Are private sector banks really more Efficient than public sector banks? – A comparative analysis using Dea

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Abstract

It has been well established that the development of financial or banking systems stimulates economic growth. Bankers are the distributors and custodians of liquid capital. Banks need to be financially strong for this purpose. The objective of this paper is to measure the technical efficiency of banks in India. The present study covers a period of ten years from March 2009 to March 2018. To initiate the econometric study in terms of data envelopment analysis, the first step is to check isotonicity assumptions. Positive correlations among all the variables satisfy the isotonicity assumptions to run the data envelopment analysis. According to the data envelopment analysis, it has been found that private sector banks, on average, run far more efficiently than public sector banks. Among fourteen banks considered in the present study, five banks are technically efficient under Charnes Cooper Rhodes (CCR) model and eight banks are technically efficient under Banker Charnes Cooper (BCC) model. Besides, the most efficient banks are from the group of private banks. The study also reveals that managerial inefficiency is the main cause of overall technical inefficiency of public sector banks than scale inefficiency. If banks are sick and are not running efficiently, then the whole economy would face challenges that might have great negative outcomes. To reach the level of efficiency, the inefficient banks should either minimize their input level for the given output or maximize their output with the given level of input.

Key Words: *Data Envelopment Analysis, Private Sector Bank, Public Sector Bank, Technical Efficiency.*
JEL Classification: *G21, G29.*

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Introduction

A healthy and sound banking system is necessary for an economy to grow. As long as an asset creates positive cash flows, it would be good, whereas if it fails to do so, it throws a negative impact on overall performance. Only an efficient bank can enlarge its business and reach customers (Maity & Ganguly, 2019) with reasonable operational costs (Maity & Sahu, 2018). The present study is an initiative to analyse the technical efficiency (TE) of selected public sector banks (PSBs) and private sector banks (PVBs) in India.

In the present market, PVBs have captured a major share of the banking market, which is now called as new PVBs. Their growth rate in terms of number of branches, number of bank employees, bank deposits and bank credits were much more impressive than that of PSBs. All PSBs and PVBs play a major role in the economic growth of the country. Banks provide a variety of financial services to their customers, like deposits, withdrawals, loans, payment services, remittance facility and insurance products. The performance of any institution is often evaluated in terms of its efficiency in the use of its resources (Saha & Ravisankar, 2000). Only efficient banks can grow their business in the form of deposits and credit, reach the customer and finally, guide policymakers in their decision-making process through developed decision-making tools. Efficient banks are better able to compete because of their lower operational costs. The present study measures TE through Data Envelopment Analysis (DEA) of PSBs and PVBs and further, makes a comparison between these bank groups. DEA still appears to be an ever-growing field. Till 2015, the Web of Science exhibits 10,720 DEA publications (Wojcik et al. 2017). The present study is structured in five sections. The first section gives an introduction; the second section highlights literature review on efficiency measurement followed by data & methodology and analysis & discussion under the third and fourth sections respectively. Conclusion with future scope is given in the fifth section.

Review of Literature

The researcher has surveyed the literature of efficiency measurement in the financial sector by applying DEA. The technique of DEA is a non-parametric estimation technique that has been used widely to measure the TE. The previous literature collected on recent studies has been summarized below:

In a study, Angelidis & Lyroudi (2006) have examined the productivity of 100 large Italian banks during 2001-2002 by using DEA. They employed DEA to find Malmquist indices of total productivity change, which is then put to use in examining productivity change of the financial institutions of the most recent member of European Union countries. Elyasiani & Mehdian (1995) have investigated the trends in TE and technological change for large and small US commercial banks during 1979-1986. Feroze (2012) has employed DEA to assess the efficiency of District Cooperative Banks (DCBs) in Kerala during 2005-2009. The empirical results of the study revealed that the level of efficiency in DCBs was 74 percent and the magnitude of inefficiency was 26 percent. Six DCBs obtained an efficiency score equal to 1 and formed an efficient frontier. Valadkhani & Moffat (2009) have measured the efficiencies through DEA of 10 major financial institutions in Botswana during 2001-2006. Using DEA, Maity & Sahu (2017) have measured the performance of State Bank of India (SBI) and associates for 2011-2016 with three output variables (deposits, advance and total income) and four input variables (branches, ATMs, assets and gross NPA). They have reported that before mergers took place, most of the associate banks of SBI operated at an efficient level and the mergers will help to decrease unhealthy competition between SBI and its associate banks, mitigate the risk and better focus on defaulters.

Saha & Ravisankar (2000) have suggested that in the Indian context, DEA could be a suitable approach towards measuring efficiency of banks. Among the variables, deposits and advances etc. are output variables and number of branches and number of staff

etc. are input variables. In their analysis, an attempt was made to quantify relative efficiency in the form of total weighted output by total weighted input. The weights have been obtained using DEA for each bank by solving a linear objective function. Results of the analysis indicate that, except for few exceptions, PSBs have in general improved their efficiency scores over the years 1992 to 1995. Despite this, a few banks like United Bank of India, UCO Bank, Central Bank of India and Syndicate Bank continued to be at the lower end of relative efficiency scales.

Further, Kumar & Gulati (2008) have evaluated the extent of Overall Technical Efficiency (OTE), Pure Technical Efficiency (PTE), and Scale Efficiency (SE) of 27 Indian PSBs in the year 2004-05. Besides this, an attempt has been made to explain the impact of environmental factors (like market share, asset quality, exposure to off-balance sheet activities, size, and profitability) on the OTE of the PSBs. The results reveal that out of 27 PSBs, 7 banks have OTE scores equal to 1 and 12 banks have PTE scores equal to 1. Average OTE of all the 27 banks was 88.5 percent. In another study, Maity & Sahu (2018) have examined the role of Indian banks in financial inclusion and also measured the comparative efficiency of PSBs and PVBs toward financial inclusion. Using DEA, the study reveals that four banks were efficient and lie on the efficient frontier under CCR model, and ten banks are efficient under BCC model.

Mazumdar (2019) has examined the efficiency of the selected banks in India for the years 2000-01 to 2014-15 through DEA. The results find that foreign banks, as a group, are the most efficient. Maity & Ganguly (2019) have analysed the trend in efficiency level during the pre and post-demonetization phase from April 2014 to March 2018 by using DEA. To analyse the TE of the banking sector, total assets, total expenses and net non-performing assets were considered as input variables and total income as output variable, which includes interest income and non-interest income.

Das & Ghosh (2006) examined the performance of banks during post-reform period 1992-2002 in India. Medium-sized PSBs were found to perform at a higher level of TE. Yue (1992) has demonstrated the use of DEA to find out the relative efficiencies of 60 commercial banks in Missouri for the period 1984 to 1990. Two alternative models of DEA have been used for evaluation: CCR model and the additive DEA model followed by window analysis of the efficiencies obtained. Chander & Chandel (2010) have analysed the financial efficiency and viability of HARCO Bank and found the bank to have performed poorly on capital adequacy, liquidity, earning quality and management efficiency parameters. Further, Burgstaller (2013) considered total funds, fixed assets and total costs as inputs, and outputs produced comprise total loans, other earning assets and non-interest income to measure efficiency in regional banking market through DEA.

In their study, Pai et al. (2020) investigated which model is appropriate (CCR or BCC model) under the same business units and different business units. Other studies by Moslemi et al. (2019), Paradi & Zhu (2013), Wanke et al. (2019) have also highlighted the importance of DEA model in measuring efficiency in the banking sector.

The above studies show that there have been widely used DEA applications to measure efficiency of financial institutions or banks by considering different parameters as input and output variables.

Objectives and Hypotheses of the Study

The following are specific objectives of the present study:

1. To assess the technical efficiency of Public Sector Banks and Private Sector Banks in India.
2. To make a comparative study of technical efficiency between Public Sector Banks and Private Sector Banks in India.

To study the above objectives, the researcher has set the below hypotheses.

Hypothesis-I:

Null Hypothesis (H_0): Private Sector Banks are not really more efficient than Public Sector Banks in India.

Alternative Hypothesis (H_1): H_0 is not true.

Data And Methodology

Data

This study is based on secondary data. The data required for this study have been extracted from the annual reports of Reserve Bank of India (RBI) and annual reports of the selected banks considered in this study. The study covers ten years starting from 2008-09 to 2017-18. Besides, annual reports of RBI, banks' secondary data have also been collected from various sources viz., books, journals, websites, etc. Data is gathered for an optimum period for accurate results. The present study is based on seven largest private banks and seven largest PSBs based on the sum of net interest income and other income as of March 2018.

Statistical and Econometric Tests Used

The basic measures of efficiency with one input and one output can be written as:

Efficiency = Output ÷ Input

Method of DEA introduced by Charnes et al. (1978) to address the problem of efficiency measurement for Decision-Making Units (DMUs) with many inputs and many outputs has been applied. To analyse the efficiency of banks' DMUs OTE (CCR model) under Constant Return Scale (CRS) assumption and PTE (BCC model) under Variable Return Scale (VRS) assumption have been used. Also, the SE can be derived by the ratio of OTE to PTE. As introduced by Charnes et al. (1978), the efficiency measure for the DMUs can be calculated by solving the following mathematical programming problem assuming that there are 'n' DMUs, each with 'm' inputs and 's' outputs:

$$\max \frac{\sum_{r=1}^{s} v_r y_{ro}}{\sum_{i=1}^{m} u_i x_{io}}$$

subject to

$$\frac{\sum_{r=1}^{s} v_r y_{rj}}{\sum_{i=1}^{m} u_i x_{ij}} \leq 1; \ (j = 1, 2, \ldots, n);$$

$$u_i, v_r \geq 0$$

Where, i =1, 2, ……., m; r = 1, 2, ……., s; yrj = amount of output 'r' produced by DMU j; xij = amount of input 'i' utilized by DMU j; vr= weight given to output r; ui= weight given to input j. To evaluate each DMU's relative efficiency score, it transformed into a linear programming problem.

$$\max \sum_{r=1}^{s} v_r y_{ro}$$

subject to

$$\sum_{r=1}^{s} v_r y_{rj} - \sum_{i=1}^{m} u_i x_{ij} \leq 0; \ (j = 1, 2, \ldots, n);$$

$$\sum_{i=1}^{m} u_i x_{ij} = 1;$$

$$u_i, v_r \geq 0$$

Banks or DMUs, on the efficiency frontier, have an efficiency score of 1. Lower scores indicate inefficient or low-efficiency level. MaxDEA 5.2 has been used to measure input-oriented TE of banks through DEA. Further, descriptive statistics like mean, maximum and minimum values, standard deviation of all the variables are determined to know the data character.

Variables of the Study

To analyse the data using DEA, the present study considers two output variables and three input variables. After a careful review of earlier literature and considering present research objectives, the study selected these input and output variables. Here, the researcher would like to assert that the choice of the variables followed two criteria: relevance and availability.

Input Variables:

Total Assets: It represents the size of the banking business which earns revenues for the bank. The bank's total assets include fixed assets, cash, balances with RBI, balances with banks in India and outside India, money at call and short notice, investments including advances, etc.

Number of Branches: The total assets of a bank also depend on branch size or number of branches. The increase in income or increase of the bank's business also depends on the number of branches. Higher the number of branches, greater is the bank's business and interest income. So, the researcher has considered number of branches as another input variable.

Expenses: It includes operating expenses, provisions and contingencies. Operating expenses include all operational costs, viz. employee costs, administrative costs, advertisement, rent, stationery, etc.

Output Variables:

Net Interest Income: Banks earn interest from advances and pay interest on deposits. Net interest income is considered as an output variable that measures the difference between interest earned and interest expended.

Other Income: In addition to interest income, banks also earn income from different sources, which form a large portion of banks' total income. Hence, other income is considered as another output variable.

Analysis And Discussion

The basic statistical values of the variables are presented in the first phase of the study. The descriptive statistics provide a historical background for the behaviour of the data used in the study. The descriptive statistics [Table 1] indicate that the variables used in the study are not stable between the banks during the study period. The table shows that there is bank-to-bank variation in respect of total assets, number of branches, expenses, net interest income and other income.

Before analyzing the efficiency, the researcher has examined assumptions of "isotonicity" relationship among input and output variables. The results find positive correlations among all of them and satisfy the isotonicity assumptions (Golany & Roll, 1989). The correlation coefficient ranged from 0.9239 to 0.9943 as depicted in Table 2.

The efficiency scores of each of the banks included in the sample are shown in Table 3. The mean efficiency score of Indian banks is 0.8859 as per Model-A (CCR Model) and 0.8983 as per Model-B (BCC Model) of the study. Table 3 shows that as per Model-A, all the top 5 banks are private banks. As per the Model-B, of the top 8 banks, 7 banks are private banks and from the public sector group, only SBI is on top. The top banks in terms of efficiency under both the models include Axis Bank Ltd., Federal Bank Ltd., HDFC Bank Ltd., ICICI Bank Ltd. and Yes Bank Ltd. and all these five banks are private. They have equal OTE and PTE and operating under CRS. The rest of the banks are operating either at Increasing Returns to Scale (IRS) or Decreasing Returns to Scale (DRS).

Table - 1: Descriptive Statistics

Banks	Net Int. Income (Rs. In billion)	Other income (Rs. In billion)	Total Assets (Rs. In billion)	No. of Branches	Total Expense (Rs. In billion)
Bank of Baroda	108.4	42.7	4007.9	3051	103.2
Bank of India	92.7	40.0	3490.3	2880	100.2
Canara Bank	84.1	41.9	3205.6	3266	87.2
IDBI Bank Ltd.	46.9	32.7	2095.5	1007	72.4
Punjab National Bank	133.3	53.0	3786.3	3695	135.1
State Bank of India	568.5	262.4	14424.8	13561	551.3
Union Bank of India	71.4	30.4	2392.3	2422	70.6
Axis Bank Ltd.	112.7	71.2	3018.4	1686	112.8
Federal Bank Ltd.	22.2	7.4	576.3	724	16.1
HDFC Bank Ltd.	196.8	79.4	4151.0	2444	149.8
ICICI Bank Ltd.	151.6	112.4	4149.2	2507	142.9
Indusind Bank Ltd.	31.0	20.8	815.3	552	31.6
Kotak Mahindra Bank Ltd.	43.7	17.4	949.1	582	36.1
Yes Bank Ltd.	30.7	19.6	1037.1	459	28.6
Mean (PSBs)	157.9	71.9	4771.8	4269	160.0
Mean (PVBs)	84.1	46.9	2099.5	1279	74.0
Overall Mean	121.0	59.4	3435.6	2774	117.0
Standard Deviation	138.5	64.8	3423.1	3299	132.4
Minimum	22.2	7.4	576.3	459	16.1
Maximum	568.5	262.4	14424.8	13561	551.3
Kurtosis	9.6	8.1	9.3	10.3	10.4
Skewness	2.9	2.7	2.8	3.0	3.0

Source: Calculated by Researcher

Table 2: Correlation among the Input and Output Variables

	Net Interest Income	Other Income	Total Assets	No. of Branches	Expenses
Net Interest Income	1				
Other Income	0.9770	1			
Total Assets	0.9863	0.9652	1		
No. of Branches	0.9629	0.9239	0.9835	1	
Expenses	0.9943	0.9772	0.9933	0.9757	1

Source: Calculated by Researcher

The average of TE scores turned out to be 0.9946 under Model-A and 1.0000 under Model-B for the 7 PVBs and 0.7772 under Model-A and 0.7966 under Model-B for the 7 PSBs as presented in Table 3. This suggests that on average, if PVBs produce outputs on the efficiency frontier instead of its current (virtual) location, would need only 99.46 percent under Model-A and 100 percent under Model-B of the inputs currently being used. This also suggests that on average, if PSBs produce outputs on the efficiency frontier instead of its current (virtual) location, would need only 77.72 percent under Model-A and 79.66 percent under Model-B of the inputs currently being used. This suggests that, by adopting best practice technology and enhancement of managerial efficiency, PVBs can, on average, reduce their inputs of branch, assets and expenses by at least 0.54 percent under Model-A and still generate the identical level of output. Under Model-B, all the selected PVBs are operating at efficiency frontier with no chances for further reduction of input level for the same level of output under DEA model.

Table 3: Results of Technical Efficiency under CCR Model and BCC Model

No.	DMU	Model-A	Model-B	Scale Efficiency Score (OTE/PTE)	Return to scale
		Technical Efficiency Score (OTE)	Pure Technical Efficiency Score (PTE)		
1	Axis Bank Ltd.	1	1	1	CRS
2	Bank of Baroda	0.7953	0.7966	0.9984	DRS
3	Bank of India	0.7182	0.7189	0.9991	IRS
4	Canara Bank	0.7833	0.7841	0.9990	IRS
5	Federal Bank Ltd.	1	1	1	CRS
6	HDFC Bank Ltd.	1	1	1	CRS
7	ICICI Bank Ltd.	1	1	1	CRS
8	IDBI Bank Ltd.	0.7375	0.7413	0.9949	IRS
9	Indusind Bank Ltd.	0.9906	1	0.9906	IRS
10	Kotak Mahindra Bank Ltd.	0.9713	1	0.9713	IRS
11	Punjab National Bank	0.7500	0.7517	0.9978	IRS
12	State Bank of India	0.8738	1	0.8738	DRS
13	Union Bank of India	0.7825	0.7837	0.9985	IRS
14	Yes Bank Ltd.	1	1	1	CRS
	Average (PSBs & PVBs)	0.8859	0.8983	0.9874	
	Average (PVBs)	0.9946	1	1	
	Average (PSBs)	0.7772	0.7966	0.9802	

Source: Calculated by Researcher
CRS = Constant returns to scale; DRS = Decreasing returns to scale;
IRS = Increasing returns to scale

Further PSBs can, on average, reduce their inputs of branch, assets and expenses by at least 22.28 percent under Model-A and 20.34 percent under Model-B and still generate the same level of output. However, the potential reduction in inputs from adopting best practices varies from bank to bank. Alternatively, PVBs have the scope of producing 1.0054 times (i.e., 1/0.9946) under Model-A and PSBs have the scope of producing 1.2867 times (i.e., 1/0.7772) under Model-A, 1.2553 times (i.e., 1/0.7966) under Model-B with the same level of inputs of branch, assets and expenses. Overall, of the selected sample, fourteen banks have the scope of producing 1.1288 times (i.e., 1/0.8859) under Model-A and 1.1132 times (i.e., 1/0.8983) under Model-B as much as outputs from the same level of inputs being used.

This means that as a group, more private banks are in the highest efficiency score than PSBs. As a group, the PSBs have displayed a lower efficiency level in both models. The study concludes that H_0 is rejected and H_1 is accepted. The result shows that PVBs are more efficient than PSBs in India. Table 3 shows that average PTE for the fourteen banks has been observed to be 0.8983 which implies that 10.2% (1-0.8983) of total 11.4% (1-0.8859) inefficiency is due to managerial inefficiency and the rest 1.2% (1-0.9874) is due to scale inefficiency.

Conclusion

In the present study, the researcher has measured the TE of Indian commercial banks by using DEA. Further, it compares the TE between PSBs and PVBs. The study finds that PVBs have been the most efficient, and PSBs are the least efficient, in utilizing the resources to deliver financial services to their customers. This result is consistent with the results of Mazumdar (2019) that PSBs, in general, are poor performers. This result contradicts the results of Dhar (2012) that PSBs are the most efficient and privately-owned banks are least efficient. The results of Sathye (2003) have found that efficiency of private banks as a group is, paradoxically lower than PSBs. Bhattacharyya et al. (1997) have found that publicly-owned banks are most efficient in utilizing resources to render services. The present study finds that Indusind Bank Ltd., Kotak Mahindra Bank Ltd. and SBI are efficient under BCC model (VRS assumption) but not efficient under CCR model (CRS assumption). This study can conclude that the TE in these three banks is caused by operations of the banks with inappropriate scale size. Among these three banks, Indusind Bank Ltd. and Kotak Mahindra Bank Ltd. are under IRS; thus, they have not taken full advantage of IRS to improve their efficiency level. It has been further noticed that Bank of Baroda, Bank of India, Canara Bank, IDBI Bank Ltd., Punjab National Bank and Union Bank of India have PTE score less than SE score. This indicates that the inefficiency in resource utilization in these six banks is due to managerial inefficiency rather than caused by operations of the banks with inappropriate scale size (Kumar & Gulati, 2008).

In a study by Saha & Ravishankar (2000) where efficiency scores have been estimated only for 25 PSBs, the estimates ranged from 0.58 to 0.74 in 1995 and the mean score was 0.69. Mean efficiency score was estimated at 0.885 by Kumar & Gulati (2008) for the study period of 2004-05 of Indian PSBs with efficiency scores of inefficient banks ranging from 0.632 to 0.974. In the present study, mean efficiency scores of PSBs range from 0.777 to 0.797 with a minimum efficiency score of 0.718 and of PVBs, ranged from 0.995 to 1.000 with a minimum efficiency score of 0.971, which is better than PSBs. These indicate that PVBs are working more efficiently than PSBs in India. The study also reveals that managerial inefficiency is the main cause of overall technical inefficiency of PSBs than scale inefficiency. Expansion of branch in large numbers with a low volume of business in rural and semi-urban areas may be another cause of lower efficiency scores than private banks. Finally, the results provide a useful lesson about bank efficiency and comparison among public and private banks. This study will help the banks to check their efficiency level and to consider various strategies for augmenting efficiency. Subsequent research may be investigated whether higher TE score by private banks

is due to better managerial control or due to technology-driven products and services. This will help other bank groups to escalate their efficiency level by taking proactive decisions.

Applicability and Generalizability

It is needless to say that the DEA is a wonderful method for benchmarking and for computing the efficiency of DMUs. While various traditional methods measure performance in monetary terms, DEA is an important methodology of performance evaluation for activities which are characterized by non-financial data (Dyckhoff & Souren, 2020).

Before using the DEA to measure efficiency, the researcher has examined the isotonicity assumption. The positive correlations among the variables satisfy the isotonicity assumptions and fulfil to run the DEA. The DEA techniques are useful for those DMUs which are homogeneous and in the same line of business.

In the present study, the banks are homogeneous from the operational point of view, though their scale of operations, the focus of business and technology employed may vary. Here, DMUs number is fourteen (selected fourteen banks) i.e., more than twice the number (i.e., ten) of input and output variables in this analysis. Therefore, in the present analysis, the proposed DEA model has high construct validity.

In the present study, the data is obtained from the annual reports of RBI and annual reports of the selected banks considered in this study. As the data is collected from the regulator's website and websites of the selected PSBs and PVBs and hence, authenticity is not an issue.

An important contribution of the paper is the classification of reasons behind the inefficiency i.e., managerial or inappropriate scale size. These results indicate that bank managers have to improve the cost aspects of their operations. Based on the nature of PSBs and PVBs activities, it is evident that banks have a large volume of fixed assets and branches. The optimisation of branches would also lead at the same time to further reduction of costs (Fukuyama & Matousek, 2017).

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