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EFFICIENCY ANALYSIS OF SELECTED PUBLIC AND PRIVATE SECTOR BANKS IN INDIA THROUGH DATA ENVELOPMENT ANALYSIS

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Abstract

The banking industry especially Indian public and private sector banks looked upon as the pivot around which the economic activities revolve. Banking system plays an important role in a nation's economy. Contribution of banking institution is highly remarkable and is indispensable in a modern society. An efficient banking practice plays a crucial role in the economic development of a country and forms the core of the money market in an advanced country as well as developing country like India. An attempt has been made in this study to evaluate the relative performance of selected public and private sector banks (DMUs) in India through Data Envelopment Analysis (DEA) for the period 2011-12. DEA is typically used to measure the technical efficiency (TE) between 0 to 1 ranges. A careful study of DEA analysis of the selected banks under study highlights the fact that by improved handling of operating expenses and interest costs and by boosting banking incomes, the less efficient banks can successfully achieve optimum performance level. Since this study attempts to maximise output, so output oriented Data Envelopment Analysis is used. The result of the study shows that 7, 11 and 8 banks are found efficient when their efficiency is measured under CRS, PTE and SE method respectively.

Key words: DEA, DMUs, Technical Efficiency, Pure Technical Efficiency, Scale Efficiency

Introduction

The banking sector plays an important role in the economy for the smooth and efficient functioning of the different economic activities of the society. Finance is at the core of socio-economic growth trajectory of a society. Banking system occupies a vital place in a nation's economy and is indispensable in a modern society. The overwhelming role of finance in the economic development of a country is well recognized and forms the core of the money market in economy.

Over decades the commercial banks have played a vital role in giving direction to economic development process by catering the financial requirement of trade and industry in the country.

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Through their lending policies they divert the economic activity as per the needs of the country. With the nationalization of banks in the most of the major commercial banks in 1969, expansions of private and foreign banks were gradually increased. The Reserve Bank of India also began enforcing uniform interest rates, spreads and service changes among the nationalized banks and also allowed the emergence of private sector banks to operate simultaneously with the public sector banks to maintain a healthy competitive environment in the economy. The banking sector reforms have opened up the scope of development in banking operations with the noble mission to provide finance to priority sectors including the agricultural sector in rural India to help widen socio-economic development.

There are growing competitions between the public sector banks and the private banks. It has been observed that in many cases the public sector banks lag behind the private sector banks in terms of increase in profitability, decrease in non-performing assets, greater mobilization of fund and disbursement of finance in cities and towns disregarding rural hinterlands of the country. On the contrary, there are opinions that the public sector banks in general are more likely to look after the employees' welfare for increasing their job performance but all these led to a steady decline in the efficiency, quality of customer services and work culture in the banks. So measurement of banks' efficiency is very relevant in this transition. In this study Data Envelopment Analysis (DEA) has been used to measure the relative technical efficiency of the selected commercial banks in India for the period 2011-12.

In this study 20 top banking companies have been selected and selection is made on the basis of their total income and balance sheet size. 10 banks have been taken from PSBs (public sector banks) group and 10 banks have been taken from Pvt.SBs (private sector banks) group.

The selected banking companies are:

Public Sector Banks (PSBs)	*Private Sector Banks (Pvt.SBs)*
State Bank of India (SBI)	ICICI Bank (ICICI)
Punjab National Bank (PNB)	HDFC Bank (HDFC)
Bank of Baroda (BOB)	Axis Bank Ltd. (AXIS)
Bank of India (BOI)	Federal Bank Ltd. (Federal)
Canara Bank (CB)	Jammu and Kashmir Bank (J&K)
Union Bank of India (UBI)	Indusind Bank Ltd. (Indusind)
Central Bank of India (CBI)	ING Vysya Bank (ING Vys)
Syndicate Bank (SB)	Karnataka Bank (K.Bnk)
Oriental Bank of Commerce (OBC)	South Indian Bank (SIB)
UCO Bank (UCO)	Karur Vysya Bank (K.Vys)

2. Data Source and Methodology

The data of the selected 20 banking companies for the period 2011-12 used in this study have been collected from secondary sources, i.e. Capitaline Corporate database, Statistical tables relating to banks in India i.e. RBI data base etc. For analyzing data a non-parametric linear programming (LP) method, Data Envelopment Analysis (DEA) has been used. The most common methods of comparison or performance evaluation were regression analysis and stochastic frontier analysis. These measures are often inadequate due to the multiple inputs and outputs related to different resources, activities and environmental factors. DEA provides a means of calculating apparent efficiency levels within a group of or organizations. In DEA study, efficiency of an organization or DMU (decision making unit) is calculated relative to the group's observed best practice. DEA evaluates the input consumed and output produced by DMUs and identifies those units that comprise an efficient frontier and lie below this frontier. The standard DEA models have an input and output orientation. An input orientation identifies the efficient consumption of input resources while holding output constant. An output orientation identifies the efficient level of output given existing resource consumption. The output orientation provides estimates of the amount by which output could be proportionally expanded given existing input levels. Two basic Data Envelopment Analysis (DEA) models namely; Charnes–Cooper–Rhodes (CCR) model for constant return to scale (CRS) and Banker–Charnes–Cooper (BCC) model for variable return to scale (VRS) have been applied to estimate the relative efficiency of the selected banking companies for the study period.

Scale efficiency is calculated as follows:

Scale Efficiency (SE) = (TE obtained from CRS/TE obtained from VRS)

This study has used output-oriented DEA model, which emphasized on the maximization of outputs and the inputs are held at their current levels.

The critical input and output components used for the analysis are:

Inputs

- Interest Cost
- Operating Cost

Outputs

- Interest Income
- Other Income

Output is treated as total incomes of the bank i.e. interest income & other income. Here interest income includes Interest/discount on advances/bills, income on investments, interest on balances with RBI and other inter-bank funds, others. Other income includes commission, exchange and brokerage, net profit (loss) on sale of investments, net profit (loss) on revaluation of investments, net profit (loss) on exchange transaction, net profit (loss) on sale of land, building & other assets, and miscellaneous income.

Input is treated as total costs of the bank, i.e. interest cost & operating cost. Interest cost includes interest on deposits, interest on RBI/inter-bank borrowings, others. Operating cost includes payments to and provisions for employees, rent, taxes and lighting, printing and stationery, advertisement and publicity, depreciation on bank's property, directors' fees, allowances and expenses, auditors' fees and expenses, law charges, postage, telegrams, telephones, etc., repairs and maintenance, insurance, other expenditure.

3. Review of Literature

In Indian context the whole literature which tries to measure/capture the performance of banks can be divided into two parts based on their methodologies viz., traditional measures and frontier approaches conducted with DEA techniques.

The major works under traditional measures are: Divitia and Venkatachalam (1978), Angadi (1983), Karkal (1983), Subramanyam (1985), Subramanyam and Swamy (1994 a,b), Das and Sarkar (1994), Hansda (1995) and Das (1999). The major findings of the above studies are; the banking functions are more or less uniform, production differences between firms are not only because of technological improvement but also comes from competence, there are wide disparities in their measure of performance of bank groups and rural branches are more profit making than urban1. Studies by Sarkar et al. (1998) compared banks of public, private and foreign sectors in India to study the effect of ownership type on different bank performance measures. Another study to compare operational efficiencies of different banks over a period of time was conducted by Rammohan (2002, 2003). Bhattacharya et al (1997) measured the productive efficiency of Indian commercial banks in the late 1980's to early 1990's. This study showcases the impact of policy measures undertaken during liberalization in 1980's on the performance of various banks. This DEA approach revealed that the Indian public sector banks were the best performing banks, as the entire banking sector was overwhelmingly dominated by the Indian public sector banks, while some of the new private sector banks were just emerging at that time in the India.

Sathye (2001) used DEA to study the relative efficiency of Indian banks in the late 1990's with that of banks operating in other countries. He found that the public sector banks have a

higher mean efficiency score as compared to the private sector banks in India, but found mixed results when comparing public sector banks and foreign commercial banks in India. Kumbhakar and Sarkar (2003) found that private sector banks in India have improved their performance when compared with public sector banks in India after the deregulation measures. Rammohan and Ray (2004) compared the revenue maximizing efficiency of banks in India in 1990's. Deposits and operating costs were taken as inputs while loans, investments and other income were taken as outputs. Their research found that public sector banks were significantly better than private sector banks on revenue maximization efficiency. However it was found that the difference in efficiency between public sector banks and foreign banks was not significant. Das et al (2004) studied the efficiency of Indian banks using DEA. Four input measures: deposits and other borrowings, number of employees, fixed assets and equity, and three output measures: investments, performing loan assets and other non-interest fee based incomes were used in the analysis. He found that Indian banks did not exhibit much of a difference in terms of input or output oriented technical and cost efficiency. However, in terms of revenue and profit efficiencies prominent differences were seen. He also found that size of the bank, ownership of the bank, and listing on the stock exchange had a positive impact on the average profit and revenue efficiency scores.

Sanjeev (2006) studied the efficiency of private banks, public banks, and foreign banks in India during 1997-2001 using DEA. He also extended his study to uncover the possibility of any relationship between the efficiency and NPA of the banks and found that efficiency has increased post-reforms and that NPA and efficiency are negatively related.

Kumar Ashish (2011) studied the efficiency of private banks, public banks and foreign banks in India using DEA. For analysing data he used interest income & other income as outputs and interest expenses & operating expenses as inputs. Major finding of the study was that the mean efficiency scores of public, private and foreign category banks did not show any significant differences.

4. Empirical Results and Interpretation

The efficiency measures computed in the present study are relative in nature. The performance of a bank is not assessed in an absolute manner but is compared with the best in the industry i.e. benchmark with the purpose of improving it. The sources of inefficiency can be determined by comparing the relative sizes of various efficiency measures. Table 1 shows the descriptive statistics of the sample N = 20 banks.

Table 1: Descriptive Statistics of Selected Input and Output variables of Banks

Variables	*Mean*	*Median*	*Maximum*	*Minimum*	*Range*	*SD*	*CV*
Interest Cost	1068542.65	282285	6323040	101833	6221207	1513902.75	141.68
Operating Cost	455883.00	328155	2606900	54160	2552740	566820.85	124.33
Interest Income	1672475.30	1554165	3642800	311290	3331510	1143680.50	68.38
Other Income	279850.95	131775	1435140	10119	1425021	343078.95	122.59

[***Source:*** Collected and compiled from year wise RBI data base]; [Amount of variables Rs. in lakh]

Under the CRS assumption both the output and input oriented technical efficiency scores are same. Here, all the efficiency scores of DEA are obtained using the DEAP- xp1 software developed by Tim Coelli (1996). All the CRS (output), VRS (output) and scale efficiency scores of the banks along with the peer counts are given in the Table 2. Table 3 shows the relative efficiency benchmark (peers) for all the selected DMUs under CRS and VRS method.

We see that under the CRS (TE) output results only seven banks- AXIS Bank (DMU 1), CB (DMU 4), HDFC Bank (DMU 7), ICICI Bank (DMU 8), OBC (DMU 14), SB (DMU 16) and UCO Bank (DMU 20) are technically efficient because they have the technical efficiency scores equal to one. We note that the technical efficiency (TE) of DMU 2 is 0.952. That is DMU 2 should be able to increase the total income by 4.8% without increasing inputs. Similar interpretation holds for the other DMUs. A remarkable thing is that Canara Bank (DMU 4) is recognized as most efficient bank because the linear combination of DMU 4 is more used than DMU 1, DMU 8, DMU 14, DMU 16 and DMU 20 as peer. So, using CRS output oriented multi stage DEA, the DMU 4 is most efficient though all of DMUs 1, 7, 8, 14, 16 and 20 have technical efficiency score equal to one.

Under the VRS (PTE) output results the 11 banks- AXIS Bank (DMU 1), CB (DMU 4), CBI (DMU 5), HDFC Bank (DMU 7), ICICI Bank (DMU 8), K.Vys Bank (DMU 13), OBC (DMU 14), PNB (DMU 15), SB (DMU 16), SBI (DMU 17) and UCO Bank (DMU 20) are technical efficient. Other 9 banks are technically inefficient as their efficiency scores are less than one. Technical efficient DMUs are peer of themselves only. We know that only the efficient DMUs form the linear combinations for the inefficient DMUs for efficiency perspective. For example, DMU 2 is a linear combination of the DMUs 1, 4, 14 and 15. That is, this linear combination of and 1, 4, 14 and 15 determines the efficient output of DMU 2. The peer counts for K.Vys Bank (DMU 13) is 7 whereas for DMU 14 it is 5 and for the other efficient DMUs 1, 4, 8 and 20 the peer counts are 4 each respectively. Since DMU 13 is most

used, so the most efficient bank is DMU 13.

The VRS efficiency results also give output scale efficiency scores with VRS efficiency scores. A DMU is considered as scale efficient if its output scale efficiency score is equal to one. Only eight banks- AXIS Bank (DMU 1), CB (DMU 4), HDFC Bank (DMU 7), ICICI Bank (DMU 8), OBC (DMU 14), SB (DMU 16), UBI (DMU 19) and UCO Bank (DMU 20) are scale efficient as their output scale efficiency scores are equal to one. So, in common we get three banks DMU 1, 4, 7, 8, 14, 16 and 20 which are efficient under both CRS and VRS assumption and they are scale efficient too.

Whether the DMU is operating in an area of increasing return to scale (IRS) or decreasing returns to scale (DRS) can be checked by running an additional DEA problem with non-increasing returns to scale (NIRS) imposed. If the NIRS TE score and VRS TE score are unequal for a DMU, then increasing returns to scale (IRS) exist for that DMU. For our given data, DRS exist for DMU 2, 3, 5, 15 and 17. IRS exists for the remaining DMU 6, 9, 10, 11, 12, 13, 18 and 19 other than DMU 1, 4, 7, 8, 14, 16 and 20.

Table 2

Efficiency Scores of Selected Public and Private sector banks obtained using DEA

DMU No	*DMUs*	*Nature*	*CRS TE*	*CRS Peers*	*VRS PTE*	*VRS Peers*	*Scale TE*	*RTS*
1	AXIS	Pvt.SB	**1.000**	2	**1.000**	4	**1.000**	-
2	BOB	PSB	0.952	0	0.990	0	0.962	DRS
3	BOI	PSB	0.956	0	0.963	0	0.993	DRS
4	CB	PSB	**1.000**	10	**1.000**	4	**1.000**	-
5	CBI	PSB	0.923	0	1.000	0	0.923	DRS
6	Federal	Pvt.SB	0.871	0	0.887	0	0.983	IRS
7	HDFC	Pvt.SB	**1.000**	0	**1.000**	0	**1.000**	-
8	ICICI	Pvt.SB	**1.000**	9	**1.000**	4	**1.000**	-
9	Indusind	Pvt.SB	0.561	0	0.577	0	0.971	IRS
10	ING Vys	Pvt.SB	0.708	0	0.757	0	0.935	IRS
11	J&K	Pvt.SB	0.854	0	0.925	0	0.923	IRS
12	K.Bnk	Pvt.SB	0.877	0	0.908	0	0.966	IRS
13	K.Vys	Pvt.SB	0.964	0	1.000	7	0.964	IRS
14	OBC	PSB	**1.000**	8	**1.000**	5	**1.000**	-
15	PNB	PSB	0.864	0	1.000	1	0.864	DRS
16	SB	PSB	**1.000**	1	**1.000**	0	**1.000**	-
17	SBI	PSB	0.582	0	1.000	0	0.582	DRS
18	SIB	Pvt.SB	0.822	0	0.934	0	0.881	IRS
19	UBI	PSB	0.863	0	0.863	0	1.000	IRS
20	UCO	PSB	**1.000**	4	**1.000**	4	**1.000**	-
Efficiency Mean Score			**0.890**	-	**0.940**	-	**0.947**	-

[***Source:*** Collected and computed from RBI data base]

Table 3

Efficiency Benchmark under CRS and VRS method of selected DMUs obtained using DEA

DMU No	*DMUs*	*CRS Benchmark*	*VRS Benchmark*
1	AXIS	AXIS(1.000)	AXIS(1.000)
2	BOB	CB(0.653); ICICI(0.168); OBC(0.340)	AXIS(0.154); CB(0.686); OBC(0.020); PNB(0.140)
3	BOI	CB(0.705); ICICI(0.160); OBC(0.169)	AXIS(0.085); CB(0.778); ICICI(0.087); OBC(0.051)
4	CB	CB(1.000)	CB(1.000)
5	CBI	AXIS(0.016); SB(1.180); UCO(0.163)	CBI(1.000)
6	Federal	CB(0.142); ICICI(0.008); OBC(0.109)	CB(0.066); K.Vys(0.838); OBC(0.079); UCO(0.017)
7	HDFC	HDFC(1.000)	HDFC(1.000)
8	ICICI	ICICI(1.000)	ICICI(1.000)
9	Indusind	UCO(0.653)	K.Vys(0.471); UCO(0.529)
10	ING Vys	CB(0.004); ICICI(0.106); OBC(0.111)	AXIS(0.080); ICICI(0.018); K.Vys(0.902)
11	J&K	CB(0.020); UCO(0.345)	K.Vys(0.828); UCO(0.172)
12	K.Bnk	CB(0.089); ICICI(0.012); OBC(0.025)	AXIS(0.000); ICICI(0.001); K.Vys(0.989); OBC(0.009)
13	K.Vys	CB(0.090); ICICI(0.010); OBC(0.016)	K.Vys(1.000)
14	OBC	OBC(1.000)	OBC(1.000)
15	PNB	CB(0.715); ICICI(0.245); OBC(0.751)	PNB(1.000)
16	SB	SB(1.000)	SB(1.000)
17	SBI	AXIS(0.779); ICICI(2.724)	SBI(1.000)
18	SIB	CB(0.014); UCO(0.267)	K.Vys(0.950); UCO(0.050)
19	UBI	CB(0.489); ICICI(0.109); OBC(0.365)	CB(0.485); ICICI(0.109); K.Vys(0.042); OBC(0.364)
20	UCO	UCO(1.000)	UCO(1.000)

[***Source:*** Collected and computed from RBI data base]

The peer weights give the weights to construct a linear combination of the efficient banks to represent an inefficient one. The descriptive statistics of the technical efficiency scores obtained from these methods are given in Table 4.

The mean and median of TE scores of CRS DEA is smaller than other two methods. Maximum TE score is one for all methods but minimum score is not same for all the three methods. The range (maximum-minimum) is biggest for CRS DEA and smallest for SE DEA. Standard deviation (SD) of TE scores also reflects this. But consistency of performance efficiency is found in SE DEA as it has the lowest coefficient of variation (CV).

Table 4: Descriptive Statistics of TE Scores in DEA model for N = 20 Banks

Methods	*Mean*	*Median*	*Max.*	*Min.*	*Range*	*SD*	*CV*
CRS	0.890	0.938	1.000	0.561	0.439	0.135	15.118
VRS	0.940	1.000	1.000	0.577	0.423	0.107	11.382
SE	0.947	0.977	1.000	0.582	0.418	0.095	10.077

[***Source:*** Table 2]

Table 5 shows summary of findings for selected DMU groups. For selected PSBs as a whole under CRS DEA total numbers of efficient banks are found 4 out of 10 DMUs. Under VRS DEA efficient numbers are 7 and under SE DEA the efficient numbers are 5.

On the other hand for selected Pvt.SBs as a whole under CRS DEA total numbers of efficient banks are found 3 out of 10 selected banks. Under VRS DEA efficient numbers are 4 and under SE DEA efficient numbers are 3.

Table 5: Summary of Findings for Selected DMU Groups

DMU Groups	*Nos. of DMUs under CRS DEA*		*Nos. of DMUs under VRS DEA*		*Nos. of DMUs under SE DEA*	
	Efficient	*Inefficient*	*Efficient*	*Inefficient*	*Efficient*	*Inefficient*
PSBs (10 banks)	4	6	7	3	5	5
%	40	60	70	30	50	50
Pvt.SBs (10 banks)	3	7	4	6	3	7
%	30	70	40	60	30	70

[***Source:*** Table 2 & 3]

5. Findings and Conclusion

Here CRS DEA gives 4 efficient banks (DMUs 4, 14, 16 and 20) under PSBs group and 3 efficient banks (DMUs 1, 7 and 8) under Pvt.SBs group, VRS DEA gives 7 efficient banks (DMUs 4, 5, 14, 15, 16, 17 and 20) under PSBs group and 4 efficient banks (DMU 1, 7, 8 and 13) under Pvt.SBs group. Now we can rank the banks according to their efficiency scores. The banks with higher technical efficiency possess top ranks. Here few banks have efficiency scores equal to one and their ranking can be determined by considering peer counts. However, the most efficient bank is Canara Bank (DMU 4) which is valid for all methods applied. This is because in CRS DEA efficient DMU 4 has 10 peer counts while other efficient DMU 8 and 14 possess the 2nd rank and 3rd rank respectively for having the peer counts of 9 and 8 respectively. DMU 20, 1 and 16 possess 4th, 6th and 7th rank respectively for having the next lowest peer counts of 4, 2 and 1 respectively.

Similar ranking can be provided in VRS DEA case. Here efficient DMUs 13 and 14 possess ranking 1 and 2 respectively for having peer counts of 7 and 5 respectively. 3rd rank is jointly occupied by DMUs 1, 4, 8 and 20 for having the same peer counts of 4 each.

The overall level of technical efficiency in the selected banks has been found to be 89 percent. This implies that the sample banks have the scope of producing 1.124 times as much output from the same inputs. The study also found that CRS-DEA consists of 7 efficient banks and the range of the efficiency scores is larger whereas VRS-DEA consists of 11 efficient banks and the range of efficiency scores is smaller than CRS-DEA. So, it may be inappropriate to use CRS-DEA instead of VRS-DEA in this case. Again, VRS assumption overcomes the shortcoming of CRS assumption which supports the idea of Banker et al. (1984) and seems to be more appropriate. On another words it can be said that scale inefficiency is the main reason of inefficiency among the selected banks. As the maximum numbers of efficient banks are found under PSBs group as compared to that of the Pvt.SBs group, so as a whole it can be said that PSBs are the better performers.

However, as mentioned by Avkiran (1999), DEA provides insights on which areas need to be improved but it do not have information on how to improve. But it can be said from the above study that those inefficient banks which are having increasing return to scale should expand their business by deploying more input resources and by utilising modern technology to reach at the optimum level of output. Further investigations are needed in order to identify approaches for each bank to increase operation profit by moving towards the efficient frontier.

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