

# Economic Efficiency (EE) Analysis of Indian Banking Industry

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The present paper seeks to analyze the cost efficiency and its determinants in Indian banking sector. A two stage analysis is conducted to achieve the objectives of the study. In the first stage CRS input oriented model is applied to obtain the efficiency scores and in the second stage the scores obtained are regressed using Tobit regression analysis. The results reveal that public sector banks are leading in all the sector banks in terms of cost efficiency. It is also observed that foreign banks are the least performer in terms of cost efficiency and have wasted around 34% of inputs used. The main reason of cost inefficiency of Indian sector banks is technical inefficiency rather allocative inefficiency.

**Key words:** Economic Efficiency, Cost Efficiency, Data Envelopment Analysis, Constant return to scale, Banking industry, India, Tobit Regression.

## Introduction

Banking sector in India is termed as the lifeline of the Indian economy. The foundation of Indian banks can be observed from 18th century. Recently, RBI took some important steps to make the sector more robust and healthy, like, deregulation of saving rates, guidelines for new banking licences and implementation of Basel III norms.

Many studies have been conducted to study the efficiency of Indian banking sector over the years. But analysis of cost efficiency has received little attention from researchers and decision maker. Cost efficiency among financial and non-financial institutions has been an area that has received some attention in the literature (Ansah-Adu et.al. 2012). The changing phase of banking sector has also changed the cost structure of the banking sector in India. A firm is termed as economically or cost efficient when it is technically as well as allocatively efficient which means it produces maximum output with minimum inputs and also with right mixture of inputs and outputs. To be cost efficient in the present volatile and competitive environment is very challenging for the firms. Only the firms which cope up with changing internal and external factors

last long. According to Cummins et.al. (1998) a firm is cost efficient if it is operating on the efficient cost frontier.

Present paper is adding a new milestone in that sense as the objective of the present paper is to analyze the cost efficiency of different sector banks over a period 2004-05 to 2008-09. Cost efficiency and economic efficiency words are used synonymously in the present study. The reason to choose the above time period is many folds. Firstly, extent of cost efficiency of different sector banks is to be studied. Secondly, the study also aims to analyze the cost efficiency of Indian banks in sub-prime crisis. Lastly, the objective is also to assess the effect of different cost determinants of the cost efficiency of Indian banks.

## LITERATURE REVIEW

Cost efficiency analysis of financial institutions has received some attention over the years in India. Different parametric and non-parametric methods have been used by the analysts to analyze the cost efficiency of different sectors. But the non-parametric Data Envelopment Analysis is the most widely used method to test the cost efficiency (see Chen et.al., 2005; Hassan et.al., 2007; Barry, et.al., 2007; Shamsi et. al., 2009). Some of the studies are reviewed below

### *International Experience*

Aly et. al. (1990) examined the components of cost efficiency of U. S. banking and found a low level of overall efficiency. The main source of inefficiency was technical in nature rather than allocative.

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Brissimis et. al. (2006) studied the technical and allocative efficiency of European banks. The findings suggested that both the technical and allocative components significantly contribute to overall inefficiency and were close to 80% and 75% technically and allocatively efficient. Mostafa (2007) explored the efficiency of GCC banks and the results indicated that the performance of several banks is sub-optimal, suggesting the potential for significant improvements.

Maggie and Heffernan (2007) studied the cost efficiency of Chinese banks over the study period 1985-2002. The results of SFA revealed that the joint-stock banks were more X-efficient than the state-owned commercial banks. Pasiouras et al. (2008) observed that higher restrictions had negative impact on the cost and profit efficiency of banks in a cross country comparison with SFA. Islam et. al. (2011) investigated the overall efficiency and its components in Microfinance institutions in Bangladesh. The mean technical, allocative, and economic efficiencies were found to be 72%, 66%, and 47 % respectively in the pooled sample under variable returns to scale specification.

### ***Indian Experience***

To date there have been very few studies undertaken in Indian banking sector that measured economic efficiency of banks. Das (1997) analyzed the overall efficiency of Indian PSBs and reported a decline in the overall efficiency over the study period. Mishra (2003) examined the Allocative efficiency of Indian banks at State level. The study found improvement in the overall allocative efficiency in the post reform period for the majority of the States.

Kumbhakar and Sarkar (2004) also concluded with the inefficiency in the public and private sector banks with the Stochastic Frontier Approach. The results also indicate that cost inefficiency of banks has increased since the initiation of the reforms, though the reduction in inefficiencies over time continues albeit at a slower rate compared to that observed in the pre-deregulation period. Kumar and Gulati (2010) also examined the cost efficiency and its determinants and found the Indian public sector banks as more technically inefficient than allocatively inefficient. The study of Kaur and Kaur (2010) revealed that private sector banks were more

cost efficient than public sector banks and there was significant impact of merger activity on the efficiency of banks over the study period.

## **RESEARCH METHODOLOGY**

Many studies have been conducted worldwide to analyze the cost efficiency of decision making units like Brissimis et.al. (2006), Pasiouras et. al. (2008), Mishra (2003), Kumbhakar and Sarkar (2004).

Cost efficiency measurement framework got noticed from the seminal work by Farrell. Farrell (1957) proposed an efficiency measure of a firm with two components: Technical efficiency which reflects the ability of a firm to obtain maximal output from a given set of inputs and Allocative efficiency which reflects the ability of a firm to use the inputs in optimal proportion, given their respective prices. These two measures are then combined to provide a measure of total economic efficiency.,

A two stage analysis is more widely used these days to further analyze the different determinants of cost efficiency. Present study also uses two stage analyses to get a complete view of the economic efficiency of banks in India. In the first stage economic efficiency is calculated with input oriented measure and then the results are regressed with the different efficiency determinants. It is noteworthy here that technical inefficiency is caused and correctable by management, and allocative inefficiency is caused by regulation and may not be controlled by the management (Hassan, 2005). Present paper utilized CRS input oriented economic efficiency measure to assess the cost efficiency of different sector banks of Indian banking industry.

**Research Objectives:** Present paper attempts to achieve following research objectives

- i. To analyze the economic/cost efficiency of different sector banks in Indian Banking Industry;
- ii. to study the different determinants of cost efficiency of different sector banks;
- iii. to provide some constructive suggestions to make Indian banks more cost efficient.

**Methodology:** For getting a convenient decomposition of cost efficiency, this paper uses

data envelopment analysis (DEA) to estimate empirically the cost, technical and allocative efficiency scores for different sector banks. The computational procedure used to implement the DEA approach to the measurement of cost efficiency and its components is of three steps (Kumar and Gulati, 2010). The first step is to obtain the measure of TE as introduced by Charnes et al. (1978). Consider K banks each of which uses N inputs to produce M outputs. For each bank  $i = 1, \dots, K$  denote input quantities by  $x_{ni}$ ,  $n = 1, \dots, N$ , and output quantities by  $y_{mi}$ ,  $m = 1, \dots, M$  with  $x_{ni} > 0$  and  $y_{mi} > 0$ , i.e., each DMU has at least one strictly positive input and one strictly positive output. Denote by  $Y = M \times K$  matrix of outputs with bank  $i$ 's output in column  $i$ . Similarly,  $X$  is a  $N \times K$  matrix of inputs. A measure  $TE_i^{CRS} = \theta_i$  of technical efficiency can be calculated as a solution to

$$\begin{aligned} \min TE_i^{CRS} &= \theta_i \\ \text{Subject to} & \\ Y\lambda_i &\geq y_i \\ X\lambda_i &\leq \theta_i x_i \\ \theta_i &\text{ free,} \\ \lambda_i &\geq 0 \end{aligned} \quad (1)$$

By solving linear programming problem (1), we identify a linear combination, described by the  $K \times 1$  vector of  $\lambda_i$  of weights, of all banks in the sample which produces at least the output quantities  $y_i$  of bank  $i$  and uses no more than a share  $\theta_i \in (0,1)$  of its inputs  $x_i$ . Banks with a non-zero weight in  $\lambda_i$  are called reference banks for the bank  $i$ . For  $\theta_i = 1$ , a bank is called technically efficient;  $\lambda_i$  then has a value of 1 at element  $i$  as the only non-zero element. The way the problem was set up ensures that  $\theta_i > 0$  and  $\theta_i \leq 1$ . By minimizing  $\theta_i$  and maximize the proportionate reduction of bank  $i$ 's inputs.

The second step is to calculate cost efficiency by solving the following linear program

(Fare and Grosskopf, 1985; Ferrier et al., 1993)

$$\begin{aligned} \min w_i x_i \\ \text{Subject to} & \\ Y\lambda_i &\geq y_i \\ X\lambda_i &\leq x_i \\ x_i &\text{ free,} \\ \lambda_i &\geq 0 \end{aligned} \quad (2)$$

where  $w_i$  denotes the vector of input prices for bank  $i$ . This yields a cost-minimizing input vector  $xi$  and a

linear combination  $\lambda_i$  of all banks which produces at least bank  $i$ 's outputs  $y_i$  and uses no more than its ideal input vector  $x_i^{CRS}$  under a CRS technology. From the solution to model (2), we get minimum costs as  $w_i x_i^{CRS}$ . Comparing minimum costs to observed cost  $w_i x_i$  of bank  $i$  give cost efficiency as

$$CE_i^{CRS} = w_i x_i^{CRS} / w_i x_i$$

The third step involves the calculation of allocative efficiency component residually as the ratio of the measure of cost efficiency to the Farrell input-oriented input - oriented measure of technical efficiency. Thus, the measure of allocative efficiency is obtained as:

$$AE_i^{CRS} = \frac{CE_i^{CRS}}{TE_i^{CRS}}$$

This relationship facilitates the decomposition of cost efficiency as  $CE_i^{CRS} = TE_i^{CRS} \times AE_i^{CRS}$ . Note that the measures of cost, technical and allocative efficiencies range between 0 and 1. In the second stage Tobit regression is applied using different efficiency determinants of banking industry in India. [see Oum and Yu (1994), Chilingirian (1995), Fethi et al. (2002), Bravo-Ureta et al. (2007)]. Following regression equations are framed to analyze the different determinants of the economic efficiency of banks.

$$Xi = \alpha_i + \beta_i (\text{CDR}) + \beta_i (\text{ICTA}) + \beta_i (\text{BTA}) + \beta_i (\text{ROE}) + \beta_i (\text{NPL}) \dots \dots \dots (1)$$

$$Xi = \alpha_i + \beta_i (\text{CDR}) + \beta_i (\text{DIVS}) + \beta_i (\text{BTA}) + \beta_i (\text{ROE}) + \beta_i (\text{NPL}) \dots \dots \dots (2)$$

$Xi$  = EE scores of banks, CDR = Credit Deposit Ratio, DIVS= Diversification, ICTA= Intermediation cost to Total Assets, BTA= Burden to Total Assets, ROE= Return on Equity, NPL= Non-performing Loans,  $\beta$ = Coefficients,  $\alpha_i$  = Constant term.

**Specification of Inputs and Outputs:** Following inputs and outputs variables are selected according to intermediation approach for the present study. Table I provide the list of inputs and outputs variables. There is no consensus over the selection of production and intermediation approach. But, it is observed in the literature that production approach is more appropriate when bank branch study is conducted while intermediation approach is used to analyze bank wise study.

**Table I Input and Output Variables**

Inputs	Outputs	Input Prices
Employees	Net Int. Income	Payment to and Provision for employees/ No. of employees
Physical Capital	Non-Int. Income	Rent, Rates & Taxes + Printing & Stationary + Dep. on Property + Repairs and maintenance + Insurance/ Physical Capital
Loanable Funds		Int. paid on deposits + Int. paid on Borrowings/ Loanable Funds

**Other Variables of the study:**

**Credit-Deposit Ratio:** It is a ratio which depicts how much a bank lends out of its deposits it has mobilised. A higher ratio indicates more reliance on deposits for lending and vice-versa.

$$CDR = \text{Credit} / \text{Deposits}$$

**Diversification:** These days' banks are performing non-traditional activities to become diversified in banking business. So, the ratio is calculated to know the effect of non-traditional activities on the economic efficiency of banks in India.

$$DIVS = \text{Non-Int. Income} / \text{Total Assets}$$

**Burden to total assets:** this is an indicator to assess the excess of operating expenses to other income of banks or vice-versa.

$$BTAR = \frac{\text{Operating expenses} - \text{Other income}}{\text{Total Assets}}$$

**Intermediation Cost to total assets:** ICTA is an indicator used to assess the proportion of operating expenses to total assets.

$$ICTA = \text{Operating Expenses} / \text{Total Assets}$$

**Return on Equity:** It is an indicator of income earned by bank for the capital invested by its shareholders.

$$ROE = \text{Net Profit} / \text{Equity Funds}$$

(Equity funds here include Equity Capital + Reserves & Surplus.)

**Non-performing Loan Ratio:** It shows the proportion of non-performing loans to net advances. The non-performing loans tell how a

bank manages its loan portfolio, which can be interpreted as the lower percentage the better the managed portfolio (Raphael, 2013).

$$NPL = \text{Non-performing loans} / \text{Net Advances}$$

**Empirical Results and Analysis**

This section is devoted towards the analysis of the different sector banks in India. Table II depicts the descriptive statistics of efficiency scores of different sector banks in India. It can be observed that public sector banks are leading with an overall mean score of 0.893 in all the three sector banks. Further, foreign banks are the least performer of cost efficiency with a score of 0.660. Minimum score of 0.483 is also obtained by one of the foreign sector bank. In other words it can also be said that foreign sector banks have maximum scope for improvement in cost efficiency in all the three sector banks.

Year wise efficiency can be analyzed with the help of table III. The table reveals that PSBs were technically and allocatively efficient (on the basis of highest score obtained) in the year 2004-05. Further, private sector banks managed to get maximum efficiency in the year 2007-08. Foreign sector banks obtained a maximum score of 0.738 in the year 2008-09. It can also be observed from the analysis of score that foreign banks have shown a continuous improvement in all the years of study except in the year 2005-06 but still have wasted many resources.

Correlation analyses of different variables under study are shown in table IV. The efficiency score of the banks are positively correlated with Return on Equity and Burden to total assets which means higher the ROE and BTA more cost efficient are the banks. Efficiency is negatively correlated

with Credit Deposit Ratio, Non-Performing Loans, Diversification and Intermediation Cost to total assets. Further, Diversification is highly correlated with Intermediation Cost to total assets with a value of 0.8432 which states that these two variables cannot be used simultaneously in a single model.

Table V is showing the Kruskal-Wallis test results to analyze is there any significant difference between the cost efficiency of different sector banks. PSBs have obtained higher mean rank and foreign sector banks have least mean rank. So, on the basis of p value it can be said that there is significant difference amongst the public, private and foreign banks cost efficiency.

The results of Tobit regression are shown in table VI. As from the results of correlation it is

observed that DIVS and ICTA cannot be studied simultaneously. So, two different models are framed to study the impact of different variables. The economic efficiency scores of banks are taken as dependent variables and CDR, DIVS, ICTA, BTA, ROE and NPL are independent variables of the study. The results reveal that CDR and NPL are negatively but significantly associated with the cost efficiency of the different sector banks which state that increase in these variables leads to decrease in the cost efficiency. Return on equity is positively contributing to cost efficiency. Diversification and Intermediation cost to total assets are negative and insignificant to cost efficiency. One variable Burden to total asset is positive in both the model but significant in model 2 and insignificant in model 1.

**Table II Overall Efficiency Descriptive of Different Sector Banks**

	PSB			PRBS			FSB		
	TE	AE	EE	TE	AE	EE	TE	AE	EE
<b>Mean</b>	0.9404	0.948	0.893	0.822	0.927	0.822	0.758	0.872	0.660
<b>Median</b>	0.961	0.960	0.915	0.896	0.923	0.809	0.747	0.865	0.624
<b>Std. Error</b>	0.0136	0.011	0.021	0.023	0.118	0.028	0.042	0.022	0.041
<b>Minimum</b>	0.824	0.844	0.752	0.709	0.832	0.640	0.512	0.618	0.483
<b>Maximum</b>	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
<b>Std. Dev.</b>	0.057	0.046	0.089	0.096	0.050	0.122	0.178	0.097	0.176

PSB= Public Sector Banks, PRBS= Private Sector Banks, FSB= Foreign Sector Banks, TE= Technical Efficiency, AE= Allocative Efficiency, EE= Economic Efficiency, AE= EE/TE

**Table III Year wise Efficiency analysis of Different Sector Banks**

	PSB			PRBS			FSB		
	TE	AE	EE	TE	AE	EE	TE	AE	EE
<b>2004-05</b>	0.955	0.977	0.933	0.887	0.887	0.784	0.727	0.860	0.622
<b>2005-06</b>	0.925	0.969	0.897	0.944	0.869	0.818	0.496	0.539	0.275
<b>2006-07</b>	0.962	0.962	0.926	0.927	0.894	0.828	0.820	0.818	0.661
<b>2007-08</b>	0.950	0.973	0.925	0.911	0.936	0.853	0.826	0.858	0.706
<b>2008-09</b>	0.947	0.983	0.932	0.899	0.904	0.803	0.876	0.839	0.738

PSB= Public Sector Banks, PRBS= Private Sector Banks, FSB= Foreign Sector Banks, TE= Technical Efficiency, AE= Allocative Efficiency, EE= Economic Efficiency, AE= EE/TE.

Source: Computed

**Table IV Correlation analysis of variables**

	CDR	DIVS	ICTA	BTAR	ROE	NPL	EE
CDR	1.000000						
DIVS	-0.093967 (-0.68061)	1.000000					
ICTA	-0.093601 (-0.67794)	0.84328* (11.3143)	1.000000				
BTAR	0.061884 (0.447106)	-0.81796* (-10.2535)	-0.38060* (-2.96793)	1.000000			
ROE	0.048002 (0.34654)	-0.041243 (-0.29766)	-0.131606 (-0.95735)	-0.069756 (-0.50424)	1.000000		
NPL	-0.43840* (-3.51745)	-0.104276 (-0.75606)	-0.159158 (-1.16252)	0.008726 (0.06293)	-0.38309* (-2.99065)	1.000000	
EE	-0.170570 (-1.24828)	-0.189892 (-1.394705)	-0.092443 (-0.66948)	0.22782*** (1.68723)	0.36297* (2.80900)	-0.30829** (-2.33699)	1.000000

*t*-statistics are shown in parenthesis. \*, \*\* and \*\*\* represents significance at 1%, 5% and 10% level respectively.  
Source: Computed

**Table V Results of Kruskal-Wallis Test**

Bank	Mean Rank
PB	36.89
PRB	30.47
FB	15.95
Chi-Square Value	17.346
P-Value	.000

(PB = Public Sector Bank, PRB = Private Sector Banks, FB = Foreign Sector Banks)

**Table VI Tobit Regression Result of Efficiency Determinants**

Variable	Model 1	Model 2
Constant	0.952818* (8.769190)	0.952858* (8.767506)
CDR	-0.002543* (2.938044)	-0.002543* (-2.938074)
DIVS	-0.008782 (-0.50537)	----
ICTA	----	-0.008790 (-0.505659)
BTA	0.026703 (0.91804)	0.035484** (2.018107)
ROE	0.004864*** (1.87597)	0.004863*** (1.875830)
NPL	-0.021918* (-2.76363)	-0.021918* (-2.763791)

Z statistics are shown in parenthesis. \*, \*\*, \*\*\* represent significance level at 1%, 5% and 10% respectively.

**Table VII Summary of Cost Minimising Input Quantities**

Bank	% of increase/decrease in Inputs			Targets		
	x1	x2	x3	x1	x2	x3
Public Sector Banks	8.84	79.47	76.67	197637	1133666	33579739
Private Sector Banks	-50.52	-40.89	-37.34	39269	70940	3658680
Foreign Sector Bank	-41.76	-22.77	35.52	17812	18625	2513825

(x1= Physical Capital, x2= Employees, x3= Loanable Funds)

## Conclusion

The present paper attempts to analyze the cost efficiency of different sector banks in India. For achieving the purpose of the study 54 different sector banks were selected over a study period of 2004-05 to 2008-09. The results revealed that public sector banks are leading in all the sector banks in terms of cost efficiency. It is also observed that foreign banks are the least performer in terms of cost efficiency and have wasted around 34% of inputs used. The main reason of cost inefficiency of Indian sector banks is technical inefficiency rather allocative inefficiency.

The results also state that return on equity and burden to total assets are positively associated with economic efficiency of different banks. Further, Credit Deposit ratio and Non-performing ratio are significantly negative to cost efficiency of banks in India which state that decrease in these variables lead to increase in cost efficiency of banks. The study also reveals that diversification is negatively affecting the cost efficiency of banks in insignificant manner which mean that diversification may be contributing to the profitability of banks but it is increasing the cost inefficiency of banks in India.

## Policy Implication and Future Prospects

The study can be useful for the analysts, decision makers, regulators and researchers. The results of the study may help the decision makers and analysts to have an overview of economic efficiency of different sector banks in India. Further, the study is also helpful in understanding the different determinants of cost efficiency through which the effect of different variables can be assessed and the same can be tackled in a systematic way in taking future decisions regarding reducing the economic inefficiency.

Different inputs and outputs can become the part of future studies to get a wider view of cost

efficiency of banks in India. Further, different variables determining the cost efficiency can also be studied to know their effect on cost efficiency.

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