

Financial Efficiency Dynamics of Indian Public Sector Banks Before and After the 2020 Merger: An Empirical Study Using Data Envelopment Analysis

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Abstract: The 2020 mega-merger of Corporation Bank and Andhra Bank with Union Bank of India represented a major structural reform in the Indian banking sector. Although consolidation was expected to strengthen capital structure and enhance performance, empirical evidence on whether efficiency improved remains limited. This study evaluates the financial efficiency of the three banks over an eleven-year period using a non-parametric Data Envelopment Analysis (DEA) approach, distinguishing between the pre-merger (2015–2019) and post-merger (2020–2025) phases. Deposits and operating expenses were treated as input variables, while advances, total income, and adjusted net profit were considered output variables. The VRS/BCC model revealed variation in technical efficiency, with several pre-merger years exhibiting full efficiency and the early post-merger period showing reduced efficiency before later improvement. Conversely, the CRS/CCR model yielded zero efficiency scores across all decision-making units, indicating the absence of scale efficiency throughout the study period. The findings suggest that the merger did not result in immediate efficiency enhancement and that the realisation of synergy depends on sustained expansion of lending, revenue, and profitability. The study contributes to merger literature by providing long-horizon DEA-based evidence on financial performance in the Indian public banking system.

Keywords: Bank mergers; Public sector banks; Data Envelopment Analysis; Financial efficiency

1. INTRODUCTION

Reforms in the Indian banking system have been characterised by periodic structural adjustments aimed at enhancing financial strength and operational resilience. Among these reforms, the 2020 public sector bank consolidation stands as one of the most notable policy interventions, in which Corporation Bank and Andhra Bank were amalgamated with Union Bank of India. This strategic decision was expected to generate operational synergies, create economies of scale, and improve long-term competitiveness both domestically and globally. The merger was also envisioned to reduce redundancy in branch networks, optimise resource allocation, and rationalise operating expenditure. However, merger-driven performance outcomes are not automatic and typically depend on the pace of managerial integration, technological alignment, and the ability to mobilise business growth following structural consolidation.

Efficiency remains a critical parameter in evaluating the success of mergers in the financial sector. A bank's economic performance depends not merely on the size of resources at its disposal, but on its capacity to convert inputs such as deposits and operating expenses into meaningful financial outputs such as advances, income, and profitability. Traditional financial ratio analysis often fails to capture this multidimensional resource–output relationship, whereas non-parametric methods such as Data Envelopment Analysis (DEA) offer a more comprehensive evaluation of



efficiency. DEA measures relative efficiency across multiple decision-making units and objectively identifies efficient and inefficient performers without assuming linearity or distributional conditions.

Existing literature on mergers presents mixed outcomes. Several studies have argued that merged banks experience short-term efficiency deterioration due to integration frictions before demonstrating gradual performance recovery over time. Others have noted that the realisation of merger benefits depends on post-merger lending expansion, business diversification, and improvements in profitability. Evidence from Indian public sector banks, however, remains limited—particularly concerning the 2020 mega-merger. In this context, a systematic investigation of financial efficiency over the pre-and post-merger periods is essential to understand whether consolidation has translated into measurable operational improvement.

The present study addresses this gap by examining financial efficiency across an eleven-year panel dataset using both BCC (VRS) and CCR (CRS) orientations of DEA. The pre-merger period (2015–2019) captures the independent performance of Corporation Bank, Andhra Bank, and Union Bank of India, while the post-merger period (2020–2025) reflects the operational results of the merged entity. By analysing efficiency scores, benchmark patterns, slack values, and returns-to-scale classification, the study provides empirical evidence on whether the merged bank achieved technical and scale efficiencies following consolidation. The findings are relevant to regulators, practitioners, and researchers evaluating the financial implications of consolidation strategies in the Indian banking sector.

2. Literature Review:

Singh & Gupta (2013), They studied the productivity and efficiency of Indian commercial banks using the DEA model. Inputs included deposits and operating costs, and outputs included credit and profitability measures. The study period covered the post–global crisis phase. Results showed gradual recovery in efficiency across Indian banks due to improved credit activity. And Proved DEA is suitable to evaluate banking performance using multiple inputs and outputs.

Kaur (2014), The study examined determinants of technical efficiency across public, private and foreign banks in India. Efficiency scores were computed using BCC/VRS orientation of DEA. Findings showed bank size had less impact than managerial productivity and cost control. Foreign banks showed higher efficiency compared to public banks.

Relevance: Efficiency differences arise mainly from internal organisational effectiveness.

Subramanyam (2014), Applied a three-stage DEA approach incorporating asset quality and risk-adjusted performance. Evaluated Indian banks using variables such as NPAs and provisioning. Findings showed public sector banks were heavily affected by asset-risk shocks. Private banks were more stable but faced operational inefficiencies. and Efficiency assessment must consider profitability and credit-risk performance.

Kumar & Singh (2014),

Investigated the impact of deregulation on banking efficiency in India. Used DEA to compare public and private bank performance before and after reforms. Results showed efficiency improvements were greater in private banks due to competitive pressure. Public banks lagged mainly due to high operating overheads. and Policy reforms alone do not ensure efficiency improvements for PSBs.

Othman et al. (2016), Compared CCR (CRS) and BCC (VRS) DEA models for banking efficiency analysis. Study evaluated banks in multiple developing countries. Efficiency scores were consistently lower under CCR due to stricter constant-scale assumption. BCC captured pure managerial efficiency better. and Validates using both CRS and VRS for a complete efficiency assessment.

Shi et al. (2017), Investigated post-merger efficiency of commercial banks in China using a two-stage DEA model. Inputs included operating expenses and deposits; outputs included loans and income. Results showed significant efficiency decline immediately after mergers. Efficiency improved gradually over time after integration stabilised. and Mergers do not automatically generate efficiency; consolidation requires adaptation.

Sudesh (2018), Evaluated efficiency of Indian banks using DEA between 2005 and 2014. SBI and associate banks recorded high efficiency due to balanced cost and credit strategy. New private banks achieved moderate efficiency; old private banks underperformed. Public banks were slower to convert resources into returns. and Cost management is a key driver of banking efficiency.

Kumar (2019), Introduced fuzzy DEA for analysing financial efficiency under uncertainty. Study analysed volatility-affected banking datasets and compared with traditional DEA. Fuzzy DEA provided more discriminatory power for ranking banks. Efficiency results were more stable under data fluctuations. and Modified DEA models may be useful in banking datasets with volatile profit values.

Basu & Sharma (2019), Compared productivity of public and private banks using DEA and Malmquist index. Data from 2008–2018 were analysed to capture changing industry dynamics. Public sector banks showed lower productivity due to higher operating costs. Private banks improved productivity rapidly due to digitization and customer focus. and Cost burden is a major reason for public sector bank inefficiency.

Pyka (2020), Studied effects of global bank consolidation on efficiency using panel DEA. Dataset included banks from Europe, Asia and Latin America post-merger. Some merged banks achieved scale benefits; others faced post-merger inefficiency. Performance depended on integration of people, systems and products.

Lee (2021), Assessed financial efficiency of ASEAN banks following consolidation using DEA. Inputs included deposits and operating costs; outputs included loans and profitability. Efficiency improved only when merged banks simultaneously expanded credit portfolios. Banks that merged but did not enlarge business volume showed no efficiency gains. and Mergers enhance efficiency only when revenue-side performance increases.

Al-Shaar & Rahman (2020), Examined scale efficiency of banks in the Middle East after mergers. DEA results classified most post-merger banks under Increasing Returns to Scale (IRS). Findings showed banks needed to grow outputs to match expanded resource base.

Cost reduction alone did not improve efficiency. and Merged banks require output expansion rather than simple consolidation.

Muto (2021), Investigated European cross-border bank mergers through CRS and VRS DEA models. Efficiency scores declined during the integration phase due to operational adjustments. Scale inefficiency persisted until profitability and lending improved.

Successful mergers recovered efficiency within three years. most importantly Time lag between merger execution and efficiency improvement is common.

Das & Mohapatra (2022), Studied efficiency of Indian merged banks from 2018–2021 using input-oriented DEA. Immediate post-merger years exhibited sharp decline in technical efficiency. Efficiency improved gradually as IT systems stabilised and branch duplication reduced. Profitability increase was found to be the main driver of recovered efficiency. and Post-merger efficiency depends on integration management, not merger itself.

Peres & Goncalves (2023), Analyzed banking mergers in Brazil using a panel-DEA framework. Found short-term disruption in efficiency due to transition and restructuring costs. Positive efficiency effects were observable only after scale benefits materialised.

Merged banks that failed to enhance revenue remained inefficient.

Chawla & Soni (2023), Evaluated performance determinants of post-merger banks in emerging economies., Efficiency increased when merged banks expanded credit activity and rationalised expenditure. Staff reduction had minimal impact compared to digitalisation and lending growth. Business transformation was more important than

cost-cutting.
mainly Growth-oriented integration yields stronger efficiency benefits than downsizing.

Abdul Latif (2022), Measured synergy realisation in Middle Eastern banks after acquisition using DEA. Combined entity recorded lower efficiency in initial period of integration. Efficiency recovered only when product diversification and market expansion strategies were adopted. Revenue growth was more influential than expense control.

Gunasekaran et al. (2023), Compared pure technical efficiency and scale efficiency in Asian banking systems. Results showed large public banks frequently operate below optimal scale (IRS). Operating efficiency was restricted by insufficient income growth relative to deposit base. Private banks achieved higher scale efficiency through digital expansion.

mainly Scale inefficiency persists unless output increases proportionately.

Rahimi (2024), Investigated technical inefficiency determinants in consolidated banks using two-stage DEA. Integration shock, IT transition and branch restructuring negatively affected early efficiency. Efficiency improved once manpower alignment and business expansion took place. Merged banks differed widely based on leadership and implementation strategy.

Pandey (2024), Reviewed efficiency measurement techniques in M&A-focused banking research. Validated DEA as the most suitable tool for evaluating multi-factor financial performance. Confirmed CRS model detects scale inefficiency, while VRS isolates pure technical efficiency. Highlighted the need for merger-specific efficiency studies in India.

RESEARCH GAPS

1. Very few studies have evaluated the 2020 mega-merger of Corporation Bank, Andhra Bank and Union Bank of India using DEA across both pre- and post-merger periods.

2. Existing merger studies mainly analyse financial ratios, stock returns or profitability, but not multidimensional financial efficiency based on inputs and outputs (Deposits → Loans/Income/Profit).

3. There is inadequate evidence on whether post-merger Union Bank of India has achieved scale efficiency (CRS) or continues to operate under Increasing Returns to Scale (IRS).

3. OBJECTIVES OF THE STUDY

1. To measure and compare the financial efficiency of banks during the pre-merger (2015–2019) and post-merger (2020–2025) periods using DEA.

2. To identify benchmark-efficient and benchmark-inefficient years and analyse improvement targets for inefficient years through slack and target data.

3. To examine whether post-merger Union Bank of India operates under IRS, CRS or DRS and determine whether scale efficiencies have been realised after consolidation.

HYPOTHESES

Null Hypotheses (H₀)

H₀₁: There is no significant difference in financial efficiency between the pre-merger and post-merger periods.
H₀₂: Post-merger Union Bank of India has not achieved benchmark efficiency compared to efficient pre-merger banks.
H₀₃: Post-merger Union Bank of India does not operate at Constant Returns to Scale (CRS).

4. METHODOLOGY

This study follows a quantitative research framework to evaluate the efficiency of public sector banks during the period surrounding the 2020 merger. A non-parametric approach was selected because banking performance involves the transformation of multiple financial resources into different financial outcomes. To capture this multidimensional structure, Data Envelopment Analysis (DEA) was used as the primary analytical tool.

Study Period

The analysis spans eleven financial years, divided into two distinct phases for comparison:

- 2015 to 2019, representing the operations of Corporation Bank, Andhra Bank and Union Bank of India as independent organisations.
- 2020 to 2025, representing the financial performance of Union Bank of India after the merger.

Decision-Making Units

The sample consists of twenty observations (DMUs). Fifteen DMUs belong to the pre-merger phase (five annual observations for each of the three banks), and the remaining five correspond to the post-merger phase of the unified bank.

Input and Output Variables

The variable structure was framed to reflect the financial functioning of banks:

Inputs: Deposits and Operating Expenses

Outputs: Advances, Total Income and Adjusted Net Profit

These variables were chosen because they represent how effectively financial resources are mobilised and used to generate income and profit.

Model Orientation and Selection

An input-oriented DEA model was adopted on the assumption that banks aim to achieve the highest possible financial return with the least consumption of resources. To generate a comprehensive view of efficiency:

The VRS/BCC model was used to compute pure technical efficiency, and

The CRS/CCR model was applied to determine scale efficiency.

Returns-to-Scale Identification

DEA classification further categorised each DMU into one of the following scale behaviours:

- Increasing Returns to Scale (IRS)
- Constant Returns to Scale (CRS)
- Decreasing Returns to Scale (DRS)

This distinction helped determine whether inefficiencies arose from managerial causes or from a scale imbalance.

DEA Model Used in the Present Study

The present paper evaluates the financial efficiency of public sector banks during the pre-merger and post-merger periods by employing an input-oriented non-parametric Data Envelopment Analysis (DEA) framework. Since banks have managerial discretion over the utilisation of resources rather than over income and profit generation, an input-oriented specification is theoretically appropriate. Every yearly financial performance of a bank is considered a Decision-Making Unit (DMU), enabling year-wise comparison of managerial efficiency.

Mathematical Model

Let a given DMU utilise m inputs to produce s outputs. For the DMU under evaluation, the input vector is x_{io} ($i = 1, 2, \dots, m$) and the output vector is y_{ro} ($r = 1, 2, \dots, s$). The input-oriented BCC (VRS) model used in the study is expressed as:

Minimise: θ

Subject to:

$$\sum (\lambda_j \times x_{ij}) + s_{i-} = \theta \times x_{io} \quad \text{for all inputs } i$$

$$\sum (\lambda_j \times y_{rj}) - s_{r+} = y_{ro} \quad \text{for all outputs } r$$

$$\sum \lambda_j = 1$$

$$\lambda_j \geq 0, \quad s_{i-} \geq 0, \quad s_{r+} \geq 0$$

Where:

- θ = efficiency score of the DMU under evaluation ($\theta = 1$ indicates full efficiency)
- λ_j = peer reference weights for DMU j
- s_{i-} = input slack (excess input usage)
- s_{r+} = output slack (shortfall in output generation)

The convexity condition $\sum \lambda_j = 1$ ensures operation under Variable Returns to Scale (VRS), thereby measuring pure technical efficiency independent of scale size.

To determine whether inefficiency arises due to inappropriate organisational scale rather than managerial causes, the CCR (CRS) DEA model is also estimated by removing the convexity constraint. Scale Efficiency (SE) is then calculated as:

$$\text{Scale Efficiency (SE)} = \text{CRS score} \div \text{VRS score}$$

A value of $SE = 1$ confirms scale efficiency, whereas $SE < 1$ indicates scale inefficiency.

Software

All DEA computations—efficiency scores, slacks, reference sets and target projections—were carried out using DEA Frontier (Excel add-in).

Data Source and Pre-processing

The study relied exclusively on secondary financial data drawn from audited annual reports of the banks and records published by the Reserve Bank of India. Since DEA requires non-negative numbers for estimation, negative profit values reported in specific years were adjusted using a constant-shift method without altering the financial relationships across observations.

5. DATA ANALYSIS

5.1 Analysis for Objective 1

To measure and compare the financial efficiency of banks during the pre-merger (2015–2019) and post-merger (2020–2025) periods using DEA.

Table 1 compares VRS (Pure technical) efficiency across both periods.

Table 1. VRS Efficiency Comparison

Period	No. of DMUs	Efficiency Range	Mean	SD
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Pre-merger (2015–2019)	15	0.44477 – 1.00000	0.881	0.184
Post-merger (2020–2025)	6	0.15089 – 0.40560	0.223	0.102

Interpretation:

The pre-merger period demonstrates much stronger operational efficiency. Three DMUs — Corporation Bank 2018, Corporation Bank 2019 and Andhra Bank 2015 — operated on the efficiency frontier, while none of the merged DMUs achieved full efficiency. The sharp decline after 2020 indicates delayed synergy realisation during integration.

Further evidence is provided by CRS performance.

Table 2. CRS Scale Efficiency Summary

CRS Result	Interpretation
0.000 for all DMUs	No unit operated at optimal scale across the study period

Interpretation:

Despite an increase in the scale of operations following the merger, scale efficiency did not materialise in either period.

Hypothesis H_{01} Status: Efficiency differs sharply across periods → H_{01} rejected.

5.2 Analysis for Objective 2

To identify benchmark-efficient and benchmark-inefficient years and analyse improvement targets for inefficient years through slack and target data.

The VRS model identifies the benchmark DMUs used as reference points by inefficient years.

Table 3. Frequency of Efficient Benchmark DMUs

Benchmark DMU	No. of Times Used as Reference	Attribute Reflected
Corp_2019	17	Balanced deposit–expenditure–profit profile
Corp_2018	6	High return with moderate cost
Andhra_2015	6	Strong profitability and cost control

Interpretation:

These three years define the optimum operating models for public sector banks during the pre-merger phase. All inefficient DMUs — including all merged years — converge toward these units.

Slack and target results further describe the extent of inefficiency.

Table 4. Slack Characteristics in Post-Merger Years (VRS Model)

Input/Output	Slack Pattern
Deposits	Excess mobilisation ranging ₹210.70 – ₹50,253 crore
Operating Expenses	Excess ranging ₹240 – ₹2,717 crore
Outputs (Advances, Profit)	Moderate slack (income gap > cost gap)

Interpretation:

The merged entity continues to absorb high levels of deposits and expenses without translating them proportionately into financial outcomes. Hence, inefficiency is resource-intensive rather than resource-deficient.

Target analysis quantifies correction.

Table 5. Required Efficiency Adjustments for Merged Entity

Year	Required Reduction in Deposits	Required Reduction in Operating Expenses
UBI 2020	23%	31%
UBI 2021	28%	34%
UBI 2022	33%	40%
UBI 2023	35%	42%
UBI 2024	37%	46%
UBI 2025	38%	48%

Interpretation:

Efficiency restoration depends on rationalising input size rather than acquiring new resources.

Hypothesis H_{02} Status: Because the merged DMUs do not match benchmark efficiency — H_{02} rejected.

5.3 Analysis for Objective 3

To examine whether post-merger Union Bank of India operates under IRS, CRS, or DRS and determine whether scale efficiencies have been realised after consolidation.

Table 6. Returns to Scale Pattern

Returns to Scale Outcome	% of DMUs	Interpretation
IRS	100%	Banks are below optimal scale and must increase outputs relative to inputs
CRS	0%	No bank achieved ideal scale
DRS	0%	No oversize diseconomy identified

Interpretation:

All observations — including merged years — operate under Increasing Returns to Scale (IRS). Therefore, increasing deposits or expanding the physical network will not enhance efficiency; efficiency will improve only if financial outputs rise faster than inputs.

Hypothesis H_{03} Status: Merged bank does not operate under CRS — H_{03} supported.

5.4 Consolidated Interpretation

Objective	Supported by Data	Hypothesis Status
Objective 1	Strong difference between pre- and post-merger efficiency	H_{01} rejected
Objective 2	Inefficient years could not match benchmark units	H_{02} rejected
Objective 3	Merged entity operates under IRS, not CRS	H_{03} supported

The merger increased the bank's size but reduced operational efficiency. The merged Union Bank of India possesses sufficient resources but does not convert them into proportional income and profit, which resulted in inefficiency. Efficiency improvement now depends on managerial and operational restructuring, not on further expansion of the bank's balance sheet or branch network.

6. Findings of the Study

1. The VRS DEA model shows that efficiency during the pre-merger period was relatively high, with three DMUs (Corporation Bank 2018, Corporation Bank 2019, and Andhra Bank 2015) operating on the efficiency frontier.
2. All post-merger years (2020–2025) recorded a steep decline in efficiency scores, indicating that the merger did not yield immediate operational benefits.
3. CRS results remained at zero for all DMUs, confirming that scale expansion did not contribute to efficiency and that inefficiency arose mainly from internal operational practices.
4. Benchmarking outcomes show that Corporation Bank 2019 served as the most frequent peer unit, implying that its pre-merger operating structure represented the most effective managerial model.
5. Slack analysis confirmed excess deposits and operating expenses in the post-merger period, demonstrating that the merged institution could have achieved the same level of advances and income with lower resource utilisation.

7. Suggestions / Managerial Implications

1. The merged bank should adopt cost discipline measures, particularly by rationalising operational expenditure and controlling deposit mobilisation costs.
2. Credit deployment efficiency needs to be strengthened, ensuring that increases in deposits translate proportionately into advances and income.
3. Replication of the operational characteristics of Corporation Bank 2019 is strongly recommended, as it consistently emerged as the most efficient benchmark.
4. Decision-making may shift towards data-driven branch productivity evaluation, including closure or restructuring of chronically underperforming units.
5. Post-merger integration should emphasise standardisation of operating procedures, minimising duplication of workforce, overlapping departments, and dispersed technology platforms.

8. Conclusion

The study evaluated the financial efficiency of Corporation Bank, Andhra Bank and Union Bank of India during 2015–2025 using DEA under CRS and VRS specifications. The findings demonstrate that the merger resulted in size expansion without a corresponding increase in efficiency. The CRS model revealed that none of the DMUs operated at an optimal scale, while the VRS model highlighted a significant decline in pure technical efficiency during the post-merger period. The evidence suggests that operational inefficiency—rather than scale deficiency—is the dominant source of performance deterioration. Efficiency can be improved not by expanding the bank further but by reducing input waste and realigning managerial practices with those followed during best-performing pre-merger years.

9. Scope for Further Research

1. The present study focused exclusively on DEA; future studies may integrate Malmquist Productivity Index (MPI) to measure productivity change over time.
2. Future research may compare the performance of merged PSBs with private sector banks or foreign banks to assess competitive positioning.
3. Further studies can extend the dataset beyond 2025 to evaluate long-term integration effects.
4. Additional variables—such as NPA levels, CASA ratio, digital transactions or employee productivity—may be incorporated to broaden the efficiency framework.

5. Cross-country studies on bank mergers may provide a global benchmark for evaluating consolidation policy in the Indian banking system.

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