

## Impact of Mergers on the Cost Efficiency of Indian Commercial Banks

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### **Abstract**

*The present paper examines the cost efficiency of Indian commercial banks by using a non-parametric Data Envelopment Analysis Technique. The cost efficiency measures of banks are examined under both separate and common frontiers. This paper also empirically examines the impact of mergers on the cost efficiency of banks that have been merged during post liberalization period. The present study based on unbalanced panel data over the period 1990-91 to 2007-08. In this paper to test the efficiency differences between public and private both parametric and non-parametric tests are employed. The findings of this study suggest that over the entire study period average cost efficiency of public sector banks found to be 73.4 and for private sector banks is 76.3 percent. The findings of this paper suggest that to some extent merger programme has been successful in Indian banking sector. The Government and Policy makers should not promote merger between strong and distressed banks as a way to promote the interest of the depositors of distressed banks, as it will have adverse effect upon the asset quality of the stronger banks.*

**Keywords:** Mergers, Indian Banks, Cost efficiency, DEA, Parametric and non-parametric tests

**JEL Classification Codes:** G21, G34, H21

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## 1. Introduction

Banks as financial intermediaries play a significant role in economic growth, provide funds for investments, and keep the cost of capital low. During the last few decades, structure of banking sector has turned from a controlled system into liberalized one. The efficiency of banks, which reflects the ability of banks in transforming its resources to output by making its best allocation, is essential for the growth of an economy. However, due to the major role played by banks in the development of economy, the banking sector has been one of the major sectors that have received renewed interest from researchers and economists.

The rapid advances in computer and communication technology have led to the development of new bank services and financial instruments (Shiang, Tai Liu, 2009). Therefore, the economies of world have experienced a revolutionary change in the environment of banking sector. The competition among banks at domestic and global level has increased and it has compelled the banking industry to improve their efficiency and productivity. Moreover, the government and policy makers have adopted various policies and measures out of which consolidation of banks emerged as one of the most preferable strategy. There are diverse ways to consolidate the banking industry the most commonly adopted by banks is merger. Merger of two weaker banks or merger of one healthy bank with one weak bank can be treated as the faster and less costly way to improve profitability than spurring internal growth (Franz, H. Khan, 2007). One of the major motive behind the mergers and acquisition in the banking industry is to achieve economies of scale and scope. This is because as the size increases the efficiency of the system also increases. Mergers also help in the diversifications of the products, which help to reduce the risk as well (Bhan, Akil, 2009)

The issue of impact of mergers on the efficiency of banks has been well studied in the literature. Most of the literature related with the impact of mergers on the efficiency of banks is found in European Countries and US. In India, literature on bank merger is very scarce. Very few studies have been conducted with the motive to examine the impact of mergers on the performance of Indian Commercial banks.

The present study makes notable contribution to the existing literature on banking efficiency in India. In most of the existing studies on the efficiency of Indian commercial banks used a balanced panel. The present study has been carried out with unbalanced panel data over the period 1990-2008.

The paper aims

1. To measure cost efficiency for individual commercial banks in India.
2. To study the impact of mergers on the cost efficiency of merged banks.

The remainder of the paper is organized as follows: Section 1 provides a brief overview of Indian banking system. Next section deals with the review of empirical

studies related with the bank efficiency and the impact of mergers on the efficiency of banks. Section 3 describes the methodology used in the present study. Section 4 provides the data and the specification of input and output variables. The empirical findings are reported in Section 5. The final section discusses the concluding remarks.

## **2. The Brief Overview of Indian Banking Sector**

In India, the Reserve Bank of India acts as a central bank of the country. Banking system has a wide mix, comprising of scheduled and non-scheduled banks, co-operative sector banks, post office saving banks, foreign and exchange banks. Table 1 provides a brief detail of the structure of Indian commercial banks as on the end March 2008. As on March 2008, the number of commercial banks is 79 comprise of 28 PSBs, 23 private sector banks and 28 foreign banks. It is evident from the table that public sector banks dominate the commercial banks in India. It has been observed that the market share of public sector banks in terms of investment, advances and assets is near about 70 percent. The Public sector banks are the biggest players in the Indian banking system and they account for 70 percent of the branches of commercial banks in India. As on March 2008, private sector banks accounts for nearly 21.7 percent while foreign banks constitutes 8.41 percent share in total assets of commercial banks.

During last few decades, the environment under which Indian banking sector has operated witnessed a remarkable changes. India embarked on a strategy of economic reforms in the wake of a serious balance of payment crisis in 1991(Mohan, Rakesh 2005). In Indian banking sector, the policy makers adopted a cautious approach for introducing reform measures on the recommendation of Narishmam Committee I (1991), Narishmam Committee II (1997) and Verma Committee (1999). The main objective of the banking sector reforms was to improve the efficiency of banks and to promote a diversified and competitive financial system. One of the outcomes of such reforms was the consolidation of the banking industry through mergers and acquisitions. Technological progress and financial deregulation have played an important role in accelerating the process of merger and acquisition in Indian banking industry. Due to technological progress, the scale at which financial services and products are produced has expanded which provide an opportunity for the banks to increase their size and scale of production. At that, time mergers of banking institutions emerged as an important strategy for growing the size of banks. Size of the bank plays a significant role to enter the global financial market.

**Table 1. Structure of Indian Banking Sector (As on March 2008)**

Bank group	Numbers			Amount in Rs. cr			
	No. of Banks	Branches	No. of Employees	Investments	Advances	Assets	Deposits
I. Public sector banks (a +b)	28	55018	715408	799841	179400	3021924	2453867
Market Share (%)		69.9%	78.8%	67.9	72.6%	69.9%	46.1%
a. State Bank of India Group	8	15814	249008	263823	593722	1010959	773874
Market Share (%)		20.1%	27.4%	22.4	24.0%	23.4	14.6%
b. Nationalized Banks	20	39204	466400	536018	1203678	2010965	1679993
Market share (%)		49.8%	51.4%	45.5	48.3%	56.5	31.5%
II. Indian private sector Banks	23	8294	158823	278578	518402	940144	2675033
Market share (%)		10.5%	17.5%	23.7	20.9%	21.7	50.3%
III. Foreign banks in India	28	279	33969	98910	161133	364099	191161
Market share (%)		0.35%	3.74%	8.4	6.5%	8.41	3.6%
IV. Total Indian private and foreign banks(II + III)	51	8573	192792	377488	679535	1304243	2866194
Market share (%)		10.9%	21.2%	32.1	27.4%	30.1	53.9%
V. Total commercial banks (I + b IV)	79	78666	908200	1177330	2476936	4326166	5320062
Market share (%)		100%	100%	100%	100%	100%	100%

Notes: Excludes Regional Rural Banks

Source: Calculated from the statistical tables relating to banks in India, 2007-08

## 2.1 Merger of Banks in India

Merger can be defined as a mean of unification of two players into single entity. Merger is a process of combining two business entities under the common ownership. According to Oxford Dictionary the expression, "Merger means combining two commercial companies into one." Bank merger is an event when previously distinct banks are consolidated into one institution (Pilloff and Santomerro, 1999). A merger occurs when an independent bank loses its charter and becomes a part of an existing bank with one headquarter and a unified branch network (Dario Farcarelli 2002). Mergers occurs by adding the active (bidder ) banks assets and liabilities to the target (Passive) bank's balance sheet and acquiring the bidder 's bank name through a series of legal and administrative measures

Mergers and acquisitions in Indian banking sector have initiated through the recommendations of Narasimham committee II. The committee recommended that merger between strong banks/ financial institutions would make for greater economic and commercial sense and would be a case where the whole is greater than the sum of its parts and have a "force multiplier effect". (Narasimham committee II, chapter, para 5.13 -5.15). Table 2 provides a list of banks that have been merged in India since post-liberalization in the country.

**Table 2. Banks Merged in India since Liberalization**

Merger Year	Acquirer Bank	Target Bank	Motive of merger	Type of Merger
1993	Punjab National Bank	New Bank of India	Restructuring of Weak Bank	Forced Merger
1993	Bank of India	Bank of Karad Ltd.	Restructuring of weak bank	Forced Merger
1995	State Bank of India	Kashinath Seth Bank	Restructuring of weak bank	Forced Merger
1997	Oriental Bank of Commerce	Punjab Co-operative Bank Ltd.	Restructuring of weak bank	Forced Merger
1997	Oriental Bank of Commerce	Bari Doab Bank Ltd.	Restructuring of weak bank	Forced Merger
1999	Union Bank of India	Sikkim Bank Ltd.	Restructuring of weak bank	Forced Merger
2000	HDFC Bank Ltd.	Times Bank	To achieve scale and scope economies	Voluntary Merger
2001	ICICI Bank	Bank of Madura	To achieve scale and scope economies	Voluntary Merger
2002	ICICI Bank	ICICI Limited	To achieve the objective of universal banking	Voluntary Merger
2002	Bank of Baroda	Benaras State Bank Ltd.	Restructuring of weak bank	Forced Merger
2003	Punjab National Bank	Nedungadi Bank Ltd.	Restructuring of weak bank	Forced Merger
2004	Bank of Baroda	South Gujarat Local Area Bank	Restructuring of weak bank	Forced Merger
2004	Oriental Bank of Commerce	Global Trust Bank	Restructuring of weak bank	Forced Merger
2005	Centurion Bank	Bank of Punjab	To achieve scale and scope economies	Voluntary merger
2006	Federal Bank	Ganesh Bank of Kurandwad	Restructuring of weak bank	Forced merger
2006	IDBI Bank	United western Bank	Restructuring of weak bank	Forced merger
2006	Centurion Bank of Punjab	Lord Krishna Bank	Expansion of size	Voluntary merger
2007	ICICI Bank	Sangli Bank	Expansion of size	Voluntary merger
2007	Indian Overseas Bank	Bharat overseas Bank	Restructuring of weak bank	Compulsory merger
2008	HDFC Bank	Centurion Bank of Punjab	Expansion of size and benefits of scope economies	Voluntary merger

Source: Compiled from Report on Trend and Progress of Banking in India, RBI, various issues.

### 3. Review of Related Literature

Several studies have been conducted to examine the efficiency of banks. Berger and Humphrey (1997) in their study provide an extensive review of studies on the efficiency of banking sector. They pointed out that, majority of studies focused on the banking markets of well-developed countries with particular emphasis on the US market.

Bhattacharyya et al. (1997) used DEA to measure the productive efficiency of 70 Indian commercial banks in the period 1986-1991. They found that the public sector banks are the most efficient banks as compared to foreign banks and private banks. They also found a temporal decline in the performance of public sector banks. Das (1997) used the cross-section data and DEA to examine the efficiency of 65 major banks for the year 1995. He found that Indian banks were more technically efficient than allocatively efficient. Mukherjee et al. (2002) examined the technical efficiency of 68 Indian commercial banks for the period 1996-1999 and found that public sector banks are more efficient than both private and foreign banks. Ram Mohan and Ray (2004) also found that public sector banks performed better than private sector banks but not differently from foreign banks. All these studies have compared the efficiency of public, private and foreign banks by using a common frontier and such comparisons are not justified on the ground that public, private and foreign banks are operated under different legal and regulatory frameworks.

The pace of bank mergers and acquisitions is increasing all over the world and it has given rise to an extensive economic research. Today, there is quite an abundance literature available on the subject of bank mergers. Berger et.al (1999) provided a comprehensive review of studies evaluating mergers and acquisitions in banking industry.

In literature, there has been number of studies conducted on the impact of mergers on the efficiency of banks. The studies that have been conducted to analyze the impact of mergers and acquisitions on bank performance can be classified as ex-ante studies and ex-post studies. Ex-ante studies assess the effect of merger on bank performance by analyzing the stock market reaction to merger announcement. Ex-ante studies are also called the event studies as the announcement of merger is considered as an event in the stock price history of the merging entity. Ex-post studies, on the other hand asses the effect of merger on banks' performance by comparing, pre and post merger performance of banks. This comparison can be made by using either traditional financial ratio analysis or by econometric and frontier analysis. There is voluminous literature on mergers and acquisitions in developed economies like US but there is dearth of literature in developing economies like India and other Asian countries. The literature suggests that there is mixed empirical evidence regarding the impact of mergers and acquisitions on the efficiency and performance of banks.

Cost efficiency gains from merger may be arise from the fact that merged banks gain access to cost saving technologies or spread their fixed cost over a larger base, thus reducing average cost.

Frei et al. (1996) suggest that the cost efficiency effects of merger and acquisition may depend on the type of merger and acquisition, the motivation behind it and the manner in which the management implemented its plans.

Vennet (1996) studied the impact of mergers on the efficiency of European Union banking industry by using some key financial ratios and stochastic frontier analysis for the period 1988-93 and found that merger improve the efficiency of participating banks. Akhavein et.al (1997) examined the price and efficiency effect of mega mergers on US banking industry and found that after merger banks have experienced higher level of profit efficiency than before merger. Berger (1998) found very little improvement in efficiency for merger and acquisition of either large or small banks. Gourlay et al. (2006) analyzed the efficiency gains from mergers among Indian banks over the period 1991-92 to 2004-05 and observed that the merger led to improvement of efficiency for the merging banks. R.B.I (2008) also drives the same conclusions and found that public sector banks have been able to get higher level of efficiency than private sector banks during post merger period.

#### **4. Methodology**

In banking literature, parametric and non-parametric approaches are frequently used for the estimation of bank efficiency. Parametric approaches include Stochastic Frontier Analysis (SFA), Thick Frontier Approach (TFA). Among, all parametric approaches SFA, also sometimes referred as econometric approach is widely used to measure the efficiency of DMU's. This approach was proposed in two separate articles by Aigner, Lovell, and Schmid (1977) and Battese, and Corra (1977). SFA specifies a functional form profit, cost and production relationship among inputs, outputs, and environmental factors and allows for random error. The SFA assumes a composed error model where inefficiencies are assumed to follow an asymmetric distribution, usually the half normal or exponential distribution, usually the standard normal [Ferrier and Lovell (1990)]. This approach is based on the assumption of a particular functional form if it is not specified correctly; the measures of efficiency may be thrown into confusion for specification of errors. Further, this approach adds the problem of decomposition of the error term into noise and inefficiency.

Contrary to parametric approach, non-parametric approach requires few assumptions about the estimated frontier and does not assume a specific functional form to represent the cost and production functions. Among, a non-parametric approach, DEA is used extensively to estimate the efficiency of DMU's. In this paper a (-3, 3) event window has been constructed to investigate the effect

of mergers and acquisitions on the Indian banking industry. The choice of event window is motivated by Rhodes (1998). Rhodes (1998) pointed out that there has been unanimous agreement among the experts that about half of any efficiency gains should be realized within three year after merger. Therefore, the efficiency for each bank involved in merger is obtained for the acquiring and target bank during the three years before merger and for the merging bank during the available years after the merger.

#### **4.1. Data Envelopment Analysis**

Data envelopment analysis sometimes also referred as frontier analysis was first introduced in the Operation Research by Charnes , Cooper and Rhodes in 1978 under the assumption of constant returns to scale. DEA is based on a concept of efficiency very similar to the microeconomic one; the main difference is that the DEA production frontier is not determined by some functional form, but it is generated from the actual data for the evaluated firms [Casu, Barbara and Molyneux, Philip (1999)]. Later, Banker, Charnes, and Cooper (1984) extended CCR model to allow variable return to scale. The CRS assumption of DEA is suitable only when all DMU's are operating at an optimal scale. However, in practical situation many factors like imperfect competition , regulatory and legal framework put constraints on DMU' s not to be operating at optimal scale. As a result, the use of CRS specification when some DMU are not operating at optimal scale will result in measures of technical efficiency, which are confounded by scale efficiencies (Philip, 1999).

DEA computes the efficiency of banks on the basis of estimated piecewise linear frontier made up by a set of efficient banks. The banks that lie on the frontier are treated as best practice banks and obtain efficiency score equal to one whereas the banks that do not lie on the frontier are relatively inefficient and their efficiency score lie in the range of zero and one. The DEA approach decomposed the CE into its two different components, TE (technical efficiency) and AE (allocative efficiency). Technical efficiency reflects the ability of a firm to maximize output from a given set of inputs whereas allocative efficiency reflects the ability of the firm to use these inputs in optimal proportions, given their respective prices where the cost of production is minimum. Technical efficiency implies that there is no waste in using inputs to produce specific quantity of output. A firm is said to be technically efficient when it cannot increase any output or decrease any input without reducing the quantities of other outputs or inputs. Combining these two measures provides a measure of cost efficiency. A firm is said to be cost efficient when it is both allocatively as well as technically efficient.

Following Farrell et al. (1957), this paper has used the input price vector to specify and obtain a measure of cost efficiency (CE) for each bank by solving this envelopment form of linear programming problem:



Mini  $w_i x_i^*$

Subject to:

$$\begin{aligned} \sum \lambda_g y_{ki} - y_{kgo} &\geq 0 \\ x_{igo}^* - \sum \lambda_g x_{ig} &\geq 0 \\ \lambda &\geq 0 \end{aligned}$$

Where

$w_i$  = vector of input prices for  $i$ th bank

$y_i$  = vector of output levels for  $i$ th bank

$x_i^*$  = cost minimizing vector of input quantities

$\lambda$  =  $n \times 1$  vector of constants

Thus, the cost efficiency of any given bank is obtained as the ratio of minimum cost to the observed cost written as follows:

$$CE = \frac{w_i x_i^*}{w_i x_i}$$

On the other hand, allocative efficiency is the ratio of cost efficiency to technical efficiency, thus  $AE = \frac{CE}{TE}$ . This procedure of cost efficiency includes any slacks into allocative efficiency because the slacks reflect sub optimal input mix [Ferrier and Lovell(1990)].

**Measuring Technical Efficiency:** The technical efficiency is obtained by using the following input oriented DEA model.

$$\text{Max } Z_0 = \frac{\sum_{k=1}^n \mu_k y_{kgo}}{\sum_{i=1}^z v_i x_{iko}}$$

Subject to:

$$\frac{\sum_{k=1}^h \mu_k y_{kgi}}{\sum_{i=1}^z v_i x_{ig}} \leq 1$$

$$\mu_k \geq \epsilon, v_i \in \epsilon, g = 1, 2, \dots, n, k = 1, 2, \dots, h, i = 1, 2, \dots, z$$

- $u_k, v_i$  = weights given to output k and input i .
- $y_{kg}$  = quantity of output k achieved by DMU g
- $x_{ig}$  = quantity of input i used by DMU g
- n = number of DMUs
- h = number of outputs
- z = number of inputs
- $\epsilon$  = a non-Archimedean (infinitesimal) constant

One of the distinct feature of these models is that the weights  $u_k, v_r$  are positive and unknown. The values of u and v are find in such a way that the efficiency of gth DMU is maximized. This model is in a ratio form and one of the key problems related with the ratio form is that it has an infinite number of solutions. The above fractional form can be transformed in a straight forward way into the following liner programs

**CCR Efficiency Measure (Linear Form)**

$$\text{Max} Z_0 = \sum_{k=1}^n \mu_k y_{kgo}$$

Subject to:

$$\sum_{k=1}^h \mu_k y_{kg} - \sum_{i=1}^z v_i x_{ig} \leq 0$$

$$\sum_{i=1}^z v_i x_{iko} = 1$$

$$\mu_k \geq \epsilon, v_i = \epsilon, g = 1, 2, \dots, n, k = 1, 2, \dots, h, i = 1, 2, \dots, z$$

**4.2. Data Base**

This paper has used time-series cross section data of commercial banks in India for the period 1990-91 to 2007-08. The sample contained the public and private sector banks that have operated in India during 1991-2008. The Times Bank of India has been excluded from the analysis due to non-availability of required data for even a single year. The required data has been culled from the “Performance Highlights of Indian Banks” various issues an annual publication of IBA and “Statistical Tables Relating to Commercial Banks in India” an annual publication of Reserve Bank of India. The numbers of observations varied across time due to entry of new private banks in 1995 and exit of banks due to merger of banks in the banking industry, which leads to an unbalanced panel data. It gives us 1055 observations with minimum 50 observations in 2008 and maximum 61 in 1998. The year-wise description of no. of observations have been given in Table 3. The present study excluded the Regional Rural Banks, it is because these banks have been established to meet some social objectives of providing credit to a specific target and their inclusion in the study could lead to misleading conclusions.

### 4.3. Specification of Variables

It is well known in the literature of banking efficiency studies, the choice of input and output variables significantly affects the efficiency scores of banks and at the same time, it is not an easy task to measure and define bank input and output variables. There is considerable disagreement among researchers about the constituents of inputs and outputs of the banking industry. Since many bank services are priced implicitly by offering below market interest rates on deposits, the observed revenue flow offer poor guidance regarding the relative importance of various outputs (Berger and Humphrey, 1992). Mainly two different approaches have been appeared in the literature regarding the measurement of inputs and outputs of banks. These approaches are the production approach and intermediation approach. The production approach views bank as using purchased funds to produce deposit and various categories of bank assets. This approach treated loans and deposits as outputs and measured in terms of the number of accounts and transactions serviced during a particular period. A shortcoming of this approach is that it considers only operating costs and excludes the interest expenses. This approach is less common in the empirical literature due to the non-availability of data on the number of accounts and transactions. In contrast, the intermediation approach views banks as financial intermediaries that collect funds from units in surplus and then transform these resources into loans and other investments. According to this approach bank, outputs are measured in monetary values and total costs include all operating and interest expenses thus providing a more thorough picture of the economic viability of a bank. This approach has been the preferred approach in most efficiency studies.

Berger and Humphrey (1997) pointed out that neither of two approaches is suitable for defining the inputs and outputs because these approaches cannot fully capture the dual role of banks as producers of services and being financial intermediaries between savers and investors. Nevertheless, they suggested that, the production approach might be more suitable for branch level efficiency studies whereas intermediation approach is well suitable for measuring bank level efficiency. This is because, at the branch level investment decisions are mostly not under the control of branches whereas at the bank level motive of management will be to reduce total cost and not just non –interest expenses. In banking literature, researches have given priority to intermediation approach.

For the purpose of present paper, modified version of intermediation approach is used for the selection of input and output variables. The selected input variables are 1) Labor (measured in terms of number of full time employees, 2) Loanable funds (measured as the sum of deposits and borrowings and 3) Physical capital comprises fixed assets and book value of premises at the end of the year . The output variables used for the estimation of efficiency are 1) Non-interest income and 2) Net –interest income (measured as the difference between interest earned

and interest expanded and 3) Advances. Further, all the input and output variables except labor are measured in crore of Rupees. In order to obtain CE of banks the analysis has been carried out with real variables. All the nominal input and output variables except (labor) have been converted into real variables by using GDP price deflator (Base 1999-2000) whereas establishment expenses incurred on staff has been deflated by consumer price index for non-manual employees. Following Denier et al. (2007) all the input and output variables have been normalized by dividing each of them except labor by number of branches of individual banks for the given year. This procedure is mainly used to reduce the effects of random noise due to the measurement errors in the inputs and outputs. One of the important pre-requisite for calculating the cost efficiency of banks is the information of input prices. Therefore, in the present analysis we also incorporate the input prices. Labor costs are proxied by dividing the establishment expenses of all banks employees by the total number of employees. The unit price of physical capital is measured by dividing the sum of expenses on rent, repairs and depreciation by total fixed assets. The price of loanable funds is computed by the total interest expenses divided by the total loanable funds. Table 3 summarizes the descriptive statistics of selected input and output variables

**Table 3. Descriptive Statistics of selected input and output variables**

year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
<b>No. of banks</b>	52	52	53	51	51	58	60	60	60	59
<b>Outputs</b>										
<b>Advances</b>										
<b>Mean</b>	429.76	411.96	393.95	611.61	400.67	1578.80	1336.26	1750.40	1598.56	1706.01
<b>S.D</b>	241.35	227.03	232.82	1297.96	189.02	6450.15	2790.03	3762.48	3846.41	3961.37
<b>Non-interest income</b>										
<b>Mean</b>	7.71	8.24	9.53	12.72	12.64	24.55	45.67	70.38	80.58	65.66
<b>S.D</b>	4.57	4.76	6.19	11.09	7.79	45.68	100.34	189.72	219.47	191.19
<b>Spread</b>										
<b>Mean</b>	223.78	213.38	348.84	295.70	292.15	325.61	323.68	363.73	402.10	442.10
<b>S.D</b>	432.16	426.47	872.71	766.85	661.17	753.13	741.47	824.73	859.35	935.52
<b>Inputs</b>										
<b>Labor</b>										
<b>Mean</b>	17628.27	17720.35	17497.30	18129.75	18547.00	16398.29	15866.47	15817.17	15809.90	16073.73
<b>S.D</b>	32562.57	32874.13	32943.89	33798.67	34538.27	33214.18	32841.26	33042.78	33362.08	33279.60
<b>Loanable Funds</b>										
<b>Mean</b>	5.09	791.97	742.65	1156.31	869.45	2512.60	2170.62	3245.08	3242.84	3532.31
<b>S.D</b>	2.83	371.13	360.79	2173.41	373.78	7795.19	4186.74	6579.34	7561.95	7307.54
<b>Physical Capital</b>										
<b>Mean</b>	810.66	4.97	5.24	9.29	10.82	59.97	96.67	216.23	191.50	184.69
<b>S.D</b>	395.08	2.64	3.05	9.24	7.65	184.07	226.71	838.96	811.44	771.88

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Prices of Inputs										
Price of Labor										
Mean	1.07	1.09	1.08	1.09	1.18	1.23	1.68	1.87	1.73	1.70
S.D	0.24	0.19	0.23	0.25	0.16	0.38	0.53	1.69	0.67	0.29
Price of loanable funds										
Mean	6.61	6.89	7.39	7.83	7.20	6.14	7.40	8.11	7.89	8.14
S.D	1.34	0.85	1.13	0.92	0.81	1.77	1.54	1.42	1.16	1.35
Price of Physical Capital										
Mean	64.74	64.48	46.50	43.59	38.10	30.56	28.89	30.14	43.77	30.65
S.D	39.49	39.48	31.37	31.58	26.46	25.87	21.88	19.37	96.75	17.51

year	2000	2001	2002	2003	2004	2005	2006	2007	2008	
No. of banks	59	58	57	56	56	56	55	52	50	
Outputs										
Advances										
Mean	2391.30	1619.40	2454.57	1646.36	1686.54	4055.11	2883.48	3495.94	400.66	
S.D	5818.71	2558.11	7629.41	2003.35	4922.64	13798.21	4302.70	3913.51	405.08	
Non-interest income										
Mean	99.78	52.51	82.88	81.70	84.08	86.54	74.56	71.53	97.35	
S.D	261.66	85.92	140.93	119.60	135.19	207.15	157.40	116.35	138.34	
Spread										
Mean	457.69	558.95	568.10	669.17	734.99	914.43	1144.63	1429.28	146.99	
S.D	949.22	1120.33	1139.17	1234.44	1096.30	1645.90	1999.93	2229.39	134.74	
Inputs										
Labor										
Mean	15941.47	14935.26	14556.54	14908.64	14917.18	14989.66	15542.51	16667.35	17443.40	
S.D	32743.46	30224.00	29379.20	29549.27	25760.12	28980.42	28329.10	27188.45	26962.62	
Loanable Funds										
Mean	5051.20	3348.15	4715.59	3239.69	3302.13	6258.26	4419.80	5240.76	3452.41	
S.D	11705.74	4866.64	13353.89	3961.59	8721.76	19694.91	6053.39	5693.27	2892.12	
Physical Capital										
Mean	195.40	110.80	180.21	100.21	91.04	115.49	80.20	87.34	105.38	
S.D	730.26	347.56	731.87	307.79	508.37	329.11	207.77	211.68	294.02	
Prices of Inputs										
Price of Labor										
Mean	1.88	2.12	2.13	2.27	2.42	2.60	2.80	2.75	3.05	
S.D	0.34	0.51	0.44	0.47	0.55	0.92	0.71	0.53	0.79	
Price of loanable funds										
Mean	7.64	632.66	7.33	6.60	5.33	4.58	4.60	4.98	13.12	
S.D	1.05	389.22	1.25	0.90	1.47	0.81	0.66	0.69	10.77	
Price of Physical Capital										
Mean	31.56	33.67	36.13	40.38	40.78	41.41	41.89	43.59	137.88	
S.D	18.07	18.01	18.32	19.04	17.85	18.76	17.03	20.26	213.05	

## 5. Empirical Analysis

### 5.1. Separate and Common Frontier Analysis

During the last few years, an important issue raised by the analysts in the literature of banking efficiency is that whether state-owned, foreign banks and private banks employed the same or somewhat different production technologies. Notable among these researchers are Elyasiani and Mehadian (1990), Isik and Hasan (2002), Burki and Niazi (2006). Most of the empirical studies revealed that if they operate in different legal and business environments, then pooling of the data in each cross-section may not be appropriate. Therefore, by following Isik and Hassan (2002), in this paper we compute DEA cost, allocative and technical efficiency of public and private banks relative to their common and separate frontiers. Both parametric (ANOVA) and Non-parametric tests (Kruskal wallis and Median Test) are performed to test the null hypothesis that efficiency measures of the public and private sector banks obtained from the common frontier are same as the efficiency scores obtained from separate frontier. The efficiency measures for pooled and separate frontier are presented in Table 4. Table clearly depicts that mean efficiency of separate frontier for each yearly cross-section and bank type is either equal to or greater than mean efficiency of pooled frontier. It implies that in sample banks pooled frontiers envelop the separate frontier.

**Table 4 . Efficiency Measures Relative to Separate and Common Frontiers  
(a) Public Sector Banks**

Year	Separate Frontier			Common Frontier		
	CE	AE	TE	CE	AE	TE
1990	0.876	0.914	0.958	0.787	0.865	0.913
1991	0.865	0.912	0.949	0.792	0.853	0.931
1992	0.716	0.794	0.899	0.669	0.767	0.865
1993	0.706	0.770	0.901	0.781	0.867	0.895
1994	0.670	0.754	0.876	0.595	0.686	0.851
1995	0.759	0.853	0.872	0.632	0.764	0.819
1996	0.700	0.808	0.854	0.594	0.744	0.797
1997	0.757	0.802	0.868	0.735	0.868	0.839
1998	0.767	0.861	0.884	0.744	0.845	0.877
1999	0.770	0.851	0.900	0.757	0.851	0.885
2000	0.777	0.865	0.895	0.762	0.860	0.883
2001	0.852	0.946	0.901	0.820	0.917	0.901
2002	0.787	0.866	0.904	0.763	0.851	0.892
2003	0.760	0.825	0.916	0.985	0.799	0.909
2004	0.734	0.792	0.923	0.723	0.786	0.918
2005	0.816	0.872	0.936	0.775	0.831	0.934
2006	0.854	0.901	0.948	0.796	0.860	0.924
2007	0.897	0.932	0.961	0.751	0.799	0.946
2008	0.711	0.745	0.951	0.485	0.513	0.945
Average	0.778	0.845	0.910	0.734	0.817	0.890

**(b) Private Sector Banks**

Year	Separate Frontier			Common Frontier		
	CE	AE	TE	CE	AE	TE
1990	0.809	0.941	0.945	0.813	0.924	0.880
1991	0.828	0.883	0.939	0.792	0.853	0.931
1992	0.738	0.860	0.859	0.728	0.872	0.838
1993	0.844	0.913	0.926	0.649	0.713	0.889
1994	0.847	0.919	0.921	0.825	0.900	0.916
1995	0.692	0.787	0.865	0.720	0.851	0.830
1996	0.548	0.653	0.834	0.415	0.515	0.803
1997	0.813	0.886	0.918	0.799	0.895	0.893
1998	0.767	0.861	0.884	0.754	0.817	0.920
1999	0.839	0.915	0.912	0.817	0.909	0.895
2000	0.841	0.925	0.903	0.821	0.919	0.889
2001	0.804	0.878	0.915	0.769	0.862	0.895
2002	0.837	0.892	0.936	0.815	0.907	0.896
2003	0.820	0.876	0.932	0.798	0.882	0.901
2004	0.820	0.876	0.934	0.816	0.899	0.904
2005	0.737	0.817	0.901	0.737	0.842	0.873
2006	0.763	0.833	0.913	0.763	0.859	0.883
2007	0.826	0.874	0.945	0.826	0.889	0.930
2008	0.847	0.904	0.932	0.842	0.911	0.919
Average	0.791	0.868	0.911	0.763	0.854	0.888

**Table 5: Summary of Tests for Common or separate Frontiers**

Efficiency measures		Analysis of Variance (ANOVA) <sup>a</sup> F(prob>F)	Kruskal- Wallis test <sup>b</sup> $\chi^2(\text{prob}>\chi^2)$	Median Test <sup>c</sup> $\chi^2(\text{prob}>\chi^2)$
1990	TE	0.46(0.633)	1.90(0.386)	Test not possible
	AE	1.504(0.226)	2.008(0.156)	1.238(0.266)
	CE	0.261(0.612)	0.380(0.538)	1.238(0.266)
1991	TE	0.307(0.582)	0.009(0.924)	0.000(1)
	AE	1.546(0.219)	2.710(0.100)	2.948(0.086)
	CE	1.849(0.180)	1.564(0.211)	2.786(0.095)
1992	TE	1.751(0.192)	1.270(0.260)	0.484(0.487)
	AE	2.901(0.095)	2.518(0.113)	2.268(0.132)
	CE	0.224(0.638)	0.630(0.428)	0.164(0.685)
1993	TE	0.931(0.339)	0.950(0.330)	0.184(0.668)
	AE	9.251(0.004)**	7.338(0.007)**	6.996(0.008)**
	CE	6.243(0.016)	4.225(0.040)	1.574(0.210)
1994	TE	1.058(0.309)	0.172(0.679)	0.024(0.877)
	AE	14.67(0.000)**	9.794(0.002)**	7.076(0.008)**
	CE	8.350(0.006)	5.893(0.015)*	2.354(0.125)
1995	TE	0.019(0.890)	0.432(0.511)	0.624(0.430)
	AE	2.449(0.123)	3.762(0.052)	3.395(0.065)
	CE	1.115(0.296)	2.471(0.116)	5.613(0.018)*

1996	TE	0.265(0.609)	0.338(0.561)	0.067(0.795)
	AE	9.293(0.003)	5.840(0.016)	1.684(0.194)
	CE	0.265(0.609)	5.626(0.018)	0.606(0.436)
1997	TE	2.373(0.129)	1.664(0.197)	0.606(0.436)
	AE	0.597(0.443)	0.227(0.634)	0.067(0.795)
	CE	1.682(0.200)	0.851(0.356)	0.067(0.795)
1998	TE	0.427(0.655)	1.669(0.196)	1.732(0.188)
	AE	1.995(0.146)	2.464(0.116)	3.395(0.065)
	CE	1.368(0.263)	1.689(0.196)	1.732(0.188)
1999	TE	0.141(0.709)	0.447(0.504)	0.506(0.4770)
	AE	5.119(0.027)*	3.723(0.068)	1.409(0.235)
	CE	2.49(0.120)	2.397(0.122)	2.924(0.087)
2000	TE	0.075(0.785)	0.205(0.650)	1.409(0.235)
	AE	6.391(0.014)*	4.921(0.02)*	2.924(0.087)
	CE	2.465(0.122)	2.704(0.100)	4.984(0.026)*
2001	TE	0.204(0.653)	0.348(0.550)	0.069(0.792)
	AE	7.444(0.008)*	7.817(0.005)*	3.395(0.065)
	CE	2.018(0.161)	2.245(0.134)	1.732(0.188)
2002	TE	1.461(0.232)	2.546(0.111)	1.442(0.230)
	AE	1.060(0.308)	0.921(0.337)	0.449(0.503)
	CE	1.859(0.178)	2.481(0.115)	0.299(0.083)
2003	TE	0.339(0.563)	1.341(0.247)	1.788(0.181)
	AE	4.151(0.047)*	3.629(0.057)	5.793(0.016)*
	CE	2.643(0.110)	4.047(0.044)*	1.788(0.181)
2004	TE	0.205(0.652)	1.395(0.237)	1.788(0.181)
	AE	9.452(0.003)*	7.566(0.006)**	8.654(0.003)**
	CE	5.584(0.022)*	6.108(0.013)*	3.504(0.061)
2005	TE	1.265(0.266)	0.248(0.6190)	0.000(1.00)
	AE	3.682(0.060)*	2.664(0.103)	2.571(0.109)
	CE	4.356(0.042)*	3.683(0.055)*	2.571(0.109)
2006	TE	1.750(0.191)	0.001(0.979)	0.439(0.508)
	AE	6.656(0.013)*	5.100(0.024)*	1.480(0.224)
	CE	7.003(0.011)*	5.607(0.018)*	8.037(0.005)**
2007	TE	0.650(0.424)	0.019(0.890)	test not performed <sup>d</sup>
	AE	7.658(0.008)**	6.404(0.011)*	2.786(0.095)
	CE	5.570(0.022)*	5.124(0.024)*	4.952(0.026)*
2008	TE	0.035(0.852)	0.501(0.056)	1.299(0.254)
	AE	6.29(0.016)**	3.652(0.056)	2.922(0.087)
	CE	4.219(0.045)*	4.820(0.028)*	5.195(0.023)*

Notes: p-values are in parenthesis. \*indicate significance at 5% levels, \*\* indicate significant at 1% levels

<sup>a</sup>Null hypothesis for ANOVA test is that mean<sup>pub</sup> = mean<sup>pri</sup>, where superscripts' pub and pri stand for public and private sectors banks respectively.

<sup>b</sup> Null hypothesis for Kruskal-Wallis test is that the efficiency distributions for the public and private banks are same.

<sup>c</sup> Median test has the null hypothesis that the median of the efficiency measures for public and private banks are equal.

<sup>d</sup> All values are less than or equal to the median, therefore, median test cannot be performed.



The results of both parametric and non-parametric tests are depicted in Table 5. The results of both the tests fail to reject the null-hypothesis that the two banking samples follow identical production technology, which indicates that data of the sample banks can be pooled. The findings of this analysis have been consistent with the findings of Burki (2006), Isik, and Hassan (2002). Table 4 provides the results of tests for same or distinct frontier. It is clearly depicted in table that except few years the efficiency scores of separate and common frontier are not different at any appropriate level of significance. From the analysis, we fail to reject the null hypothesis for the earlier years (1990-1996) but not for the more recent years. It implies that banks observed in recent years have access to different and more efficient technology compared to banks in the previous years.

## **5.2 Bank Ownership Wise Analysis of Efficiency of Banks**

Table 6 presents the bank ownership wise analysis of average cost efficiency scores of Indian commercial banks along with its two components technical efficiency (TE) and allocative efficiency (AE). It is evident from the table that cost efficiency of private sector banks is 76.3 per cent followed by 73.4 percent of public sector banks during the entire study period. This indicates that the private sector banks have the potential for cost saving by 23.7 per cent or in other words, private sector banks have could use only 76.3 per cent of resources actually employed to produce the given level of output. The table also indicates that public sector banks can cut their costs by 26.6 per cent to become fully efficient banks and to capture the position of best practice frontier. The findings of this study reported that private sector banks have performed better than public sector banks in cost savings with the given state of technology .the decomposition of CE into its two components clearly indicates that in each year allocatively inefficiency is always higher than technical inefficiency. It implies that the dominant source of cost inefficiency among Indian commercial banks is allocative inefficiency rather than technical inefficiency. It suggests that managers of Indian banks are relatively good in using the minimum level of inputs at a given level of outputs but they were not good in selecting the optimal mix of inputs at given prices.

**Table 6. Bank Ownership Wise Average Cost Efficiency of Commercial Banks**

Year	Cost Efficiency			Technical Efficiency			Allocative Efficiency		
	PSBs	PVTs	CBs	PSBs	PVTs	CBs	PSBs	PVTs	CBs
1989-90	0.787	0.813	0.802	0.913	0.880	0.898	0.865	0.924	0.893
1990-91	0.792	0.792	0.796	0.931	0.931	0.920	0.853	0.853	0.866
1991-92	0.669	0.728	0.697	0.865	0.838	0.853	0.767	0.872	0.816
1992-93	0.781	0.649	0.709	0.895	0.889	0.892	0.867	0.713	0.789
1993-94	0.595	0.825	0.704	0.851	0.916	0.882	0.686	0.900	0.787
1994-95	0.632	0.720	0.680	0.819	0.830	0.825	0.764	0.851	0.81
1995-96	0.594	0.415	0.496	0.797	0.803	0.800	0.744	0.515	0.618
1996-97	0.735	0.799	0.770	0.839	0.893	0.869	0.868	0.895	0.883
1997-98	0.744	0.754	0.750	0.877	0.920	0.903	0.845	0.817	0.830
1998-99	0.757	0.817	0.790	0.885	0.895	0.891	0.851	0.909	0.882
1999-00	0.762	0.821	0.795	0.883	0.889	0.887	0.86	0.919	0.892
2000-01	0.820	0.769	0.795	0.901	0.895	0.887	0.917	0.862	0.881
2001-02	0.763	0.815	0.791	0.892	0.896	0.894	0.851	0.907	0.881
2002-03	0.985	0.798	0.764	0.909	0.901	0.905	0.799	0.882	0.842
2003-04	0.723	0.816	0.772	0.918	0.904	0.911	0.786	0.899	0.845
2004-05	0.775	0.737	0.756	0.934	0.873	0.903	0.831	0.842	0.837
2005-06	0.796	0.763	0.779	0.924	0.883	0.904	0.860	0.859	0.859
2006-07	0.751	0.826	0.790	0.946	0.930	0.939	0.799	0.889	0.840
2007-08	0.492	0.842	0.649	0.945	0.919	0.934	0.513	0.911	0.693
Average	0.734	0.763	0.741	0.891	0.889	0.889	0.807	0.854	0.829

### 5.3 Impact of Mergers on Cost Efficiency

In order to study the impact of mergers on the cost efficiency of participated banks the performances of banks have been compared for three year before and after merger. Both parametric and non-parametric tests are performed to examine the differences in the efficiency of banks between the two periods that is before and after merger programme.

Table 7 depicts the CE estimates along with its decomposition into TE and AE. It is apparent from the table that 6 out of 11 bank analyzed have experienced efficiency gains from merger.

**Table 7. Summary of Mean Efficiency Levels of Indian Merged Banks<sup>1</sup>**

Name of Bank	Pre -merger			Post -merger		
	TE	AE	CE	TE	AE	CE
Punjab National Bank	0.879	0.945	0.829	0.712	0.780	0.553
New Bank of India	0.813	0.515	0.417			
Bank of India	0.995	0.720	0.716	0.813	0.751	0.607
Bank of Karad	0.816	0.982	0.777			
Oriental Bank of Commerce	0.968	0.942	0.912	1	0.999	0.999
Punjab Co-operative Bank	0.668	0.559	0.387			
ICICI Bank	0.920	0.796	0.729	0.986	0.960	0.948
Bank of Madura	0.920	0.948	0.872			
Bank of Baroda	1	0.962	0.962	0.978	0.810	0.792
Benras State Bank	0.707	0.827	0.710			
Punjab National Bank	0.917	0.909	0.834	0.983	0.820	0.806
Nedungadi Bank	0.872	0.904	0.783			
Oriental Bank of Commerce	1	0.910	0.910	1	0.942	0.942
Global Trust Bank	0.951	0.846	0.803			
Centurion Bank	0.842	0.818	0.689	1	0.793	0.793
Bank of Punjab	0.998	0.865	0.863			
Bank of Baroda	1	1	1	0.999	0.932	0.929
Bareilly Co-operation Bank	1	0.472	0.472			
Fedral Bank	0.882	0.830	0.734	0.964	0.901	0.860
Ganesh Bank of Kurdwand	0.715	0.887	0.687			
IDBI Bank	1	0.970	0.644	1	0.965	0.968
United Western Bank	0.880	0.812	0.710			

Source : Author's own calculations

<sup>1</sup> Three year pre-merger and three year post-merger efficiency, TE –Technical efficiency, AE- Allocative Efficiency, CE- Cost Efficiency

The results of parametric and non-parametric tests are presented in Table 8. The empirical findings indicated that there exists a huge difference in efficiency between two periods. Table clearly depicts that Oriental Bank of Commerce enjoyed cost efficiency gains both times. The cost efficiency of Oriental Bank of Commerce when it acquired the Punjab Co-operative bank seem to be more compared to its pre merger efficiency (0.967<1) although it is not statistically significant at any conventional levels. Once again, this bank acquired the Global Trust Bank and again it experienced efficiency gains from merger.

**Table 8. Parametric and Non-parametric Tests for Efficiency Differences between Pre-Merger and Post-Merger Periods**

Parametric test(t-test)				Non-parametric test(Mann-Whitney test)	
Hypotheses				Median <sub>pre-merger</sub> =Median <sub>post-merger</sub>	
Test statistics		t(prob>t)		Z(prob>Z)	
Bank Name	Efficiency	Mean	t-value	Mean Rank	Z-statistics
<b>Punjab National Bank</b>					
Pre-merger	TE	0.879	1.856	4.67	-1.528
Post-merger	TE	0.712	(0.137)	2.33	(0.127)
Pre-merger	AE	0.945	4.237	5	-1.964
Post-merger	AE	0.780	(0.013)*	2	(0.050)
Pre-merger	CE	0.829	3.800	5	-1.964
Post-merger	CE	0.553	(0.019)*	2	(0.050)
<b>Bank of India</b>					
Pre-merger	TE	0.995	4.76	5	-1.993
Post-merger	TE	0.813	(0.009)*	2	(0.046)*
Pre-merger	AE	0.720	3.331	3	-0.655
Post-merger	AE	0.751	(0.029)*	4	(0.513)
Pre-merger	CE	0.716	0.546	5	-1.964
Post-merger	CE	0.607	(0.614)	2	(0.050)*
<b>Oriental Bank of Commerce</b>					
Pre-merger	TE	0.9687	-1.000	3	-1.000
Post-merger	TE	1.000	(0.374)	4	(0.317)
Pre-merger	AE	0.9420	-5.407	2	-1.993
Post-merger	AE	0.993	(0.006)*	5	(0.046)*
Pre-merger	CE	0.912	-2.963	2	-1.993
Post-merger	CE	0.993	(0.041)*	5	(0.046)*
<b>ICICI Bank</b>					
Pre-merger	TE	0.9207	-1.127	2.67	-1.159
Post-merger	TE	0.9863	(0.323)	4.33	(0.246)
Pre-merger	AE	0.7960	-3.091	2	-1.993
Post-merger	AE	0.9597	(0.037)*	5	(0.046)*
Pre-merger	CE	0.7293	-3.853	2	-1.993
Post-merger	CE	0.9477	(0.018)*	5	(0.046)*
<b>Bank of Baroda</b>					
Pre-merger	TE	1.000	1.969	4.50	-1.549
Post-merger	TE	0.932	(0.120)	2.50	(0.121)
Pre-merger	AE	1.000	1.953	4.50	-1.549
Post-merger	AE	0.929	(0.122)	2.50	(0.121)
Pre-merger	CE	1.000	1	4	-1.000
Post-merger	CE	0.999	(0.374)	3	(0.317)

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<b>Punjab National Bank</b>					
Pre-merger	TE	0.917	-2.509	2	-1.964
Post-merger	TE	0.9833		5	(0.050)
Pre-merger	AE	0.9090	1.284	4.33	-1.091
Post-merger	AE	0.8200	(0.269)	2.67	(0.275)
Pre-merger	CE	0.8340	0.392	3.83	-0.443
Post-merger	CE	0.8063	(0.715)	3.17	(0.658)
<b>Oriental Bank of Commerce</b>					
Pre-merger	TE	<sup>a</sup> t	<sup>a</sup> t	3.50	0.000
Post-merger	TE	<sup>a</sup> t	<sup>a</sup> t	3.50	(1.00)
Pre-merger	AE	0.9103	0.302	3.67	-0.232
Post-merger	AE	0.9420	(0.778)	3.33	(0.817)
Pre-merger	CE	0.9103	0.302	3.67	-0.232
Post-merger	CE	0.9420	(0.778)	3.33	(0.817)
<b>Centurion Bank**</b>					
Pre-merger	TE	0.8420	7.674*	2	-1.77
Post-merger	TE	1.000	(0.005)	4.50	(0.076)**
Pre-merger	AE	0.818	0.660	3.33	0.577
Post-merger	AE	0.7935	(0.556)	2.50	(0.564)
Pre-merger	CE	0.6887	3.424*	2.00	-1.732
Post-merger	CE	0.7935	(0.042)	4.50	(0.083)**
<b>Bank of Baroda</b>					
Pre-merger	TE	1.000	1.463	4.50	-1.54
Post-merger	TE	0.978	(0.217)	2.50	(0.121)
Pre-merger	AE	0.962	0.962	5	-1.993
Post-merger	AE	0.810	0.810	2	-(0.046)*
Pre-merger	CE	0.963	0.962	5	-1.993
Post-merger	CE	0.793	0.792	2	(0.046)*
<b>Federal Bank</b>					
Pre-merger	TE	0.882	2.757	2.00	-1.732
Post-merger	TE	0.963	(0.086)**	4.50	(0.083)**
Pre-merger	AE	0.830	1.294	2.33	1.155
Post-merger	AE	0.901	(0.286)	4.00	(0.248)
Pre-merger	CE	0.733	1.798	2.33	-1.55
Post-merger	CE	0.868	(0.170)	4.00	(0.248)
<b>IDBI Bank</b>					
Pre-merger	TE	<sup>a</sup> t	<sup>a</sup> t	3	0.000
Post-merger	TE	<sup>a</sup> t	<sup>a</sup> t	3	(1.000)
Pre-merger	AE	0.977	0.696	3.33	-0.577
Post-merger	AE	0.964	(0.536)	2.50	(0.564)
Pre-merger	CE	0.977	0.487	3.33	-0.577
Post-merger	CE	0.968	(0.660)	2.50	(0.564)

Source: Author's own calculations, <sup>a</sup>t denotes t cannot be computed because S.D between groups is Zero. \*\* Centurion Bank after acquiring Bank of Punjab in 2005 was known as Centurion Bank of Punjab, later this bank has been merged with HDFC bank. The values in parentheses show the p-values.

## 6. Conclusion and Policy Implications

Applying, a non-parametric DEA approach, this paper examine the cost, technical and allocative efficiency of Indian banks over the period 1990-91-2007-08. This paper also investigated the effects of mergers and acquisition on the cost efficiency of Indian Banks that have merged during 1991-92 to 2007-08. The findings of this study suggest that over the entire study period average cost efficiency of public sector banks found to be 73.4 and for private sector banks is 76.3 percent.

Overall, results indicate that mergers led to higher level of cost efficiencies for the merging banks. The decomposition of cost efficiency into its components suggests that technical efficiency has been main source of efficiency gains from merger rather than allocative efficiency. Merger between distressed and strong banks did not yield any significant efficiency gains to participating banks. However, the forced merger among these banks succeeded in protecting the interest of depositors of weak banks but stakeholders of these banks have not exhibited any gains from mergers.

The empirical findings of this study suggest that trend of merger in Indian banking sector has so far been restricted to restructuring of weak and financially distressed banks. The Government should not be seen merger as a means of bailing out of weak banks. The empirical findings further suggest that strong banks should not be merged with weak banks, as it will have adverse affect upon the asset quality of the stronger banks. The need of the hour is that the strong banks should be merged with strong banks to compete with foreign banks and to enter in the global financial market. The Indian financial system requires very large banks to absorb various risks that have been emerged from operating in local and global market. The prime factors for future mergers in Indian banking industry included the Basel –II environment, challenges of free convertibility and requirement of large investment banks. Therefore, the Government and policy makers should be more cautious in promoting merger as a way to reap economies of scale and scope.

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