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A Study of Technical Efficiency of Banks in India Using Dea

Nandkumar[1], Archana Singh[2]
[1]*Assistant Professor, Department of Humanities. DTU,*
[2]*Assistant Professor, Delhi School of Management. DTU,*

Abstract: *This study uses DEA approach to estimate the technical efficiency of commercial banks in India over the years 2006-2010. The results indicate that deregulation of banking sector has led to an increase in the efficiency of commercial banks in India. Banks like Allahabad bank, Canara bank, Kotak Mahindra bank, ICICI bank and Yes bank are very efficient and show consistency in their performance. On the other hand, the performance of banks like SBI, PNB and HDFC can be a matter of concern as their efficiency scores are below satisfactory level. The major factor resulting in the poor performance of these two banks is their huge amount of deposits and operating expenses. Also, the excess number of employees is increasing their problems. So, here either these banks possess blocked/non-performing assets or are not able to make a set off between the deposits and advances. Being major banks in the country, they deserve better attention by the regulators and the administrators.The study also shows that performance of private sector banks has been better than public sector banks during the period.*
Keywords: *DEA; Efficiency; DMU; CCR model; Fractional LPP;*

I. Introduction

The Banking sector plays an important role in the mobilization and allocation of savings in an economy. It plays the role of mediator between the net savers and net borrowers. The gain to the real sector depend on how efficiently the financial sector performs their function of inter -mediation. An efficient banking system contributes in an extensive way to higher economic growth in any country. Thus, study of banking efficiency is very important for policy makers, industry leaders and many others who rely on banking sector.

A lot of research has been conducted over the past decade in the area of measuring efficiency of firms, companies, banks and other decision making units. Studies in the past used conventional ratios such as return on assets to evaluate efficiency. Most of these studies which look at the efficiency concentrate on cost, profit income or revenue efficiencies. Later research in the area used various measures of performance which include financial index (Wu et. al 2006), a non parametric approach- Data Envelopment Approach (DEA) (Wu, 2005), parametric approach and Stochastic Production Approach (SPA) (Radam et. al 2008). DEA is frequently used to measure relative efficiency of decision making units. DEA is defined by Charnes et al (1978) as a mathematical programming model applied to observations data that provide a new way of obtaining empirical estimate of relations such as the production functions or efficient production possibility surface which are considered to be the corner stone of modern economics. It is a non-parametric multiple input output efficiency technique that measures the relative efficiency of decision making units.

CCR-Model was introduced by Charnes, Cooper and Rhodes (1978). This model measures the efficiency of each DMU which is obtained as a maximum of the ratio of total sum of weighted outputs to total sum of weighted inputs. Consequently, the efficiency can be defined as follow.

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

The weights for the ratio are determined by the restriction that the similar ratios for every DMU have to be less than or equal to unity, thus reducing multiple inputs and outputs to a single “virtual” input and single “virtual” output without requiring pre-assigned weights. Therefore, the efficiency score is a function of the weights or the “virtual” input-output combination. Suppose that there are n DMUs, each with n inputs and s outputs, relative efficiency score of a given DMU_0 is obtained by solving the following linear programming model.

$$max \ \left(\theta = \frac{\sum_{r=1}^{s} u_r y_{r0}}{\sum_{i=1}^{m} v_i x_{i0}}\right)$$

subject to

$$\frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \leq 1 \ ; j = 1,2, \dots, n$$

where
$v_i \geq 0; i = 1,2, \dots, m$
$u_i \geq 0; r = 1,2, \dots, s$
and x_{ij}= the amount of input i utilized by the jth DMU
y_{rj}= the amount of output r produced by the jth DMU
v_i= weight given to input i
u_r= weight given to output r
Following the Charnes – Cooper transformation (1962), one can select a representative solution (v,u) for which

$$\sum_{r=1}^{m} v_i x_{i0} = 1$$

Hence, the denominator in the efficiency score θ shown above is set equal to one, the transformed linear programming model for DMU_0 can be written as follow.
Max $\theta = \sum_{r=1}^{s} u_r y_{r0}$
Subject to, $\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \leq 0 \; ; j = 1,2, \dots, n$
And $\sum_{i=1}^{m} v_i x_{i0} = 1$
$v_i \geq 0; i = 1,2, \dots, m$
$u_i \geq 0; r = 1,2, \dots, s$

The linear programming model shown above will be run n times in identifying the relative efficiency score of all the DMUs. Each DMU selects input and output weights that maximize its efficiency score. Generally, a DMU is considered to be efficient if it obtains a score of 1.00, implying 100% efficiency; whereas a score of less than 1.00 implies that it is relatively inefficient.

II. Literature Review

Avkiran used DEA model, taking interest expense and non-interest expense as input variable and interest income and non-interest income as output variables to examine the efficiency of Australian trading banks for the period 1986 to 1995 and found that their efficiency rose in the post regulation period and acquiring banks were more efficient than target banks. Chen and Yeh (1998) calculated the operating efficiencies of 34 commercial banks of Taiwan's banks using the DEA model where in input variables included staff employed, interest expense and output variables include loans investment and interest revenue, non-interest revenue and bank assets. The author concluded that a bank with better efficiency does not always mean that it has better effectiveness.

In the case of Turkish Banks, (Mehmet Hasan Eken Suleyman Kale, A J B M vol. 5(3) PP 889-901, 4 Feb, 2011), it is apparent that branch size and scale efficiency are related to each other. As branch size increases scale efficiency increases too and after the most productive scale size, however, as the size increases efficiency decreases. Al-Shammari and Salimi (1998) have examined the comparative operating efficiency of Jordanian commercial banks from 1991-1994 using a modified version of DEA and found that the majority banks were fairly inefficient over the period 1991-1994. Noulas (2001) employed both DEA model and the traditional approach to study the effect of banking deregulation on private and public owned banks. The interest expense and non-interest expense were the input variable and interest revenue and non-interest revenue were the output variables. The result reveals that the state banks were less efficient than the private banks and the gap widened during the study period.

In India also, several studies have been carried out on Efficiency Analysis using DEA approach. Bhattacharya et al (1997) used DEA to measure the productive efficiency of Indian commercial banks in the late 80s to early 90s and studied the impact of policy on liberalizing measures taken in 1980s on the performance of various categories of banks. They found that Indian Public banks were the best performing banks as the banking sector was overwhelmingly dominated by Indian public sector banks while the new private sector banks were yet to emerge fully in the Indian banking scenario.

Sathye (2001) studied the relative efficiency of Indian banks in late 1990s and compared the efficiency of Indian banks with that of banks of other countries. He found that public sector banks have a higher mean efficiency score as compared to the private sector banks in India, but found mixed results when comparing public banks and foreign commercial banks in India. He also found that most banks on efficient frontier are foreign owned.

Rammohan and Ray (2004) compared the revenue maximizing efficiency of public, private and foreign banks in India using physical quantities of inputs and outputs in 1990s with deposits and operating costs as input and loans, investment and other income as outputs. They found that public sector banks were significantly better than private banks on revenue maximization efficiency, but between public and private sector banks the difference in efficiency was not significant.

Shanmugam and Das (2004) studied banking efficiency using a Stochastic Frontier Production function model during the reform model period 1992-99. The study considers the input variables (viz deposits, borrowings, labour and fixed assets) and four output variables (viz net interest income, non-interest income, credits and investments). They found that deposits are dominant in producing all outputs and technical efficiency of raising interest margin is varied across the banks. In particular they found that reform measures introduced since 1992 have not helped the banks in raising their interest margin. Also, in general, they found that private foreign banks performed better than public banks.

Sanjeev (2006) studied efficiency of private, public and foreign banks operating in India during the period 1997-2001 using DEA. He also studied if any relationship can be established between the efficiency and non-performing assets of the bank. He found that there is an increase in efficiency in post reform period and that non-performing assets and efficiency are negatively related.

Noulas and Ketkar (1996) measured the efficiency of public sector banks of India by using the Data Envelopment Analysis. The study considered 18 public sector banks and the necessary information for analysis have been collected from the RBI publications for the year 1993. The study identified that pure technical efficiency was 1.5 percent and scale inefficiency was 2.25 percent and none of the banks were operating under decreasing returns to scale.

III. Research Methodology

The present study considers ten commercial banks as decision making units. Out of these, five are public sector banks and other five are private sector banks. Selecting various inputs and outputs is a challenging task in the model because they can be misleading in nature. This paper considers three inputs which are- deposits, number of employees, operating expenses and the three outputs are investments, other income and advances. In this study the data related to various input and outputs over the period 2006 - 2010 have been taken from RBI website (www.rbi.org.in). The ten decision making units (banks) considered in the present study are as follows:

Public Sector Banks	Private Sector Banks
State Bank of India(A)	HDFC Bank(F)
Punjab National Bank(B)	Axis Bank(G)
Canara Bank(C)	ICICI Bank(H)
Vijaya Bank(D)	Yes Bank(I)
Allahabad Bank(E)	Kotak Mahindra Bank(J)

The Linear Programming model formulated for the year **2010** is as:

1. The L.P. for **DMU A (SBI)** is:

<A> max $\theta = u$

Subject to $804116 v_1 + 200299 v_2 + 20319 v_3 = 1$

$285790 u_1 + 14968 u_2 + 631914 u_3 <= 804116 v_1 + 200299 v_2 + 20319 v_3$

$77724 u_1 + 3565 u_2 + 186601 u_3 <= 249330 v_1 + 53417 v_2 + 4762 v_3$

$38429 u_1 + 1516 u_2 + 71605 u_3 <= 106056 v_1 + 20959 v_2 + 1618 v_3$

$69677 u_1 + 2858 u_2 + 169335 u_3 <= 234651 v_1 + 43380 v_2 + 3478 v_3$

$21107 u_1 + 679 u_2 + 41522 u_3 <= 61932 v_1 + 11565 v_2 + 1072 v_3$

$58608 u_1 + 3808 u_2 + 125831 u_3 <= 167404 v_1 + 51888 v_2 + 5764 v_3$

$55975 u_1 + 3946 u_2 + 104343 u_3 <= 141300 v_1 + 21640 v_2 + 3710 v_3$

$12513 u_1 + 628 u_2 + 20775 u_3 <= 23886 v_1 + 8632 v_2 + 1189 v_3$

$120893 u_1 + 7478 u_2 + 181206 u_3 <= 202017 v_1 + 35256 v_2 + 5860 v_3$

$10210 u_1 + 576 u_2 + 22193 u_3 <= 26799 v_1 + 3034 v_2 + 500 v_3$

Where all variables are constrained to be non-negative & u_1, u_2, u_3 are output variable weight & v_1, v_2, v_3 are input variable weight.

2. The L.P. for **DMU B (PNB)** is:

<B> max $\theta = u$

Subject to $249330 v_1 + 53417 v_2 + 4762 v_3 = 1$

$285790 u_1 + 14968 u_2 + 631914 u_3 <= 804116 v_1 + 200299 v_2 + 20319 v_3$

$77724 u_1 + 3565 u_2 + 186601 u_3 <= 249330 v_1 + 53417 v_2 + 4762 v_3$

$38429 u_1 + 1516 u_2 + 71605 u_3 <= 106056 v_1 + 20959 v_2 + 1618 v_3$

$69677 u_1 + 2858 u_2 + 169335 u_3 <= 234651 v_1 + 43380 v_2 + 3478 v_3$

$21107 u_1 + 679 u_2 + 41522 u_3 <= 61932 v_1 + 11565 v_2 + 1072 v_3$

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$120893 u_1 + 7478 u_2 + 181206 u_3 <= 202017 v_1 + 35256 v_2 + 5860 v_3$
$10210 u_1 + 576 u_2 + 22193 u_3 <= 26799 v_1 + 3034 v_2 + 500 v_3$
Where all variables are constrained to be non negative & u_1, u_2, u_3 are output variable weight & v_1, v_2, v_3 are input variable weight.

3. The L.P. for **DMU C (Allahabad Bank)** is:
<C> max $\theta = u$
Subject to $106056 v_1 + 20959 v_2 +1618 v_3 =1$
$285790 u_1+ 14968 u_2 + 631914 u_3 <= 804116 v_1 + 200299 v_2 + 20319 v_3$
$77724 u_1 +3565 u_2 +186601 u_3 <= 249330 v_1 + 53417 v_2 +4762 v_3$
$38429 u_1 + 1516 u_2 + 71605 u_3 <= 106056 v_1 + 20959 v_2 +1618 v_3$
$69677 u_1 + 2858 u_2 +169335 u_3 <= 234651 v_1+ 43380 v_2 + 3478 v_3$
$21107 u_1 + 679 u_2 + 41522 u_3 <= 61932 v_1 + 11565 v_2 + 1072 v_3$
$58608 u_1 + 3808 u_2 + 125831 u_3 <= 167404 v_1 + 51888 v_2 + 5764 v_3$
$55975 u_1 + 3946 u_2 + 104343 u_3 <= 141300 v_1 + 21640 v_2 + 3710 v_3$
$12513 u_1 + 628 u_2 + 20775 u_3 <= 23886 v_1 + 8632 v_2 + 1189 v_3$
$120893 u_1 + 7478 u_2 + 181206 u_3 <= 202017 v_1 + 35256 v_2 + 5860 v_3$
$10210 u_1 + 576 u_2 + 22193 u_3 <= 26799 v_1 + 3034 v_2 + 500 v_3$
Where all variables are constrained to be non negative & u_1, u_2, u_3 are output variable weight & v_1, v_2, v_3 are input variable weight.

4. The L.P. for **DMU D (Canara Bank)** is:
<D> max $\theta = u$
Subject to $234651 v_1+ 43380 v_2 + 3478 v_3 =1$
$285790 u_1+ 14968 u_2 + 631914 u_3 <= 804116 v_1 + 200299 v_2 + 20319 v_3$
$77724 u_1 +3565 u_2 +186601 u_3 <= 249330 v_1 + 53417 v_2 +4762 v_3$
$38429 u_1 + 1516 u_2 + 71605 u_3 <= 106056 v_1 + 20959 v_2 +1618 v_3$
$69677 u_1 + 2858 u_2 +169335 u_3 <= 234651 v_1+ 43380 v_2 + 3478 v_3$
$21107 u_1 + 679 u_2 + 41522 u_3 <= 61932 v_1 + 11565 v_2 + 1072 v_3$
$58608 u_1 + 3808 u_2 + 125831 u_3 <= 167404 v_1 + 51888 v_2 + 5764 v_3$
$55975 u_1 + 3946 u_2 + 104343 u_3 <= 141300 v_1 + 21640 v_2 + 3710 v_3$
$12513 u_1 + 628 u_2 + 20775 u_3 <= 23886 v_1 + 8632 v_2 + 1189 v_3$
$120893 u_1 + 7478 u_2 + 181206 u_3 <= 202017 v_1 + 35256 v_2 + 5860 v_3$
$10210 u_1 + 576 u_2 + 22193 u_3 <= 26799 v_1 + 3034 v_2 + 500 v_3$
Where all variables are constrained to be non negative & u_1, u_2, u_3 are output variable weight & v_1, v_2, v_3 are input variable weight.

5. The L.P. for **DMU E (Vijaya Bank)** is:
<E> max $\theta = u$
Subject to $61932 v_1 + 11565 v_2 + 1072 v_3 =1$
$285790 u_1+ 14968 u_2 + 631914 u_3 <= 804116 v_1 + 200299 v_2 + 20319 v_3$
$77724 u_1 +3565 u_2 +186601 u_3 <= 249330 v_1 + 53417 v_2 +4762 v_3$
$38429 u_1 + 1516 u_2 + 71605 u_3 <= 106056 v_1 + 20959 v_2 +1618 v_3$
$69677 u_1 + 2858 u_2 +169335 u_3 <= 234651 v_1+ 43380 v_2 + 3478 v_3$
$21107 u_1 + 679 u_2 + 41522 u_3 <= 61932 v_1 + 11565 v_2 + 1072 v_3$
$58608 u_1 + 3808 u_2 + 125831 u_3 <= 167404 v_1 + 51888 v_2 + 5764 v_3$
$55975 u_1 + 3946 u_2 + 104343 u_3 <= 141300 v_1 + 21640 v_2 + 3710 v_3$
$12513 u_1 + 628 u_2 + 20775 u_3 <= 23886 v_1 + 8632 v_2 + 1189 v_3$
$120893 u_1 + 7478 u_2 + 181206 u_3 <= 202017 v_1 + 35256 v_2 + 5860 v_3$
$10210 u_1 + 576 u_2 + 22193 u_3 <= 26799 v_1 + 3034 v_2 + 500 v_3$

Where all variables are constrained to be non negative & u_1, u_2, u_3 are output variable weight & v_1, v_2, v_3 are input variable weight.

6. The L.P. for **DMU F (HDFC)** is:
<F> max $\theta = u$
Subject to $167404 v_1 + 51888 v_2 + 5764 v_3 =1$
$285790 u_1+ 14968 u_2 + 631914 u_3 <= 804116 v_1 + 200299 v_2 + 20319 v_3$
$77724 u_1 +3565 u_2 +186601 u_3 <= 249330 v_1 + 53417 v_2 +4762 v_3$
$38429 u_1 + 1516 u_2 + 71605 u_3 <= 106056 v_1 + 20959 v_2 +1618 v_3$
$69677 u_1 + 2858 u_2 +169335 u_3 <= 234651 v_1+ 43380 v_2 + 3478 v_3$

$21107 u_1 + 679 u_2 + 41522 u_3 <= 61932 v_1 + 11565 v_2 + 1072 v_3$
$58608 u_1 + 3808 u_2 + 125831 u_3 <= 167404 v_1 + 51888 v_2 + 5764 v_3$
$55975 u_1 + 3946 u_2 + 104343 u_3 <= 141300 v_1 + 21640 v_2 + 3710 v_3$
$12513 u_1 + 628 u_2 + 20775 u_3 <= 23886 v_1 + 8632 v_2 + 1189 v_3$
$120893 u_1 + 7478 u_2 + 181206 u_3 <= 202017 v_1 + 35256 v_2 + 5860 v_3$
$10210 u_1 + 576 u_2 + 22193 u_3 <= 26799 v_1 + 3034 v_2 + 500 v_3$

Where all variables are constrained to be non negative & u_1, u_2, u_3 are output variable weight & v_1, v_2, v_3 are input variable weight.

7. The L.P. for **DMU G (Axis Bank)** is:
<G> max $\theta = u$
Subject to $141300 v_1 + 21640 v_2 + 3710 v_3 =1$

$285790 u_1+ 14968 u_2 + 631914 u_3 <= 804116 v_1 + 200299 v_2 + 20319 v_3$
$77724 u_1 +3565 u_2 +186601 u_3 <= 249330 v_1 + 53417 v_2 +4762 v_3$
$38429 u_1 + 1516 u_2 + 71605 u_3 <= 106056 v_1 + 20959 v_2 +1618 v_3$
$69677 u_1 + 2858 u_2 +169335 u_3 <= 234651 v_1+ 43380 v_2 + 3478 v_3$
$21107 u_1 + 679 u_2 + 41522 u_3 <= 61932 v_1 + 11565 v_2 + 1072 v_3$
$58608 u_1 + 3808 u_2 + 125831 u_3 <= 167404 v_1 + 51888 v_2 + 5764 v_3$
$55975 u_1 + 3946 u_2 + 104343 u_3 <= 141300 v_1 + 21640 v_2 + 3710 v_3$
$12513 u_1 + 628 u_2 + 20775 u_3 <= 23886 v_1 + 8632 v_2 + 1189 v_3$
$120893 u_1 + 7478 u_2 + 181206 u_3 <= 202017 v_1 + 35256 v_2 + 5860 v_3$
$10210 u_1 + 576 u_2 + 22193 u_3 <= 26799 v_1 + 3034 v_2 + 500 v_3$

Where all variables are constrained to be non negative & u_1, u_2, u_3 are output variable weight & v_1, v_2, v_3 are input variable weight.

8. The L.P. for **DMU H (Kotak Mahindra Bank)** is:
<H> max $\theta = u$
Subject to $23886 v_1 + 8632 v_2 + 1189 v_3 =1$

$285790 u_1+ 14968 u_2 + 631914 u_3 <= 804116 v_1 + 200299 v_2 + 20319 v_3$
$77724 u_1 +3565 u_2 +186601 u_3 <= 249330 v_1 + 53417 v_2 +4762 v_3$
$38429 u_1 + 1516 u_2 + 71605 u_3 <= 106056 v_1 + 20959 v_2 +1618 v_3$
$69677 u_1 + 2858 u_2 +169335 u_3 <= 234651 v_1+ 43380 v_2 + 3478 v_3$
$21107 u_1 + 679 u_2 + 41522 u_3 <= 61932 v_1 + 11565 v_2 + 1072 v_3$
$58608 u_1 + 3808 u_2 + 125831 u_3 <= 167404 v_1 + 51888 v_2 + 5764 v_3$
$55975 u_1 + 3946 u_2 + 104343 u_3 <= 141300 v_1 + 21640 v_2 + 3710 v_3$
$12513 u_1 + 628 u_2 + 20775 u_3 <= 23886 v_1 + 8632 v_2 + 1189 v_3$
$120893 u_1 + 7478 u_2 + 181206 u_3 <= 202017 v_1 + 35256 v_2 + 5860 v_3$
$10210 u_1 + 576 u_2 + 22193 u_3 <= 26799 v_1 + 3034 v_2 + 500 v_3$

Where all variables are constrained to be non negative & u_1, u_2, u_3 are output variable weight & v_1, v_2, v_3 are input variable weight.

9. The L.P. for **DMU I (ICICI Bank)** is:
<I> max $\theta = u$
Subject to $202017 v_1 + 35256 v_2 + 5860 v_3 =1$

$285790 u_1+ 14968 u_2 + 631914 u_3 <= 804116 v_1 + 200299 v_2 + 20319 v_3$
$77724 u_1 +3565 u_2 +186601 u_3 <= 249330 v_1 + 53417 v_2 +4762 v_3$
$38429 u_1 + 1516 u_2 + 71605 u_3 <= 106056 v_1 + 20959 v_2 +1618 v_3$
$69677 u_1 + 2858 u_2 +169335 u_3 <= 234651 v_1+ 43380 v_2 + 3478 v_3$
$21107 u_1 + 679 u_2 + 41522 u_3 <= 61932 v_1 + 11565 v_2 + 1072 v_3$
$58608 u_1 + 3808 u_2 + 125831 u_3 <= 167404 v_1 + 51888 v_2 + 5764 v_3$
$55975 u_1 + 3946 u_2 + 104343 u_3 <= 141300 v_1 + 21640 v_2 + 3710 v_3$
$12513 u_1 + 628 u_2 + 20775 u_3 <= 23886 v_1 + 8632 v_2 + 1189 v_3$
$120893 u_1 + 7478 u_2 + 181206 u_3 <= 202017 v_1 + 35256 v_2 + 5860 v_3$
$10210 u_1 + 576 u_2 + 22193 u_3 <= 26799 v_1 + 3034 v_2 + 500 v_3$

Where all variables are constrained to be non negative & u_1, u_2, u_3 are output variable weight & v_1, v_2, v_3 are input variable weight.

10. The L.P. for **DMU J (Yes Bank)** is:

<J> max $\theta = u$

Subject to $26799 v_1 + 3034 v_2 + 500 v_3 = 1$

$285790 u_1 + 14968 u_2 + 631914 u_3 \le 804116 v_1 + 200299 v_2 + 20319 v_3$

$77724 u_1 + 3565 u_2 + 186601 u_3 \le 249330 v_1 + 53417 v_2 + 4762 v_3$

$38429 u_1 + 1516 u_2 + 71605 u_3 \le 106056 v_1 + 20959 v_2 + 1618 v_3$

$69677 u_1 + 2858 u_2 + 169335 u_3 \le 234651 v_1 + 43380 v_2 + 3478 v_3$

$21107 u_1 + 679 u_2 + 41522 u_3 \le 61932 v_1 + 11565 v_2 + 1072 v_3$

$58608 u_1 + 3808 u_2 + 125831 u_3 \le 167404 v_1 + 51888 v_2 + 5764 v_3$

$55975 u_1 + 3946 u_2 + 104343 u_3 \le 141300 v_1 + 21640 v_2 + 3710 v_3$

$12513 u_1 + 628 u_2 + 20775 u_3 \le 23886 v_1 + 8632 v_2 + 1189 v_3$

$120893 u_1 + 7478 u_2 + 181206 u_3 \le 202017 v_1 + 35256 v_2 + 5860 v_3$

$10210 u_1 + 576 u_2 + 22193 u_3 \le 26799 v_1 + 3034 v_2 + 500 v_3$

Where all variables are considered to be non negative & u_1, u_2, u_3 are output variable weight & v_1, v_2, v_3 are input variable weight.

Similarly Linear Programming model is formulated for the year **2009, 2008, 2007 and2006.**

The efficiency of various DMUs obtained using the CCR model is as follows:

Table 1: Technical Efficiency of Banks

Serial Number	**DMU (Banks)**	**Efficiency 2006**	**Efficiency 2007**	**Efficiency 2008**	**Efficiency 2009**	**Efficiency 2010**
A	State Bank of India	0.891611	0.9390914	0.980034	0.9582734	0.9010883
B	Punjab National Bank	0.821143	0.8883662	0.943514	0.9225176	0.9005408
C	Allahabad Bank	0.909731	1	1	1	1
D	Canara Bank	1	1	0.966503	1	1
E	Vijaya Bank	1	0.9750875	1	0.9475686	0.8946582
F	HDFC Bank	0.985309	0.8937566	1	0.8436847	0.8379867
G	Axis Bank	1	1	1	0.9714755	0.875286
H	Kotak Mahindra Bank	1	1	1	1	0.9696454
I	ICICI Bank	1	1	1	1	1
J	**Yes Bank**	**1**	**1**	**1**	**1**	**1**

Table 2 Average Efficiency scores of Banks

Serial No	Period	Average Efficiency score
1.	2006	0.96078
2.	2007	0.96963
3.	2008	0.98900
4.	2009	0.96435
5.	2010	0.9379

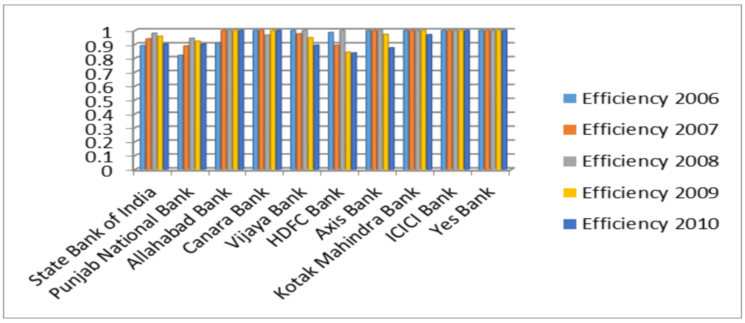

Figure 1: Efficiency trend Graph 2006 - 2010

IV. Conclusion

- This study attempts to investigate the technical efficiency of Indian commercial banks during the period of 2006-2010. Tests for each year have been run, for ten Indian commercial banks.

- The results suggest that the mean technical efficiency improved from 2006 to 2008 and then technical efficiency declined during the period 2008 to 2010. The result also shows that the banks like Allahabad bank, Canara bank, Kotak Mahindra bank, ICICI bank and Yes bank are very efficient and they have consistency in their performance.
- Banks like SBI, PNB and HDFC can be a matter of concern as their efficiency scores are below satisfactory level. The major factor resulting in the poor performance by these two banks is their huge amounts of deposits and operating expenses. Also, the excess number of employees is increasing their problems. Either these banks possess blocked/non-performing assets or are not able to make a set off between the deposits and advances. Being major banks in the country, they deserve to be paid a better attention of the regulators and the administrators.
- The performance of private sector banks is better than public sector banks during the period of investigation, 2006-2010.

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