Efficiency of Commercial Banks in India: A Non-parametric study using Data Envelopment Analysis.

Jayeeta Paul
Assistant Professor in Commerce
J.D. Birla Institute, Affiliated to Jadavpur University.

ABSTRACT: One of the major areas of macro-economy that has been the subject of focused attention is the efficiency of the banking sector. The major objectives of Indian banking sector reforms were to encourage operational self-sufficiency, flexibility and competition in the system and to increase the banking standards in India to the international best practices. The present study attempts to examine the changes in the productive efficiency of Indian commercial banks after financial sector reforms were initiated in 1992. Analysis of production based efficiency can be viewed as another form of representation of the financial performance of the micro level units of the banking sector. This paper seeks to determine the impact of various market and regulatory initiatives on efficiency improvements of Indian banks. Efficiency of firm is measured in terms of its relative performance that is, efficiency of a firm relative to the efficiencies of firms in a sample. Data Envelopment Analysis (DEA) has been used to identify banks that are on the output frontier given the various inputs at their disposal. The present study is confined only to the Constant-Return-to-Scale (CRS) assumption of decision making units (DMUs).

We have classified Indian Commercial banks in three categories a) Public sector banks b) Private commercial banks and d) foreign banks. Considering Input and Output data set on the relevant parameters such as deposits, net profits, advances as given by each individual banks, non-interest income, interest spread, net worth, borrowings of the banks, operating expenses, number of employees in the country and number of bank branches in the country for the period 2000-2010, the present paper intends to represent efficiency change of Indian commercial banks in the liberalized regime. Comparison of efficiency change among different categories of banks seems also to be significant while trade and financial sector liberalization has been emergent in pushing the efficiency level upward both for private as well as public commercial banks. The better performance of the micro units of the banking sector indicates better financial inclusion of different stakeholders like firms, small investors, common households, etc.

Keywords: Efficiency, DEA, DMU, CRS, Commercial Banks.
INTRODUCTION: A stable and efficient banking system has been the cynosure of research efforts throughout the world. It is being noted that in developing countries like India that continuous financial deregulation, increased competition from the non-banking sectors, capital market restructuring, gradual upgradation towards full account convertibility and universalisation of banking operations have transformed the role of a bank from an intermediary between a borrower and a saver to a more customer-centric entity. The banks comprise more than three-fifth of financial system assets and dominate the whole financial sector in India by playing a central role in mobilizing savings in growth processes. Hence it is necessary to understand the efficiency of Indian commercial banks.

Indian banking system is particularly interesting because of the diversity of bank ownership form, and the relationship between bank ownership and regulatory burden. Indian banks can be classified into three ownership groups: publicly owned, privately owned and foreign owned. Although the three groups of banks operate in the same market, each group faces a different set of regulations, and these regulations have evolved through time. In the light of this uneven and changing regulatory environment, we expect to find performance variation, both across groups of banks and through time. Efficiency of a bank is generally conceptualized as the extent to which the bank is able to utilize its resources (inputs) to generate business transactions (output), and is measured by their ratio, where larger value of this ratio indicates better performance. Efficiency is defined in two ways – technical efficiency and economic efficiency. The former arises when a (bank) firm minimizes its inputs, given output while in the latter case the banking firm maximizes its output, given inputs. Technical efficiency is, thus, input saving and the economic efficiency represents output augmentation. Traditional accounting and financial ratio methods have been very useful in the past for providing information for benchmarking a bank's efficiency, but they have certain methodological limitations. The biggest disadvantage of such ratio method is it cannot take all the financial inputs or the output at the same time. Thus, overall performance is difficult to analyse using such traditional accounting techniques. Data envelopment analysis (DEA) is a mathematical approach to handle situations with multiple inputs and multiple output and has been a proven way to measure bank performance. This frontier analysis method can identify banks which are able to convert multiple inputs to produce higher amount of a combination of output. These are called efficient banks and their efficiency is measured by the ratio of their combination of multiple output to their multiple inputs (Coelli et al., 1998).

The structure of this article is as follows: firstly, we provide a brief introduction on the different efficiency measurement techniques that is applied in the banking sector with special focus on the DEA method in the context of the Indian banking sector. Then we discuss about
our own performance model used in this study and the data source used. Results analyzed are discussed in the next section. Lastly, we give the conclusion and the scope for future research.

Efficiency measuring techniques in Banking institutions: The main objective of applying efficiency measuring techniques in any study is to identify the units which are performing well. Both parametric and non parametric frontier analysis techniques are being used to measure efficiency of a bank or branches within an individual bank. The result obtained can be used for policy formulation regarding merger of banks, rating of banks in the banking industry, improvement of banks performance by benchmarking against the best performers and so on and so forth.

Here, we give a brief introduction to the different parametric and non parametric methods which have been used by the researchers studying financial institution efficiency (Berger and Humphrey, 1997).

**Parametric frontier methods:** Here we specify a functional form of the best practice frontier and there are three methods used in literature. They are:

1. **Stochastic Frontier Approach (SFA):** The most commonly employed econometric method is the Stochastic Frontier Analysis (SFA) as in Kaparakis et al. (1994), Berger and Humphrey (1997), Hao et al. (2001), which specifies frontier functions for one input – multiple output or one output-multiple input scenarios. The methodology separates random errors from the inefficiency component and also varies from other parametric approaches as it imposes different distributional assumptions to accomplish this disentanglement. The SFA approach ranks the firm with lower costs for a given set of input prices (but the same output quantities) as more efficient than another firm.

2. **Distribution –Free Approach (DFA):** The Distribution-Free Approach (DFA) as in Berger, Hancock and Humphrey (1993), Akhavein et al. (1997) and DeYoung (1997) estimates efficiency by specifying a functional form for the frontier, much like the SFA, but does not impose a parametric structure on the random errors or inefficiencies. DFA makes the assumption that random errors average out to zero, while the average efficiency of each firm remains constant over time. Shifts in the efficiency frontier over time, caused by any number of external forces result in DFA scores that reflect the average deviation of each firm from the best average practice frontier instead of the efficiency at any one point in time (Berger and Humphrey, 1997).

3. **Thick Frontier Approach (TFA):** The Thick Frontier Approach (TFA) as in Berger and Humphrey (1991), Clark (1996) and De Young (1998) is the least frequently used parametric technique. TFA measures the general level of overall efficiency, rather than point estimates of efficiency for individual firms.
Non parametric frontier methods: Here we do not consider any functional form of the best practice frontier. Two methods have been used to study efficiency of financial institutions. They are:

1. **Data Envelopment Analysis (DEA):** Data Envelopment Analysis (DEA) developed by Charnes et al. (1978) is a linear programming based technique where the set of best practice units are those for which no other decision-making units or linear combination of units has as much or more of every output (given inputs) or little or less of every input (given outputs). It is a piecewise linear combination that connects the set of best practice units.

DEA occasionally called frontier analysis is a performance measurement nonparametric analytic technique which can be used for analyzing the relative efficiency of productive units, having the same multiple inputs and multiple outputs. One of the earliest studies on DEA is the study of Farrell (1957) who attempted to measure the technical efficiency of production in single input and single output case. DEA was originally developed by Charnes, Cooper and Rhodes (1978) with the assumption of constant return to scale (CRS) in attempt to propose a model that generalizes the single-input, single output measure of a DMU to a multiple inputs, multiple outputs setting. DEA was extended by Banker, Charnes and Cooper (1984) to include variable return to scale (VRS).

DEA is a deterministic methodology for examining the relative efficiency, based on the data of selected inputs and outputs of a number of entities called decision–making units (DMUs). From the set of available data, DEA identifies relative efficient DMUs (which are used as reference points) which define the efficiency frontier and evaluate the inefficient of other DMUs which lie below that frontier.

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 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 (TEVRS) 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 TECRS and TEVRS 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 = TECRS/TEVRS

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.

Mathematical Formulations of Data Envelopment Analysis

DEA has the following mathematical representations:

Maximize bank efficiency

\[ E_b = \frac{\sum_{r=1}^{R} u_{rb} y_{rb}}{\sum_{i=1}^{I} v_{ib} x_{ib}} \]

Subject to

\[ \frac{\sum_{r=1}^{R} u_{rb} y_{rb}}{\sum_{i=1}^{I} v_{ib} x_{ib}} \leq 1 \forall j, \quad i = 1, 2, \ldots, b, \ldots, N \]

And \( u_{rb} v_{ib} \geq 1 \) for all \( r, i \) (where \( i = 1, 2, \ldots, R \) and \( i = 1, 2, \ldots, N \))

Where \( E_b \): efficiency of unit \( b \)

\( y_{rj} \): observed quantity of output \( r \) produced by unit \( j = 1, 2, \ldots, b, \ldots, N \)

\( x_{ij} \): observed quantity of input \( i \) used by unit \( j = 1, 2, \ldots, b, \ldots, N \)

\( u_{rb} \), the weight (to be determined) given to output \( r \) by base unit \( b \)

\( v_{ib} \), the weight (to be determined) given to input \( i \) by the base unit \( b \)

\( \varepsilon \): a very small positive number (non-Archimedean infinitesimal)

In our present study, we have applied the output-oriented (CCR) DEA model to measure the performance efficiency of the Indian Banks (Charnes et al., 1978).

Max \( \Phi_0 + \varepsilon \left( \sum_{i=1}^{I} s^-_i + \sum_{r=1}^{R} s^+_r \right) \)

Subject to \( \sum_{j=1}^{J} \lambda_j x_{ij} + s^-_i = x_{i0} \quad i = 1, 2, \ldots, N \)

\( \sum_{j=1}^{J} \lambda_j y_{rj} + s^+_r = \Phi_0 y_{r0}, \quad r = 1, 2, \ldots, R \)
\[
\sum_{j=1}^{n} \lambda_j = 1
\]
\[
\lambda_j s_j s_j^+ \geq 0
\]

Where \( x_{ij} \) and \( y_{rf} \) are the amount of \( i \)th input consumed and the amount of \( r \)th output produced by the \( j \)th DMU. If \( \mathbf{0} = 1 \) and all the input/output slacks are zero, then a unit is said to be efficient.

2. **Free Disposal Hull (FDH):** This is a special case of DEA model where points on lines connecting the DEA vertices are not included in the frontier but the FDH production possibility set consists of only DEA vertices and FDH points interior to the vertices (Berger and Humphrey, 1997).

Is there a best practice frontier method?

In the literature, there exists a difference of opinion among researchers on the best possible method to determine the efficiency of banks. The parametric approach presupposes the shape of the frontier and if the function form is misspecified, then the measured efficiency gets mixed up with specification error. Though the non-parametric methods do not assume a functional form, they do not allow any random error. If it exists, then measured efficiency gets confounded with random deviation from true efficiency (Berger and Humphrey, 1997). The DEA or the SFA method is generally used for efficiency measurement. Though, SFA can account for noise and can be used to conduct conventional test of hypothesis, it requires a distributional form for the inefficiency term, functional form of the production function, and is difficult to accommodate multiple outputs (Coelli et al., 1998). Hence DEA is preferred over SFA by the researchers in most of the efficiency measurement studies. It is found that multiple inputs like assets, employees, investments, etc are used by commercial banks to generate multiple outputs like profits, revenues, and so on and so forth and also the complex relationship between the inputs and the outputs is not known explicitly. As DEA have the ability to handle multiple input output transformation, it is the non-parametric technique of DEA which is being used to measure the efficiency of commercial banks instead of any parametric frontier technique.

**INDIAN BANKING SECTOR:**

The banking system in India, like those in most developing economies, is characterized by the coexistence of different ownership groups, public and private, and within private, domestic and foreign. Prior to 1970 the public sector contained only one bank, which was nationalized in 1951. Subsequently, most of Indian banking was brought into the public sector by the
nationalization of 14 major banks in 1970, and by the nationalization of six additional banks in 1980. The main goal of the nationalization program were

(i) to break the monopsony control of the large business houses over the country’s banks
(ii) to spread banking services into the previously neglected suburban and rural areas
(iii) to mobilize deposits and direct funds towards investment in the public sector and loans to the priority sector (agriculture, small scale enterprises, and the export sector) and
(iv) to make credit planning a part of the national economic plan.

Details are available in Bhattacharya (1993), Ghosh (1993) and Rangarajan (1993). It was observed that by the early nineties, public sector banks accounted for nearly 90 percent of total deposits and advances, with the residual being almost equally split between private and foreign banks.

However, by this time, the excessive focus on quantitative achievements had made many of the public sector banks unprofitable and undercapitalized by international standards. Many banks were earning less than reasonable rates of return, had low capital adequacy and high non-performing assets, and were providing poor quality customer service. Operating costs were increasing at a very high rate and the rapid growth in staff and promotions had diluted the quality of manpower.

In recognition of these growing illnesses, the Reserve Bank of India launched major banking sector reforms in 1991 aimed at creating a more profitable, efficient, and sound banking system, based on the recommendations of the first Narasimham Committee on Financial Sector Reforms and later in 1994 by constituting the Board of Financial Supervision, the Government took several important steps to strengthen the functioning of the financial sector. Some of the important steps were reduction in the levels of cash reserve ratio and statutory liquidity ratio and creation of a more competitive environment in the financial sector through reform measures – such as relaxation of entry-exit norms, reduction in public ownership in banking industry, and allowing banks to access the capital market for meeting their fund requirement (RBI Bulletin, August 1999). To identify the weak public sector banks and develop a restructuring policy for them with the motive to equip them to thrive in the new liberalized regime, the government in October 1999 had to constitute the Verma Committee (Verma Committee Report, 1999). Therefore, it is important to find out how the Indian banks, belonging to both public and private sectors, would be able to compete with the multinational banks,
EFFICIENCY STUDIES OF INDIAN BANKS USING DEA:

Studies on bank productivity and efficiency have mostly related to the United States. For India investigations of this nature are still in a nascent stage and have typically adopted two approaches. The parametric Stochastic Frontier Analysis (SFA) and the non parametric Data Envelopment Analysis have been widely used for measuring efficiency scores in India. During the late 1980s and particularly in the 1990s, the DEA method has been used extensively to evaluate banking institutions.

Bhattacharya et al. (1997) examined the efficiency of Indian banks using a two step procedure, DEA technique to determine the technical efficiency and then applying stochastic frontier approach to explain variation in calculated efficiency. They applied intermediation approach using two inputs (interest expense and operating expense) and three outputs (deposits, advances and investments) on five-year data of 70 banks, for the period 1986-1991. They constructed one grand frontier on the entire data set for DEA analysis and found that the public sector banks were more efficient than foreign banks, which in turn were marginally more efficient than private sector banks. The average efficiency of the sector as a whole was found to be 80.35 percent, ranging from an average of 75.37 percent for private sector banks and 87.40 percent for public sector banks. They also found that 78 percent of banks operated with decreasing returns to scale while 16 percent showed increasing returns to scale. For the second stage, regression analysis, they used a set of variable to account for time, ownership and regulatory policy. They concluded that public sector bank efficiency declined over time whereas that of foreign sector banks improved over time. The performance of private sector banks remained almost unchanged.

Das (1997) studied public sector banks, accounting for the majority of the banking business and operating under the same regulatory framework imposed by the RBI with similar social obligations. Efficiency of the public banks was measured for the years 1970, 1978, 1984, 1990 and 1996 to examine the change in efficiency and compare the changes before and after their nationalization. The paper used intermediation approach with inputs – like labour measured by the number of employees of the individual banks; and loanable funds constituting deposits and borrowings – and output – like interest margin measured by the difference of the total interest earned by the bank and the total interest paid by them which essentially measures their financial intermediation skills; and the earnings from the customers on commission, exchange, brokerage which a bank earns for the services provided. They found that the overall efficiency has declined in the post deregulation period with State Bank of India and its associates to be
more efficient than the other nationalized banks. Inefficiency was found to be technical in nature, which showed there is under-utilization or wastage of resources rather than incorrect input combination.

Noulas and Ketkar (1996) measured the efficiency of public sector banks of India by using the Data Envelopment Analysis. The study considered 18 public sector banks and the necessary information for analysis have been collected from the RBI publications for the year 1993. The study identified that pure technical efficiency was 1.5 percent and scale inefficiency was 2.25 percent and none of the banks were operating under decreasing returns to scale.

Saha and Ravishankar (2000) have analyzed the performance of Indian banks using DEA approach. They have analyzed performance of 25 public sector banks over a period 1992-1995. The analysis is done in two stages. In the first stage, efficiency is measured as a ratio of certain output to input. Number of branches, number of employees, establishment expenses and non-establishment expenses were taken as inputs. Deposits, advances, investments, spread, total income, interest income, non-interest income and working funds were taken as measures of outputs. The ratios were plotted and extreme points were joined to form linear efficiency frontier. In the second stage, DEA was used on the same data to determine the efficiency frontier. They concluded that DEA is useful technique in determining relative efficiency. Their findings indicated that efficiency of public sector banks improved over the time period.

Sathye (2003) used DEA to study the relative efficiency of Indian banks in the late 1990’s with that of banks operating in other countries. He found that the public sector banks have a higher mean efficiency score as compared to the private sector banks in India, but found mixed results when comparing public sector banks and foreign commercial banks in India.

Kumbhakar and Sarkar (2003) and Kumbhakar and Sarkar (2004) used the parametric method to evaluate the efficiency of the Indian banking system using panel data for the period 1986-2000. Postulating a cost function and using stochastic cost frontier, they determined the changes in efficiency over time. Using dummy variables, they also found contribution of reforms and role of ownership to the change in efficiency. They found the Indian banking system to be cost inefficient but the tendency for inefficiency to decline over time. They found the private sector banks to be more cost efficient than public sector banks. The deregulation resulted in increase in inefficiency and there was no significant difference in impact of deregulation on private sector banks and public sector banks.
Ram Mohan and Ray (2003) have studied productivity and efficiency of public and private sector banks in India, using non-parametric DEA, for the period 1992-2000. They studied 27 public sector banks, 21 old private sector banks and 14 foreign banks. They employed three measures: Tornquist total factor productivity growth, Malmquist efficiency index and revenue maximization efficiency. They assumed CRS technology and used intermediation approach with interest cost and operating cost as inputs and loan income, investment income and non-interest income as outputs. They found public sector banks to be more efficient and productive compared to their private sector competitors.

Das et al, (2004) examined the efficiency of Indian banks by using DEA model. Four input measures: deposits and other borrowings, number of employees, fixed assets and equity, and three output measures: investments, performing loan assets and other non-interest fee based incomes were used in the analysis. He found that Indian banks did not exhibit much of a difference in terms of input or output oriented technical and cost efficiency. However, in terms of revenue and profit efficiencies prominent differences were seen. He also found that size of the bank, ownership of the bank, and listing on the stock exchange had a positive impact on the average profit and revenue efficiency scores.

METHODOLOGY:

THE PERFORMANCE MODEL:

Data envelopment analysis has been extensively used to study performance of the banking sector both for banks as a whole and for branches of individual banks in the last decade. DEA is a linear programming technique initially developed by Charnes, Cooper and Rhodes (1978) to evaluate the efficiency of public sector non-profit organisations. The choice of inputs and outputs in DEA is a matter of long standing debate among researchers. Two approaches exist. One is called the production approach while the other an intermediation approach. In the production-type approach, banks are considered as deposit and loan producers and it is assumed that banks use inputs such as capital and labor to produce a number of deposits and loans. This approach is more suitable for measuring efficiencies of bank branches as customer level satisfactions are carried out at the branch level where the branch managers have little control on the overall decision making regarding the funding and investment decisions of the bank. According to the intermediation approach, banks are considered the intermediaries that transfer the financial resources from surplus agents to the fund deficit ones. In this approach it is considered that the bank uses as inputs: deposits, other funds and, equity, which they
transform into outputs such as: loans and financial investments. The opportunity for using each method varies depending on circumstances (Tortosa- Ausina, 2002). The intermediation approach is considered relevant for the banking sector, where the largest share of activity consists of transforming the attracted funds into loans or financial investments (Andrie and Cocris, 2010).

In this study our objective is to do performance benchmarking of the 40 banks operating in India. Since following the process of financial liberalization in India the sustenance of any banking firm depends on its intermediation power of transferring funds from savers to investors and since its profit maximization would involve minimization of total cost, which includes both operating and interest expenses incurred and not just the production cost, we have considered the ‘intermediation approach’ to measure efficiency of Indian banks. The following output variables are selected for our DEA model:

i. deposits,
ii. net profits
iii. advances as given by each individual banks
iv. non-interest income like sum of commission exchange and brokerage; sale of investments, revaluation of investments, sale of land/ buildings, exchange transactions, income earned from dividends and other miscellaneous income; and
v. interest spread which is the difference between the interest earned by the bank and the interest paid by it.

The five input parameters taken are:

i. net worth of the banks
ii. borrowings of the banks
iii. operating expenses which are non-interest related expenses like sum of establishment expenses, rent, taxes, and electricity; printing and stationery; advertising; depreciation; directors fees; auditors fees; law charges; post, telegram, and telephone expenses; repair and maintenance; insurance and miscellaneous other expenses
iv. number of employees in the country and
v. number of bank branches in the country.

DATA: The source of the data used in this research is the ‘Statistical Tables relating to banks in India’ published by the Reserve Bank of India. This is an annual report, which contains the financial information about all banks including public, private and foreign banks, operating in India. Data was collected for 40 banks over the period 2000 – 2010. All banks, on which data
existed in the report for the given period, were included in the research. All the financial data is in terms of Indian rupees (in millions).

ANALYSIS AND RESULTS:
We employed, output-oriented, constant returns to scale CCR DEA model (Charnes, Cooper and Rhodes, 1978), where we assume that banks are trying to deliver maximum output by using available resources. Banks are studied sector-wise according to ownership and also in the collated form where they are compared across ownership over the period 2000 – 2010. Table 1 gives the summarized form of the average efficiency figures by ownership form over the period 2000 – 2010. Private banks efficiency is better than public sector banks because of the rapid technology applications and aggressive marketing efforts.

<table>
<thead>
<tr>
<th>Year</th>
<th>All Banks Mean</th>
<th>All Banks Standard Deviation</th>
<th>Public Sector Banks Mean</th>
<th>Public Sector Banks Standard Deviation</th>
<th>Private Sector Banks Mean</th>
<th>Private Sector Banks Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>0.949</td>
<td>0.077</td>
<td>0.954</td>
<td>0.055</td>
<td>0.952</td>
<td>0.095</td>
</tr>
<tr>
<td>2009</td>
<td>0.964</td>
<td>0.055</td>
<td>0.949</td>
<td>0.061</td>
<td>0.980</td>
<td>0.046</td>
</tr>
<tr>
<td>2008</td>
<td>0.976</td>
<td>0.041</td>
<td>0.970</td>
<td>0.043</td>
<td>0.982</td>
<td>0.040</td>
</tr>
<tr>
<td>2007</td>
<td>0.959</td>
<td>0.060</td>
<td>0.946</td>
<td>0.055</td>
<td>0.972</td>
<td>0.063</td>
</tr>
<tr>
<td>2006</td>
<td>0.917</td>
<td>0.093</td>
<td>0.897</td>
<td>0.088</td>
<td>0.936</td>
<td>0.097</td>
</tr>
<tr>
<td>2005</td>
<td>0.913</td>
<td>0.104</td>
<td>0.875</td>
<td>0.103</td>
<td>0.950</td>
<td>0.093</td>
</tr>
<tr>
<td>2004</td>
<td>0.897</td>
<td>0.111</td>
<td>0.828</td>
<td>0.093</td>
<td>0.958</td>
<td>0.090</td>
</tr>
<tr>
<td>2003</td>
<td>0.907</td>
<td>0.102</td>
<td>0.857</td>
<td>0.097</td>
<td>0.956</td>
<td>0.081</td>
</tr>
<tr>
<td>2002</td>
<td>0.917</td>
<td>0.095</td>
<td>0.882</td>
<td>0.097</td>
<td>0.952</td>
<td>0.081</td>
</tr>
<tr>
<td>2001</td>
<td>0.878</td>
<td>0.124</td>
<td>0.812</td>
<td>0.118</td>
<td>0.943</td>
<td>0.094</td>
</tr>
<tr>
<td>2000</td>
<td>0.857</td>
<td>0.123</td>
<td>0.808</td>
<td>0.118</td>
<td>0.907</td>
<td>0.108</td>
</tr>
</tbody>
</table>

CONCLUSION:
Like any other study, this research is also having certain limitations. The variables selected as input and output be regarded as examples rather than universally accepted measures of bank performance. The major contribution of this paper is the methodology to measure the performance of the Indian banking sector after liberalization. Our contribution lies in using the DEA methodology to understand issues of performance benchmarking through application of output-oriented CCR model on the banking sector for the period 2000-2010. The banks which were identified as weak banks were mainly because of a high percentage of non-performing assets, capital adequacy ratio less than the standard norm, overstaffing problems and so on and so forth which showed that the business policy of these banks was not properly planned to withstand the nature of competition in the market.
Such type of performance analysis can help individual banks benchmark themselves against competition, compete with better performers, develop their own business strategies and strive for excellence.

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