CHAPTER 3

Good management is about making choices, so a decision not to do something should be analyzed as closely as a decision to do something.

3. Research Methodology

3.1 Post-merger performance evaluation of select commercial banks in India (Ratio analysis approach)

3.1.1 Sampling Design

The period of study, 1994-2009, (post liberalization period) has been selected to focus on major commercial bank mergers in India while providing sufficient data to compare/evaluate the pre and post-merger corporate performance/financial performance of the acquiring Indian commercial banks. Further, the period was chosen keeping in view the availability of three-year pre and post-merger data of the acquiring banks. To obtain a clean data set, overlapping mergers (which otherwise would confound the analysis) occurring during the window period (-3 and +3 years excluding the merger year) were excluded from the sample. The resulting list was further filtered to exclude i) merging banks with incomplete data and ii) mergers where the target banks were either co-operative banks or Local Area Banks (LABs).

After the above interventions, a sample of 11 commercial bank mergers was arrived at for analysis purposes. The commercial banks were selected such that the data were available for the pre and post-merger period for acquiring banks and for the combined entity. The data of each bank included in the sample for the entire window period (-3, +3) years
was taken from the database of CMIE, Prowess. The details of sample finally selected for data collection and analysis are furnished in Table 3.1

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Acquiring Bank</th>
<th>Target Bank</th>
<th>Year of Amalgamation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bank of India</td>
<td>Parur Central Bank Ltd.</td>
<td>1993-1994</td>
</tr>
<tr>
<td>2</td>
<td>State Bank of India</td>
<td>Kashi Nath Seth Bank Ltd.</td>
<td>1996-1997</td>
</tr>
<tr>
<td>3</td>
<td>Bank of Baroda</td>
<td>Bareilly Corporation Bank Ltd.</td>
<td>1999-2000</td>
</tr>
<tr>
<td>5</td>
<td>Union Bank of India</td>
<td>Sikkim Bank Ltd.</td>
<td>1999-2000</td>
</tr>
<tr>
<td>6</td>
<td>HDFC Bank Ltd.</td>
<td>Times Bank Ltd.</td>
<td>1999-2000</td>
</tr>
<tr>
<td>7</td>
<td>ICICI Bank Ltd.</td>
<td>Bank of Madura Ltd.</td>
<td>1999-2000</td>
</tr>
<tr>
<td>8</td>
<td>Bank of Baroda</td>
<td>Banares State Bank Ltd.</td>
<td>2002-2003</td>
</tr>
<tr>
<td>9</td>
<td>Punjab National Bank</td>
<td>Nedungadi Bank Ltd.</td>
<td>2002-2003</td>
</tr>
<tr>
<td>10</td>
<td>Oriental Bank of Commerce</td>
<td>Global Trust Bank Ltd.</td>
<td>2004-2005</td>
</tr>
<tr>
<td>11</td>
<td>IDBI Bank Ltd</td>
<td>IDBI Ltd.</td>
<td>2005-2006</td>
</tr>
</tbody>
</table>

Source: RBI Website, www.rbi.org.in

3.1.2 Research Design

Financial economists have employed a number of metrics to evaluate acquisition success. The most common technique entails measuring the change in the company’s value at the time of announcement of the acquisition. In addition to the stock price based studies, financial economists also use accounting-based (operating performance based) studies which involve looking at the change over time (usually one to five years) in some measure of earnings, cash flow, margins or productivity. The implicit assumptions in these studies, again, are that the acquisition
is important enough to drive the changes and that no other factors are important on average (Kaplan, 2006). The central objective of all post merger studies is to singularly address the question, whether the acquirers show improved performance after the merger or not?

Numerous studies have examined the effects of bank mergers on bank operating efficiency and profitability. The results generally suggest that mergers do not improve cost efficiency or profitability (John et al., 1990). The typical methodology employed in the accounting based studies is to compare the performance of combined entity with control groups, which are broadly of two types. They could either be before-and-after comparisons or comparisons with firms that have not experienced any merger but are similar in terms of size and industry to which they belong. Both these methodologies have their strengths and weaknesses.

The first approach, often called as “change model” has been adopted in this study for two reasons. Firstly, the matched sample of non-acquiring banks may not exhibit firm level characteristics of the acquiring banks. Secondly, each bank responds to changes in industry/economy in different ways depending upon its inherent capabilities.

A range of difficulties confront the practical implementation of impact evaluations based on control groups. The prominent of these are:
Sample selection bias: the control sample may turn out not to be completely comparable, i.e. it fails to satisfy the criterion of “being like the treatment group in all respects”.

Mis-specification of underlying relationships: simple trend comparisons of target group and control group may obscure the causal processes at work; for example there may be hidden relationships between the selected independent and dependent variable, or externalities, or variations over time in the structure of response of the target group to the treatment (“structural breaks”) (Mosley, 1998).

Kene et al (1999) in their highly analytical note on “concepts and methods of impact evaluation” opined that establishing control groups is the most straightforward means of assessing the counterfactual but determining what is a “counterfactual” is not as straightforward. According to them, typically, the task manager and/or the analyst has some priors regarding the counterfactual. However, the counterfactual from the participant’s point of view may differ from that posited by the analyst.

Carmine (2009) in his study on “Mergers and innovation in big pharma” expressed the view that a convincing identification of causality would
always be hindered by the fact that econometricians cannot observe most of the information that the merging firms employ in their decision.

Chen et al (2009) in their study on “Foreign Ownership and Firm Performance: Emerging-Market Acquisitions in the United States” observe that a firm is “selected” into the control group if it is sufficiently similar to acquired U.S. firms on the basis of the key determinants of the acquisition decision. It therefore follows that the key determinants of acquisition decision, which are not often made explicit, will significantly affect the practical implementation of control group based impact evaluation.

For comparing pre- and post-merger efficiencies of the acquiring banks, the study uses three years\(^1\) data before and three years data after the merger year for hypotheses testing. Merger year is denoted as \(T_0\) while pre and post-merger years are denoted as \((T-3, T-2, T-1)\) and \((T+1, T+2, T+3)\) respectively. The year \(T_0\) has been excluded from the analysis for the year’s figures are unduly affected by one-time merger costs making it difficult to compare them with the figures of other years.

\(^1\) Financial year(s)
3.1.3 Sources of data and Data Collection method

The present study primarily depends on secondary data. Data on operating performance for three years before and three years after the year of merger for each acquiring commercial bank were obtained from Prowess database of the Centre for Monitoring Indian Economy (CMIE). Data has also been collected from the websites of Indian Banks Association (IBA), Mumbai and the Reserve Bank of India (www.rbi.org.in) in addition to books, journals, business magazines and newspapers.

3.2 Post-merger efficiency evaluation of select commercial banks in India: Data Envelopment Analysis (DEA) Approach

3.2.1 Sampling Design: The sample comprises 20 major public sector banks and 7 new generation private sector banks (The sample size varies between 24 and 27). The study covers the time period between the years (financial) 1995 and 2009 to capture the rapid changes within the Indian banking industry following the onset of economic reform process and subsequent bank consolidation. The study attempts to analyze 8 commercial bank mergers (involving six/five\(^2\) public sector banks and two private sector banks as acquiring banks) by benchmarking them against a set of 20 other major commercial banks (15 banks drawn from public sector and 5 drawn from private sector).

\(^2\) BOB is involved in two mergers as the acquiring bank.
The lists of banks included in the sample and the commercial bank mergers that have been analyzed in the study are furnished in the Tables 3.2 and 3.3 respectively.

**Table 3.2**

**Sample**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of the Bank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Allahabad Bank</td>
</tr>
<tr>
<td>2</td>
<td>Andhra Bank</td>
</tr>
<tr>
<td>3</td>
<td>Bank Of Baroda</td>
</tr>
<tr>
<td>4</td>
<td>Bank Of India</td>
</tr>
<tr>
<td>5</td>
<td>Bank Of Maharashtra</td>
</tr>
<tr>
<td>6</td>
<td>Canara Bank</td>
</tr>
<tr>
<td>7</td>
<td>Central Bank Of India</td>
</tr>
<tr>
<td>8</td>
<td>Corporation Bank</td>
</tr>
<tr>
<td>9</td>
<td>Dena Bank</td>
</tr>
<tr>
<td>10</td>
<td>Indian Bank</td>
</tr>
<tr>
<td>11</td>
<td>Indian Overseas Bank</td>
</tr>
<tr>
<td>12</td>
<td>Oriental Bank Of Commerce</td>
</tr>
<tr>
<td>13</td>
<td>Punjab &amp; Sind Bank</td>
</tr>
<tr>
<td>14</td>
<td>Punjab National Bank</td>
</tr>
<tr>
<td>15</td>
<td>Syndicate Bank</td>
</tr>
<tr>
<td>16</td>
<td>Uco Bank</td>
</tr>
<tr>
<td>17</td>
<td>Union Bank Of India</td>
</tr>
<tr>
<td>18</td>
<td>United Bank Of India</td>
</tr>
<tr>
<td>19</td>
<td>Vijaya Bank</td>
</tr>
<tr>
<td>20</td>
<td>State Bank of India</td>
</tr>
<tr>
<td>21</td>
<td>Axis Bank Ltd.</td>
</tr>
<tr>
<td>22</td>
<td>Centurion Bank Of Punjab Ltd.</td>
</tr>
<tr>
<td>23</td>
<td>Development Credit Bank Ltd.</td>
</tr>
<tr>
<td>24</td>
<td>H D F C Bank Ltd.</td>
</tr>
<tr>
<td>25</td>
<td>I C I C I Bank Ltd.</td>
</tr>
<tr>
<td>26</td>
<td>Indusind Bank Ltd.</td>
</tr>
<tr>
<td>27</td>
<td>Kotak Mahindra Bank Ltd.</td>
</tr>
</tbody>
</table>

Source: Author’s perspective
Table 3.3
List of Commercial Bank Mergers Analyzed

<table>
<thead>
<tr>
<th>Year of merger</th>
<th>Mergers Banks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>ORIENTAL BANK OF COMERCE - BARI DOAB BANK</td>
</tr>
<tr>
<td>2000</td>
<td>BANK OF BARODA - BAREILLY CORPORATION BANK LTD.</td>
</tr>
<tr>
<td>2000</td>
<td>UNION BANK OF INDIA - SIKKIM BANK</td>
</tr>
<tr>
<td>2000</td>
<td>HDFC BANK - TIMES BANK</td>
</tr>
<tr>
<td>2001</td>
<td>ICICI BANK - BANK OF MADURA</td>
</tr>
<tr>
<td>2003</td>
<td>BANK OF BARODA - BENARAS STATE BANK LTD.</td>
</tr>
<tr>
<td>2003</td>
<td>PUNJAB NATIONAL BANK - NEDUNGADI BANK LTD.</td>
</tr>
<tr>
<td>2005</td>
<td>ORIENTAL BANK OF COMERCE - GLOBAL TRUST BANK</td>
</tr>
</tbody>
</table>

Source: www.rbi.org.in

3.2.2 Research Design

3.2.2.1 Measuring bank efficiency: In literature, a variety of efficiency measures have been employed for evaluating the performance of different industries such as banking, healthcare, pharmaceutical and other industries. Similar efficiency concepts can also be applied in assessing the performance improvements of commercial banks following mergers and acquisitions. While the bank merger studies look for gains and losses for the shareholders in the capital market context, financial ratio analysis examines performance change, post-merger. However, these methods do not examine change in performance by treating banks as firms and how varying combinations (mixes) of input, output and cost structure change during the post-merger period. The proposed DEA methodology analyzes efficiency changes during the merger process form
a micro-economic perspective, considering merged and non-merged banks as economic units.

DEA, a non-parametric method, is particularly suited when the sample size is small (Evanoff et al, 1991). It is however desirable to use a sample size substantially greater than the product of number of inputs and outputs if the analysis is to discriminate between efficient units and the inefficient ones effectively. A particular advantage of DEA is that it does not require knowledge of the proper functional form of the frontier, in determining the most efficient DMUs and therefore captures the interplay between various inputs and outputs of different dimensions (Avkiran, 1999). On the other hand, a major shortcoming of DEA is that it assumes data to be free of measurement error (Mester, 1996). Hence there is an imperative need to ensure integrity of data if the results are to be reliable. DEA results are sample specific.

This nonparametric programming (DEA) was first introduced by Charnes et al. (1978) to measure the efficiency of DMUs under input orientation and CRS. This was extended by Banker et al (1984) to permit variable returns to scale (VRS). It has proved, over time, to be an effective tool for addressing strategic, policy and operational problems, besides developing benchmarks (Barr et al, 2002). DAE has of late been widely used to measure the efficiency of financial institutions over the parametric methods (Bhattacharyya et al, 1997).
Some advantages of DEA which make it a popular tool for efficiency measurement are:

✓ DEA compares one decision making unit (DEA) to another peer or a combination thereof.
✓ It can handle multiple inputs and outputs.
✓ The units of inputs and outputs may vary as they do not affect the efficiency computations.
✓ DEA produces relative efficiency measures of the decision making units (DMUs).

Farrell (1957) was instrumental in developing the concept of productive (economic) efficiency of a firm as the product of its technical efficiency (TE) and allocative efficiency (AE). Technical efficiency captures the ability of a firm to produce maximum output with a given set of inputs while the allocative efficiency indicates the ability of the firm to use inputs in optimal proportions.

For the calculation of technical efficiency measures under the assumption of constant returns to scale (CRS) the study employs the model of Charnes, Cooper and Rhodes (1978) and under the assumption of variable returns to scale (VRS) the model of Banker, Charnes and Cooper (1984) has been used. According to these two models, a DMU (in this study, the DMU is a bank) is efficient if TE equals one (TE = 1) and a TE score less than one indicates to what extent a bank should
equiproportionally reduce inputs to be able to produce a level of output as efficient as technically efficient banks.

A firm (bank) is said to exhibit Technical Efficiency (TE$_{CRS}$) if it produces on the boundary of the production possibility set, i.e., it maximizes output with the given inputs and after having chosen technology. This frontier or boundary is defined as the best practice observed assuming CRS. The Technical efficiency can be further decomposed into pure technical efficiency (TE$_{VRS}$) and Scale efficiency (SE). To calculate Scale efficiency (SE), the methodology of Coelli et al (1998) has been adopted. Computation of SE calls for the calculation of TE measures under CRS and VRS. If there is a difference between TE$_{CRS}$ and TE$_{VRS}$ scores for a given bank, it indicates that the bank is scale inefficient. Scale efficiency can be calculated by dividing the technical efficiency (TE$_{CRS}$) by Pure technical efficiency (PTE) or (TE$_{VRS}$). So

$$SE = \frac{TE_{CRS}}{TE_{VRS}}$$

**Interpretation of Scale Efficiency:**

--If SE=1, then a bank is scale efficient, i.e., its combination of inputs and outputs is efficient both under CRS and VRS.

--If SE<1, then the combination of inputs and outputs is not scale efficient. To know whether a firm operates under increasing returns to scale (IRS) or decreasing returns to scale (DRS), another DEA model under the non-increasing returns to scale (NIRS) is applied. Scale
efficiency is then derived in accordance with the following criteria (Fare, Grosskopf, Lovell 1994)

--- If \( \frac{T_{ECRS}}{T_{ENIRS}} = 1 \), then a firm (bank) operates under increasing returns to scale. However, if \( \frac{T_{ECRS}}{T_{ENIRS}} < 1 \); then a bank operates under decreasing return to scale and inefficiency is the result of large output.

Formal notation of DEA models used is as follows:

\[
\begin{align*}
\text{Min} & \quad z_i = \theta - \varepsilon X \lambda + \varepsilon Y_i \\
\theta, \lambda, \varepsilon, \varepsilon & \geq 0 \\
\text{Subject to} & \\
Y \lambda & = Y_i \\
\theta X_i - X \lambda & = 0 \\
\lambda, \varepsilon^+, \varepsilon^- & \geq 0
\end{align*}
\]

and additional scale constraints

a) \( \lambda \geq 0 \) in CRS program
b) \( 1 \lambda = 1 \) in VRS program
c) \( 1 \lambda \leq 1 \) in NIRS program
Where $\theta$ is a measure of technical efficiency (TE), $Y_i = (y_1\ldots\ldots y_m)$ is an output vector, $X_i=(x_1\ldots\ldots x_k)$ is an input vector. $Y$ is $(n \times m)$ matrix of $m$ outputs of the each $n$ investigated banks and $X$ is $(n \times k)$ matrix of $k$ inputs of each of the $n$ investigated banks and $1'=(1\ldots 1)$ is a row vector. In the program, $(1)$ $s^+$ is $m \times 1$ vector of slack represent output deficits, $s^–$ is $k \times 1$ vector of slacks representing excess of input and $1'=(1\ldots, 1)$ is a row sum-up vector of the appropriate dimension $(1x m, or 1x k)$. Index $i$ shows the evaluated bank and $\lambda$ is a vector of $k$ intensities that characterize each bank. A bank (DMU) is efficient if and only if the following conditions are satisfied:

1. $\theta^* = 1$

2. All slack variables $s^+$ and $s^–$ equal zero.

**3.2.2.2 Input orientation** aims at reducing the input amounts by as much as possible while keeping atleast the present output levels of each DMU, while the other called output orientation, maximizes output levels given the present level input consumptions (Cooper, Seiford & Tone, 2006). The present study adopts input orientation, keeping in view the fact, in banking markets in India, bank managements have more discretion over input levels than output levels.
To compute Scale efficiency (SE), both Constant Returns to Scale (CRS) and Variable returns to Scale (VRS) models of DEA have to be employed. If technical efficiency scores measured under the above two models are different, the implication is that scale inefficiencies are present. If the technical efficiency scores obtained from DEA under CRS and VRS models are different, they are represented by $TE_{CRS}$ and $TE_{VRS}$ respectively. Accordingly, the scale efficiency (SE) present in the bank (DMU) may be measured as

$$SE = \frac{TE_{CRS}}{TE_{VRS}}$$

or

$$\text{Technical Efficiency (TE)} = \text{Pure Technical Efficiency (PTE)} \times \text{Scale Efficiency (SE)}$$

It therefore follows that that the technical efficiency score obtained under CRS can also be obtained as a product of scale efficiency present in the banking unit and the technical efficiency obtained under VRS.

Of late, the focus has shifted to X-efficiencies, that is the ability of management to control costs and generate revenues (Elyasiani and Mehdian, 1990, Ferrier and Lovell, 1990, Allen and Rai, 1996; Mester, 1996). X-efficiency is made up of technical and allocative efficiencies of banks, where allocative efficiency is defined as a decline in performance from selecting an ineffective production plan, while the technical efficiency is defined as the poor implementation of this production plan (Berger et al, 1993b). Research literature indicates that X-inefficiencies account for
20% or more of costs, while scale and scope inefficiencies account for less than 5% of costs of banking (Berger et al, 1993a).

While there is no consensus on the best procedure for measurement of X-efficiencies, four common methodologies, i.e i) Econometric Frontier Approach (EFA) ii) Thick Frontier Approach (TFA) iii) Distribution Free Approach (DFA) and iv) Data Envelopment Analysis (DEA) are available in the literature. They differ in assumptions made about the distribution of differences in X-efficiencies and random error (Berger et al, 1993a). DEA, the procedure adopted in this research study, usually assumes no random error, i.e all deviations from the estimated efficient frontier constitute X-inefficiencies.

One major objective of the study is to evaluate the post-merger efficiencies of Indian commercial banks (acquiring banks) which have undergone mergers during the post-reform period and analyze the factors influencing the commercial bank efficiency in the Indian context. The efficiencies measured include Technical Efficiency (TE), Pure Technical Efficiency (PTE), Scale Efficiency (SE), X-efficiency (Cost Efficiency) and Profit Efficiency (PE). In cost frontier analysis, the analyst attempts to estimate the maximum amount a bank could reduce its costs while still producing the same amount and combination of financial services. These potential cost savings are referred to as cost inefficiencies, or sometimes as X-inefficiencies (Robert De Young, 1997). Eliminating cost inefficiencies differs from achieving scale economies, which calls upon
the bank to increase the amount of output it produces. In a similar fashion, shedding cost inefficiencies differs from capturing increased scope economies, which requires a bank to alter the combination of outputs it produces. It has been argued by some researchers that Profit efficiency analysis is more appropriate than that of Cost efficiency to the study of M&As because it includes the revenue effects of changes in output that typically occurs after mergers (Allen N.Berger, 1998).

DEA is used to investigate the efficiency effects of commercial bank mergers to compare the above efficiencies for merged and non-merged banks (Acquiring banks before merger). Next, a comparative analysis of the efficiencies referred to above, of the merged and non-merged acquiring banks in the sample (3 years average pre-merger to 3-years average post-merger) has been done. DEA is quite popular in measuring efficiency in national banking industries [Ferrier and Lovell(1990),Berger et al(1993)]. The choice of [-3,+3] event window has been influenced by Rhoades (1998,p. 278) who pointed out that there has been unanimous agreement among the experts that about half of any efficiency gains should be apparent after one year and all gains should be realized within three years after the merger(Sufian et al,2007).
3.2.2.3 Choice of inputs and outputs:

The literature review indicates that there is no consensus on selection of outputs and inputs for commercial banks (Aly et al, 1990). The proposed model of inputs and outputs follows the intermediation approach (proposed by Sealey and Lindley, 1977) to modeling bank behavior in which deposits are regarded as being converted into loans (Mester, 1987). The alternative is the production approach in which banks are regarded as using labor and capital to generate deposits and loans. Between these two approaches, the intermediation approach is preferable since it normally includes interest expense, a large proportion of any bank’s total costs (Elyasiani and Mehdian, 1990; Berger and Humphrey, 1991). Due to a small sample size varying between 24-27 banks across 1995-2009, it was decided to keep the number of variables entering DEA to a minimum and enhance the discrimination between efficient and inefficient DMUs. The sample size compares favorably with some of other small sample sizes in the DEA literature (See Table 3.4).
Table 3.4
A Comparative presentation of the study sample with the samples of other DEA studies

<table>
<thead>
<tr>
<th>Researchers(Year)</th>
<th>Sample Size</th>
<th>InputsxOutputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>This study</td>
<td>24-27</td>
<td>2x2=4; 3x2=6</td>
</tr>
<tr>
<td>Liu and Tripe(2002)</td>
<td>7 (7-14)</td>
<td>2x2=4 and 2x3=6</td>
</tr>
<tr>
<td>Avkiran(1999)</td>
<td>16-19</td>
<td>2x2=4</td>
</tr>
<tr>
<td>Oral and Yolalan(1990)</td>
<td>20</td>
<td>5x4=20</td>
</tr>
<tr>
<td>Vassiloglou and Giokas(1990)</td>
<td>20</td>
<td>4x4=16</td>
</tr>
<tr>
<td>Giokas(1991)</td>
<td>17</td>
<td>3x3=9</td>
</tr>
<tr>
<td>Haag and Jaska(1995)</td>
<td>14</td>
<td>3x4=12</td>
</tr>
<tr>
<td>Yeh(1996)</td>
<td>7</td>
<td>3x3=9</td>
</tr>
<tr>
<td>Sufian(2004)</td>
<td>10</td>
<td>3x2=6</td>
</tr>
</tbody>
</table>


The choice of variables has been influenced by two major objectives: i) To provide a parsimonious model ii) To avoid the use of unnecessary variables which will reduce the degrees of freedom. For calculating technical efficiency two sets of variables, designated as Model 1 and Model 2 have been defined. All variables are measured in crores of rupees.

**Model 1**: Indian banking sector has been making efforts to earn increased fee-based revenues from non-fund based businesses in the deregulated period. Following Jaffry et al (2005) and Sturn and Williams (2004) among others, Non-interest income (NI) has been selected as a proxy for non-traditional activities (like forex trading, bank assurance, services, issuance of bank guarantees and Letters of Credits etc) and as an output vector. The other output vector, Interest income (II) reflects bank’s main business activity. It is assumed that interest income and
non-interest income are produced from Interest expense and Non-interest expense which become the input vectors for Model 1 (Yeh, 1996; Noulas, 2001; Ataullah et al, 2004; Ataullah and Leh, 2006).

**Model 2:** In Model 2, the approach of Avkiran (1999) has been broadly followed, to include Total Deposits (TD) and Compensation to Employees (CE) as input vectors to produce Loans and Advances (LA) and Non-interest income (NI). The second model has been necessitated by the sensitivity of the results (efficiency scores) to the variables selected (Avkiran, 1999). The input vectors for Model 2 are, Total Deposits (TD) and Compensation for Employees (CE) as a proxy for staff numbers (Avkiran, 1999). While the information on staff numbers over the study period has not been available, the research study views that employee compensation is a better proxy for the effort or contribution of members of the staff to the production process.

The input and output variables selected for calculating Cost(X-efficiency) and Profit efficiencies (herein after referred to as **Models 3 and 4**) and their selection procedure are explained below. Cost or X-efficiency is defined as the relative efficiency of banks at *minimizing costs* in the production of earning assets (Mester, 1996; Resti, 1997). Profit or P-efficiency, on the other hand, is defined as the profit maximizing or value-added efficiency of banks. X-efficiency need not necessarily be equated with Profit efficiency as a bank may not improve its profit margin with a higher production of
earning assets. Further, Profit, unlike income, also takes into account expenses, taxes and the degree of financial leverage employed by the bank (Chu and Lim, 1998). X-efficiency may be defined as the general efficiency of a firm judged on managerial and technological criteria in transforming inputs at minimum costs into maximum profits. It includes intra-bank economic efficiency, intra-bank motivational efficiency-individual personality; and external motivational efficiency-arising from management incentives and the environment. Banks that exhibit X-inefficiency are either wasting resources (technical efficiency), or are using inefficient businesses processes (allocative efficiency) or both which is attributed to employee management or environmental factors (Leibenstein, 1978).

To calculate Cost(X-efficiency) and Profit efficiencies, the model suggested by Chu and Lim (1998) has been broadly followed. The three inputs and two outputs of the model may be represented in the following diagram 3.1.

**Figure 3.1**

**Inputs and Outputs of Chu and Lim’s Model**

1. Share holders Fund
2. Interest Expenses
3. Operating Expenses

Bank transforms input into output

1. Annual increase in average assets
2. Total income(For CE)
3. Profit after tax(For PE)

(The three inputs and outputs used in the DEA models 3 and 4)
The rationale for selecting the variables is briefly explained as follows:

**Shareholders’ Fund (SF):** This is the amount of capital provided by the shareholders of the bank. This includes paid-up capital, capital reserves, statutory reserves and balance in the Profit and Loss (P&L) account. Examples of researchers that have used this input are Hughes and Mester (1993 and 1996); McAllister and McManus (1993). Capital adequacy is an important parameter of solvency risks used by all bank regulators. This is broadly represented by the Tier-I capital of the bank in the Models 3&4.

**Interest Expenses (IE):** As already referred to above, this measure has been used by several researchers in bank efficiency studies (Avkiran, 1999; Yeh, 1996). Capital provided by the bank’s depositors is better proxied by interest expenses rather than deposits as all types of bank deposits do not carry the same rate of interest.

**Operational expenses (including provisions) (OE):** The traditional factors of production land and labor etc are proxied by non-interest expenses like wages, physical capital expenses and provisions.

**Annual increase in average total assets (ATA):** This variable has not been employed in DEA efficiency literature quite often, to the best of the researcher’s knowledge. It is a proxy for future income or future profit. This choice brings novelty to literature as it represents both present and future earnings.
Total Income (For X-efficiency) (TI): represents the sum of interest and non-interest incomes. Income has not been dis-aggregated since the inherent objective here is to compare X-efficiency and P-efficiency scores.

Profit (For P-efficiency) (PE): X-efficiency and P-efficiency differ on the choice of total income or Profit after tax as the second output vector.

3.2.2.4 Malmquist index: DEA-based Malmquist productivity index (MPI) measures the productivity change over time. This index can be decomposed into two components: one measures the technical efficiency change and the other measures the frontier shift. MPI has been used in several applications like productivity developments in Swedish hospitals (Fare et al, 1994b), total factor productivity (TFP) evolution in Organization for Economic Cooperation and Development (OECD) countries (Muados et al., 1999), studying the effect of mergers on bank efficiency and productivity (Radam et al, 2008).

Fare et al’s (1992) input-oriented MPI, which measures the total factor productivity change (TFPCH) of a particular firm in time $t + 1$ and $t$, is given as $\text{TFPCH} (y$ and $x$ represent outputs and inputs across time $t$ and $t+1)$

$$= \left[ \frac{D_o^{x,t} (x_o^{t+1}, y_o^{t+1})}{D_o^{x,t} (x_o^t, y_o^t)} \cdot \frac{D_o^{y,t+1} (x_o^t, y_o^{t+1})}{D_o^{y,t+1} (x_o^t, y_o^t)} \right]^{1/2}$$

decomposed MPI of total factor productivity change (TFPCH) into two components (Chen and Ali, 2004): 

$$ TFPCH = \left[ \frac{D_o^t(x_o^{t+1}, y_o^{t+1})}{D_o^t(x_o^t, y_o^t)} \right] \frac{D_o^{t+1}(x_o^{t+1}, y_o^{t+1})}{D_o^{t+1}(x_o^t, y_o^t)} \right]^{1/2} $$

While the first component measures the change in technical efficiency, $TEFFCH$, the second component reproduced below ($TECHCH$) measures the technological frontier shift between time periods $t$ and $t+1$. 

According to Fare et al (1992, 1994a), a value of $TECHCH$ greater than one indicates a positive shift or technical progress and a value less than one is indicative of a negative shift or technical regress, and a 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:

$$ TFPCH = TEFFCH \times TECHCH $$
3.2.2.5 Tobit regression analysis

An interesting dimension of DEA analysis is to identify the determinants efficiency scores obtained from DEA models. The DEA scores fall between 0 and 1. This causes the dependent variable to be a limited dependent variable. The DEA literature indicates that Tobit model has been extensively employed to understand the factors influencing the efficiency scores provided by the DEA which will in turn help us in formulating policies to improve performance. DEA efficiency scores obtained are used as the dependent variables in the Tobit model, which was first introduced by Tobin (1958) in econometrics. These models are also called censored regression models since information on the regressand is available only for some observations. Hence, estimation using Ordinary Least Squares (OLS) regression results in a biased and inconsistent parameter estimates since OLS assumes a normal and homoscedastic distribution of the disturbance and the dependent variable (Maddala, 1983).

DEA Literature review indicates that quite a few DEA applications have employed a two-stage methodology involving both DEA and Tobit model. Kirjavinen et al (1998) studied efficiency differences among Finnish senior secondary schools using four models. As a second stage after DEA analysis, they explained the degree of inefficiency using a statistical Tobit model. They found the average efficiency in the most extensive models to be 82-84 percent. Fethi et al (2000) conducted an efficiency analysis
study of European airlines using DEA. To identify the effects of various explanatory variables on efficiency, they had employed Tobit model. The study served a variety of policy purposes and aimed at improving performance.

Jackson and Fethi (2000) and Gregorian and Manole (2002) applied DEA and Tobit to evaluate the technical efficiency of Turkish commercial banks & banks in transition countries respectively. Barbara et al (2003) in their paper investigate whether there has been an improvement and convergence of productive efficiency across European banking markets since the creation of the Single Internal Market. Using efficiency measures derived from DEA estimation we also evaluate the determinants of European bank efficiency using the Tobit regression model approach. Overall, the results suggest that since the EU’s Single Market Programme there has been a small improvement in bank efficiency levels, although there is little evidence to suggest that these have converged.

Sufian (2007) conducted an event study window analysis of Data Envelopment Analysis (DEA) to investigate the effects of mergers and acquisitions (M&As) on Singapore domestic banking groups’ efficiency. The results suggest that the merger has resulted in higher Singapore banking groups’ mean overall efficiency post-merger. Despite that, from the scale efficiency perspective, the findings do not support for further consolidation in the Singapore banking sector.
In most cases, the results confirmed the hypothesis that the acquiring banks’ mean overall efficiency improved (deteriorates) post-merger resulting from the merger with a more (less) efficient bank. Tobit regression model has been employed to determine factors affecting bank performance. The results suggest that bank profitability has significant positive impact on bank efficiency, whereas poor loan quality has significant negative influence on bank performance.

Lee et al (2009) undertake an empirical analysis of efficiency in the Malaysian water sector using the Data Envelopment Analysis (DEA) approach, and regression analysis (Tobit/OLS). The DEA analysis finds that the mean technical efficiency of the water sector in Malaysia to be about 66%, indicating a significant room for improvements in technical efficiency in the Malaysian water sector. There are also significant differences in the efficiency in the water sector across the different states. However, efficiency gains based on ownership status could not be ascertained solely from the evidences in this paper.

Gul et al (2009) in their paper analyse technical efficiency of cotton farms in Çukurova region in Turkey. Data was collected from cotton farms through a questionnaire study. Data collection was carried out following 2004-2005 growing seasons. Technical efficiency of cotton farms was estimated using the Data Envelopment Analysis (DEA) and technical efficiency scores were calculated employing an input oriented DEA. Tobit regression analysis was used to identify determinants of technical
efficiency. Results indicate that cotton farmers can save inputs by at least 20% while remaining at the same production level. Factors strongly affecting efficiency level of the farmers were found to be farmers’ age, education level and groups of cotton growing areas.

Chang et al (2011) in their study apply a novel evaluation model to identify resource utility rate in the banking sector for enhancing branch operations. The Data Envelopment Analysis (DEA) model along with Tobit regression has been used to determine the operational efficiency of each studied bank branch. This study identifies non-performing loan ratio as an undesirable output. The results further indicate that insufficient branches generally exhibit wasted personnel expenses and low profits. The study results can offer feasible strategies for adoption by bank branch managers to enhance performance.

Rachita(2011), in her paper on “Estimation of technical, pure technical and scale efficiencies of Indian banks: An analysis from cross-sectional perspective” has attempted to measure the extent of technical, pure technical and scale efficiencies of Indian domestic banking industry using the non-parametric technique of data envelopment analysis followed by Tobit regression using DEA efficiency scores. The empirical results show that only 9 of the 51 domestic banks operating in the financial year 2006-07 have been found to be efficient and, thus define the efficient frontier of the Indian domestic banking industry, with the TE scores ranging from 0.505 to 1, with an average of 0.792. Her findings
indicate that managerial inefficiency is the main source of overall technical inefficiency in Indian domestic banking industry. The new private sector banks dominate in the formation of the efficient frontier. While the efficiency differences between public and private sector banks are not statistically significant, there exist significant differences between large and medium sized banks with regard to scale efficiency. The results pertaining to Tobit analysis reveal that the exposure to off-balance sheet activities and profitability are the most influential determinants of technical efficiency.

The standard Tobit model may be defined as follows, for observation (bank) $i$:

$$
y_i^* = \beta' x_i + \varepsilon_i
$$

$$
y_i = y_i^* \quad \text{if} \quad y_i^* \geq 0 \quad \text{and} \quad y_i = 0 \quad \text{otherwise}
$$

where $\varepsilon_i \sim N(0, \sigma^2)$, $x_i$ and $\beta$ are vectors of explanatory variables and unknown parameters, respectively. The $y^*$ is a latent variable and $y_i$ is the DEA score.

The likelihood function ($L$) is maximized to solve $\beta$ and $\sigma$ based on 24-27 observations (banks) of $y_i$ and $x_i$ is

$$
L = \prod_{y_i=0} (1-F) \prod_{y_i=0} \frac{1}{(2\pi\sigma^2)^{1/2}} X e^{-\frac{1}{2\sigma^2}(y_i-\beta'x_i)^2}
$$
where
\[ F_i = \int_{-\infty}^{\beta'x_i/\sigma} \frac{1}{(2\pi)^{1/2}} e^{-t^2/2} \, dt \]

The first product is over the observations for which the banks are 100% efficient \((y=0)\) and the second product is over the observations for which \(Ho\) the banks are inefficient \((y>0)\). \(F_i\) is the distribution function of the standard normal evaluated at \(\beta'x_i/\sigma\).

3.2.3 Data Collection

The data (on both the public and private sector banks) used in the study has been collected from the Prowess data base of the Centre for Monitoring Indian Economy (CMIE).

3.3 Evaluation of customer perceptions in the face of commercial bank mergers in India/Marketing implications of commercial bank mergers in India

3.3.1 Sampling Design and Data collection sources

The study essentially employs primary data. Primary data was collected by a structured survey. In a scientifically developed questionnaire (please refer to Appendix -B) several statements which describe present day banking activities/services of the commercial banks in India have been included based on past research in the areas of banking service quality/customer perception and the expected benefits from commercial bank mergers, from the perspective of customers (Bank Mergers Report 2009). In addition, the questionnaire seeks information on the
demographic and behavioral variables of the respondents and their opinions on commercial bank mergers. The questionnaire has been improved by pretesting on a small sample of respondents (50) similar to those who would be included in the actual survey in terms of background characteristics, familiarity with the topic and attitudes and behaviors of interest. The internal consistency of all the items in the questionnaire was verified through Cronbach Alpha (Joseph A Gliem et al, 2003) which was fairly good at around 0.70. All items were measured by responses on a five point Likert scale. The analysis of primary data has been carried out using Statistical Package for Social Sciences (SPSS) 16.0 version for windows. The questionnaire has been personally administered on a sample size of 280, chosen on a convenient basis from both the public and private sector banks in the city of Hyderabad (Andhra Pradesh).

The customer sample (size) has been divided in the ratio of 75:25 as between public and private sector banks having regard to the ratio of number of public and private sector bank branches in Hyderabad city and the average business handled by them. However, convenience sampling technique has been employed in the selection of respondents. Each customer has been evaluated on 20 parameters and the degree of perception of customers has been quantified using a five point Likert scale.
The demographic profile of the sample respondents comprises of a wide variety of bank customers of public and private sector banks drawn from different professional and economic backgrounds. The details are furnished in the following pages.

**Sample Profile: Characteristics of Respondents**

**Sample Size: 280**

**Demographic Variables Selected For the Study (S.Nos:1-4)**

**Graph 3.2**
**Gender-wise distribution**

![Gender Distribution Graph]

Source: Processed Data
Graph 3.3
Age-wise distribution

Source: Processed Data

Graph 3.4
Qualification-wise distribution

Source: Processed Data
Graph 3.5
Income-wise distribution

Yearly income (Rs.lakhs)

Source: Processed Data
Behavioral Variables Selected for the Study (S.Nos: 5&6)

Graph 3.6

Length of Association (with the bank)-wise distribution

Length of Association with the Bank

- Less than 2 years: 2%
- 2 to 5 years: 29%
- 5 to 10 years: 14%
- More than 10 years: 55%

Source: Processed Data

Graph 3.7

Transaction Frequency-wise distribution

Monthly Transaction Frequency

- Once: 26%
- Twice: 26%
- 3 to 5 times: 33%
- More than 5 times: 15%

Source: Processed Data
3.3.2 Research Design

When evaluating service quality, consumers examine five dimensions: tangibles, reliability, responsiveness, assurance, and empathy (Parasuraman et al, 1988). A test instrument called SERVQUAL was developed to measure service quality based on Gap theory (Parasuraman et al, 1988). Gap theory is a method of measuring service quality as the difference between the customer's perceived level of service received and the expected level of service. SERVQUAL employs 21 questions to measure the five dimensions referred to above.

3.3.2.1 Problems with SERVQUAL

Though SERVQUAL is an excellent instrument for measuring service quality, it poses three potential problems to the managers. First, SERVQUAL measures customers’ expectations of the ideal firm in a particular service industry. This may or may not be relevant to the capabilities of a particular service firm or set of service firms available to a consumer. SERVQUAL’s generic nature is its second problem. Since it is not industry specific, it does not measure variables that are important in the context of a particular industry (Clow et al, 2008). The third problem relates to the gap theory on which the methodology is based. Measuring consumer expectations after a service has been provided will bias consumers’ responses (Clow et al, 1993).
3.3.2.2 Service Performance Measures

An alternative to gap methodology for measuring service quality is to obtain service performance measures, which are classified into internal measures and customer measures. Internal measures of service quality provide objective measures of firm’s performance, while the customer measures measure attitudes and opinions of customers (Clow et al, 2008). Internal measures enable the firms to develop competitive advantage, by comparing firm’s ratings with the industry benchmarks. In the process they help the firms in developing appropriate promotional strategies. But they have their share of weaknesses as well. They are designed from service firm’s point of view but not customer’s. Further, while they do not measure the behavioral side of the service experience, it may so happen that they are not important to the customers.

3.3.2.3 Customer Measures

In view of the above deficiencies, many service firms survey their customers to determine their attitudes and opinions. Customer measures offer several advantages over internal measures of service quality (Clow et al, 2008). One of the main advantages is that firms gain valuable insights in to the customer perception of their service. These perceptions can be of use to the firms in developing their marketing and operational plans. This information can also be used to improve their efforts to meet the customer needs effectively. Customers may also provide valuable insights regarding the efficiency of the process which provides the
service. This could help the service firm in their business process reengineering effort (BPR). For the reasons stated, the present study adopts Customer measures approach to evaluate the customer perceptions of banking services in the face of bank mergers in the Indian context, which is the topic of interest. Incidentally, Factor Analysis has been employed to identify the critical factors influencing the customer perception in the face of commercial bank mergers in India.