

## ASSESSING THE ENVIRONMENTAL EFFICIENCY OF INDIAN COMMERCIAL BANKS - AN APPLICATION OF DATA ENVELOPMENT ANALYSIS

T. SUBRAMANYAM<sup>1</sup>, B. VENKATESWARLU, G. Y. MYTHILI, RANADHEER DONTI,  
AND V. SATISH KUMAR

**ABSTRACT.** This paper attempts to evaluate the efficiency of Indian banks using data envelopment analysis (DEA) models. The main focus of this study is to assess whether the management has any significant impact during the efficiency evaluation. The DEA used to examine the technical efficiency of public, private, and foreign sector banks under homogenous and heterogeneous environments to check whether the working environment plays a vital role in efficiency evaluation. The results have shown public sector banks are affecting more due to ownership. The public and private sector banks have shown significant improvement in their efficiency scores when evaluating under a heterogeneous environment. The foreign sector is free of ownership impact due to their small scale banking business in India.

### 1. INTRODUCTION

The banking system plays a predominant role in the growth of any countries economy. The Indian banking system is known as the backbone of our Indian economy due to the nature of a strong and stable industry comparing to the majority of the developed countries in the world. The role of banks is to provide financial services to the customers and channel the funds between depositors and

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<sup>1</sup>*corresponding author*

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borrowers [1, 8]. Due to the deregulation of the banking system, more banks started working in Indian soil under different ownerships. Based on the ownerships of banks, the banks are broadly classified into three categories, namely, Public, Private, and Foreign Sector banks. The role of public sector banks is crucial in India due to their primary objective of channeling the credit to the priority sectors. These banks will act as intermediaries for the government and the public to optimize the social benefits by expanding the branches geographically to channel the funds of government policies to the people living in rural areas.

The nationalization of banks taken place to enhance the role of the banking system in building the economy in terms of creating job opportunities, strong industry base, infrastructure creation, social welfare, and add revenue to the government treasury, etc. In India majority of the employees are working under the government sector to cater to the needs of billions of people. According to the FY-2019 RBI bulletins, around 62% of employees working in public sector banks, 37% in private sector banks, and only 2% of employees working under foreign sector banks. Due to the globalization, more number of private and foreign sector banks started working in Indian soil. According to FY-2019 RBI bulletins, there were 20 public sector banks, 22 private and 42 foreign sector banks are working in India soil. The main focus of these banks is to create more funds and channel the funds between the depositors and borrowers and strengthen their banking business. Due to the entry of private and foreign sector banks, there is a huge competition in the banking industry. According to FY-2019 RBI Bulletins, around 66% of the deposits are under public sector banks, 29% under private sector banks, and only 5% of the deposits are under foreign sector banks.

Reserve Bank of India (RBI) monitors the day-to-day banking business and controls the activities of banks towards strengthening their banking business through their balance sheets. Even though the share of private and foreign sector banks is less in terms of deposits, there is a huge competition with the public sector banks due to their working style, objectives, and ownerships. Due to the competitive environment in the banking industry, there is a huge risk in the banking business and it is necessary to monitor the banking business to protect the customers' wealth. There are huge numbers of factors in the banking business to deteriorate the efficiency of a bank. Banks must be proactive in

these factors to minimize the risk of ruin the banking business. It is necessary to measure the performance of every bank to know whether the bank is functioning in a healthy environment or not. Data Envelopment Analysis (DEA) is a mathematical technique uses optimization techniques to measure the relative efficiency of commercial bank comparing with other banks in the homogeneous environment. The main advantage of DEA is utilizing multiple inputs and multiple outputs for comparison [2,3,7].

Since the objectives and functioning of public and private banks are different, it is necessary to evaluate the efficiency of banks under a heterogeneous environment. The efficiency of a particular bank is evaluated effectively if we measure the performance in its real working environment. The present paper attempts to measure the efficiency of Indian commercial banks in their real working environment after disentangling the impact of working and scale environment. After the introduction, section-2 explains the review of literature on different studies on banking efficiency. Section-3, explains the methods utilized for performing environmental efficiency and scale efficiency. The analysis and conclusions are discussed in section-4 and 5.

## 2. LITERATURE REVIEW

The efficiency evaluation of banks and bank branches is important for bank management, customers, and policymakers. To know whether the bank is working under an efficient environment one needs to model a bank in a mathematical perspective according to the needs of analysts [5,6,8]. Farrell, M.J (1957), originated the evaluation of technical efficiency (TE) and allocative efficiencies (AE) of organizational units. Sherman, H. D., and Gold, F (1985) applied DEA models to measure the bank branches to identify the inefficient branches by considering the services provided and resources used to provide the bank services. Due to the availability of a huge number of services called as variables, there is no general method to measure the efficiency of banks. The most popular methods are 'Intermediation' and 'Production' approach. In intermediation approaches, banks are viewed as intermediaries between depositors and borrowers whereas in the production approach banks produce services to the customers [1,8].

The main advantage of the DEA is the number of input and output variable are predefined. In the case of banking, there is no general agreement on the

selection of input and output variables and too many input and output variables will decrease the discriminating power of the DEA [6,9]. Numerous studies utilized DEA models in different ways by incorporating the undesirable variables, new performance indicator variables while assessing the efficiency of organizational units [5,6,10]. The present study aimed to measure the efficiency of Indian public and private sector banks the number of employees, operating expenses as the input variables and deposits, interest income, and other income are output variables.

### 3. METHODS

The basic DEA models proposed by Charnes, Cooper and Rhodes [2, 3] measures the efficiency of decision making units with multiple inputs and outputs under the assumption of homogeneous environment. If there are  $n$ -decision making units (DMU), and each DMU employs  $m$ -similar inputs to produce  $s$ -similar outputs, the CCR model can be represented as:

$$\Theta^{CCR} = \sum_{r=1}^s \mu_r u_{ro}$$

$$\text{subject to } \sum_{i=1}^m V_i X_{io} = 1, \sum_{r=1}^s \mu_r u_{rj} - \sum_{i=1}^m V_i X_{ij}, \quad j = 1, 2, 3 \dots n,$$

$$\text{and } \mu_r \geq 0, V_i \geq 0.$$

The former model is useful to measure the technical efficiency of banks under homogeneous environment with constant returns to scale. Since the goals, objectives and working environment is totally depends on the ownership of banks, the efficiency evaluation of banks may differ. The efficiency evaluation can be done under heterogeneous environment using the model:

$$\Theta^{CCR} = \sum_{r=1}^s \mu_r u_{ro}$$

$$\text{subject to } \sum_{i=1}^m V_i X_{io} = 1, \sum_{r=1}^s \mu_r u_{rj_o} - \sum_{i=1}^m V_i X_{ij_o}, \quad j_o = \{j : j \in g_1, g_2, g_3\},$$

$$\text{and } \mu_r \geq 0, V_i \geq 0.$$

Here  $g_1, g_2$  and  $g_3$  represents the public, private and foreign sector banks working under heterogeneous environments. After capturing the environmental effect, the scale differences can be captured using the hybrid model using [2] as

$$\Theta^{BCC,H} = \text{Min} \lambda$$

$$\text{subject to } \sum_{i=j_0}^n \lambda_j X_{ij} \leq \lambda X_{io}, i = 1, 2, \dots, m, \sum_{i=j_0}^n \lambda_j u_{rj} \geq u_{ro}, r = 1, 2, \dots, s,$$

$$\sum_{i=j_0}^n \lambda_j = 1 \text{ and } \lambda \geq 0$$

According to the fundamental theorem of duality it is possible to represent the above models in the following inequality:

$$\Theta^{CCR} \leq \Theta^{CCR,H} \leq \Theta^{BCC,H}$$

To capture the environmental differences and scale difference from the overall technical efficiency, it is necessary to decompose the efficiencies multiplicatively. The multiplicative decomposition which captures the difference due to environmental and scale is proposed as under:

$$\Theta^{CCR} = \underbrace{\left[ \frac{\Theta^{CCR}}{\Theta^{CCR,H}} \right]}_{\text{Environmental Efficiency}} \underbrace{\left[ \frac{\Theta^{CCR,H}}{\Theta^{BCC,H}} \right]}_{\text{Scale Efficiency}} \underbrace{[\Theta^{BCC,H}]}_{\text{Pure Technical Efficiency}}$$

#### 4. ANALYSIS

The banking business of 84 commercial banks for the FY 2018-19, represented in below Table 1. The percentages indicate share of the banks. The public sector banks holds more than 60% of the business. More than 65% of the deposits, 72% of fixed assets are controlled by public sector banks. Under the assumption of homogenous and heterogeneous environments, the average efficiency score of 84 commercial banks represented in the Table 2. The banks experienced around 35% input losses due to environmental inefficiency and 15% due to scale inefficiency.

The banking business of foreign sector banks is small comparing to public and private sector banks. Due to the inclusion of foreign banks under homogeneous environment, none of the banks are efficient other than foreign banks.

Bank	Employees	Deposits	Investments	Advances
Public	806983(62%)	8486215(66%)	2702386(64%)	5926286(61%)
Private	477495(37%)	3770013(29%)	1219517(29%)	3327328(34%)
Foreign	23249(2%)	581857(5%)	313317(7%)	396724(4%)

TABLE 1. Summary of Indian Banking Business: FY-2018-19

	$\Theta^{CCR}$	$\Theta^{CCR,H}$	$\Theta^{BCC,H}$	$\Theta^{CCR}/\Theta^{CCR,H}$	$\Theta^{CCR,H}/\Theta^{BCC,H}$
Mean	0.2753	0.6201	0.7705	0.5745	0.7987
S.D	0.2534	0.3043	0.2359	0.4283	0.2713
CV(%)	92%	49%	31%	75%	34%
Minimum	0.0563	0.0590	0.1276	0.1118	0.1046
Maximum	1.0000	1.0000	1.0000	1.0000	1.0000

TABLE 2. Overall, Environmental and Scale Efficiencies

The public sector banks experienced more input losses due to the homogeneous environment. Under heterogeneous environment, the efficiency of public sector banks is 0.91, which indicates only 9% input losses comparing to 87% input loss in homogeneous environment and 35% of the public sector banks are scale efficient.

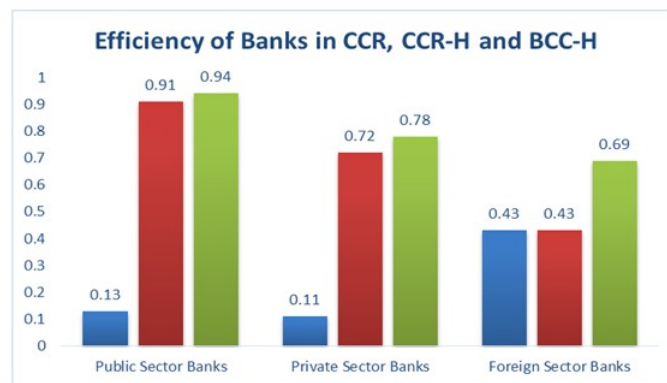


FIGURE 1. Bank Group Wise Efficiency Analysis

The private sector banks experienced more input losses due to inclusion of foreign banks in homogeneous environment. These banks are more cautious about expanding their banking business by adopting new technologies every time. The private sector banks experienced 61% input losses as compared with 89% input losses in homogeneous environment. The foreign banks are not experienced any input losses due to the homogeneous working environment. The reason is due to the less number of offices, and less banking business. Comparing to public and private banks, the foreign banks are already working in superior environment due to their small scale banking business. These banks experienced only scale differences around 29%.

#### **Statistical Significance:**

To test the whether the working environment has statistical significance under the assumption of normality; we have applied the t-test statistics for difference of means.

There is no significant difference between homogeneous and heterogeneous environments. The above table reveals that there is a high statistical significance

	t-value	p- value	Result
Overall	8.07*	0.0000	Sig.at 5%
Public	40.71*	0.0000	Sig.at 5%
Private	16.32*	0.0000	Sig.at 5%
Foreign	#DIV/0!	#DIV/0!	Not sig.at 5%

TABLE 3. T- Test difference of Means (Significance Values)

between homogeneous and heterogeneous environments. The significance difference of public sector banks is more comparing to private sector banks. It shows how the public sector banks are suffering due to working environment. The foreign banks have shown no statistical significance difference.

## 5. CONCLUSIONS

This study attempts to test whether the working environment has any impact on the efficiency evaluation of banks. The public sector banks are working towards building the Indian economy by channeling the funds to the priority

sector. Whereas private and foreign sector bank's main aim is to strengthen their banking business. Under the heterogeneous environment, the public sector banks are working better with an average efficiency of 91% comparing to private and foreign sector banks efficiencies 72% and 43% respectively. This study concludes that the working environment plays a major role during the efficiency evaluation of public and private sector banks working in India. The study reveals that the working environment has a significant impact and foreign banks have a negative role while evaluating the efficiency of Indian Banks.

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DEPARTMENT OF MATHEMATICS AND STATISTICS  
M.S RAMAIAH UNIVERSITY OF APPLIED SCIENCES  
BANGALORE, 560058  
*Email address:* subramanyam.mt.mp@msruas.ac.in

DEPARTMENT OF MATHEMATICS  
VELLORE INSTITUTE OF TECHNOLOGY  
VELLORE, 632014  
*Email address:* venkatesh.reddy@vit.ac.in

DEPARTMENT OF MATHEMATICS  
VELLORE INSTITUTE OF TECHNOLOGY  
VELLORE, 632014  
*Email address:* gy.mythili@gmail.com

DEPARTMENT OF MATHEMATICS  
ST.MARTIN'S ENGINEERING COLLEGE  
DHOOOLAPALLY, SECUNDERABAD, TELANGANA, INDIA, 500100  
*Email address:* ranadheer.phdku@gmail.com

DEPARTMENT OF HAS  
SRI VENKATESWARA COLLEGE OF ENGINEERING AND TECHNOLOGY  
CHITTOOR, ANDHRA PRADESH, 517127  
*Email address:* vvsatishkumar2004@gmail.com