



Employee productivity and financial performance of Indian public sector banks: Evidence from 2021 to 2025

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Abstract

This study examines how selected financial and employee related indicators are associated with the profitability of Indian public sector banks. The sample covers all 12 public sector banks observed annually from 2021 to 2025, which gives 60 bank year observations drawn from the Reserve Bank of India Database on Indian Economy and bank annual reports. Return on assets is the dependent variable. The explanatory variables are the capital adequacy ratio, net nonperforming assets in ₹ crore, business per employee, profit per employee, the cash deposit ratio, the credit deposit ratio, the spread ratio and the burden to assets ratio. The analysis combines descriptive statistics, Pearson correlation, diagnostic tests and a pooled multiple regression with heteroskedasticity robust standard errors. The model explains about 97 per cent of the variation in return on assets. Profit per employee has a positive and statistically significant coefficient, while business per employee has a negative and statistically significant conditional coefficient, a pattern that reflects the correlation of 0.848 between the two productivity measures. The other six indicators are not significant at the 5 per cent level. Collinearity diagnostics show heavy overlap among several predictors, and profit per employee shares its numerator with return on assets. The results are therefore read as sample specific associations and not as causal effects. The study adds recent bank level evidence on employee productivity and profitability in Indian public sector banking.

Keywords: Public Sector Banks, Return On Assets, Bank Efficiency, Employee Productivity, Financial Performance, Capital Adequacy, Nonperforming Assets, Pooled Regression

JEL Classification: G21, G28, D24

1. Introduction

Public sector banks (PSBs) remain the backbone of the Indian financial system. They mobilise a large share of household deposits, extend credit to agriculture, industry, services and priority sectors, and act as the main channel through which the government delivers financial inclusion programmes and transmits monetary policy. Because of this position, the financial health of PSBs is of concern not only to their shareholders but also to depositors, borrowers, regulators and policymakers. A weak public sector bank can constrain credit supply, raise the fiscal cost of recapitalisation and weaken confidence in the wider banking system. The period examined in this study, 2021 to 2025, followed a phase of large scale restructuring. PSBs operated in an environment shaped by regulatory change, consolidation, resolution of stressed assets, expansion of digital banking and a growing emphasis on productivity and operating costs. Over these years many PSBs moved from losses or thin profits towards more stable earnings, although the pace of recovery differed markedly across institutions. This variation across banks and years provides a useful setting in which to ask which observable characteristics are associated with better profitability. Return on assets (ROA) is widely used as the summary measure of bank profitability because it expresses earnings relative to the total resources under management and is less affected by differences in capital structure than return on equity. ROA is an outcome, however. It reflects the combined influence of capital strength, asset quality, liquidity management, employee productivity, the pricing of loans and deposits, and the cost of running the bank. Each of these dimensions can be captured by observable ratios reported in annual accounts and regulatory returns. Indian banking research has followed two broad routes. One route uses frontier techniques such as Data Envelopment Analysis (DEA) and stochastic frontier analysis to estimate efficiency scores. Kumar (2008), for instance, investigated the relationship between efficiency and profitability in Indian PSBs through DEA, and Sangeetha (2020) examined technical efficiency and productivity using a nonparametric approach. The other route relates profitability to a set of bank specific and macroeconomic determinants using regression models, as in Seenaiyah et al. (2015) and Almaqtari et al. (2019). The present study follows the second route while borrowing the emphasis on efficiency and productivity that characterises the first.

Public ownership dominates Indian banking. Fourteen large commercial banks were nationalised in 1969 and six more in 1980, and the State Bank of India and its associates were already under public control. For decades the PSB group was the principal instrument of the state for directing credit to priority areas. The liberalisation of the early 1990s introduced prudential norms, greater competition from private and foreign banks and a stronger emphasis on profitability and capital adequacy. Studies of that period, such as Bhattacharyya et al. (1997) and Kumbhakar and Sarkar (2003), examined how deregulation and ownership shaped efficiency and productivity growth. The decade before the study period was difficult. A sharp rise in nonperforming assets, partly linked to lending in infrastructure and corporate sectors, eroded PSB profits and capital. The Reserve Bank of India (RBI) placed several PSBs under its Prompt Corrective Action framework, the

government announced a large recapitalisation programme in 2017, and the Insolvency and Bankruptcy Code was introduced to improve the resolution of stressed loans. Consolidation followed. The number of PSBs was reduced from 27 in 2017 to 12 through a series of mergers, the last of which took effect on 1 April 2020. The 12 banks listed in Appendix 1 are the institutions that remained after this process. The empirical analysis uses these 12 PSBs, with annual observations for 2021 to 2025. Because all mergers had taken effect before the first year of observation, the panel covers a period in which the institutional structure of the group was stable. The period captures the adjustment in banking activity after the pandemic, including changes in credit growth, asset quality and profitability, and the continued shift of PSBs towards technology enabled service delivery.

Most existing research on bank performance has relied on frontier methods, stochastic techniques and panel data models. Almaqtari et al. (2019) examined Indian commercial banks with panel data and compared pooled, fixed effects and random effects specifications when studying profitability. Their findings illustrate the relevance of bank specific characteristics such as size, asset management, operational efficiency and leverage. Athanasoglou et al. (2008) and Dietrich and Wanzenried (2011) reached a similar general conclusion for banks in Greece and Switzerland, namely that internal characteristics of the bank explain a considerable part of differences in profitability. There are three reasons for revisiting the question for Indian PSBs. First, the structure of the group has changed substantially, so evidence from before the consolidation may not describe the present set of 12 banks. Second, most studies of profitability give limited attention to employee productivity, although PSBs employ a very large workforce and staff costs form a major part of operating expenses. Third, the recovery in profitability after 2021 has been uneven, which makes it useful to ask whether ratios that are easy to observe, and that management can monitor, move together with ROA across banks and years. A compact and transparent analysis of this kind can inform managers and regulators without requiring the technical apparatus of frontier estimation.

The research gap arises from the following three related issues.

- A considerable part of the earlier literature approaches efficiency through frontier measures, or treats the determinants of profitability separately from measures of efficiency. The two literatures are therefore rarely brought together in one model that uses ratios readily available to bank managers.
- Employee related productivity indicators are not consistently examined in the same model as liquidity, intermediation and operating ratios. Business per employee and profit per employee are commonly reported in bank annual reports but are seldom tested jointly against ROA.
- Few studies use the complete set of 12 PSBs over a common five year period that follows the last round of mergers. Using all 12 banks, the present analysis relates eight observable

indicators to ROA within one pooled specification and provides a compact setting for examining recent bank level patterns.

The study pursues the following objectives:

1. To examine the financial performance of the 12 Indian public sector banks during 2021 to 2025 using selected financial and efficiency related indicators.
2. To examine the association between ROA and selected indicators of capital adequacy, employee productivity, asset quality, credit and deposit deployment, intermediation and operating efficiency.
3. To assess the combined explanatory relationship of the selected indicators with ROA.
4. To identify the statistical limitations of the pooled specification, especially collinearity among predictors, and to draw cautious managerial and policy implications.

In line with these objectives, the study addresses the following research questions.

1. What are the patterns of financial and efficiency related indicators across Indian PSBs during 2021 to 2025?
2. Which selected indicators are significantly associated with ROA?
3. To what extent do the selected indicators jointly explain variation in ROA?
4. How far do collinearity and the construction of the productivity variables affect the interpretation of the estimated coefficients?

Eight null hypotheses are tested, one for each explanatory variable. Each is stated against a two sided alternative that the variable has a nonzero coefficient in the ROA equation.

H01: CAR is not significantly associated with ROA.

H02: NNPA is not significantly associated with ROA.

H03: BPE is not significantly associated with ROA.

H04: PPE is not significantly associated with ROA.

H05: Cash Deposit Ratio is not significantly associated with ROA.

H06: Credit Deposit Ratio is not significantly associated with ROA.

H07: Spread Ratio is not significantly associated with ROA.

H08: Burden to Assets Ratio is not significantly associated with ROA.

The tests are two sided, but the literature reviewed in Section 2 suggests the signs that would be expected on theoretical grounds. These expectations, summarised in Table 3 of Section 3, are used later to judge whether the estimated coefficients are consistent with prior reasoning.

The scope of this study is limited to the 12 PSBs in the dataset and to the five financial years from 2021 through 2025. The analysis uses secondary bank level information. Macroeconomic variables, market based measures of performance and primary survey responses fall outside the scope of this study. The study does not attempt to estimate efficiency frontiers, and it does not compare PSBs with private sector or foreign banks. The paper first reviews the literature on banking efficiency and profitability in Section 2. Section 3 describes the research design, data, variables, expected signs and the regression model. Section 4 reports the descriptive, correlation, collinearity and regression results, followed by hypothesis testing and discussion. Section 5 concludes with the major findings, managerial and policy implications, recommendations, limitations and suggestions for future research.

2. Literature Review

2.1 Bank Efficiency and Profitability

Efficiency in banking refers broadly to the way an institution uses its available resources to produce financial services and other outputs. Employees, deposits and capital can be viewed as inputs, while lending, investment and related activities represent outputs. Berger and Humphrey (1997) surveyed more than a hundred studies of financial institution efficiency across countries and distinguished parametric, nonparametric and accounting based approaches. The two dominant frontier families are DEA, developed from the work of Charnes et al. (1978) and Banker et al. (1984), and stochastic frontier analysis, which follows Aigner et al. (1977). Both compare each bank with a best practice benchmark and allow the distance from that benchmark to be interpreted as inefficiency. Berger and Mester (1997) added that measured efficiency differences among banks are driven by a mix of managerial quality, scale, product mix and environmental conditions. Their discussion is relevant to the present study because it implies that simple financial ratios can proxy for different elements of efficiency, even when a full frontier is not estimated. Ratio based analysis has the advantages of transparency and easy replication, and it is closer to the indicators that bank boards and supervisors actually track. The link between efficient resource use and profitability has been examined in Indian banking for several years. Kumar (2008) described a relationship between technical efficiency and profitability for Indian public sector banks using DEA and obtained an average technical efficiency score of 88.5 per cent for the banks examined. Sathye (2003) compared public, private and foreign banks in India with DEA and showed that efficiency conclusions depend on the choice of inputs and outputs, a caution that applies equally to ratio based work.

The Indian evidence also shows that institutional and regulatory conditions can shape efficiency. Bhattacharyya et al. (1997) studied productive efficiency during the liberalisation period, while Kumbhakar and Sarkar (2003) analysed deregulation, productivity growth and ownership. Das and Ghosh (2009) focused on profit efficiency following financial deregulation, and Das and Kumbhakar (2012) considered productivity and efficiency changes while allowing for the quality

of inputs and outputs. Fujii et al. (2014) showed that efficiency and productivity estimates for Indian banks change when undesirable outputs such as nonperforming loans are incorporated. Patra et al. (2023) compared public and private sector banks in a two stage analysis in which efficiency scores were related to bank characteristics. Together, these studies support a broader view of bank performance in which productivity and institutional conditions are considered alongside profitability.

2.2 Bank Specific Determinants of Profitability

A large international literature relates bank profitability to bank specific, industry specific and macroeconomic factors. Molyneux and Thornton (1992) and Bourke (1989) were early contributors for European and other advanced economies. Demirgüç-Kunt and Huizinga (1999), using data for many countries, showed that bank characteristics and the macroeconomic environment both influence margins and profitability. Goddard et al. (2004) examined European banks using cross sectional and dynamic panel methods, and Pasiouras and Kosmidou (2007) compared domestic and foreign commercial banks in the European Union. Athanasoglou et al. (2008) found that capital strength, credit risk, operating expense management and productivity growth were among the bank specific factors linked to profitability in Greece. Dietrich and Wanzenried (2011) studied Swiss banks before and during the financial crisis. For India, Almaqtari et al. (2019), using ten years of panel observations for Indian commercial banks, analysed that factors including size, asset management, operational efficiency and leverage were relevant to ROA. Their comparison of pooled, fixed effects and random effects models also shows that repeated observations in bank level data deserve attention when interpreting results. Seenaiiah et al. (2015) examined the determinants of profitability in the post reform period, and Nalliboyina and Chalam (2023) studied the factors determining the financial performance of Indian public sector banks. These studies establish that bank level ratios carry information about profitability, but they differ in the variables included, the period covered and the estimator used.

2.3 Employee Productivity and Bank Performance

Business per employee and profit per employee are distinct aspects of employee performance. Business per employee, usually defined as total deposits plus advances divided by the number of employees, measures the volume of business handled by each member of staff. It is closely related to the scale of operations and the degree of automation. Profit per employee measures the earnings generated per member of staff and therefore combines volume, pricing and cost. PSBs are labour intensive, and staff expenses form a large part of their operating costs, so these indicators are of obvious managerial interest. The productivity literature suggests that labour productivity matters for profitability, but that it should be interpreted with attention to how it is constructed. Athanasoglou et al. (2008) treated productivity growth as a determinant of bank profits. Das and Kumbhakar (2012) emphasised that measures of productivity and efficiency should reflect the quality of inputs and outputs. A ratio such as profit per employee shares its numerator with ROA,

so a strong statistical association may partly reflect arithmetic overlap and not only a behavioural relationship. This point is taken up in the empirical sections.

2.4 Asset Quality and Capital Adequacy

Asset quality is important for profitability because problem loans can require additional provisioning and reduce the earning capacity of the loan portfolio. Berger and DeYoung (1997) examined the relationship between problem loans and cost efficiency in United States banks and found that the two are linked over time, which supports the view that asset quality and operating performance cannot be separated. Rahaman and Sur (2021) identified the drivers of NPAs in Indian PSBs using panel methods. Patra et al. (2023) also included asset quality measures among the variables associated with bank efficiency, and Fujii et al. (2014) treated nonperforming loans as an undesirable output. These findings provide a basis for retaining NNPA in the present specification. An important measurement issue arises here. Asset quality is usually analysed through ratios such as gross or net NPA divided by gross or net advances, which are independent of bank size. In the dataset used in this study NNPA is measured in absolute ₹ crore. Absolute values are mechanically larger for larger banks, and the effect on ROA may therefore be confounded with size. The implications are discussed in Section 4.6.

Theory does not deliver an unambiguous prediction for the relationship between capital and profitability. Berger (1995) discussed the relationship between capital and earnings in banking and showed that a positive association can arise if well capitalised banks face lower expected costs of financial distress and lower funding costs. Demirgüç-Kunt and Huizinga (1999) reported that better capitalised banks tend to have higher margins and profits. A contrary argument is that holding capital above what is needed reduces leverage and therefore return on equity, and that capital raised through public recapitalisation may reflect weakness and not strength. Capital adequacy in India follows the Basel III framework (Basel Committee on Banking Supervision, 2011), and observed capital ratios are also shaped by regulatory minimums and by government support to PSBs.

The sign and size of the CAR coefficient are therefore left to the empirical results rather than assumed beforehand.

2.5 Credit, Deposit Deployment and Operating Efficiency

Deposit and credit deployment provide another perspective on bank performance, that is, both the quantity and quality of assets deployed. A higher credit deposit ratio indicates that a larger share of mobilised deposits is converted into loans, which usually earn a higher yield than investments in government securities or balances held as cash. At the same time, a very high ratio can signal liquidity pressure or aggressive lending. The cash deposit ratio measures the proportion of deposits held in the form of cash and balances with the central bank. Cash earns little or no return, so a higher ratio is expected to reduce profitability unless it is accompanied by lower funding cost or

lower risk. Molyneux and Thornton (1992) and Bourke (1989) included liquidity related variables among the determinants of bank profits, and the evidence on their sign has been mixed.

Spread and burden ratios indicate aspects of operating and intermediation performance. The spread reflects the difference between the return earned on assets and the cost of funds. The classical model of Ho and Saunders (1981) explains interest margins as a price set by a risk averse bank acting as a dealer between depositors and borrowers, and later empirical work links margins to operating costs, risk and market structure. The burden ratio, usually measured as non interest expenses net of non interest income relative to total assets, reflects how far fee income and other non interest earnings cover the costs of staff and premises. A lower burden is expected to support profitability. Operating cost management was found to be a significant determinant of profitability by Athanasoglou et al. (2008).

2.6 Summary of Selected Studies and Conceptual Position

Table 1 summarises the studies that inform the choice of variables and the interpretation of results.

Table 1. Summary of Selected Studies

Study	Focus	Relevance to the present study
Kumar (2008)	DEA efficiency and profitability in Indian PSBs	Links efficiency to profitability in the same bank group
Sangeetha (2020)	Technical efficiency of Indian PSBs, nonparametric approach	Recent evidence on PSB efficiency
Almaqtari et al. (2019)	Panel data determinants of ROA in Indian commercial banks	Model comparison and choice of bank specific determinants
Athanasoglou et al. (2008)	Bank specific, industry and macroeconomic determinants of profitability	Productivity, capital, credit risk and expenses as determinants
Berger and Humphrey (1997)	International survey of efficiency studies	Concept and measurement of efficiency
Berger and DeYoung (1997)	Problem loans and cost efficiency	Asset quality and operating performance

Study	Focus	Relevance to the present study
Berger (1995)	Capital and earnings in banking	Ambiguous capital and profit relationship
Fujii et al. (2014)	Efficiency of Indian banks with undesirable outputs	Role of nonperforming loans in efficiency
Rahaman and Sur (2021)	Drivers of NPAs in Indian PSBs	Justifies inclusion of asset quality
Patra et al. (2023)	Two stage efficiency analysis of Indian public and private banks	Bank characteristics related to efficiency
Ho and Saunders (1981)	Theory of interest margins	Interpretation of the spread ratio

Source: Compiled by the authors from the studies cited.

The literature identifies several recurring dimensions of bank performance: efficiency, employee productivity, asset quality, capital strength and intermediation. The present study combines these dimensions in one empirical framework. ROA is the dependent variable, and CAR, NNPA, BPE, PPE, Cash Deposit Ratio, Credit Deposit Ratio, Spread Ratio and Burden to Assets Ratio are the explanatory variables. The framework is designed to identify statistical associations in the sample; it is not a causal model.

Source: Compiled by the authors from the respective bank annual reports and relevant banking literature (Almaqtari et al., 2019; Kumar, 2008).

3. Research Methodology

3.1 Research Design, Sample and Data

The study follows a quantitative empirical approach using numerical observations recorded for each bank year combination. The analysis investigates whether differences in the selected indicators are associated with differences in ROA. The design is descriptive and associational. It combines summary statistics, Pearson correlation, diagnostic tests and a pooled multiple regression, and it does not claim to identify causal effects. The study covers all 12 public sector banks in operation after the consolidation of 2020, listed in Appendix 1. Because the entire population is included, there is no sampling error arising from the selection of banks. Each bank is observed for five financial years from 2021 to 2025, which gives a balanced panel of 60 bank

year observations. The panel is short in the time dimension and small in the cross section, and this affects the estimators that can reasonably be applied. The study uses secondary data obtained from the RBI Database on Indian Economy (DBIE) and the annual reports of the selected PSBs. Where the same item was available from both sources, the published annual report was treated as the reference for verification.

3.2 Variables Used in the Study

ROA is the dependent variable and measures profit after tax relative to total assets. The eight explanatory variables cover capital strength (CAR), asset quality (NNPA), employee productivity (BPE and PPE), liquidity and deployment (Cash Deposit Ratio and Credit Deposit Ratio) and intermediation and operating efficiency (Spread Ratio and Burden to Assets Ratio). Table 2 gives the measurement of each variable.

Table 2. Measurement of Study Variables

Variable	Symbol	Role	Unit or measurement
Return on Assets	ROA	Dependent	Percentage
Capital Adequacy Ratio	CAR	Independent	Percentage
Net Non Performing Assets	NNPA	Independent	₹ crore
Business per Employee	BPE	Independent	₹ lakh per employee
Profit per Employee	PPE	Independent	₹ lakh per employee
Cash Deposit Ratio	CDR	Independent	Percentage
Credit Deposit Ratio	CR	Independent	Percentage
Spread Ratio	SR	Independent	Ratio or percentage as reported
Burden to Assets Ratio	BR	Independent	Ratio as reported

Source: Compiled by the authors.

One measurement point requires clarification. NNPA is entered in the dataset as an absolute amount in ₹ crore, not as a percentage or ratio. The analysis therefore retains the monetary form

of NNPA throughout the manuscript rather than describing it as an NNPA ratio. The implications of this choice are discussed in Section 4.6.

3.3 Expected Signs of the Coefficients

The theoretical and empirical literature reviewed in Section 2 suggests a direction for the relationship between each explanatory variable and ROA. These expectations are summarised in Table 3. They serve as a benchmark against which the estimated signs are compared in Section 4. The hypotheses themselves remain two sided.

Table 3. Expected Direction of Association with ROA

Variable	Expected sign	Reasoning
CAR	Ambiguous	Strong capital lowers funding cost and distress risk, but excess capital can reduce leverage and returns
NNPA	Negative	Problem loans require provisions and reduce interest income
BPE	Positive	Higher business per employee spreads staff cost over a larger volume of business
PPE	Positive	Profit per employee rises with earnings, which are also the numerator of ROA
Cash Deposit Ratio	Negative	Cash and reserve balances earn little return
Credit Deposit Ratio	Positive	Loans usually earn more than other uses of funds
Spread Ratio	Positive	A wider gap between yield and cost of funds raises net interest income
Burden to Assets Ratio	Negative	A higher net operating burden reduces profit

Source: Authors' synthesis of the literature reviewed in Section 2.

3.4 Model Specification and Estimation

The empirical model is a pooled multiple regression of ROA on the eight explanatory variables:

$$ROA_{it} = \beta_0 + \beta_1 CAR_{it} + \beta_2 NNPA_{it} + \beta_3 BPE_{it} + \beta_4 PPE_{it} + \beta_5 CDR_{it} + \beta_6 CR_{it} + \beta_7 SR_{it} + \beta_8 BR_{it} + \varepsilon_{it}$$

where i indexes the bank, t indexes the year, β_0 is the intercept, β_1 to β_8 are the slope coefficients and ε is the error term. A pooled specification treats all 60 observations as a single cross section and assumes that the intercept is common to all banks and years. This is a strong assumption, and it is retained here because the panel has only five years and 12 banks, which leaves limited scope for estimating bank specific and year specific effects reliably. Wooldridge (2010) discusses the conditions under which pooled estimation is appropriate and the alternatives when unobserved bank effects are present.

The analysis proceeds in five steps. First, descriptive statistics, including skewness and kurtosis, describe the distribution of each variable. Second, normality is assessed with the Shapiro and Wilk (1965) test for the dependent variable and the Jarque and Bera (1987) test for the regression residuals. Third, the Pearson correlation matrix is examined to identify strongly related predictors. Fourth, multicollinearity is assessed through variance inflation factors and tolerance values, following the diagnostic logic described by Belsley et al. (1980). Fifth, the model is estimated by ordinary least squares. The Breusch and Pagan (1979) test is used to examine heteroskedasticity, and, because the test is significant, coefficient inference relies on the HC1 variant of the heteroskedasticity consistent covariance estimator proposed by White (1980). The significance level is set at 5 per cent. Petersen (2009) shows that standard errors in panel data may be biased when residuals are correlated within a bank over time. Clustered standard errors are the usual remedy, but they perform poorly when the number of clusters is as small as 12. The study therefore reports heteroskedasticity robust standard errors and treats the resulting inference with caution, and this issue is returned to in the limitations.

4. Data Analysis and Interpretation

4.1 Descriptive Statistics and Normality

Table 4 reports descriptive statistics for the nine variables. Each variable has 60 observations.

Table 4. Descriptive Statistics

Variable	N	Mean	Std. Dev.	Minimum	Maximum	Skewness	Kurtosis
ROA	60	0.634	0.565	-2.550	1.750	-2.935	16.468
CAR	60	16.007	1.632	12.560	20.530	0.222	-0.009

Variable	N	Mean	Std. Dev.	Minimum	Maximum	Skewness	Kurtosis
NNPA	60	9698.431	9875.228	408.990	38575.700	1.349	1.069
BPE	60	2390.015	545.117	1470.000	3744.000	0.702	-0.021
PPE	60	11.400	10.121	-30.940	37.830	-0.626	4.514
CASHDEP	60	6.015	1.953	3.529	12.370	1.225	1.278
CREDITDEP	60	68.031	7.828	47.452	82.169	-0.614	0.034
SPREAD	60	9.095	3.724	4.635	22.616	1.680	3.070
BURDEN	60	0.794	0.306	0.001	1.412	-0.178	-0.436

Source: Authors' calculations from DBIE and bank annual reports. Kurtosis is reported as excess kurtosis.

The average ROA of the 12 banks over the period is 0.634 per cent, with a standard deviation of 0.565. The range is wide, from a loss of 2.550 per cent to a profit of 1.750 per cent of assets. The lowest ROA observation is for Punjab and Sind Bank in 2021, while the highest is recorded for Bank of Maharashtra in 2025. The gap between these two observations illustrates how unevenly the recovery of PSB profitability has proceeded. The strongly negative skewness of ROA (-2.935) and the very high excess kurtosis (16.468) show that the distribution is dominated by a small number of loss making observations in the left tail. CAR averages 16.007 per cent, with a minimum of 12.560 per cent and a maximum of 20.530 per cent. Even the weakest observation is above the minimum total capital requirement plus conservation buffer prescribed under the Basel III based norms applied in India, which indicates that regulatory capital was not a binding constraint for any bank in the sample. CAR is close to symmetric, with skewness of 0.222 and excess kurtosis close to zero. NNPA has a mean of ₹9,698.431 crore and a standard deviation of ₹9,875.228 crore. The standard deviation is slightly larger than the mean, and values range from ₹408.990 crore to ₹38,575.700 crore. This spread reflects differences in the size of the banks as much as differences in the quality of their loan books, which supports the earlier remark on the limitation of an absolute measure. BPE records a sample mean of ₹2,390.015 lakh per employee whereas the corresponding mean for PPE is ₹11.400 lakh per employee. BPE ranges from ₹1,470 lakh to ₹3,744 lakh, and PPE from a loss of ₹30.940 lakh to a profit of ₹37.830 lakh per employee. The negative minimum of PPE corresponds to loss making bank years. The dispersion in these measures indicates that the

banks do not exhibit a common level of profitability or employee productivity. The credit deposit ratio averages 68.031 per cent with a range of 47.452 to 82.169 per cent, which shows substantial variation in the extent to which deposits are deployed as loans. The cash deposit ratio averages 6.015, the spread ratio 9.095 and the burden to assets ratio 0.794. The distributions are also uneven. ROA shows strong negative skewness, while PPE, the cash deposit ratio and the spread ratio depart from symmetry as well, with the spread ratio and the cash deposit ratio skewed to the right. The Shapiro and Wilk test rejects normality for the observed ROA values. This result is consistent with the high skewness and kurtosis reported above. For the regression analysis, however, the residuals are more relevant than the marginal distribution of the dependent variable. The residual Jarque and Bera statistic is 2.797 with $p = .247$, so there is no statistically significant evidence of residual non normality at the 5 per cent level. The assumption of approximately normal errors is therefore not rejected for the estimated model, although the small sample limits the power of such tests.

4.2 Correlation Analysis

Table 5 presents the Pearson correlation matrix.

Table 5. Pearson Correlation Matrix

Variable	ROA	CAR	NNPA	BPE	PPE	CDR	CR	SR	BR
ROA	1.000	0.372	-0.178	0.664	0.946	-0.083	0.550	-0.255	-0.136
CAR	0.372	1.000	-0.621	0.479	0.410	0.098	0.583	-0.135	0.135
NNPA	-0.178	-0.621	1.000	-0.130	-0.154	-0.192	-0.103	-0.136	-0.162
BPE	0.664	0.479	-0.130	1.000	0.848	0.006	0.794	-0.257	0.079
PPE	0.946	0.410	-0.154	0.848	1.000	-0.058	0.658	-0.265	-0.072
CASHDEP	-0.083	0.098	-0.192	0.006	-0.058	1.000	-0.312	0.930	0.002
CREDITDEP	0.550	0.583	-0.103	0.794	0.658	-0.312	1.000	-0.601	0.147
SPREAD	-0.255	-0.135	-0.136	-0.257	-0.265	0.930	-0.601	1.000	-0.011
BURDEN	-0.136	0.135	-0.162	0.079	-0.072	0.002	0.147	-0.011	1.000

Source: Authors' calculations. CDR is the cash deposit ratio, CR the credit deposit ratio, SR the spread ratio and BR the burden to assets ratio.

The correlation matrix shows positive associations between ROA and CAR (.372), BPE (.664), PPE (.946) and the credit deposit ratio (.550). ROA is negatively related to NNPA (−.178), the cash deposit ratio (−.083), the spread ratio (−.255) and the burden to assets ratio (−.136). ROA has the strongest bivariate association with PPE, which is understandable because profit is the numerator of both variables. The squared correlation of .946 implies that PPE alone accounts for close to 90 per cent of the variation in ROA in a bivariate sense. Several predictors are also strongly related to one another. The correlation between BPE and PPE is .848, while the cash deposit ratio and the spread ratio record .930 and BPE and the credit deposit ratio record .794. CAR and NNPA are correlated at −.621, and CAR and the credit deposit ratio at .583. The regression coefficients must therefore be read as conditional relationships: each coefficient reflects the association left after the other predictors are included in the model.

4.3 Multicollinearity Analysis

Table 6 reports the variance inflation factors (VIF) and tolerance values. A common rule of thumb treats a VIF above 10 as a sign of serious collinearity.

Table 6. Multicollinearity Diagnostics

Variable	VIF	Tolerance
CAR	276.667	0.004
NNPA	3.483	0.287
BPE	141.838	0.007
PPE	9.053	0.110
CASHDEP	146.369	0.007
CREDITDEP	427.754	0.002
SPREAD	101.023	0.010
BURDEN	9.248	0.108

Source: Authors' calculations.

Five of the eight variables (CAR, BPE, the cash deposit ratio, the credit deposit ratio and the spread ratio) have VIF values far above 10, and the values for PPE and the burden to assets ratio lie just below it. Only NNPA shows a low value. The diagnostics show that individual regression coefficients can be difficult to interpret in isolation, as some explanatory variables contain similar information. High collinearity does not bias the coefficient estimates, but it inflates their sampling variance and makes individual estimates unstable. It is one reason why several coefficients in the next section are statistically insignificant despite the high overall fit.

4.4 Multiple Regression Analysis

Since the Breusch and Pagan test is statistically significant ($LM = 34.664$, $p < .001$), the coefficient estimates are evaluated using HC1 heteroskedasticity robust standard errors. Table 7 reports the results.

Table 7. Pooled Multiple Regression with Heteroskedasticity Robust Standard Errors

Variable	B	Robust SE	z or t	p value	Decision at 5%
Constant	0.79762	0.37537	2.125	0.034	Significant
CAR	-0.004584	0.015472	-0.296	0.767	Accept H0
NNPA	-0.000002	0.000002	-0.957	0.338	Accept H0
BPE	-0.000642	0.000105	-6.140	0.000	Reject H0
PPE	0.076430	0.006251	12.228	0.000	Reject H0
Cash Deposit Ratio	0.051460	0.047912	1.074	0.283	Accept H0
Credit Deposit Ratio	0.007621	0.006031	1.264	0.206	Accept H0
Spread Ratio	-0.024349	0.027068	-0.900	0.368	Accept H0
Burden to Assets Ratio	-0.018825	0.036828	-0.511	0.609	Accept H0

Source: Authors' calculations. $R^2 = 0.970$; adjusted $R^2 = 0.965$; $F(8, 51) = 206.658$, $p < .001$.

The model has an R^2 of 0.970 and an adjusted R^2 of 0.965, and the conventional F test ($F(8, 51) = 206.658, p < .001$) rejects the hypothesis that all slope coefficients are jointly zero. The relatively high R^2 should nevertheless be interpreted cautiously because several predictors are strongly correlated and because PPE, which shares its numerator with ROA, accounts for most of the explained variation. PPE has a positive coefficient of 0.07643 ($p < .001$), while BPE has a negative coefficient of 0.000642 ($p < .001$). In practical terms, a rise of ₹1 lakh in profit per employee is associated with an increase of about 0.076 percentage points in ROA, holding the other variables constant. A change of one standard deviation in PPE (₹10.121 lakh) corresponds to about 0.774 percentage points of ROA, which is larger than one standard deviation of ROA itself. A rise of ₹100 lakh in BPE is associated with a fall of about 0.064 percentage points in ROA, and a change of one standard deviation in BPE (₹545.117 lakh) with a fall of about 0.350 percentage points. The difference in signs needs careful interpretation because the two productivity variables correlate at .848. The BPE coefficient represents the relationship remaining after PPE and the other predictors have been held constant. It should not be taken to mean that increasing business handled per employee necessarily reduces profitability.

The other six predictors do not meet the 5 per cent significance criterion. The estimated coefficient for CAR is -0.004584 ($p = .767$), and the coefficient for NNPA is approximately -0.000002 ($p = .338$). The p values for the cash deposit ratio, the credit deposit ratio, the spread ratio and the burden to assets ratio are .283, .206, .368 and .609, respectively. Under this specification, the data do not provide sufficient evidence of a statistically nonzero incremental relationship between these variables and ROA. The signs of the NNPA, burden and credit deposit coefficients agree with the expectations in Table 3, whereas the signs of the cash deposit ratio and the spread ratio do not, but none of these coefficients is precisely estimated.

4.5 Hypothesis Testing

Table 8 summarises the decisions on the eight null hypotheses.

Table 8. Summary of Hypothesis Testing

Hypothesis	Variable	p value	Decision
H01	CAR	0.767	Accept H0
H02	NNPA	0.338	Accept H0
H03	BPE	0.000	Reject H0
H04	PPE	0.000	Reject H0

Hypothesis	Variable	p value	Decision
H05	Cash Deposit Ratio	0.283	Accept H0
H06	Credit Deposit Ratio	0.206	Accept H0
H07	Spread Ratio	0.368	Accept H0
H08	Burden to Assets Ratio	0.609	Accept H0

Source: Authors' calculations. Decisions are at the 5 per cent level. "Accept H0" is used to mean that H0 is not rejected.

With α set at .05, the null hypotheses for CAR, NNPA, the cash deposit ratio, the credit deposit ratio, the spread ratio and the burden to assets ratio are not rejected. The null hypotheses for BPE and PPE are rejected because their regression coefficients are statistically significant. These decisions describe associations within the pooled model; they do not establish causation, particularly in view of the strong relationship between the two employee productivity measures and the short panel period.

4.6 Discussion of Findings

The positive PPE coefficient is plausible given how the variables are constructed. Profit per employee and ROA both have profit as the numerator, so banks with higher profit relative to staff strength will usually also record higher profit relative to assets. The finding is therefore consistent with the view of Athanasoglou et al. (2008) that productivity matters for profitability, but part of the strength of the association is arithmetic. It would be wrong to read the coefficient as evidence that a policy of raising profit per employee would by itself raise ROA. The negative BPE coefficient should be interpreted even more cautiously. BPE and PPE share a correlation of .848, so the regression is separating two measures that contain considerable overlapping information. The coefficient on BPE consequently describes only the part of its association with ROA that remains after PPE and the other predictors are controlled for. Once profit per employee is fixed, a bank with higher business per employee is one that earns the same profit per employee from a larger volume of business, which implies a thinner margin on that business. This is a mechanical reading of a conditional coefficient and is not evidence that higher business handled per employee causes lower ROA. The bivariate correlation between BPE and ROA is in fact positive (.664). NNPA is not statistically significant in this pooled model, but this should not be interpreted as evidence that asset quality has no relevance. Berger and DeYoung (1997) and Rahaman and Sur (2021) both indicate that problem loans matter for bank performance. In this dataset NNPA is measured in absolute ₹ crore, so larger banks can mechanically record larger values. A ratio or

other size adjusted measure could lead to a different result. This is an important measurement limitation of the current specification. The strong negative correlation between CAR and NNPA ($-.621$) further suggests that part of the effect of asset quality is absorbed by the capital variable.

After the simultaneous controls are introduced, CAR, the deposit and credit ratios, the spread ratio and the burden to assets ratio do not show statistically significant incremental relationships with ROA. This does not mean that these dimensions are unimportant for bank management. Their separate effects may be obscured by the current sample, by correlation among predictors, or by bank and year specific factors that are not included in the pooled model. The very high correlation between the cash deposit ratio and the spread ratio ($.930$) and the size of the VIF values in Table 6 mean that the data contain little independent variation from which to identify these individual coefficients. It is also plausible that the regulatory framework, including capital norms and the government support given to PSBs, narrowed differences in capital and liquidity across banks and reduced their power to explain differences in profitability.

Table 9. Estimated Results Compared With Expectations

Variable	Expected sign	Estimated sign	Significant at 5%	Comment
CAR	Ambiguous	Negative	No	Overlaps with NNPA and credit deposit ratio
NNPA	Negative	Negative	No	Absolute measure confounded with size
BPE	Positive	Negative	Yes	Conditional on PPE; collinearity
PPE	Positive	Positive	Yes	Shares numerator with ROA
Cash Deposit Ratio	Negative	Positive	No	Correlated $.930$ with spread ratio
Credit Deposit Ratio	Positive	Positive	No	Correlated with BPE and CAR
Spread Ratio	Positive	Negative	No	Correlated with cash deposit ratio

Variable	Expected sign	Estimated sign	Significant at 5%	Comment
Burden to Assets Ratio	Negative	Negative	No	Weak evidence

Source: Authors' synthesis of Tables 3 and 7.

Taken together, the results support a cautious reading. Employee productivity is the only dimension for which the sample provides statistically significant evidence, and even there the evidence is affected by construction and collinearity. For the remaining dimensions, the absence of significance reflects the limits of a small pooled sample with overlapping predictors as much as the absence of a relationship.

5. Conclusion and Recommendations

5.1 Major Findings and Conclusion

- PPE is positively associated with ROA and BPE has a negative conditional coefficient; both are statistically significant at the 5 per cent level.
- CAR, NNPA, the cash deposit ratio, the credit deposit ratio, the spread ratio and the burden to assets ratio are not statistically significant in the estimated model.
- The model explains about 97 per cent of the variation in ROA (adjusted $R^2 = 0.965$), but much of this fit is attributable to PPE, which shares its numerator with ROA.
- Collinearity is severe for several predictors, especially the cash deposit ratio and the spread ratio (.930) and the two employee productivity measures (.848), and this limits the interpretation of individual coefficients.

The results show a strong association between profit generated per employee and ROA. The findings support a consolidated picture in which employee productivity is considered alongside asset quality, capital adequacy, liquidity and credit intermediation, and they show that profit based productivity measures track ROA closely across the 12 PSBs. At the same time, the study shows that a pooled regression of ROA on a large set of overlapping ratios yields limited information about the separate roles of capital, asset quality, liquidity and operating efficiency. The estimates should be regarded as sample specific statistical associations, and the negative BPE coefficient in particular should not be read as a behavioural or causal relationship. The main contribution of the study lies in documenting these patterns for the post consolidation set of 12 PSBs and in showing clearly where the pooled approach reaches its limits. The diagnostic evidence provides a practical lesson for applied work on Indian banks: ratios that are closely related by construction should not be entered together without examining their joint behaviour.

5.2 Policy Implications and Recommendations

For PSB management, efficiency assessments would be more useful if they used several indicators together and not a single measure. Profit per employee is a helpful summary of how effectively staff resources translate into earnings, but because it moves closely with ROA it should be supplemented with measures that are not mechanically related to profit, such as cost to income ratios and business per employee adjusted for the size of the bank. Boards and supervisors reviewing branch and staff deployment could use productivity indicators as diagnostic screens for identifying units that lag behind peers, rather than as targets to be maximised in isolation. For regulators and policymakers, the results underline the value of size adjusted asset quality indicators in supervisory dashboards, and of reporting standards that allow comparable measurement of productivity across banks. Since the empirical results do not establish causation, they should not be used on their own to justify staffing or lending decisions.

The following recommendations follow from the analysis.

1. Employee productivity can be improved through technology adoption, reskilling and better allocation of staff between branches and specialised functions, with progress tracked through both business per employee and profit per employee.
2. Profit per employee can also be considered as one of the efficiency indicators, but it should be interpreted together with ROA and cost measures because it shares the profit numerator with ROA.
3. Both GNPA and NNPA should be monitored, preferably as ratios to advances and alongside provision coverage, so that comparisons across banks of different size are meaningful.
4. An efficient asset quality monitoring system and a balanced credit and deposit deployment policy should be adopted, so that liquidity is maintained without unduly reducing the share of funds placed in loans.
5. Banks and supervisors should report and review productivity, capital, asset quality and intermediation indicators jointly, and should test for overlap among indicators before using them as separate targets.

5.3 Limitations and Future Research

The study has several limitations. First, macroeconomic factors such as growth, inflation and interest rates are excluded, and the period considered is short, with only five annual observations for each bank. Second, the pooled specification does not control for unobserved bank specific characteristics such as ownership history, business mix and geographic presence, or for year specific shocks common to all banks. Third, NNPA is measured in absolute ₹ crore and not as a ratio, which confounds asset quality with size. Fourth, PPE and ROA share a numerator, and BPE



and PPE are highly correlated, so the productivity coefficients are affected by construction and collinearity. Fifth, some VIF values are extremely high, and the reported figures should be checked against centred calculations before being relied upon. Sixth, with only 12 banks, clustered standard errors are not reliable, and residual correlation within banks may still affect inference. Finally, the results describe associations and cannot be given a causal interpretation. Further work could extend the analysis over a longer period and could also study private sector banks and foreign banks for comparison. Fixed effects and random effects models, with the choice guided by the Hausman (1978) test, would allow for unobserved bank characteristics. Dynamic panel specifications with lagged ROA could capture the persistence of profitability documented by Goddard et al. (2004). Size adjusted asset quality ratios, and other indicators of cost efficiency, should replace or supplement absolute NNPA. Ridge regression, principal components or a reduced set of predictors could address collinearity directly. Finally, frontier efficiency scores from DEA or stochastic frontier analysis could be related to profitability in a second stage, in the manner of Patra et al. (2023), to link the ratio based and frontier based approaches.

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References

- Aigner, D., Lovell, C. A. K., & Schmidt, P. (1977). Formulation and estimation of stochastic frontier production function models. *Journal of Econometrics*, 6(1), 21–37. [https://doi.org/10.1016/0304-4076\(77\)90052-5](https://doi.org/10.1016/0304-4076(77)90052-5)
- Almaqtari, F. A., Al-Homaidi, E. A., Tabash, M. I., & Farhan, N. H. (2019). The determinants of profitability of Indian commercial banks: A panel data approach. *International Journal of Finance & Economics*, 24(1), 168–185. <https://doi.org/10.1002/ijfe.1655>
- Athanasoglou, P. P., Brissimis, S. N., & Delis, M. D. (2008). Bank specific, industry specific and macroeconomic determinants of bank profitability. *Journal of International Financial Markets, Institutions and Money*, 18(2), 121–136. <https://doi.org/10.1016/j.intfin.2006.07.001>
- Banker, R. D., Charnes, A., & Cooper, W. W. (1984). Some models for estimating technical and scale inefficiencies in data envelopment analysis. *Management Science*, 30(9), 1078–1092. <https://doi.org/10.1287/mnsc.30.9.1078>
- Basel Committee on Banking Supervision. (2011). *Basel III: A global regulatory framework for more resilient banks and banking systems* (rev. ed.). Bank for International Settlements. <https://www.bis.org/publ/bcbs189.htm>
- Belsley, D. A., Kuh, E., & Welsch, R. E. (1980). *Regression diagnostics: Identifying influential data and sources of collinearity*. Wiley.
- Berger, A. N. (1995). The relationship between capital and earnings in banking. *Journal of Money, Credit and Banking*, 27(2), 432–456. <https://doi.org/10.2307/2077877>
- Berger, A. N., & DeYoung, R. (1997). Problem loans and cost efficiency in commercial banks. *Journal of Banking & Finance*, 21(6), 849–870. [https://doi.org/10.1016/S0378-4266\(97\)00003-4](https://doi.org/10.1016/S0378-4266(97)00003-4)
- Berger, A. N., & Humphrey, D. B. (1997). Efficiency of financial institutions: International survey and directions for future research. *European Journal of Operational Research*, 98(2), 175–212. [https://doi.org/10.1016/S0377-2217\(96\)00342-6](https://doi.org/10.1016/S0377-2217(96)00342-6)
- Berger, A. N., & Mester, L. J. (1997). Inside the black box: What explains differences in the efficiencies of financial institutions? *Journal of Banking & Finance*, 21(7), 895–947. [https://doi.org/10.1016/S0378-4266\(97\)00010-1](https://doi.org/10.1016/S0378-4266(97)00010-1)
- Bhattacharyya, A., Lovell, C. A. K., & Sahay, P. (1997). The impact of liberalization on the productive efficiency of Indian commercial banks. *European Journal of Operational Research*, 98(2), 332–345. [https://doi.org/10.1016/S0377-2217\(96\)00351-7](https://doi.org/10.1016/S0377-2217(96)00351-7)



- Bourke, P. (1989). Concentration and other determinants of bank profitability in Europe, North America and Australia. *Journal of Banking & Finance*, 13(1), 65–79. [https://doi.org/10.1016/0378-4266\(89\)90020-4](https://doi.org/10.1016/0378-4266(89)90020-4)
- Breusch, T. S., & Pagan, A. R. (1979). A simple test for heteroscedasticity and random coefficient variation. *Econometrica*, 47(5), 1287–1294. <https://doi.org/10.2307/1911963>
- Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European Journal of Operational Research*, 2(6), 429–444. [https://doi.org/10.1016/0377-2217\(78\)90138-8](https://doi.org/10.1016/0377-2217(78)90138-8)
- Das, A., & Ghosh, S. (2009). Financial deregulation and profit efficiency: A nonparametric analysis of Indian banks. *Journal of Economics and Business*, 61(6), 509–528. <https://doi.org/10.1016/j.jeconbus.2009.07.003>
- Das, A., & Kumbhakar, S. C. (2012). Productivity and efficiency dynamics in Indian banking: An input distance function approach incorporating quality of inputs and outputs. *Journal of Applied Econometrics*, 27(2), 205–234. <https://doi.org/10.1002/jae.1183>
- Demirgüç-Kunt, A., & Huizinga, H. (1999). Determinants of commercial bank interest margins and profitability: Some international evidence. *The World Bank Economic Review*, 13(2), 379–408. <https://doi.org/10.1093/wber/13.2.379>
- Dietrich, A., & Wanzenried, G. (2011). Determinants of bank profitability before and during the crisis: Evidence from Switzerland. *Journal of International Financial Markets, Institutions and Money*, 21(3), 307–327. <https://doi.org/10.1016/j.intfin.2010.11.002>
- Fujii, H., Managi, S., & Matousek, R. (2014). Indian bank efficiency and productivity changes with undesirable outputs: A disaggregated approach. *Journal of Banking & Finance*, 38(1), 41–50. <https://doi.org/10.1016/j.jbankfin.2013.09.022>
- Goddard, J., Molyneux, P., & Wilson, J. O. S. (2004). The profitability of European banks: A cross sectional and dynamic panel analysis. *The Manchester School*, 72(3), 363–381. <https://doi.org/10.1111/j.1467-9957.2004.00397.x>
- Hausman, J. A. (1978). Specification tests in econometrics. *Econometrica*, 46(6), 1251–1271. <https://doi.org/10.2307/1913827>
- Ho, T. S. Y., & Saunders, A. (1981). The determinants of bank interest margins: Theory and empirical evidence. *Journal of Financial and Quantitative Analysis*, 16(4), 581–600. <https://doi.org/10.2307/2330377>
- Jarque, C. M., & Bera, A. K. (1987). A test for normality of observations and regression residuals. *International Statistical Review*, 55(2), 163–172. <https://doi.org/10.2307/1403192>



- Kumar, S. (2008). An analysis of efficiency profitability relationship in Indian public sector banks. *Global Business Review*, 9(1), 115–129. <https://doi.org/10.1177/097215090700900108>
- Kumbhakar, S. C., & Sarkar, S. (2003). Deregulation, ownership, and productivity growth in the banking industry: Evidence from India. *Journal of Money, Credit and Banking*, 35(3), 403–424. <https://doi.org/10.1353/mcb.2003.0020>
- Molyneux, P., & Thornton, J. (1992). Determinants of European bank profitability: A note. *Journal of Banking & Finance*, 16(6), 1173–1178. [https://doi.org/10.1016/0378-4266\(92\)90065-8](https://doi.org/10.1016/0378-4266(92)90065-8)
- Nalliboyina, S. B., & Chalam, G. V. (2023). Factors determining the financial performance of public sector banks in India. *Asian Journal of Economics, Business and Accounting*, 23(14), 57–71. <https://doi.org/10.9734/ajeba/2023/v23i141005>
- Pasiouras, F., & Kosmidou, K. (2007). Factors influencing the profitability of domestic and foreign commercial banks in the European Union. *Research in International Business and Finance*, 21(2), 222–237. <https://doi.org/10.1016/j.ribaf.2006.03.007>
- Patra, B., Padhan, P. C., & Padhi, P. (2023). Efficiency of Indian banks: Private versus public sector banks: A two stage analysis. *Cogent Economics & Finance*, 11(1), Article 2163081. <https://doi.org/10.1080/23322039.2022.2163081>
- Petersen, M. A. (2009). Estimating standard errors in finance panel data sets: Comparing approaches. *The Review of Financial Studies*, 22(1), 435–480. <https://doi.org/10.1093/rfs/hhn053>
- Rahaman, S. M., & Sur, D. (2021). Identifying key drivers of non performing assets in Indian public sector banks: A panel data analysis. *Vision*, 25(1), 56–67. <https://doi.org/10.1177/22779752211000146>
- Sangeetha, R. (2020). How efficient are public sector banks in India? A non parametric approach. *Banks and Bank Systems*, 15(4), 108–120. [https://doi.org/10.21511/bbs.15\(4\).2020.10](https://doi.org/10.21511/bbs.15(4).2020.10)
- Sathye, M. (2003). Efficiency of banks in a developing economy: The case of India. *European Journal of Operational Research*, 148(3), 662–671. [https://doi.org/10.1016/S0377-2217\(02\)00471-X](https://doi.org/10.1016/S0377-2217(02)00471-X)
- Seenaiiah, K., Rath, B. N., & Samantaraya, A. (2015). Determinants of bank profitability in the post reform period: Evidence from India. *Global Business Review*, 16(5_suppl), 82S–92S. <https://doi.org/10.1177/0972150915601241>
- Shapiro, S. S., & Wilk, M. B. (1965). An analysis of variance test for normality (complete samples). *Biometrika*, 52(3–4), 591–611. <https://doi.org/10.1093/biomet/52.3-4.591>



- White, H. (1980). A heteroskedasticity consistent covariance matrix estimator and a direct test for heteroskedasticity. *Econometrica*, 48(4), 817–838. <https://doi.org/10.2307/1912934>
- Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data* (2nd ed.). MIT Press.

Glossary of Terms

Term	Meaning
ROA	Return on Assets
CAR	Capital Adequacy Ratio
NNPA	Net Non Performing Assets
GNPA	Gross Non Performing Assets
BPE	Business per Employee
PPE	Profit per Employee
CDR	Cash Deposit Ratio
CR	Credit Deposit Ratio
SR	Spread Ratio
BR	Burden to Assets Ratio
PSBs	Public Sector Banks
VIF	Variance Inflation Factor
DEA	Data Envelopment Analysis
DBIE	Database on Indian Economy
RBI	Reserve Bank of India

Appendix 1: List of Public Sector Banks

- Bank of Baroda
- Bank of India
- Bank of Maharashtra
- Canara Bank
- Central Bank of India
- Indian Bank
- Indian Overseas Bank
- Punjab and Sind Bank
- Punjab National Bank
- State Bank of India
- UCO Bank
- Union Bank of India

Source: Reserve Bank of India.

Appendix 2: Regression Model and Statistical Output

$$ROA_{it} = \beta_0 + \beta_1 CAR_{it} + \beta_2 NNPA_{it} + \beta_3 BPE_{it} + \beta_4 PPE_{it} + \beta_5 CDR_{it} + \beta_6 CR_{it} + \beta_7 SR_{it} + \beta_8 BR_{it} + \varepsilon_{it}$$

$R^2 = 0.970$; adjusted $R^2 = 0.965$; conventional $F(8, 51) = 206.658$, $p < .001$. Breusch and Pagan test: $LM = 34.664$, $p < .001$. Jarque and Bera test for pooled residuals: $JB = 2.797$, $p = .247$.