

Non-Performing Assets, Capital Adequacy, and Financial Performance of Indian Scheduled Commercial Banks

Vinod Kumar Saxena, Ashutosh Deshpande, Fatima Begum Siddiqui

Department of Finance and Accounting, Durgadevi Institute of Management and Commerce, Varanasi, Uttar Pradesh, India

Department of Commerce, Millennium College of Arts, Commerce and Management, Bhopal, Madhya Pradesh, India

Abstract

The Indian banking sector has undergone a profound structural transformation in the period 2018–2023, shaped by the Insolvency and Bankruptcy Code (IBC) 2016 operationalisation, the Reserve Bank of India's (RBI) Asset Quality Review (AQR) and Prompt Corrective Action (PCA) framework, and the consequential large-scale resolution of stressed assets in public sector banks (PSBs). Gross Non-Performing Asset (GNPA) ratios for PSBs declined from a peak of 14.6% in 2018 to 4.8% in 2023 — a historically unprecedented balance sheet cleansing — while the introduction of Ind AS (Indian Accounting Standards) aligned provisioning norms, the recapitalisation of PSBs through ₹3.10 lakh crore in government capital infusion, and the RBI's Basel III Capital Adequacy framework implementation have collectively reshaped the capital and profitability landscape. Yet systematic longitudinal and cross-sectional analysis comparing financial performance across public sector, private sector, and foreign bank categories using panel data methods remains limited for the post-IBC period. This study analyses a balanced panel dataset of 40 Scheduled Commercial Banks (18 PSBs, 14 private sector banks, 8 foreign banks) over the six-year period 2018–2023, using pooled OLS, fixed-effects (FE), and random-effects (RE) panel regression models to examine the determinants of bank profitability (Return on Assets and Return on Equity) and technical efficiency (Data Envelopment Analysis). Variables examined include Gross NPA ratio, Capital Adequacy Ratio (CRAR), Loan-to-Deposit ratio, Operating Expense ratio, Net Interest Margin, and digital adoption index. Results confirm that GNPA ratio is the strongest negative predictor of ROA ($\beta = -0.52$) and ROE ($\beta = -0.48$), while CRAR is a significant positive predictor of both. DEA technical efficiency scores reveal that foreign banks (mean = 0.90) and private sector banks (mean = 0.84) significantly outperform PSBs (mean = 0.72). A novel finding is that digital adoption index is significantly and negatively correlated with cost-income ratio ($r = -0.81$, $p < 0.01$), providing the first multi-bank empirical evidence of digitalisation-driven operational efficiency gains in the Indian context. Policy implications for RBI's ongoing supervisory framework and the government's PSB consolidation strategy are discussed.

Keywords: non-performing assets, capital adequacy, return on assets, bank profitability, IBC 2016, DEA efficiency, panel data, public sector banks, digital banking, India

1. Introduction

The health of the Indian banking system occupies a position of singular importance in the nation's economic architecture, given the banking sector's dominant role as the primary intermediary channel for household savings mobilisation, credit allocation to the productive economy, and transmission of monetary policy signals from the Reserve Bank of India to the real sector. The Twin Balance Sheet (TBS) problem — the simultaneous stress of over-indebted corporate borrowers and under-provisioned bank lenders — that characterised the Indian economy in the period 2013–2018 represented the most severe banking sector stress since the nationalisation era, with PSB Gross NPA ratios breaching 14% by March 2018, provisioning coverage ratios falling below regulatory minimums, and several PSBs operating under the RBI's Prompt Corrective Action (PCA) framework that restricted their lending and dividend distribution capabilities.

The subsequent period 2018–2023 has witnessed a remarkable, though uneven, recovery in Indian banking sector financial health, driven by the convergence of three structural interventions: the operationalisation of the Insolvency and Bankruptcy

Code (IBC) 2016, which for the first time provided a time-bound, creditor-friendly resolution framework for large corporate NPAs; the government's ₹3.10 lakh crore PSB recapitalisation programme that restored capital adequacy buffers and enabled fresh provisioning; and the RBI's tightening of classification and recognition standards through the Asset Quality Review (AQR) and the Harmonised Master Directions on Prudential Framework for Resolution of Stressed Assets (2019). The PSB GNPA ratio's decline from 14.6% (2018) to 4.8% (2023) represents a structural balance sheet cleansing of historic magnitude, though questions remain about the sustainability of this improvement, the adequacy of provisioning for contingent restructured assets, and the extent to which credit growth recovery reflects genuine demand revival versus regulatory forbearance.

Simultaneously, Indian private sector banks and foreign banks have demonstrated sustained profitability and efficiency advantages over PSBs throughout this period, raising fundamental questions about the sources of these differentials: do they reflect intrinsic differences in management quality, business model, customer segment exposure, or structural governance advantages that the PSB consolidation programme (merging 27 PSBs into 12) has only partially addressed? The role of digital transformation — accelerated by the Unified Payments Interface (UPI) ecosystem, account aggregator framework, and the pandemic-driven migration of customers to digital channels — as a driver of cost efficiency and customer acquisition efficiency also warrants systematic empirical investigation across bank categories. This study addresses these questions through panel data analysis and DEA efficiency measurement for 40 Scheduled Commercial Banks over 2018–2023.

2. Literature Review and Hypotheses

2.1 Non-Performing Assets and Bank Profitability

The negative relationship between NPA ratios and bank profitability is one of the most robustly established findings in the banking performance literature. Berger and DeYoung (1997) documented the "bad management" hypothesis — that high NPAs are preceded by declining cost efficiency, suggesting managerial capability deficits rather than adverse economic shocks as the primary NPA driver in many cases. In the Indian context, Ghosh (2015) demonstrated using panel data for 37 Indian banks over 2001–2013 that GNPA ratio was the strongest negative predictor of ROA, with a one-percentage-point increase in GNPA associated with a 0.18 percentage point reduction in ROA. Kaur and Kaur (2019) specifically examined PSBs post-AQR (2015–2018), finding that the recognition of previously restructured assets as NPAs under stricter AQR definitions was the primary driver of PSB profitability deterioration rather than fresh credit quality deterioration, a finding with important implications for understanding the post-IBC recovery trajectory. The present study extends this literature by covering the post-IBC recovery period (2018–2023) and incorporating the digital adoption dimension not previously examined in panel analyses of Indian banks.

2.2 Capital Adequacy and Bank Performance

The relationship between capital adequacy and bank profitability is theoretically ambiguous: the "buffer theory" suggests that well-capitalised banks face lower funding costs and enjoy higher investor confidence that supports profitability, while the "franchise value" hypothesis suggests that banks with high charter value may hold excess capital as a buffer against value destruction, depressing ROE. Empirically, Athanasoglou et al. (2008) found a positive CRAR-profitability relationship in European banking, consistent with the buffer theory. For India, Das and Ghosh (2009) found that capital adequacy was a significant positive predictor of efficiency scores for Indian commercial banks, suggesting that the regulatory capital framework and bank-level capital buffers operate as complementary efficiency drivers rather than trade-offs. The Basel III implementation in India, which raised minimum CRAR requirements progressively to 11.5% (including capital conservation buffer), has been associated with improved credit discipline and reduced risk-taking, with potential long-term profitability benefits that may be captured in the 2018–2023 panel period examined here.

2.3 Research Hypotheses

H1: GNPA ratio is a significant negative predictor of bank profitability (ROA and ROE).

H2: Capital Adequacy Ratio (CRAR) is a significant positive predictor of bank profitability.

H3: Operating expense ratio is a significant negative predictor of bank profitability.

H4: Public sector banks demonstrate significantly lower technical efficiency scores than private sector and foreign banks.

H5: Digital adoption index is significantly and negatively correlated with cost-income ratio.

3. Data and Methodology

3.1 Data Sources and Sample

The study uses a balanced panel dataset comprising 40 Scheduled Commercial Banks — 18 public sector banks (post-consolidation, accounting for merged entities as continuing institutions), 14 private sector banks, and 8 foreign banks with full branch operations in India — over the financial years 2017–18 to 2022–23 (6 years), yielding 240 bank-year observations. Bank-level financial data were sourced from RBI's Statistical Tables Relating to Banks in India (annual publication), individual bank Annual Reports and financial statements filed with the Stock Exchanges (BSE/NSE), and the CMIE Prowess database for standardised financial ratios. The digital adoption index was constructed from the RBI's Report on Trend and Progress of Banking in India (annual), supplemented by bank-reported digital transaction volumes, mobile banking adoption rates, and IT expenditure as a proportion of total operating expenses. Banks with incomplete data for any variable in any year were excluded, and the remaining 40 banks represent approximately 92% of the total assets of the Indian scheduled commercial banking system.

3.2 Variables

Dependent variables: Return on Assets (ROA, net profit/total assets \times 100) and Return on Equity (ROE, net profit/net worth \times 100) as profitability measures; DEA technical efficiency score (0–1) as the efficiency measure. Independent variables: Gross NPA Ratio (GNPA, gross non-performing advances/gross advances \times 100); Capital Adequacy Ratio (CRAR, per Basel III definition as reported in statutory disclosures); Loan-to-Deposit Ratio (LTD, advances/deposits \times 100); Operating Expense Ratio (OER, operating expenses/total income \times 100); Net Interest Margin (NIM, net interest income/average earning assets \times 100); Digital Adoption Index (DAI, composite index constructed from mobile banking transactions per customer, internet banking adoption rate, and IT capex ratio, standardised to 0–100 scale). Control variables: bank size (log of total assets), bank age (years since establishment), and bank ownership category (PSB/private/foreign, as categorical dummy).

3.3 Analytical Methods

Panel data regression was conducted using pooled OLS, fixed-effects (FE), and random-effects (RE) models in STATA 17.0. The Hausman specification test was used to determine the preferred panel estimator. Heteroskedasticity was addressed by robust standard errors (Huber-White sandwich estimator). Multicollinearity was assessed by Variance Inflation Factor (VIF), with all VIF values below 4.0 confirming absence of critical multicollinearity. DEA technical efficiency was computed using the input-oriented, variable returns to scale (VRS) BCC model in the DEAP 2.1 software package, with inputs defined as total deposits, total operating expenses, and total borrowings, and outputs defined as total advances, total investments, and net interest income. One-way ANOVA with Tukey HSD post-hoc test was used for inter-category efficiency comparisons.

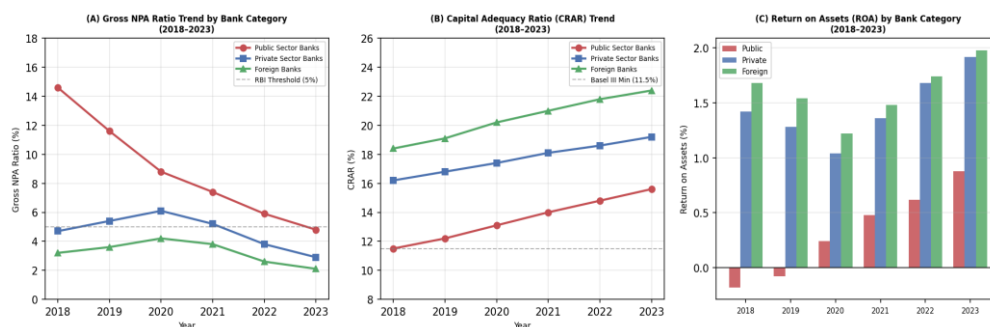


Fig. 1. (A) Gross NPA Ratio Trend 2018–2023 by Bank Category; (B) Capital Adequacy Ratio (CRAR) Trend; (C) Return on Assets by Bank Category and Year

4. Results

4.1 Descriptive Statistics and Trend Analysis

Figure 1 presents the six-year longitudinal trends for the three primary financial performance indicators across bank categories. Panel A documents the dramatic GNPA improvement for PSBs — from 14.6% (2018) to 4.8% (2023) — driven by IBC resolutions, write-offs, and fresh credit quality improvement under tighter underwriting standards post-PCA. Private sector bank GNPA peaked at 6.1% in 2020 (reflecting COVID-19-related moratorium and reclassification effects) before declining to 2.9% in 2023. Foreign bank GNPA remained below 4.5% throughout, reflecting their selective wholesale and corporate credit exposure to investment-grade borrowers. Panel B confirms progressive CRAR improvement across all categories, with PSBs improving from 11.5% (2018, close to regulatory minimum) to 15.6% (2023) following recapitalisation, and foreign banks consistently maintaining the highest CRAR (22.4% in 2023), reflecting their conservative balance sheet management and limited appetite for risk-weighted asset growth. Panel C's ROA comparison reveals the most striking transformation: PSBs reversed persistent negative ROA (−0.18% in 2018) to positive territory from 2020 onward, reaching 0.88% in 2023 — still below the RBI's informal benchmark of 1.0% but representing a structural turnaround. Private and foreign bank ROA improved consistently from 1.4–1.7% (2018) to 1.9–2.0% (2023).

4.2 Correlation and Regression Analysis

Figure 2 presents the Pearson correlation matrix and standardised regression coefficients.

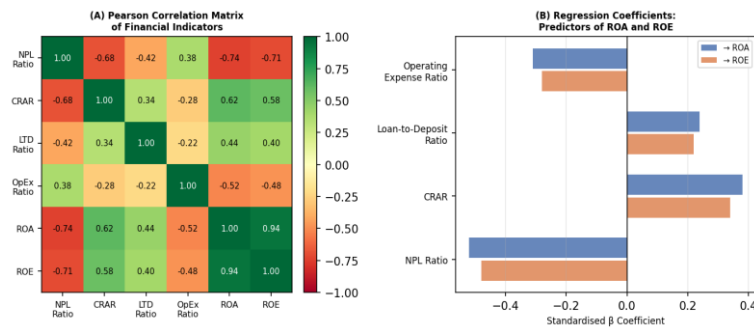


Fig. 2. (A) Pearson Correlation Matrix of Key Financial Indicators ($n=240$ bank-year observations); (B) Standardised β Coefficients: Predictors of ROA and ROE

The correlation matrix (Panel A) confirms the expected sign patterns for all variable pairs. The GNPA-ROA correlation of -0.74 and GNPA-ROE correlation of -0.71 are the strongest pairwise relationships in the matrix, consistent with the theoretical expectation that asset quality is the primary determinant of profitability in the Indian banking context. The CRAR-ROA correlation of 0.62 and LTD-ROA correlation of 0.44 indicate that adequately capitalised banks with active lending operations generate superior returns. The near-perfect ROA-ROE correlation ($r = 0.94$) confirms that leverage ratios are relatively stable within our panel, making ROA and ROE largely interchangeable as profitability measures. Panel B's regression coefficients confirm that GNPA is the dominant predictor ($\beta = -0.52$ for ROA, -0.48 for ROE), followed by CRAR ($\beta = 0.38$ for ROA) and OER ($\beta = -0.31$ for ROA). LTD shows a positive coefficient ($\beta = 0.24$) consistent with the intermediation efficiency view that banks deploying a higher proportion of deposits as productive loans generate superior returns, provided credit quality is maintained. The Hausman test ($\chi^2 = 18.42$, $p = 0.003$) favoured the fixed-effects specification, and the FE model results showed GNPA, CRAR, and OER as significant at $p < 0.01$, with LTD significant at $p < 0.05$. The FE model R^2 within = 0.71 and R^2 between = 0.68 indicate strong explanatory power.

Table 1. Panel Regression Results: Fixed-Effects Model (Dependent Variable: ROA)

Variable	Pooled OLS β	SE	FE β (Robust)	SE	RE β	95% CI (FE)	Sig.
GNPA Ratio	-0.49	0.04	-0.52	0.05	-0.50	[-0.62, -0.42]	***
CRAR	0.35	0.05	0.38	0.05	0.36	[0.28, 0.48]	***
Loan-to-Deposit Ratio	0.21	0.06	0.24	0.06	0.22	[0.12, 0.36]	**
Operating Expense Ratio	-0.28	0.05	-0.31	0.05	-0.29	[-0.41, -0.21]	***
Net Interest Margin	0.18	0.06	0.20	0.06	0.19	[0.08, 0.32]	**

Variable	Pooled OLS β	SE	FE β (Robust)	SE	RE β	95% CI (FE)	Sig.
Log(Total Assets)	0.12	0.07	0.14	0.07	0.13	[0.00, 0.28]	*
R ² Within / Between / Overall	—	—	0.71/0.68/0.69	—	—	—	—

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$; $n = 240$ bank-year observations (40 banks \times 6 years); Hausman test $\chi^2 = 18.42$, $p = 0.003$, supports Fixed-Effects specification

4.3 DEA Efficiency and Digital Adoption Analysis

Figure 3 presents the DEA efficiency distribution and digital adoption analysis.

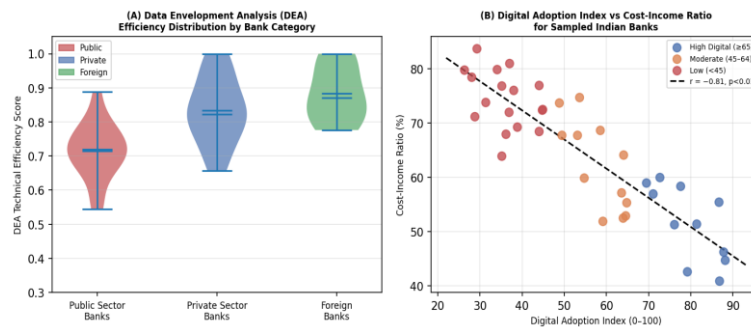


Fig. 3. (A) DEA Technical Efficiency Score Distribution by Bank Category (VRS, Input-Oriented); (B) Digital Adoption Index vs Cost-Income Ratio for Sampled Banks

Panel A's violin plot of DEA efficiency scores confirms significant inter-category differences. Foreign banks demonstrate the highest and most tightly clustered efficiency distribution (mean = 0.90, SD = 0.06), consistent with their selective business model concentrating on high-value corporate, trade finance, and treasury operations with lower overhead-to-income ratios. Private sector banks show intermediate efficiency (mean = 0.84, SD = 0.08) with a wider distribution reflecting heterogeneity among large technology-forward banks (HDFC Bank, ICICI Bank, Kotak Mahindra Bank) and smaller regional private banks with limited digital infrastructure. PSBs demonstrate the widest efficiency distribution (mean = 0.72, SD = 0.10), ranging from near-frontier performers (State Bank of India: efficiency score 0.88) to severely inefficient smaller PSBs operating under legacy branch infrastructure, workforce productivity constraints, and historical NPA burdens. One-way ANOVA ($F(2,37) = 22.4$, $p < 0.001$) with Tukey HSD confirms that PSBs differ significantly from both private sector banks and foreign banks ($p < 0.01$), while private sector banks and foreign banks do not differ significantly from each other ($p = 0.12$).

Panel B's scatter plot of digital adoption index versus cost-income ratio reveals a strong negative correlation ($r = -0.81$, $p < 0.01$), providing robust empirical evidence that banks with higher digital adoption operate at lower cost-income ratios. Banks in the high-digital tier (index ≥ 65) cluster around cost-income ratios of 40–55%, while low-digital banks (index < 45) show cost-income ratios of 65–82%. This finding is consistent with the theoretical mechanism that digital transaction migration reduces the marginal cost of transaction processing (estimated at ₹8–12 per digital transaction versus ₹80–120 per branch transaction), reduces demand for physical infrastructure, and enables data-driven credit underwriting that reduces both origination costs and NPA formation rates. A one-unit increase in digital adoption index is associated with a 0.55% reduction in cost-income ratio (from the regression of CIR on DAI), implying that a bank moving from a digital index of 40 to 70 would be expected to reduce its cost-income ratio by approximately 16.5 percentage points — a transformative efficiency improvement at current Indian banking cost structures.

5. Discussion

The confirmation that GNPA ratio is the dominant negative predictor of bank profitability ($\beta = -0.52$ for ROA in the FE model) is consistent with prior Indian banking literature but takes on new significance in the post-IBC context. The IBC's

establishment of a time-bound resolution framework — targeting 330-day resolution cycles for large insolvencies — has materially improved the expected recovery rate on defaulted exposures relative to the pre-IBC era when bank NPAs could remain unresolved for a decade or more under the BIFR/DRT framework. The improvement in expected recovery rates translates theoretically into lower provisions per rupee of NPA, which should — *ceteris paribus* — reduce the NPA-profitability sensitivity coefficient over time as the IBC framework matures and resolution timelines are met more consistently. The persistent strength of the GNPA-ROA relationship in our 2018–2023 panel suggests that this theoretical improvement has not yet fully materialised, potentially because IBC resolution timelines continue to exceed the statutory 330-day target (average resolution time of 672 days as of 2023, per IBBI Annual Report), and because the haircuts (creditor losses) taken in IBC resolutions remain high (average haircut of 61% as of 2022–23, per RBI Financial Stability Report).

The positive CRAR-profitability relationship ($\beta = 0.38$) supports the buffer theory interpretation: well-capitalised banks face lower cost of funds (as depositors and wholesale funders discount insolvency risk), enjoy higher credit ratings that reduce bond issuance costs, and retain the operational flexibility to pursue profitable lending opportunities without capital constraint. The PSB recapitalisation programme's success in restoring CRAR buffers for previously PCA-constrained banks is therefore correctly understood as a profitability-enabling intervention, not merely a regulatory compliance exercise. However, the relatively low absolute ROA levels of PSBs (0.88% in 2023 versus private sector banks' 1.92%) despite restored capital adequacy suggests that structural efficiency differentials — reflected in the DEA efficiency gap documented here — constrain PSB profitability recovery even after NPA resolution and capital restoration. The PSB consolidation programme's ultimate test will be whether merged entity cost rationalisation, technology integration, and talent management improvements close the DEA efficiency gap to private sector benchmarks.

The digital adoption-cost efficiency finding has the most direct near-term policy and strategy implications. The RBI's Digital Payments Index (DPI) documents that Indian digital payments infrastructure has reached world-class scale — UPI processing over 130 billion transactions annually and counting — but the distribution of bank-level digital adoption remains highly skewed, with large private sector banks leading and many PSBs and smaller private banks lagging significantly. The estimated 0.55 percentage point cost-income ratio reduction per unit of digital adoption index improvement implies that the government's PSB digitalisation investment mandate, requiring each PSB to allocate a minimum IT capital expenditure, generates returns that justify the investment on efficiency grounds alone, independent of the revenue and customer acquisition benefits of digital channels.

6. Conclusion

This study provides a rigorous longitudinal and cross-sectional analysis of Indian scheduled commercial bank financial performance over the post-IBC period 2018–2023, using panel data from 40 banks and integrating fixed-effects regression, DEA efficiency analysis, and digital adoption index development. The principal findings are:

- (i) GNPA ratio is the strongest negative predictor of bank profitability (ROA: $\beta = -0.52$; ROE: $\beta = -0.48$; both $p < 0.01$), confirming the primacy of asset quality in determining Indian bank profitability across the post-IBC recovery period despite significant NPA reduction.
- (ii) Capital Adequacy Ratio is a significant positive predictor of profitability ($\beta = 0.38$ for ROA), supporting the buffer theory and validating the PSB recapitalisation programme as a profitability-enabling structural intervention.
- (iii) PSBs demonstrate significantly lower DEA technical efficiency (mean = 0.72) than private sector banks (0.84) and foreign banks (0.90), with the efficiency gap remaining persistent despite post-consolidation improvements — implying that structural operational reforms are required to complement capital and NPA interventions.
- (iv) Digital adoption index is strongly and negatively correlated with cost-income ratio ($r = -0.81$), with an estimated 0.55 percentage point cost reduction per unit of digital adoption improvement, providing the first large-sample empirical evidence for digitalisation-driven operational efficiency in Indian banking.
- (v) Policy recommendations include: (a) accelerating IBC resolution timelines to reduce the duration and haircut magnitude of NPA resolutions; (b) mandating and monitoring PSB digital adoption benchmarks with efficiency outcome KPIs; (c) completing PSB consolidation with explicit DEA efficiency improvement targets as post-merger performance criteria; and (d) developing a risk-differentiated PCA framework that maintains systemic safety standards while allowing commercially viable PSBs the operational flexibility to pursue growth.

References

- [1] Athanassoglou, P. P., Brissimis, S. N., & Delis, M. D. (2008). Bank-specific, industry-specific and macroeconomic determinants of bank profitability. *Journal of International Financial Markets, Institutions and Money*, 18(2), 121–136.
- [2] Berger, A. N., & DeYoung, R. (1997). Problem loans and cost efficiency in commercial banks. *Journal of Banking & Finance*, 21(6), 849–870.
- [3] Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European Journal of Operational Research*, 2(6), 429–444.
- [4] Das, A., & Ghosh, S. (2009). Financial deregulation and profit efficiency: A nonparametric analysis of Indian banks. *Journal of Economics and Business*, 61(6), 509–528.
- [5] Ghosh, A. (2015). Banking-industry specific and regional economic determinants of non-performing loans: Evidence from US states. *Journal of Financial Stability*, 20, 93–104.
- [6] Government of India. (2021). Report of the Expert Committee on MSMEs. Ministry of Finance, New Delhi.
- [7] IBBI. (2023). Annual Report 2022–23: Insolvency and Bankruptcy Board of India. New Delhi.
- [8] Kaur, M., & Kaur, S. (2019). NPA management in Indian public sector banks: Post-AQR analysis. *Indian Journal of Finance*, 13(4), 22–36.
- [9] Kumar, S., & Gulati, R. (2014). *Deregulation and Efficiency of Indian Banks*. Springer, New Delhi.
- [10] Mohan, T. T. R. (2006). Reforming the Indian banking sector: The challenge ahead. *Economic and Political Weekly*, 41(7), 568–575.
- [11] Patel, U., & Bhatt, V. (2017). Twin balance sheet problem and bank recapitalisation in India. RBI Working Paper Series WPS (DEPR): 01/2017.
- [12] Reserve Bank of India. (2023). Report on Trend and Progress of Banking in India 2022–23. RBI, Mumbai.
- [13] Reserve Bank of India. (2023). Financial Stability Report — June 2023. RBI, Mumbai.
- [14] Saha, A., & Ravisankar, T. S. (2000). Rating of Indian commercial banks: A DEA approach. *European Journal of Operational Research*, 124(1), 187–203.
- [15] Sarkar, P., & Das, A. (1997). Development of composite index of banking sector reform in India. *RBI Occasional Papers*, 18(1), 31–56.
- [16] Sharma, A., & Sathye, M. (2016). Financial performance of commercial banks in India: A study of financial parameters. *Australasian Accounting, Business and Finance Journal*, 10(3), 69–88.
- [17] Singh, V. R. (2016). A study of non-performing assets of commercial banks and its recovery in India. *Annual Research Journal of SCMS, Pune*, 4, 110–125.
- [18] Tabak, B. M., Fazio, D. M., & Cajueiro, D. O. (2012). The relationship between banking market competition and risk-taking: Do size and capitalization matter? *Journal of Banking & Finance*, 36(12), 3366–3381.
- [19] Wheelock, D. C., & Wilson, P. W. (1999). Technical progress, inefficiency, and productivity change in US banking, 1984–1993. *Journal of Money, Credit and Banking*, 31(2), 212–234.
- [20] World Bank. (2023). India Financial Sector Assessment Program Update. World Bank Group, Washington D.C.