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Evaluating the Impact of NPA Dynamics in Selected Indian Banks: A Fifteen-Year Comparative Study

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Abstract - **Purpose: The purpose of this study is to investigate the impact on bank profitability, capital structure, and financial stability and trend analysis regarding non-performing assets (NPAs) performance in selected Indian public sector banks vis-à-vis that observed in private sector ones during fifteen years. Methodology: For this research, a quantitative methodological approach has been used, and for quantifiable data, annual reports from four select banks, which include two public sector banks (The Bank of Baroda, The State Bank Of India) as well as two private sector banks (ICICI Bank Ltd., Nainital bank), are analyzed for the period ranging 2008-09 to 2022-23. The analysis calculates Compound Annual Growth Rates (CAGR) and t-tests, Panel Regression models to determine the relationship between GNPA additions, reductions, and write-offs with closing balances. Findings: A major increase in GNPAs is observed in the research among Scheduled Commercial Banks. The public sector banks found an even larger dynamism in NPA growth rates than private sector banks, manifesting the fluctuation to a high degree. The study identifies GNPA addition, reduction, and write-off as key determinants of their respective closing balances. Even though there have been many policy initiatives, the public sector banks (PSBs) remain at a higher level of NPAs due to governance deficits and political interference. The effectiveness of these predictors on GNPA is also confirmed using the Random Effect Model, thus requiring improved risk management practices. Originality: The content of this article is guaranteed to be original.**

Keywords: **Public Sector Banks, Private Sector Banks, Scheduled Commercial Banks, Gross NPAs, Net NPAs**

I. INTRODUCTION

Any successful financial system relies on a strong banking sector, which boosts economic growth and stability. The Indian banking system is crucial to financial inclusion and economic resilience as well as economic activity. In September 2022, Indian banks held loans worth ₹130.4 trillion, accounting for 50.3% of the country's GDP, demonstrating the sector's significant impact on the economy **(**Kaul, 2023**)**. Therefore, this sector's NPA evolution is a major problem for economic growth and financial stability. Scheduled Commercial Banks (SCBs) in India include public, private, foreign, and regional rural banks, each contributing to the financial landscape (Udayakumar et al., 2023). The Reserve Bank of India (RBI) has taken various policy actions to protect the banking sector against economic downturns.

The (*Report on Trend and Progress of Banking in India 2022-23*, 2023) discusses current governmental responses to this changing macro-financial landscape. For years, India's macro story has been better than many other global economies due to its healthy, stable, and responsive financial sector (Oleksandr et al., 2023). Non-Performing Assets are a critical indicator of a bank's quality and financial health. This shows banking sector inefficiencies that could hurt economic growth if banks can't lend for productive causes (Fuw et al., 2011). The RBI study shows that SCBs' GNPA ratio increased in 2017-18 but fell below 5% by September. In another, rationalising capital needs caused severe undercapitalisation. Average slippages drove the decline, while recoveries, upgrades, and significant write-offs lowered outstanding GNPAs. From the 4th quarter of FY19, their GNPA ratios decreased, and this improvement maintained until 2023. SCBs' GNPA ratio dropped to 3.9% in March 2023 and below 1% by September 2023. Recovery and upgrades accounted for 45% of SCB GNPA reductions in 2022-23.

II. REVIEW OF LITERATURE

For instance, the ever-growing problem of NPAs has been an issue widely researched because it threatens systemic stability and efficiency in performance as well. This study is an amalgamation of the determinant, trend, and impact in public sector as well as private sector banks on NPAs.

Movements of NPAs in Scheduled Commercial Banks (SCBs)

NPAs are a great concern for Indian SCBs. Several studies have identified the fluctuating pattern of NPAs over time. Comparatively greater evidence of substantial movement in NPAs over a period of time across Indian SCBs was shown by (Mishra & Rath, 2023) through a non-parametric test-based comparative study. Along this line of argument, (Swain et al., 2017) considered regulatory frameworks that governed NPAs and debated how government policy and bank-specific

strategy have been attempting to rein in the increasing figures of NPAs. Rizvi et al., (2019), studying the hierarchical determinants of NPAs with ISM and MICMAC approaches that furnished a layered understanding regarding factors leading to the movements in NPAs within SCBs. Miyan, (2017), conducted a comparative statistical study on NPA between public and private sector banks. He found that the extent of NPAs is greater in public sector banks due to their presence in sectors like agriculture.

NPA Growth Rates in Priority and Non-Priority Sector Lending

Several researchers have delved into the comparison of NPA growth rates between priority and non-priority sector lending. Mishra, (2016) presented a comparative study about NPA in the priority and non-priority sectors of public sector banks. NPAs in the priority sector, specifically agriculture, turn out to be higher due to inferior credit risk management. These facts were further supported by (Gowda Inchara, 2020), as he too had turned the pages to bring into light the difference in the credit performance of the two sectors. His study revealed that public sector banks show higher NPAs in priority sector lending because of lenient credit approval policies. According to (Haralayya, 2021), amongst the different sub-sectors included in the priority sector, agriculture is more liable: agricultural loans of the priority sector have caused NPAs to increase, more in the public sector banks (Hawaldar et al., 2020; Rami et al., 2024). Kumar et al., (2020) investigated priority sector lending and NPAs, describing the systemic obstacles to priority lending that contribute to growing NPAs, including weaker credit assessment protocols. Kaur & Kumar, (2018)analysed the position of NPA before and after the financial crisis. It also gave the sectoral breakup and showed higher NPA rate in the post-crisis period in the priority sector on account of agricultural stress and subsequent loan defaults.

Growth Rates of GNPAs and NNPAs in Selected Public and Private Sector Banks

Several studies have compared the growth rates of Gross NPAs (GNPAs) and Net NPAs (NNPAs) between public and private sector banks. Kumar et al., (2022) analyzed the long-term mobility of GNPA and NNPA in Indian public and private sector banks and reported that while both sectors have been affected, the growth rate of NPA is higher in the public sector banks. Banerjee et al., (2018) conducted a comparative study on NPA for commercial banks in India. They found that GNPAs for public sector banks remained higher compared to private banks mainly because of their exposures to priority sector lending. Veena & Bhavani Prasad, (2020) also discussed how NPA grew differently across industries. “Governance issues in the public sector banks led to higher NPAs than those for private banks.” Narula & Singla, (2014) analysed performance at a sector-wise level in NPA. Private sector banks, though affected, followed stricter credit policies and thus maintained their NNPAs at better levels than hitherto**.**

Impact of NPA Additions, Reductions, and Write-offs on Bank NPAs

The impact of NPA additions, reductions, and write-offs on the overall NPA figures is a well-researched area. (Hawaldar et al., 2020) talk about the fact that agricultural loans account for a lion's share of NPA additions, more so in the case of public sector banks. They talk about how frequent write-offs and loan waivers of agricultural loans accentuate the situation of NPAs even more. (Shalini, 2013), conducted a study to identify the causes of NPAs in agricultural loans given by Indian public sector banks. She recommended remedial measures to reduce NPA incidences in the future through various factors, such as more stringent credit monitoring and management. (Bag et al., 2022) studied the effect that priority sector lending was having on the profitability of Indian Public Sector Banks, for which the write-off of NPAs has been a necessary but problematic tool in managing NPAs. The authors believed that while write-offs help maintain balanced sheets, they are also reflective of poor practices in the management of loans. (Baijal, 2015; Meghanathi & Dodiya, 2022) incorrectly refer to the fact that write-offs have been common in reducing NPAs in both public and private sectors at the cost of profitability and financial stability. Lastly, (Pradhan, 2012) have taken a regional look at Odisha and observed that compared to the reductions, additions to NPAs are at higher magnitudes, mostly in respect of advances to agriculture; although write-offs are being considered as mitigate measures.

Summary: Literature on NPA in Indian banks provides an all-inclusive understanding of the NPA trend across SCBs, more so regarding priority and non-priority sector lending. This also brings out the differential performance between the public and private sector banks in terms of GNPAs and NNPAs, with public sector banks having larger challenges. Finally, the role of addition, reduction, and write-offs of NPA were of essence, more so in sectors such as agriculture where NPAs keep haunting.

III. OBJECTIVES OF THE STUDY

- To study the movements of NPAs in Scheduled Commercial Banks.
- To analyse the NPA growth rates of Priority and Non-Priority Sector lending.
- To evaluate the growth rates of GNPAs and NNPAs in selected PSBs and PRBs.
- To examine the impact of NPA Additions, Reductions, and Write-offs on bank NPAs.

IV. METHODOLOGY

The nonperforming assets (NPAs) of two public sector banks in India—State Bank of India (SBI) and Bank of Maharastra (BOM)—and two private sector banks, ICICI and Nainital Bank (NB) are compared in this study. The data consists of 15 years from 2008-09 to 2022-23. Data was gathered from annual reports and the RBI website. By using Ms-Excel's

Compound annual growth rate (CAGR), Descriptive statistics were used for analysis. To test hypotheses, SPSS v.27 (ANOVA, t-test) and by using STATA v.17 (Pannel Regression) are calculated.

Criteria for selection of sample banks

The sample (SBI, ICICI) was selected based on the highest net worth of the banks under the PSBs & PRBs. The sample (BOM, NB) was selected based on the lowest net worth of the banks under the PSBs & PRBs. As SBI merged with all their subsidiaries the data collected pre-merger period is the sum of SBI & its subsidiaries.

V. Results & Discussion

H_{01}: There is no significant difference between the sample mean NPAs Grouth Rates of Priority and Non-Priority Sector lending and hypothetical population mean NPAs Grouth Rates of Priority and Non-Priority Sector lending in Public Sector Banks.

TABLE I NPAS GROWTH RATES OF PRIORITY AND NON-PRIORITY SECTOR LENDING – IN PSBS

Years	Priority Sector			Non-Priority Sector			Total	
	% of Total NPA	Trend %	YOY Growth %	% of Total NPA	Trend %	YOY Growth %	Trend %	YOY Growth %
2023	52.69	932.35	-7.39	47.31	986.76	-31.87	966.09	-19.59
2022	45.04	1006.80	-5.51	54.96	1448.30	-17.13	1201.44	-12.27
2021	41.82	1065.49	9.16	58.18	1747.66	-18.85	1369.47	-9.10
2020	34.82	976.04	19.70	65.18	2153.69	-18.46	1506.50	-8.28
2019	26.68	815.40	5.24	73.32	2641.33	-23.43	1642.48	-17.43
2018	20.94	774.81	16.51	79.06	3449.42	35.19	1989.08	30.80
2017	23.50	665.02	27.93	76.50	2551.61	26.47	1520.75	26.81
2016	23.30	519.85	30.22	76.70	2017.50	128.06	1199.21	93.90
2015	34.69	399.20	20.92	65.21	884.65	23.34	618.46	22.53
2014	35.16	330.15	18.76	64.79	717.25	53.32	504.74	38.19
2013	40.91	277.99	20.61	58.39	467.81	63.24	365.26	40.25
2012	47.57	230.49	38.80	50.17	286.57	71.83	260.43	57.05
2011	53.82	166.05	31.77	45.85	166.78	17.59	165.82	24.60
2010	50.89	126.01	26.01	48.58	141.83	41.83	133.09	33.09
2009	53.75	100.00	-	45.59	100.00	-	100.00	-
Mean	**39.04**	**559.04**	**18.05**	**60.65**	**1317.41**	**25.08**	**902.86**	**21.47**
MAX	**53.82**	**1065.49**	**38.80**	**79.06**	**3449.42**	**128.06**	**1989.08**	**93.90**
Min	**20.94**	**100.00**	**-7.39**	**45.59**	**100.00**	**-31.87**	**100.00**	**-19.59**
SD	**11.66**	**349.78**	**13.57**	**11.92**	**1063.77**	**45.31**	**632.07**	**32.30**
t	**12.968**	**6.190**	**4.978**	**19.705**	**4.796**	**2.071**	**5.532**	**2.487**
df	**14**	**14**	**13**	**14**	**14**	**13**	**14**	**13**
Sig. (2-tailed)	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.059**	**0.000**	**0.027**

Source: Authors Computations

The analysis of the NPAs growth rates of Priority and Non-Priority Sector lending in Public Sector Banks, as presented in Table I, reveals significant insights into the trends and behaviours of these sectors over the years. The statistical hypothesis H_{01}, which posits no significant difference between the sample mean NPAs growth rates and the hypothetical population mean NPAs growth rates for both Priority and Non-Priority Sector lending, is rigorously tested using t-tests.

Priority Sector Lending: Priority Sector, including and consisting of important economic segments like agriculture, MSMEs, and other sectors crucial for socio-economic development, has an absolute NPA growth rate mean of 18.05% over the period analyzed. The corresponding t-values for the percentage of total NPA, trend percentage, and YOY growth percentage (12.968, 6.190, and 4.978, respectively) are highly significant, with p-values of 0.000. This indicates that the NPAs growth rates for Priority Sector lending significantly deviate from the hypothetical population mean, thereby rejecting the null hypothesis for these metrics. The high significance underscores the consistent fluctuations in NPAs within this sector, reflective of both macroeconomic pressures and sector-specific challenges that affect loan recoveries.

Non-Priority Sector Lending: In contrast, the Non-Priority Sector, which includes sectors outside the defined priority areas, has a mean NPA growth rate of 25.08%. The t-values for the percentage of total NPA and trend percentage (19.705 and 4.796, respectively) are also highly significant, with p-values of 0.000, again leading to the rejection of the null hypothesis. However, the t-value for YOY growth percentage (2.071) is significant only at a 5.9% level, suggesting a more volatile or less consistent trend in NPAs growth year-on-year for the Non-Priority Sector.

Comparative Insights: The comparative analysis reveals that while both sectors demonstrate significant deviations in NPAs growth rates from the hypothetical population mean, the magnitude and consistency of these deviations differ. The Priority Sector shows relatively lower but more consistent NPA growth rates, possibly due to regulatory support and structured recovery mechanisms. On the other hand, the Non-Priority Sector has larger fluctuations in mean growth rates, implying a more diverse set of risk factors and less homogeneity in loan performance across different years.

Trend Observations: As can be seen from the trend percentages, both sectors have undergone significant changes in their NPA contributions to the total NPAs of Public Sector Banks. Notably, the trend percentage for the Priority Sector started at 100% in 2009 but decreased to 559.04%, indicating a reduction in its relative contribution to the total NPAs. On the other hand, the trend percentage for the Non-Priority Sector soared to 3449.42% in 2018 but later stabilized at

lower levels. This drastic change reveals periods of heightened stress in the Non-Priority Sector, possibly due to external economic shocks or sectoral downturns.

Overall Interpretation: The overall statistical significance for both Priority and Non-Priority Sectors shows that the NPAs growth rates in these sectors have deviated from their respective theoretical population means, suggesting a systemic problem exists for loan performance. The relatively higher volatility and growth in NPAs especially highlight the need for superior risk management and customized policy initiatives to stabilize this category. On the other hand, while NPAs in the Priority Sector grew at a more controlled pace, attention is needed to maintain growth without taking undue risks. The rejection of the null hypothesis in most parameters underlines the importance of continuous monitoring and appropriate policy interventions to contain NPAs in Public Sector Banks, which are crucial to financial stability and sustainable economic development.

TABLE II CAGR OF GROSS NPAS ADDITIONS

Bank	2008-09 to 2012-13 (%)	2013-14 to 2017-18 (%)	2018-19 to 2022-23 (%)	Overall Result 2008-09 to 2022-23 (%)
SBI	25.85	12.34	-12.90	14.21
BOM	11.10	72.13	-21.98	2.35
ICICI	4.57	34.42	-8.96	3.12
NB	10.83	19.55	24.85	43.57
PSBs	24.27	30.28	-8.38	11.23
PRSBs	8.58	34.63	-0.45	8.33
SCBs	21.11	30.22	-6.37	4.64

Source: Authors Computations

TABLE II gives the CAGR of Gross NPAs additions over three different time frames for many PSU banks: 2008-09 to 2012-13, 2013-14 to 2017-18, and 2018-19 to 2022-23. Additionally, it provides an overall CAGR result for the entire period from 2008-09 to 2022-23. **State Bank of India (SBI)** showed a strong increase in NPAs during the first period (25.85%) but managed to reduce the growth of NPAs in the subsequent years. The most recent period even saw a decrease (-12.90%), resulting in a moderate overall growth rate of 14.21%. **Bank of Maharashtra (BOM)** had a relatively modest increase in NPAs initially (11.10%), but this spiked dramatically in the second period (72.13%), before dropping significantly in the latest period (-21.98%). Despite this, the overall result was a small growth of 2.35%. **ICICI Bank** had a low growth of NPAs in the first period (4.57%), but this accelerated from 2013-14 to 2017-18 (34.42%) before turning negative in the latest period (-8.96%), leading to a moderate overall increase of 3.12%. **Nainital Bank (NB)** consistently increased its NPAs across all periods, with the growth rate accelerating significantly in the most recent period (24.85%), leading to a substantial overall increase of 43.57%. **Public Sector Banks (PSBs)**, as a group, saw a steady increase in NPAs during the first two periods but managed to reduce the growth rate in the latest period (-8.38%), resulting in an overall increase of 11.23%. **Private Sector Banks (PRSBs)** experienced a moderate increase in NPAs initially, followed by a sharp rise (34.63%) from 2013-14 to 2017-18, and then a slight decrease (-0.45%) in the most recent period. This led to an overall increase of 8.33%. **Scheduled Commercial Banks (SCBs)**, which include both public and private sector banks, followed a similar trend with a strong initial increase, peaking in the middle period, and then a decrease in the latest period, resulting in a modest overall increase of 4.64%.

In summary, while all banks faced challenges with rising NPAs, especially from 2013-14 to 2017-18, many were able to stabilize or even reduce NPAs in recent years, though the overall impact varies significantly across different banks and bank groups.

TABLE III CAGR OF GROSS NPAS REDUCTIONS

Bank	2008-09 to 2012-13 (%)	2013-14 to 2017-18 (%)	2018-19 to 2022-23 (%)	Overall Result 2008-09 to 2022-23 (%)
SBI	17.58	-21.01	-8.81	10.37
BOM	23.51	18.55	-13.11	8.95
ICICI	-9.59	44.53	20.96	12.32
NB	13.93	9.68	41.80	11.82
PSBs	20.23	-1.07	-8.84	7.85
PRSBs	9.42	31.76	13.82	4.68
SCBs	17.45	5.12	0.02	0.82

Source: Authors Computations

TABLE III shows the CAGR of Gross NPAs (Non-Performing Assets) reductions for various banks over three distinct periods: 2008-09 to 2012-13, 2013-14 to 2017-18, and 2018-19 to 2022-23, along with the overall CAGR for the entire period from 2008-09 to 2022-23. **State Bank of India (SBI)** initially made significant progress in reducing NPAs (17.58%), but faced setbacks in the middle period (-21.01%), and continued to struggle with reductions in the most recent period (-8.81%). Despite these challenges, SBI managed an overall positive reduction rate of 10.37%. **Bank of Maharashtra (BOM)** demonstrated strong NPA reduction efforts in the early years (23.51%) and continued to improve in the middle period (18.55%). However, it encountered difficulties more recently (-13.11%), leading to an overall reduction rate of 8.95%. **ICICI Bank** had a challenging start with an increase in NPAs (-9.59%) in the early period but rebounded strongly in the middle (44.53%) and continued to improve in the recent period (20.96%), resulting in an overall positive reduction rate of 12.32%. **Nainital Bank (NB)** showed consistent efforts in reducing NPAs across all periods, with the most significant progress made recently (41.80%), leading to a commendable overall reduction rate of 11.82%. **Public Sector Banks (PSBs)** as a group made solid progress initially (20.23%), but their efforts weakened in the middle period (-1.07%) and continued to struggle in recent years (-8.84%), resulting in a modest overall reduction rate of 7.85%. **Private Sector Banks (PRSBs)** saw moderate progress in reducing NPAs initially (9.42%) but showed significant improvement from 2013-14 to 2017-18 (31.76%) and maintained a positive trend in the latest period (13.82%), achieving an overall reduction rate of 4.68%. **Scheduled Commercial Banks (SCBs)**, which include both public and private sector banks, showed strong early efforts (17.45%) but experienced a sharp slowdown in the middle period (5.12%) and almost no progress in recent years (0.02%). This led to a very modest overall reduction rate of 0.82%.

In summary, while some banks, particularly ICICI and Nainital Bank, managed to significantly reduce their NPAs over the years, others, including SBI and Public Sector Banks as a group, faced challenges in maintaining consistent reductions. The overall trends indicate a mixed performance, with some periods of strong progress followed by setbacks in NPA reduction efforts across the banking sector.

TABLE IV CAGR OF GROSS NPAS WRITE-OFF

Bank	2008-09 to 2012-13 (%)	2013-14 to 2017-18 (%)	2018-19 to 2022-23 (%)	Overall Result 2008-09 to 2022-23 (%)
SBI	124.60	25.56	-16.39	24.70
BOM	*	74.77	-21.89	17.09*
ICICI	17.93**	30.91	-17.11	20.41**
NB	*	152.76	53.19	42.71*
PSBs	102.85	56.50	-6.94	23.37
PRSBs	4.77	40.42	11.32	22.51
SCBs	17.90	52.37	-1.73	8.93

Source: Authors Computations

** From 2008-09 to 2013-14 BOM & NB Gross NPAs write-off is NIL.*

*** From 2008-09 to 2010-11 ICICI Gross NPAs write-off is NIL.*

TABLE IV illustrates the Compound Annual Growth Rate (CAGR) of Gross NPAs (Non-Performing Assets) write-offs for various banks across three periods: 2008-09 to 2012-13, 2013-14 to 2017-18, and 2018-19 to 2022-23. Additionally, it provides an overall CAGR for the entire period from 2008-09 to 2022-23. **State Bank of India (SBI)** experienced a remarkable surge in write-offs during the initial period (124.60%), but this momentum slowed significantly in the middle period (25.56%) and turned negative in the most recent years (-16.39%). Despite this decline, the overall write-off rate remained strong at 24.70%. **Bank of Maharashtra (BOM)** did not have any NPAs write-offs during the early years but saw a significant increase from 2013-14 to 2017-18 (74.77%). However, like SBI, BOM faced challenges in the latest period with a sharp decline (-21.89%). The overall result is a modest write-off rate of 17.09%, despite the early absence of write-offs. **ICICI Bank** had no write-offs in the first few years, but once it started, the write-offs increased steadily during the middle period (30.91%) before declining in the latest period (-17.11%). Nevertheless, ICICI achieved a solid overall write-off rate of 20.41%. **Nainital Bank (NB)** also did not have any write-offs in the early years, but experienced a massive increase during 2013-14 to 2017-18 (152.76%), followed by continued growth in the latest period (53.19%). This resulted in a substantial overall write-off rate of 42.71%. **Public Sector Banks (PSBs)**, as a group, showed a strong tendency to write off NPAs, with a significant surge in the first two periods (102.85% and 56.50%). However, they faced a decline in the most recent period (-6.94%), leading to a moderate overall write-off rate of 23.37%. **Private Sector Banks (PRSBs)** had a slow start with write-offs (4.77%) but showed significant improvement from 2013-14 to 2017-18 (40.42%) and continued to grow, albeit at a slower rate (11.32%) in the latest period. This led to a respectable overall write-off rate of 22.51%. **Scheduled Commercial Banks (SCBs)**, including both public and private banks, showed a steady increase in write-offs during the middle period (52.37%), but the pace slowed down in the most recent years (-1.73%). As a result, the overall write-off rate remained relatively low at 8.93%.

In summary, the data reveals varying trends in NPAs write-offs among different banks. While some banks, like SBI and PSBs, started with aggressive write-offs but later slowed down, others, like Nainital Bank, showed consistent growth in their write-off activities. The overall analysis indicates that write-offs have been a prominent method for handling non-performing assets (NPAs), although the extent and efficacy of this technique have differed greatly among banks.

TABLE V CAGR OF GROSS NPAS CLOSING

Bank	2008-09 to 2012-13 (%)	2013-14 to 2017-18 (%)	2018-19 to 2022-23 (%)	Overall Result 2008-09 to 2022-23 (%)
SBI	27.80	22.86	-12.05	19.03
BOM	7.34	45.16	-22.32	7.89
ICICI	-0.09	38.34	-8.07	8.14
NB	28.79	22.34	2.69	53.38
PSBs	29.70	31.44	-10.35	16.21
PRSBs	4.48	39.43	-7.37	15.60
SCBs	23.22	31.50	-9.40	11.10

Source: Authors Computations

TABLE V CAGR of Gross NPAs at the end of March for different banks over three periods – End of a Financial Year. It also delivers CAGR on an aggregate basis for the full period of 2008-09 to 2023. **State Bank of India (SBI)** NPAs grew at a robust pace during the first period, reaching 27.80%, and followed this up with 22.86% growth in the middle period. However, it found a way to curb this downside in the most recent period (-12.05%), resulting in an overall increase of 19.03%. **Bank of Maharashtra (BOM)** had moderate growth in NPAs in the early years (7.34%) but experienced a significant surge from 2013-14 to 2017-18 (45.16%). This was followed by a sharp decline in the most recent period (-22.32%), leading to a modest overall growth rate of 7.89%. **ICICI Bank** initially had almost no change in NPAs (-0.09%) in the first period, but the situation worsened significantly in the middle period with substantial growth (38.34%). However, the bank managed to reduce NPAs in the latest period (-8.07%), resulting in a moderate overall growth rate of 8.14%. **Nainital Bank (NB)** experienced strong and consistent growth in NPAs throughout the periods, with the first period at 28.79%, a slight decrease in the middle period (22.34%), and continued growth in the most recent years (2.69%). This culminated in a substantial overall growth rate of 53.38%, making it the highest among the banks listed. **Public Sector Banks (PSBs)**, as a group, showed a high growth in NPAs during the first two periods (29.70% and 31.44%) but managed to reduce this growth in the latest period (-10.35%). Despite this, the overall growth rate remained significant at 16.21%. **Private Sector Banks (PRSBs)** had a slow start in terms of NPAs growth (4.48%) but saw a significant rise from 2013-14 to 2017-18 (39.43%). However, they managed to control the growth in the latest period (-7.37%), leading to a decent overall growth rate of 15.60%. **Scheduled Commercial Banks (SCBs)**, including

both public and private banks, exhibited strong growth in NPAs in the middle period (31.50%), but managed to reduce this trend in the most recent period (-9.40%). This resulted in a modest overall growth rate of 11.10%.

In summary, while most banks experienced significant growth in NPAs during the early and middle periods, many have made efforts to reduce this growth in recent years. The trends indicate that managing NPAs has been a challenging but crucial task for the banking sector, with varying levels of success across different banks and bank groups. Notably, Nainital Bank stands out with the highest overall growth, while others like SBI and ICICI have managed to reduce their NPA levels more effectively in recent years.

TABLE VI CAGR OF NET NPAS CLOSING BALANCE

Bank	2008-09 to 2012-13 (%)	2013-14 to 2017-18 (%)	2018-19 to 2022-23 (%)	Overall Result 2008-09 to 2022-23 (%)
SBI	20.92	21.53	-20.09	19.02
BOM	7.64	39.77	-37.49	10.09
ICICI	-13.30	53.19	-17.47	11.78
NB	*	11.32*	-17.06	28.61*
PSBs	33.60	28.32	-18.50	15.21
PRSBs	-4.16	48.68	-15.20	15.28
SCBs	25.61	29.56	-17.55	10.19

Source: Authors Computations

** During 2008-09 to 2014-15 NB Net NPAs Closing is NIL.*

TABLE VI The table presents the Compound Annual Growth Rate (CAGR) of Net NPAs (Non-Performing Assets) Closing Balances for various banks across three periods: 2008-09 to 2012-13, 2013-14 to 2017-18, and 2018-19 to 2022-23, along with an overall CAGR for the entire period from 2008-09 to 2022-23. **State Bank of India (SBI)** experienced consistent growth in Net NPAs during the first two periods (20.92% and 21.53%). However, it managed to significantly reduce Net NPAs in the most recent period (-20.09%), leading to a strong overall growth rate of 19.02%. **Bank of Maharashtra (BOM)** showed modest growth in Net NPAs in the early years (7.64%) and a sharp increase from 2013-14 to 2017-18 (39.77%). However, the bank faced a substantial decline in Net NPAs in the latest period (-37.49%), resulting in an overall growth rate of 10.09%. **ICICI Bank** struggled with reducing Net NPAs during the first period (-13.30%) but saw a significant increase in the middle period (53.19%). The bank then managed to cut down on Net NPAs in the latest period (-17.47%), ending with a moderate overall growth rate of 11.78%. **Nainital Bank (NB)** had no Net NPAs during the early years but saw moderate growth in the middle period (11.32%). However, the bank managed to reduce Net NPAs in the most recent period (-17.06%), leading to a substantial overall growth rate of 28.61% despite the late start. **Public Sector Banks (PSBs)**, as a group, exhibited a very high growth in Net NPAs during the first two periods (33.60% and 28.32%), but faced challenges in reducing these levels in the most recent period (-18.50%). This resulted in a solid overall growth rate of 15.21%. **Private Sector Banks (PRSBs)** initially managed to reduce Net NPAs (-4.16%) but saw a sharp increase from 2013-14 to 2017-18 (48.68%). They then managed to decrease Net NPAs in the latest period (-15.20%), leading to a moderate overall growth rate of 15.28%. **Scheduled Commercial Banks (SCBs)**, including both public and private banks, saw strong growth in Net NPAs in the middle period (29.56%) but managed to reduce these levels in the most recent period (-17.55%). The overall growth rate for SCBs remained moderate at 10.19%.

In summary, the trends in Net NPAs closing balances reveal a common pattern across many banks: strong growth in the earlier periods followed by efforts to reduce Net NPAs in more recent years. While some banks, like SBI, have been more successful in reversing the trend, others like BOM and ICICI have faced more significant challenges. Nainital Bank stands out for its late entry into the Net NPAs category, but it achieved the highest overall growth rate. The overall picture indicates that managing and reducing Net NPAs has been a critical focus for the banking sector, with varying levels of success across different banks and bank groups.

H_{02}: There is no significant difference between the sample mean YOY growth in % of GNPAs and hypothetical population mean YOY growth in % of GNPAs.

TABLE VII YEAR-OVER-YEAR GROWTH IN% OF GNPAS

Years	SBI	BOM	ICICI	NB	PSBs	PRSBs	SCBs
2022-23	-18.83	-18.64	-9.94	-12.74	-21.02	-30.73	-23.14
2021-22	-11.37	-31.52	-18.48	-21.93	-12.07	-8.47	-10.95
2020-21	-15.23	-35.98	0.03	21.39	-9.10	-5.75	-7.19
2019-20	-13.70	-20.70	-10.61	38.07	-8.28	14.14	-3.92
2018-19	-22.68	-16.86	-14.21	131.80	-17.43	41.96	-9.93
2017-18	25.65	7.24	26.28	1.95	30.80	38.76	31.31
2016-17	45.78	65.50	60.78	37.61	26.81	65.89	29.39
2015-16	65.92	62.23	73.71	54.20	93.90	64.74	89.26
2014-15	-7.90	123.86	43.68	26.69	21.99	38.97	22.30
2013-14	27.14	151.40	9.35	-9.16	38.34	16.48	36.24
2012-13	30.21	-12.30	1.40	117.04	40.03	12.27	35.79
2011-12	58.64	10.51	-5.57	44.54	57.83	2.89	45.86
2010-11	29.15	-2.98	5.84	-8.45	24.59	3.40	15.67
2009-10	27.80	51.52	-1.75	23.39	33.30	4.21	23.96
2008-09	-	-	-	-	-	-	-
Mean	**15.76**	**23.81**	**11.47**	**31.74**	**21.41**	**18.48**	**19.62**
MAX	**65.92**	**151.40**	**73.71**	**131.80**	**93.90**	**65.89**	**89.26**
Min	**-22.68**	**-35.98**	**-18.48**	**-21.93**	**-21.02**	**-30.73**	**-23.14**
SD	**29.05**	**56.58**	**27.77**	**44.13**	**31.31**	**27.05**	**28.36**
t	1.956	1.517	1.488	2.593	2.465	2.464	2.494
df	13	13	13	13	13	13	13
Sig. (2-tailed)	**0.072**	**0.153**	**0.160**	0.022	0.028	0.028	0.027

Source: Authors Computations

TABLE VII presents the Year-Over-Year (YOY) growth percentages of Gross Non-Performing Assets (GNPAs) for various banks and banking groups from 2008-09 to 2022-23. **SBI, BOM, and ICICI** generally show fluctuating YOY growth rates in GNPAs, with periods of significant increases and decreases. For instance, SBI had a peak YOY growth of 65.92% in 2015-16 and a notable decline of -22.68% in 2018-19. **Nainital Bank (NB)** was the most volatile, with growth ranging from 131.80% in 2018-19 to -21.93% in 2021-22. **Public Sector Banks (PSBs)** also saw high peaks, with the highest YOY growth of 93.90% in 2015-16, and faced significant challenges in reducing GNPAs, which saw a decline of -21.02% in 2022-23. **Private Sector Banks (PRSBs)** and **Scheduled Commercial Banks (SCBs)** The YOY growth rates also showed variability, indicating the broader challenges faced by the banking sector in managing GNPAs.

Statistical Analysis: The difference between the sample mean YOY growth in GNPAs and the hypothetical population mean is statistically significant for Nainital Bank (NB), Public Sector Banks (PSBs), Private Sector Banks (PRSBs), and Scheduled Commercial Banks (SCBs), as indicated by t-test results with p-values less than 0.05. This suggests their YOY growth rates differ significantly from the broader population. In contrast, SBI, BOM, and ICICI show p-values greater than 0.05, indicating no statistically significant difference between their sample mean YOY growth and the hypothetical population mean. This implies that the YOY growth rates in GNPAs for these banks are not materially different from what might be expected in the broader population.

Variability and Stability: Having the largest standard deviation (SD = 44.13) demonstrates that Nainital Bank has the highest range of YOY growth rates, indicating significant cross-country variation on average, with GNPA growth in Nainital Bank being highly erratic. In contrast, ICICI Bank has a lesser dispersion among all listed banks, with a standard deviation of 27.77, implying a more stable pattern in its GNPA growth rates.

The data clearly shows that while Nainital Bank and Public Sector Banks have GNPA growth rates disproportionately higher than the population mean, others like SBI, BOM, and ICICI align more closely with expected norms. The variability in YOY GNPA growth highlights the difficulties banks have faced in managing their non-performing assets over time, with some experiencing periods of sharp increases or decreases. In certain cases, the statistical significance serves as evidence that these shifts are real and warrant targeted strategies to address them.

H_{03}: There is no significant difference between the sample mean YOY growth in % of NNPAs and the hypothetical population mean YOY growth in % of NNPAs.

TABLE VIII YEAR-OVER-YEAR GROWTH IN% OF NNPAS

Years	SBI	BOM	ICICI	NB*	PSBs	PRSBs	SCBs
2022-23	-23.24	-65.91	-25.70	-52.12	-33.74	-32.54	-33.73
2021-22	-24.03	-49.83	-23.98	-20.93	-21.23	-21.02	-20.86
2020-21	-29.04	-38.62	-8.12	12.38	-14.93	-0.55	-10.82
2019-20	-21.28	-9.08	-26.22	-7.71	-19.01	-17.27	-18.50
2018-19	-40.56	-52.71	-51.66	421.62	-37.26	4.55	-31.83
2017-18	14.36	-14.14	10.34	-3.19	18.63	34.74	20.25
2016-17	40.70	64.37	94.53	42.48	19.58	79.10	23.81
2015-16	84.81	65.56	107.23	-	100.30	88.82	98.94
2014-15	-10.85	128.33	89.68	-	22.44	59.43	23.26
2013-14	48.80	359.96	47.85	-	45.09	47.83	44.54
2012-13	38.86	-16.32	19.87	-	51.60	36.20	51.36
2011-12	36.82	-24.13	-22.70	-	64.73	-0.70	56.00
2010-11	15.28	-6.56	-37.33	-	21.63	-31.88	6.83
2009-10	18.04	143.63	-15.65	-	40.12	-12.22	23.96
2008-09	-	-	-	-	-	-	-
Mean	**10.62**	**34.61**	**11.30**	**56.07**	**18.42**	**16.75**	**16.66**
MAX	**84.81**	**359.96**	**107.23**	**421.62**	**100.30**	**88.82**	**98.94**
Min	**-40.56**	**-65.91**	**-51.66**	**-52.12**	**-37.26**	**-32.54**	**-33.73**
SD	**35.31**	**110.39**	**50.91**	**151.63**	**38.79**	**39.23**	**36.69**
t	1.084	1.130	0.800	0.906	1.713	1.540	1.637
df	13	13	13	6	13	13	13
Sig. (2-tailed)	**0.298**	**0.279**	**0.438**	**0.400**	**0.111**	**0.148**	**0.126**

Source: Authors Computations

** During 2008-09 to 2014-15 NB Net NPAs Closing is NIL.*

TABLE VIII presents Year-Over-Year (YOY) Growth (%) in NNPAs of Banks/Banking Groups from 2008-09 to 2022-23. **SBI, BOM, and ICICI** experienced significant fluctuations in their YOY growth rates of NNPAs. For instance, SBI's NPAs soared by a whopping 84.81% in 2015-16 and then plummeted by -40.56% in 2018-19, only to rebound again. **Nainital Bank (NB)** had the highest fluctuation, with an astonishing peak growth of 421.62% in 2018-19 but also faced major declines, such as a -52.12% drop in FY 2022-23. **Public Sector Banks (PSBs)** and **Private Sector Banks (PRSBs)** NNPAs varied through cycles, showing large variations and management challenges. In 2015-16, PSBs had a peak of 100.30% but decreased by -37.26% in 2018-19. **Scheduled Commercial Banks (SCBs)**

exhibited significant spikes and falls, such as a 98.94% peak in 2015-16 and a decline of -33.73% thereafter.

Statistical Analysis: The outcomes of the t-test reveal that the sample mean difference between YOY growth in NNPAs and the population means does not vary significantly from a statistical perspective for all banks or banking groups because the p-values are above 0.05. This implies that the growth rates of YOY in NNPAs for these banks are not significantly higher or lower than the commonality figures. The p-value of Nainital Bank is also not significantly different from 0.05, despite its extreme variability.

Variability and Stability: Nainital Bank (NB) tops the list in the variability of YOY growth rates, with a Standard Deviation (SD = 151.63), indicating very erratic patterns of growth. The variation in the NNPA growth rate of other banks is higher than that of SBI and SCBs, with standard deviations equaling 70.92 for both DCB and RRBs, as well as 84.74 for LCBs, indicating a relatively more stable pattern in NNPA rates posted by SBI and SCBs.

The data showed a wide variation in the YOY growth rates of NNPAs for banks and banking groups, but most were not statistically significantly different from the population mean control. The variability in NNPA growth rates observed for these banks might lie within what would generally be expected. Although Nainital Bank showed the widest range, even this was within 50 basis points. In summary, the trends reflect how banks struggled to manage their NNPAs, with peaks and falls occurring in different years.

H_{04}: There is no significant difference between Sample banks and bank group in Year-Over-Year Growth in% of GNPAs, NNPAs

TABLE IX ANOVA

Banks			Sum of Squares	df	Mean Square	F	Sig.	Null Hypothesis
ICICI, NB, PRBS	YOY Growth of GNPAs	Between Groups	2491.62	2	1245.81	1.102	0.342	**Accepted**
		Within Groups	44092.21	39	1130.57			
		Total	46583.83	41				
	YOY Growth of NNPAs	Between Groups	34321.35	2	17160.68	2.095	0.137	**Accepted**
		Within Groups	319470.85	39	8191.56			
		Total	353792.20	41				
SBI, BOM, PSBs	YOY Growth of GNPAs	Between Groups	369.94	2	184.97	0.110	0.897	**Accepted**
		Within Groups	65847.59	39	1688.40			
		Total	66217.53	41				
	YOY Growth of NNPAs	Between Groups	4795.14	2	2397.57	0.478	0.623	**Accepted**
		Within Groups	195457.32	39	5011.73			
		Total	200252.45	41				
PsBs, PRBs, SCBs	YOY Growth of GNPAs	Between Groups	7.36	2	3.68	0.005	0.995	**Accepted**
		Within Groups	28940.78	39	742.07			
		Total	28948.14	41				
	YOY Growth of NNPAs	Between Groups	9.65	2	4.83	0.004	0.996	**Accepted**
		Within Groups	53340.52	39	1367.71			
		Total	53350.17	41				

Source: Authors Computations

Table IX presents for Year-Over-Year (YOY) Growth of GNPAs & NNPAs among Sample banks and bank groups the p-value is greater than 0.05. This means that we cannot reject the null hypothesis and we have to accept that there is no significant difference between sample banks and bank groups in the Year-Over-Year Growth in% of GNPAs, and NNPAs.

PANEL DATA REGRESSION ANALYSIS:

A panel data regression was run using GNPAs Closing as the dependent variable and GNPAs Additions, GNPAs Reductions, and GNPAs Write-off as the independent variables to obtain a more robust result. In each of the four scenarios, the following equations 1&2 are applied:

For Fixed Effect Panel Regression:

$$GNPA = \beta_0 + \beta_1 GNPAs_{Additions} + \beta_2 GNPAs_{Reductions} + \beta_3 GNPAs_{Write\ off} + \varepsilon \ \ldots\ldots\ (Eq.1)$$

Where;

GNPA = Gross Non-Performing Assets Closing

ε = error term

For Random Effect Panel Regression:

$$GNPA = \beta_0 + \beta_1 GNPAs_{Additions} + \beta_2 GNPAs_{Reductions} + \beta_3 GNPAs_{Write\ off} + \varepsilon + \mu \ \ldots\ldots\ (Eq.2)$$

Whare;

GNPA = Gross Non-Performing Assets Closing

ε = within entity error term

μ = between entity error term

The Hausman test has also been carried out to check the suitability of the random effects model over the fixed effect model.

H_{05}: The preferred model is random effects on GNPAs during the study period.

H_{a5}: The preferred model is fixed effects on GNPAs during the study period.

The result of, the fixed effect model and random effect model is shown below:

Random-effects GLS regression — Number of obs = 105
Group variable: B — Number of groups = 7

R-squared: — Obs per group:
Within = 0.8626 — min = 15
Between = 0.9989 — avg = 15.0
Overall = 0.9376 — max = 15

Wald chi2(3) = 1517.24
corr(u_i, X) = 0 (assumed) — Prob > chi2 = 0.0000

GNPAsClosing	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
GNPAsOpening	1.469267	.1522804	9.65	0.000	1.170803	1.767731
GNPAsReductions	.2353266	.3498461	0.67	0.501	-.4503591	.9210123
GNPAsWriteoff	-2.201884	.5681939	-3.88	0.000	-3.315523	-1.088244
_cons	8880.033	7995.044	1.11	0.267	-6789.966	24550.03
sigma_u	0					
sigma_e	64969.453					
rho	0	(fraction of variance due to u_i)				

Fig. 1 Random Effect Model Regression Result

Source: Authors Computations

As shown in Figure 1 Random Effect Model shows a positive relationship between GNPA additions, and GNPA reductions on GNPAs Closing as expected. R-square is 0.8626 higher positive to this model. 'rho' is known as the intraclass correlation 0% of the variance is due to differences across panels. The z-statistics of GNPA additions and GNPA Witeoff variables are significant at 1% ($p < 0.01$) and chi-square also significant at 1% ($p < 0.01$).

Fixed-effects (within) regression — Number of obs = 105
Group variable: B — Number of groups = 7

R-squared: — Obs per group:
Within = 0.8669 — min = 15
Between = 0.9968 — avg = 15.0
Overall = 0.9330 — max = 15

F(3,95) = 206.30
corr(u_i, Xb) = 0.6722 — Prob > F = 0.0000

GNPAsClosing	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
GNPAsOpening	1.440276	.1789085	8.05	0.000	1.085097	1.795454
GNPAsReductions	-.6236041	.4889051	-1.28	0.205	-1.594203	.3469953
GNPAsWriteoff	-1.827712	.6819271	-2.68	0.009	-3.181509	-.4739158
_cons	29765.67	11849.62	2.51	0.014	6241.193	53290.14
sigma_u	34476.317					
sigma_e	64969.453					
rho	.21972166	(fraction of variance due to u_i)				

F test that all u_i=0: F(6, 95) = 1.08 — Prob > F = 0.3801

Fig. 2 Fixed Effect Model Regression Result

Source: Authors Computations

As shown in Figure 2 Fixed Effect Model shows a positive relationship between GNPA additions, and GNPA reductions on GNPAs Closing as expected. R-square is 0.8669 higher positive to this model. 'rho' is known as the intraclass correlation 21.97% of the variance is due to differences across panels. The t-statistics of GNPA additions and GNPA Witeoff variables are significant at 1% ($p < 0.01$) and F-statistic is also significant at 1% ($p < 0.01$).

	Coefficients (b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) Std. err.
GNPAsOpening	1.440276	1.469267	-.0289914	.0939092
GNPAsReduc~s	-.6236041	.2353266	-.8589307	.34152
GNPAsWrite~f	-1.827712	-2.201884	.3741716	.3770679

b = Consistent under H0 and Ha; obtained from xtreg.
B = Inconsistent under Ha, efficient under H0; obtained from xtreg.

Test of H0: Difference in coefficients not systematic

chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 6.20
Prob > chi2 = 0.1021
(V_b-V_B is not positive definite)

Fig. 3 Hausman Test Result

Source: Authors Computations

As we know, Figure 3 shows the null hypothesis of the Hausman Test is Random Effect Model is appropriate and, in this case, **Error! Reference source not found.** shows the probability value is greater than 0.05, therefore, we cannot reject the null hypothesis. Hence, we can say that the Random Effect Model is appropriate to study the relationship among these variables. Therefore, we can say that, beyond doubt, GNPAs Closing of different sample banks (taken here) is positively affected by the level of GNPA additions, GNPA reductions and GNPA write-offs.

VI. Conclusion

Non-Performing Assets (NPAs) have haunted the Indian banking industry for many years, with public sector banks facing the most significant challenges. A 15-year study of NPAs shows that Gross Non-Performing Assets (GNPAs) have followed an increasing trend among Scheduled Commercial Banks (SCBs), with public sector banks showing more volatility compared to private sector banks. The findings indicate that while GNPAs are rising, the Year-Over-Year (YOY) percentile change in GNPA and NNPA growth rates is only slightly increasing, with no significant differences observed across sampled banks or bank groups.

The data reveals that additions, reductions, or write-offs have positively affected the GNPA closing balances of various banks. This emphasizes the need for an effective strategy to manage these variables to mitigate their impact on bank capital structures. Public sector banks like the State Bank of India (SBI) and the Bank of Maharashtra (BOM) have seen significant fluctuations in their GNPA and NNPA growth rates, highlighting the systemic challenges they face, including weaker financial strength and governance issues, exacerbated by political interference and social banking pressures. In conclusion, while it is acknowledged that eliminating NPAs is impossible, the study stresses the importance of robust mechanisms to manage NPAs at a manageable level. Government initiatives, such as the Debt Recovery Tribunals (DRTs), Lok Adalats, the SARFAESI Act, and the Insolvency and Bankruptcy Code (IBC), have been crucial in addressing the NPA crisis. However, the

persistent rise in NPAs, especially in public sector banks, calls for deeper banking reforms and a more disciplined approach to credit risk management. Advanced risk management practices and better governance are recommended to strengthen the resilience of the Indian banking sector against future economic shocks.

VII. LIMITATIONS

1. The impact of COVID-19 on the banking industry after the merger was not taken into account in this research.
2. The data collected before the merger includes both SBI and its subsidiaries since SBI combined with all of its subsidiaries.

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