



## Technical Efficiency of Banks in India-A study measuring efficiency of select public sector and private sector banks using DEA

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### Introduction

The banking sector of India has been dominating the Indian financial system. Banking sector plays a very vital role in fulfilling the diversified needs of the customers in India. The Indian banking sector plays a very crucial role in financial inclusion. In India the banking sector has been classified in to mainly public sector banks, private sector banks and foreign banks. The most dominant being the public sector banks, Indian banking sector is equally dominated by the private sector banks. Even though the public sector banks are having largest network of branches creation and found to be dominating in terms of their lending and borrowing operations, they face competition from private sector banks. The public sector banks are even spread out across the nations with more number of branches which help in generating revenue for credit creation. The banking sector reforms as part of financial sector reforms in India in 1991 have brought drastic changes in the Indian banking sector. The paper is structured as follows: the first section will discuss review of literature in banking followed by methodology, data and specification of bank inputs and outputs. Empirical findings are discussed in the next section followed by the suggestions.

### Literature Review

During the late 1980s and particularly in the 1990s, the DEA method has been used extensively to evaluate banking institutions. Sathye (2003) 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 found to 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.

San O et al, (2011) in their study used non parametric Data Envelopment Analysis (DEA) to analyze and compare the efficiency of foreign and domestic banks in Malaysia. The analysis was based on a panel data set of 9 domestic banks and 12 foreign banks in Malaysia over the period of 2002-2009. On the basis of Intermediation approach, the inputs and outputs were selected for computerizing the efficiency scores. Surprisingly, the findings are inconsistent with most of the findings of previous studies where the foreign banks were outperforming their domestic peers in term of efficiency. Conversely, the finding of this study shows that domestic banks have a higher efficiency level than foreign banks, this imply that domestic banks are relatively more managerially efficient in controlling their costs. The second stage of the empirical results was based on the Tobit model, which suggests that the pure technical efficiency (PTE) of banks in Malaysia is mainly affected by capital strength, loan quality, expenses and asset size.



### Objectives of the Study

- To measure the technical efficiency of select Indian public sector banks and private banks using data envelopment analysis, a non parametric method during the period between 2009-2013
- To identify the most efficient banks using Data envelopment analysis by ranking the banks on the basis of efficiency scores obtained.

### Scope of the study

The study covers only Indian public sector banks and private banks for which the data on selected inputs and outputs is available continuously for the period between 2009 and 2013. As such the number of public sector banks and private banks selected for the study is limited to 33. 20 banks were selected under public sector banks category and 13 banks were selected under private banks category. The study is confined to measurement of technical efficiency of selected public sector banks and private banks and thereby identifying the efficient banks.

### Methodology of the study

The study is carried out by taking secondary data in to consideration. For efficiency related concepts and about Data Envelopment Analysis, data from journals, websites, books and etc was taken, while to measure the technical efficiency, software developed by Tim Coelli on DEA was used for the purpose of analysis and thereby to identify the efficient banks. The efficiency scores

are calculated using Data envelopment analysis, a non parametric technique. The output oriented two stage DEA method was adopted for analysis. The inputs and outputs selected for the study were based on intermediation approach. The inputs for the study are fixed assets, deposits, number of employees and number of offices while outputs selected for the study were loans and investments..The sample size for the study is 33 banks which belong to the category of public sector banks (20) and private banks (13). The list of banks for the study is as follows:

List of public sector banks	List of private sector banks
Allahabad Bank	AXIS Bank Ltd.
Andhra Bank	City Union Bank Ltd.
Bank of Baroda	Development Credit Bank Limited
Bank of India	Dhanlaxmi Bank Ltd.
Bank of Maharashtra	ICICI Bank Limited
Canara Bank	IndusInd Bank Limited
Central Bank Of India	ING Vysya Bank Ltd.



Corporation Bank	Karnataka Bank Ltd.
Dena Bank	Kotak Mahindra Bank Limited
IDBI Bank	HDFC Bank Ltd.
Indian Bank	Karur Vysya Bank Ltd.
Indian Overseas Bank	Lakshmi Vilas Bank Ltd
Oriental Bank of Commerce	South Indian Bank Ltd.
Punjab National Bank	
State Bank of India	
Syndicate Bank	
UCO Bank	
Union Bank of India	
United Bank of India	
Vijaya Bank	

Technical efficiency according to Variable Returns to Scale Assumption(VRSTE)							
S. No	Name of the Bank	2009	2010	2011	2012	2013	Average
1	Allahabad Bank	1	1	0.863	0.664	1	0.9054
2	Andhra Bank	1	1	1	0.902	0.413	0.863
3	Bank of Baroda	1	1	1	1	1	1
4	Bank of India	0.993	1	0.918	1	1	0.9822
5	Bank of Maharashtra	0.814	0.74	0.808	0.786	1	0.8296
6	Canara Bank	0.913	0.946	0.9	1	1	0.9518
7	Central Bank of India	1	0.844	0.823	0.897	1	0.9128
8	Corporation Bank	0.868	0.739	1	0.695	1	0.8604
9	Dena Bank	1	0.882	0.874	1	1	0.9512
10	IDBI Bank	1	0.736	1	1	0.716	0.8904
11	Indian Bank	1	1	0.791	1	1	0.9582
12	Indian Overseas Bank	1	0.982	0.896	1	1	0.9756



13	Oriental Bank of Commerce	1	1	0.84	1	1	0.968
14	Punjab National Bank	1	1	0.927	1	1	0.9854
15	State Bank of India	1	1	1	1	1	1
16	Syndicate Bank	1	1	0.973	1	0.757	0.946
17	UCO Bank	1	0.783	0.869	0.802	0.827	0.8562
18	Union Bank of India	0.858	0.856	0.889	1	0.886	0.8978
19	United Bank of India	0.84	0.656	0.797	0.835	1	0.8256
20	Vijaya Bank	0.848	0.798	0.839	0.962	0.985	0.8864
21	AXIS Bank Ltd.	1	1	0.993	1	1	0.9986
22	City Union Bank Ltd.	1	1	1	1	1	1
23	Development Credit Bank Limited	1	1	1	1	1	1
24	Dhanlaxmi Bank Ltd.	1	1	0.893	1	1	0.9786
25	ICICI Bank Limited	1	0.68	1	0.831	0.813	0.8648
26	IndusInd Bank Limited	1	0.844	0.842	0.811	0.372	0.7738
27	ING Vysya Bank Ltd.	0.913	0.769	0.842	0.883	1	0.8814
28	Karnataka Bank Ltd.	0.954	0.664	1	0.91	0.282	0.762
29	Kotak Mahindra Bank Limited	1	0.927	1	0.663	0.533	0.8246
30	HDFC Bank Ltd.	1	1	0.929	0.702	1	0.9262
31	Karur Vysya Bank Ltd.	0.915	0.865	0.904	1	0.568	0.8504
32	Lakshmi Vilas Bank Ltd.	1	1	1	1	1	1
33	South Indian Bank Ltd.	1	1	0.807	0.977	0.993	0.9554
	Average	0.9671	0.9003	0.9156	0.9187	0.8831	0.9170
		52	33	67	88	82	24

It can be observed from the table that the overall average technical efficiency of selected banks for the period between 2009 and 2013 was found to be 91.70% under VRS approach. That means still the selected banks can maximize their

output by 8.3% at the given level of inputs. Among the 33 banks selected for the study, Bank of Baroda, State Bank of India, City Union Bank Limited, Development Credit Bank Limited and Lakshmi Vilas Bank Ltd have recorded



100% average technical efficiency during the period from 2009 to 2013. Among the 33 banks selected for the study, 14 Banks have recorded average technical efficiency scores of more than 90%. Axis Bank has recorded average technical efficiency score of 99.86%, followed by Punjab National Bank, Bank of India, Dhanalaxmi Bank, Indian Overseas Bank, Oriental Bank of Commerce, Indian Bank, South Indian Bank Ltd, Canara Bank, Dena Bank, Syndicate Bank, HDFC Bank Ltd, Central Bank of India, and Allahabad Bank with average technical efficiency scores of 98.54%, 98.22%, 97.86%, 97.56%, 96.8%, 95.

82%, 95.54%, 95.18%, 95.12%, 94.6%, 92.62%, 91.28% and 90.54% respectively. Among the selected banks, Karnataka Bank Ltd Bank recorded lowest average efficiency score of 76.2% followed by Indus land Bank Limited with average efficiency scores of 77.38%. It can be inferred that Karnataka Bank Ltd can maximize its output by 23.8%, and Indus land Bank Limited by 22.62%. The technical efficiency of selected public sector and private banks in the year 2009 was found to be 96.7%, 90.03% in 2010, 91.56%, 91.87% and 88.31% in the years 2011, 2012 and 2013 respectively.

Year	Average efficiency of Public sector banks(VRS assumption)	Average efficiency of private banks(VRS assumption)
2009	0.9567	0.983231
2010	0.8981	0.903769
2011	0.90035	0.939231
2012	0.92715	0.905923
2013	0.9292	0.812385

It can be observed from the graph that there is a declining trend of average technical efficiency of selected banks under VRS assumption during the period of the study i.e. from 2009 to 2013.

Greater fall in average technical efficiency (VRS) was observed for private

banks from 90.59% in 2012 to 81.23% in 2013. Even though public sector banks experienced a fall in average technical efficiency i.e. from 95.67% in 2009 to 89.81% in 2010. In the later years, there was a revival and the average efficiency score was stabilized in the year 2013.

Scale efficiency of selected public and private sector banks from 2009-2013							
S. No	Banks	2009	2010	2011	2012	2013	Average
1	Allahabad Bank	1	1	0.987	0.982	1	0.9938
2	Andhra Bank	1	1	1	0.987	0.909	0.9792
3	Bank of Baroda	1	1	0.934	1	1	0.9868



4	Bank of India	1	1	0.868	0.918	1	0.9572
5	Bank of Maharashtra	0.998	0.999	0.992	0.985	0.869	0.9686
6	Canara Bank	0.999	0.986	0.961	1	1	0.9892
7	Central Bank of India	1	0.995	0.974	0.914	1	0.9766
8	Corporation Bank	0.973	0.999	1	0.995	1	0.9934
9	Dena Bank	0.94	0.994	0.992	1	1	0.9852
10	IDBI Bank	1	1	1	1	0.987	0.9974
11	Indian Bank	0.898	0.837	0.983	0.757	0.997	0.8944
12	Indian Overseas Bank	1	0.815	0.985	1	1	0.96
13	Oriental Bank of Commerce	0.919	1	0.995	1	1	0.9828
14	Punjab National Bank	0.983	1	0.979	1	1	0.9924
15	State Bank of India	1	1	1	1	0.088	0.8176
16	Syndicate Bank	1	1	0.999	1	0.969	0.9936
17	UCO Bank	0.984	0.957	0.989	0.99	0.818	0.9476
18	Union Bank of India	0.969	0.999	0.988	1	0.947	0.9806
19	United Bank of India	0.975	0.999	0.99	0.816	0.752	0.9064
20	Vijaya Bank	0.997	0.977	0.991	0.728	0.96	0.9306
21	AXIS Bank Ltd.	1	0.877	0.942	1	0.842	0.9322
22	City Union Bank Ltd.	1	1	0.88	0.928	0.462	0.854
23	Development Credit Bank Limited	1	1	0.757	1	1	0.9514
24	Dhanlaxmi Bank Ltd.	0.995	0.92	0.876	1	1	0.9582
25	ICICI Bank Limited	1	0.973	1	0.656	1	0.9258
26	IndusInd Bank Limited	1	1	0.969	0.976	0.753	0.9396
27	ING Vysya Bank Ltd.	0.847	0.998	0.978	0.955	1	0.9556
28	Karnataka Bank Ltd.	0.709	0.981	1	0.94	0.991	0.9242
29	Kotak Mahindra Bank Limited	1	0.85	1	0.985	0.567	0.8804
30	HDFC Bank Ltd.	1	1	0.959	0.986	0.861	0.9612
31	Karur Vysya Bank Ltd.	0.982	1	0.942	0.887	0.594	0.881



32	Lakshmi Vilas Bank Ltd.	1	1	1	0.823	1	0.9646
33	South Indian Bank Ltd.	1	0.946	0.964	0.946	0.715	0.9142
	<b>Average</b>	<b>0.9747</b>	<b>0.9727</b>	<b>0.9658</b>	<b>0.9440</b>	<b>0.8812</b>	<b>0.9477</b>
		<b>88</b>	<b>88</b>	<b>79</b>	<b>61</b>	<b>42</b>	<b>52</b>

It is evident from the analysis that, the overall average scale efficiency of selected public sector and private banks for the period between 2009 and 2013 was found to be 94.77%. That means still the selected banks can maximize their scale efficiency by 5.23%. Among the 33 banks selected for the study, about 28 banks have achieved scale efficiency of

more than 90%. State Bank of India has recorded lowest average scale efficiency score of 81.76%, followed by City Union Bank Ltd with average scale efficiency score of 85.4%. The average scale efficiency of banks in the year 2009 was 97.47%, 97.27% in 2010, 96.58%, 94.40% and 88.12% in the years 2011, 2012 and 2013 respectively.

Year	Average scale efficiency of Public sector banks	Average scale efficiency of private banks
2009	0.98175	0.964077
2010	0.97785	0.965
2011	0.98035	0.943615
2012	0.9536	0.929385
2013	0.9148	0.829615

**Graph showing the scale efficiencies of selected public sector and private banks during 2009-2013**

It is evident from the graph that the scale efficiency of selected banks during the period of the study i.e. from 2009-2013 observes a declining trend. It is observed that both public sector banks and private

banks have faced a decrease in scale efficiency from 2009 to 2013. But the private sector banks have experienced a greater fall i.e. 96.40% in 2009 to 82.96% in 2013 while the public sector banks observed a fall from 98.17% in 2009 to 91.48% in 2013.

Decomposition of Scale efficiency for the year 2013	
Constant returns to scale(CRS)	15
Decreasing returns to scale(DRS)	11
Increased returns to scale(IRS)	07



From the above graph, it can be inferred that about 21% i.e. 7 Banks are operating under increasing returns to scale, about 33% i.e. 11 banks are operating under decreasing returns to scale and 46% i.e. 12 banks are operating under constant returns to scale.

S.No	Name of the bank	VRSTE_AV G	RAN K	SCALE_AV G	RAN K
1	Allahabad Bank	0.9054	15	0.9938	2
2	Andhra Bank	0.863	21	0.9792	11
3	Bank of Baroda	1	1	0.9868	7
4	Bank of India	0.9822	4	0.9572	18
5	Bank of Maharashtra	0.8296	25	0.9686	13
6	Canara Bank	0.9518	10	0.9892	6
7	Central Bank of India	0.9128	14	0.9766	12
8	Corporation Bank	0.8604	22	0.9934	4
9	Dena Bank	0.9512	11	0.9852	8
10	IDBI Bank	0.8904	17	0.9974	1
11	Indian Bank	0.9582	8	0.8944	29
12	Indian Overseas Bank	0.9756	6	0.96	16
13	Oriental Bank of Commerce	0.968	7	0.9828	9
14	Punjab National Bank	0.9854	3	0.9924	5
15	State Bank of India	1	1	0.8176	33
16	Syndicate Bank	0.946	12	0.9936	3
17	UCO Bank	0.8562	23	0.9476	21
18	Union Bank of India	0.8978	16	0.9806	10
19	United Bank of India	0.8256	26	0.9064	28
20	Vijaya Bank	0.8864	18	0.9306	24
21	AXIS Bank Ltd.	0.9986	2	0.9322	23
22	City Union Bank Ltd.	1	1	0.854	32
23	Development Credit Bank Limited	1	1	0.9514	20
24	Dhanlaxmi Bank Ltd.	0.9786	5	0.9582	17





25	ICICI Bank Limited	0.8648	20	0.9258	25
26	IndusInd Bank Limited	0.7738	28	0.9396	22
27	ING Vysya Bank Ltd.	0.8814	19	0.9556	19
28	Karnataka Bank Ltd.	0.762	29	0.9242	26
29	Kotak Mahindra Bank Limited	0.8246	27	0.8804	31
30	HDFC Bank Ltd.	0.9262	13	0.9612	15
31	Karur Vysya Bank Ltd.	0.8504	24	0.881	30
32	Lakshmi Vilas Bank Ltd.	1	1	0.9646	14
33	South Indian Bank Ltd.	0.9554	9	0.9142	27
	<b>Average</b>				

The table above shows the ranks given to the selected public sector banks under VRS (pure technical efficiency) and Scale efficiency on the basis of efficiency scores obtained using DEA analysis. It can be observed that Bank of Baroda and Punjab National Bank have ranked better than other banks under two assumptions.

#### Findings

- From the study, it was observed that the overall average technical efficiency of selected public sector and private sector banks for the period 2009 to 2013 was found to be 91.70% under VRS assumption. It implies that there is substantial room for the banks to enhance their output with the existing resources.
- The overall average scale efficiency of selected banks was found to be 94.77%.
- It was observed that among the 33 banks selected for the study, Bank of Baroda, State Bank of India, City Union Bank Limited, Development Credit Bank Limited and Lakshmi Vilas Bank Ltd have recorded 100% average technical efficiency during the period from 2009 to 2013 under VRS assumption.
- From the study it was found that the Karnataka Bank Ltd Bank recorded lowest average efficiency score of 76.2% followed by Indus land Bank Limited with average efficiency scores of 77.38%.
- From the study it can be evident that none of the banks have achieved 100% scale efficiency.
- State Bank of India recorded lowest scale efficiency score of 81.76%.
- There is a declining trend of VRS\_TE and Scale efficiency scores of sample public and private sector banks during the period of the study.
- Bank of Baroda, State Bank of India, City Union Bank Ltd, Development Credit Bank Limited and Lakshmi Vilas Bank Ltd have stood at first position in pure technical efficiency with 100% efficiency score, followed by Axis Bank, Punjab National Bank, Bank of India, Dhanalaxmi Bank Ltd,



Indian Overseas Bank, Oriental Bank of Commerce, Indian Bank, South Indian Bank Ltd and Canara bank.

It was observed that 8 public sector banks were found in the top 10 list of efficient banks while there are about 6 private banks in the list, which implies that both public and private sector banks are competing with each other in achieving pure technical efficiency.

- IDBI ranked first in terms of scale efficiency with efficiency score of 99.74% followed by Allahabad bank, Syndicate Bank, Corporation Bank, Punjab National Bank, Canara Bank, Bank of Baroda, Dena Bank, Oriental Bank of Commerce and Union Bank of India. It was observed that none of the private banks have occupied position in top 10 list of scale efficient banks.
- From the study, by decomposing the efficiency in to pure technical efficiency and scale efficiency, it was observed that the decrease in efficiency of State Bank of India is due to scale inefficiency rather than pure technical inefficiency.
- The decomposition of scale efficiency for the year 2013 reveals that about 46% of banks are operating under CRS, 21% banks under IRS and 33% banks are operating under DRS.

#### Suggestions

- The selected public sector units can maximize their output by 8.4% under CRS assumption and 4.55% under VRS assumption at the given level of inputs by making effective utilization of inputs.

- The selected public sector units can maximize their scale efficiency by 4%.
- As 21% of banks are operating under increasing returns to scale, they can increase their scale of operations so that they can increase their returns.
- As 33% of selected banks are operating under decreasing returns to scale, they can decrease their scale of operations so that they can increase their returns.
- As SBI has recorded 100% of pure technical efficiency, the major problem is scale inefficiency and hence it should strive to improve its scale efficiency. So it should take necessary measures to increase its returns by properly planning its scale of operations and effective utilization of inputs.
- Out of 33 banks selected for the study, only Bank of Baroda and Punjab National Bank have recorded highest efficiency scores under assumptions (VRS and SCALE). Hence the rest of the banks need to take these banks as benchmarks in terms of their process of operations and should strive to achieve efficiency.
- As none of the private banks have found place in top 10 list of scale efficient banks, which is an indication of failure of banks to operate at most productive scale size. They should take necessary measures to increase its returns by properly planning its scale of operations and effective utilization of inputs.

#### References

- AIKhatlan, KH and Malik, S, A. (2008). Are Saudi Banks Efficient?



- Evidence using Data Envelopment Analysis (DEA). *International journal of economics and finance*. 2(2), 53-59.
- Charnes A., Cooper W.W. and Lewin A. Y. and Seiford L. M. (1994), Data Envelopment Analysis: Theory, Methodology and Applications, Kluwer Academic Press, Boston, 3-12.
- Coelli, T.(1996). A guide to DEAP version 2.1: a data envelopment analysis (computer) program, center for efficiency and productivity analysis. Armidale, NSW Australia:University of New England.
- Coelli, T.G., Prasada Rao D.S. and Battese, G. (1998).An introduction to efficiency and productivity analysis.London: Kluwer Academic Publishers.
- Coelli, T. J. and Perelman, S. (1999). A comparison of parametric and non-parametric distance functions: with application to European railways. *European Journal of Operational Research*, 117(2), 326-339.
- Das.A and Ghosh. S,( 2006). Financial deregulation and efficiency: An empirical analysis of Indian banks during the post reform period. *Review of Financial Economics*. 15(3).197-199.
- Debasiah S S. (2006). Efficiency Performance in Indian Banking – Use of Data Envelopment Analysis. *Global Business Review*, 7(2).325 – 333.
- Kumar, S and Gulati, R.(2008). An Examination of Technical, Pure Technical, and Scale Efficiencies in Indian Public Sector Banks using Data Envelopment Analysis. *Eurasian Journal of Business and Economics*.1 (2), 33-69.
- Kumbhakar. S.C. and Sarkar, S. (2004). Deregulation, Ownership and Efficiency in Indian Banking: An application of Stochastic Frontier Analysis. IGIDD working paper. Available at: [www.igidr.ac.in/conf/finwrk/workshop.pdf](http://www.igidr.ac.in/conf/finwrk/workshop.pdf).
- Moh'd Al-Jarrah, I.( 2007). The use of DEA in measuring efficiency in Arabian banking. *Banks and Bank Systems Journal*. 2(4),21- 30.
- Mostafa, M. M. (2007).Modeling the efficiency of top Arab banks: A DEA–neural network approach. *Expert Systems with Applications* 36(1), 309-320.
- San.O.T, Lim Y. T, and Teh B, H.(2011). A Comparison on Efficiency of Domestic and Foreign Banks in Malaysia: A DEA Approach. *Business Management Dynamics*.1 (4), 33-49.
- Satye. M,(2003). Efficiency of Banks in developing Economy. The case of India. *European Journal of Operational Research*. 148(3), 662-671.