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A comparative study on the efficiency of the public and private sector banks post-merger: A Data Envelopment Analysis

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Abstract

The paper compares the operation efficiency of the public service banks against the private service banks post-merger. The paper also makes an attempt to rank the individual banks in the years before and after mergers. Hence, the study taken a period of five years from 2017 to 2022. The researchers employed the data envelopment analysis (DEA) methodology to calculate the efficiency. From this viewpoint, the merger of the public service banks enhanced their performance but still lagged behind the private sector banks.

Keywords: Public Sector Banks (PSBs), Private Sector Banks (PVBs), Data Envelopment Analysis (DEA), Overall Technical Efficiency.

1. Introduction

In India, the banking sector is divided into public and PVBs, contributing significantly to the economic landscape of the country. State-owned banks, often referred to as public sector banks, have been the mainstay of the Indian banking industry, handling a major share of assets and deposits. These banks are typically viewed as policy tools of the government, designed to support financial inclusion and government-led economic development schemes. Meanwhile, PVBs, with their increasingly aggressive business strategies, technology-driven approaches, and customer-centric systems, are making notable inroads, especially in urban areas. The relationship between these two sectors has changed dramatically, particularly following a series of mergers that have prompted a reassessment of their relative efficiencies.

In India, the banking sector plays a pivotal role in shaping the country's economic landscape. This crucial responsibility is shared by both public and PVBs, each playing a distinct yet complementary role. Although, they are strengthening their grip in the different sectors. While PSBs have traditionally played a crucial role in promoting financial inclusion (Jain, 2015), PVBs have prioritised innovation, customer service, and technology adoption.

Over the years, the industry has witnessed a distinct dichotomy between PSBs and PVBs. The evolving dynamics suggest a trend where PSBs seemingly fall behind their private sector counterparts (Koundal, 2022). To address this, the Indian government implemented several measures such as mergers, recapitalisation efforts, and governance reforms to emphasise its dedication to enhancing the strength of PSBs (Ministry of Finance, 2019). In this paper, researchers try to find whether the PSBs' merger improved their performance.

2. Literature Review

In this section, researchers focus on efficiency-related studies based on Indian banks. In a study, Bhattacharyya et al. (1997) analysed the operational efficacy of seventy commercial banks in India throughout the liberalisation era. They calculated the efficiency score using DEA followed by frontier analysis and concluded that public banks operate with the highest degree of efficiency, and foreign and private banks afterwards. An alternative study demonstrates that, on the whole, PSBs' efficacy scores have increased from 1992 to 1995. But a few banks have remained at the bottom of the relative efficiency range. The variables selected for analysis output consist of branches and staff, while deposits and advances, among others, are considered input variables (Saha and Ravisankar, 2000).

Another study measures the performance of commercial banks for the period 1992-2002, where researchers used DEA based on intermediation, value-added, and operating approaches. The findings suggest that medium-scale public sector banks performed well and exhibited a higher propensity for technological efficiency (Das and Ghosh, 2006). From 2004 to 2005, Kumar and Gulati (2008) attempted to establish a relationship between factors like profitability, market share, asset quality, and exposure to off-balance sheet activities with efficiency. They estimate scale, pure and overall technical efficiency using both the CCR and BCC models. Then, they determined the relationship between Overall Technical Efficiency (OTE) and the aforementioned factors by employing logistic regression. A study on the District Cooperative Bank (DCBs) in Karela from 2005-2009. The findings indicate that DCBs exhibit an efficiency level of 74%, and six DCBs achieve an efficiency score of one (Feroze, 2012).

An additional study was conducted in which the efficiency of Indian banks in facilitating financial inclusion was assessed using the DEA. Additionally, the findings indicate that a subset of PSBs function at an efficiency of 97.48%, while PVBs operate at 92.26%. PSBs' input could be decreased by 2.52% and PVBs by 7.74% (Maity and Sahu, 2018). Another investigation conducted by the same researchers compares the PSBs' efficiency before and after the introduction of 'Pradhan Mantri Jan Dhan Yojana' ('PMJDY'). According to the findings, implementing the 'PMJDY' increased the overall efficiency of the PSBs; however, not all institutions performed equally (Maity and Sahu, 2020).

Patra et al. (2023) did a two-stage analysis of the efficiency of the Indian banks. The DEA was used in the first stage of the analysis, and the Tobit regression model was used in the second stage. In the DEA, the efficiency scores of the PSBs are higher than those of the PVBs. Return on Assets (ROA) and Return on Capital (ROC) levels significantly impact all aspects of efficiency for private banks, according to Tobit regression model results.

Another study also conducted a two-stage DEA frontier analysis of the Islamic banking sector's efficiency. In the first stage, they observed that the banking sector's efficiency and performance increased. In the pandemic, they also observed that the country's economic development improved the banking system (Mai et al., 2023). Shi et al. (2023) analysis the efficiency of the bank of China. Authors proposed an improved slacks-based measure model (SBM). This proposed methodology divides efficiency for banks into two continuous stages. During the initial phase, the outputs are classified into two categories: interest revenue and non-interest income. These outputs are then distributed and treated as the final outputs. In the second phase, non-performing loans are considered as undesired outcomes.

A study in India used DEA and Stochastic Frontier techniques, as well as the logit technique, to measure the performance of the banking sector in India. The DEA results show that both PSBs and PVBs have demonstrated

superior profit efficiency with the provided technology. The foreign sector banks exhibit a higher overall profit inefficiency score compared to both public and PVBs. According to the predicted results of DEA for the period 2020–2021, commercial banks were unable to efficiently generate profits across all bank groups, possibly due to the impact of COVID-19 (Mariappan, 2024). A study is based on 'PMJDY', which analyses seven-year data to measure banking efficiency in India. The results indicate that public sector banks are performing better than PVBs, and very few banks have performed efficiently (Agarwala et al., 2024).

Considering the absence of research in this area, it is crucial to examine the performance of PSBs in India before and after their merger between 2017 and 2022. To address this research gap, the current study establishes particular aims. The study examines the efficiency of the public and private banks operating in India post-merger.

3. Data and Research Methodology

3.1 Data

The entire research is done using secondary data collected from statistical tables relating to banks from the database on the Indian economy by Reserve Bank of India (2023).

3.2 Variables of the study

Based on a literature review, the present study uses a DEA methodology involving an informed choice of input and output variables. The number of inputs and outputs chosen depends upon the assumptions given by Cooper et al. (2007). The assumption is in the equation (1),

$$n >= (p \times q) \quad (1)$$

where n = number of decision-making units (DMU), p = number of inputs, and q = number of outputs.

In order to achieve the research objective, the researchers examined a total of 44 banks, taking into account the variables of cash in hand and fixed assets as input factors and advances, deposits, and investments as output factors (Table 1).

Table 1. List of Input and Output factors

INPUT	OUTPUT
Cash in hand (Alam and Rastgi, 2019)	Advances (Maity and Sahu, 2020)
Fixed assets (Maity and Sahu, 2020)	Deposits (Agarwala et al., 2024; Maity and Sahu, 2020)
	Investments (Shahooth and Battal, 2006)

Researchers also verified the isotonicity relation among the variables, which concluded that an increase in the input causes an increase in the output or positive correlation (Golany and Roll, 1989).

3.3 Research methodology of the data

The DEA approach was established by Charnes et al. (1978) for the purpose of assessing the efficiency of DMUs. The DEA method typically employs two techniques. Both are based on scaling relationships; one is constant return (CCR) and the other is variable return (BCC) (Banker et al., 1984; Charnes et al., 1978). In this study, researchers use an output-oriented model that maximises the output while keeping the input constant.

Using this method, the most efficient DMUs are given a score of 1, while the least efficient ones receive a score close to 0. Consider a system with *n* DMUs, each with *p* number of inputs and *q* number of outputs. A test DMU0 ("*o*" indicates a focused DMU) has been given a relative efficiency score according to the following model:

$$Max \frac{\sum_{r=1}^{q} v_r y_{r0}}{\sum_{i=1}^{p} u_i x_{i0}}$$

Subject to,

$$\frac{\sum_{r=1}^{q} v_r y_{rj}}{\sum_{i=1}^{p} u_i x_{ij}} \leq 1 \; ; (j = 1,2,3, \dots, n); (i = 1,2,3, \dots, p); (r = 1,2,3, \dots, q); \quad (2)$$

$$u_i, v_r \geq 0.$$

where y_{rj}= *Output "r" produced by DMU "j",* v_r= *Weight of the output "r",* x_{ij}= *Input "i" employed by DMU "j",* and u_i= *Wight of the input "i".*

The equation is converted into a linear programming scenario to find the efficiency score of the DMUs.

$$Max \sum_{r=1}^{q} v_r \, y_{ro}$$

Subject to,

$$\sum_{r=1}^{q} v_r \, y_{ro} - \sum_{i=1}^{p} u_i \, x_{ij} \leq 0; (j = 1,2,3, .., n) \quad (3)$$

$$\sum_{i=1}^{p} u_i \, x_{ij} = 1;$$

$$u_i \, , v_r \geq 0$$

3.4 Analytical Tool

The researchers employed the MaxDEA tool to assess the efficiency of the banks in this investigation. Estimations have been conducted for each year spanning from 2017 to 2022.

4. Analysis and Discussion

The estimated OTE (Overall Technical Efficiency) values for public and PVBs (DMUs) based on the output-oriented CCR model are shown in Table 2, covering the study period from 31st March 2017 to 2022.

Table 2. OTE Scores of DMUs from 31st March 2017 to 2022

DMU	2017	2018	2019	2020	2021	2022
ALLAHABAD BANK	0.784704 (IE)	0.843265(IE)	0.91675(IE)	1(E)	*	*
ANDHRA BANK	0.731369(IE)	0.585425(IE)	0.609013(IE)	0.848261(IE)	*	*
BANK OF BARODA	0.685957(IE)	0.587822(IE)	0.504692(IE)	0.805646(IE)	0.794662(IE)	0.846614(IE)
BANK OF INDIA	0.684186(IE)	0.551548(IE)	0.508299(IE)	0.606246(IE)	0.554471(IE)	0.789392(IE)
BANK OF MAHARASHTRA	0.67213(IE)	0.538734(IE)	0.544091(IE)	0.876554(IE)	0.610984(IE)	0.655935(IE)
BHARATIYA MAHILA BANK LTD.	0.527327(IE)	*	*	*	*	*
CANARA BANK	0.710732(IE)	0.543507(IE)	0.476537(IE)	0.549838(IE)	0.704418(IE)	0.846486(IE)
CENTRAL BANK OF INDIA	0.515535(IE)	0.546265(IE)	0.587443(IE)	0.927053(IE)	0.85454(IE)	0.834897(IE)
CORPORATION BANK	0.816953(IE)	0.696489(IE)	0.473194(IE)	0.960054(IE)	*	*
DENA BANK	0.568448(IE)	0.600363(IE)	0.4481(IE)	*	*	*
IDBI BANK LIMITED##	0.352149(IE)	0.417677(IE)	0.279354(IE)	0.364966(IE)	0.22957(IE)	0.300216(IE)
INDIAN BANK	1 (E)	0.924603(IE)	0.55586(IE)	0.848268(IE)	0.94209(IE)	0.912004(IE)
INDIAN OVERSEAS BANK	0.562301(IE)	0.442988(IE)	0.530696(IE)	0.676003(IE)	0.856622(IE)	0.786687(IE)
ORIENTAL BANK OF COMMERCE	0.84749(IE)	0.625297(IE)	0.574264(IE)	0.905406(IE)	*	*

PUNJAB AND SIND BANK	0.851777(IE)	0.984936(IE)	1(E)	0.923824(IE)	1(E)	1(E)
PUNJAB NATIONAL BANK	0.871821(IE)	0.843732(IE)	0.888309(IE)	1(E)	0.974608(IE)	1(E)
STATE BANK OF INDIA	0.49956(IE)	0.497613(IE)	0.408999(IE)	0.692242(IE)	0.558434(IE)	0.790923(IE)
SYNDICATE BANK	0.881439(IE)	0.817955(IE)	0.638284(IE)	0.807013(IE)	*	*
UCO BANK	0.77531(IE)	0.720544(IE)	0.832999(IE)	0.990033(IE)	0.966746(IE)	0.884001(IE)
UNION BANK OF INDIA	0.99095(IE)	0.878145(IE)	0.829534(IE)	0.911752(IE)	0.825848(IE)	1(E)
UNITED BANK OF INDIA	0.821206(IE)	0.624082(IE)	0.571858(IE)	0.944199(IE)	*	*
VIJAYA BANK	0.817886(IE)	0.768841(IE)	0.783087(IE)	*	*	*
AXIS BANK LIMITED	0.529041(IE)	0.473441(IE)	0.482913(IE)	0.591656(IE)	0.6082(IE)	0.804968(IE)
BANDHAN BANK LIMITED	0.440978(IE)	0.588752(IE)	0.462424(IE)	0.868093(IE)	0.83179(IE)	0.708418(IE)
CITY UNION BANK LIMITED	0.6695(IE)	0.602578(IE)	0.539773(IE)	0.593761(IE)	0.578691(IE)	0.829303(IE)
CSB BANK LIMITED	0.742649(IE)	0.698084(IE)	0.616845(IE)	0.630369(IE)	0.729353(IE)	0.730224(IE)
DCB BANK LIMITED	0.331796(IE)	0.295118(IE)	0.305382(IE)	0.519412(IE)	0.577938(IE)	0.664947(IE)
FEDERAL BANK LTD	0.953875(IE)	1(E)	1(E)	1(E)	1(E)	1(E)
HDFC BANK LTD.	0.848822(IE)	0.89972(IE)	0.812122(IE)	1(E)	1(E)	1(E)
ICICI BANK LIMITED	0.307381(IE)	0.312566(IE)	0.292005(IE)	0.472041(IE)	0.581524(IE)	0.691858(IE)
IDFC FIRST BANK LIMITED	1(E)	1(E)	1(E)	1(E)	0.818894(IE)	0.817227(IE)
INDUSIND BANK LTD	0.453453(IE)	0.469264(IE)	0.544158(IE)	0.779568(IE)	0.847028(IE)	1(E)
JAMMU & KASHMIR BANK LTD	0.591946(IE)	0.640318(IE)	0.470977(IE)	0.559001(IE)	0.592629(IE)	0.564426(IE)
KARNATAKA BANK LTD	0.509856(IE)	0.439567(IE)	0.444999(IE)	0.560217(IE)	0.505671(IE)	0.588126(IE)
KARUR VYSYA BANK LTD	0.613288(IE)	0.441697(IE)	0.366524(IE)	0.410924(IE)	0.467075(IE)	0.641805(IE)
KOTAK MAHINDRA BANK LTD.	0.590071(IE)	0.522696(IE)	0.512549(IE)	0.809412(IE)	1(E)	1(E)
LAKSHMI VILAS BANK LTD	0.40677(IE)	0.342551(IE)	0.242403(IE)	0.255457(IE)	*	*
NAINITAL BANK LTD	1(E)	0.895842(IE)	0.807651(IE)	1(E)	1(E)	0.838222(IE)
RBL BANK LIMITED	0.784911(IE)	0.622946(IE)	0.973153(IE)	1(E)	1(E)	1(E)
SOUTH INDIAN BANK LTD	0.528565(IE)	0.661494(IE)	0.749686(IE)	0.722334(IE)	0.657629(IE)	0.685013(IE)
TAMILNAD MERCANTILE BANK LTD	1(E)	0.953784(IE)	0.891579(IE)	1(E)	1(E)	0.86605(IE)
THE DHANALAKSHMI BANK LTD	0.347365(IE)	0.319943(IE)	0.347615(IE)	0.392227(IE)	0.382611(IE)	0.428031(IE)
YES BANK LTD.	1(E)	1(E)	1(E)	0.783901(IE)	0.939811(IE)	1(E)

Source: Researchers Calculations.

Note:

- E: Efficient / IE: Inefficient.
- OTE for cells marked with '*' are unavailable as the relevant banks are merged with other banks.
- IDBI Bank worked as a public sector bank till 2018; from 2019, the bank performed as a private sector bank.

5. Inferences

5.1 Public sector banks

The study presents insights into the efficiency trends of various public sector banks in India over recent years. The following are key findings related to specific banks:

- Allahabad Bank exhibited inefficiency in its operations in 2017. However, throughout the course of subsequent years, the bank made significant progress towards achieving efficiency, resulting in its attainment of an efficient position in 2020. After March 2020, the merger between Allahabad Bank and Indian Bank took place.
- In 2017, Andhra Bank had 73% operating efficiency, dropping to 59% in 2018. In 2019, the recovery rate was 60% lower than in 2017. The bank had 84% operational efficiency in 2020. Andhra Bank and Union Bank of India merged on 1st April, 2020. The bank's efficiency fell short from 2017 to 2020.
- In 2017, the Bank of Baroda needed to be more efficient. It decreased to 50% again in 2018. However, in 2020, the bank's recovery rate was 80%, and it stayed on this course till 2022, maybe because of the April 2019 merger between Dena and Vijay Bank. However, it did not reach an ideal position during the trial.
- Throughout the study, it is evident that the Bank of India does not achieve an optimal level of efficiency. The bank achieved the greatest score in 2022, although the score remains far distant from the optimal ranking.
- In 2020, Bank Maharashtra demonstrated the maximum level of operational efficiency. Prior to and after that year, the bank never surpassed 87%. Throughout the study, the bank never obtained an ideal efficient score.
- Bharat Mahila Bank works till 2017; from 1st April 2017, the bank merged with the State Bank of India.
- Canara Bank operated with an efficiency of 71% in 2017, but this decline continues through 2021. It demonstrated its peak efficacy in 2022. The entire research reveals that the bank is inefficient.
- The Central Bank of India exhibited decreased efficiency until the year 2020, after which there was a slight decline observed; however, it was not as pronounced as in the years 2017 and 2018. The entire period reveals that the bank is inefficient.
- Corporation Bank showed a decline after 2017, but it recovered in 2020. From 1st April 2020 the bank merged with Union Bank of India.
- Dena Bank showed lower efficiency till 2019. Dena Bank was amalgamated into the Bank of Baroda on 1st April 2019.
- IDBI Bank operated as a public sector bank till 20th January, 2019, after which it was officially designated as a private sector bank starting from 21st January, 2019. Despite all the attempts, it was unable to achieve an efficiency rate of 50% during the specified term.
- Indian Bank exhibited optimal operational efficiency throughout 2017. In 2018, the bank had a slight decline, reaching a level of 92%. However, the most significant decline observed over the entire time was in 2019, with a decrease of 55%. The recovery rate exhibited an increase from 84% in 2020 to 94% in 2021. Given the bank's current recovery rate of over 90%, there is a reasonable expectation that it will attain the benchmark of efficiency in the future.

- The efficiency of the Indian Overseas Bank is mediocre, as it never reaches the 90% mark. The minimum efficiency was observed in 2018, while the maximum operational efficacy of 85% was attained in 2021. Throughout the study period, the bank failed to reach an efficient mark.
- Oriental Bank of Commerce merged with PNB on 1st April 2020. Before that, the bank was operating at 90% efficiency in 2020.
- Punjab and Sind Bank showed excellent efficiency in the entire study period. The banks worked efficiently in 2019, 2021 and 2022 to achieve the highest efficiency mark. In 2018 and 2018, the banks operated close to the efficient mark of 98% and 92%. The bank's efficiency was only 85% in 2017.
- Punjab National Bank operated efficiently at 87% in 2017 and 84% in 2018. The bank's operating efficiency rose to 88% in 2019. In 2020, the bank achieved the efficient mark. The Oriental Bank of Commerce and the United Bank of India were merged to form the Punjab National Bank. A merger made Punjab National Bank India's second-largest public sector bank by branch network, after State Bank of India. However, the bank will drop to 97% in 2021 and reach efficiency in 2022.
- In 2017, the State Bank of India (SBI), Bharatiya Mahila Bank, and its associate institutions merged. However, the efficiency of the State Bank of India was subpar until 2019. 2020 the bank experienced minimal progress and again demonstrated a decline in 2021. However, it experienced a recovery to 79% in 2022. Though SBI is India's largest bank, it consistently falls short of achieving optimal efficiency, according to this study.
- Syndicate Bank was merged with Canara Bank on 1st April 2020. Before that, bank efficiency was maintained at around 80%.
- The efficiency of the Union Bank of India was 99% in 2017. The banks subsequently experienced a decline until 2020. The bank achieved operational efficiency in 2021. Corporation Bank and Andhra Bank merged with Union Bank on 1st April, 2020.
- The operational efficiency of the United Bank of India was 82% in 2017, but it subsequently declined until 2019. The bank reached a peak of 94% in 2020. On 1st April, 2020, the bank underwent a merger with Punjab National Bank.
- Vijay Bank worked till 2020; after that, the bank merged with the Bank of Baroda. From 2017 to 2020, the bank showed an average performance.

5.2 Private Banks

The analysis of private sector banks reveals varying levels of operational efficiency over the study period. Key findings for individual banks are as follows:

- Axis Bank in 2017 was on 52% operational efficiency. Later, the bank showed a decline in efficiency. Although the bank recovered to 59% in 2020 and gradually improved its performance. The bank never met efficiency standards during this study period.
- Bandhan Bank showed an average performance till 2020. In 2020, the bank showed the highest efficiency of 86%. However, the bank failed to sustain or improve its position after that. Throughout this study period, the bank failed to fulfil efficiency standards.
- The performance of City Union Bank showed a gradual decline until 2021. The bank's efficiency peaked in 2022 at 82%, up from 82% in 2021.
- CSB Bank showed the highest efficiency in 2017,74%. From 2018 to 2020, the bank never crossed the 70% mark. However, from the results of 2021 and 2022, it seems that the bank is in the recovery mode.
- DCB Bank exhibited poor performance until 2019. The DCB bank demonstrated notable advancements in 2020. Subsequently, the bank steadily enhances its operational efficiency.

- In 2017, the bank had a 95% efficiency rate. The bank will consistently maintain the highest efficiency level from 2018 to 2022. Four times during the research period, the bank performed at its highest level of effectiveness.
- HDFC Bank worked at 84% in 2017, 89% in 2018 and 81% in 2019. From 2020 to 2022, the bank will maintain its efficiency. Four times during the research period, the bank performed at its highest level of effectiveness.
- IDFC First Bank showed the highest level of efficacy from 2017 to 2020. After that, the bank main its efficiency at around 81%. The bank managed to sustain the efficiency for four years in the study period.
- Throughout the research, IndusInd Bank's operational efficiency increased gradually. The bank's efficiency stood at 45% in 2017, but as time progressed, it surpassed that threshold and attained complete operational efficiency in 2022.
- The Jammu and Kashmir Bank performed average in the entire study period. Never touch the optimal level of efficiency in the term. The highest mark the bank was able to match is 59% in 2021.
- In 2017, the Karnataka Bank operated with an efficacy of 50%. The bank then experienced a decline that lasted until 2020. The bank attained a level of efficacy of 56% in 2020. Then, it experiences a decline in performance. The bank maintained the maximum operational efficiency of 58% during the entire period.
- Karur Vysya Bank demonstrated 61% efficiency in 2017. Subsequently, the bank maintained an operational efficacy below 50% from 2018 to 2021. The bank operated with an efficiency level of 64% in 2022.
- Kotak Mahendra Bank Showed a downward trend from 2017 to 2019. From 2020, the bank increased to 80% and in the next two years, the bank managed to achieve the highest efficiency.
- Lakshmi Vilas Bank showed low performance till 2020. After that, it was merged with DBS Bank.
- The efficiency of Nainital Bank was highest in 2017. Subsequently, the bank exhibited a little decline in performance. However, the bank was in an efficient position in 2020 and 2021. The bank's efficiency in 2022 was 84%.
- As of 2017, the RBL Bank was operating at 78%. Following that, the bank experienced a brief decline in efficiency before recovering to 97%. The bank maintained optimal operational efficacy between 2020 and 2022.
- South Indian Bank performed above average in the entire study period. The banks lie between 52% and 75%. The highest performance made by the bank was in 2019.
- Tamilnad Mercantile Bank in 2017, working efficiently. The banks showed little downward in the following two years, but the efficiency was not less than 89%. In 2020 and 2021, the bank achieved the efficient mark. However, the bank showed an operational efficiency of 87% in 2022, which is the lowest efficiency of the bank in the entire study period.
- The Dhanalakshmi Bank operated inefficiently during the entire study period. Never cross the 43% operating efficiency.
- The Yes Bank worked at optimal efficiency from 2017 to 2019. Although it showed little downward movement in 2020 and 2021, it recovered its efficiency in 2022. The bank made three times the operating efficiency in five years.

6. Conclusion

Public-sector banks substantially impact India's banking system, catering to a considerable proportion of the population, particularly in rural and semi-urban regions. Nevertheless, in recent years, there has been an increasing concern regarding the performance and competitiveness of public-sector banks compared to private-sector banks. This situation can be verified through the analysis. Significant mergers happened in the public-sector

banking sector in 2020. Previously, researchers discovered that public banks performed poorly compared to private ones. Following mergers, the number of efficient banks is initially the same as before. However, public bank performance improved in 2022. Yet, they continue to lag behind private banks in terms of performance.

Several factors like Non-Performing Assets, inadequate capital, and slow technology adoption have eroded public banks' financial health, limiting their ability to lend and compete effectively. Additionally, PSBs often face bureaucratic hurdles and political interference, making them less agile and innovative than their private counterparts. In conclusion, while public service banks face significant challenges, they can regain their lost ground through comprehensive reforms. Embracing technology, improving governance, and fostering a culture of innovation are key to their revival. The government also needs to play a proactive role by providing support and creating an enabling environment for their success. Only through dedicated and collaborative efforts can ensure that public service banks continue to play a vital role in India's financial system.

References

Agarwala, N., Maity, S., & Sahu, T. N. (2024). Efficiency of Indian banks in fostering financial inclusion: an emerging economy perspective. Journal of Financial Services Marketing, 29, 341–353.

Alam, T., & Rastgi, R. (2019). Trend analysis of cost efficiency for the pharmaceutical industry: A DEA approach. Management Science Letters, 9(5), 749–754.

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.

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.

Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. European Journal of Operational Research, 2(6), 429–444.

Cooper, W. W., Seiford, L. M., & Tone, K. (2007). Data Envelopment Analysis: A Comprehensive Text with Models, Applications, References and DEA-Solver Software. 2nd ed. New York: Springer Science + Business Media, LLC.

Das, A., & Ghosh, S. (2006). Financial deregulation and efficiency: An empirical analysis of Indian banks during the post reform period. Review of Financial Economics, 15(3), 193–221.

Feroze, P. S. (2012). Technical efficiency and its decomposition in district co-operative banks in Kerala: A data envelopment analysis approach. South Asian Journal of Marketing & Management Research, 2(3), 21–36.

Golany, B., & Roll, Y. (1989). An application procedure for DEA. Omega, 17(3), 237–250.

Jain, C. S. (2015). A Study of Banking Sector's Initiatives Towards Financial Inclusion in India. Journal of Commerce and Management Thought, 6(1), 55-77.

Koundal, V. (2022). Performance of Indian banks in Indian financial system. International Journal of Social Science & Interdisciplinary Research, 11(02), 1–4.

Kumar, S., & Gulati, R. (2008). An Examination of Technical, Pure Technical, and Scale Efficiencies in Indian Public Sector Banks using Data Envelopment Analysis. Eurasian Journal of Business and Economics, 1(2), 33–69.

Mai, X. T. T., Nguyen, H. T. N., Ngo, T., Le, T. D. Q., & Nguyen, L. P. (2023). Efficiency of the Islamic Banking Sector: Evidence from Two-Stage DEA Double Frontiers Analysis. International Journal of Financial Studies, 11(1), 32.

Maity, S., & Sahu, T. N. (2018). Financial Inclusion in India: Role of Public and Private Sector Banks. SCMS Journal of Indian Management, *15*(4), 62–73.

Maity, S., & Sahu, T. N. (2020). Role of public sector banks towards financial inclusion during pre and post introduction of PMJDY: a study on efficiency review. Rajagiri Management Journal, *14*(2), 95–105.

Mariappan, R. (2024). A comparative analysis of profit performance of banking sector in India: A three stage approach. Journal of South Asian Research, 2(1), 103–121.

Ministry of Finance. (2019). Initiatives to improve the conditions of Government Banks. https://pib.gov.in/Pressreleaseshare.aspx?PRID=1575650, Accessed 13 March 2024.

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), 2163081.

Reserve Bank of India. (2023). Handbook of statistics on Indian economy. https://data.rbi.org.in/, Accessed 14 March 2024.

Saha, A., & Ravisankar, T. S. (2000). Rating of Indian commercial banks: A DEA approach. European Journal of Operational Research, 124(1), 187–203.

Shahooth, K., & Battal, A. (2006). Using Data Envelopment Analysis to Measure Cost Efficiency with an Application on Islamic Banks. Sientific Journal of Administrative Development, 4, 134-156.

Shi, X., Wang, L., & Emrouznejad, A. (2023). Performance evaluation of Chinese commercial banks by an improved slacks-based DEA model. Socio-Economic Planning Sciences, 90, 101702.