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Data envelopment analysis:Evaluating the relative efficiency of Public sector Banks in India

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Abstract: *This paper implements a Data Envelopment Analysis (DEA) approach to measure the relative performance of public sector banks in India for the period of 2013. In this study 20 Banks, each with 4 inputs and 3 outputs are considered. Each banks is identified as Decision making Unit (DMU).Bankers, Charnes, Cooper method, which admits VRS has applied here to compute efficiency score for each bank. Efficient banks whose Technical Efficiency (TE) scores is unity and inefficient banks whose Technical Efficiency scores less than unity has identified. The researcher also suggested the target for inefficient banks to attain efficiency.*

Keywords: Data Envelopment Analysis, DMUs, Technical Efficiency, VRS**.**

1. Introduction

In our country the public sector banks effectively competes with foreign and private sector banks. They are well recognized for their customer service and leveraging Technology for effective uses of the resources. They contribute about 13% of business in the banking sector.

Owing to robust economic condition, the margin of the banks has increased tremendously. The Indian banking sector is poised for healthy growth in the forthcoming years. D&B India is confident that India's Top Banks 2013 will provide the right platform to enable the banks to prepare for the upcoming opportunities.

Over the last 10 years, the efficiency of financial institutions especially banks has been changed significantly. The deregulation of financial systems, rapid technological advances and free entry of foreign and new private banks helped in this change process. The intense competition arise to cater same pie of consumers by the public sector banks (PSBs), old private banks, new private banks and foreign banks has evoked interest in study. Many questions such as how effective of these banks are providing services and making profits.

2. Data Envelopment Analysis

2.1 DEA Explained

DEA was first proposed by Charnes et al. (1978), and is a non-parametric method of efficiency analysis for comparing units relative to their best peers (efficient frontier) rather than average performers, and to identify benchmarks for inefficient units. It does not require any assumption on the shape of the DMUs frontier surface and it makes simultaneous use of multiple inputs and multiple outputs. DEA defines the relative efficiency for each DMU (bank branches, hospitals, schools) by comparing the DMU's inputs and outputs to other DMUs data in the same ''cultural or working'' environment. The outcomes of a DEA study includes: i) A piecewise linear empirical envelopment frontier surface of the best practice , consisting of DMUs exhibiting the highest attainable outputs for their given level of inputs; ii) An efficiency metric (score) to represent the maximal performance measure for each DMU measured by its distance to the frontier surface; iii) Efficient projections onto the efficient frontier with identification of an efficient reference set consisting of the "close " efficient DMUs for benchmarking and improving each inefficient unit; iv) a ranking of units from best (highest score) to worst (lowest score).

There are basically two types of DEA models: Charnes et al. (1978) introduced the constant returns to scale (CRS) and Banker et al. (1984) introduced the variable returns-to-scale (VRS) model. DEA models are also classified as input-oriented, output-oriented or additive (both inputs and outputs are optimized in the best interest of the evaluated unit) based on the direction of the projection of the inefficient unit onto the frontier surface. In the present study, DEA input-oriented models are chosen because the cost minimization (or reduction) is considered for a given bank's operation. Based on Zhu (2004), the following mathematical formulation of an input-oriented DEA model where the inputs are minimized and the outputs are kept at their current level is presented

Model 2 – BCC or VRS Input Oriented

$$\begin{aligned} &Min\theta \\ &s.t \quad Y\lambda \geq Y_0 \\ &\quad X\lambda \leq \theta X_0 \\ &\quad \lambda \geq 0 \\ &\quad \sum_{n=1}^{N} \lambda_n = 1 \\ &\quad \lambda \geq 0 \end{aligned}$$

where θ = Efficiency Measure, X= [X1, X2,….. Xn] = Vector of Inputs, Y= [Y1, Y2,….. Yn] = Vector of Outputs, λ = [λ1, λ1,…….λ1] = Vector of Outputs,Y0= output of the observed DMU, X0= input of the observed DMU, When the above model is solved through LP Package, it gives 'θ' values i.e. efficiency scores and DMU weight λI 's. Keep on changing the observed DMU, we get efficiency scores and Peer weight for each DMU.

A DMU is said to efficient if

$\theta = 1$
$\lambda I = 1$ and $\lambda j = 0$, $j \neq i$
All input and output slack will be zero

2.2 Applications in Banking Sector

DEA applications on the European and Mediterranean banking industry include but not limited to Mostafa (2007), Al-Muharrami (2007) and Ramanathan (2007) on Gulf Cooperation Council banks; Halkos and Salamouris (2004), and Athanassopoulos and Giokas (2000) on Greek commercial banks, Tortosa_Ausina et al. (2008) on Spanish saving banks, Mercan et al. (2003) on Turkish banks, Havrylchyk (2006) on Polish banks, and Camanho and Dyson (2006) on Portuguese banks. For comprehensive bibliographies on DEA, we refer to Gattoufi et al (2004) and for more details on theory and application we refer to Cooper et al. (2006) and Zhu (2004).

2.3DEA implementation in Public Sector Banks

The Data used in this Paper are secondary collected from the "Reserve Bank of India (RBI), Department of Statistical Analysis and Computer Service" covering the period 2012-2013.We has considered all 20 public sector banks which contributes much to our INDIAN economy. Hence the DEA is applied for the following DMUs.

Here each bank is considered as DMU and the same are listed below, Allahabad Bank, Andhra Bank, Bank Of Baroda, Bank Of India, Bank Of Maharashtra, Canara Bank, Central Bank Of India, Corporation Bank, Dena Bank, Indian Bank, Indian Overseas Bank, Oriental Bank Of Commerce, Punjab & Sind Bank, Punjab National Bank, Syndicate Bank, UCO Bank, Union Bank Of India, United Bank Of India and Vijaya Bank.

The possible inputs and outputs in DEA represent the activities and role of a bank

For each DMU four inputs and outputs with unit measurement viz.,

Table 1: Inputs and Outputs Discription

Inputs	*Measurements*	*Outputs*	*Measurements*
No of branches No of employees Capital Expenditure	Actual No's Actual No's in Millions in Millions	Deposits Loan/Advances Interest	in Millions in Millions in Millions

When applying DEA, it is assumed that the inputs fully represent all the used resources and the outputs describe all the produced activities by the DMUs.

3. Analysis and Results

TABLE 2: Descriptive Statistics Input

	INPUT 1	*INPUT 2*	*INPUT 3*	*INPUT 4*
Mean	2704.4	25384.7	141641.6	32359.05
Std. Deviation	1343.886	14141.384	85777.127	18335.408
Minimum	1073	8533	46041	11193
Maximum	5975	63292	326769	81651

TABLE 3: Descriptive Statistics Output

	OUTPUT1	*OUTPOT2*	*OUTPUT3*
Mean	2063626.2	1457360.5	195554.4
Std. Deviation	1135458	754455.41	99179.271
Minimum	706415	514308	73401
Maximum	4738833	3281858	418933

TABLE 4: Descriptive Statistics Output

DMU'S	*PEERS*
Allahabad Bank	Canara Bank, Union Bank Of India, Corporation Bank
Andhra Bank	Corporation Bank, Union Bank Of India, Punjab National Bank, IDBI Ltd.
Bank Of Baroda	Bank Of Baroda
Bank Of India	Bank Of India
Bank Of Maharashtra	Corporation Bank, IDBI Ltd, Punjab National Bank,
Canara Bank	Canara Bank
Central Bank Of India	United Bank Of India, Canara Bank, Union Bank Of India
Corporation Bank	Corporation Bank
Dena Bank	Dena Bank
Indian Bank	Indian Bank
Indian Overseas Bank	Corporation Bank, Indian Bank, Punjab National Bank
Oriental Bank Of Commerce	Canara Bank, Corporation Bank, United Bank Of India, Union Bank Of India
Punjab & Sind Bank	Corporation Bank, Indian Bank, Canara Bank
Punjab National Bank	Punjab National Bank
Syndicate Bank	Syndicate Bank
UCO Bank	UCO Bank
Union Bank Of India	Union Bank Of India
United Bank Of India	United Bank Of India
Vijaya Bank	Union Bank Of India, IDBI Ltd.
IDBI Ltd.	IDBI Ltd.

3.1 Technical Efficiencies Analysis

Table 1: SBcc-I) and Peer Count Sum

DMU'S	*PEER WEIGHTS*	*PEER COUNT*
Allahabad Bank	0.076, 0.484, 0.441	0
Andhra Bank	0.371, 0.247, 0.218, 0.165	0
Bank Of Baroda	1	0
Bank Of India	1	0
Bank Of Maharashtra	0.121, 0.866, 0.013	0
Canara Bank	1	4
Central Bank Of India	0.406, 0.099, 0.495	0
Corporation Bank	1	6
Dena Bank	1	0
Indian Bank	1	2
Indian Overseas Bank	0.774, 0.021, 0.206	0
Oriental Bank Of Commerce	0.106, 0.026, 0.254, 0.614	0
Punjab & Sind Bank	0.828, 0.094, 0.078	0
Punjab National Bank	1	3
Syndicate Bank	1	0
UCO Bank	1	0
Union Bank Of India	1	5
United Bank Of India	1	2
Vijaya Bank	0.048, 0.952	0
IDBI Ltd.	1	3

3.2 Bank Rankings

Table : Ranking of DMU's

DMU'S	*RANKING*
Canara Bank	3
Corporation Bank	1
Indian Bank	5
Punjab National Bank	4
Union Bank Of India	2
United Bank Of India	5
IDBI Ltd.	4

Conclusion

Summary and Conclusions

In the application of BCC model, 7 banks are Efficient whose teta value equal to 1 ($\theta = 1$).

It is identified that the remaining 13 banks of the set of 20 banks are Inefficient relatively

The reference DMU i.e. the set of peers for the Inefficient banks is constructed

The Peer weight of the reference DMU will fix the input and output target for the Inefficient bank

For example: The efficient banks Viz.,

The Canara Bank, Union bank and Corporation Bank is the Peers to the Inefficient Bank Allahabad Bank.

The Corporation Bank stood first rank, Union Bank of India and Canara Bank gets second and third ranks respectively, Punjab National Bank and IDBI Ltd both receives fourth rank. Indian Bank and United Bank of India secured Fifth rank.

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