

TECHNICAL EFFICIENCY OF PUBLIC SECTOR BANKS IN INDIA BY USING DATA ENVELOPMENT ANALYSIS

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Abstract:

This study evaluates the efficiency of public sector banks in India using Data Envelopment Analysis (DEA). DEA is a non-parametric method used to assess the relative efficiency of decision-making units (DMUs) such as banks, by comparing the inputs and outputs. The analysis covers various aspects of banking operations, including financial performance, operational efficiency, and service quality, to identify the most efficient banks and provide insights for improving the performance of less efficient ones.

Keywords: Public Sector Banks (PSBs), Data Envelopment Analysis, Efficiency, Financial Performance.

Introduction:

Public sector banks (PSBs) in India play a pivotal role in the country's financial landscape, serving as crucial instruments for economic development, financial inclusion, and stability. With a vast network spanning rural and urban areas, PSBs mobilize savings, provide credit to various sectors, and contribute significantly to the nation's GDP. However, ensuring optimal operation efficiency remains a critical challenge to maximize their impact and sustainability.

Efficiency evaluation is essential for assessing how effectively PSBs utilize their resources to generate outputs, such as loans, advances, and deposits, relative to their peers and potential benchmarks. Among the various methodologies available, Data Envelopment Analysis (DEA) emerges as a powerful tool for measuring efficiency without imposing stringent assumptions about functional forms or the distribution of inefficiency.

1. Importance of Public Sector Banks:

Public sector banks account for a substantial share of India's banking sector, embodying the government's commitment to financial inclusion and equitable growth. They serve diverse customer segments, ranging from small farmers and entrepreneurs to large corporations, thereby playing a critical role in fostering economic development across rural and urban India.

2. Challenges in Efficiency:

Despite their strategic importance, PSBs face several challenges affecting operational efficiency. These include bureaucratic inefficiencies, legacy systems, high non-performing assets (NPAs), and varying levels of technological adoption. Addressing these challenges is crucial to enhance their competitiveness, improve service delivery, and meet evolving customer expectations in a rapidly transforming banking environment.

3. Data Envelopment Analysis (DEA):

DEA provides a robust framework for evaluating the relative efficiency of PSBs by comparing their performance against a frontier of best practices derived from peer institutions. Unlike traditional parametric methods, DEA accommodates multiple inputs and outputs, making it well-suited for assessing the complex operations of PSBs. By quantifying efficiency scores, DEA helps identify inefficient banks that can learn from their more efficient counterparts, promoting best practices and operational improvements.

I. Review of Literature:

DEA, introduced by Charnes, Cooper, and Rhodes in 1978, is a non-parametric method used to evaluate the efficiency of decision-making units (DMUs). It has been extensively applied in the banking sector to measure the relative efficiency of banks by comparing their input-output combinations. In the context of PSBs in India, DEA has helped identify efficiency gaps and best practices.

- **Kumar and Gulati (2008):** This study assessed the efficiency of Indian PSBs during the post-reform period (1992-2004). Using an input-oriented DEA model, the study found significant inefficiencies in many PSBs, primarily due to high operating costs and poor management practices. The study highlighted the need for better resource utilization and managerial improvements.
- **Das, Nag, and Ray (2005):** The authors evaluated the performance of Indian banks using DEA for the period 1997-2003. They compared public, private, and foreign banks, finding that PSBs lagged behind private and foreign banks in terms of technical efficiency. The study suggested that PSBs need to adopt advanced technologies and improve their operational practices to enhance efficiency.
- **Sathye (2003):** This research analyzed the efficiency of Indian PSBs using DEA for the period 1997-1998. The study identified significant inefficiencies and recommended strategic restructuring, better human resource management, and technological upgradation as critical steps for improvement.
- **Kumar, Verma, and Kumar (2012):** The study applied DEA to assess the efficiency of Indian PSBs for the period 2005-2010. It found variations in efficiency scores across different banks and attributed inefficiencies to factors such as overstaffing, high non-performing assets (NPAs), and inadequate use of technology. The study called for policy interventions and managerial reforms to address these issues.
- **Bhattacharyya, Lovell, and Sahay (1997):** This seminal study analyzed the productive efficiency of Indian commercial banks, including PSBs, using DEA for the period 1986-1991. The findings indicated that PSBs were less efficient compared to private and foreign banks, mainly due to scale

inefficiencies and suboptimal resource allocation. The study emphasized the need for structural reforms in the banking sector.

- **Emrouznejad and Yang (2018):** Discussed the integration of big data analytics with DEA, emphasizing how large datasets can enhance efficiency analysis.
- **Liu, Lu, and Lu (2016):** Explored the use of big data in DEA, providing case studies and methodological advancements.
- **Sherman and Gold (1985):** Applied DEA to evaluate the efficiency of bank branches, influencing subsequent research on financial institutions.
- **Berger and Humphrey (1997):** Reviewed the application of DEA in banking, summarizing findings from various studies and suggesting future research directions.

II. Methodology:

Data envelopment analysis is a deterministic approach employed to measure the input and output technical efficiencies. In a firm or production unit inputs are combined to produce one or more outputs subject to technology. The production varies from one unit to another. This kind of variation causes efficiency differences among the competing DMUs.

Assume that for each of the N firms, there are data on K inputs and M outputs represented by the column vectors and respectively for the i th firm. The $K \times N$ input matrixes X and $K \times M$ output matrix Y represent the data of all $K \times N$ DMUs. The purpose of DEA is to construct a nonparametric envelopment frontier over the data points such that all observed points lie on or below the production frontier.

The best way to introduce DEA is through the ratio form. For each DMU we would like to obtain a measure of the ratio of all outputs over all inputs, such as, where U is the $M \times 1$ vector of output weights and V is a $K \times 1$ vector of input weights. To select optimal weight, we specify the Input – Oriented CCR model for mathematical programming problems as:

$$\begin{aligned}
 & \text{Min } \theta \\
 \text{Subject to } & \sum_{j=1}^n \lambda_j x_{ij} \leq \theta x_{i0}, \quad \forall_i \\
 & \sum_{j=1}^n \lambda_j y_{rj} \geq y_{r0}, \quad \forall_r \\
 & \lambda_j \geq 0 \quad \forall_j
 \end{aligned}$$

Given,

x_{ij} : The amount of input i used by DMU $_j$

y_{rj} : The amount of output r produced by DMU $_j$

θ : Efficiency score of the DMU being evaluated (DMU $_0$)

Where:

λ_j are the weights assigned to each DMU

x_{i0} and y_{i0} are the inputs and outputs of DMU being evaluated.

III. Source of Data:

The data for the present study is obtained from the Indian Banking Association Bulletin (IBA) during the years 2017-18. Here two input variables and two output variables are used. They are Interest Income and Other income (Input variables), Deposits, and Advances (Output variables).

IV. Result and Discusses:

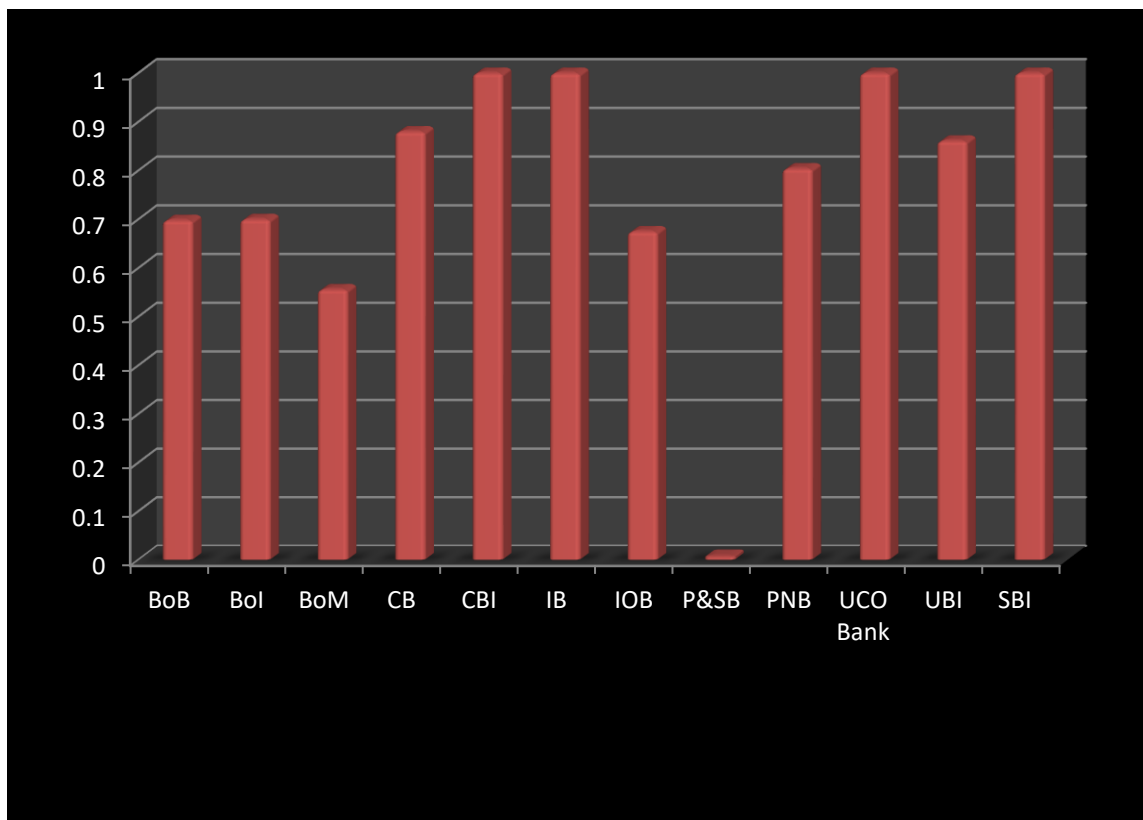
The results are obtained by using the Data Envelopment Analysis program with the help of the CCR model.

1. Technical Efficiency:

Technical efficiency reflects the ability of the firm to obtain maximum outputs from the set of inputs.

S. No	Decision Making Units (DMUs)	Technical Efficiency (TE)
1	Bank of Baroda	0.698 (9)
2	Bank of India	0.700 (8)
3	Bank of Maharashtra	0.556 (11)
4	Canara Bank	0.880 (5)
5	Central Bank of India	1.000 (1)
6	Indian Bank	1.000 (1)
7	Indian Overseas Bank	0.675 (10)
8	Punjab & Sind Bank	0.008 (12)
9	Punjab National Bank	0.804 (7)
10	UCO Bank	1.000 (1)
11	Union Bank of India	0.861 (6)
12	State Bank of India (SBI)	1.000 (1)
	Mean	0.765

From the above table, it has been observed that among 12 Public sector banks, four banks have consistently shown technical efficiencies above their average technical efficiency. The remaining three banks registered their technical efficiencies below their average technical efficiency. Among these 12 public sector banks four banks, Central Bank of India, Indian Overseas Bank, UCO Bank, and State Bank of India are first position where whereas Punjab & Sind Bank is last position. In this analysis, the technical efficiencies of 12 public sector banks in India are also graphically represented as follows:



V. Conclusion:

In this paper, we observe that among 12 public sector banks (PSBs) in India, the average technical efficiency is 0.765. Also Central Bank of India, Indian Overseas Bank, UCO Bank, and State Bank of India stay in the first position whereas Punjab & Sind Bank is last position.

In this connection we observe that three banks are the above average Technical efficiency banks that banks are Canara Bank (0.880), Punjab National Bank (0.804) & Union Bank of India (0.861).

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