IOSR Journal of Business and Management (IOSR-JBM)
e-ISSN:2278-487X, p-ISSN: 2319-7668. Volume 27, Issue 5. Ser. 10 (May. 2025), PP 01-17
www.iosrjournals.org

Efficiency Comparison In Micro Finance Banks – DEA Approach

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Abstract
Data Envelopment Analysis (DEA) is a methodology based upon an interesting application of linear programming. It was originally developed for performance measurement. It has been successfully employed for assessing the relative performance of a set of firms that use variety of identical inputs to produce a variety of identical outputs. The main aim of the research is to compare the Efficiency of Micro Finance Banks in India during the period 2022-2024 by using Data Envelopment Analysis Models.

Keywords: *Data Envelopment Analysis (DEA), Efficiency, Decision Making Units (DMUs)*

Date of Submission: 14-05-2025 Date of Acceptance: 24-05-2025

I. Introduction:

Generally, the performance of a DMU is assessed with DEA and is obtained by using the concept of efficiency which is the ratio of weighted sum of outputs to a weighted sum of inputs. Efficiencies obtained by using DEA are relative to the best performance of a virtual DMU. The best performing DMU is assigned an efficiency score of unity and the performance of others varies between zero and one.

The DEA is a mathematical programming technique that finds number of practical applications to measure the performance of similar units, such as a set of hospitals, a set of schools, a set of industries etc. Thus, DEA is a methodology based upon an interesting application of linear programming technique and it was originally developed for performance measurement.

A producer who cannot vary his output enquires for possible reduction of inputs. If reduction is not possible he is efficient, otherwise inefficient. In this case the producer minimizes the total cost of production. Alternatively, if inputs cannot be varied, which is often in short run, the entrepreneur enquires for further output augmentation, if such augmentation is not possible he is efficient, otherwise inefficient. In this situation the implicit assumption is revenue maximization. However, in long run, inputs as well as outputs can be varied simultaneously, where the underlying optimization is profit maximization. If the producer neither reduces inputs nor augments outputs, production is profit efficient, otherwise inefficient. A production process can be inefficient in two ways. One of it can be detected by estimated production frontier. It can be technically inefficient, if it fails to produce maximum output from a given input bundle, technical inefficiency results in an equi-proportionate over utilization of all inputs. It can also be Allocatively inefficient in the sense that the marginal revenue product of an input might not be equal to marginal cost of that input. Allocatively inefficiency results in utilization of inputs in the wrong proportions, given input prices. Schmidt and Lovell (1979) developed a method to estimate technical and Allocative Efficiencies of different forms by considering duality between production frontier and cost functions.

II. Methodology

Data envelopment analysis is a deterministic approach employed to measure input and output technical efficiencies. In a firm or production unit inputs are combined to produce one or more outputs subject to technology. The techniques of production vary from one unit to another. This kind of variation causes efficiency differences among the competing decision-making units. Efficient measurement dates back to Farrell whose pioneering work sparked off interest in several researchers in producer's theory.

(a) Input technical efficiency-constant returns to scale:

The Linear Programming Problem to estimate the Technical Efficiency by using CRS is given by $\text{Max} \prod = \lambda$

Subject to $\sum_{i=1}^{n} \lambda_i x_i \le \lambda x_0$

$$\sum_{i=1}^{n} \lambda_i y_i \le y_0,$$

$$\lambda_i \ge 0.$$

The above LP problem admits constant returns to scale.

(b) Input technical efficiency-non-increasing returns to scale:

The empirical production frontier that admits non-increasing returns to scale in one input and one output technology may be expressed as shown in the following figure (2.1)

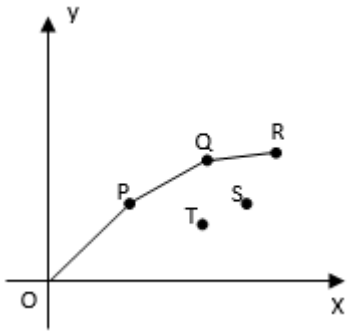

Fig. 2.1

The production units which operate at P,Q and R determine the non-increasing returns to scale empirical frontier.To estimate technical efficiency under this technology one solves the linear programming problem:

$\text{Min} \prod = \lambda$

such that $\lambda x_0 \in L^D(y_0)$

Equivalently, $\text{Min} \prod = \lambda$

$$\sum \lambda_i x_i \le \lambda x_0,$$

Such that $\sum \lambda_i y_i \ge y_0,$

$$\lambda_i \ge 0,$$

$$\sum \lambda_i \le 1.$$

The empirical frontier that admits constant, increasing and decreasing returns to scale may be expressed as shown in the fig. (2.2)

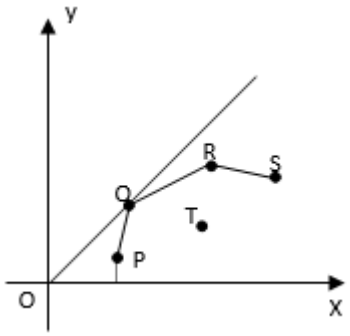

Fig. 2.2

The variable returns to scale frontier is determined by the decision making units P,Q,R and S and production unit is inefficient. The linear programming problems that identify the constant increases and decreases and returns to the scale are.

$$\text{Min} \prod = \lambda$$

Such that $\lambda x_0 \in L^v(y_0)$

Equivalently, we solve,

$$\text{Min} \prod = \lambda$$

$$\text{Such that} \sum \lambda_i x_i \le \lambda x_0 ,$$
$$\lambda_i \ge 0.$$

$$\sum \lambda_i y_i \ge y_0$$

$$\sum \lambda_i \le 1.$$

III. Source Of Data

The secondary data collected from Indian Banking Association (IBA) during the period 2022-2024.

IV. Data Analysis

Data Envelopment Analysis is a data oriented approach for evaluating the performance of a set of peer entities called decision making unit which convert multiple inputs into multiple outputs. Recent years have seen a great variety of applications of DEA for use in evaluating the performance of many different kinds of entities engaged in many different activities in many different contexts in many different countries.The DEA applications have used DMUs of variousforms to evaluate the performance of entities, such as hospitals, universities,cities,

courts, business firms, and others including the performance of countries, regions etc. Because it requires very few assumptions, DEA has also opened up the possibilities for use in cases which have been resistant to other approaches because of the complex nature of the relations between the multiple inputs and multiple outputs involved in DMUs.

Inthepresentstudy12 small finance banks were exposed to a common frontier and their relative efficiencies are evaluated by formulating and solving linear programming problems.

The CCR (1978) and BCC (1984) problems are solved for small finance banks with the help of the following linear programming problems.

(i)

$$\lambda(CCR) = Min\lambda$$

$$Subject\,to \sum_{j=1}^{46} \lambda_j x_{ij} \leq \lambda x_{i0}, \quad i = 1,2,3$$

$$\sum_{j=1}^{46} \lambda_j y_{rj} \geq y_{r0}, \quad r = 1,2,3$$

$$\lambda_j \geq 0$$

(ii)

$$\lambda(BCC) = Min\lambda$$

$$subject\,to \sum_{j=1}^{46} \lambda_j x_{ij} \leq \lambda x_{i0}, \quad i = 1,2,3$$

$$\sum_{j=1}^{46} \lambda_j y_{rj} \geq y_{r0}, \quad r = 1,2,3$$

$$\sum_{j=1}^{46} \lambda_j = 1$$

$$\lambda(CCR) \leq \lambda(BCC)$$

The ratio measures Input Scale Efficiency and indicates Overall and Pure Technical Efficiencies.

Overall Technical Efficiency

The Overall Technical Efficiency is an important characteristic of a production unit. In estimating the Overall Technical Efficiency the observed input vector is reduced radially in the direction of input set that admits only constant return to scale. The input vector on the boundary of input set is compared with input vector itself. The comparison yields an estimate of Overall Technical Efficiency. For the data collected on Indian commercial banks, the overall technical efficiencies are calculated and are given the following tables.

TABLE4.1
Banks– Overall Technical Efficiency

S.No.	MicroFinanceBanks(DMUs)	Overall Technical Efficiency
1	AusmallfinancebankLtd.	1
2	Capitalsmallfinancebank Ltd.	1
3	EquitassmallfinancebankLtd.	0.753
4	ESAFsmallfinancebankLtd.	1
5	FincaresmallfinancebankLtd.	0.582
6	JanasmallfinancebankLtd.	1
7	NortheastsmallfinancebankLtd.	1
8	SuryodaysmallfinancebankLtd.	0.728
9	UjjivansmallfinancebankLtd.	0.784
10	UtkarshsmallfinancebankLtd.	0.911
11	ShivaliksmallfinancebankLtd.	1
12	Unitysmallfinancebankltd.	1

S.No.	MicroFinanceBanks(DMUs)	Overall Technical Efficiency
1	AusmallfinancebankLtd.	0.769
2	Capitalsmallfinancebank Ltd.	1
3	EquitassmallfinancebankLtd.	1
4	ESAFsmallfinancebankLtd.	1
5	FincaresmallfinancebankLtd.	1
6	JanasmallfinancebankLtd.	0.872
7	NortheastsmallfinancebankLtd.	1
8	SuryodaysmallfinancebankLtd.	1
9	UjjivansmallfinancebankLtd.	1
10	UtkarshsmallfinancebankLtd.	0.664
11	ShivaliksmallfinancebankLtd.	1
12	UnitysmallfinancebankLtd.	1

S.No.	MicroFinanceBanks(DMUs)	Overall Technical Efficiency
1	AusmallfinancebankLtd.	1
2	Capitalsmallfinancebank Ltd.	1
3	EquitassmallfinancebankLtd.	1
4	ESAFsmallfinancebankLtd.	1
5	FincaresmallfinancebankLtd.	1
6	JanasmallfinancebankLtd.	1
7	NortheastsmallfinancebankLtd.	1
8	SuryodaysmallfinancebankLtd.	1
9	UjjivansmallfinancebankLtd.	0.7281
10	UtkarshsmallfinancebankLtd.	1
11	ShivaliksmallfinancebankLtd.	1
12	UnitysmallfinancebankLtd.	1

12 Indian small finance bank. Among the banks Au, Capital, ESAF, Jana, North East, Shivalik and Unity small finance banks Ltd., are overall technical efficient. These banks have emanated with 100 percent Overall Technical Efficiency score. The remaining 5 banks of are overall technical inefficient and they experienced input losses.

Overall Technical Efficiencies 5 banks have fallen in the interval 50 and 90 percent. The Overall Technical Efficiencies of 1 banks have fallen in the interval 90 to100 percentage shown in the following figure. The banks falling at the bottom are Equitas, fincare, suryoday, ujjivan, utkarsh. The Overall Technical Efficiency of Banks is distributed over the interval, $0.582 \leq OTE \leq 1.000$ similarly 2023 and 2022 banks.

Pure Technical Efficiency

The Pure Technical Efficiency measures how a DMU utilizes the resources under exogenous environments. A commercial bank that doesn't experience any input losses under constant return to scale is always said to be pure technical efficient. For the collected data pure technical efficiencies are calculated and given in the following tables.

Table 4.2

Banks- Pure Technical Efficiency

S.No.	MicroFinanceBanks(DMUs)	PURETECHNICALEFFICIENCY
1	AusmallfinancebankLtd.	1
2	Capitalsmallfinancebank Ltd.	1
3	EquitassmallfinancebankLtd.	0.784
4	ESAFsmallfinancebankLtd.	1
5	FincaresmallfinancebankLtd.	0.68
6	JanasmallfinancebankLtd.	1
7	NortheastsmallfinancebankLtd.	1
8	SuryodaysmallfinancebankLtd.	1
9	UjjivansmallfinancebankLtd.	1
10	UtkarshsmallfinancebankLtd.	1
11	ShivaliksmallfinancebankLtd.	1
12	UnitysmallfinancebankLtd.	1

S.No.	MicroFinanceBanks(DMUs)	PURETECH NICALEFFI CIENCY
1	AusmallfinancebankLtd.	0.877
2	Capitalsmallfinancebank Ltd.	1
3	EquitassmallfinancebankLtd.	1
4	ESAFsmallfinancebankLtd.	1
5	FincaresmallfinancebankLtd.	1
6	JanasmallfinancebankLtd.	1
7	NortheastsmallfinancebankLtd.	1
8	SuryodaysmallfinancebankLtd.	1
9	UjjivansmallfinancebankLtd.	1
10	UtkarshsmallfinancebankLtd.	1
11	ShivaliksmallfinancebankLtd.	1
12	UnitysmallfinancebankLtd.	1

S.No.	MicroFinanceBanks(DMUs)	PURETECH NICALEFFI CIENCY
1	AusmallfinancebankLtd.	1
2	Capitalsmallfinancebank Ltd.	1
3	EquitassmallfinancebankLtd.	1
4	ESAFsmallfinancebankLtd.	1
5	FincaresmallfinancebankLtd.	1
6	JanasmallfinancebankLtd.	1
7	NortheastsmallfinancebankLtd.	1
8	SuryodaysmallfinancebankLtd.	1
9	UjjivansmallfinancebankLtd.	0.746
10	UtkarshsmallfinancebankLtd.	1
11	ShivaliksmallfinancebankLtd.	1
12	UnitysmallfinancebankLtd.	1

Above table the Pure Technical Efficiency (PTE) of small finance banks are given. Among the 12 small finance banks 9 banks are pure technical efficient.

This indicates that 90 percent of banks are pure technical efficient attaining 100 percent efficiency score. The remaining 1 banks have input losses due to Pure Technical Efficiency.

The Pure Technical Efficiency of the small finance Banks is distributed over the interval,$0.746 \leq PTE \leq 1.000$. Similarly 2023 and 2022 Micro Finance Banks.

In the Efficient Peer of Micro Finance Banks

If a Data Envelopment Analysis problem is solved for an inefficient DMUs then efficient peers are found. There latively inefficient DMU imitates the management style of its peer. An appropriate efficient peer is the best practices performer in the sample that is similar to the inefficient unit in some respect (size and other chrematistics) and is able to lend insights useful for inefficient unit to improve. Both qualitative and quantitative information are to be included in the criteria. In the context of financial markets, peer group usually refers to companies that operate in the same industry sector and are of similar type.

Table 4.3 Banks–Efficient Peers

firm	Banks	RoleModels		
1	Au small financebank Ltd.			
2	Capitalsmall financebank Ltd			
3	Equitassmallfinance bank Ltd.	Capital small finance bank Ltd.(2)	Au small finance bank Ltd.(1)	Janasmall finance bank Ltd.(6)
4	ESAFsmallfinance bank Ltd.			
5	Fincaresmallfinance bank Ltd.	Unity small finance bank Ltd.(12)	ESAF small finance bank Ltd.(4)	Shivalik small finance bank Ltd.(11)
6	Janasmallfinance bank Ltd.			
7	North east small financebankLtd.			
8	Suryoday small financebankLtd.			
9	Ujjivansmallfinance bank Ltd.			
10	Utkarshsmallfinance			
	bankLtd.			
11	Shivaliksmallfinance bank Ltd.			
12	Unitysmallfinance bank Ltd.			

firm	Banks	Role Model s	
1	Ausmallfinancebank Ltd.	Jana small finance bank Ltd.(6)	Ujjivan small finance bank Ltd.(9)
2	Capitalsmallfinance bankLtd		
3	Equitassmallfinancebank Ltd.		
4	ESAFsmallfinancebankLtd.		
5	Fincaresmallfinancebank Ltd.		
6	Janasmallfinancebank Ltd.		
7	Northeastsmallfinance bank Ltd.		
8	Suryodaysmallfinancebank Ltd.		
9	Ujjivansmallfinancebank Ltd.		
10	Utkarshsmallfinancebank Ltd.		
11	Shivaliksmallfinancebank Ltd.		
12	UnitysmallfinancebankLtd.		

firm	Banks	RoleModels		
1	Ausmallfinance bankLtd.			
2	Capitalsmall financebankLtd			
3	Equitassmallfinance bank Ltd.			
4	ESAFsmallfinance bank Ltd.			
5	Fincaresmallfinance bank Ltd.			
6	Janasmallfinancebank Ltd.			
7	North east small financebankLtd.			
8	Suryodaysmallfinance bank Ltd.			
9	Ujjivansmallfinance bank Ltd.	Suryoday small finance bank Ltd.(8)	ESAF small finance bank Ltd.(4)	Fincare small finance bank Ltd.(5)
10	Utkarshsmallfinance bank Ltd.			
11	Shivaliksmallfinance bank Ltd.			
12	Unitysmallfinance			

Generally, Equitas small finance bank Ltd. have capital small finance bank Ltd., Au small finance bank Ltd and Jana small finance bank Ltd. Are efficient peers or role models. And also Fincare small finance bank Ltd.have Unity small finance bank Ltd. ESAF small finance bank Ltd.and shivalik small finance bank Ltd.

Table4.4 Banks-Peer Count

S.No.	MicroFinanceBanks(DMUs)	PEER COUNT
1	AusmallfinancebankLtd.	1
2	Capitalsmallfinancebank Ltd.	2
3	EquitassmallfinancebankLtd.	0
4	ESAFsmallfinancebankLtd.	1
5	FincaresmallfinancebankLtd.	0
6	JanasmallfinancebankLtd.	1
7	NortheastsmallfinancebankLtd.	0
8	SuryodaysmallfinancebankLtd.	0
9	UjjivansmallfinancebankLtd.	0
10	UtkarshsmallfinancebankLtd.	0
11	ShivaliksmallfinancebankLtd.	1
12	UnitysmallfinancebankLtd.	3

S.No.	MicroFinanceBanks(DMUs)	PEER COUNT
1	AusmallfinancebankLtd.	0
2	Capitalsmallfinancebank Ltd.	0
3	EquitassmallfinancebankLtd.	0
4	ESAFsmallfinancebankLtd.	0
5	FincaresmallfinancebankLtd.	0
6	JanasmallfinancebankLtd.	0
7	NortheastsmallfinancebankLtd.	1
8	SuryodaysmallfinancebankLtd.	0
9	UjjivansmallfinancebankLtd.	1
10	UtkarshsmallfinancebankLtd.	0
11	ShivaliksmallfinancebankLtd.	0
12	UnitysmallfinancebankLtd.	0

S.No.	MicroFinanceBanks(DMUs)	PEER COUNT
1	AusmallfinancebankLtd.	1
2	Capitalsmallfinancebank Ltd.	0
3	EquitassmallfinancebankLtd.	0
4	ESAFsmallfinancebankLtd.	1
5	FincaresmallfinancebankLtd.	1
6	JanasmallfinancebankLtd.	0
7	NortheastsmallfinancebankLtd.	0
8	SuryodaysmallfinancebankLtd.	1
9	UjjivansmallfinancebankLtd.	0
10	UtkarshsmallfinancebankLtd.	0
11	ShivaliksmallfinancebankLtd.	0
12	UnitysmallfinancebankLtd.	0

Here the bank with largest peer count is considered to be a most popular role model bank. In the analysis it has been observed that the Au small finance banks ltd., ESAF small finance banks ltd., Jana small finance banks ltd., Shivalik small finance banks ltd. Rolemodelhave1isinefficientbanks.AlsoCapital small finance bank ltd. Is role model have 2 Is inefficient banks and Unity small finance bank is role model have 3 is inefficient banks. Similarly 2023 and 2022 Micro Finance Banks

Scale Efficiency

Generally, the economic data often influenced by return to scale. Solving DEA problems we can identify return to scale as constant, increasing or decreasing Any departure of return to scale from constant returns leads to scale inefficiency. A DMU is said to be scale efficient if and only if its returns are constant. The scale efficiency occurs when the firms produce on the lowest point of its long run average cost and therefore benefits fully from economies of scale. For the data collected on Indian banks scale efficiencies are calculated and are given in the following tables.

Banks- Scale Efficiency

S.No.	MicroFinanceBanks(DMUs)	SCALEEF FICIENCY
1	AusmallfinancebankLtd.	1
2	Capitalsmallfinancebank Ltd.	1
3	EquitassmallfinancebankLtd.	0.961
4	ESAFsmallfinancebankLtd.	1
5	FincaresmallfinancebankLtd.	0.856
6	JanasmallfinancebankLtd.	1
7	NortheastsmallfinancebankLtd.	1
8	SuryodaysmallfinancebankLtd.	0.728

9	UjjivansmallfinancebankLtd.	0.784
10	UtkarshsmallfinancebankLtd.	0.911
11	ShivaliksmallfinancebankLtd.	1
12	UnitysmallfinancebankLtd.	1

S.No.	MicroFinanceBanks(DMUs)	SCALEEF FICIENCY
1	AusmallfinancebankLtd.	0.877
2	Capitalsmallfinancebank Ltd.	1
3	EquitassmallfinancebankLtd.	1
4	ESAFsmallfinancebankLtd.	1
5	FincaresmallfinancebankLtd.	1
6	JanasmallfinancebankLtd.	0.872
7	NortheastsmallfinancebankLtd.	1
8	SuryodaysmallfinancebankLtd.	1
9	UjjivansmallfinancebankLtd.	1
10	UtkarshsmallfinancebankLtd.	0.664
11	ShivaliksmallfinancebankLtd.	1
12	UnitysmallfinancebankLtd.	1

S.No.	MicroFinanceBanks(DMUs)	FICIENCY
1	AusmallfinancebankLtd.	1
2	Capitalsmallfinancebank Ltd.	1
3	EquitassmallfinancebankLtd.	1
4	ESAFsmallfinancebankLtd.	1
5	FincaresmallfinancebankLtd.	1
6	JanasmallfinancebankLtd.	1
7	NortheastsmallfinancebankLtd.	1
8	SuryodaysmallfinancebankLtd.	1
9	UjjivansmallfinancebankLtd.	0.976
10	UtkarshsmallfinancebankLtd.	1
11	ShivaliksmallfinancebankLtd.	1
12	UnitysmallfinancebankLtd.	1

From the above table, it has been observed that among 12 small finance banks 7 banks experience decreasing returns to scale and the remaining 7 banks are found scale efficient. These7banks are not Lose any inputs attributed to input scale in efficiency. These banks are Au small finance bank Ltd, capital small finance bank Ltd, ESAF small finance bank Ltd, Jana small finance bank Ltd, North East small finance bank Ltd, Shivalik small finance bank Ltd, Unity small finance bank Ltd. These banks achieve cent percent Scale Efficiency.

It may be remembered that this bank was found input puretechnical efficient. The Scale Efficiency of the small finance Banks is distributed over the interval,0.728 ≤SE≤ 1.00.
Similarly 2023 and 2022 Micro Finance Banks.

Technical Efficiency

Technical Efficiency (TE) reflects the ability of a firm to obtain maximum output from a given set of inputs for the data collected on Indian Banks TechnicalEfficienciesarecalculatedandaregiveninthefollowingtables.

Table4.6
Banks-Technical Efficiency Estimates

S.No.	MicroFinanceBanks(DMUs)	TECHNICALEFFICIENCYESTIMATES
1	AusmallfinancebankLtd.	1
2	Capitalsmallfinancebank Ltd.	1
3	EquitassmallfinancebankLtd.	0.754
4	ESAFsmallfinancebankLtd.	1
5	FincaresmallfinancebankLtd.	0.582
6	JanasmallfinancebankLtd.	1
7	NortheastsmallfinancebankLtd.	1
8	SuryodaysmallfinancebankLtd.	0.728
9	UjjivansmallfinancebankLtd.	0.784
10	UtkarshsmallfinancebankLtd.	0.911
11	ShivaliksmallfinancebankLtd.	1
12	UnitysmallfinancebankLtd.	1

S.No.	MicroFinanceBanks(DMUs)	TECHNICAL EFFICIENCY ESTIMATES
1	AusmallfinancebankLtd.	0.769
2	Capitalsmallfinancebank Ltd.	1
3	EquitassmallfinancebankLtd.	1
4	ESAFsmallfinancebankLtd.	1
5	FincaresmallfinancebankLtd.	1
6	JanasmallfinancebankLtd.	0.872
7	NortheastsmallfinancebankLtd.	1
8	SuryodaysmallfinancebankLtd.	1
9	UjjivansmallfinancebankLtd.	1
10	UtkarshsmallfinancebankLtd.	0.664
11	ShivaliksmallfinancebankLtd.	1
12	UnitysmallfinancebankLtd.	1

S.No.	MicroFinanceBanks(DMUs)	TECHNICAL EFFICIENCY ESTIMATES
1	AusmallfinancebankLtd.	1
2	Capitalsmallfinancebank Ltd.	1
3	EquitassmallfinancebankLtd.	1
4	ESAFsmallfinancebankLtd.	1
5	FincaresmallfinancebankLtd.	1
6	JanasmallfinancebankLtd.	1
7	NortheastsmallfinancebankLtd.	1
8	SuryodaysmallfinancebankLtd.	1
9	UjjivansmallfinancebankLtd.	0.728
10	UtkarshsmallfinancebankLtd.	1
11	ShivaliksmallfinancebankLtd.	1
12	UnitysmallfinancebankLtd.	1

It has been observed from the above table that among 12 small finance banks 5 banks have consistently shown the Technical Efficiency (TE) above to its average Technical Efficiency. The remaining 7 banks registered its Technical Efficiencies below to its average Technical Efficiency. The Utkarsh small finance Bank of India stays in first position where as fincare small finance Bank Stay in the last position.
Similarly 2023 and 2022 small finance banks

V. Conclusions

The present study aim sat constructing and solving linear programming problems to estimate Technical, Pure Technical, Scale and Overall Technical Efficiencies of small finance banks in India.

The data for the study is obtained from Reserve Bank of India bullet in (2022-2024). The study uses data on four DEA inputs and three DEA outputs. The DEA input variables are deposits, total Income, total assets and Other Income. The DEA output variables are interest income, Investments and total expenditure. The study uses Data Envelopment Analysis to measure bank efficiency. The following CCR (1978) and BCC (1984) problems are solved for 12 INDIAN Micro Finance banks.

(i)

$$\lambda(CCR) = Min\lambda$$

$$Subject\,to \sum_{j=1}^{46} \lambda_j x_{ij} \le \lambda x_{i0}, \quad i = 1,2,3$$

$$\sum_{j=1}^{46} \lambda_j y_{rj} \ge y_{r0}, \quad r = 1,2,3$$

$$\lambda_j \ge 0$$

(ii) $\lambda(BCC) = Min\,\lambda$

$$subject\,to \sum_{j=1}^{46} \lambda_j x_{ij} \le \lambda x_{i0}, \quad i = 1,2,3$$

$$\sum_{j=1}^{46} \lambda_j y_{rj} \ge y_{r0}, \quad r = 1,2,3$$

$$\sum_{j=1}^{46} \lambda_j = 1$$

$$\lambda(CCR) \le \lambda(BCC)$$

Theratio $\frac{\lambda(CCR)}{\lambda(BCC)}$ measures Input Scale Efficiency.

$\lambda(CCR) and\ \lambda(BCC)$indicates

Overall Technical Efficiency

Small finance banks-2024 0.582≤OTE≤1.00

The Overall Technical Efficiency (OTE) estimates obtained from the above table reveals that 7 out of 12 small finance banks are consistently shown the OTE above to the average OTE where as the remaining 5banks registered it OTEs below to the average OTE.

Similarly in 2023 and 2022

A Pure Technical Efficiency measures how a DMU utilizes the resources under exogenous environment. A small finance banks

That does not experience any input losses under constant return to scale is always said to be pure technical efficient. It has been observed from the analysis that 20 per cent of small finances banks are pure technical efficient by attaining per cent Pure Technical Efficiency score. The remaining 80 percent small finance banks experienced input losses due to Input Pure Technical Efficiency. The Pure Technical Efficiencies of Indian Banks during the period 2022-2024 is distributed over the interval.

Similarly in 2023 and 2022.

As given below:

Pure Technical Efficiency

Small finance Banks-2024 0.68≤PTE≤1.00

The Pure Technical Efficiency (PTE) obtained from the above table reveals that out of 12 small finance banks 10 banks have consistently shown PTE above to its average PTE and the remaining2banks registered it Pure Technical Efficiency below to it save rage PTE.

By solving DEA problems we can identify return to scale as constant increasing or decreasing. Any departure of return to scale from constant returns leads to scale inefficiency. A DMU is said to be scale efficient if and only if its returns are constant. It has been observed from the analysis 7 banks out of 12 small finance banks are scale efficient. Banks experienced decreasing return. The Scale Efficiencies of Indian Banks during the period 2022-2024is distributed over the interval as given below:

Scale Efficiency

Small finance Banks 0.728≤SE≤1.00

The Scale Efficiency (SE) estimates obtained from the above table reveals that 7 out of 12 small finance banks have consistantly shown scale Efficiency above to its average SE where as the remaining 5 banks registered its Scale Efficiencies below to its average Scale Efficiency.

Similally in 2022 and 2023

S.no	Banks	Investment	Interest cost	Total expenditure	Deposit	Total assets	Other income	Total income
	Small finance Banks							
1	Au small finance BankLtd.	15,307	5,922	5,100	52,585	69,078	994	6,916
2	Capital small finance BankLtd.	1,357	578	519	6,046	7,154	54	632

3	Equitas small finance bankLtd.	4,450	3,460	3,125	18,951	26,948	538	3,998
4	ESAFsmall finance bank Ltd.	4,070	1,940	1,656	12,815	17,708	208	2,148
5	Fincare small finance bankLtd.	2,152	1,449	1,217	6,456	10,902	196	1,645
6	Janasmall finance bank Ltd.	5,065	2,727	2,476	13,536	20,189	324	3,051
7	NorthEast small finance Bank Ltd.	277	314	264	1,529	2,352	14	328
8	Suryodav small finance bankLtd.	2,058	942	770	3,854	8,180	94	1,036

9	Ujjivan small finance bankLtd	4,153	2,813	2,536	18,292	23,612	360	3,173
10	Utkarsh small finance BankLtd.	2,348	1,849	1,522	10,074	15,064	185	2,034
11	Shivalik small finance bankLtd.	425	131	141	1,593	1,890	15	146
12	Unity small finance BankLtd.	2,771	154	296	3,822	10,811	0	154

	TOTAL SMALL FINANCE BANKS	44,433	22,278	19,622	1,49,553	2,13,886	2,981	25,262

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