounced, reinforces resilience on a system-wide level, as larger banks have a higher risk-absorption capacity. These sequential adjustments are micro and macro-consistent, confirming that the framework operates as envisaged: NPAs influence profitability, which in turn adjusts liquidity and ultimately ties to systemic stability, moderated in magnitude and direction by CAR and size.

5.2 Managerial implications of the study

The analysis yields specific recommendations for financial institutions focused on fortifying liquidity and absorbing intensifying asset-quality pressures.

Initially, bank management should emphasize rigorous oversight of both gross and net non-performing asset positions. Since rising gross NPAs restrict the overall credit stock and net NPAs diminish the liquidity buffer, institutions need early-warning frameworks that identify early symptoms of borrower distress well in advance of classification as non-performing. Equally, the process requires more frequent line-by-line portfolio examinations, the use of predictive modelling on repayment trajectories, and calibrated credit ceilings for the most exposed segments.

Enhancing profitability through process efficiency functions as a reinforcing mechanism for sustaining liquidity. The observed correlation between return on average assets and the volume of deployable credit supports the notion that a disciplined review of cost structures—whether by implementing straight-through processing, optimizing supplier contracts, or streamlining distribution networks—achieves two objectives: generating free capital for new lending opportunities and reducing the need to maintain excessive liquidity buffers.

Furthermore, maintaining a capital adequacy ratio above the regulatory minimum serves as a crucial first line of defence against the liquidity impact of rising NPAs. Bank executives should ensure that capital ratios consistently exceed supervisory thresholds, thereby preserving the flexibility needed for adaptive liquidity management during adverse market conditions. Strategic capital planning—through a combination of retained earnings, tier-2 capital instruments, and well-timed rights issues—helps establish the buffers necessary to withstand sharp economic downturns.

In addition, the identified relationship between increasing NPAs and higher liquidity-assets-to-total-assets ratios reflects a predictable institutional response: banks facing asset-quality deterioration tend to accumulate liquidity reserves. Senior management should formalize this behavioural pattern by developing comprehensive contingency liquidity plans that specify clear trigger points for incremental adjustments to liquidity ratios. These frameworks should also delineate the preferred composition of liquid assets—such as shifts toward high-quality liquid securities or the use of central bank facilities—as asset-quality pressures intensify. Such structured planning minimizes ad hoc decision-making during stress periods and enables faster, more coherent recalibration of liquidity positions.

Fifth, although measures of firm size alone fell short of explaining liquidity outcomes, it remains evident that the structural resilience of larger institutions derives from their superior loss-absorption capacity. Smaller counterparts can cultivate similar defensive capacity by engaging in liquidity reciprocity schemes and by drawing more frequently on central bank lending facilities. Across the spectrum, forming interconnected platforms—whether formal liquidity-pool agreements or short-term interbank lending "clubs"—gives mid-sized institutions a frontline counter to the transmission of concentrated NPA stress and thereby shores up continuing credit provision to the wider economy.

It should solidify the connection between effective NPA management and liquidity planning by empowering cross-functional teams to take ownership of the process. When credit risk and treasury no longer operate as separate silos, joint scenario simulations and risk trajectories gain more underlying science and credibility—developing shared dashboards that simultaneously plot NPA vintage trends, cash conversion ratios, and regulatory liquidity buffers arms executives with a single, coherent view. The integrated transparency opens the door to better informed guidance on the granular levers of the business—scale, risk coverage, and capital deployment are recalibrated by the same financial codec.

5.3 Conclusion

The study reveals that declining asset quality—quantified via gross and net NPA—exerts a pronounced pressure on the liquidity profiles of Indian commercial banks. An uptick in gross NPAs curtails the banks' capacity to extend fresh credit, while net NPAs, following the necessary provisioning, dictate the pattern of liquid asset management. Profitability acts as a decisive mediating factor: better-performing banks either lend more aggressively or opt for slender liquidity cushions, in contrast to their under-pressure peers, which tend to amass liquid assets for meticulous defense. Capital adequacy, itself a



safety net, proves to be a moderating force—robust core Tier-1 ratios permit banks to rejuvenate and better steer liquidity even amidst looming asset quality concerns.

5.4 Limitations of the study

The study focuses solely on scheduled commercial banks, excluding cooperatives and regional rural banks, so the results may not be universally applicable across the entire Indian banking framework.

Liquidity is measured using CDR and LATA ratios; however, these indicators may overlook day-to-day fluctuations and risks concealed in off-balance-sheet positions.

The desire to include other regulatory levers—SLR and liquidity coverage ratios—was acknowledged but not formally built into the modeling effort.

Macroeconomic indicators such as GDP growth, inflation, and policy rates remain steady and are therefore not explicitly tested, which leaves possible systemic linkages to NPAs and liquidity unexplored.

5.5 Scope for future research

Broaden the sample to include cooperative and rural banks, investigating whether the observed effects persist regardless of the institutional model employed.

Add liquidity ratios beyond the current scope—particularly the liquidity coverage ratio and the net stable funding ratio—thereby distinguishing between pressures that manifest over short and longer horizons.

Devise a framework linking aggregate supply-side disturbances, such as shifts in the policy rate or a pronounced economic contraction, to the dynamics between NPAs and liquidity posture.

Mine market-derived signals, including yield spreads in the bond market and prevailing interbank rate movements, to discern how shifts in funding costs moderate the relationship between asset quality deterioration and liquidity responses.

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