



INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Measuring Technical Efficiency Of Indian Private Banks Using DEA Based - CRR Model

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Abstract

DEA based CRR model is a very effective non-parametric tool to find the technical efficiency of any organisation, termed as DMU. The present study uses DEA approach to estimate technical efficiency of five private commercial banks in India based on the data for the year 2018-19. Two of the five selected banks, HDFC bank and Kotak Mahindra bank, are found to be efficient ($\lambda=1$). ICICI bank, Axis bank and Federal bank are found to be inefficient based on the variables selected for the present study. The major factor resulting in poor performance of all the three banks is mismanagement of fixed assets. In case of Federal bank it is found that the input- Deposits has under-performed. Findings of the study reveal that some portion of the bank's inputs are freely disposed or lost. Thus for increasing the efficiency these banks must fully utilise their inputs to gain maximum output.

Keywords: CRR model, CRTS, DEA technique, DMU, Private bank and Technical Efficiency.

1. Introduction

Indian banking sector was liberated for free entry of domestic private banks and foreign banks in the banking business. In the post-liberalisation era domestic private banks and foreign banks started their operations in competition with the public sector banks in India. In the present era the operation of banking companies are geographically widespread; also with the help of IT, technological innovative services are provided to its customers. Banking being a service industry, the efficiency of its services is directly related to the profitability and success of the bank. Efficient banking system contributes extensively towards the economic growth of the country. Data Envelopment Analysis technique is frequently used to measure the efficiency of various organisations known as Decision Making Units (DMU). There are many studies that have used DEA technique to measure the efficiency of Indian commercial banks. The present study has applied DEA to find the technical efficiency of 5 private commercial banks operating in India.

2. DEA Technique

Data Envelopment Analysis (DEA) Technique is "a non-parametric technique that generates a comparative ratio of weighted outputs to inputs for each decision making unit i.e. a relative efficiency score". Originally this technique was employed to investigate the relative efficiency of not for-profit organisations only. Looking at its significance it was adopted by computing the efficiency of profit-making organisations. DEA method is simpler method of computing the overall efficiency, in which the researcher requires to make a prior choice of

entities (termed as Decision Making Units - DMUs) that are to be evaluated. Also the variables of *Input and Output* that are used for evaluation are to be predetermined for designing the research model.

3. DEA based CRR Model

Charnes, Cooper and Rhodes initially proposed the CRR model in the year 1978, assuming constant return to scale (CRTS) frontier. Under the CCR model, the overall efficiency (OE) of a DMU is computed; OE aggregates the Technical efficiency (TE) and Scale efficiency (SE) of a unit. Assumption of constant return to scale indicates that an increase in Input will results in proportionate increase in Output of the DMU under consideration. CRR model can be either: (a) *Input oriented model*, which focuses on increasing the efficiency of a DMU by decreasing the inputs keeping the output level constant. This is also called as the *Minimization* model. (b) *Output oriented model* focus on increasing the output keeping the input level constant. This is also called the *Maximisation* model.

In the present study, CRR maximisation model is employed which is mathematically represented as follows:

$$\text{Max } \theta_k = \frac{u_1 y_{1k} + u_2 y_{2k} + \dots + u_s y_{sk}}{v_1 x_{1k} + v_2 x_{2k} + \dots + v_m x_{mk}},$$

Subject to

$$\frac{u_1 y_{1j} + u_2 y_{2j} + \dots + u_s y_{sj}}{v_1 x_{1j} + v_2 x_{2j} + \dots + v_m x_{mj}} \leq 1, \quad (j=1, 2, \dots, n)$$

$$v_1, v_2, \dots, v_m \geq 0$$

$$u_1, u_2, \dots, u_s \geq 0,$$

Where, k is the generic DMU and its efficiency is θ_k .

Solving this fractional problem for each DMU, one gets the efficiency scores of

$$0 \leq \theta_k \leq 1, \quad (k=1, 2, \dots, n)$$

Efficient DMUs will have the score equal to 1 whereas Non-efficient DMU will have the score of less than 1.

4. Research Methodology

The present study is based on the objectives: To compute and study Technical Efficiency (TE) of selected Private Banks in India. The sources for collection of Secondary data are Annual Reports uploaded on the original website of Selected Private Commercial Banks. Five private commercial banks are selected for the present study. They are ICICI, HDFC, Axis bank, Kotak Mahindra bank and Federal Bank. Data relating to Deposits, Fixed assets, Investments and Interest Income for the year 2018-19 is collected.

For DEA analysis they are referred to as DMU1, DMU2, DMU3, DMU4 and DMU5 respectively. Deposits, Fixed assets and Investments are considered as **Input** and Interest income is taken as **Output** for conducting DEA analysis. DEA Software – DEAP Version 2.1 is employed for running the model.

5. Literature Review

Singh and Kaur (2016) undertook a study to calculate the relative efficiency of public and private sector banks of India by applying DEA approach. Findings of the paper suggest that private sector banks are more efficient than the public sector banks. As per the authors, 'the banks like HDFC, Federal bank, Yes bank and other private banks achieve 100% efficiency in all the observed ten years, but the public banks like United Bank of India, State Bank of Hyderabad, Central Bank of India etc. could not achieve 100% efficiency not in an observed single year. Goyal et al. (2018) developed a DEA model applying directional distance based meta-frontier DEA approach to 66 Indian banks from the period 2015-2016. The results of this study shows that Indian banking system is not fully efficient (efficiency is only 73.44%).

Gulati and Kumar (2017) computed the efficiency of banks using the two-stage network data envelopment analysis (NDEA) model to obtain intermediation, operational and overall bank efficiency of the Indian banking industry. By applying the bootstrapped truncated regression the authors suggest that the efficiency depend on the bank size, liquidity position, directed lending and intermediation cost. Ray (2016) in his research study estimated the overall cost efficiency network of branches of a public sector banks in India. The branches selected for the study were in the geographical area in the city of Calcutta, using the data collected for the year 2012. The objective of the study was to find the optimal number of branches to be opened within a postal district for the bank to operate at the least operational cost. The finding of the study shows that reduction in the number of branches will be more cost efficient. Shimpi L (2017) studied the efficiency of private banks providing e-banking services to its customers. The findings of the study suggest that private banks were more technically sound in providing e-banking services to its customers.

Zhu and Zhang (2018) carried out a comparative study to find the operational efficiencies of banks operating in China and India using the data for the year 2012 and 2013. The study has different models showing variations in the efficiency scores by variation in the input-output variables selected for the study. The findings of the study show that the mean technical efficiency score of Chinese banks is higher than the

Indian banks in 2012-2013. Tamatam et al. (2019) evaluate three efficiencies (overall technical, pure technical and scale) by selecting 17 private and 21 public sector banks belonging to Indian banking sector. The study covered the period from 2008-2017. They developed 18 different DEA models. The models were compared using non- parametric statistical tests. Their findings suggest that the efficiency calculated by different DEA models is dependent on two variables: ownership type and size of the banks.

6. Empirical Findings

Five private banks belonging to Indian banking sector has been selected for the present study. Data collected for the year 2018-19 have been collected on the various 'inputs' and 'output' variables as mentioned in research methodology paragraph. The data collected is analysed using DEA-CRR model. The overall technical efficiency (TE) of the 5 banks calculated by the constant return to scale (CRTS) is mentioned in table 1. Only DMU2 and DMU4 emerged as efficient with score 1. Rest DMUs are found to be inefficient showing that these DMUs are suffering input losses. The technical efficiency variations for the five private banks have the following bound:

$$0.844 \leq (\lambda) \text{ CRTS} \leq 0.943$$

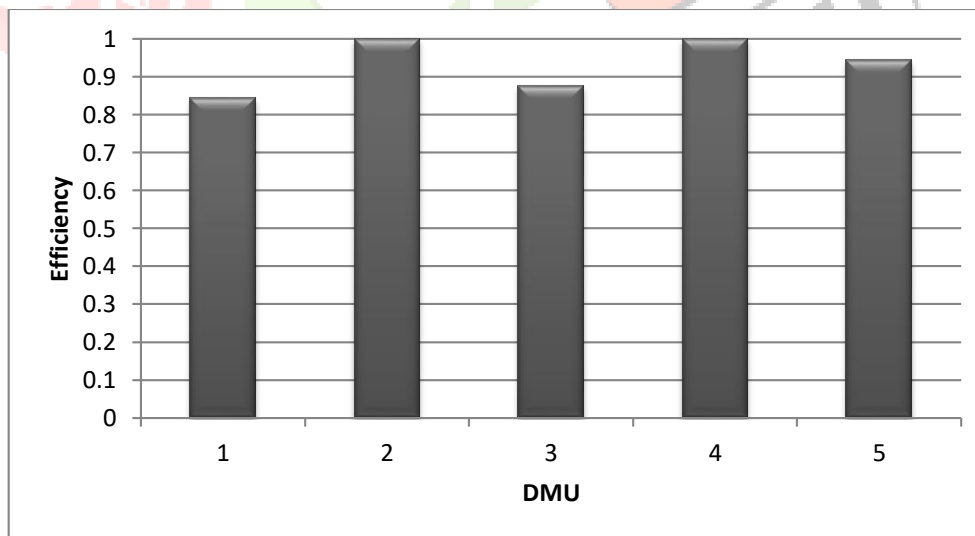
The technical efficiency (λ) of DMU 1 is 0.844, this mean that the output of this DMU is only 84.4% of its inputs. 15.60% of the inputs are lost or freely disposed. This bank can increase its efficiency by better reduction in the inputs.

Table 1
Efficiency Summary

DMU	Technical Efficiency Score	Rank	Reference(λ)
1	0.844	5	4
2	1	1	2
3	0.876	4	4
4	1	1	4
5	0.943	3	2,4

DMU5 has efficiency of 94.3% and has ranked 3 in the five private banks selected for the present study. DMU1 has the least score in the set of five selected private sector banks. Reference set presented in the above table refers to that efficient DMU which match in scale size. The technical efficiency of the 5 banks is graphically presented in the following figure.

Figure 1
Efficiency score of DMUs



The CRR statistics of the analysis is presented in table 2. The total number of banks selected for the present study is 05. Out of this 2 banks are found to be efficient (TE=1) and 3 banks are found to be inefficient (TE<1).

Table 2
CRR Statistics

No. of efficient DMUs	02
No. of inefficient DMUs	03
Average	0.9328
Max	1
Min	0.8442
Standard Deviation (SD)	0.0711

Analysis of the above table shows that the average technical score of the group of the selected private banks is 0.9328, whereas the minimum score is 0.8442. The standard deviation (SD) is 0.0711. The TE of the inefficient DMUs range between 0.8442 to 0.943.

7. Conclusion

HDFC bank and Kotak Mahindra bank are found to be efficient (λ) based on constant return to scale (CRTS). ICICI bank, Axis bank and Federal bank are found inefficient on the basis of the input and output variables selected for the present study. Study of the slack shows that for Federal bank reduction its input (deposits) by Rs. 35123 can increase its efficiency. This can be explained as the input 'deposits' is under-utilised by the bank. Similarly for ICICI bank reduction in input (fixed assets) can improve the efficiency of the bank. In other words, fixed assets of this bank are mismanaged resulting in reduction in its efficiency.

DEA based CRR model has proved to be an important mathematical model in computing the technical efficiency of banks. Results of application of this model in the present study have highlighted the grey area which is mismanaged by the bank. Improvement in management of those inputs has the potential to increase the efficiency of the said bank.

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