CHAPTER- 3

RESEARCH METHODOLOGY

A systematic process and methodology is needed to conduct the research in a successful manner. This chapter highlights the methodology and process used to conduct the present research. This chapter justifies the present study and highlights the main objectives and scope of the study. Further this chapter discusses the research methodology adopted for attaining the objectives. In the end of the chapter, limitations of the study are discussed.

3.1 INTRODUCTION

The success of an economy up to a very large extent depends on the efficiency of banking system. Failure of banking system reduces the growth of the economy. We had a very good example of US economy which was facing financial crises in 2007-08 due to failure of banking system. This gave a path to analyze efficiency of Indian commercial banks whether they are capable or not to face such type of situation. Recently a large number of studies analyzing the financial performance of commercial banks have come up, yet certain important aspects are still closed and untouched. In most of these studies, analysis is based upon very limited number of variables, limited numbers of years and for limited banks and bank groups. Moreover, most of these studies analyse the performance of banks taking simple ratio and regression method. There are very few studies which measure the efficiency of all public and private sector banks and bank group by taking the required number of variables. Therefore, it is desirable to take up a comprehensive study for evaluating and comparing the efficiency of different aspects of commercial banks in India. The present study has made an attempt to overcome the limitations of the existing studies. The study aims to attain the following objectives.
3.2 OBJECTIVES OF THE STUDY

The major objective of the study is to measure the efficiency, profitability and overall performance of banks and bank groups in public and private sector banks during the study period 2006-07 to 2012-13. Keeping in view the main objectives of the study, an attempt has been made to attain the following objectives:

- To measure and compare the technical and scale efficiency of Indian commercial banks.
- To identify the potential improvements.
- To identify the factors affecting efficiency of scheduled commercial banks.
- To evaluate the best bank regarding financial performance.
- To offer some feasible suggestion for efficient functioning of banks and draw some policy implications.

3.3 RESASERCH METHODOLOGY

Financial ratio analysis, growth analysis and Stochastic Frontier Analysis (SFA) are commonly used technique to measure efficiency of banks. Financial ratios are popular due to easy in calculating, interpretation, inter-bank comparison. But the drawback of ratio analysis is that there is no suitable criterion for selecting different ratios that are most appropriate for efficiency analysis. Growth analysis is another important method to measure bank efficiency. Growth may be linear, compounded or exponential. However, the drawback of this approach is that the parameters are average value and if the firms are heterogeneous then this method become inappropriate. (Gitow Gor 2011).

Stochastic Frontier Analysis (SFA) is also another very important approach to measure efficiency. This approach is basically regression analysis which shows cause and effect relationship between dependent and independent variables. This method is useful because it can handle outlier and allow for hypothesis testing. This method has also some drawbacks. The main drawbacks of SFA are its various assumptions regarding function from the model, error term, degree of freedom. SFA also can not handle multiple inputs.
and outputs because it restricts the analysis to one dependent variable (Johnes, 2012). For these reasons, this method is found inappropriate for present study.

The present study is based upon two methods:

1. CAMEL APPROACH

2 DATA ENVELOPMENT ANALYSIS

3.4 CAMEL APPROACH

CAMEL approach is internationally accepted ratio base method. CAMEL is an acronym for five components of bank safety and soundness.

- Capital Adequacy
- Asset Quality
- Management Efficiency
- Earning Capacity
- Liquidity

**Capital Adequacy**

It is one of the major indicators of financial health of a bank. It reflects the overall financial position of the bank and also the ability of bank to meet the future capital requirement. It is measured with the help of Capital Adequacy Ratio (CAR).

**Assets Quality**

Assets quality is another vital component of CAMEL approach to measure the financial health of bank assets. Net NPA to Net Advances ratio is used to analyse assets quality of various banks. This ratio measures the quality of advances. The lower the ratio the better is the quality of advances.

**Management Efficiency**

Management efficiency is an important parameter to judge the efficiency of human resources. Physical measurement in terms of output is not possible in banking sector.
Labour efficiency is measured with the help of business per employee of different banks. Improvement in efficiency will ultimately lead to larger profit and lower cost. Thus, profits per employee are also taken as indicator to measure the efficiency of management. Business per employee and profit per employee ratio are used to evaluate the efficiency of management.

**EARNING CAPACITY**

The earning Capacity is very important criteria that reflect the ability of a bank to earn consistency. Banks should increase their income resources to enhance their earning capacity. Banks can increase their growth and productivity by increasing earning capacity. Earning capacity is measured with the help of return on assets and spread as percentage of assets.

**LIQUIDITY**

Liquidity is also another important parameter which measures the capacity of banks to meet its financial obligations. There should be a proper balance so far liquidity is concern. If liquidity is too much low, then banks are not in a position to meet its current financial liabilities. On the other hand, if liquidity is too much high then banks are not utilizing their cash properly. Thus, a proper balance is necessary in liquidity so that banks can generate high profit while at the same time provide liquidity to the depositors. Credit-Deposits ratio is used to evaluate liquidity.

In brief, CAMEL approach is summarized in the below figure.

<table>
<thead>
<tr>
<th>C</th>
<th>CAPITAL ADEQUACY</th>
<th>CAPITAL ADEQUACY RATIO</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>ASSETS QUALITY</td>
<td>NET NPA TO NET ADVANCES</td>
</tr>
<tr>
<td>M</td>
<td>MANAGEMENT EFFICIENCY</td>
<td>BUSINESS PER EMPLOYEE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PROFIT PER EMPLOYEE</td>
</tr>
<tr>
<td>E</td>
<td>EARNING CAPACITY</td>
<td>RETURN ON ASSETS (ROA)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SPREAD AS A PERCENTAGE TO ASSETS</td>
</tr>
<tr>
<td>L</td>
<td>LIQUIDITY</td>
<td>CREDIT –DEPOSITS RATIO</td>
</tr>
</tbody>
</table>
**Annual Compound Growth Rate (ACGR)**

Tabulated data was analyzed with the help of annual compound growth rate to know the progress of Scheduled Commercial Banks in India. The formula of CAGR is given below:

\[
\text{ACGR} = \log \left( \frac{CV}{BV} \right)^t \]

**ACGR** = Annual Compound Growth Rate  
**CV** = Current Value  
**BV** = Base Value  
**t** = time

**Co-Variance (CV)**

Co-Variance (CV) is used to find out the instability in various performance indicators of Scheduled Commercial Banks in India. The formula of CV is given below

\[
\text{CV} = \frac{SD}{\text{Mean}} \times 100
\]

**CV** = Coefficient of Variance  
**SD** = Standard Deviation

**3.5 DATA ENVELOPMENT ANALYSIS (DEA)**

Now a day, the most popular method to measure the efficiency of firms is Data Envelopment Analysis (DEA). DEA is a non-parametric method of measuring efficiency of firms i.e. Decision Making Units (DMUs). It is based on linear programming technique to measure the relative efficiency of firms where multiple inputs and outputs are used. The value of efficiency based on DEA is between 0 and 1.

---

12 I am indebted to Dr. Subhash C. Ray for giving valuable suggestions at IIT workshop, Mumbai (17-19 August 2010)
DEA is a popular non-parametric method applied in evaluating the efficiency of hospitals, Libraries, insurances and especially of banking. Farrel (1957) made a path breaking contribution by constructing a LP model using actual input-output and provide the technical efficiency of DMUs. Later, Charnes, Cooper and Rhodes (CCR) (1978) and Banker, Charnes and Cooper (BCC) (1984) gave a significant contribution in the DEA. CCR and BCC are two basic models to measure technical efficiency in DEA. The CCR model assumes constant return to scale while BCC is an extension of CCR model and provide technical efficiency under variable return to scale. Brief discussions on these two basic models are given later in this chapter.

3.5 Performance of a Firm is Measured with the help of Two Components (Tapiwala 2010).

1. Productivity
2. Efficiency

Productivity is descriptive measure of performance. It is defined as a quantitative relationship between output and input.

Average Productivity of firm A (AP_A) = outputs/inputs = Y_A/X_A

Similarly,

Average Productivity of firm B (AP_B) = outputs/inputs = Y_B/X_B

Comparison of two firms productivity = AP_A/AP_B (Productivity Index)

If this value is greater than one then Firm A is more productive than Firm B and vice versa. The productivity index provides a comparison between firms without considering technology.

On the other hand, efficiency is a normative measure. Efficiency compares the actual output from a given inputs with maximum producible outputs.

T.E. of output = E_O = AP/AP* = Y/X /Y*/X

Thus, E_O = Y/Y*, similarly,
\[ E_i = \frac{X^*}{X} \]

Here, \( E_0 \) is efficiency of output.

\( E_i \) is efficiency of input.

\( X^* \) and \( Y^* \) are maximum input and output respectively and \( X \) and \( Y \) are actual input and output.

Thus, efficiency can be input oriented or output oriented depends upon the objective of the firm. If a firm want to reduce its inputs assuming outputs constant then input oriented method is appropriate. If firm want to increase its outputs with given inputs then output oriented method is chosen.

**Charans, Coopers, Rhodes (CCR) model**

In 1978, CCR introduced a model to evaluate the relative performance of decision making units (DMUs) using multiple inputs and outputs. The model can be input oriented or output oriented.

Mathematical formulation of output oriented technical efficiency of firm K is

\[
\text{Max} = \theta
\]

Subject to

\[
\sum_{j=1}^{N} \lambda_j X_{ij} \leq X_{ik} \quad (i = 1,2,\ldots,n)
\]

\[
\sum_{j=1}^{N} \lambda_j Y_{rj} \geq \theta Y_{rk} \quad (r = 1,2,\ldots,m)
\]

The TE of firm K would be measured by

\[ TEk = \frac{1}{\theta^*} \]
Where, \( \theta^* \) is the optimal solution of the DEA LP problem. Here \( X^j = (X^j_1, X^j_2, \ldots, X^j_n) \) are bundle of \( n \) inputs used and \( Y^j = (y^j_1, y^j_2, \ldots, y^j_m) \) are the bundle of \( m \) outputs produced by firm \( j (j = 1, 2, \ldots, N) \), \( (X^k, y^k) \) are actual inputs and outputs of firm \( K \).

The main drawback of CCR model is that there are no constraint for weights is except positivity condition. Therefore, CCR model measure Technical Efficiency (TE) under Constant Return to Scale (CRS) only.

**BANKE, charnes and cooper (BCC) model**

BCC is another version of DEA which is commonly used in research. BCC (1984) is more flexible and allows Variable Return to Scale (VRS). BCC model add the convexity condition i.e. \( \sum \lambda_j = 1 \) in CCR model to measure TE under variable return to scale. This model can be also input or output oriented.

Mathematical formulation of output oriented technical efficiency of firm \( K \) is

Max = \( \theta \)

Subject to

\[ \sum_{j=1}^{N} \lambda_j X_{ij} \leq X_{ik} \quad (i = 1, 2, \ldots, n) \]

\[ \sum_{j=1}^{N} \lambda_j Y_{rj} \geq \theta Y_{rk} \quad (r = 1, 2, \ldots, m) \]

\[ \sum_{j=1}^{N} \lambda_j = 1, \quad \lambda_j \geq 0 \quad (j = 1, 2, \ldots, N) \]

The TE of firm \( K \) would be measured by

\[ TEk = \frac{1}{\theta^*} \]
Where $\theta^*$ is the optimal solution of the DEA LP problem. Here $X^j = (X_1^j, X_2^j, \ldots, X_n^j)$ are bundle of $n$ inputs used and $Y^j = (y_1^j, y_2^j, \ldots, y_m^j)$ are the bundle of $m$ outputs produced by firm $j$ ($j = 1, 2, \ldots, N$) , $(X^k, y^k)$ are actual inputs and outputs of firm $K$.

In general DEA model incorporating the additional convexity constraint to take into account variable return to scale are called BCC DEA or VRS DEA model tells that each DMUs is Increasing Return to Scale (IRS) or Decreasing Return to Scale (DRS) or Constant Return to Scale (CRS).

**Technical and Scale efficiency (Ramanathan, 2003)**

The two model discuses earlier are CCR and BCC model. The CCR model estimates the gross (Overall) efficiency of a DMUs under CRS. This efficiency is a combination of technical efficiency and scale efficiency. Technical Efficiency describes the efficiency in converting inputs to outputs, while scale efficiency recognizes that economy of scale cannot be attained at all scale of production and that there is one most productive scale size where scale efficiency is maximum at 100% BCC models divides the overall TE into pure TE and scale efficiency (SE). The relationship between TE and SE is shown in figure 3.1.
In figure 3.1, B,C,D firms are TE efficient under VRS while A firm is TE efficient under CRS. Firm E is inefficient in case of both CRS and VRS assumptions.

<table>
<thead>
<tr>
<th>In BCC Model</th>
<th>In CCR Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency of E firm = HF/HE (Pure TE)</td>
<td>Efficiency of E firm = HG/HE (TE and SE) (Overall TE)</td>
</tr>
</tbody>
</table>

Overall TE (CCR efficiency) = SE X TE under VRS

\[ \frac{HG}{HE} = \left( \frac{HG}{HF} \right) \times \left( \frac{HF}{HE} \right) \]

Hence, \[ SE = \frac{TE \text{ under CRS}}{TE \text{ under VRS}} \]

TE under CRs is always less than or equal to pure TE under VRS.

\[ TE \text{ under CRS} \leq TE \text{ under VRS}. \] Thus, TE under CRS gives the lowest efficiency score, while TE under VRS gives the highest efficiency score.

**Theoretical Justification of Variables**

The selection of appropriate inputs and outputs is the major task in banking efficiency studies. There has been an on going debate about choice of inputs and outputs. There two major approaches to determine efficiency are the production approach and intermediation approach (Sealy and Lindley, 1977).

The production approach treats banks as service provided to customers. The output under this approach is measured by number and type of transactions, number of accounts while labor and capital are used as inputs. It is further stated that production approach is more appropriate to determine branch efficiency (Berger and Humphrey, 1977).

The intermediation approach treats banks who mobilize financial resources from unused and idle resources to the active and for most use full purpose. For this, banks collect deposit from savers and lend these deposits to the investors. They earned interest income on loan and paid interest expenses on deposits. This approach includes operating
and interest expenses as inputs where as interest income and other income as outputs. Berger and Humphrey (1997) suggested that the intermediation approach is best for analyzing the efficiency at bank level.

Elyasian and Mehdian (1990) gave following three advantages of intermediation approach over production approach. Firstly, it measure bank total cost more exactly as it does not exclude interest expense. Secondly, it has an edge over other definition for data quality consideration. Thirdly, it assumes deposit as input. Therefore, majority of studies adopted intermediation approach.

We have also used intermediation approach in our study. We have taken two inputs and two outputs in the present study and output oriented DEA technique has been adopted.

**Table 3.1 Outputs and Inputs of the Study**

<table>
<thead>
<tr>
<th>OUTPUTS</th>
<th>INPUTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTEREST INCOME</td>
<td>OTHER INCOME</td>
</tr>
<tr>
<td>INTEREST EXPENSES</td>
<td>OPERATING EXPENSES</td>
</tr>
</tbody>
</table>

Sources: On the basis of Previous Chapter.

The inputs used for calculating various efficiency score are.

1. **Interest Expenses**

Interest expenses related to the funds raised by bank. Banks raise funds from public as deposits, from money/capital market and RBI/banks as borrowing. Interest expenditure is of three types:

- Interest on deposits from public/banks/other institutions.
- Interest on borrowings form RBI and other banks
- Others i.e. discount/interest on all borrowings / refinance from financial institutions.

Interest expenditure depends on the size of deposits portfolio, the term structure and the interest rate etc.
2. Operating Expenses

It is also called establishment cost. It is incurred for maintaining the staff, premises etc. and for carrying day to day operations. Major types of operating expenditure are:

- Payment to and provisions for employees which includes staff salaries, allowances, bonus etc.
- Rent, taxes and lighting
- Printing, stationary, advertisement and publicity
- Depreciation, Director’s fees, Auditor’s fees etc.

Payment to employees is the major element in operating cost. Because of industry wide wage agreements banks in India have very little flexibility in rationing the same.

The output variables are:

1. Interest Income

Interest income of banks depends upon the size of assets portfolio, the rate of interest and the percentage of standard assets, i.e. the earning assets. It consists of

- Interest on advances and discount on bills
- Income on investments, which includes all income derived from the investment portfolio by way of interest and dividend.
- Interest on balance held with RBI and other inter-bank funds.

Earlier, RBI used to administer the interest rate offered by banks and banks were required to lend a major part of their resources to directed priority sectors of the economy. As such, bank had less scope for interest rate management than now. At present bank fix the interest rate for borrowers based on prime lending rate, risk rating of the borrower and other business related factors.
2. Other Income

Other income of banks arises from sources other than money lent. It is also called non-interest income. It comprises

- Fees income,
- Trading income on investment,
- Income from foreign exchange operations and
- Miscellaneous income.

Fee income represents the income on services provided by banks like demand drafts, telegraphic transfers, brokerage or commission earned on forex transitions, distributed of third party products like mutual funds, insurance and financial advisory services. Fee income is a relatively easier way to increase revenues as the business does not involve any fund based exposure like a loan or cash advances.

Review of literature based on DEA helps us in selecting inputs and outputs for the present study.

Ram Mohan and Ray (2004) stated that “Using deposits and loans as outputs would have been appropriate in the nationalized era when maximizing these was indeed the objective of a bank but they, perhaps, less appropriate in the reforms era. Banks are not simply maximizing deposits and loan; they are in the business of maximizing profits. If inputs are treated as pre-determined, this amounts to maximizing revenue.”

Now, banks are also trying to maximizing revenue and profit with given resources. Therefore, in our study we have also used output orientation method to find out potential improvement in interest income and other income.

The DEA results are affected by number of inputs and outputs, therefore the appropriate number of inputs and outputs are necessary to find accurate efficiency. The relationship between the number of DMUs and the number of inputs and outputs is some time specified as follows.

\[ N \geq (M \times S) \] or
N ≥ 3(M + S)

Where,

N= Number of DMUs
M= Number of Inputs
S= Number of Outputs

The first rule of thumb states that number of DMUs should be greater than or equal to the product of inputs and outputs. While second rule states that the sample size should be at least three times larger than the sum of the number of inputs and outputs (R.Ramanathan, 2003).

In our study we have taken two inputs (M) and two outputs (N) with at least 46 DMUs. Therefore, study have fulfilled both the above rule of thumb.

Strengths and limitations of DEA (R. Ramanathan, 2003)

Data Envelopment Analysis is a powerful technique for performance measurement. Some of the characteristics that make it powerful are:

- DEA can handle multiple inputs and multiple outputs simultaneously.
- DEA is non parametric in the sense that it does not require any assumption of a functional form relating inputs and outputs.
- Inputs and outputs can have different units. For example, \( X_1 \) could be in unit of number while \( X_2 \) could be in the unit of rupees.
- DMUs are directly compared against a peer or combination of peer.
- DEA can also provide potential improvement in inputs and outputs.

Limitations of DEA

However, DEA has certain limitations. An analyst should keep these limitations in mind when choosing whether or not to use DEA. (P. Kumar, 2006)

- Since DEA is an extreme point technique, noise (even symmetrical noise with zero mean) such as measurement error can cause significant problems.
DEA is good at estimating “relative” efficiency of a DMU but it coverage’s very slowly to “absolute” efficiency. In other words, it can tell you that you are doing compared to your peers but not compared to a “theoretical maximum.”

Since DEA is a non parametric technique, statistical hypothesis tests are difficult and are the focus of ongoing research.

Since a standard formulation of DEA creates a separate linear program for each DMU, large problems can be computationally intensive.

DEA does not provide rank to 100% efficient units. It is difficult to tell which bank is more efficient among 100% efficient bank.

In spite of above these limitations, DEA is powerful tool for service industry specially in banking sector. According to Tapiawala (2010) DEA has been found to be suitable in solving the following three basic performance questions that any bank is faced with.

- How well a bank is doing relative to the others doing the same thing? What does it need to improve?
- Who are the best in class performers for bench marking purposes?
- By definition, a “benchmark” is a standard, against which other similar thing must be measured and or judged i.e., something that is worth striving for, once it is known.

Therefore, we have used DEA technique in our study. We have used output oriented model because in input oriented model the cost are needed which are not available in banking transactions.

**Data Collection**

In research, the quality and richness of results will be of high level if the used information is a texture of verity and correctness. Therefore, due consideration has been given to the type and method of data collection (Wilkinson and Bhandarka, 2000). There are two types of data: Primary data and secondary data. The present study is entirely based on secondary data relating to scheduled commercial Banks of India.
Data Sources

Secondary data has been collected from various reports of Reserve Bank of India, Books, Generals, Magazines and website of RBI and Indian Bank Association (IBA) has also been used for data collection. Data are also drawn from Economic survey of Government of India. Annual Publication on performance highlights of banks by Indian Bank Association (IBA) are the official source of information.

In short, the data are extracted from the following sources:

- Annual Publication on performance highlights of bank, IBA, various issues.
- Reserve Bank of India Bulletins, various issues.
- Economic Survey, Govt. of India, various issues.
- Annual Reports of Respective Banks, various issues.
- Annual Reports on Currency and Finance, RBI.
- www.rbi.org.in

The study includes all the public sector and private sector banks operating in India. For analytical purpose, public sector banks are divided into two sub groups:

2. Nationalized Banks.

Similarly, Private Sector Banks are also divided into two sub groups:

1. Old Private Sector Banks.

For the year-wise analysis we have taken all the Public Sector Banks and Private Sector Banks which are operating in year 2006-07 to 2012-13. But for bank group wise, all the Public Sector Banks and Private Sector Banks which are operating in year 2012-13 have been taken.
LIMITATIONS OF THE STUDY

The researcher is a student and has to complete the project within a very limited time period. As such, he is faced with various constraints like times and money. In short, he has to conduct the study in a limited manner. The major limitations of the study as faced by the researcher are as under.

- Banking Industry in being basically a service industry creates more problems in measurement of output than any manufacturing industry.
- The study is based on secondary data so the limitations of secondary data also apply to the study.
- Data used in the study is highly aggregative.
- Artificial window dressing of the Balance Sheets has concealed the true state of affairs in banks.
- Number of years in the present study is only seven.

Despite of the limitations mentioned above, the present study is an honest attempt to analyze the efficiency of bank with an alternative method.