

# Measuring The Productivity of Indian Public Sector Banks: An Application of Data Envelopment Analysis

*Stuti Gupta\**

The reforms in banking sector in India started in 1991. The main aim was to improve productivity and efficiency of the financial system. Productivity of banks is worked out as the ratio of Output to Input. The banking structure in India mainly comprises of public sector banks, private sector banks and foreign banks. The public sector banks branches are widely spread to contribute lending and borrowing to meet out the need of the society and implementing the Govt. policies for the masses. Indian financial system was deregulated in 1991 followed by various financial sector reforms during the period 1990 - 1998 which led to a major restructuring of the Indian banking industry.

The first Committee on Financial Systems (CFS) (Narasimham 1991) made recommendations, followed by Committee on Banking Sector Reforms (BSR) (Narasimham 1998) which suggested reforms in a phased manner. These reforms changed the various parameters of banking system. Thereafter, RBI set up Steering Committee which gave its recommendations that led to formulation of 'Ownership and Governance' and the implementation of the 'New Capital Adequacy Framework' in banks in 2005. The main aim of these reforms was to improve the performance of banks keeping in view unexpected global recession and internal disturbances.

The aim of this paper is to analyse the productivity of the Indian public sector banks from 1991 till 2010. The capital efficiency of 25 public sector banks was compared by using their balance sheet data. The Data Envelopment Analysis (DEA) has been used to estimate the efficiency scores and to construct the Malmquist productivity index. The results show that if a bank is scale efficient it may not be technically efficient. If a Decision-Making Unit (DMU) is productive efficient then it needs not be scale efficient.

**Keywords:** Public Sector Banks, Data Envelopment Analysis, Malmquist productivity index

## INTRODUCTION

With the introduction of financial reforms in India in 1991, banks have been given liberty to fix their own rates of interests on their assets as well as liabilities besides the charges quoted on their miscellaneous business. Private Banks have been permitted to open branches along with foreign banks resulting in competition among banks. To attract more and more customers, banks started to offer new products to suit the needs of the customers. The business hours have also been extended, and computerisation has been introduced resulting in 24 hours banking via Automatic Teller Machines (ATMs), online banking, core banking, etc. Now, the objective of the banks is growth with profit.

As the banking industry is an important financial sector of the Indian economy, it is very important for senior managers, regulators and investors to identify the major drivers of a bank's efficiency. Apart from financial ratios, the efficiency analysis of the banks depends upon productivity and profitability. In this

paper an analysis of productivity of the Public Sector Banks has been done using Data Envelopment Analysis (DEA) technique.

## OBJECTIVE

The objective is to analyze the productivity of the Indian Public sector banks in post reform period and comparison of capital efficiency of individual and group banks from 1991 till 2010. The Public Sector Banks are divided into two groups- State Bank Group and Nationalised Banks. The inter-bank group as well as intra bank group comparison of Public Sector Banks is done on the basis of productivity level.

## DATA COLLECTION

The present study is based on the secondary data. The required data have been collected from various sources such as Reports on Trends and Progress of Banking in India, Statistical Tables relating to Banks in India, RBI Bulletins, IBA Bulletins, other publications of RBI, annual reports of Banks and capitaline database.

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\* Assistant Professor, Department of Economics, Shyamlal College (Eve.), University of Delhi, Delhi, (India)

## REVIEW OF LITERATURE

Many studies have been undertaken to measure the productivity in banking. Bhattacharya, Lovell and Sahay (1997) observed the productive efficiency of Indian banks during 1986-1991 and found out that the average performance of banks had increased after 1987. Publically owned banks were more efficient than the privately owned or foreign owned banks. Trippe (2004) compared the efficiency of New Zealand banks with Australian banks using DEA. There were no major differences in the selected banks with respect to scale and size of equity. However, there was difference in efficiency due to difference in pattern of regulations and degree of competition. Galagedera and Edirisuriya (2005) used total deposits and operating expenses as input and loans and other earning assets as output in the DEA analysis to examine efficiency performance of Indian commercial banks for the period of (1995-2002) using. They reported no significant growth in productivity during the sample period. Sunil Kumar and Ruchita Gulati (2008) evaluated the extent of technical, pure technical, and scale efficiencies in Indian public sector banking industry using cross-sectional data for 27 banks in the year 2004/05. The results indicated that the 7 PSBs scored OTE score of unity and, thus, defined the efficient frontier. The resource utilization process in these banks is functioning well. The remaining 20 banks can improve their efficiency by reducing inputs. Ray and Das (2010) evaluated the cost and profit efficiency gains of Indian Banking Sector during 1997-2003 using DEA methodology. The result showed that the state-owned banks are more efficient than their private-sector counter parts. Moreover, small banks (with assets up to Rs.50 billion) were found to be less efficient, signifying the existence of scale diseconomies. There were reasonable differences in efficiency across various ownership categories of the banks.

## SAMPLE AND METHODOLOGY

The data of total 25 banks is collected to compare the capital efficiency of the banks. Investments and loans are taken as the output of the banks. The outputs are produced with the help of the capital ploughed and reserves maintained. Hence, capital and reserves are taken as inputs of the banks. The deposits collected are also taken as the inputs of the banks. DEA is used

to estimate the efficiency scores. It is a non-parametric method of measuring efficiency that uses mathematical programming rather than regression. DEA establishes the benchmark efficiency score of unity that no individual firm can exceed. Consequently, an efficient firm receives efficiency scores of unity and inefficient firms receive DEA scores less than unity.

DEA measures average productivity through the aggregation of inputs and outputs. DEA-based Malmquist productivity index (MPI) measures the productivity change over time. Fare et al (1992) divided MPI of total factor productivity change (TFPCH) into two parts (Chen and Ali, 2004): one measures the technical efficiency change (TECHCH) and the other measures the frontier shift (TEFFCH).

According to Fare et al (1992, 1994), there is a positive shift or technical progress if the value of TECHCH greater than one. Similarly, there is a negative shift or technical regress if the value is less than one. The value of one indicates no shift in technology frontier. The Malmquist productivity index of total factor productivity change (TFPCH) over period  $t$  and  $t+1$  is given as the product of technical efficiency change (TEFFCH) and technological change (TECHCH) as shown below:

$$\text{TFPCH} = \text{TEFFCH} * \text{TECHCH}$$

## DATA ANALYSIS

### Analysing the Capital Efficiency of different Bank Groups under CRS Model

The efficiency of groups of banks is measured with the balance sheet data of the banks. Table 1 gives the DEA scores with respect to capital efficiency of banks using inputs and output selected from balance sheet structure of data in CRS model.

The average efficiency shows that the SB group is ranked first followed by the NBs group. Table 1 also shows the number of efficient banks during the study period. The year 1996, 1997 and the year 2003 proved to be better years for the NBs group.

### Capital Efficiency Status of Individual Banks under CRS Model

The analysis also compare the efficiency of individual banks in the groups facing same external environment,

but still fallout differently in efficiency boundaries Table 2 shows that in the NBs group, Punjab National Bank is the one, which has shown the highest efficiency. Allahabad Bank was the least efficient bank in the sample period (Only efficient in 1998).

Table 3 shows that in SB group, State Bank of India and State Bank of Hyderabad are efficient with 20 years and 19 years of efficiency in 20 years. Moreover, State Bank of India is on the frontier throughout the period. State Bank of Mysore, and State Bank of Bikaner and Jaipur are on the second position with the good efficiency score for 18 years. In SB group, State Bank of Patiala is the least efficient.

### **Analysing the Capital Efficiency of different Bank Groups under VRS Model**

Table 4, shows that the efficiency scores of the SB group is one for three times in the period 1991-2010 (in 1994, 1996 and 2001). The ranking as per the average efficiency remains more or less same as CRS. SB group is at the first position with 0.9927; NBs group stands second with 0.9881.

In table 4, the efficient units from different groups of banks under VRS model are shown. Here, the proportionately maximum efficient units are from SB group.

### **Capital Efficiency Status of Individual Banks under VRS Model**

The VRS model also supports the result of CRS model to show that Allahabad Bank is not doing good business to prove efficient (table 5). This bank appears on the frontier only for three times out of 20 years and that is before 1997 (one year in CRS model). However, the performance of Vijaya Bank is the worst as it was on the frontier for only two times. On the other hand, Punjab National Bank is efficient for all 20 years, followed by Corporation Bank, Central Bank of India and Canara Bank with good performance for 17 years. In VRS model the efficiency of Syndicate Bank differs from CRS model. In CRS model, it is efficient only for 10 years but in VRS model it is efficient for 16 years.

SB group (table 6) has also shown the maximum numbers of time that their member banks are efficient. In SB group, State Bank of India, State Bank of

Bikaner and Jaipur and State Bank of Patiala show the efficiency in all 20 years; followed by State Bank of Mysore (19 years). Except few years, all the banks in the SB group are shown as the efficient banks. The result of State Bank of Patiala is quite surprising under VRS model as compared to CRS model.

### **Malmquist Index for Capital Efficiency**

In Table 7, the firm's 'summary means' are compared with each other. The NBs group and SB group have shown that they are better off in efficiency change and scale efficiency change. SB group is better in technical efficiency change than other groups of Banks.

### **CONCLUSION**

In the present study capital efficiency of individual and group banks is compared by using different inputs and outputs. In order to measure capital efficiency; capital, reserves and deposits are taken as inputs and investment and loans are as outputs. The efficiencies are compared at constant returns to scale as well as variable return to scale. While comparing the capital efficiency of different groups of banks in CRS and VRS, SB group stands ahead of nationalized banks. As far as individual banks comparison under CRS and VRS is concerned, the best performed banks under each group are: Punjab National Bank and State Bank of India. On the other hand worst performed banks are Allahabad Bank and State and Bank of Patiala in CRS. The least performed banks under VRS are Vijaya Bank and State Bank of Travancore. Malmquist Index Summary of firm means with assets and liabilities data of banks groups is compared and the result is same. The first place is occupied by SB group, followed by NBs.

The Malmquist result shows that if a bank is scale efficient it may not be technically efficient. If a DMU is productive efficient then it needs not be scale efficient. There is a definite and positive effect of reforms experienced by the banks. Of course, the degree and intensity of the effect is different for different groups as well as for an individual bank.

One of the reasons for low capital efficiency among the banks is high NPAs. Various banks impose high sales targets for the sales staff for disbursement of loans which leads to disbursement of loans to the

individual & corporate without enquiring about their credit worthiness and without having adequate know your customer norms. Therefore, banks should have strict policies for the disbursement of loans and should have frequent as well as performance audits to ensure know your customer guidelines and other internal guidelines are strictly adhered to reduce the level of stressed assets.

For a strong and resilient banking system, banks need to go beyond peripheral issues and tackle significant issues like improvement in profitability, efficiency and technology, while achieving economies of scale through consolidation and exploring available cost effective solutions. In order to improve the Malmquist productivity score, banks need technological advancement as well as improvement in managerial skills. It will help in increasing the productivity of the banks by increasing capital efficiency.

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## TABLES

**Table 1:**  
**Capital Efficiency of Different Group of Banks and Number of Efficient Units in CRS Model during 1991-2010**

Bank	91	92	93	94	95	96	97	98	99	2000	1	2	3	4	5	6	7	8	9	10	Avg.
<b>NBs (19)</b>	0.97	0.98	0.96	0.97	0.95	0.97	0.96	0.97	0.97	0.97	0.97	0.93	0.99	0.98	0.99	0.93	0.95	0.9	0.93	0.97	0.96
<b>SB (6)</b>	0.96	0.98	0.95	0.96	0.96	0.99	0.97	0.96	0.97	0.98	0.99	0.96	0.96	0.98	0.99	0.99	0.98	0.93	0.96	0.98	0.97
<b>NBs (19)</b>	12	10	8	7	10	10	11	11	10	9	9	12	12	11	12	14	11	10	9	10	
<b>SB (6)</b>	4	6	2	5	5	5	6	6	6	6	5	5	6	5	5	5	6	4	5	6	

**Table 2:**  
**Capital Efficiency Status of Individual Banks (NBs Group) (Under CRS Conditions)**

Bank	91	92	93	94	95	96	97	98	99	2000	01	02	03	04	05	06	07	08	09	10
ABD BANK	I	I	I	I	I	I	I	E	I	I	I	I	I	I	I	I	I	L	I	I
AND BANK	L	I	I	I	E	E	E	I	E	I	I	I	L	E	E	E	L	L	E	I
BOB	L	L	L	L	L	L	L	I	L	I	L	I	E	E	E	E	E	E	I	I
BOI	L	L	L	L	L	L	L	I	L	I	I	L	I	I	E	E	E	L	I	I
BOMa	L	L	I	I	I	I	I	I	E	I	E	E	L	L	E	E	E	E	L	I
CB	E	E	E	I	E	I	I	I	E	I	L	L	I	I	I	E	E	I	L	I
CBI	E	I	I	I	L	L	L	I	L	I	E	E	L	L	I	L	L	I	E	E
COR BANK	L	L	L	I	L	I	L	I	E	E	E	L	L	I	I	L	E	E	E	E
DENA BANK	L	L	L	L	I	L	I	I	L	L	I	I	E	E	E	L	L	L	L	E
IB	I	I	I	I	L	L	I	L	L	L	I	I	L	L	E	E	E	L	I	E
IOB	L	L	L	I	L	I	I	L	L	E	E	E	L	I	L	E	E	E	I	E
OBC	L	I	I	L	I	L	E	E	I	E	E	L	I	I	L	I	I	I	L	E
PSIND BANK	I	I	L	I	I	I	I	L	I	I	I	I	I	E	E	E	I	I	E	E
PNB	E	E	E	E	E	E	E	E	I	E	E	E	E	E	E	E	E	E	E	E
SYNBANK	L	I	I	I	L	I	L	L	I	I	E	E	I	L	L	E	I	I	I	E
UCO BANK	I	I	I	L	I	I	I	L	I	I	I	E	E	L	L	I	I	I	I	E
UBI	I	E	I	L	I	I	L	L	I	E	I	I	I	I	I	E	I	I	I	I
UNIBI	I	I	I	I	I	E	E	L	I	L	I	L	L	L	I	I	I	I	I	I
VB	I	L	I	I	I	E	E	L	I	L	I	L	L	I	I	I	I	I	I	I

Source: computed from individual Bank DEA scores

I stands for inefficient unit i.e. DEA score < 0.5

L stands for less efficient unit i.e. DEA score range is 0.5- 1

E stands for efficient unit DEA score = 1

**Table 3:**  
**Capital Efficiency Status of Individual Banks (SB Group) (Under CRS Conditions)**

Bank	91	92	93	94	95	96	97	98	99	2000	01	02	03	04	05	06	07	08	09	10
SBI	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
SBBJ	I	L	I	L	E	L	E	E	L	L	L	L	L	E	E	E	L	E	E	L
SBH	I	L	E	L	E	E	L	L	L	E	E	L	E	E	E	L	L	E	E	L
SBM	L	L	I	L	L	L	L	E	E	L	E	L	E	L	E	I	E	L	L	L
SBOP	L	L	I	I	I	L	L	L	L	L	I	E	L	L	L	E	L	I	I	L
SBT	E	L	I	E	L	I	L	L	E	E	L	I	L	I	I	E	L	I	L	E

Source: computed from individual Bank DEA scores

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<b>NBs (19)</b>	0.98	0.99	0.99	0.99	0.97	0.98	0.99	0.98	0.99	0.9	0.98	0.97	0.99	0.98	0.97	0.96	0.96	0.92	0.95	0.98	0.98
<b>SB (6)</b>	0.98	0.99	0.99	1	0.98	1	0.99	0.97	0.99	0.99		0.98	0.99	0.99	0.98	0.99	0.98	0.99	0.96	0.98	0.99
<b>NBs (19)</b>	15	12	13	10	14	14	12	17	13	12	13	15	15	14	13	14	13	12	14	14	
<b>SB (6)</b>	5	6	6	6	6	5	6	4	5	6	6	6	6	6	5	6	6	5	6	6	

Source: computed using DEA program developed by Coille

Figures in the Bracket shows the numbers of the sample Banks selected in the group.

The no. of banks are computed by the researcher.

In table 4, the efficient units from different groups of banks under VRS model are shown. Here, the proportionately maximum efficient units are from SB group.

**Table 5:**  
**Capital Efficiency Status of Individual Banks (NBs Group) (Under VRS Conditions)**

Bank	91	92	93	94	95	96	97	98	99	2000	01	02	03	04	05	06	07	08	09	10
ABD BANK	I	I	E	E	L	I	E	L	I	L	I	I	L	L	I	I	L	I	L	I
AND BANK	L	I	E	E	E	E	E	E	I	I	L	L	L	E	E	I	E	I	E	I
BOB	L	I	E	E	L	E	L	E	I	L	E	L	E	E	E	I	E	I	E	E
BOI	L	I	E	E	L	E	I	I	I	L	L	L	I	L	E	E	E	E	L	E
BOMa	L	L	L	L	L	E	L	E	I	I	E	E	L	E	E	E	E	E	I	E
CB	E	E	E	E	E	I	L	L	E	E	L	L	L	L	I	E	E	E	I	E
CBI	E	I	L	L	E	L	L	L	E	E	E	E	L	E	L	I	I	L	E	E
COR BANK	L	L	L	L	L	I	E	E	E	E	E	L	L	I	L	L	I	E	E	E
DENA BANK	L	E	L	E	I	E	I	L	L	L	I	I	E	E	E	E	L	E	L	E
IB	I	L	L	I	E	E	I	E	L	E	I	I	E	I	E	E	E	I	L	E
IOB	L	L	L	I	L	E	I	L	E	E	E	E	E	L	I	E	E	I	E	E
OBC	L	I	I	L	I	E	E	E	E	E	E	L	E	L	I	I	I	I	E	E
PSIND BANK	L	L	L	I	I	I	I	L	I	L	I	I	I	E	E	E	I	I	E	E
PNB	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
SYN BANK	L	L	I	I	L	I	L	L	L	I	E	E	L	E	E	E	E	E	L	E
UCO BANK	L	L	I	I	I	I	L	L	L	I	E	E	E	E	L	L	L	E	E	E

UBI	L	E	I	I	I	L	L	L	L	I	E	L	E	I	E	E	E	L	I	I
UNIBI	I	I	I	I	L	E	E	L	L	I	I	L	I	I	I	E	I	E	I	I
VB	I	L	I	I	L	E	I	I	L	I	I	E	I	I	I	L	I	L	I	I

Source: computed from individual Bank DEA scores

I stands for inefficient unit i.e. DEA score < 0.5

L stands for less efficient unit i.e. DEA score range is 0.5- 1

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SBBJ	L	E	E	E	E	L	E	E	L	L	L	L	L	E	E	E	E	E	E	L
SBH	I	L	E	E	E	E	L	I	I	E	E	L	E	E	E	L	E	E	E	E
SBM	L	L	L	E	E	L	L	I	E	L	L	L	E	E	E	L	E	L	L	L
SBOP	L	E	E	E	E	L	E	L	L	E	L	E	L	L	E	E	E	E	E	L
SBT	E	L	L	E	L	I	L	L	E	E	L	L	L	L	I	E	E	I	L	L

Source: computed from individual Bank DEA scores

I stands for inefficient unit i.e. DEA score < 0.5

L stands for less efficient unit i.e. DEA score range is 0.5- 1

E stands for efficient unit DEA score = 1

**Table 7:**  
**Malmquist Index Summary of Firm Means with Assets and Liabilities Data**

	EFFCH	TECHCH	PECH	SECH	TFPCH
<b>NBs</b>	1	0.97	1	1	0.995
<b>SB</b>	1	0.99	1	1	0.997

Source : Computed by the researcher

EFFCH: Efficiency Change

TECHCH: Technology Change (Absorption)

PECH: Productive Efficiency Change

SECH: Scale Efficiency Change

TFPCH: Total Factor Productivity Change