EFFICIENCY OF PUBLIC SECTOR BANKS IN INDIA: EVIDENCE BASED ON DATA ENVELOPMENT ANALYSIS

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Abstract

Data Envelopment Analysis (DEA) is non-parametric method used for measuring the efficiency of Decision Making Units (DMU). It was first developed by Charnes, Cooper and Rhodes in 1978 and commonly known as CCR model. It is a linear programming method to measure the efficiency of multiple DMU's with the help of multiple inputs and outputs. In this study, to know the efficiency of 17 Public sector banks for ten years (Before merger and after merger) Data Envelopment Analysis has been used.

INTRODUCTION:

Efficiency in Banking Sector

Indian financial system comprises banking industry and capital market, the banks played a pivotal role of financial intermediaries by assisting the growth processes and in mobilization of savings. The performance of any firm is measured using efficiency, effectiveness and productivity; efficiency specifies the objectives and success of a firm. Likewise performance of financial system depends on the efficiency and efficacy (**Anil, K. Sharma *et al*., 2012**)[1]. The performance of the economy is dependent on banking sector as it is a principal component of financial service industry. After independence, the Indian banking sector went through structural changes since its independence in respect of its financial linkages with the rest of the economy and to meet the social and economic objectives (**Subar, C. Kumbakarnan** and **Sabrata Sarkar, 2005**)[2]. The foundation of productivity in service industry is generally measured by two key concepts, namely effectiveness and efficiency (**Sherman, H. D.,** and **J. Zhu, 2006**)[3].

Efficiency can be defined as the ratio of output to input; more output per unit of input indicates greater efficiency while maximum output per unit of input reflects optimum efficiency (**Cooper, *et al*., 2006**)[4]. The efficiency performance is the indicator of achieving highest possible outcome (outputs) with the use of minimal resources (inputs), the management considered efficiency as suitable step to improve the inefficient units (**Violeta cvetkoska** and **Gordana Savic, 2017**)[5]. Efficiency is attained when bank is not able to reduce the input level to produce same output level or unable to produce outputs with given resources (**Resti, 1997**)[6].

The financial sector is influenced by the commercial banks' activities. The traditional bank activities include distribution and collection of funds (**Madhavi, A.** and **C. Subbarami reddy, 2016**)[7]. There has been a shift in focus to track other income generating activities connecting the reform period 1991-2001 and post reform period; the commercial banks' performance was found significantly improved (**Bhatia** and **Mahendra, 2015**)[8].

The banks' performances were closely related to the economy than any other sectors, and resulted in moderate growth due to the economic slowdowns and global development in the financial year 2012 (**Limbore** and **Mane, 2014**)[9]. The performance of banking sector ranges above 80%, which indicates transformation of inputs to outputs. SBI and ICICI bank efficient scores were below satisfactory level, but ICICI bank had showed an extraordinary achievement in the past years (**Prasad, 2011**)[10]. Public sector banks had higher mean when compared to private sector banks, however varied result had found that when comparing public sector banks and foreign banks, foreign banks had highest efficiency scores (**Milind, 2002**)[11].

It has been found that the banks receiving high efficiency scores are much more likely to survive than banks

which have relatively low scores (**Richard** and **Thomas, 1996**)[12]. The efficiency had become critical for banks' growth and survival due to increase in competition and high standard of customer oriented services (**Gupta, *et al.,* 2008**)[13].

Overall efficiency

The bank exposure to off balance sheet activities had a positive impact on overall technical efficiency (**Kumar** and **Gulati, 2008**)[14]. The small cooperative banks in gulf countries were found to be overall technically efficient than the bigger cooperative banks (**Al Muharrami, 2008**)[15]. The Pakistani banks were found to have overall efficiency scores and are good at utilizing their inputs reasonably but not at optimal level (**Hafil ahmed *et al.,* 2015**)[16]. The elements like profitability, asset quality, and market shares did not have any positive impact on overall technical efficiency of Indian public sector (**Sunil** and **Rachita, 2008**)[17].

Cost efficiency

Cost efficiency shows significant increase in the study period, which suggested that the Life Insurance Corporation benefits the modernization technique, which will help them to understand the future competition (**Kaoru** and **Biresh, 2005**)[18]. The public sector banks in India had a lower average cost efficiency than the private sector banks (**Pardeep** and **Gian, 2010**)[19]. Islamic Shariah based and state-owned commercial banks were cost inefficient when compared to private commercial banks in Bangladesh (**Bellal Hossain Raju, 2017**)[20].

Revenue efficiency

During the pre merger period, the revenue efficiency of Malaysian banks had increased compared to post merger period (**Fadzlan Sufian *et al.,* 2012**)[21]. The big Islamic banks are relatively more cost, revenue and profit efficient than the small banks in Organisation for Islamic conference (OIC) countries (**Mohammed Khaled, 2008**)[22].

Profit efficiency

Public sector banks and private sector in India had lower cost and profit efficiency as compared to foreign sector banks, whereas public sector banks are more revenue efficient (**Megha** and **Aparna, 2015**)[23]. The profit efficiency had a positive impact on share price and returns, however there was no significant relationship between the return and cost efficiency (**Liadaki** and **Gaganis, 2013**)[24]. Based on the efficiency scores, the banks in Turkey required different handling of the branches with low production and in case of low profit efficiency, the banks should be merged with high production and high profit efficiency (**Mehmet** and **Suleyman, 2011**)[25].

Technical efficiency

In case of central and European countries' banks, the panel regression shows that the customer deposits had a positive impact on the technical efficiency during the financial crisis (**Eva Horvatova, 2018**)[26]. The commercial banks in Turkey were technically inefficient in converting their resources into loans (**Sameul Yannick *et al.,* 2016**)[27].

Pure Technical Efficiency

The efficiency scores of banks in India were decomposed into pure technical efficiency and scale efficiency; pure technical inefficiency in Indian Private sector banks was due to poor input utilization and failed to operate at most productive scale size (**Selvam** and **Joan, 2013**)[28].

Allocative Efficiency

Allocative efficiency measures showed that the private banks in India performed consistently well and better than the other categories of banks (**Uday Kumar *et al.,* 2016**)[29]. The banking sector in Austria, Germany, and the UK had lower allocative inefficiency scores whereas the banking sector of Ireland, Portugal and Italy had much more to gain their allocative efficiency level (**Sophocles *et al.,* 2008**)[30].

Scale Efficiency

The banking sector in Pakistan had a negative relationship between the size and the scale efficiency (**Quershi** and **Shaik, 2012**)[31]. The banks were able to use their resources to generate best outputs under constant returns to scale and variable returns to scale assumptions (**Eriki, 2014**)[32].

Research Gap

Previous research works on efficiency relating to banking sector were very few and hence, the present study focuses on the cost, revenue, profit and scale efficiency of banking sector in India using Data Envelopment Analysis.

Significance and Scope of the Study

❖ The present study focuses on cost, revenue, profit and scale efficiency of public sector banks in India using selected variables.

❖ The study compares the efficiency scores of public sector banks during the period 2009-2019.

Research Questions

▪ What is the difference among the efficiency scores of public sector banks during the period?

▪ What is the difference between the efficiency scores of State Bank of India and the other public sector banks?

▪ What are the efficiency scores of State Bank of India during the study period?

▪ How far the efficiency scores of State Bank of India differs before and after merger?

Objectives of the Study

General Objective

➢ To estimate the cost, revenue, profit and scale efficiencies of public sector banks in India, in general and the State Bank of India in particular before and after merger.

Specific Objectives

➢ To analyze the cost, revenue and profit efficiencies of public sector banks in India under VRS and CRS approaches.

➢ To analyze the scale efficiency of public sector banks in India.

➢ To analyze the cost, revenue and profit efficiencies of State Bank of India and its associates during pre-merger period.

➢ To analyze the scale efficiency of State Bank of India and its associates during pre- merger period.

➢ To analyze the cost, revenue and profit efficiencies of State Bank of India during post-merger period.

➢ To analyze the scale efficiency of State Bank of India during post-merger period.

Hypotheses Developed for the Study

The efficiency of Public Sector Banks in India has been studied by analyzing the cost, revenue, profit and scale efficiencies for the period from 2009 to 2019. The following hypotheses are developed for the study.

H_0^1: There is no significant difference in cost efficiency of Public Sector Banks in India between variable returns to scale and constant returns to scale approaches.

H_0^2: There is no significant difference in revenue efficiency of Public Sector Banks in India between variable returns to scale and constant returns to scale approaches.

H_0^3: There is no significant difference in profit efficiency of Public Sector Banks in India between variable returns to scale and constant returns to scale approaches.

Methodology

Sources of Data

The study used secondary data, which are collected from respective banks' annual report and Centre for Monitoring Indian Economy (CMIE) prowess package. The information about the growth and development of public sector banks are collected from e-journals and published research papers.

The period of the study is 10 years i.e., from 2009 to 2019, considering the SBI's pre merger period (2009-2017) and post merger period (2017-2019) and the other public sector banks in India. And considering the overall public sector banks during the period 2009 to 2019.

Sampling design

The study has chosen 17 public sector banks in India. The total number of banks in India was 18 Public sector banks and 21 private sector banks. Out of 18 public sector banks, full fledged data were available for 17 banks for the period 2009-2019. Hence they are selected for the study. The selected 17 public sector banks are presented in table I.1.

Table I.1

List of selected public sector banks in India for the study

1	Allahabad Bank	7	Corporation Bank	13	State Bank of India
2	Andhra Bank	8	Indian Bank	14	Syndicate Bank
3	Bank of Baroda	9	Indian Overseas Bank	15	UCO Bank
4	Bank of India	10	Oriental Bank of India	16	Union Bank of India
5	Canara Bank	11	Punjab and Sind Bank	17	United Bank of India
6	Central Bank of India	12	Punjab National Bank		

Variables used for analysis

Based on the review of literature, the study considered three input variables and three output variables.

Input variables

X_1= Deposits X_2= Labour X_3= Capital

Output variables

Y_1= Loans

Y_2= Investments

Y_3= Off Balance Sheet items

Research Methods

The study used Data Envelopment Analysis (DEA) model, which is popularly known as Frontier analysis, it was first introduced by Charnes, Cooper, and Rhodes (CCR) in 1978 and later in 1984 by Banker, Charnes and Cooper extended the CCR model to variable returns to scale.

The DEA calculates the efficiency based on linear frontier. The decision making units (DMUs), which lie on frontier is said to be efficient and have an efficiency score equal to one, however the DMUs which do not lie on frontier is said to be inefficient and have an efficiency score of zero to one.

Returns to Scale Approach

The returns to scale consists of three laws; they are law of increasing returns to scale, law of constant returns to scale and law of diminishing returns to scale. If output increases by more than the proportional change in all inputs, then it is increasing returns to scale. If output increases by same proportional change in all inputs, then it is constant returns to scale. If output increases by less than the proportional change in all inputs, then it is diminishing returns to scale.

Variable Returns to Scale (VRS) Approach

Variable returns to scale is a type of frontier scale, which estimates the efficiencies whether the increase or decrease in input or output does not result in proportional change in input or output respectively. The VRS includes

both increasing returns to scale and decreasing returns to scale.

Constant Returns to Scale (CRS) Approach

Constant returns to scale is defined as percentage change in all inputs result in an equal percentage change in all outputs. The CRS occurs when increase in number of inputs leads to equal increase in number of inputs. This assumption is used when DMUs are operating at an optimal scale.

Limitations of the Study

i. The study considered 17 public sector banks only.

ii. The study period covers only 10 years.

iii. The study attempted to analyze the cost, profit, revenue and scale efficiency of Public Sector Banks in India. The other efficiencies viz. technical efficiency, pure technical efficiency, and allocative efficiency are not studied.

REVIEW OF LITREATURE

Lina Novickyte and **Jolanta Prozdz** (2018)[33], in a research work titled *"Measuring the Efficiency in the Lithuanian Banking Sector: The DEA Application"* measured efficiency scores for the period 2012-16 using input-output oriented data envelopment analysis and variable returns to scale (VRS) and constant returns to scale (CRS). The input variables viz. 'deposits', and 'labour expenses' and output variables viz. 'operating profit', and 'loans' were used for analysis. The analysis showed that Lithuanian bank efficiency had better results however, the banks owned by Nordic parent group showed inefficiency.

Kekoura Sakouvogui (2019)[34], in a study titled *"Banks Performance Evaluation: A Hybrid DEA-SVM – The Case of US Agricultural Banks"* evaluated the efficiency of 182 banks in US for the period 2010-16 using data envelopment analysis (DEA) and support vector machine (SVM). With intermediation approach two inputs viz. 'total interest expenses', and 'total non-interest expenses' and two output variables viz. 'total loans' and 'other earning assets' were used for analysis. The study showed that the agricultural banking sector was more efficient and stable during the study period. **Mohammed Reza Ghaeli** (2019)[35], in a research study titled *"Measuring the Relative Efficiency of Canadian Versus US Banks"* measured the relative efficiency of five Canadian banks versus six US banks using data envelopment analysis (DEA) for the year 2017. The input variables used include 'number of employees', and 'total assets' and output variable used include 'net revenue'. The study showed that US firms were better when compared with Canadian banks and it was found that the US banks maintained average efficiency of 0.87% whereas Canadian banks had average efficiency of 0.72%.

Ridho Muarief (2019)[36], in a research paper titled *"Analysis of Commercial Bank Efficiency in Indonesia using Data Envelopment Analysis (DEA) Method as Banking Performance Consideration"* measured the relative efficiency of five commercial banks in Indonesia for the period 2008-13 using data envelopment analysis (DEA). The input variables viz. 'total assets', 'revenue', and 'total deposits' and output variables viz. 'total assets' 'labour costs' and 'interest expenses' were used for analysis and the study showed that three banks were efficient.

Suresh *et al.* (2019)[37], in a research work titled *"Efficiency of Indian Banks-Data Envelopment Analysis Approach"* analysed the technical efficiency, pure technical efficiency, scale efficiency, increasing returns to scale (IRS) and decreasing returns to scale (DRS) of 20 banks for the period 2010-11 using data envelopment analysis (DEA). The input variables used include 'total deposits' and 'interest expenses' and output variables used include 'net profit' and 'interest income'. The study found that 14 banks had technical efficiency, which was above the average while six banks had technical efficiency below the average; in case of scale efficiency, nine banks were above the average and seven banks were equal to average while four banks were below average.

Qingxia Li (2019)[38], in a research work titled *"The Impact of Liquidity Risk of Commercial Banks on Systematic Risk of Banking Industry: Study of 16 Listed Commercial Banks"* measured the efficiency scores of 16 banks listed on Shanghai Stock Exchange and Shezhen Stock Exchange using data envelopment analysis (DEA) for the year 2017. One input variable, 'capital adequacy ratio' and one output variable 'return on assets' were used for analysis. The study showed that large banks had no contribution to systematic risk than the liquidity risk of individual commercial banks.

EFFICIENCY OF PUBLIC SECTOR BANKS IN INDIA- ANALYSIS

Cost Efficiency (CE), Revenue Efficiency (RE), and Profit Efficiency (PE) of Public Sector Banks in India

Variable Returns to Scale (VRS) Approach

The descriptive statistics of input variables and output variables of public sector banks (PSBs) in India are presented in the table.1. The input variables viz. 'deposits', 'labour' and 'capital' and the output variables viz. 'loans', 'investments' and 'off balance sheet items' are considered for analysis. The input variable 'deposits' ranges from 79115.8 to 1982231.5; 'labour' ranges from 500.2 to 4912.1; 'capital' ranges from 288.9 to 2368.7; and output variable 'loans' ranges from 55196 to 1565678.4; 'investments' ranges from 24892.6 to 711215.6; 'off balance sheet items' ranges from 772.2 to 168134.4. Standard deviation of the variables for the study period are 439205.54; 11376.40; 717.97; 349870.03; 157994.48; 39327.64 respectively. The co-efficient of variation is high in off balance sheet items as 232.54% and it is low in capital 71.34%.

TABLE:1 Descriptive Statistics of Input and Output Variables of Public Sector Banks in India for the period from 2009 to 2019

INPUT/ OUTPUT	Variables	Minimum	Maximum	Mean	Std. Deviation	Co-efficient of variation
Input Variables	Deposits	79115.8	1982232	342185	439205.5	128.35%
	Labour	500.2	49172.1	6249.21	11376.4	182.04%
	Capital	288.9	2368.7	1006.28	717.97	71.34%
Output Variables	Loans	55196	1565678	259784	349870	134.67%
	Investments	24892.6	711216	113140	157994.5	139.64%
	Off balance sheet items	772.2	168134	16911.6	39327.64	232.54%

Source: Computed from the data collected from CMIE Prowess package

Efficiency of PSBs- VRS Approach

The DEA is tested with the rule of thumb on the selection of input and output variables as suggested by Cooper *et al.*(2002). Thus, the efficiency scores ranges from 0 to 1. Table**.** 2 shows that during the period 2009-19, cost efficiency of PSBs is perfectly efficient for four banks viz. Punjab and Sind Bank, Punjab National Bank, State Bank of India, and United Bank of India; revenue efficiency is perfectly efficient for seven PSBs viz. Central Bank of India, Corporation Bank, Punjab and Sind Bank, Punjab National Bank, State Bank of India, Syndicate Bank, and UCO Bank; and profit efficiency is perfectly efficient for 10 PSBs viz. Canara Bank, Central Bank of India, Corporation Bank, Oriental Bank of Commerce, Punjab and Sind Bank, Punjab National Bank, State Bank of India, Syndicate Bank, UCO Bank, and United Bank of India.

TABLE: 2 Cost Efficiency, Revenue Efficiency and Profit Efficiency of Public Sector Banks in India- VRS Approach

Sl. No.	PSBs	CE	RE	PE
1	Allahabad Bank	0.91	0.71	0.09
2	Andhra Bank	0.81	0.74	0.13
3	Bank of Baroda	0.62	0.78	0.11

4	Bank of India	0.63	0.65	0.04
5	Canara Bank	0.66	0.98	1
6	Central Bank of India	0.76	1	1
7	Corporation Bank	0.81	1	1
8	Indian Bank	0.79	0.92	0.18
9	Indian Overseas Bank	0.84	0.82	0.14
10	Oriental Bank of Commerce	0.89	0.98	1
11	Punjab and Sind Bank	1	1	1
12	Punjab National Bank	1	1	1
13	State Bank of India	1	1	1
14	Syndicate Bank	0.78	1	1
15	UCO Bank	0.82	1	1
16	Union Bank of India	0.70	0.90	0.14
17	United Bank of India	1	0.79	1

Source: Computed from the data collected from CMIE Prowess package CE-Cost Efficiency; RE-Revenue Efficiency; PE-Profit Efficiency

The cost efficiency scores for the other banks are moderate and ranges from 0.62 (Bank of Baroda) to 0.91 (Allahabad Bank) and revenue efficiency scores are high and ranges from 0.65 (Bank of India) to 0.98 (Canara Bank and Oriental Bank of Commerce) and profit efficiency scores are low and ranges from 0.04 (Bank of India) to 0.18 (Indian Bank). In general, revenue efficiency is higher when compared to cost efficiency (moderate) and profit efficiency (low).

The table further shows that among the three efficiencies, revenue efficiency is high (98%); cost efficiency is comparatively moderate (91%); when compared with revenue and cost efficiencies, the profit efficiency is found to be low (18%) during the study period. The cost efficiency had contributed to the high revenue efficiency for all the PSBs during the study period.

FIGURE : A Cost Efficiency, Revenue Efficiency and Profit Efficiency of PSBs in India during the study period- VRS Approach
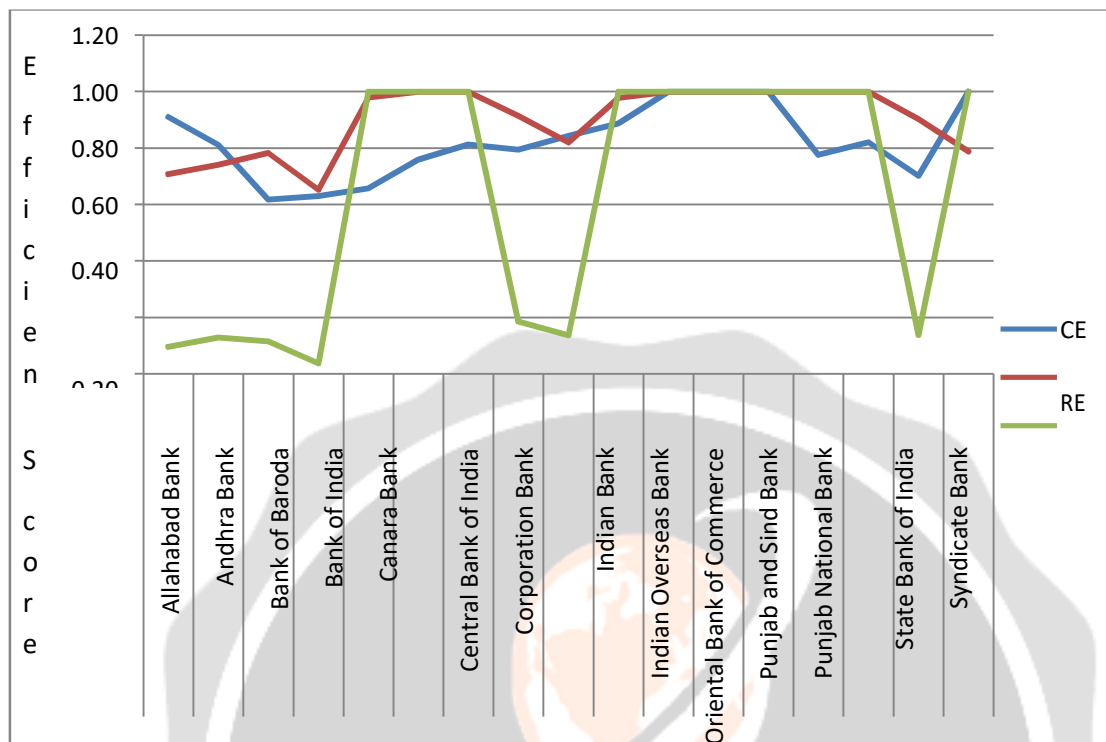
Source: Computed from the data collected from CMIE Prowess package CE- Cost Efficiency; RE- Revenue Efficiency; PE-Profit Efficiency

Cost Efficiency (CE), Revenue Efficiency (RE), and Profit Efficiency (PE) of Public Sector Banks in India Constant Returns to Scale (CRS) Approach

Efficiency of PSBs- CRS Approach

Table .3 shows the efficiency of 17 PSBs during the study period under CRS Approach. Cost efficiency of PSBs is perfectly efficient for two banks viz. Punjab National Bank and State Bank of India; and revenue efficiency is perfectly efficient for five PSBs viz. Bank of Baroda, Corporation Bank, Punjab and Sind Bank, Punjab National Bank and State Bank of India; and profit efficiency is perfectly efficient for eight PSBs viz. Central Bank of India, Corporation Bank, Oriental Bank of Commerce, Punjab and Sind Bank, Punjab National Bank, State Bank of India, Syndicate Bank and UCO Bank.

Table. 3 Cost Efficiency, Revenue Efficiency and Profit Efficiency of Public Sector Banks in India- CRS Approach

Sl. No.	PSBs	CE	RE	PE
1	Allahabad Bank	0.67	0.64	0.07
2	Andhra Bank	0.65	0.63	0.08
3	Bank of Baroda	0.61	1	0.11
4	Bank of India	0.62	0.59	0.03

5	Canara Bank	0.65	0.96	0.09
6	Central Bank of India	0.70	0.91	1
7	Corporation Bank	0.69	1	1
8	Indian Bank	0.64	0.90	0.18
9	Indian Overseas Bank	0.66	0.80	0.10
10	Oriental Bank of Commerce	0.66	0.97	1
11	Punjab and Sind Bank	0.65	1	1
12	Punjab National Bank	1	1	1
13	State Bank of India	1	1	1
14	Syndicate Bank	0.69	0.97	1
15	UCO Bank	0.72	0.94	1
16	Union Bank of India	0.66	0.86	0.14
17	United Bank of India	0.79	0.71	0.09

Source: Computed from the data collected from CMIE Prowess package CE- Cost Efficiency; RE- Revenue Efficiency; PE-Profit Efficiency

The cost efficiency scores for other banks are moderate and ranges from 0.61 (Bank of Baroda) to 0.79 (United Bank of India) and revenue efficiency scores are high, which ranges from 0.59 (Bank of India) to 0.97 (Syndicate Bank; Oriental Bank of Commerce) and profit efficiency scores are low and ranges from 0.03 (Bank of India) to 0.18 (Indian Bank). Revenue efficiency is higher when compared with cost efficiency (moderate) and profit efficiency (low).

The table further shows that among the three efficiencies, revenue efficiency is high (97%); cost efficiency is comparatively moderate (79%) and profit efficiency is low (18%). When compared with revenue and cost efficiencies, profit efficiency is low during the study period. The cost efficiency has contributed to the high revenue efficiency for all the PSBs during the study period.

Figure . B
Cost Efficiency, Revenue Efficiency and Profit Efficiency of PSBs in India during the study period- CRS Approach
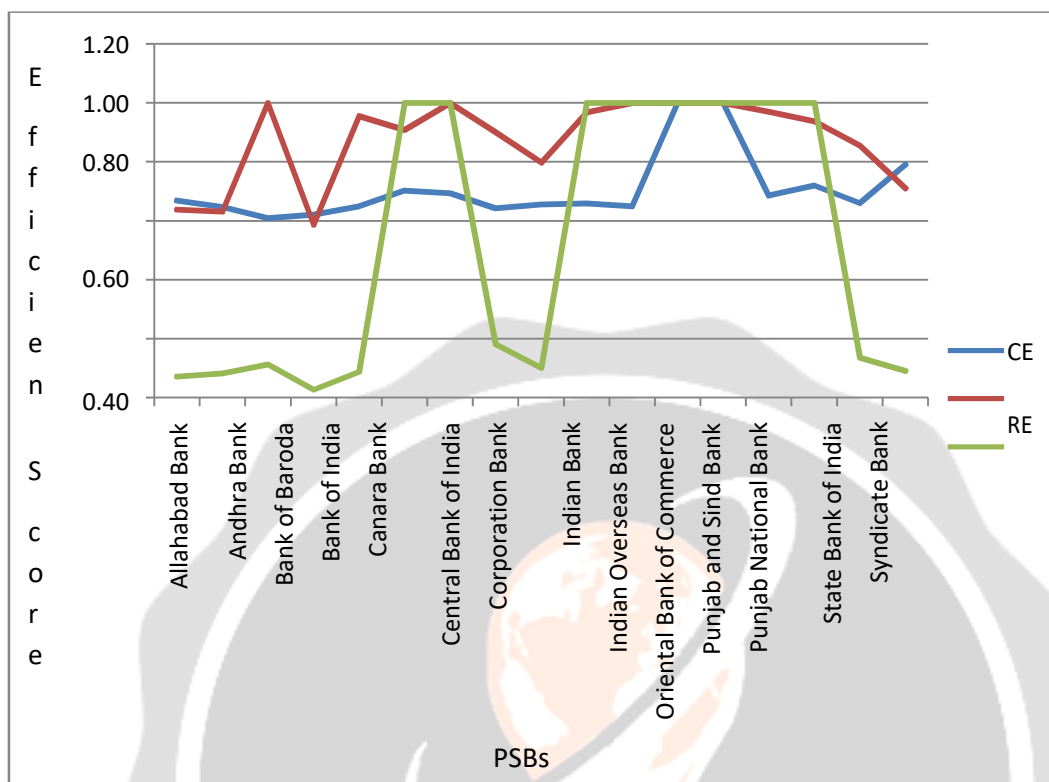
Source: Computed from the data collected from CMIE Prowess package CE- Cost Efficiency; RE- Revenue Efficiency; PE-Profit Efficiency

The analysis reveals that the H_0^1: *"There is no significant difference in cost efficiency of Public Sector Banks in India between variable returns to scale and constant returns to scale approaches"* is rejected because four PSBs viz. Punjab and Sind Bank, Punjab National Bank, State Bank of India and United bank of India are perfectly efficient in cost under VRS approach, while only two PSBs viz. Punjab National Bank and State bank of India are perfectly efficient in cost (vide table IV. 3) under CRS approach. H_0^2: *"There is no significant difference in revenue efficiency of Public Sector Banks in India between variable returns to scale and constant returns to scale approaches"* is rejected because seven PSBs viz. Central Bank of India, Corporation Bank, Punjab and Sind bank, Punjab National Bank, State Bank of India, Syndicate Bank, and UCO bank are perfectly efficient in revenue under VRS approach, while only five PSBs viz. Bank of Baroda, Corporation Bank, Punjab and Sind Bank, Punjab National Bank, and State Bank of India are perfectly efficient in revenue under CRS approach. H_0^3: *"There is no significant difference in profit efficiency of Public Sector Banks in India between variable returns to scale and constant returns to scale approaches"* is rejected because 10 PSBs viz. Canara Bank, Central bank of India, Corporation Bank, Oriental Bank of commerce, Punjab and Sind bank, Punjab National Bank, State Bank of India, Syndicate Bank, UCO Bank, and United Bank of India are perfectly efficient in profit (vide table IV. 2) under VRS approach, while eight banks viz. Central Bank of India, Corporation Bank, Oriental Bank of Commerce, Punjab and Sind Bank, Punjab National bank, State Bank of India, Syndicate Bank, and UCO Bank are perfectly efficient in profit (vide table IV. 3) under CRS approach.

Scale Efficiency of PSBs in India

Scale efficiency is calculated for cost, revenue and profit efficiencies.

$$Scale\ Efficiency = \frac{Efficiency\ Scores\ of\ CRS\ Approach}{Efficiency\ Scores\ of\ VRS\ Approach}$$

Table . 4 (vide figure IV.C) shows scale efficiency of cost, revenue and profit efficiencies of PSBs. Cost scale efficiency is perfectly efficient for two PSBs viz. Punjab National Bank and State Bank of India. Revenue scale efficiency is perfectly efficient for five PSBs viz. Bank of Baroda, Corporation Bank, Punjab and Sind Bank, Punjab National Bank and State Bank of India. Profit scale efficiency is perfectly efficient for nine PSBs viz. Central Bank of India, Corporation Bank, Oriental Bank of Commerce, Punjab and Sind Bank, Punjab National Bank, State Bank of India, Syndicate Bank, UCO Bank, and Union Bank of India.

The cost scale efficiency scores for the other PSBs are moderate and ranges from 0.65 (Punjab and Sind Bank) to 0.99 (Bank of Baroda, Bank of India and Canara Bank); revenue scale efficiency scores are high and ranges from 0.85 (Andhra Bank) to 0.99 (Oriental Bank of Commerce); profit scale efficiency scores are low and ranges from 0.09 (Canara Bank) to
0.99 (Bank of Baroda).

For the other PSBs, all the three efficiencies show highest efficiency (i.e) 99%. Cost scale efficiency has improved from 65% to 99%; revenue scale efficiency has improved from 85% to 99%, while profit scale efficiency has improved from 9% to 99%. The result indicates that profit scale efficiency has been improved during the study period.
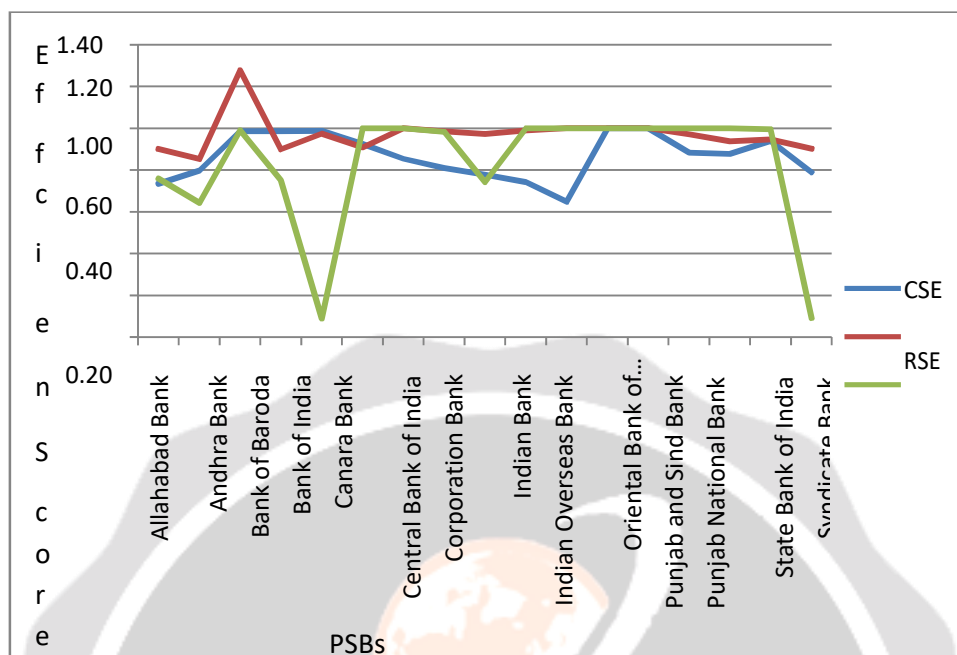
Table . 4Cost Scale Efficiency, Revenue Scale Efficiency and Profit Scale Efficiency of PSBs during 2009-2019

Sl. No.	PSBs	CSE	RSE	PSE
1	Allahabad Bank	0.73	0.90	0.76
2	Andhra Bank	0.80	0.85	0.64
3	Bank of Baroda	0.99	1	0.99
4	Bank of India	0.99	0.90	0.75
5	Canara Bank	0.99	0.97	0.09
6	Central Bank of India	0.92	0.91	1
7	Corporation Bank	0.85	1	1
8	Indian Bank	0.81	0.98	0.98
9	Indian Overseas Bank	0.78	0.97	0.74
10	Oriental Bank of Commerce	0.74	0.99	1
11	Punjab and Sind Bank	0.65	1	1
12	Punjab National Bank	1	1	1
13	State Bank of India	1	1	1
14	Syndicate Bank	0.88	0.97	1
15	UCO Bank	0.88	0.94	1
16	Union Bank of India	0.94	0.95	1
17	United Bank of India	0.79	0.90	0.09

Source: Computed from the data collected from CMIE Prowess package
CSE- Cost Scale Efficiency, RSE- Revenue Scale Efficiency, PSE- Profit Scale
Efficiency

Figure . C

Scale Efficiency of PSBs in India during the study period

Source: Computed from the data collected from CMIE Prowess package

CSE- Cost Scale Efficiency; RSE- Revenue Scale Efficiency; PSE- Profit Scale Efficiency.

Conclusion

Therefore, $H0^1$: *"there is no significant difference in cost efficiency of Public Sector Banks in India between variable returns to scale and constant returns to scale approaches";*

$H0^2$: *"there is no significant difference in revenue efficiency of Public Sector Banks in India between variable returns to scale and constant returns to scale approaches";*

$H0^3$: *"there is no significant difference in profit efficiency of Public Sector Banks in India between variable returns to scale and constant returns to scale approaches"* are rejected.

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