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Efficiency Analysis of Public Sector Scheduled Commercial Banks in Agricultural Lending Using Slack Based DEA Model

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Abstract
This study analyzedthe operational efficiency of 12 public sector scheduled commercial banks from 2010 to 2018 using the SBM technique in DEA model. The results of SBM model showed that SBI, PNB and PSB were fully efficient banks and the remaining banks were inefficient banks. The inefficient banks need to adjust their input and output variables as per the slack values suggested by the SBM model. Therefore, this study guides the scheduled commercial banks to improve their overallperformance by improving the factors on which they were laggingas suggested by the SBM model.

Keywords:agricultural loan; DEA model;non-parametric approach;SBM model; technical efficiency.

1. Introduction

Banks play a crucialrole in the agricultural economy in the developing countries like India.About two- third of the Indianpopulation lives in rural India and their livelihoods directly or indirectly dependson agricultural and allied activities. The agriculture sector contributed 14.6% of the total gross value added (GVA) in the year2017-2018 and during this periodbanks disbursed Rs. 11.8 lakh croreof credit to agricultural and allied sector, which has grown impressively at a compound annual growth rate (CAGR) of 16 per cent(Annual report NABARD, 2018).Therefore,the role of banksinprovidingcreditto the agriculture sector is important. Moreover, theflowof credit to the agricultural sectoris increasing steadily due to various initiatives taken by the government, RBI, NABARD, and other financial institutions in India.

The agricultural creditby commercial banks is the subject of intense study all over the world.The commercial banks are one of the major players in providing agricultural credit and their contribution to thetotal agricultural credit is 75 per cent(Annual report NABARD, 2018). However, the share of agricultural credit in net commercial bank creditsis still very low and hence requires immediate attention fromthe policy makers.The reason for low agricultural credits is because of its

poor resource utilization efficiency which discourages commercial banks to extend agricultural credits. The resource utilization efficiency of scheduled commercial bank isimportant as only efficientbanks can withstandadverse market eventsand maintaintheir market share while achieving long-term growth(Kumar & Gulati, 2008). As a result, the RBIfocused on increasing efficiency and waste minimizationof scheduled commercial banks. Therefore, it is necessary that the efficiency of banks is assessed on a regular basis and work is done to increase them by decreasing the input variables and increasing the output variables. Comparative study of bank's performance is essential to benefit investors, clients and policy makers(Mukta, 2016) .

According to Rickets and Stover (1978), the parameterssuch asdebt to equity, profitmargin, return on equity, and return on assetsare the performance indicators for computingthe efficiency of anorganization. However, these parametersare moreoften usedtoevaluate the performance of the company rather than to calculate the performance of the banks.Banks require a wide range of other important parameters for their performance analysis. Traditional performance evaluation approaches, such as transaction costs and profitability, were found to be inadequate because these approaches did not take into account the complications of each branch's operations or the different outputs generated by multiple inputs.

In banks, other methods such asdata envelopment analysis (DEA) are used for financial analysisto evaluate theperformance of banks. (Sherman & Gold, 1985)wasat the forefront ofextending DEA across banks to evaluatethe efficiency of 14 bank branches. Following this study, the banking sector has emerged as one of the most important areas for DEA implementation, as evidenced by the studies of(Casu & Molyneux, 2003; George Assaf, Barros, & Matousek, 2011; Gulati & Kumar, 2017; Holod & Lewis, 2011; Jemric & Vujcic, 2002; Luo, Bi, & Liang, 2012; Pasiouras, 2008; Sufian, 2015). In the present work, the DEA is used to calculatethe efficiency of selected banks and to conduct their comparative analysis.

2.Literature review

(Bdour & Al-khoury, 2008)studiedthe relative efficiencyof Tordanian banks between 1998 to 2004using DEA as a quantitative method. This study observed that the efficiencyof banks increasedin all the years except in the year 2003-2004. However,somebanks observeda reduction in efficiency. Furthermore, this analysis showed that the efficiency of banks was negatively affectedby both asset utilization and the labour factor. Similarly, the efficiencycalculation of 27 Indian public sector banks using DEA method were also done in the year 2004-2005 by (Kumar & Gulati, 2010).

(Mohan & Ray, 2004)analyzed the comparative performance of three types of banks – public, private and foreign banks – using three outputs, namely loans, investmentand other incomeand two inputs, namely deposits and operatingcosts. They also compared the efficiency of revenue maximizationof banks in the period 1992-2000.In this study, the public sector banksoutperformed private sector banks, but not better than foreign banks.

Another study conducted by (Shanmugam & Das, 2004) evaluated the bank profitability byexamining the technical efficiency of commercial banks in four different categories of banks in India during the banking sector reform period inthe year 1992-1999. This analysis used the stochastic frontier

approachto panel data forfour output variables, namely non-interest income, credit,interest margin, and investment. This study showed that there wasa large difference in efficiency gains among the sample of these four groups of banks in increasing investment, credit and non-interest income. The findings of the analysis showed that both state group banks and the private-foreign group banks have remarkable positive performance compared to counterpart banks.

(Halkos & Salamouris, 2004) examined the performance of the Greek banking industry using DEA model by six carefully chosenfinancial efficiency ratios overthe timeframe between 1997 to 1999. The efficiency was measured using six ratios,namely return difference of interest bearing assets(R.D.I.B.A), net interest margin, efficiency ratio, return on assets, profit/loss per employee, and return on equity. This analysis observedthat the overall efficiency of the Greek banking system has steadily increased.

(Mukta, 2016)examined the efficiency of 57 commercial banks operating in Indiausing DEA model. In the analysis,the input variableswerecapital, cost to income ratio, advances, number of employeesandtotalassets, and output variables werereturn on assets, non-interest income, interest spread, percentage decrease in non-performing assets, and deposit to advance ratio. The efficiency of banks wasassessesbetween 2009-10 and2012-13. The study foundtheoverall efficiencyof commercial banks was 53 %, whichmeans that commercial banks have a scope to produce 1.88 times moreoutput of the same input.

In a similarstudy by (Kumar, 2008), the DEA model was used to express the relationship between technical efficiency(TE) and productivity for the year 2005 in Indian public sector banks. In the study, the average TE was 88.5% which indicatedthat if these banksrun at full efficiency, they candeliver 1.13 times more outputfrom the same input.

(Muharrami, 2008)examinedthe scale, technical and pure technical efficiency of 27 public sector banks operating in Indiaduring the period 2004 to 2005. The resultsexhibited that the total TEof public sector bankswas 88.5%.Therefore, thesebanks could reduce input utilization by11.5 %without reducing output if these banks were equally efficientas compared tothe seven benchmarks banks identified by the DEA model.

(Sathye, 2003) studied the productive efficiency of three forms of private,public and foreign banksin the developing countries. The efficiency of these bankswas measured by DEA model. This analysis developed two models to explorehow changes in efficiency change the bank's input and output. This research highlighted that theefficiency of private sector bankswas lower than that of foreign banks and public sector banks in India.

(Chaluvadi, Raut, & Gardas, 2018)implemented a two-stage DEAmodel to measure the comparative performance of 18 private sector banks and 26 public sector banks for the period 2008–2013. The study concluded that two banks from public sector banks and eight from private sector bankswere found to be the most efficient banks.

3. Data sourceand methodology

3.1 Data source

The selection of12 Indian public sector scheduled commercial banks,also known as decision making units (DMUs),was based on banks listed by RBI during the years 2010 to 2018.

3.2 Variable description

The selection of input and output variables is crucial for the effectiveimplementation of DEA model.Different authors used different

methodsfor choosing input and output variables of banks. The two main methods comprise the intermediate method and production method. (Fethi & Pasiouras, 2011) reviewed 151 papers on DEA modeland concluded that the intermediatemethodwas more prevalent. Therefore, the present study selected input and output variables based on intermediate approach. According to the intermediate approach, banks provide financial services or act as intermediaries to divert financial resources. The main function of the bank is to collect the funds and convert it into loans and then distribute these loans to fund demanders to earn profit. The input and output variables used incurrent DEA model are listed in Table 1.

Table 1:Explanation of input and output variables.

Variables	Description	Units
Inputs variables		
Gross Assets (X_1)	The value of assets before any deductions	Crore
Employee cost(X_2)	The cost of total active employee	Crore
Operating expenses (X_3)	Rent, insurance, traveling expenses, repair and maintenance, salaries and wages of administrative staff , legal expenses etc.	Crore
Outputs variables		
Agricultural Loan (Y_1)	KCC and other scheme launched by NABARD	Crore
Interest income (Y_2)	Interest income a bank earns from its lending activities and the interest it pays to depositors.	Crore

4. Methodology framework of efficiency: data envelopment analysis

DEA model was first used by (Farrell, 1957)toestimatethe optimized value of input and output variables froma sample using a non-parametric optimization method for productivitymeasurement. The nonlinear measurements of productivityof theoutput/input ratio were translated into linear programming, which gave each DMU a relative efficiency score of 0 to 1. (Tone, 2018)proposed the SBM model usinga non-radial, input / output slack test andobtaineda measure of efficiency between 0 and 1.In this model, a value of unity indicates that no slackis present in the combination of input/output variables and that the DMU operates at the efficient frontier. The SBM model calculatesthe efficiencyof an inefficient DMU by the farthest frontier point within a range using the fractional linear programming equationsgiven below.

$$Min\rho = \frac{1-\frac{1}{m}\sum_{i=1}^{m}\frac{s_i^-}{X_{io}}}{1+\frac{1}{s}\sum_{r=1}^{s}\frac{s_r^+}{X_{ro}}} \quad \text{(Eq. 1)}$$

$$s.t\ X_o = X\lambda + s^- \quad \text{(Eq. 2)}$$

$$Y_o = Y\lambda - s^+ \quad \text{(Eq. 3)}$$

$$\lambda_1 + \lambda_2 + \ldots + \lambda_n = 1 \quad \text{(Eq. 4)}$$

$$\lambda, s^-, s^+ \geq 0 \quad \text{(Eq. 5)}$$

where s_i^- and s_r^+ are the input and output slacks, ρ is the indicator of non-radial

slack, $X\lambda$ and $Y\lambda$ are the input and output efficiency frontier standard values.

When $X \geq 0$ and $X_{io} = 0$, $\frac{s_i^-}{X_{io}}$ must be removedfrom the objective function. If $Y_{ro} \leq 0, Y_{ro}$ mustbe exchanged by a nominal positive value to specify the negative effect of $\frac{s_r^+}{Y_{ro}}$ on the SBM. Ifall the input slacks (s_i^-) and output slacks (s_r^+) are 0, there is no slack in any of the DMU inputs or outputs, at which point $\rho = 1$ and the DMU is refereed as efficient.

5. Results and discussions

5.1. Analysis of efficiency with the assumption ofvariable return to scale (VRS)

The performance of scheduled commercial banks wascalculated using SBM model proposed by (Tone, 2001) to find outthe efficiency of banks with the assumption of non- oriented VRS. Table 2 shows the annual efficiency scorescalculated by the SBM model during the period 2010-2018. To become highly efficienttheDMUs must minimise their inputs and maximize their outputs. Increasingcompetitionwithin the banking system putspressure on these banks to usetheir resources more efficiently.

Table 2: Efficiency score of banks obtained by SBM model.

DMUs	**SBM Scores**									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	Mean
SBI	1	1	1	1	1	1	1	1	1	1
BOB	0.753	0.753	0.81	0.776	1	1	0.686	0.658	1	0.8436
PNB	1	1	1	1	1	1	1	1	1	1
CANBK	1	1	1	1	1	1	1	1	1	1
PSB	1	1	1	1	1	1	1	1	1	1
INDIANB	0.761	0.73	1	1	0.78	1	1	0.484	1	0.8755
MAHABANK	0.539	0.54	0.676	0.662	0.646	0.673	0.793	0.055	0.639	0.5759
BANKINDIA	1	0.696	0.78	0.781	0.892	0.796	0.629	0.467	0.789	0.749
CENTRAKBK	1	1	0.782	1	1	1	1	1	1	0.9782
IOB	0.658	0.741	1	1	1	0.878	0.784	0.208	0.551	0.7432
UCOBANK	1	1	1	1	1	1	1	1	1	0.9519
UNIONBANK	1	0.692	0.588	0.724	1	0.889	1	1	1	0.8893
Mean	0.8926	0.846	0.8863	0.9119	0.9432	0.9363	0.9077	0.7393	0.9149	0.88388
No. of efficient bank	8	6	7	8	9	8	8	7	9	

Table 2shows the relative efficiency of banks calculated by the SBM model during 2010-2018. The results of the SBM model found four banks in the sample namely SBI, PNB,

CANARABK, and PSB asfully efficient banks, therefore,there is no needfor improvement in their input and output variables. The remaining banks in the sample wereinefficient, and therefore requiredadjustments in their input and output variables according to their slack values.

In the first five years, the average number of efficient banks was seven. However, the average number of efficient banks increased to eight over the next four years. This analysis concludedthe increase in the number of efficient banks during the last nineyears. Theaverage least efficiency score of banks in 2017 was 73.93 %, indicating that overall banks produced their output at an efficient level rather than at an inefficient level.

In 2014, the average efficiency of banks washigher as compared to other years as shown in Table 2. In the remaining years, the efficiency score ranged between 84% and 93%. UCOBANKwas fully efficient during whole study period. IOB and BANKINDIA outperformed their counterparts and this can be attributed tothe fact that these banks receivedmorefinancial support from the government as compared toother banks.

In the analysis, it wasconcluded that despite the process of equalization among scheduled commercial banks, these banks still remain at low levels of efficiency and find itdifficult to survive in anincreasingly competitive environment. This findingcan be substantiatedby the fact that in 2018, the level of inefficiency of most of the inefficient banks increased compared to the previous years.

5.2. Adjustment of input and output variables according to slacks

This study analyzesthe slack valuesof 12 banks using SBM model as shown in Table 3-7. It was found thatout of 12 banks,eight bankshave anefficiency score of less than 1. These slack values provide important information onall theareas based on which inefficient banks need to improve theiroperations to reach theefficient frontier. Each bank can maximize their efficiency by adjusting their input and output variablesas per the suggested level of input and output variables by SBM model. The slack values of these banks are givenin Table 3. According to these values, the inefficient banks can reach efficientfrontier by adjusting their input and output variables. To reach the inefficient bank at the efficient frontier, the input slack has to be subtracted from theirinput variables and the output slack has to be addedto their output variables.A bank that has zero slack in all its input and output variables is a fully efficient bank. Zero slack means that banks do not have to make any changes totheir input and output variables. They are already on the efficient frontier. This is the reason for slack appearance in some variables of the inefficient bank.

Table 3: Slack values calculated by SBM model during 2009-11.

DMUs	2009 - 2010					2010 -2011				
	Inputs decreasing %			Outputs increasing %		Inputs decreasing %			Outputs increasing %	
	X_1	X_2	X_3	Y_1	Y_2	X_1	X_2	X_3	Y_1	Y_2
SBI	-	-	-	-	-	-	-	-	-	-
BOB	14.6	-	17.53	37.16	-	17.68	2.61	-	47.6	-
PNB	-	-	-	-	-	-	-	-	-	-

CANBK	-	-	-	-	-	-	-	-	-	-
PSB	-	-	-	-	-	-	-	-	-	-
INDIANB	-	-	12.38	52.02	-	10.42	23.36	17.76	5.39	21.46
MAHABANK	14.64	27.07	-	96.26	23.5	7.59	-	23.41	86.69	45.29
BANKINDIA	-	-	-	-	-	12.1	14.79	6.05	55.84	-
CENTRAKBK	-	-	-	-	-	-	-	-	-	-
IOB	9.24	-	22.79	71.61	-	20.68	33.02	3.98	-	17.87
UCOBANK	-	-	-	-	-	-	-	-	-	-
UNIONBANK	-	-	-	-	-	32.57	40.95	12.1	-	6.58

Table 4: Slack values calculated by SBM model during 2011-13.

DMUs	2011- 2012					2012-2013				
	Inputs decreasing %			Outputs increasing %		Inputs decreasing %			Outputs increasing %	
	X_1	X_2	X_3	Y_1	Y_2	X_1	X_2	X_3	Y_1	Y_2
SBI	-	-	-	-	-	-	-	-	-	-
BOB	1.74	24.17	6.6	16.43	3.84	5.68	23.8	6.24	27.03	-
PNB	-	-	-	-	-	-	-	-	-	-
CANBK	-	-	-	-	-	-	-	-	-	-
PSB	-	-	-	-	-	-	-	-	-	-
INDIANB	-	-	-	-	-	-	-	-	-	-
MAHABANK	-	33.15	3.41	15.95	43.67	26.8	-	-	35.92	39.17
BANKINDIA	-	30.52	7.96	20.84	2.61	-	29.85	6.2	21.04	4.22
CENTRAKBK	-	22.56	15.19	-	23.6	-	-	-	-	-
IOB	-	-	-	-	-	-	-	-	-	-
UCOBANK	-	-	-	-	-	-	-	-	-	-
UNIONBANK	-	29.93	44.51	36.57	19.11	-	26.8	8.21	31.58	12.37

Table 5: Slack values calculated by SBM model during 2013-15.

	2013-2014					2014-2015				
	Inputs decreasing %			Outputs increasing %		Inputs decreasing %			Outputs increasing %	
	X_1	X_2	X_3	Y_1	Y_2	X_1	X_2	X_3	Y_1	Y_2
SBI	-	-	-	-	-	-	-	-	-	-
BOB	-	-	-	-	-	-	-	-	-	-
PNB	-	-	-	-	-	-	-	-	-	-
CANBK	-	-	-	-	-	-	-	-	-	-
PSB	-	-	-	-	-	-	-	-	-	-
INDIANB	20.56	10.27	8.09	-	23.17	-	-	-	-	-
MAHABANK	10.62	14.78	-	34.04	49.37	-	26.11	6.52	57.83	7.06
BANKINDIA	-	23.05	9.32	-	-	4.43	-	40.67	13.57	-
CENTRAKBK	-	-	-	-	-	-	-	-	-	-

IOB	-	-	-	-	-	7.21	-	29.43	-	-
UCOBANK	-	-	-	-	-	-	-	-	-	-
UNIONBANK	-	-	-	-	-	-	-	32.43	0.72	-

Table 6: Slack values calculated by SBM model during 2015-17.

DMUs	2015- 2016					2016- 2017				
	Inputs decreasing %			Outputs increasing %		Inputs decreasing %			Outputs increasing %	
	X_1	X_2	X_3	Y_1	Y_2	X_1	X_2	X_3	Y_1	Y_2
SBI	-	-	-	-	-	-	-	-	-	-
BOB	36.44	15.73	35.78	0	-	15.09	-	9.2	79.28	-
PNB	-	-	-	-	-	-	-	-	-	-
CANBK	-	-	-	-	-	-	-	-	-	-
PSB	-	-	-	-	-	-	-	-	-	-
INDIANB	-	-	-	-	-	-	-	7.32	203.36	-
MAHABANK	9.31	20.81	16.55	12.88	-	-	40.57	18.6	2714.17	-
BANKINDIA	20.32	33.61	23.93	35.41	-	19.29	31.02	12.76	138.56	-
CENTRAKBK	-	-	-	-	-	-	-	-	-	-
IOB	-	43.18	20.97	0.57	-	3.58	43.35	24.59	531.55	-
UCOBANK	-	-	-	-	-	-	-	-	-	-
UNIONBANK	-	-	-	-	-	-	-	-	-	-

Table 7: Slack values calculated by SBM model during 2017-19.

DMUs	2017-2018				
	Inputs decreasing %			Outputs increasing %	
	X_1	X_2	X_3	Y_1	Y_2
SBI	-	-	-	-	-
BOB	-	-	-	-	-
PNB	-	-	-	-	-
CANBK	-	-	-	-	-
PSB	-	-	-	-	-
INDIANB	-	-	-	-	-
MAHABANK	10.11	43.66	-	42.61	14.35
BANKINDIA	8.54	6.71	6.51	35.12	-
CENTRAKBK	-	-	-	-	-
IOB	31.52	68.77	31.49	3.37	-
UCOBANK	-	-	-	-	-
UNIONBANK	-	-	-	-	-

In 2010 only four banks namely BOB, INDIANB, MAHABANK, and IOB had slacks in their input and output variables. The remaining banks have no slacks in their input

and output variables. BOB has slack value onthe input side is 14.6 %in X_1 and 17.53 %in X_3 and the slack at the output side is 37.16 %in Y_1. These three values indicate that BOB is not utilising its gross assets and operating expenses efficiently. Therefore, these resultssuggested that BOB needs to reduce its gross assets by 14.6 % and operating expenses by 17.53 % and increase itsoutput Y_1 by 37.16 %to become an efficient bank. Similarly, the reaming three inefficient banks namely MAHABANK, INDIANB, and IOBmust change the combination of input and output variables as per their slack values to become efficient. MAHABANK slack value of the input side is 14.64 % in X_1 and 27.07 % in X_2 and 96.26 % in Y_1 and 23.5 % in Y_2 on the output side. INDIANB has slack only in one input variables X_3 is 12.38 % and one output slack is 52.02 % in Y_1. Input side slack of IOB bank is9.24 % in X_1 and 22.79 % in X_3 and output side slack is 71.61 % in Y_1. In the above analysis, it is observed that the values of two key input (X_1, X_3) and one output (Y_1) variablesmust be changed in most of the inefficient banks to become efficient. Theinefficient bank should utilize itsgross assets and operating expenses efficiently to generate maximum loan.

In 2011, six banks were found to be inefficient, namely BOB, INDIANB, MAHABANK, BANINDIA, IOB, and UNIONBANK because they all have slack ininput and output variables. In BOB bank, X_1 and X_2 variables have input slack and Y_1 variable have output slack andtheir slack values are 17.68 % in X_1,2.61 % in $X_2$and 47.6 % in Y_1respectively. Similarly, the remaining five inefficient banks also have slacks in theirinput and output variables. These inefficient banks can become efficient by adjusting their slack value as suggestedin Table3.

In 2012,the input variable X_1has slack onlyin BOB. In the input variable X_2, the highest slack value of 33.15 %was found inMAHABANK and in the remaining inefficient banksthe slack value of variable X_2varied between 24.17 and29.93 %. In the input variable X_3,UNIONBANK has the highest slack value of 44.51 % and the remainingfour inefficient banks have slack between3.41 and 15.19 %.In the output variables,UNIONBANK has highest slack in Y_1 and MAHABANK hashighest slack in Y_2. The above analysis suggest thatto improve interest income,MAHABANK should control itsemployee costs and UNIONBANK should control itsoperating expenses to achieve itsmaximum efficiency level of output variable Y_1.

In 2013, MAHABANK and BANKINDIA have the highestslack in input variable X_1 and X_2with26.8 % and 29.85 % respectively. MAHABANK has the highest slack in output variable Y_1 and Y_2.

In 2014, only three banks have slack in their inputs and outputs variable. INDIANB has slack in all three input variables i.e. 20.56 % in X_1, 10.27 % in X_2 and 8.09 % in X_3, butoutput slack only in one variable Y_2. BANKINDIA has slack only in input variable X_2 is 23.05 % and $X_3$is 9.32 % and there is no slack in output variables. The slack value of MAHABANKwashighest in both the output variables Y_1 and Y_2 with the slack values of 34.04 % and 49.37 % respectively. The numbers of banks having slacks in 2014 also have slacks in 2015.In BANKINDIA, the slack value of input variable X_2increasedto 40.67 % and X_3 to13.57 over the previous year. Similarly, MAHABANK has increased the slack value of input variable X_2to26.11 and X_3 to6.52 % and output variable Y_1 to57.83 % and Y_2to7.06 %. In previous year 2014,there is

no slack in IOB, but this year there is slack in two inputs variables X_1 and X_3.

In 2016,the four banks have slack in their input and output variables. In BOB, the slack in input variables X_1, X_2 and X_3 are 36.44 %, 15.73 %, and 35.78 % respectively. However, BOB has no slack in output variables. MAHABANK can improve its loans to that of efficient banks by an addition of 12.88 % in Y_1. The improvement can also be achieved by reducing the input variables X_1, X_2 and X_3 by 9.31 %, 20.81 % and 16.55 % respectively.Similarly, the required change in input and output variables in BANKINDIA to convert it in efficient bank is shown in Table6. IOB bank can become efficient if the input variable X_2 is reduced by 43.18 % and X_3 by 20.97 % of their existing level.

In 2017, five bank have slacks in their input and output variable. BOB need to improve in their output variable Y_1 by 79.28 % and input variable X_1 and X_3 by 15.09 % and 9.2 % respectively to become efficient. INDIANB has slack in output variable Y_1 is 203.36. In order to improve their loan volume it needs todecrease operating expenses by 7.32 %. MAHABANK required highest improvement in their loan volume by increasing output variable Y_1 by 2714.17 % and reducing input variables X_2 by 40.57 % and X_3 by 18.6 % respectively.In BANKINDIA,the input variable X_1should bedecreased by 12.76 %, X_2 by 31.02 % and X_3 by 12.76 % respectively and output variable Y_1 by increase by 138.56 % to become efficient. IOB need to decrease inputs variables X_1, X_2,and X_3 by 3.58 %, 43.35 %and 24.59 % respectively and need to increase output variable Y_1 by 531.55 % to become efficient.

In 2018, only three banks required to improve their inputs and outputs variables to become efficient. MAHABANK needs to increase their output variables Y_1 by 42.61 % and Y_2 by 14.35 % and decrease input variable X_1 by 10.11 % and X_2 by 43.66 %. BANKINDIA needs todecrease input variablesX1, X2 and X3 by 8.54 %, 6.71 %and 36.51 %respectively and need to increase output variable $Y_1$by 35.12 %to become efficient. Similarly, IOB need to change input and output variables as per suggested levels given in Table 7.

Table 3 shows the estimatedincreasein output demand for the inefficient banks between 2010 and 2018.The effect is a decrease in the utilization of all three gross assets, employee costs, operational inputs or a possible rise in the production of bank outputs. This is apparent from the banking industry's knowledge of the threats they face in the coming future. Bank management should continue to make decisions on reallocating capital within their banks in order to maximize efficiencyand maintain long-term growth and profitability.

5.3. Input and output with the largest need for improvements from 2010 to 2018

Table 8: Input and output with the largest need for improvements from 2010 to 2018.

Years	Inputs			Outputs	
	X_1	X_2	X_3	Y_1	Y_2
2010	MAHABANK	MAHABANK	IOB	MAHABANK	MAHABANK
2011	UNIONBANK	UNIONBANK	MAHABANK	MAHABANK	MAHABANK
2012	BOB	MAHABANK	UNIONBANK	UNIONBANK	UNIONBANK

2013	BANKINDIA	BANKINDIA	UNIONBANK	MAHABANK	MAHABANK
2014	INDIANB	BANKINDIA	BANKINDIA	MAHABANK	MAHABANK
2015	IOB	MAHABANK	BANKINDIA	MAHABANK	MAHABANK
2016	BOB	IOB	BOB	BANKINDIA	-
2017	BANKINDIA	IOB	IOB	MAHABANK	-
2018	IOB	IOB	IOB	MAHABANK	MAHABANK

The banks that required the highest improvement in their inputs and outputs from the year 2010 to 2018 are shown in Table 8. For the input variables X_1(gross assets), the banks thatrequiredthe highest improvements in the year 2010 and 2011 were MAHABANK and UNIONBANK. Similarly,BOB in 2012 and 2016; BANKINDIA in 2013 and 2017;IOB in 2015 and 2018;INDIANB and UCOBANK in 2014 required the highest improvement in 2014 respectively. For the input variable X_2(operating expenses), MAHABANKin years 2010, 2012, and 2015;BANKINDIA in 2013 and 2014;IOB in 2016, 2017, and 2018;and UNIONBANK in 2011 respectivelyrequired highest improvement. For the input variable X_3(employee cost), IOB in 2010,2017, and 2018;UNIONBANK in 2012 and 2013;BANKINDIA in 2014and2015; and MAHABANK and BOB in 2011 and 2016respectivelyrequired highest improvement.

For the output variable Y_1(loan), MAHABANK in 2010, 2011, 2013, 2014, 2015, 2017 and 2018;UNIONBANK in 2012;and BANKINDIA in 2016 required highest improvement respectively. Similarly, in the output variable Y_2 (employee cost), MAHABANK required improvement in all the years except 2013, 2016 and 2017. UNIONBANK required improvement in 2013 and no improvement wasrequired in 2016 and 2017.

6. Conclusion

Based on previous studies, it is observed that there is a lack of comprehensive efficiency analysis in agricultural credit in Indian schedule commercial banks. In this context, this study analysing the comparative efficiency of schedule commercial banks using DEA model. It also exploredthe reasons ofinefficiency byanalysing the slacks of input and output variables based on the SBM model rather than using the traditional DEA model. It was observed that some banks which have not properly utilized their inputs like gross assets, employee cost and operating expenseswere inefficient in comparison to frontier banks which properly utilized their input variables. Therefore each bank has different efficiency as each bank have different gross assets, operating expenses and employee cost. Inefficient banks can optimize these parameters to become efficient using this model. Slack provides a marginal value for inefficient banks, setting a scale for managers to undertake optimum utilization of resources in the activities of banks. In future, this model can be utilized for evaluating efficiency of banks before and after the government reforms in theagricultural sector. Implementing reforms in government policies is a continuous process and the government keeps on improving the functioning of banks over time.In addition, work can be extended to measure the relative efficiency of the branches of all scheduled commercial banks.

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