

# Quarterly Performance Benchmarking of Selected Banks in India- A DEA Approach

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## Abstract

The study is a novel idea aimed at evaluation the quarterly performance of banks in India for the recent three years. Evaluating and assessing the efficiency will help banks in recognizing the areas of inefficiency and framing appropriate strategies to increase its position in the market. The study analysed the quarterly efficiencies of selected public sector and private sector banks in India for recent three-quarters of FY 2016-17 using the non-parametric performance evaluation technique of Data Envelopment Analysis. A total of 20 banks, 15 public sector, and 5 private sector banks, were selected as samples for the study. Out of sample units studied, some of the banks proved consistency in performance during the study period, and also most of the banks did not have consistency, mainly public sector banks. The contribution is a novel idea that demonstrates that an efficiently performing company may not always remain efficient and vice versa and management have to keep a check on the performance on a continuous basis. For an inefficient bank to become efficient, target input levels for underperforming banks are also suggested. The slack inputs give a direction for managers in banks in identifying the areas of optimisation viz. minimisation of inputs for the efficient performance.

**Key Words:** Performance evaluation, efficiency, benchmarking, bank, DEA, Slack Variables.

**JEL classification:** G21.

## 1. Introduction

### Motivation

In the highly volatile, uncertain, complex and ambiguous business world, companies always strive to stay competitive. To know whether they are competitive enough, companies measure their performance and optimise accordingly in order to remain competitive and improve their competitiveness in the market. One of the key performance indicators is the efficiency of performance. A relative measure of efficiency provides a good indicator of performance in a competitive market. The banking industry is one of the highly competitive industry with even foreign banks also competing for a share in the industry. Therefore, evaluating the efficiency will help banks in identifying the areas of inefficacy and formulating suitable strategies to improve its relative position in the market. It can also provide a framework to the regulators to assess the financial soundness of individual banks, specifically public sector banks and to work out appropriate interventions to prevent systemic failures.

## 2. Review of Literature

The literature on performance evaluation of firms has been a multi-dimensional area of research since last two decades. Performance efficiency are evaluated based on two broad approaches parametric and non-parametric. Parametric approaches include qualitative study, hypothesis testing, regression analysis, Performance Index and so on. Whereas, the most important and widely used non-parametric approach is Data Envelopment analysis in the banking sector. Saha and Ravishankar (2000) of National Institute of Bank Management located in Pune, based on their empirical study on banks, suggested DEA as the most apt methodology for relative efficiency evaluation of banks and even gave credits to the DEA methodology as superior to the conventional ratio analysis adopted for performance evaluation. Therefore, the study focusses on performance evaluation of selected public and private sector domestic banks employing DEA methodology.

Saha and Ravishankar (2000), in their study, the input variables used were number of branches and employees, interest, establishment, and non-establishment expenditure and the outputs used were deposits, advances, investments, interest and non-interest income, total income and working funds. Their results indicate that most of the public sector banks have improved their efficiency scores over, barring few such as Syndicate Bank and Central Bank of India continued to be at the lower end of the relative efficiency during their study period.

Sathye (2003) studied the performance efficiencies of banks in India and compared their efficiencies with that of other countries. Their sample included 27 public sector banks, 33 private banks, and 34 foreign banks. As per their

study, State Bank of India and Bank of Baroda were the two public banks in India that were on par with global banks in terms of efficiency. Their study also reported that public sector banks in India were more efficient than private sector banks and foreign commercial banks. In the study involving 27 public sector banks in India of Kumar and Gulati (2008), various efficiencies of all the banks were evaluated and analysed for the FY 2004-05, out of which 7 were identified as most efficient. Their empirical findings reveal that the public sector banks have an average overall technical efficiency of 88.5%. However, they generalised on the input reduction of 11.5% with reference to the efficient banks. Das & Ray (2010) evaluated the cost and profit efficiency of commercial banks in India using DEA and analysed the statistical distribution of the efficiency. Their results indicated that state-owned banks performed better than their counterparts including private and foreign banks.

Rajput & Gupta (2011) studied the technical efficiency of public sector banks in India during the post-reforms period from 1992-1993 to 2009-2010. The results showed a positive impact on twenty banks out of the twenty-seven and remaining seven banks showed an egeative impact. Bapat (2012) calculated the efficiencies for the FY 2007-08 to FY 2009-10 and observed that efficiency of banks came down in the year 2008-09. Post that, the efficiency had beaten earlier figures indicating the revival of the banking sector. Das and Kumhakar (2012) attempted to know the efficiency and productivity of Indian public and private sector banks during the post-reform period 1996-2005, by using hedonic aggregator function. In their study, they observed and identified that productivity of public sector banks exceeded the efficiency of private sector banks during the study period. Bandyopadhyay and Ganguly (2012) Estimation of default and asset correlation is crucial for banks to manage and measure portfolio credit risk. Different correlation estimates provides an incentive to optimize the portfolio's risk profile by investing in different classes of assets.

Arif and ahmed (2012) multiple regressions show that liquidity risk affects bank profitability significantly, with liquidity gap and non-performing as the two factors exacerbating the liquidity risk. They have a negative relationship with profitability A severe liquidity crisis may develop into a complete capitalization crisis within a short period. It can be concluded that the harmful effects of liquidity can be avoided by maintaining sufficient casher serves, high provisioning of NPLs also reduces the profitability of the banks. Jayaram and Srinivasan (2014) studied on 34 Indian banks based on cost, revenue, and profit efficiency by using DEA and Shannon entropy method, the main objective of this paper is to find out a comprehensive efficiency index and found out banks which are close to efficient frontier ranked better when compared other banks which are away from the efficient frontier.

Aliasghar and Akbar (2014) conducted a study on performance evaluation and ranking the branches of the bank in Iran using Fuzzy AHP and TOPSIS a Multi-

criteria decision-making approach aimed to rank the branches of a bank based on interest-free loan funds by synthesizing financial and non-financial performance. Woong, Tseng, Deng and Lee (2014) development of a financial performance measurement model to evaluate a bank's financial performance using a set of factors from the CAMEL (Capital adequacy, Assets, Management Capability, Earning and Liquidity) system. The stochastic setting of the efficiency measurement is handled in determining the bank's future financial operations to improve the overall financial soundness of the bank.

Kumar and Gulati (2016) examined the performance of Indian banking sector in terms of efficiency using DEA based meta-frontier framework to compare the efficiencies of different ownership groups viz. public and private, including foreign banks. Their study demonstrated that foreign banks employ the most superior production technology and hence are highly profit efficient compared with domestic banks.

Kaveri (2015) worked out in the paper how banks are eager to sell their NPAs to Asset Reconstruction Companies and the several issues like liquidity management, capital, improving loan recovery and cost control and how banks and RBI have taken several measures to this process.

Mahendru & Bhatia (2017) Overall, the cost, revenue, and profit efficiency score for banks belonging to different sectors confirms that Indian scheduled commercial banks were not able to maintain their input output synchronization in terms of cost and revenue. Sharma and Chhabra (2017) attempts in their study about the various reasons for growing NPA along with growing GDP. By substantiating the factors like macro level variables, sector-wise analysis, bank group wise analysis and mechanism to deal with NPA in India. This study concluded in such a way, to boost economy in 2008 corporate lending taken as priority at that time by banks and later on defaultment from their side mounts to the growing NPAs

### **Problem Statement**

Although companies publish quarterly results and the performance indicators for all quarters in a year, the results shown are based on only simple ratios analyses, which consider single input and a single output.

Further, research publications have also focused on either time-series analysis or analysis. One of the gaps identified, based on literature review, is that there is no prior study done in evaluating the quarterly operating performance of banks in India considering multiple inputs and multiple outputs, which is more apt performance indicator than single ratio analysis (Ramanathan, 2003).

With this problem identified, the research attempts to answer the question of how much is the variation in quarterly performance efficiencies of banks in India?

## Objectives and Hypothesis

To answer the research question, the objectives of the study is

- To evaluate the quarterly operational performance efficiencies of public and private sector banks in India.
- To suggest the optimum value for inputs to give efficient output for inefficient banks based on slack variable.

This paper is organized as follows: Section 2 explains the research methodology adopted for performance evaluation, focusing on DEA methodology and details about the various existing models along with the model adopted for the study. The data and estimation procedure is also explained in section 2. Section 3 describes the results and discussion based on the analysis, and finally, Section 4 summarizes the findings and concludes the paper with final comments.

## 3. Methodology

### Econometric Model

Saha and Ravishankar (2000) of National Institute of Bank Management, based on their empirical study on banks, suggested Data Envelopment Analysis (DEA) as the most apt methodology for relative efficiency evaluation of banks and even gave credits to the DEA methodology as superior to the conventional ratio analysis adopted for performance evaluation.

Therefore, the study focusses on performance evaluation of banks employing DEA methodology. This efficiency measure indicates whether a bank uses the minimum quantity of inputs to produce a given amount of outputs or maximizes the output quantity. Avkiran (2006) has stressed on the ability of DEA to handle multiple inputs and outputs even without making any judgment on their importance. Ramanathan (2003) defined efficiency with multiple inputs and multiple outputs as

$$\text{Efficiency} = \frac{\text{weighted sum of outputs}}{\text{weighted sum of inputs}}$$

Further, considering multiple outputs and multiple inputs, efficiency can be written as

$$\text{Efficiency of unit } j = \frac{u_1 y_{1j} + u_2 y_{2j} + \dots}{v_1 x_{1j} + v_2 x_{2j} + \dots}$$

where  $u_1$  = the weight given to output 1,  $v_1$  = the weight given to input 1

$y_{1j}$  = the amount of output from unit  $j$ ,  $x_{1j}$  = the amount of input 1 to unit

Further, the efficiency considering the multiple outputs and multiple inputs mathematically was described by Ramanathan (2003) as given in model.

where

$$\max E_m = \frac{\sum_{j=1}^J v_{jm} y_{jm}}{\sum_{i=1}^I u_{im} x_{im}}$$

$E_m$  is the efficiency of the  $m$ th DMU, subject to

$y_{jm}$  is  $j$ th output of the  $m$ th DMU,

$v_{jm}$  is the weight of that output,

$x_{im}$  is  $i$ th input of the  $m$ th DMU,

$u_{im}$  is the weight of that input, and

$y_{jn}$  and  $x_{in}$  are  $j$ th output and  $i$ th input

$$0 \leq \frac{\sum_{j=1}^J v_{jm} y_{jn}}{\sum_{i=1}^I u_{im} x_{in}} \leq 1; \quad n=1, 2, K, N$$

$$v_{jm}, u_{im} \geq 0; \quad i=1, 2, K, I; \quad j=1, 2, K, J$$

The core aspect of the DEA analysis is deciding the inputs and outputs. DEA is conducted with assumption of constant returns to scale (CRS), or variable returns to scale (VRS). CRS based DEA was proposed in a seminal paper by Charnes *et al.* (1978), and the efficiency was called as overall technical efficiency (OTE). OTE takes into account the size of the bank as well as inefficiencies because of input–output relationship. Later, VRS based DEA approach was proposed by Banker *et al.* (1984) which decomposes OTE into two components, pure technical efficiency (PTE) and scale efficiency (SE). PTE relates to the ability of a firm to utilize the available resources, and SE refers to taking advantage of economies of scale. Thus, the linear programming problem (LPP) based model for output maximization with CRS by Charnes *et al.* (1978) is given as:

$$\text{Maximize } \theta_o = \sum_{r=1}^s u_r y_{ro}$$

subject to:

$$\sum_{i=1}^m v_i x_{io} = 1 \quad i = 1, \dots, m$$

$$\sum_{r=1}^s u_r y_{rj} - \sum_{i=1}^m v_i x_{ij} \leq 0 \quad r = 1, \dots, s$$

$$u_r, v_i \geq 0 \quad j = 1, \dots, n$$

The LPP based, input-minimising model with VRS was developed by Banker *et al.* (1984) as:

$$\theta^* = \min \theta$$

subject to

$$\sum_{j=1}^n \lambda_j x_{ij} \leq \theta x_{io} \quad i = 1, 2, \dots, m;$$

$$\sum_{j=1}^n \lambda_j y_{rj} \geq y_{ro} \quad r = 1, 2, \dots, s;$$

$$\sum_{j=1}^n \lambda_j = 1$$

$$\lambda_j \geq 0 \quad j = 1, 2, \dots, n.$$

Where

$\Theta$  is the dual variable corresponding to equality constraint that normalizes weighted sum of inputs

$\lambda$  is the dual variable corresponding to the other inequality constraints of the primal

### **Data -Sample**

For evaluating the quarterly performance of banks, 20 banks in India were selected in the sample study based on the availability of quarterly data required for analysis and convenience in collecting the data. Out of the total 20 banks selected, 15 are random selected public sector banks, and 5 are the leading private banks in India.

The source of data is published quarterly financial results and press releases of banks on their respective websites. Nagaraju (2014) and Ho(2008) had used operating expenses and employees as two of the inputs in their model in performance efficiency evaluation.

In this study, instead of a number of employees, employee cost is selected as the cost-to-company is more important than the number of employees.

Therefore, input variables chosen for the study are total expenses (excluding employee expenses), employee expenses, and net Non-Performing-Assets (NPAs). The output variables are total income and operating profit.

### **Estimation Procedure**

The performance efficiency of banks is calculated using STATA 13 software package. Since the methodology adopted is non-parametric type, there are no assumptions such as normality, linearity and so on for the variables. The study was conducted for first three-quarters of Financial Year 2016-17. Q4 data are not yet available for all the banks under study and hence not considered in efficiency calculation.

As the study is to evaluate the operational performance of firms, only PTE is calculated for each firm, called as DMU in DEA. In this study, Input-Oriented approach with VRS model is used for PTE evaluation using the BCC model.

## **4. Results and Discussion**

Based on the data collected from the quarterly performance results published, the performance efficiencies calculated under input-oriented VRS assumption and the chart showing the variation of performance efficiency are shown below in Table 3.1 and Fig. 3.1 respectively.

Table 3.1 Efficiency scores & Descriptive Statistics of banks for Q1, Q2, and Q3 of FY2016-17

Bank	Q1	Q2	Q3	Mean Efficiency	CV of Efficiency
dmu:Canara_Bank	0.823766	0.695172	0.818567	0.77	8.90%
dmu:SBI	1.000000	1.000000	1.000000	1.00	0.00%
dmu:Indian_Bank	0.938615	0.800289	0.908452	0.87	7.57%
dmu:Syndicate_Bank	0.835481	0.716510	0.818976	0.78	6.40%
dmu:Indian_Overseas_Bank	0.842452	0.738999	0.825128	0.79	6.40%
dmu:Karnataka_Bank	1.000000	1.000000	1.000000	1.00	0.00%
dmu:Vijaya_Bank	0.912907	0.785397	0.856463	0.84	6.48%
dmu:UCO_Bank	0.886433	0.813482	0.867717	0.85	4.00%
dmu:Central_Bank_of_India	0.787732	0.703866	0.848874	0.78	9.33%
dmu:IDBI_Bank	0.891591	0.808311	1.000000	0.90	10.65%
dmu:Oriental_Bank_of_Commerce	0.938763	0.743851	0.856805	0.83	10.12%
dmu:United_Bank_of_India	0.920177	0.826212	0.869009	0.86	4.51%
dmu:Corporation_Bank	1.000000	1.000000	1.000000	1.00	0.00%
dmu:Bank_of_India	0.884371	0.730036	0.840631	0.81	8.80%
dmu:Bank_of_Baroda	0.871833	0.725527	0.892000	0.82	10.70%
dmu:HDFC	1.000000	1.000000	1.000000	1.00	0.00%
dmu:ICICI_Bank	0.995225	1.000000	1.000000	1.00	0.21%
dmu:Axis_Bank	1.000000	1.000000	1.000000	1.00	0.00%
dmu:Kotak_Mahindra	1.000000	1.000000	1.000000	1.00	0.00%
dmu:Yes_Bank	1.000000	1.000000	1.000000	1.00	0.00%

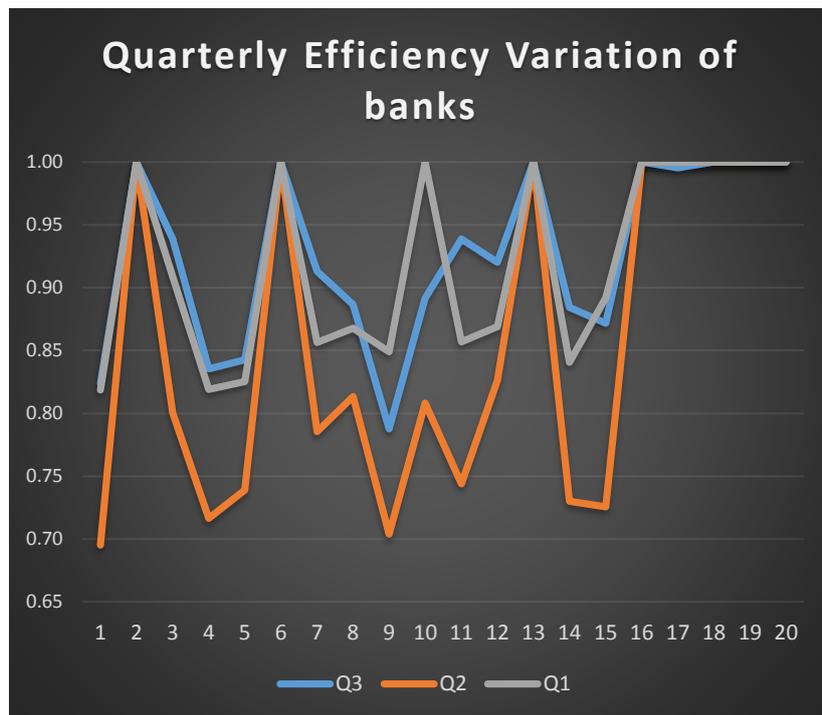


Figure 3.1: Quarterly Efficiency Variation of Banks for Q1, Q2, and Q3 of FY2016-17

It can be observed from Table 3.1, out of 20 banks SBI, Karnataka Bank and Corporation bank in public sector and HDFC, Axis, Kotak Mahindra and Yes Bank in private sector are benchmarking banks for other banks since all the four banks proved consistent performance in all the three-quarters of study period and have also shown zero percent variation in efficiency.

Whereas Canara Bank, Syndicate Bank, Indian Overseas Bank, and Central Bank of India are the least efficient among the 20 with mean efficiency in the last three-quarters below 0.80, i.e., they are only 80% efficient relative to the other efficient banks mentioned above.

In addition, the coefficient of variation of efficiency of Bank of Baroda is the highest at about 10.7% indicating high degree of fluctuation and variation in the performance efficiency and low consistency.

Saha and Ravishankar (2000) had identified the inefficient performance of some of the banks viz. United Bank of India, UCO Bank, Syndicate Bank and Central Bank of India. Our study shows they still remain inefficient and have not improved in their efficiency even after 15 years.

Saha and Ravishankar (2000) also identified banks like State Bank of India, Corporation Bank, Canara Bank, Bank of Baroda and Oriental Bank of Commerce, being consistently among the relatively more efficient banks. As on date, only SBI and Canara Bank among them have been relatively more efficient and other two Bank of Baroda and Oriental Bank of Commerce have become inefficient in the performance.

Further, Sathye (2003) reported that public sector banks in India were more efficient than private sector banks. However, the current study shows that, over the years, private sector banks have become highly efficient when compared with public sector banks.

Table 3.2 shows the suggested input levels (since input-oriented model is adopted) for each of the inefficient banks, termed as slacks in DEA. With a view to raise the efficiency, the banks should reduce their input-level to the suggested slack level.

From the Table 3.2, it is very evident that the major input slacks are suggested for Net NPA, which should be interpreted as the major cause of inefficiency of banks is due to the existence of high levels of NPAs.

Reducing NPA to the respective slack amount suggested will make the banks efficient similar to existing efficient banks.

Table 3.2: Input Slacks for Q1, Q2, and Q3 of FY2016-17

Decision making units (DMU)	Rank	theta	% efficiency	Input slack			Output slack		
				Total expenditure	Employee cost	Net NPA	Total Income	operating profit	Gross Advances
Canara	16	0.885	88.46%	.	25.1912	10072	.	1147.56	.
SBI	10	1.000	100.00%	0	.	0	0	.	.
Indian Bank	14	0.965	96.51%	.	71.1543	.	.	147.824	.
Syndicate Bank	12	0.985	98.47%	.	334.106	.	.	366.091	.
IOB	17	0.849	84.88%	.	98.6743	15419.3	.	710.483	.
Karnataka Bank	1	1.000	100.00%	0	.	0	0	0	0
Vijaya Bank	13	0.973	97.32%	.	137.689	.	.	188.709	.
UCO Bank	18	0.828	82.78%	.	.	1418.77	163.189	815.587	.
Central Bank of India	20	0.800	79.97%	.	.	9739.95	.	1212.61	35568
IDBI Bank	1	1.000	100.00%	0	.	0	.	0	.
Oriental Bank of Commerce	1	1.000	100.00%	.	.	0	0	0	.
United Bank of India	19	0.821	82.09%	.	139.768	3201.5	.	568.264	.
Corporation Bank	1	1.000	100.00%	0	.	0	0	0	.
Bank of India	11	1.000	100.00%	.	.	0	1.11E-12	0	.
Bank of Baroda	15	0.955	95.49%	.	.	.	207.181	651.1	.
HDFC	1	1.000	100.00%	0	0	.	0	.	0
ICICI Bank	1	1.000	100.00%	.	0	.	.	0	.
Axis Bank	1	1.000	100.00%	0	.	0	0	.	.
Kotak Mahindra	1	1.000	100.00%	.	0	.	0	.	0
Yes Bank	1	1.000	100.00%	.	0	.	.	0	0

## 5. Conclusions

The study analysed the quarterly efficiencies of selected public sector and private sector banks in India for recent three-quarters of FY 2016-17 using the non-parametric performance evaluation technique of DEA. Out of 20 sample units studied, some of the banks proved consistency in performance during the study period, and most of the banks did not have consistency, mainly public sector banks. Target input levels for underperforming banks have been suggested in terms of input slacks, keeping highly efficient banks under study as benchmarks. The contribution is a novel idea that demonstrates that an efficiently performing company may not always remain efficient and vice versa and management has to keep a check on its performance on a continuous basis. The slack inputs give a direction for managers in banks in identifying the areas of optimisation viz. minimisation of inputs for the efficient performance or efficiency improvement. The study was limited only to 20 selected public and private sector banks in India. Future study can include all the public and private sector banks in India, which will give a more holistic comparison of all banks in the sector.

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