

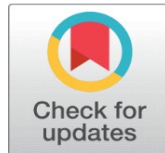
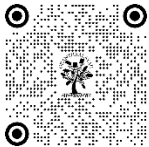
NPA AND PROFITABILITY IN INDIAN SCHEDULED COMMERCIAL BANKS: DYNAMIC PANEL DATA ESTIMATION USING GMM

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ABSTRACT

Scheduled commercial banks play an important role in Indian financial system. These banks have undergone into many reforms to improve the operational performance and financial health. Despite of various reforms, the problem of non-performing assets persists in Scheduled Commercial Banks of India affecting the profitability, liquidity and overall financial health. This paper evaluates the problem of non-performing asset influencing the profitability of Scheduled Commercial Banks in India. To study, a sample of 52 banks having chronic non-performing assets over a period of 2003-2023 have been considered. The study uses Dynamic panel regression based on the Differenced GMM and System GMM. Both the models show robust results with the NNPA significantly affecting profitability.

Keywords: Non-performing Assets, Profitability, Dynamic Panel, Generalised Method of Moments (GMM)

JEL Classification — C33, E58, G21

1. INTRODUCTION

(Greeshmadas, 2022) Scheduled commercial banks (SCBs) in India play a crucial role in the nation's financial system. As of 2025, (Reserve Bank of India, 2025) there are 137 SCBs, including 12 public sector, 21 private, and 44 foreign banks. These banks have undergone significant reforms since the 1990s to improve their operational performance and financial health (M. Ibrahim, 2011).

In India, scheduled commercial banks face a major problem with non-performing assets (NPAs), which have an impact on their entire financial health, liquidity, and profitability (Sindhu, 2020; Thammanaveni, 2016). Compared to private and foreign banks, public sector banks have consistently shown greater non-performing asset (NPA) levels. (Sarkar, 2025). The growth rate of NPAs often exceeds that of gross advances, with non-priority sectors and large borrowers contributing significantly to the problem (Sindhu, 2020). Various factors, including economic slowdowns and demand fluctuations, have contributed to the accumulation of NPAs (Sarkar, 2025). To address this issue, the Government of India with Reserve Bank of India have implemented recovery methods such as Lok Adalats, SARFAESI Act, and Debt Recovery Tribunals (Kumar & Abhay, 2017; Thammanaveni, n.d.). Despite these efforts, NPAs remain a

persistent concern, necessitating improved credit appraisal processes and management strategies to enhance the overall performance of the banking sector (Singh, 2013; Sarkar, 2025).

2. REVIEW OF LITERATURE

(Rani et al., 2024) The relationship between bank profitability and non-performing assets (NPAs) has been extensively studied in the Indian banking sector. (Das & Uppal, 2021; Gaur & Mohapatra, 2020; Sen Ahana, 2021) Multiple studies have found a negative correlation between NPAs and profitability measures such as Return on assets, Return on equity and Net interest margin. (Maity & Sahu, 2017) highlight that reducing NPAs can significantly improve the efficiency and profitability of banks. Also, the mounting NPAs adversely affect the growth and profitability of banking institutions, emphasizing the need for effective management strategies to mitigate these risks. Similarly, (Das & Uppal, 2021) provide empirical evidence that rising NPAs lead to a decline in interest margins, thereby reducing profitability. Their findings are corroborated by other studies, such as those by (Sinha & Sharma, 2016), which also report a negative correlation between NPA and profitability in commercial banks of India over extended periods. Further supporting this view, (Kanoujiya et al., 2023) assert that there is an inverse relationship between NPAs and profitability in Indian banks. They note that while NPAs are a significant concern, the regulatory environment does not appear to directly influence this relationship. This suggests that banks must focus on internal management practices to address the challenges posed by NPAs. (Bolarinwa & Soetan, 2019) The impact of NPAs on profitability is not limited to public sector banks only, the private sector banks also experience similar challenges. (Bajaj et al., 2021) discuss how NPAs affect operational efficiency, which in turn impacts profitability due to increased loan loss provisions and reduced revenue-generating assets. Their analysis indicates that as NPAs rise, banks face a gradual decline in their ability to manage costs effectively, leading to lower profitability. Moreover, the findings of (Khan, 2024) reinforce the notion that NPAs are a major detractor from the banking sector's profits. His study emphasizes that NPAs carry significant negative regression coefficients, indicating a strong inverse relationship with profitability. This is further supported by the work of (Gaur & Mohapatra, 2020), who explore the gravity of the impact that NPAs have on bank profitability, considering bank specific, industry specific, and macroeconomic factors.

The literature consistently demonstrates that NPAs are detrimental to the profitability of Indian banks. The need for effective risk management and recovery strategies is essential to enhance the financial health of these institutions. As NPAs continue to pose a significant threat to the banking sector's stability, ongoing research and policy interventions are essential to mitigate their impact. Therefore, the objective is to study the relation between the non-performing assets and profitability of Indian scheduled commercial banks as a chronic issue.

3. METHODOLOGY

3.1. SAMPLE

The paper examines 52 banks (12 public, 17 private and 23 foreign banks) listed in the second schedule of Reserve Banks of India Act 1934 is taken as a sample for the period of 2002-03 to 2022-23.

3.2. VARIABLES

ROA is dependent variable, taken as a proxy for profitability. NNPA is independent variable which represents the asset quality. While NIM, NII, Operating Efficiency, CAR and log of total asset are the bank specific control variable. Whereas the GDP growth is chosen as a proxy for economic growth.

Table-1: Variables used in Research Model

Variable	Notation	Measures	Previous Studies
Dependent Variables			
Profitability	Return on Asset (ROA)	$\frac{\text{Net profit}}{\text{Total asset}}$	(Batwo Michael & Guidi, 2020; Krishnankutty & Kumar Mohanty, 2018)
Independent Variables			
Asset Quality	Net Non-performing Asset (NNPA)	$\frac{\text{Net NPA}}{\text{Net Advances}}$	(Barge A, 2012; Bawa et al., 2019; Das & Uppal, 2021; Jayanata Kumar, 2012; Krishnudu G., 2022; Prasad G.V. Bhavani & D Veena, 2011; Satpathy et al., 2015; Singodiya et al., 2022)
Control Variables			

Core Business Income	Net Interest Margin (NIM)	$\frac{\text{Interest income} - \text{Interest expense}}{\text{Total Asset}}$	(Prasanna P. Krishna et al., 2014; Radivojevic & Jovovic, 2017)
Income Diversity	Non-interest Income (NII)	$\frac{\text{Non interest income}}{\text{Average Earning Asset}}$	(Alfadli & Rjoub, 2020; Mostak Ahamed, 2017)
Efficiency	Operational Efficiency (OE)	$\frac{\text{Operating cost}}{\text{Operating income}}$	(Batwo Michael & Guidi, 2020; Yahya et al., 2017)
Capital Adequacy	Capital Adequacy Ratio (CAR)	$\frac{\text{Tier I} + \text{Tier II Capital}}{\text{Risk Weighted Asset}}$	(Krishnankutty & Kumar Mohanty, 2018)
Size	Total Assets	Log of Total Asset	(Batwo Michael & Guidi, 2020; Rachman et al., 2018)
Economy Growth	GDPg	Gross Domestic Product growth	(Krishnankutty & Kumar Mohanty, 2018; Ozili, 2018)

Source: Compiled by the author

3.3. METHOD

The study begins with pre-estimation tests. (Levin et al., 2002) Unit root test to verify stationarity. After satisfying the assumption of stationarity, the study provides description of the variables through descriptive statistics. Further, to check multicollinearity the study presents Correlation matrix in Table-3 and in Table-4 test of Variance Inflation Factor (VIF), White test is incorporated to check heteroskedasticity and Wooldridge test for autocorrelation. Then the used dynamic panel regression model using difference GMM and system GMM estimation. Further, the model is tested for Hansen and Sargan statistics to check the instrument validity.

3.4. MODEL SPECIFICATION

A. Dynamic Panel Regression Equation

To estimate the impact of NPA's on bank profitability, this paper implements dynamic panel model. (Enowbi Batuo & Guidi, 2021) In such models lagged dependent variable are used to resolve the potential problem of autocorrelation, heteroscedasticity and endogeneity. The study uses the dynamic panel data structure model which is defined as follows:

$$Y_{it} = \alpha + \beta_1 Y_{i,t-1} + \beta_2 X_{i,t} + \varepsilon_{i,t}$$

Where, $Y_{i,t}$ is the dependent variable for individual i at time t ; $Y_{i,t-1}$ is the lagged dependent variable. $X_{i,t}$ are the explanatory variables, α is the constant and β are coefficients to be estimated, $\varepsilon_{i,t}$ is the error term consisting $v_{i,t}$ unobserved bank specific effect and $u_{i,t}$ idiosyncratic error. (Arellano & Bond, 1991) The unobserved bank-specific effect $v_{i,t}$ can be correlated with the lagged dependent variable $Y_{i,t-1}$ leading static panel estimator inconsistent, to overcome this problem Generalized Method of Moments (GMM) estimator is used.

B. Differenced GMM regression equation

The difference GMM dynamic panel estimation is proposed by Arellano-Bond (1991). In this estimation model all the covariates transformed into first-difference then GMM is applied.

$$\Delta ROA_{it} = \alpha_1 + \beta_1 \Delta ROA_{i,t-1} + \beta_2 \Delta NNPA_{i,t} + \beta_3 \Delta LNIM_{i,t} + \beta_4 \Delta LNII_{i,t} + \beta_5 \Delta LEFF_{i,t} + \beta_6 \Delta LCAR_{i,t} + \beta_7 \Delta LTA_{i,t} + \beta_8 \Delta GDPg_{i,t} + \Delta u_{it}$$

(Arellano & Bond, 1991) The Difference GMM suffers from weak instrument problems because it uses lagged variables as instruments for the first-differenced equation. Such lagged levels become weak predictors of the changes in the variables when the current values are strongly correlated with past values.

C. System GMM regression equation

(Arellano & Bover, 1995; Blundell & Bond, 1998) To overcome the weak instrument problem, we use system GMM. (Roodman, 2009) Lagged differences of the variables are used as instrument for the level equation in the model. This

exploits more information in the data compared to difference GMM, leading more efficient estimates with smaller standard errors.

$$ROA_{it} = \alpha_1 + \beta_1 ROA_{i,t-1} + \beta_2 NNPA_{i,t} + \beta_3 LNIM_{i,t} + \beta_4 LNII_{i,t} + \beta_5 LEFF_{i,t} + \beta_6 LCAR_{i,t} + \beta_7 LTA_{i,t} + \beta_8 GDPg_{i,t} + u_{it}$$

4. ANALYSIS

Table-2: Descriptive Statistics

Variable	Obs.	Mean	Std. dev.	Min	Max
<i>Dependent variable</i>					
ROA	1,092	1.2257	1.4552	-6.8481	11.2563
<i>Independent variables</i>					
NNPA	1,092	2.0734	3.2750	-0.2916	35.4274
NIM	1,092	0.5569	0.1486	-0.8022	0.9687
OE	1,092	1.6559	0.1510	1.0837	2.1194
NII	1,084	1.1980	0.2726	-0.2597	1.9337
CAR	1,092	1.2570	0.2325	0.8759	2.2244
LTA	1,092	4.3140	1.0867	1.4782	6.7049
GDPg	1,092	6.4393	3.1279	-5.7777	9.6896

Source: Calculated by the author

Table-2 shows the descriptive statistics of 52 selected Scheduled Commercial Banks over the period from 2003 to 2023 consisting 1,092 observations. The average ROA is 1.2257, with high standard deviation 1.4552 shows significant variability and the minimum value -6.8481 and maximum value 11.2563 reveal a wide range of profitability levels across the banks. The average value of NNPA is 2.0734, with a considerable standard deviation 3.2750. The presence of both minimum -0.2916, maximum 35.4274 suggests significant heterogeneity in the quality of loan portfolios. The mean NIM is 0.5569, indicating a moderate level of interest income. The standard deviation 0.1486 suggests that interest income levels are relatively concentrated around the mean. The average efficiency score OE is 1.6559, with a moderate standard deviation 0.1510. The mean NII is 1.1980, suggesting positive growth in non-interest income. The average CAR is 1.2570, with a moderate standard deviation 0.2325. The mean of the LTA is 4.3140, the standard deviation 1.0867 suggests substantial variation in bank sizes within the sample. The average GDPg is 6.4393, with a high standard deviation 3.1279. The presence of both minimum -5.7777, maximum: 9.6896 GDPg rates indicates significant economic fluctuations during the sample period.

Table-3: Corelation Matrix

Variable	ROA	NNPA	NIM	NII	OE	CAR	LTA	GDPg
ROA	1							
NNPA	-0.3523	1						
NIM	0.4615	-0.1882	1					
NII	0.5488	-0.0687	0.2541	1				
EFF	-0.5614	0.1529	-0.3155	-0.2878	1			
CAR	0.3326	-0.1035	0.3	0.2084	-0.2306	1		
LTA	-0.3034	-0.0102	-0.249	-0.2772	0.0742	-0.6657	1	
GDPg	0.0552	0.044	0.0253	0.0653	-0.0206	0.0185	-0.0893	1

Source: Calculated by the author

From Table-3, independent variable NNPA, OE and LTA show negative relation to ROA. This means higher level of bad loans (NNPA) would negatively impacts profitability. (Sahul Hamid, 2017) Also, the banks with higher operating efficiency ratios (OE) tend to have lower ROA and NIM. This suggests banks that can successfully control their operating costs are probably going to be more profitable. While the other NIM, NII, CAR and GDPg are positively related with ROA. ROA and Capital Adequacy Ratio (CAR) have strong negative correlation with Bank Size (LTA) this may due to higher increased operational complexity, higher competitive pressures and risk-taking activities.

Table-4: Result for Unit-root, VIF Test, Heteroscedasticity, Autocorrelation Test

	Unit root Test	VIF Test		Heteroscedasticity Test	Autocorrelation Test
Variables	Levin, Lin & Chu	VIF	1/VIF	White Test	Wooldridge Test
NNPA	0.00	1.06	0.939		
OE	0.00	1.23	0.810		
NIM	0.00	1.24	0.806		
NII	0.00	1.2	0.835	chi2 (35) = 139.81	F (1,51) = 2.648
CAR	0.0368	1.97	0.509		
LTA	0.00	1.96	0.509		
GDPg	0.00	1.02	0.985		
		Mean VIF = 1.38		Prob > chi2 = 0.0000	Prob > F = 0.1098

(Source: Calculated by the author)

In Table-4, the unit root tests for Levin, Lin & Chu is conducted to examine the stationarity of the series. The Levin Lin & Chu Shin test results indicate that all variables are stationary at their levels, as their p-values are below 0.05. The variance inflation factor (VIF) measures to test the multicollinearity. VIF value less than 10 indicates there is no serious issue of multicollinearity in independent variables. The White test for heteroskedasticity have p-value less than 0.05, means that the variance of errors in regression model is constant and there is strong evidence of heteroscedasticity in the model. Since, the value of Wooldridge test for autocorrelation is 0.1098, we failed to reject the null hypothesis, suggesting there is no strong evidence of first-order autocorrelation in residuals of the model.

Table-5: Dynamic Panel Data Analysis: GMM Estimation

	<i>Difference GMM</i>			<i>System GMM</i>		
ROA	Coefficient	Robust std. err.	P>z	Coefficient	Robust std. err.	P>z
ROA L1.	0.1798***	0.0615	0.0030	0.1969***	0.0652	0.0030
NNPA	-0.1319***	0.0218	0.0000	-0.1114***	0.0192	0.0000
NIM	0.7424*	0.4076	0.0690	1.2924***	0.4564	0.0050
NII	1.3027***	0.2607	0.0000	1.5700***	0.2217	0.0000
EFF	-3.6287***	0.6253	0.0000	-2.7519***	0.4380	0.0000
LTA	-0.2070*	0.1097	0.0590	-0.1126**	0.0481	0.0190
CAR	0.3089	0.3730	0.4080	0.1074	0.3192	0.7370
GDPg	0.0234	0.0166	0.1570	0.0279*	0.0155	0.0720
cons				3.3294	1.2752	0.0090
<i>Model Diagnostics</i>						
No. of Obs.	980			1032		
Wald chi2(8)	326.16			2096.13		
Prob > chi2	0.000			0.000		
AR (2) Pr > z	0.402			0.408		
Sargan Prob > chi2	0.120			0.126		
Hansen	0.327			0.353		

Source: Calculated by the author

(Gaur & Mohapatra, 2020) The profitability is time persistent as the profitability of past year creates a momentum for reinvestment, research and development. It also boosts the investor's confidence and reputation of the company which affects the future returns. The lag values of the dependent variable are not considered in the static panel data, therefore GMM estimation model is appropriate.

Table-5 shows the output of GMM estimation for bank profitability (ROA) by using two equations first is one-step Differenced GMM and other is one-step System GMM. We estimated the Difference GMM and System GMM models for

dynamic panel data analysis to check the robustness of our results. (Zaman et al., 2011) In both model the lagged value of dependent variable impacting positive and statistically significant (0.1798), (0.1969) respectively. This suggests that the profitability in the previous period positively influences the current profitability. The NNPA negatively impact ROA, with significant coefficients in both Difference GMM (-0.1319) and System GMM (-0.1114). This indicates that higher NPAs reduce profitability. NIM has a positive and significant impact on ROA. The effect is stronger in System GMM (1.2924) compared to Difference GMM (0.7424). (NII) non-interest income positively and significantly impacts ROA in both models. The effect is stronger in System GMM (1.5700) at 1% level of significance whereas in Difference GMM (1.3027) at 10% level of significance. (Gaur & Mohapatra, 2020; Nisar et al., 2018) Banks to have less reliance on interest income, they take up nontraditional revenue generation activities for efficiency in the portfolio of income. (Cost-Income) OE negatively impacts ROA, indicating that higher inefficiency reduces profitability. The coefficients are significant in both models, with a stronger negative effect observed in Difference GMM (-3.6287) than in System GMM (-2.7519). LTA negatively impact ROA significantly in System GMM (Coefficient: -0.1126) and marginally significant in Difference GMM (Coefficient: -0.2070). The CAR does not significantly impact ROA in either model. GDP growth has a positive but marginal significance in System GMM (Coefficient: 0.0279) and statistically insignificant impact in Difference GMM (Coefficient: 0.0234). The Constant in System GMM is significant (Coefficient: 3.3294) suggesting a baseline level of profitability.

4.1. MODEL DIAGNOSTICS

The Wald Chi-squared Test for both Differenced and System GMM models show strong overall significance (p-value = 0.000), indicating that the independent variables collectively explain the variability in ROA. Further, the p-value for (Arellano & Bond, 1991) test indicates no second-order autocorrelation in the residuals for Difference GMM 0.402 and System GMM 0.402. The p-values for Sargan Test in Difference GMM is 0.120 and System GMM is 0.126 rejects the null hypothesis suggesting the instruments are valid. Also, The Hansen Test p-values for Difference GMM is 0.327 and System GMM is 0.353 further confirm the validity of the instruments, as they are not overidentified.

5. CONCLUSION

Both Difference and System GMM models provide robust results with significant variables affecting ROA. (Nisar et al., 2018; Prasad G.V. Bhavani & D Veena, 2011; Singodiya et al., 2022) Key determinants of ROA include the lagged ROA, NIM (net interest income), NII (non-interest income) having a strong positive impact. (Siraj & P. Sudarsanna Pillai, 2013; Sufian et al., 2016) Whereas, the NNPA (net non-performing assets) and EFFI (efficiency) impacting negatively. Diagnostic tests confirm that both models satisfy key assumptions and use valid instruments. However, the System GMM appears to provide stronger and more precise estimates, evident from smaller standard errors for several variables.

5.1. IMPLICATIONS

The fact that NPAs continue to have a negative effect on profitability even after numerous reforms raises the possibility that current approaches are inadequate. A multifaceted approach is required, that emphasises both prevention and resolution. First and foremost, stricter loan monitoring and improved credit appraisal procedures are essential to prevent the accumulation of NPAs. This involves using data analytics and technology to enhance risk assessment and credit rating. Second, proactive loan restructuring measures and improved early warning systems can help address potential NPAs at an early stage. (Kanoujiya et al., 2023) Thirdly, to establish a culture of accountability and prudent lending practices requires strengthening corporate governance in banks, which includes increased board independence and strong risk management systems. Fourth, more regulatory and supervisory control is required, along with strict enforcement of rules and prompt corrective action for banks that are having trouble. Last but not least, expediting the resolution of stressed assets can be achieved by enhancing the Insolvency and Bankruptcy Code (IBC) procedure and simplifying debt collection procedures. For Indian SCBs, which are essential to the country's financial system, to remain healthy, stable, and profitable over the long run, the NPA issue must be resolved. Future research could explore sector-specific NPA drivers and the effectiveness of different resolution strategies to further inform policy interventions.

CONFLICT OF INTERESTS

None.

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