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RESEARCH ARTICLE

PERFORMANCE EVALUATION OF PUBILC SECTOR BANKS IN INDIA-DATA ENVELOPMENT ANALYSIS

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ABSTRACT

Banking sector of India is flourishing and contributing to its economy. In this aspect measuring relative efficiency among the banks is essential. Data Envelopment Analysis technique is used for this purpose. The data are collected from performance highlights of twenty six different banks in India published by Indian banks association. Data Envelopment Analysis is mainly of two types – constant returns to scale and variable returns to scale with Input and Output oriented. Since this study attempts to maximize output, so the output oriented Data Envelopment Analysis is considered here. The most efficient bank is one that obtains the highest efficiency score.

INTRODUCTION

Financial institutions around the world experienced substantial changes in the last few years, viz., Technological progress, reduced information costs, fiercer competition among both bank andnon-bank financial intermediaries and ongoing deregulation, all led to substantial changes in numerous financial systems. Bank efficiency has been an important issue in this transition. There are two types of methods to measure comparative efficiency: parametric and non-parametric methods. The non-parametric approaches use mathematical programming techniques (Coelli, 1996); among those Data Envelopment Analysis (DEA) is widely used. The primary focus of DEA is to measure the production or performance function of DMUs (decision making units).DEA evaluates the inputs consumed and outputs produced by DMUs and identify those units that comprise an efficient frontier and those that lie below this frontier. The standard DEA models have an input and output orientation. An input orientation identifies the efficient consumption of resources while holding outputs constant. An output orientation identifies the efficient level of output given existing resource consumption. The output orientation provides estimates of the amount by which outputs could be proportionally expanded given existing input levels. In addition, DEA models can be either constant or variable returns to scale (Banker *et al*., 1984). DEA model can be used with very small data precisely because it is a non-parametric approach. 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 used to identify banks that are on the output frontier given the various inputs at their disposal. Jackson and Fethi (2000) study on Turkish banks found that the profitable banks are more likely to operate at higher levels of technical efficiency. Seiford and Thrall (1990) found that mathematical programming procedure used by DEA for efficient frontier estimation is comparatively robust. DEA is a linear programming model introduced by Charnes *et al*. (1978) to measure efficiency under the assumption of constant returns to scale and extended by Banker *et al*. (1984) to allow variable returns to scale. A large number of papers have extended and applied the DEA methodology (Coelli, 1996). Bhattacharyya *et al.* (1997) examined the productive efficiency of 70 Indian commercial banks during early stages (1986-1991) prior to liberalization. They used DEA to calculate radial technical efficiency scores. Sathye (2003) measured the productive efficiency of banks in India using DEA. The study shows that the mean efficiency score of Indian banks compares well with the world mean efficiency score. Sufian (2007) has employed the DEA method to investigate the Russian Journal of Agricultural and Socio-Economic Sciences, No. 5 (5) / 201218effects of mergers and acquisitions on the efficiency of Malaysian banks. DEA has become increasingly popular in measuring efficiency indifferent national banking institutes. Dwivedi and Charyulu (2011) seek to determine the impact of various market and regulatory initiatives on efficiency improvements of Indian banks.

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DATA AND METHODOLOGY

The data for this study are collected from 26 banks through the performance highlights of public sector banks 2010-2011. Some of these reports published by Indian banks association, Mumbai. This study mainly emphasis on twelve variables. Number of branches, Number of staff, Paid up capital, Reserves & surplus, Deposits, Investments, Fixed assets and Advances are considered as input and Interest earned, Income, Expenditure and Net profit are considered as output variable that is to be maximized. A linear programming problem is applied to create a virtually efficient DMU that sits on the efficiency frontier, in which each DMU has a hundred (100) percent efficiency relative to every other DMU. Here the banks are considered as DMUs.

Efficiency in DEA defined as the ratio of the weighted sum of outputs to its weighted sum of inputs. Given n outputs and m inputs, efficiency (b_0) for bank 0 is defined as follows

$$\text{maximise } = b_0 = \frac{\sum_{r=1}^{p} u_r \times y_{r0}}{\sum_{i=1}^{m} v_i \times x_{i0}}$$

Subject to

$$\frac{\sum_{r=1}^{p} u_r \times y_{rj}}{\sum_{i=1}^{m} v_i \times x_{ij}} \le 1 \qquad j = 1,....,n$$

where

y_{r0} = quantity of output r for bank 0

u_r = weight attached to output $r, u_r > 0, r = 1,...., p$

x_{i0} = quantity of input i for bank 0

v_i = weight attached to input $i, v_i > 0,\ i = 1,...., m$

The weights are specific to each unit so that $0 \le b_0 \le 1$ and a value of unity implies complete technical efficiency relative to the sample of unity under scrutiny. Since the weights are not known a priori, they are calculated from the efficiency frontier by comparing a particular bank with other ones producing similar outputs and using similar inputs, known as the bank's peers DEA computes all possible sets of weights which satisfy all constraints and chooses those which give the most favorable view of the bank, that is the highest efficiency score. This can be stated as a mathematical linear programming problem by constraining either the numerator or the denominator of the efficiency ratio to be equal to one .The problem then becomes one of either maximizing weighted output with weighted input equal to one or minimizing weighted input with weighted output equal to one. The input minimizing programme (using duality in linear programming) which is used in this study is as follows, for bank 0 in a sample of n banks;

$$\text{minmize } b_0 = \theta$$

Subject to

$$\sum_{j=1}^{n} x_{ij} \times \lambda_j \le x_{i0}\,\theta \qquad j = 1,....,n$$

$$\sum_{j=1}^{n} \lambda_j \times y_{rj} \ge y_{r0} \qquad j = 1,....,n$$

Where

$\lambda_j \ge 0,\ j = 1,....,n$,

λ_j are weights on units sought to form a composite unit to outperform j_0 When the model is solved for each bank in the set, it gives an efficiency score θ and DMU weights λ_j .The factor θ needed to reduce the input of bank 0 to a frontier formed by its peers , or convex combinations of them, which produce no less output than bank 0. The bank will be efficient if θ equal to one. If θ is less than one, the bank will be inefficient. Then the composite unit provides targets for the inefficient unit and θ represents the maximum inputs that a bank should be using to attain at least its current output. This paper uses the Output -orientation in the DEA models described above, as output quantity is the primary decision variable over which bank managers have most control. Input quantity is also examined as the source of variation in efficiency across bank.

DEA can be carried out with either the constant or variable returns to scale assumption (CRS or VRS). The model is consistent with the CRS production frontier described above is given a further constraint in order to calculate the VRS frontier.

$$\sum_{j=1}^{n} \lambda_j = 1$$

The VRS approach produces technical efficiency scores which are greater than or equal to those obtained using CRS and is therefore probably the more flexible assumption of the underlying production technology.

Output- Oriented CCR Model (CCR)

$$\begin{aligned} &Max\,\phi \\ &s.t \quad Y\lambda \ge \phi Y_0 \\ &\qquad X\lambda \le X_0 \\ &\qquad \lambda \ge 0, \end{aligned}$$

Output- Oriented BCC Model (BCC-I)

$$\begin{aligned} &Max\,\phi \\ &s.t \quad Y\lambda \ge \phi Y_0 \\ &\qquad X\lambda \le X_0 \\ &\qquad \sum_{n=1}^{N} \lambda_n = 1 \\ &\qquad \lambda \ge 0, \end{aligned}$$

where $1 \le \phi \le \infty$, and $\phi - 1$ is the proportional increase in outputs that could be achieved by the j-th DMU, with input quantities held constant.

RESULTS AND INTERPRETATIONS

The following table shows the descriptive statistics of the sample n=26 banks.

Table 1. Descriptive Statistics

Variables	Mean	Standard deviation	Minimum	Maximum	N
Number of Branches	2460.62	2561.02	707.00	13698.00	26
Number of staff	38310.85	87195.05	8107.00	461480.00	26
Paid uo capital	654.98	604.85	20.75	2450.52	26
Reserves&surplus	10430.60	12397.82	2800.81	64351.04	26
Deposits	168191.70	177177.90	43225.47	933932.80	26
Investment	51097.45	55178.49	12927.14	295600.60	26
Fixed Assests	1390.60	1181.44	209.48	4764.19	26
Advances	127137.97	142994.42	34029.81	756719.45	26
Interest Earned	14089.16	15184.63	4079.08	81394.36	26
Income	15930.13	18123.06	4534.25	97218.96	26
Expendtiture	14203.18	16487.82	4033.63	88954.44	26
Net Profit	1726.95	1760.80	330.39	8264.52	26

Conclusion

- Under CRS model it is identified that 17 banks are efficient and 9 banks are inefficient as a set of 26 banks considered in this study. Further it is observed that few efficient banks are acting as peer to many inefficient banks. Peer group known as reference set gives input and output targets to the inefficient DMUs for improving their efficiency. Ranking producer has been carried out based on peer counts So State bank Patiala stood rank 1, IDBI bank stood rank 2 and State bank of Hyderabad gets rank 3 and so on.
- Further on an application of VRS DEA model it is observed that 22 banks are functioning efficiently and 4 banks are

Table 2. Efficiency score of CRS and VRS

DMU	CRS TE	CRS Peers	VRS TE	VRS Peers
Allahabad Bank	*1.050*	λ_{10} =0.22,λ_{12}=0.05,λ_{22}=0.39,λ_{24} =0.84 ,λ_{26} =0.02	*1.013*	λ_{7} =0.05,λ_{10}=0.14,λ_{12}=0.02,λ_{14} =0.01, λ_{20} =0.01 , λ_{22} =0.62, λ_{26} =0.14
Andhra Bank	1.000	λ_{2} =1.000	1.000	λ_{2} =1.000
Bank of Baroda	1.000	λ_{3} =1.000	1.000	λ_{3} =1.000
Bank of India	*1.152*	λ_{21} =1.53 , λ_{22} =1.19,λ_{26} =0.45	1.000	λ_{4} =1.000
Bank of Maharashtra	1.000	λ_{5} =1.000	1.000	λ_{5} =1.000
Canara Bank	1.000	λ_{6} =1.000	1.000	λ_{6} =1.000
Central Bank of India	1.000	λ_{7} =1.000	1.000	λ_{7} =1.000
Corporation Bank	1.000	λ_{8} =1.000	1.000	λ_{8} =1.000
Dena Bank	*1.083*	λ_{16} =0.08,λ_{22}=0.35,λ_{24} =0.27,λ_{26} =0.00	1.000	λ_{9} =1.000
Indian Bank	1.000	λ_{10} =1.000	1.000	λ_{10} =1.000
Indian Overseas Bank	*1.152*	λ_{23} =0.20,λ_{24} =1.77,λ_{26} =0.09	*1.087*	λ_{2} =0.025,λ_{7}=0.16,λ_{15}=0.02,λ_{20} =0.02, λ_{22} =0.50 , λ_{24} =0.05
Oriental Bank of Commerce	1.000	λ_{12} =1.000	1.000	λ_{12} =1.000
Punjab &Sind Bank	*1.061*	λ_{12} =0.00,λ_{22}=0.13,λ_{24} =0.42,λ_{26} =0.08	1.000	λ_{13} =1.000
Punjab National Bank	1.000	λ_{14} =1.000	1.000	λ_{14} =1.000
Syndicate Bank	*1.019*	λ_{7} =0.10 , λ_{16} =0.08,λ_{21} =1.46,λ_{24} =0.34	1.000	λ_{15} =1.000
UCO Bank	1.000	λ_{16} =1.000	1.000	λ_{16} =1.000
Union Bank of India	*1.097*	λ_{2} =0.37,λ_{3}=0.01,λ_{22} =0.81,λ_{24} =0.84 ,λ_{26} =0.16	*1.027*	λ_{7} =0.04, λ_{14} =0.30, λ_{15}=0.18,λ_{24} =0.22, λ_{26} =0.26
United Bank of India	*1.056*	λ_{5} =0.12 , λ_{7} =0.00,λ_{24} =0.92	*1.055*	λ_{5} =0.00 , λ_{7} =0.03 , λ_{24} =0.97
Vijaya Bank	*1.010*	λ_{16} =0.20 , λ_{24} =0.53,λ_{26} =0.01	1.000	λ_{19} =1.000
State Bank of india (SBI)	1.000	λ_{20} =1.000	1.000	λ_{20} =1.000
State Bank of Bikaner & Jaipur	1.000	λ_{21} =1.000	1.000	λ_{21} =1.000
State Bank of Hyderbad	1.000	λ_{22} =1.000	1.000	λ_{22} =1.000
State Bank of Mysore	1.000	λ_{23} =1.000	1.000	λ_{23} =1.000
State Bank of Patiala	1.000	λ_{24} =1.000	1.000	λ_{24} =1.000
State Bank of Travancore	1.000	λ_{25} =1.000	1.000	λ_{25} =1.000
IDBI Bank Ltd.	1.000	λ_{26} =1.000	1.000	λ_{26} =1.000

inefficient. Each inefficient bank could improve its efficiency by comparing its inputs and outputs to their reference set. Ranking among efficient DMUs were assigned similar to CRS model. So Central Bank of India gets rank 1, and tie occurs between IDBI Bank Ltd and State Bank of Hyderabad as assigned as rank 2

- On comparing both CRS and VRS model, it is identified that the number of efficient Banks are more in VRS than CRS.This is because of the relaxed assumption of VRS.

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