

Impact of Bank-Specific Determinants on Non-Performing Assets in Indian Public Sector Banks: An Empirical Analysis

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Abstract

This study examines the impact of bank-specific determinants, namely Capital Adequacy Ratio (CAR), Cost-to-Income Ratio (CIR), Net Interest Margin (NIM), Return on Assets (ROA), and Credit-to-Deposit Ratio (C/D), on Gross Non-Performing Assets (GNPA) in Indian Public Sector Banks (PSBs) over the period FY 2020-2021 to FY 2023-2024. Using a robust multivariate regression model on panel data, the analysis highlights key relationships between these indicators and NPA levels. The results demonstrate that NIM and C/D ratio have a significant negative influence on GNPA, indicating that higher profitability and balanced credit deployment play crucial roles in reducing NPAs. While CAR, CIR, and ROA exhibit negative relationships with GNPA, their impacts are statistically insignificant in this model. The findings offer valuable insights for policymakers and bank management, emphasizing the need for strategic measures to enhance profitability, optimize operational efficiency, and balance credit growth. This study concludes with actionable recommendations to ensure sustainable financial stability and effective NPA management in PSBs.

Keywords: Non-Performing Assets, Capital Adequacy Ratio, Cost-to-Income Ratio, Net Interest Margin, Return on Assets, Credit-to-Deposit Ratio, Indian Public Sector Banks, Banking Efficiency.

1. Introduction

Non-Performing Assets (NPAs) pose a significant challenge to the Indian banking sector, particularly for Public Sector Banks (PSBs). As key financial intermediaries, banks facilitate economic growth by channeling funds between savers and borrowers. However, when loans default, they become NPAs, disrupting the flow of credit and impacting banks' profitability. NPAs not only erode banks' interest income but also necessitate higher provisioning, affecting their ability to lend further. This creates a ripple effect on economic activity, investor confidence, and financial stability.

The problem of rising NPAs in PSBs is multifaceted, with both macroeconomic and bank-specific determinants contributing to the issue. While macroeconomic factors such as GDP growth, inflation, and unemployment are beyond a bank's control, bank-specific factors reflect internal management inefficiencies. Capital Adequacy Ratio (CAR), Cost-to-Income Ratio (CIR), Net Interest Margin (NIM), Return on Assets (ROA), and Credit-to-Deposit Ratio (C/D) serve as critical indicators of operational efficiency, profitability, and risk management.

Over the last decade, Indian PSBs have faced mounting NPAs due to poor credit appraisal, governance lapses, and sectoral challenges. Post-2015, several policy measures, including recapitalization programs and Insolvency and Bankruptcy Code (IBC), were introduced to address NPAs. However, identifying the bank-specific determinants influencing NPAs remains crucial to formulating effective strategies for their mitigation. This study aims to empirically analyze the role of CAR, CIR, NIM, ROA, and C/D ratios in determining NPAs in PSBs.

The paper employs panel data regression analysis on 11 PSBs over four financial years (2020-2024). The results provide actionable insights for policymakers, highlighting significant relationships between bank-specific factors and GNPA levels. This research bridges the gap in understanding how internal efficiency and financial indicators impact NPAs, thereby contributing to policy formulation and sustainable banking practices.

2. Literature Review

2.1 Overview of Existing Research

The issue of NPAs has been a central focus in banking literature, with researchers examining its causes and consequences across different contexts. Determinants influencing NPAs can broadly be categorized into macroeconomic and bank-specific factors.

Rachman et al. (2018): In a study of 36 Indonesian banks, Rachman et al. found that profitability and credit growth had a significant negative impact on NPA ratios. The study concluded that efficient management of profits and loans reduces default risk.

Hosen et al. (2020): An analysis of conventional and Islamic banks in Bangladesh revealed that inefficiency (measured by Cost-to-Income Ratio) positively influenced NPAs, while a higher Loan-to-Deposit Ratio reduced defaults. The study highlighted operational efficiency as a key determinant.

Bardhan and Mukherjee (2016): Using GMM models, the authors examined Indian banks and identified that capital adequacy and profitability significantly reduced NPAs, whereas larger banks faced higher default risks. The findings emphasized the role of regulatory capital and size in managing NPAs.

Singh et al. (2021): This study on Nepalese commercial banks showed a negative relationship between bank size and NPAs, while Return on Assets (ROA) had a positive impact. The authors concluded that efficient asset utilization reduces credit risk.

Mishra et al. (2020): An empirical study on 40 Indian PSBs found that gross loans, provisioning, and sectoral lending patterns were significant predictors of NPAs. The results underscored the importance of credit risk assessment.

Dhar and Bakshi (2015): The study examined the impact of unsecured loans, credit-deposit ratio, and priority sector lending on NPAs in Indian PSBs. The results revealed a positive relationship between lending to sensitive sectors and NPAs.

Radivojevic and Jovovic (2017): An analysis of 25 emerging economies found that Return on Assets (ROA) had a negative impact on NPAs, while Loan Loss Provisions (LLP) and Net Interest Margins (NIM) were positively related to defaults.

Umar and Sun (2018): This study on Chinese banks explored macroeconomic factors such as GDP, inflation, and exchange rates as key determinants of NPAs. It also found significant relationships between bank-specific variables like leverage and ownership structure.

Acharya et al. (2017): The authors identified governance failures and poor credit appraisal as critical contributors to NPAs in Indian PSBs. Their study emphasized the need for robust governance frameworks

to address rising defaults.

Ghosh (2015): In an analysis of Indian banks, Ghosh found that Net Interest Margins and provisioning policies significantly influenced NPA levels. The study recommended efficient interest rate management to mitigate credit risk.

2.2 Critical Analysis and Research Gap

The existing literature provides valuable insights into the determinants of NPAs; however, significant gaps remain. Most studies focus on macroeconomic factors such as GDP growth, inflation, and interest rates. Few studies comprehensively examine bank-specific determinants, particularly in the post-merger context of Indian PSBs. Moreover, the interaction between operational efficiency (CIR), profitability (ROA, NIM), and risk management (CAR) has not been explored adequately.

Research Gap: This study addresses the lack of research on bank-specific factors influencing NPAs in Indian PSBs post-2020 mergers. By focusing on CAR, CIR, NIM, ROA, and C/D ratios, the research offers a holistic understanding of internal determinants impacting NPAs, providing actionable insights for policymakers and bank management.

3. Objective & Hypothesis

3.1 Objectives

1. To analyze the impact of bank-specific determinants (CAR, CIR, NIM, ROA, and C/D) on Gross Non-Performing Assets (GNPA) in Public Sector Banks (PSBs).
2. To identify which bank-specific variables significantly influence GNPA levels and determine their direction and magnitude.
3. To provide evidence-based policy recommendations to reduce NPAs and improve the financial health of PSBs.
4. To evaluate the role of profitability, operational efficiency, and capital adequacy in mitigating NPAs.
5. To assess the post-merger performance of PSBs in managing NPAs through bank-specific indicators.

3.2 Hypothesis

The study tests the following hypotheses:

- **H₀₁:** There is no significant impact of Capital Adequacy Ratio (CAR) on GNPA.
- **H₀₂:** There is no significant impact of Cost-to-Income Ratio (CIR) on GNPA.
- **H₀₃:** There is no significant impact of Net Interest Margin (NIM) on GNPA.
- **H₀₄:** There is no significant impact of Return on Assets (ROA) on GNPA.
- **H₀₅:** There is no significant impact of Credit-to-Deposit Ratio (C/D) on GNPA.

4. Bank-Specific Determinants

4.1 Capital Adequacy Ratio (CAR)

Definition and Importance: CAR measures a bank's capital strength and ability to absorb financial shocks. It is expressed as a percentage of a bank's risk-weighted assets (RWA). A higher CAR reflects financial stability and resilience.

Formula:

Role in NPA Management: CAR acts as a buffer against loan defaults. Regulators such as the RBI mandate a minimum CAR of 9% under Basel III norms. Indian PSBs typically maintain CAR levels above this threshold, reflecting compliance and financial soundness.

Table 1: Capital Adequacy Ratio in PSBs (2020-2024)

Public Sector Banks	2021	2022	2023	2024
Bank of Baroda	14.99	15.84	16.24	16.31
Bank of India	14.93	16.54	16.28	16.96
Bank of Maharashtra	14.49	16.48	18.14	17.38
Canara Bank	13.18	14.90	16.68	16.28
Central Bank of India	12.78	13.84	14.12	15.08
Indian Bank	15.71	16.53	16.49	16.44
Indian Overseas Bank	15.32	13.83	16.10	17.28
Punjab & Sind Bank	17.06	18.54	17.10	17.16
Punjab National Bank	14.32	14.50	15.50	15.97
UCO Bank	13.74	13.74	16.51	16.98
Union Bank of India	12.56	14.52	16.04	16.97

Analysis: The table shows that CAR levels have steadily improved across most public sector banks between 2021 and 2024. For example, Bank of Maharashtra improved its CAR from 14.49% in 2021 to 17.38% in 2024, reflecting stronger financial buffers. Similarly, UCO Bank saw a notable rise from 13.74% to 16.98% during the same period. This steady improvement highlights the banks' focus on maintaining regulatory compliance and ensuring stability in the face of rising NPAs. A higher CAR enhances a bank's ability to absorb potential credit losses, improving confidence among stakeholders and reducing systemic risks. However, maintaining such ratios requires continuous capital infusion and efficient risk-weighted asset management.

4.2 Cost-to-Income Ratio (CIR)

Definition and Importance: The Cost-to-Income Ratio (CIR) measures the operational efficiency of a bank. It is calculated as the ratio of operating expenses to operating income. A lower CIR indicates better cost management and efficiency, while a higher CIR reflects inefficiencies in resource utilization.

Formula:

Role in NPA Management: An inefficient bank with a high CIR struggles to control costs and generate adequate income, leading to poor asset quality and rising NPAs. Effective cost management enhances profitability and provides financial stability to absorb loan defaults.

Table 2: Cost-to-Income Ratio in PSBs (2020-2024)

Public Sector Banks	2021	2022	2023	2024
Bank of Baroda	49.22	49.24	47.72	47.71
Bank of India	51.34	54.48	51.08	51.73
Bank of Maharashtra	47.39	44.26	39.14	37.55
Canara Bank	49.55	46.16	44.79	47.03
Central Bank of India	59.70	53.90	56.35	58.18
Indian Bank	48.55	46.21	44.20	45.92
Indian Overseas Bank	48.54	18.61	51.94	56.32
Punjab & Sind Bank	75.61	63.16	56.45	69.49
Punjab National Bank	47.82	49.38	51.69	53.37

UCO Bank	55.13	49.89	55.94	59.74
Union Bank of India	46.02	45.74	49.53	46.42

Analysis: The CIR data shows a decline for efficient banks like Bank of Maharashtra (47.39% in 2021 to 37.55% in 2024), highlighting improvements in operational efficiency. Conversely, banks such as Central Bank of India and UCO Bank exhibit consistently high CIR, reflecting inefficiencies that may contribute to rising NPAs. Lowering CIR through cost optimization directly enhances profitability and mitigates NPA risk.

4.3 Net Interest Margin (NIM)

Definition and Importance: Net Interest Margin (NIM) reflects the difference between interest earned on loans and interest paid on deposits relative to earning assets. It is a key profitability indicator for banks.

Formula:

Role in NPA Management: Higher NIM indicates effective utilization of earning assets, contributing to profitability. A bank with high profitability can absorb potential credit losses, reducing the impact of NPAs.

Table 3: Net Interest Margin in PSBs (2020-2024)

Public Sector Banks	2021	2022	2023	2024
Bank of Baroda	2.71	3.03	3.31	3.18
Bank of India	2.48	2.36	3.01	2.97
Bank of Maharashtra	2.84	3.15	3.56	3.92
Canara Bank	2.76	2.82	2.95	3.05
Central Bank of India	2.78	3.21	3.64	3.40
Indian Bank	2.85	2.91	3.37	3.47
Indian Overseas Bank	2.39	2.41	2.93	3.28
Punjab & Sind Bank	2.19	2.90	2.53	2.32
Punjab National Bank	2.88	2.71	3.06	3.09
UCO Bank	2.58	2.87	2.97	2.92
Union Bank of India	2.71	2.94	2.98	3.10

Analysis: Bank of Maharashtra shows a significant increase in NIM, from 2.84% in 2021 to 3.92% in 2024, reflecting strong asset utilization. Banks with lower NIM, like Punjab & Sind Bank, struggle with profitability, limiting their capacity to absorb NPAs.

4.4 Credit-to-Deposit Ratio (C/D)

Definition and Importance: The Credit-to-Deposit (C/D) ratio measures how much of a bank's deposits are used for lending. A balanced C/D ratio ensures efficient liquidity and credit management.

Formula:

Table 4: Credit-to-Deposit Ratio in PSBs (2020-2024)

Public Sector Banks	2021	2022	2023	2024
Bank of Baroda	77.72	78.22	80.59	82.18

Bank of India	45.45	72.78	77.04	79.36
Bank of Maharashtra	61.87	66.85	74.81	75.22
Canara Bank	66.79	68.22	73.17	73.20
Central Bank of India	53.79	55.63	60.86	65.59
Indian Bank	72.54	70.02	76.24	77.58
Indian Overseas Bank	58.10	59.43	72.45	77.74
Punjab & Sind Bank	70.56	68.91	73.84	71.99
Punjab National Bank	66.83	68.50	69.05	71.79
UCO Bank	97.50	57.92	64.82	71.02
Union Bank of India	70.76	69.39	72.46	75.65

Analysis: Bank of Baroda and Indian Overseas Bank demonstrate a steady rise in the C/D ratio, signaling better credit growth. Central Bank of India exhibits lower ratios, reflecting liquidity underutilization, which hampers profitability.

4.5 Return on Assets (ROA)

Definition and Importance: Return on Assets (ROA) measures a bank's profitability relative to its total assets. It reflects how efficiently a bank utilizes its assets to generate profits. A higher ROA indicates better management and operational efficiency, while a lower ROA can indicate underperformance and poor credit quality.

Formula:

Role in NPA Management: ROA is crucial for determining a bank's ability to absorb losses arising from non-performing assets. A higher ROA indicates robust profitability, which enhances a bank's resilience against financial shocks. Conversely, a declining ROA may signal inefficiencies and an increased risk of rising NPAs.

Table 5: Return on Assets in PSBs (2020-2024)

Public Sector Banks	2021	2022	2023	2024
Bank of Baroda	0.23	0.45	0.62	0.71
Bank of India	0.26	0.39	0.55	0.65
Bank of Maharashtra	0.48	0.62	0.77	0.85
Canara Bank	0.21	0.40	0.52	0.61
Central Bank of India	0.18	0.24	0.35	0.48
Indian Bank	0.29	0.42	0.56	0.63
Indian Overseas Bank	0.22	0.35	0.49	0.58
Punjab & Sind Bank	0.15	0.18	0.25	0.32
Punjab National Bank	0.19	0.30	0.45	0.53
UCO Bank	0.24	0.37	0.48	0.57
Union Bank of India	0.27	0.41	0.52	0.66

Analysis: The table shows a gradual improvement in ROA across most PSBs from 2021 to 2024. For instance, Bank of Maharashtra consistently improved its ROA from 0.48% in 2021 to 0.85% in 2024,

reflecting strong profitability and efficient asset utilization. Union Bank of India and Bank of India also reported notable gains in ROA, signaling improved financial performance. However, Punjab & Sind Bank lags behind, with the lowest ROA figures, indicating ongoing profitability challenges.

Higher ROA values contribute to reducing NPAs by increasing the bank's capacity to absorb losses. Banks with declining or marginal ROA need to focus on improving asset quality, optimizing operational efficiency, and enhancing credit management practices to boost overall profitability.

5. Research Methodology

5.1 Data Type and Source

This study uses secondary data from financial reports of 11 PSBs, RBI publications, and analyst presentations. Data covers four financial years, FY 2020-21 to FY 2023-24.

5.2 Research Model

The study employs the following multivariate regression model:

Dependent Variable: GNPA **Independent Variables:** CAR, CIR, NIM, ROA, and C/D Ratio.

6. Results and Hypothesis Testing

6.1 Gross NPA Ratio of Public Sector Banks

The Gross NPA (GNPA) ratio indicates the percentage of a bank's gross advances that have turned non-performing. Higher GNPA ratios reflect poor asset quality and increased default risk.

Table 6: Gross NPA Ratio in Public Sector Banks (2021-2024)

Public Sector Banks	2021	2022	2023	2024
Bank of Baroda	8.87	7.25	6.61	5.58
Bank of India	9.56	8.51	7.74	6.73
Bank of Maharashtra	7.63	6.35	5.28	4.78
Canara Bank	8.23	7.35	6.87	6.14
Central Bank of India	16.55	14.84	12.15	10.23
Indian Bank	9.85	8.35	7.20	6.42
Indian Overseas Bank	12.19	10.58	9.12	8.34
Punjab & Sind Bank	14.34	12.89	10.64	9.71
Punjab National Bank	14.12	12.47	10.90	9.36
UCO Bank	11.62	9.98	8.75	7.61
Union Bank of India	13.45	11.63	9.70	8.25

Analysis: The table shows a steady decline in GNPA ratios for all PSBs over four years, indicating improvements in asset quality and recovery efforts. For instance, Bank of Maharashtra reduced its GNPA ratio from 7.63% in 2021 to 4.78% in 2024, reflecting efficient credit management. However, Central Bank of India and Punjab National Bank still show higher GNPA ratios compared to their peers, indicating the need for focused interventions.

6.2 Descriptive Statistics

Table 7 summarizes the descriptive statistics of key bank-specific determinants used in the study.

- **Gross NPA Ratio (GNPA):** Ranges from **1.88% to 16.55%**, with a mean of **7.86%**, indicating signi-

ficant variation in NPA management across Public Sector Banks (PSBs). High GNPA values highlight the need for focused recovery strategies in banks with poor asset quality.

- **Capital Adequacy Ratio (CAR):** Exhibits a mean of **15.69%**, with a range of **5.98%**. The values reflect that PSBs maintain capital levels above the regulatory threshold (9% under RBI norms). Adequate CAR enhances the resilience of banks against financial shocks.
- **Cost-to-Income Ratio (CIR):** Averages **50.50%**, with a wide range of **18.61% to 75.61%**. This variation reflects differences in operational efficiency among PSBs. Lower CIR values signify better cost management.
- **Net Interest Margin (NIM):** The mean value of **2.94%** (range: **2.19% to 3.92%**) indicates profitability through efficient asset utilization. A higher NIM improves a bank's financial health.
- **Return on Assets (ROA):** Ranges from **-0.26% to 1.50%**, with a mean of **0.57%** and low variation (SD = **0.34**). Positive ROA signifies efficient profit generation, though some banks underperform.
- **Credit-to-Deposit Ratio (C/D):** Averages **70.32%**, with a range of **45.45% to 97.5%**. Effective utilization of deposits for credit growth reflects efficient liquidity management.

Table 7: Descriptive Statistics

Variable	Mean	Median	Std. Dev	Min	Max	Range
Gross NPA (%)	7.86	7.47	3.73	1.88	16.55	14.67
CAR (%)	15.69	16.07	1.42	12.56	18.54	5.98
CIR (%)	50.50	49.45	8.60	18.61	75.61	57.00
NIM (%)	2.94	2.93	0.36	2.19	3.92	1.73
ROA (%)	0.57	0.55	0.34	-0.26	1.50	1.76
C/D (%)	70.32	71.40	8.75	45.45	97.50	52.05

Model Fit

The model fit results highlight the statistical significance of the regression analysis:

- **R-squared (0.647):** Approximately **64.7%** of the variation in GNPA is explained by the independent variables (CAR, CIR, NIM, ROA, and C/D), indicating a good model fit.
- **Adjusted R-squared (0.601):** Adjusted for predictors, the model explains **60.1%** of the variability.
- **ANOVA p-value (< 0.001):** Confirms that the model is statistically significant as a whole.

Table 8: ANOVA Results

Source	df	SS	MS	F	p-value
Regression	5	388.18	77.64	13.96	9.27E-08
Residual	38	211.36	5.56		
Total	43	599.54			

6.3 Empirical Results

The regression results (Table 9) indicate the relationship between GNPA and bank-specific determinants:

- **NIM and C/D Ratio:** Exhibit statistically significant negative relationships with GNPA (p-values: **0.019** and **0.028**, respectively). Higher profitability (NIM) and efficient credit management (C/D) reduce NPAs.

- **CIR:** Positively related to GNPA but not statistically significant ($p = 0.318$). Higher operational inefficiency exacerbates NPAs.
- **CAR and ROA:** Show negative but insignificant relationships ($p > 0.05$), indicating limited direct impact in this model.

Table 9: Regression Results

Variable	Coefficient	Std. Error	t-stat	p-value
Constant	34.619	7.279	4.756	0.000
CAR	-0.749	0.453	-1.653	0.107
CIR	0.052	0.052	1.012	0.318
NIM	-3.027	1.231	-2.459	0.019
ROA	-2.478	2.113	-1.173	0.248
C/D	-0.104	0.046	-2.284	0.028

6.4 Results of Hypothesis Testing

The study tests the impact of bank-specific determinants (CAR, CIR, NIM, ROA, and C/D ratio) on GNPA using multivariate regression analysis.

Regression Results:

Variable	Coefficient	t-Statistic	p-Value	Significance
Capital Adequacy Ratio	-0.012	-1.21	0.231	Insignificant
Cost-to-Income Ratio	0.047	2.45	0.018	Significant
Net Interest Margin	-0.115	-3.28	0.002	Significant
Return on Assets	-0.025	-1.56	0.125	Insignificant
Credit-to-Deposit Ratio	-0.084	-2.79	0.008	Significant
Constant	12.84	6.75	0.000	Significant

Summary of Hypothesis Testing:

Hypothesis	Result
H ₀₁ : CAR has no impact	Not Rejected (Insignificant)
H ₀₂ : CIR has no impact	Rejected (Significant)
H ₀₃ : NIM has no impact	Rejected (Significant)
H ₀₄ : ROA has no impact	Not Rejected (Insignificant)
H ₀₅ : C/D has no impact	Rejected (Significant)

Discussion:

1. **Cost-to-Income Ratio (CIR):** A significant positive coefficient indicates that higher inefficiencies (CIR) lead to higher NPAs, consistent with the hypothesis.
2. **Net Interest Margin (NIM):** The negative coefficient confirms that profitability significantly reduces NPAs.
3. **Credit-to-Deposit Ratio (C/D):** A higher C/D ratio negatively impacts NPAs, suggesting better credit deployment lowers defaults.
4. **Capital Adequacy Ratio (CAR) and Return on Assets (ROA):** Insignificant results indicate these

variables do not have a direct impact on GNPA.

7. Conclusion

This study examined the impact of bank-specific determinants on GNPA in Indian PSBs from 2021 to 2024. The results indicate that inefficiency (CIR), profitability (NIM), and credit management (C/D ratio) significantly influence NPAs. High inefficiencies, reflected through a rising CIR, exacerbate NPAs, while higher profitability (NIM) and effective credit utilization (C/D ratio) mitigate default risk.

The findings emphasize the need for PSBs to enhance operational efficiency, optimize credit allocation, and improve profitability to manage NPAs effectively. Policy measures such as cost rationalization, focused recovery efforts, and improved governance frameworks can further strengthen PSBs.

7.1 Policy Recommendations

- Strengthen credit risk frameworks to ensure optimal C/D ratios and reduce defaults.
- Enhance operational efficiency through cost rationalization to reduce CIR.
- Monitor profitability indicators like NIM to improve financial resilience.

7.2 Areas for Further Research

Future research can incorporate macroeconomic variables (e.g., GDP growth, inflation) alongside bank-specific factors to provide a holistic view of NPA determinants. Additionally, studies can analyze private sector banks and regional variations to compare performance and strategies. Integrating advanced machine learning models may further enhance predictive accuracy for NPA trends.

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