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A Study on Performance Efficiency of Nationalized Banks of India: A DEA Approach

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Abstract

Purpose: The aim of this research work is to investigate and examine the performance of the Nationalized Banks of India individually and to identify the best operating banks.**Design / Methodology/ Approach:** For this study the researcher collected the data of the Nationalized Banks for the financial years 2007 to 2012 by considering four input variables and three output variables. The Data Envelopment Analysis technique has been employed to study the performance of the banks individually. **Findings:** Our study reveals that : Only the 21% banks are relatively efficient based on the input oriented technical efficiency [CRS]. Only 31.6% banks are relatively efficient based on the input oriented technical efficiency [VRS]. Altogether only 21% of the banks are functioning effectively and efficiently and the remaining banks are not functioning up to that expected level.

Key Words: Data Envelopment Analysis, Decision Making Unit, Performance, Efficiency, Constant Return to Scale, Variable Return to Scale
JEL Classification : C14, C61, G21

1. Introduction

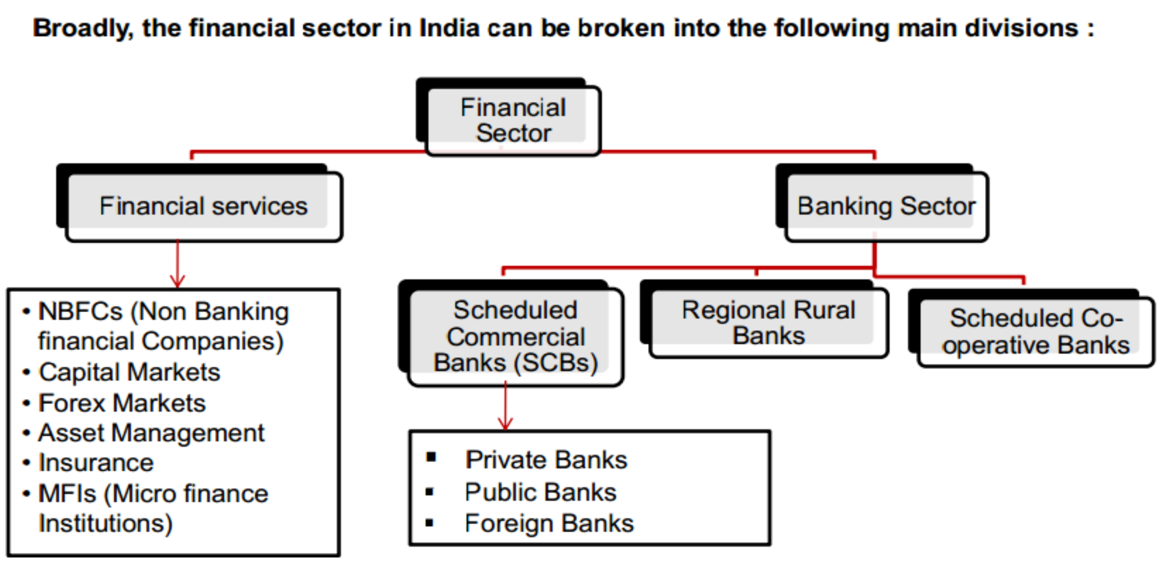
It is one of the main activities of any firm to monitor its efficiency. In the current scenario there are a number of methods based either on the traditional approach or using IT to evaluate the efficiency of a system. Efficiency measurement methods can be divided into three main categories: ratio indicators, parametric and nonparametric methods. In selecting indicators to measure efficiency one can focus primarily on a firm's inputs and outputs.

In general, the term productive unit refers to a unit producing certain outputs by spending certain inputs. The evaluation of efficiency in production units and determining the sources of their inefficiency is a precondition to effectively improve the performance of any such unit in a competitive environment.

Bank[s] branches can be considered as production units too. In general, they are homogeneous units performing similar activities. All inputs and outputs have an impact on the efficient operation of such units, even though some are relatively considered to be more important or less important to each other.

Scheduled Banks in India are those banks which have been included in the Second Schedule of the Reserve Bank of India (RBI) Act, 1934. RBI in turn includes only those banks in this schedule which satisfy the criteria laid down vide section 42 (6) (a) of the Act.

Performance is normally referred to as the bank's ability to generate transaction by effectively utilizing its resources. Based on the economical term, efficiency refers to the ratio of outputs to inputs.Input refers to the scarce resource and output in terms of goods and services offered to the consumers. One can understand the notion of efficiency in terms of banking operation as more consequential as the banking sector is deemed to play a vital role in the financial division of a country. The banking sector of a country is one of the most important sectors of the country's economy. Hence, it is highly essential to measure its performance using the proper tool. Usually, the performance is measured with the help of Financial Management tools like, Return on Assets [ROA], Return on Investments [ROI], Return on Equity [ROE], Equity to Assets [ETA] and Internal Growth of Equity [IGE], etc. These measures are lacking in the sense that they are not total productivity measures but are partial productivity measures. As a blessing in disguise Data Envelopment Analysis (DEA) came to the rescue. It is considered as a tool for measuring total productivity. That is, one can mix all the inputs and outputs to study the effectiveness of any type of organization.



Kinds of Banks available in India

The large numbers of commercial banks in India, their high branch density, the quick technological change and the increased competition have added more pressure to improve performance. Instead of studying a bank's partial productivity, with the available Financial Management Tool like Ratio Analysis, it is the order of the hour to study the total productivity. In this context, the author has introduced the concept of DEA model in this research paper. This system has the benefit of developing a data-driven technological frontier that necessitates no specification of any scrupulous functional shape or error structure. This study fills the gap in the literature by leaving from the traditional method of evaluating the efficiency of a bank.

DEA was first introduced by (Charnes et al., 1978) as a Mathematical Programming Model with the help of the theoretical frame work given by (Farrell, 1957), for computing the relative efficiencies of multiple Decision Making Units (DMUs), and it falls under the special category of Fractional Programming. DEA is a special technique which offers a comparative ratio for each unit in terms of output and input. The ratio is stated as efficiency score for each unit. The measure of performance lies in the range 0 to 1. If the performance measure is 1 then the organization is considered to be highly efficient and if the measure is tending towards 0, the efficiency is otherwise. One of the significant roles of DEA is that the efficiency scores indicate the gap for potential improvements and developments for inefficient DMUs. DEA firstly applied by (Sherman and Gold, 1985) for assessing the efficiency of bank branches, is a tool for evaluating relative efficiency since it first identifies the bank's efficiency frontier and then compares it with other banks. It allows ranks to be awarded to the banks according to their technical efficiency scores and also to single out the driving forces for inefficiencies. In the banking industry, the DEA model is preferable to an econometric approach of efficient measurement because it has a number of advantages.

There are:

- ✓ It can simultaneously analyze several inputs and outputs, which is an alternative characteristic, because production in the banking industry often involves multiple inputs and outputs.
- ✓ It does not require any assumptions about the functional form of technology, and
- ✓ It calculates a maximal performance measure for each production unit relative to all other production units in the observed population with the sole condition that each production unit lies on or below the external.

This paper differs entirely from all other previous works by investigating and examining the current performance of the Nationalized Banks of India individually, in terms of their efficiency for the period [2007 – 2012] using the Data Envelopment Analysis. This study classifies the nationalized banks into two categories as efficient and inefficient. The remedial measures are discussed in order to improve the efficiency of the banks.

2. Review of Literature

The Financial Management Tool known as Ratio Analysis Technique [RAT] has been used for many years to evaluate the performance of the Banks. The financial statements are examined to find different ratios and then compare them with the defined Benchmark. In this research paper, the traditional parametric technique is replaced with the non – parametric method DEA to investigate the performance of the Banks.

(Seiford and Zhu, 1999) examined the profitability and marketability of the top 55 U.S. commercial banks by applying the DEA model and concluded that large banks performed better with respect to profitability than small size banks, while small size banks have the better characteristic of marketability as compared to large size banks.

(Maudos et al, 2002) studied the cost and profit efficiency of 832 European banks based on ten European Union Countries (period 1993 – 1996). The return on assets (ROE) and return on equity (ROA) were acquired as performance measures to check profit efficiency of banks using DEA. This study was made based on the four dimensions namely the market characteristics, differences in size, other bank characteristics and specialization. Variations in profit terms were found to be greater than the variations in cost terms.

(Park and Weber, 2006) tested the profitability of all Korean banks by testing with (traditional hypothesis approach) market structure hypothesis against efficient structure hypothesis applied after examination of the panel data (for the period of 1992-2002); with the help of (DEA) model. The outcome of this study shows that the performance measures significantly affects the profitability of banks. (Pastor, Lovell, and Tulkens, 2006) discussed the financial performance of branch offices. They studied 573 branch offices, for a six-month accounting period, of large European savings banks. Data Envelopment Analysis (DEA) and Free Disposal Hull (FDH) programming mathematical models were used to estimate financial performance with respect to their safeguard against expenses in giving customer services and building customer bases. They concluded that the financial performance evaluation factors can be reduced without statistical loss of significant information to the bank management.

(Sufian, 2009) studied the efficiency of the Malaysian banking sector during the Asian Crisis of 1997 for the period of 1995-1999. The efficiency of individual banks was computed by DEA technique. They considered the Profitability as the major ingredient which was used to evaluate the efficiency with other explanatory variables, like bank size and ownership. The outcome of this study indicated that as there is a positive association between the Efficiency of banks and loans intensity and the relationship is otherwise for the economic conditions and expense preference behavior. (Izah Mohd Tahir, Nor Mazlina Abu Bakar and Sudin Haron, 2009) evaluated the overall pure technical and scale efficiencies for Malaysian commercial banks during the period 2000-2006. The results suggest that domestic banks were relatively more efficient than foreign banks. They suggested that the domestic banks' inefficiency were attributed to pure technical inefficiency rather than scale inefficiency. In contrast, foreign banks inefficiency was attributed to scale inefficiency rather than pure technical inefficiency.

(Khalid AlKhathlan and Syed Abdul Malik, 2010) analyzed the relative efficiency of Saudi Banks using annual data from 2003 through 2008 using DEA. The results show that, on a relative scale, Saudi banks were efficient in the management of their financial resources. In addition, the results would provide crucial information about the Saudi banks' financial conditions and management performance for the benefit of bank regulators, managers and bank stock investors. (Nigmonov, 2010) studied the banks' performance and efficiency in Uzbekistan for the period of 2004-2006. The basic two DEA models were applied to analyze the data under the assumption of a constant and variable return to scale. The results have revealed that inefficiency occurs due to technical efficiency and overall banks average efficiency level decreased. (Sufian and Habibullah, 2010) analyzed the efficiency of the Thailand banking sector covering the duration 1999-2008 with the help of DEA approach. The results have shown that inefficiency was offset during formulation of technical efficiency with respect to pure technical efficiency in the banking sector. The efficiency level of banks in data envelopment analysis is measured using a ratio of weighted sum of outputs to the weighted sum of inputs. (Joseph Magnus Frimpong, 2010) examined the relative efficiency of the banks in Ghana during the year 2007 based on the dataset provided by Ghana Banking.

(Mehmet Hasan Eken and Suleyman Kale, 2011) studied the performance model for measuring the relative efficiency and potential improvement capabilities of bank branches by identifying their strengths and weaknesses and the production and profitability aspects of the branches. Under both productivity and profitability approaches, efficiency characteristics of branches, which are grouped according to different sizes and regions, have similar tendencies. In both analyses, it is apparent that branch size and scale efficiency are related to each other. As branch size increases scale efficiency increases too and after the most productive scale size, however, as size increases efficiency decreases. Too small and too large branches need special attention. Putting production and profit efficiency scores on two scales reveals the performing characteristics of branches. Each region needs different handling. Branches with low production-low profit efficiency should be evolved towards high production-high profit efficiency region. (Tobias Olweny and Themba Mamba Shipho, 2011) studied to determine and evaluate the effects of bank-specific factors; Capital adequacy, Asset quality, liquidity, operational cost efficiency and income diversification on the profitability of commercial banks in Kenya. The second objective was to determine and evaluate the effects of market structure factors: foreign ownership and market concentration, on the profitability of commercial banks in Kenya. This study adopted an explanatory approach by using panel data research design to fulfill the above objectives. Annual financial statements of 38 Kenyan commercial banks from 2002 to 2008 were obtained from the CBK and Banking Survey.

(Mohammad Romel Bhuia, Azizul Baten, Anaton Abdulbasah Kamil and Nandini Deb, 2012) analyzed the relative efficiency of Bangladesh online banks during 2001 – 2007 by utilizing Data Envelopment Analysis. Based on the several online sampled banks, the findings reveal that the most efficient banks were AL-Arafah Islami Bank Limited, Shahajalal Islami Bank Limited, Eastern Bank Limited, and the less efficient banks over the study period were Janata Bank Limited, Uttara Bank Limited, United Commercial Bank Limited, Pubali Bank Limited, and AB Bank Limited. Among the three groups Group-1 (n=20), Group-2 (n=18), Group-3 (n=15) it was observed that the individual efficiency level of banks are increasing group by group. The efficiency level of Group-2 was slightly increased from the efficiency level of Group-1. The source of efficiency of the sampled banks was found to be lower for technical efficiency and scale efficiency rather than pure technical efficiency. (Anastasios D. Varias and Stella Sofianopoulou, 2012) evaluated the efficiency of the biggest commercial banks that operated in Greece at the financial year 2009 by using DEA with multiple inputs and outputs. The innovation of the paper refers to the choice of data and the use of a combination of the intermediation approach. The results indicate several inefficiencies that may not have direct relation to the profitability of such institutions. But, these inefficiencies indicate the vulnerability of the Greek banking system and its potential to ask for help from the FSF (Financial Stability Fund).

(Aswini Kumar Mishra, Jigar, N., Gadhia, Bibhu Prasad Kar, Biswabas Patra and Shivi Anand, 2013) tested the soundness and the second is to measure the efficiency of 12public and private sector banks based on market cap. As far as the first objective is concerned, CAMEL approach has been used over a period of twelve years (2000-2011), and it is established that private sector banks are at the top of the list, with their performances in terms of soundness being the best. Public sector banks like Union Bank and SBI have taken a back seat and display low economic soundness in comparison. On the other hand, the present study makes an attempt to measure the efficiency change of these selected banks operating in India during 2010-2012. By using frontier based non-parametric technique, Data Envelopment Analysis, provides significant insights on the efficiency of different banks and places the private sector ones at an advantageous position and thereby hints out the possibility of further improvisation of most of the public sector banks. DEA results exhibit that among the public sector banks, the performance of Bank of India, Canara Bank and Punjab National Bank got dampened in the last two years under study, whereas among the private sector banks, except the case for Axis Bank which was not found to be satisfactory at all, the remaining private sector banks show marked consistency in their efficiency level during the period under study. (Saâd Benbachir, Mohamed Abouch, Yassine El Haddad and Anas Benbachir, 2013) evaluated the relative efficiency for the bank branches of a Moroccan regional bank during the period 2007-2010 using DEA. As a result, they identified the inefficient bank branches with the help of identifying their strengths and weaknesses. (Karan S. Thagunna and Shashank Poudel, 2013) studied the relative efficiency and potential improvement capabilities of Nepali banks by scrutinizing intermediation aspects with the help of DEA. The outcome of this study reveals that efficiency level is relatively stable and has increased overall. Additionally, it also breaks down the overall efficiency of banks into technical and scale efficiency.

(Sangeetha R. and Jain Mathew, 2013) studied banking companies in the service sector exhibiting the problem of distinct results in terms of efficiency. To measure the stability, sustainability and profitability of the banking system, it is therefore crucial to scale the operations of banks performing in India. A well-organized banking system will provide an extensive way to higher economic growth in any country. Thus, evaluating the technical efficiency is important to depositors, owners, potential investors, managers and to policy makers. The present study investigates the technical efficiency of public sector banks in India by considering the study period between 2008-09 and 2010-11. For this purpose, the data envelopment analysis was used with two input variables and two output variables .The efficiency scores were calculated for a sample of twenty-six public sector banks operating in India. The result shows that Corporation Bank, State Bank of India and IDBI were consistently performed efficiently in all the years under study.

3. Research Methodology

3.1 Data Collection

For this study, the required data of all the Nationalized Banks have been taken from their respective official websites for the financial years 2007 – 2012.

3.2 Selection of inputs and outputs

Reviewing the literature on the application of data envelopment analysis (DEA), different studies have used different combination of inputs and outputs. In this study the researcher considered four input variables and three output variables in order to have an elaborate study. The variables under the study are listed below:

Variables which are related to Banking Sector considered

Input Variables	Output Variables
Operating Expenses	Net Interest Income
Deposits	Investments
Total Expenditure	Assets
Labor	

3.3 Pearson Correlation between variables

To start with the DEA approach, the correlation values will be evaluated and used to examine whether the association of the input and output variables obey the isotonic hypothesis. The table given below indicates that a significant positive association exists between the input and output variables, which specifically states that the isotonic hypothesis exists. It further conveys that the DEA can be used to know the efficiency of the banks.

3.4 CCR and BCC Model

The original CCR model was pertinent only to that expertise which is categorized by constant returns to scale. The major advancement was extended by Charnes, and Cooper (BCC) model to facilitate expertise that reveals variable returns to scale. This study has used input-oriented DEA model, which emphasizes on the minimization of inputs and the maximization of outputs held at their current levels. Also the BCC model with variable return to scale is considered.

3.4.1 General form of CCR Model

The general form Output Maximization DEA [CCR] model can be represented in the form of Fractional Programming Model as follows:

Here the general model is constructed to maximize the efficiency of the q^{th} output variable:

v_{jq} - j^{th} output value of the q^{th} DMU

y_{jq} - j^{th} output variable of the q^{th} DMU

u_{iq} - i[th] input value of the q[th] DMU
x_{iq} - i[th] input variable of the q[th] DMU
E_q - Efficiency of the qth DMU

$$Max\ \ E_q = \frac{\sum_{j=1}^{m} v_{jq}\, y_{jq}}{\sum_{i=1}^{s} u_{iq}\, x_{iq}}$$

subject to the constraints $\frac{\sum_{j=1}^{m} v_{jq} y_{jq}}{\sum_{i=1}^{s} u_{iq} x_{iq}} \leq 1;\ q = 1,2,\ldots,n$

$$v_{jq}, y_{jq}, u_{iq}, x_{iq} \geq 0\ for\ all\ i = 1,2,..s; j = 1,2,..m, q = 1,2, \ldots n$$

Solving this fractional programming problem directly is so tedious; hence the fractional programming model is converted into regular linear programming model as described below:

$$Max\ \ E_q = \sum_{j=1}^{m} v_{jq} y_{jq}$$

Subject to the constraints

$$\sum_{i=1}^{s} u_{iq} x_{iq} = 1;\ \sum_{j=1}^{m} v_{jq} y_{jq} - \sum_{i=1}^{s} u_{iq} x_{iq} \leq 0;\ q = 1,2, \ldots n$$

$$v_{jq}, y_{jq}, u_{iq}, x_{iq} \geq 0\ for\ all\ i = 1,2,..s; j = 1,2,..m, q = 1,2, \ldots n$$

The general form of input minimization DEA [CCR] linear programming model can be represented as follows:

$$Min\ E_q = \sum_{i=1}^{s} u_{iq} x_{iq}$$

Subject to the constraints

$$\sum_{j=1}^{m} v_{jq} y_{jq} = 1;\ \sum_{j=1}^{m} v_{jq} y_{jq} \ - \ \sum_{i=1}^{s} u_{iq} x_{iq} \quad \leq\ 0;\ q = 1,2, \ldots n$$

$$v_{jq}, y_{jq}, u_{iq}, x_{iq} \geq 0\ for\ all\ i = 1,2,..s; j = 1,2,..m, q = 1,2, \ldots n$$

3.4.2 General form of BCC Model:

The DEA envelopment program for considering variables return to scale is as follows:

$$Min\ \theta_m$$

Subject to the Constraints

$$Y\lambda \ \geq\ Y_m\ ;\ X\,\lambda \ \leq\ \theta X_m;\ \sum_{n=1}^{N} \lambda_n = \ 1$$
$$\lambda \geq\ 0\ ;\ \theta_m\ free\ variable$$

4. Empirical Results

4.1 Input-Oriented Technical Efficiency (Constant Return to Scale)

Table 4.1 communicates that the DEA efficiency score based input oriented technical efficiency [Constant return to scale] under the CCR Model. The Analysis report strongly communicates Bank of Baroda, Corporation Bank, IDBI and Syndicate bank is relatively efficient based on the input oriented technical efficiency [CRS] for the year 2007 – 2012.

It is observed that there is a varying trend in their mean of technical efficiency of commercial banks of India from 2007 to 2012, the score lies in the interval [0.8694, 1.000]. The average efficiency of all the banks for the entire period is less than 1.

4.2 Input-Oriented Pure Technical Efficiency (Variable Return to Scale)

Table 4.2 communicates that the DEA efficiency score based input oriented technical efficiency [Variable Return to Scale] under the BCC Model. In BCC Model there is an increase in number of banks which shows the consistency in their performance. The Analysis report strongly communicates that six banks attained maximum efficiency score 1 for the year 2007 – 2012. It is observed that there is a varying trend in their mean of technical efficiency of commercial banks of India from 2007 to 2012, the score lies in the interval [90.92, 1.000]. The average efficiency of all the banks for the entire period is less than 1.

Table-4.1. Input-Oriented Technical Efficiency (Constant Return to Scale)

Name Of The Bank	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	Mean efficiency of the individual banks
Allahabad bank	0.913	0.969	0.999	1	1	0.9762
Andhra Bank	.959	1	0.946	0.885	0.853	0.9286
Bank of Baroda	1	1	1	1	1	1
Bank of Maharastra	0.955	.967	0.849	0.874	0.849	0.8988
Canara bank	0.931	1	1	0.936	0.914	0.9562
Central bank of India	1	1	0.872	0.855	0.833	0.912
Corporation bank	1	1	1	1	1	1
Dena Bank	1	1	0.858	0.918	0.910	0.9372
IDBI Bank	1	1	1	1	1	1
Indian Bank	1	1	0.843	0.836	0.668	0.8694
IOB	0.854	1	1	0.849	1	0.9406
Oriental Bank of Commerce	1	1	.976	1	.927	0.9806

PNB	0.905	1	0.844	0.831	0.792	0.8744
SBI	0.884	0.922	0.973	0.802	0.802	0.8766
Syndicate Bank	1	1	1	1	1	1
UCO Bank	0.947	0.925	.736	0.934	0.905	0.8894
Union Bank of India	1	1	0.971	0.875	0.857	0.9406
Vijaya Bank	.967	.878	1	0.902	0.918	0.933
Bank of India	1	.965	1	0.944	0.866	0.955
Mean Efficiency of over all banks	0.964	0.980	0.938	0.918	0.900	

Table-4.2. Input-Oriented Technical Efficiency (Variable Return to Scale)

Name Of The Bank	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	Mean efficiency of the individual banks
Allahabad bank	0.930	1	1	1	1	0.986
Andhra Bank	0.978	1	1	1	0.955	0.9866
Bank of Baroda	1	1	1	1	1	1
Bank of Maharastra	1	1	1	0.957	1	0.9914
Canara bank	1	1	1	0.990	0.916	0.9812
Central bank of India	1	1	0.885	0.868	0.853	0.9212
Corporation bank	1	1	1	1	1	1
Dena Bank	1	1	1	1	1	1
IDBI Bank	1	1	1	1	1	1
Indian Bank	1	1	0.901	0.875	0.821	0.9194
IOB	0.854	1	1	0.869	1	0.9446
Oriental Bank of Commerce	1	1	1	1	0.945	0.989
PNB	0.963	1	0.855	0.860	0.903	0.9162
SBI	1	1	1	1	1	1
Syndicate Bank	1	1	1	1	1	1

UCO Bank	0.948	0.938	0.781	0.950	0.929	0.9092
Union Bank of India	1	1	0.974	0.885	0.873	0.9464
Vijaya Bank	1	1	1	0.976	1	0.9952
Bank of India	1	0.989	1	0.945	0.866	0.96
Mean Efficiency of over all banks	0.983	.996	0.968	0.957	0.951	

4.3 Input-Oriented Scale Efficiency

Table 4.3 shows the mean efficiency each year by decomposing technical efficiency into pure technical efficiency and scale efficiency. Decomposing technical efficiency into pure technical efficiency and scale efficiency allows us to gain insight into the main sources of inefficiencies. The average index of technical efficiency during the study period varies in between 86.94% to 100%, pure technical efficiency varying at 90.92% to 100%, and of scale efficiency varying at 87.66 to 100%.

4.4 Over all mean efficiency

Among all the nineteen banks considered for the study, four banks [21%] are highly consistent with the efficiency score of 1 and stand first. The rank of all the nineteen banks is given in the Table 4.4.

5. Summary and concluding remarks

This research analysis is based on the application of Data Envelopment Analysis to compute the relative efficiency of nationalized banks of India. The outcome of this research study reveals certain constructive managerial insights into evaluation and advancing of banking operations. The estimated result analysis shows that 21% banks are relatively efficient with maximum efficiency score 1 throughout the study period. But still the remaining fifteen less efficient banks can successfully endorse their resource utilization efficiency by improved efficient handling of all the input and output variables.

Table-4.3. Input-Oriented Scale Efficiency (Variable Return to Scale)

Name Of The Bank	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	Mean efficiency of the individual banks
Allahabad bank	0.982	.969	.999	1	1	0.99
Andhra Bank	0.981	1	0.906	0.885	0.893	0.933
Bank of Baroda	1	1	1	1	1	1
Bank of Maharastra	0.955	0.967	0.849	0.913	0.849	0.9066
Canara bank	0.931	1	1	0.945	0.997	0.9746
Central bank of India	1	1	0.985	0.985	0.977	0.9894

Corporation bank	1	1	1	1	1	1
Dena Bank	1	1	.858	0.918	0.910	0.9372
IDBI Bank	1	1	1	1	1	1
Indian Bank	1	1	.936	0.956	0.814	0.9412
IOB	1	1	1	0.977	1	0.9954
Oriental Bank of Commerce	1	1	.976	1	0.980	0.9912
PNB	0.940	1	0.987	0.967	0.877	0.9542
SBI	0.884	.922	0.973	0.802	0.802	0.8766
Syndicate Bank	1	1	1	1	1	1
UCO Bank	0.998	0.986	.943	0.983	0.974	0.9768
Union Bank of India	1	1	0.997	0.989	0.982	0.9936
Vijaya Bank	0.967	0.878	1	0.924	0.918	0.9374
Bank of India	1	0.977	1	0.999	1	0.9952
Mean Efficiency of over all banks	0.981	0.984	0.969	0.960	0.946	

Table-4.4. Over all mean efficiency of all the measures put together

Name of the Banks	Mean efficiency of the individual banks [input-CRS]	Mean efficiency of the individual banks [input VRS]	Mean of mean efficiency	Rank based mean on efficiency
Allahabad bank	0.986	0.9762	0.9811	3
Andhra Bank	0.9866	0.9286	0.9576	7
Bank of Baroda	1	1	1	1
Bank of Maharastra	0.9914	0.8988	0.9451	9
Canara Bank	0.9812	0.9562	0.9687	4
Central Bank of India	0.9212	0.912	0.9166	13

Corporation Bank	1	1	1	1
Dena Bank	1	0.9372	0.9686	5
IDBI Bank	1	1	1	1
Indian Bank	0.9194	0.8694	0.8944	16
IOB	0.9446	0.9406	0.9426	11
Oriental Bank of Commerce	0.989	0.9806	0.9848	2
PNB	0.9162	0.8744	0.8953	15
SBI	1	0.8766	0.9383	12
Sydincate Bank	1	1	1	1
UCO Bank	0.9092	0.8894	0.8993	14
Union Bank of India	0.9464	0.9406	0.9435	10
Vijaya Bank	0.9952	0.933	0.9641	6
Bank of India	0.96	0.955	0.9575	8

Table-4.5. Relationship between the variables under study

Variables	I1	I2	I3	I4	O1	O2	O3
I1	1						
I2	.456**	1	.				
I3	.538**	.454**	1				
I4	.654**	.512**	.569**	1			
O1	.712**	.566**	.662**	.868**	1		
O2	.617**	.508**	.650**	.763**	.877**	1	
O3	.739**	.609**	.725**	.761**	.873**	.793**	1

**. Correlation is significant at the 0.01 level (2-tailed).

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