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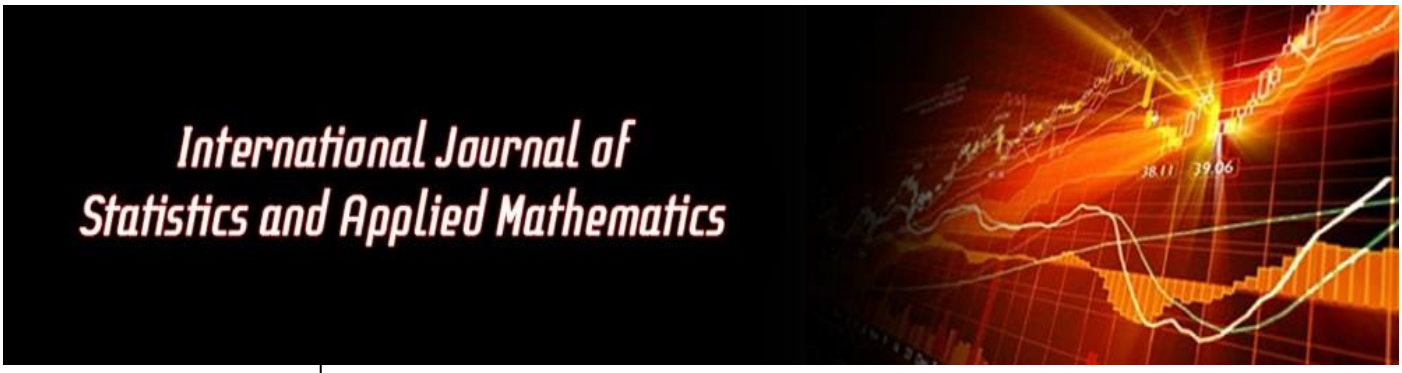

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J Rajesh
Assistant Professor, Department of Statistics, DRBCCC Hindu College, Chennai, Tamil Nadu, India

V Prakash
Associate Professor, Department of Statistics, Presidency College, Chennai, Tamil Nadu, India

Correspondence
J Rajesh
Assistant Professor, Department of Statistics, DRBCCC Hindu College, Chennai, Tamil Nadu, India

Performance evaluation of district central co-operative banks in India: A data envelopment analysis

J Rajesh and V Prakash

Abstract
Cooperative banks play an important role in the Indian banking system. In this paper, Data Envelopment Analysis (DEA) model is applied to evaluate the efficiency of District Central Cooperative Banks (DCCB) in India. DEA is a mathematical modeling technique used to evaluate the relative efficiency of Decision making units (DMUs). We considered each DCCB as a Decision making unit. Nineteen DCCB functioning in India are taken into an account for the analysis. Banker Charnes Cooper (BCC) Output - oriented model allowing variable returns to scale (VRS) is applied. It is found that Karnataka DCCB is inefficient compared to its peers. The projection analysis is carried out for this DMU and it reveals that it has to make improvement into output.

Keywords: Data Envelopment analysis, Decision making units, district central cooperative bank, banker, Charnes and Cooper, variable returns to scale

Introduction

A cooperative bank is a financial entity that belongs to its members, who are owners and customers of their own bank. Cooperative banks are often created by persons belonging to the same local or professional community or sharing a common interest. Cooperative banks generally provide their members with a wide range of banking and financial services (loans, deposits, banking accounts etc.). Cooperative banks differ from stockholder banks by their organization, goals, values and governance. In most countries, they are supervised and controlled by banking authorities and have to respect prudential banking regulations, which put them at a level playing field with stockholder banks. Depending on countries, this control and supervision can be implemented directly by state entities or delegated to a cooperative federation or central body. Cooperative banking is retail and commercial banking organized on a cooperative basis.

The central cooperative banks are located at the district headquarters or some prominent town of the district. For the cooperative banks in India, cooperatives are organized groups of people and jointly managed and democratically controlled enterprises. They exist to serve their members and depositors and produce better benefits and services for them. Cooperative banks have completed 100 years of existence in India. They play a very important role in the financial system. The cooperative banks in India form an integral part of our money market today.

The cooperative banking structure is a three tier federal one and it include

- A State Cooperative Bank works at the apex level
- The Central Cooperative Bank works at the Intermediate Level.
- Primary Cooperative credit societies at base level

DCCB's are the federations of primary credit societies in a district and are of two types those having a membership of primary societies only and those having a membership of societies as well as individuals. The funds of the bank consist of share capital, deposits, loans and overdrafts from state cooperative banks and joint stocks. These banks provide finance to member societies within the limits of the borrowing capacity of societies. They also conduct all the business of a joint stock bank.

All over the world, number of studies has applied DEA to the question of efficiency in commercial banking but very little empirical research can be observed in India. The authors are the opinion that only a limited number of studies has been carried out with using modeling approach. This has been motivated the authors to study the efficient DCCB.

Review of Literature

Farrel (1957) [1] is considered to be the most influential paper on DEA. The further pioneering contributions were made by CCR (1978, 1979) [2, 3] and CCR (1981) [4]. Banker, Charnes and Cooper (1984) [5] and Charnes *et al* (1985) [6]. Banker and Morey (1986) have evaluated the relative technical and scale efficiencies of DMUs by means of mathematical programming formulations when some of the inputs and outputs are exogenously fixed and beyond the discretionary control of DMU personnel.

Bhattacharya *et al*. (1997) [8] Saha and Ravishankar (2000) [9], Tone Kaoru (2001) [10] proposed a slacks-based measure of efficiency in DEA and stated that this measure has a close connection to BCC measure of efficiency. Leleu (2006) [11] studied DEA in the context of continuous optimization using BCC models. Appa *et al* (2006) [12] considered a new framework for the solution of DEA models based on Banker *et al* (2004) [13]. Banker and Chang (2006) [14] studied the super efficiency procedure for outlier identification in DEA models

Asmild *et al* (2007) [15] developed procedures for measuring overall efficiency and effectiveness using DEA. Sahoo, B.K., Sengupta, J.K., and Mandal, A. (2007) [16], Sunilkumar and Rachita Gulati. (2008) [17] Dwivedi A.K. & Charyulu D.K., (2011) [18], are among those few researchers who have examined performance of the Indian commercial banks. They have mainly considered the reform impact and different ownership groups e.g. Public, private and foreign

DEA Approach

DEA is a mathematical modeling technique for the analysis of the relative efficiency of DUMs with multiple inputs and multiple outputs. It is based on Linear Programming problem and It determines the efficient frontier by evaluating all DMUs and measuring their performance in respected to best practice DMUs. Basic DEA models are developed by CCR (1978) [2] and BCC (1984) [5]. CCR based on Constant Returns to scale and BCC admits Variable Returns to Scale.

CCR DEA Model

Efficiency in DEA is defined as the ratio of the weighted sum of outputs to its weighted sum of inputs. Let there be N DMUs and each unit has r outputs and k inputs. Efficiency of observed DMU (z_0) is defined as follow

$$\max \quad z_0 \qquad \frac{\sum_{j=1}^{r} v_j \; y_{j0}}{\sum_{i=1}^{k} u_i \; x_{i0}}$$

Subject to

$$\frac{\sum_{j=1}^{r} v_j \; y_{j0}}{\sum_{i=1}^{k} u_i \; x_{i0}} \quad \leq 1$$

Where

$j=1,\ldots,r$, $i=1,\ldots,k$, y_{j0} = j th output of observed DMU,

v_j = weight of that output

x_{i0} = i th input of observed DMU, u_i = weight of that input

The above fractional programming problem can be converted in to a linear program by normalizing either the numerator or denominator. Here we normalize the denominator i.e the weighted sum of nputs equal to unity. Therefore, the above fractional programming problem reduced to

$$\max \; z_0 = \sum_{j=1}^{r} v_j \; y_{j0}$$

Subject to

$$\sum_{i=1}^{k} u_i \; x_{i0} = 1$$

$$\sum_{j=1}^{r} v_j \; y_{j0} - \sum_{i=1}^{k} u_i \; x_{i0} \; \leq 0$$

$$v_j \, . u_i \geq 0$$

The above model should be solved for N times one for each DMU. When it is solved, it gives relative efficiency scores $z_0 \, (0 \leq z_0 \leq 1)$, input and output weights. In general, a DMU is considered to be efficient if it obtains a score of 1 and inefficient if it sets scores less than 1.

According to the theory of duality in Linear programming problem (LPP) every primal has it own dual so the dual LPP corresponding to above primal is

$$\min \quad \theta$$

Subject to

$$\sum_{s=1}^{N} x_{is} \; \lambda_s \; \leq \; \theta \, x_{i0} \quad , \qquad i = 1,\ldots,k$$

$$\sum_{s=1}^{N} y_{js} \; \lambda_s \; \geq y_{j0} \quad , \qquad j = 1,\ldots,r$$

$$\lambda_s \; \geq \; 0 \qquad\qquad\qquad s = 1,\ldots,N$$

where θ is the Efficiency score and λ_s is the weight of DMUs

when the above model is solved for each DMU in the set, it gives an efficiency score θ and DMU weights λ_s .The factor θ needed to reduce the input of observed DMU to a frontier formed by its peers, or convex combinations of them, which produce no less output than observed DMU. The DMU will be efficient if θ equal to one and all slacks equal to zero. If θ is less than one then DMU will be inefficient. Then the composite unit provides targets for the inefficient unit and θ represents the maximum inputs that a DMU should be using to attain at least its current output.

The above model is Charnes, Cooper and Rhodes (CCR) which allows constant returns to scale. The other model known as BCC and it allows variable returns to scale. Banker

Charnes and Cooper modified CCR model by introducing the constraint $\sum_{s=1}^{N}\lambda_s = 1$ is called convexity constraint.

Output oriented BCC model used in the study for the analysis of efficiency is given below.

Output- Oriented BCC Model (BCC)

$$\begin{aligned} &Max\,\phi \\ &s.t \quad Y\lambda \geq \phi Y_0 \\ &\quad X\lambda \leq X_0 \\ &\quad \sum_{s=1}^{N}\lambda_s = 1 \\ &\quad \lambda \geq 0, \end{aligned}$$

where ϕ = Efficiency Measure, X= [X_1, X_2,…,X_N] = Vector of Inputs
Y= [Y_1, Y_2,…,Y_N] = Vector of Outputs, λ = [λ_1, λ_2,…,λ_N] = Vector of Weights
Y_0= output of the observed DMU, X_0= input of the observed DMU N= Number of DMU's

Solving the above model it gives ϕ which is the optimal efficiency score satisfies $\phi \geq 1$, with $\phi = 1$ indicating efficient unit and $\phi > 1$ indicating extent of radial inefficient related to best practice DMU in the sample and simultaneously extent to which all outputs increased proportional with given input level to project inefficient DMU onto frontier.

Emprirical Analysis

The data for this study are taken from " Basic Data on performance District Central Cooperative banks 2011-2012" published by National Federation of State Cooperative Banks Ltd, Mumbai. This study covers 19 state district cooperative banks and mainly emphasis on totally nine variables include C/D ratio which we generate on a special interest.

Collection demand ratio (C/D ratio) defined as = (Collection / Demand) * 100

DCCB's follows intermediation approaches, banks primarily intermediating funds between savers and investors under this approach. Nine variables including six inputs and three outputs are considered in this study.

Inputs: Number of Offices, Number of Employees, Paid up Capital, Total Deposits, Cost of Management and Working Capital.

Outputs: Investments, Total Loans & Advances and Collection demand ratio (C/D ratio)

Computations

The following table shows the descriptive statistics of the sample n=19 banks.

Table: 1 Descriptive Statistics

Variables	Mean	Standard deviation	Minimum	Maximum	N
Number of Offices	710.26	811.00	120	3737	19
Number of Employees	4526.11	5460.94	596	25299	19
Paid up Capital	43099.58	49441.32	493	187338	19
Total Deposits	930644.11	1079581.46	54835	4867429	19
Cost of Management	30867.79	30814.16	1932	136406	19
Working Capital	1354243.32	1443258.51	61757	6508574	19
Investments	474793.74	497418.13	44373	2281322	19
Total Loans & Advances	855549.05	82933.98	1920	3169819	19
C/D Ratio	743445	174331	20.66	93.56	19

The above table shows that District Central Co-operative banks between 120 and 3737 operate through the country. An average of 710.26 banks operating to get the maximum deposit Rs 4867429 in selected 19 states.

Efficiency score of Variable returns to scale

Table 2: Efficiency score of VRS

DMU	VRS TE	Peers Weights
Andhra Pradesh	1.000	λ_1 =1.000
Bihar	1.000	λ_2 =1.000
Chhattisgarh	1.000	λ_3 =1.000
Gujarat	1.000	λ_4 =1.000
Haryana	1.000	λ_5 =1.000
Himachal Pradesh	1.000	λ_6 =1.000
Jammu And Kashmir	1.000	λ_7 =1.000
Jharkhand	1.000	λ_8 =1.000
Karnataka	*1.007*	λ_4=0.044,λ_{14}=0.180, λ_{16}=0.291,λ_{18} =0.485
Kerala	1.000	λ_{10} =1.000
Madhya Pradesh	1.000	λ_{11} =1.000
Maharashtra	1.000	λ_{12} =1.000
Orissa	1.000	λ_{13}=1.000
Punjab	1.000	λ_{14} =1.000
Rajasthan	1.000	λ_{15} =1.000
Tamil Nadu	1.000	λ_{16} =1.000
Uttar Pradesh	1.000	λ_{17} =1.000
Uttarakhand	1.000	λ_{18}=1.000
West Bengal	1.000	λ_{19}=1.000

Projection analysis

Table 3: Projection analysis

Variable	Original value	Radial movement	Slack movement	Target value
Investments	320666.000	2343.631	25149.906	348159.537
Total Loans & Advances	992941.000	7257.043	0.000	1000198.043
C/D Ratio	91.610	0.670	0.000	92.280
Number of Offices	596.000	0.000	-80.724	515.276
Number of Employees	4224.000	0.000	-1450.192	2773.808
Paid up Capital	44146.000	0.000	0.000	44146.000
Total Deposits	827970.000	0.000	0.000	827970.000
Cost of Management	36195.000	0.000	-6122.884	30072.116
Working Capital	1359678.000	0.000	-88559.572	1271118.428

Table 3 shows that projection analysis for inefficient DMU Karnataka. In this state operating 596 district central cooperative banks, reduce 81 banks through slack movements to attain optimum level.

Summary and Conclusion

In this study mainly focuses on performance evaluation of district central cooperative banks in India. It is observed that 18 banks are efficient and 1 bank is inefficient. The inefficient bank viz., Karnataka has to increase 0.7% of their outputs with the same amount of inputs that is currently employed. The state Karnataka could improve its efficiency by comparing all its inputs and outputs to its reference set formed by its peers. The convex combination of the peers gives the output and input target to the inefficient DMUs. The inefficient DMU Karnataka could maximize its first outputs through radial and slack movement. Futher second and third output could attain its maximum level through radial movement only.

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