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MEASURING THE EFFICIENCY OF REGIONAL RURAL BANKS IN INDIA

Shibu Das* **Dr. Ayekpam Ibemcha Chanu****
**Research Scholar, Department of Commerce, Assam University, Diphu Campus.*
***Assistant Professor, Assam University, Diphu Campus.*

Abstract
Efficiency analysis can easily depict an organisation's ability to utilize its resources to generate business transactions. The main objective of the paper is to measure the level of efficiency (in terms of technical, cost and allocative) of twenty two Regional Rural Banks of India. An attempt has also been made to explore the influential determinants that affect the level of efficiency. The paper which is empirical in nature is based on secondary data and the efficiency is measured for the year 2014-2015 and 2015-2016 by using Data Envelopment Analysis under Constant Return to Scale; further Tobit regression approach has been applied to find out the factors responsible for inefficiency. The findings reveal that there is variance in the efficiency score among the RRBs; and out of different variables, size of the bank, exposures to off balance and sponsorship have no significant bearing on level of efficiency of RRBs during the study period. It is suggested that inefficient banks should try to modify their financial policies, managerial policies and cost policies to increase level of efficiency.

Keywords: Regional Rural Bank, Data Envelopment Analysis, Tobit Regression, Technical Efficiency, Cost Efficiency, Allocative Efficiency.

Introduction

Efficiency is generally conceived as one of the most important criterion to measure the performance of a bank. The efficiency analysis can easily depict an organisation's ability to utilize its resources to generate business transactions. Therefore, efficiency of a bank relates to how well a bank employs its resources (inputs) relative to current best practice that a bank simultaneously minimises cost (input oriented measured) and maximises revenue (output oriented measured) based on an existing level of production technology (Farrell, 1957). However, in most of the cases, efficiency of banks is measured by their ratio and larger value of this ratio suggests better performance (Paul, 2010).

In India, Regional Rural Banks (RRBs) were established under the Regional Rural Banks Act of 1976 as an alternative to commercial banks and cooperative banks to cater the needs of rural credit. However, Indian banking sector has already exposed to the open market and many private and foreign players have already entered in this sector. It is a big challenge of RRBs in India (Chanu & Das, 2016). Thus, it is the right time to evaluate and measure the level of efficiency of RRBs in relation to cost efficiency, technical efficiency and allocative efficiency. The results of efficiency analyses would clearly reveal how well the RRBs utilise their inputs properly and which are efficient or inefficient RRBs in India.

Significance of the Study

Efficiency studies not only throw a light on the proper utilization of input, but also give a direction on minimisation of cost and allocation of resources. Such studies can also help the organization to formulate policies to improve their level of outputs by minimisation of cost. The present study which is based on RRBs in India, not only finds out the efficient banks amongst themselves by using Data Envelopment Analysis (DEA) but also analyses the factors responsible for inefficiency of the inefficient banks. Such studies are highly significant today; because, in the competitive market, the efficient organisations can easily face the challenges. Hence forth, the RRBs in India would be able to challenge the competition, if they are efficient.

Review of Literature

This section provides an overview of literature on efficiency studies published during the period from 2000 to 2016. There are a number of studies conducted with regard to efficiency of banks by using both Data Envelopment Analysis (DEA) & Malmquist Productivity Index (MPI) technique like Avkiran, N.K. (2000), Drake, L. (2001), Caceres, J. F. (2002), Zhao, T., Casu, B., & Ferrari, A. (2007), Deb, J. (2011), Singh, H. (2013). There are studies which apply only DEA technique to measure efficiency of banks and microfinance institutions. Some of them are Drake, et, al (2005), Yang, Z. (2009), Dang Thanh Ngo. (2010). Chanu & Das (2014) Takbiri, et, al, (2015) etc. In some studies like Chinubhai, A. (2008), Akmal, M. & Saleem, M.(2008), Chanu & Das (2016) both DEA and Tobit Regression Analysis have been used to measure efficiency of banks.

However, most of the studies are on commercial banks of foreign countries. For example, the studies of Avkiran, N.K. (2000) are on Australian commercial banks for the period of 1986 to 1995, Drake, L. (2001) on UK banks for the period of 1984-1995, Caceres, J. F. (2002) on Chilean Bank for the period of 1989-1999, Drake, et, al (2005) on Hong Kong banks for the

period of 1995-2001, Akmal, M. & Saleem, M.(2008) on Pakistani Banks for the period of ten years (1995-2005), Yang, Z. (2009) on Canadian Bank Branches, Dang Thanh Ngo. (2010) on Vietnamese commercial banks for the year 2008, Takbiri, O, et, al, (2015) on Bank Shahr of Tehran, etc.

On Cost, technical and allocative efficiency, the study of Kumar, S., & Gulati, R. (2010) on Indian Public Sector Banks and on technical inefficiency Gulati, R. (2011a) may also be mentioned.

There are a few studies with regard to Indian commercial banks and Microfinance institutions of North-Eastern Region of India. Study of Das, A, et, al (2005) on Indian Commercial Bank for the period of 1997-2003, Zhao, et, al (2007) on Indian commercial banking for the period of 1992-2004, Gupta, O.K, et, al., (2008) on Indian Banks for the period from 1999-2003, Deb, J. (2011) on commercial bank branches which operates in North Eastern region of India for the period of 2003-2007, Singh, H. (2013) on Commercial Banks of India for the period of 2001-2011, Chanu & Das (2014) on micro finance institutions of north east India, Chanu & Das (2016) on select RRBs in India etc. are some of the studies which are found in the literature and reviewed for the present paper.

Research Gap

Though there are many studies on efficiency studies, the efficiency analysis of RRBs in India is lacking in the existing literature. Chanu & Das (2016) employed DEA in evaluating the performance and factors of (in)efficiency of the Regional Rural Banks in India in their previous study. But that is only for one financial year (2014). Therefore, more detailed study is required to analyse the performance, improvement of efficiency, reducing cost and maximising profits RRBs in India.

Limitations of the Present Study

The present study is based on secondary data which is extracted from the annual reports of select regional rural banks of India. Hence, the reliability of data depends upon the information provided by the banks. All the Regional Rural Banks are not taken into consideration to measure the level of efficiency due to lack of data. There are many models to measure the level of efficiency as well as examine the determinants of inefficiency. The study is limited to two models namely Data Envelopment Analysis and Tobit Regression model.

Objectives of the Study

- To measure technical efficiency, cost efficiency and allocative efficiency of the Regional Rural Banks in India; and
- To find out the influential factors that affects the level of efficiency.

Hypotheses

H_{01}: There is no significant difference in relation to level of technical efficiency, cost efficiency and allocative efficiency amongst the Regional Rural Banks in India; and

H_{02}: All the factors of Regional Rural Bank have same influence in the level of efficiency.

Methodology

The study is empirical and descriptive in nature and based on secondary data. Data have been collected from secondary sources i,e., annual reports of selected RRBs in India; published and unpublished documents maintained by banks; Reserve Bank India's annual reports; journals; books; annual reports of NABARD; websites; published and unpublished dissertations and theses; research articles from various journals. The present study covers two financial years; from April 2014- March 2015 to April 2015- March 2016.

Population & Sample Size: 56 (Total number of Regional Rural Bank in India)[1] and the sample size of the present study is 22 (Twenty Two).

Sample Size Determination Design: Purposive design (though there are 56 RRBs which are operating in India, data of only 22 RRBs are available, hence, they are considered)

Software Used: Data is analyzed by using the DEA Excel Solver, Zhu (2003) and Gretl for Tobit Regression software.

[1]*Retrived from https://www.rbi.org.in/Scripts/AboutUsDisplay.aspx?pg=RegionalRuralBanks.htm [accessed on 23-4-2016]*

Theoretical Framework of the Present Study

Efficiency of financial institutions can be measured by both parametric and non-parametric approaches (Berger & Humphrey, 1997). According to Reddy, A.A (2006) and Kumar, S., & R., Gulati. (2010), the most widely used non-parametric approaches are Data Envelopment Analysis (DEA) and Free Disposal Hull (FDH).

DEA was originally developed by Charnes, Cooper and Rhodes (1978) with the assumption of constant return to scale (CRS). CRS assumes that the Decision Making Unit's (DMU) scale of operations does not influence its efficiency (Avkiran, N.K. 2006). Therefore, input oriented measured and output oriented measured efficiency scores are equal in this system (Fare, R., & Lovell, C. A. 1978). DEA examines the relative efficiency which is based on the data of selected inputs and outputs of a number of entities called DMUs. In the present study, RRBs are DMUs. The technical efficiency score of a DMU lies between 0 and 1; here, score 1 means fully efficient; on the other, the values which do not lie on the efficient frontier (0≤ scores > 1) are deemed relatively inefficient (Ray, C., 2004).

Cost efficiency (CE) is composed of two distinct and separable components: technical efficiency (TE) and allocative efficiency (AE). The Technical efficiency shows the ability of a firm to produce existing level of output with the minimum inputs (input-oriented), or to produce maximal output from a given set of inputs (output-oriented) and the allocative efficiency shows the ability of a firm to use the inputs in optimal proportions, given their respective prices (Farrell,1957). Hence, according to Barros, C. P., & Mascarenhas, M. J. (2005), allocative efficiency relates to prices, while technical efficiency relates to quantities. Thus, cost inefficiency incorporates both allocative inefficiency from failing to react optimally to relative prices of inputs and technical inefficiency from employing too much of the inputs to produce a certain output bundle. It is noteworthy here that technical inefficiency is caused and correctable by management, and allocative inefficiency is caused by regulation and may not be controlled by the management (Hassan, M.K., 2005).

In the present study, DEA is used to estimate empirically the cost, technical and allocative efficiency scores for the period 2014-2015 and 2015-2016. The computational procedure used to implement the DEA approach to the measurement of cost efficiency and its components is of three steps. The first step is to obtain the measure of TE.

Consider, N= RRBs, each of which uses I inputs to produce J outputs. For each RRBs i = 1,.....,N denote input quantities by X_{ni}, n = 1,....., I , and output quantities by Y_{mi} , m = 1,.....,J , with $X_{ni} > 0$ and $Y_{mi} > 0$, i.e., each DMU has at least one strictly positive input and one strictly positive output. Denote by Y a J×N matrix of outputs with RRB i's output in column i. Similarly, X is a I×N matrix of inputs. A measure $TE_i^{CRS}=\theta_i$ of technical efficiency can be calculated as a solution to

$$\text{Min } TE_i^{CRS}=\theta_i$$
$$\Theta_i, \lambda_i$$

Subject to

$$Y\lambda_i \geq Y_i$$

$$X\lambda_i \leq \theta i\, X_i \qquad \ldots.(1)$$

$$\theta_i \text{ free}$$

$$\lambda_i \geq 0$$

By solving linear programming problem (1), we identify a linear combination, described by the *Nx1* vector of λ_i of weights, of all RRBs in the sample which produces at least the output quantities *Yi* of RRB *i* and uses no more than a share $\theta_i \in (0,1)$ of its inputs *xi* . RRBs with a nonzero weight in λ_i are called reference banks for the bank *i*. For $\theta_i = 1$, a bank is called technically efficient; λ_i then has a value of 1 at element *i* as the only non-zero element. The way the problem has been set up ensures that $\theta_i > 0$ and $\theta_i \leq 1$. By minimizing θ_i , we maximize the proportionate reduction of RRB *i*'s inputs.

The second step is to measure cost efficiency by solving the following linear program (see Fare and Grosskopf, 1985; Ferrier *et al*., 1993; for details).

$$\text{Min } W_i' X_i$$
$$X_i\, \lambda_i$$

Subject to

$$Y\lambda_i \geq Y_i$$

$$X\lambda_i \leq X_i \qquad \ldots.(2)$$

$$X_i \text{ free}$$

$$\lambda_i \geq 0$$

where w_i denotes the vector of input prices for RRB *i*. This yields a cost minimizing input vector *xi* and a linear combination $\boldsymbol{\lambda_i}$ of all RRBs which produces at least RRB *i*'s outputs *yi* and uses no more than its ideal input vector X_i^{CRS} under a CRS. From the solution to model (2), we get minimum costs as $W_i^{'}X_i^{CRS}$. Comparing minimum costs to observed costs $W_i^{'}X_i$ of RRB i gives cost efficiency as

$$CE_i^{CRS} = \frac{W_i^{'}X_i^{CRS}}{W_i^{'}X_i}$$

The third step involves the calculation of allocative efficiency component residually as the ratio of the measure of cost efficiency to the Farrell input-oriented measure of technical efficiency. Thus, the measure of allocative efficiency is obtained as:

$$AE_i^{CRS} = \frac{CE_i^{CRS}}{TE_i^{CRS}}$$

Description of Input and Output Variables

The definition and measurement of inputs and outputs in the banking function remain a combative issue among researchers (Ab-rahim, *et,al.*, 2009). There are two main approaches in the selection of inputs and outputs for measuring level of banking efficiency namely the production approach and intermediation approach (Sealey, C.W. Jr., and Lindley, J.T. 1977).

According to Berger, A. N., & Humphrey, D.B. (1997), intermediation approach is best fitted for analyzing bank level efficiency; in the bank level analysis, management will aim to cut down total costs and not just non-interest expenses (Gulati, R., 2011). In the present study, intermediation approach is used to measure the technical efficiency, cost efficiency and allocative efficiency. In table 1, inputs and output variables which have been used in the present study are presented

Table 1: Description of variables used in efficiency measurement for the present study

Name of the Variables	Notations	Description in the balance sheet	Unit of Measurement
Inputs:			
Physical Capital	X1	Fixed assets	Rupees
Labour	X2	Staff	Numbers
Loanable Fund	X3	Deposits + Borrowings	Rupees
Input Prices:			
Price of Physical Capital	W1	(Rent, taxes and lighting + Printing and stationary + Depreciation on bank's property + Repairs and maintenance + Insurance) / Fixed assets	Rupees
Price of Labour	W2	(Payment to and provisions for employees) / staff	Rupees
Price of Loanable Fund	W3	(Interest paid on deposits + Interest paid on borrowings from RBI and other agencies)/ Loanable funds	Rupees
Outputs:			
Net Interest Income	Y1	Interest earned - Interest expended	Rupees
Non-interest Income	Y2	Commission, Exchange & brokerage, Profit on sale of Investments, Recovery in write off accounts, Miscellaneous, Profit on sale of Dead Stock Items.	Rupees

Source: Compiled from literatures

Empirical Results

Table 2 presents technical efficiency (TE), cost efficiency (CE) and allocative efficiency (AL) scores for individual RRBs for the financial years 2014-2015 and 2015-2016.

Table 2: Efficiency Scores of RRBs

S. No	DMU[i]	2014-2015			2015-2016		
		TE	CE	AE	TE	CE	AE
1	DMU1	0.898	0.755	0.841	1	1	1
2	DMU2	0.996	0.929	0.932	0.945	0.936	0.990
3	DMU3	1	1	1	0.812	0.802	0.988
4	DMU4	1	0.984	0.984	0.622	0.575	0.925
5	DMU5	1	1	1	1	1	1
6	DMU6	0.627	0.611	0.974	0.212	0.202	0.952
7	DMU7	0.900	0.801	0.890	0.343	0.307	0.898
8	DMU8	1	1	1	1	0.987	0.987
9	DMU9	1	0.969	0.969	0.563	0.547	0.970
10	DMU10	1	0.859	0.859	0.863	0.661	0.766
11	DMU11	0.769	0.733	0.954	0.615	0.584	0.950
12	DMU12	0.798	0.683	0.856	0.468	0.467	0.999
13	DMU13	0.865	0.853	0.986	0.626	0.583	0.931
14	DMU14	0.742	0.641	0.864	0.762	0.750	0.984
15	DMU15	0.705	0.700	0.992	0.596	0.585	0.982
16	DMU16	1	0.776	0.776	1	1	1
17	DMU17	0.878	0.761	0.867	0.352	0.322	0.915
18	DMU18	0.817	0.781	0.956	0.642	0.609	0.949
19	DMU19	0.840	0.800	0.952	0.653	0.651	0.997
20	DMU20	1	1	1	1	1	1
21	DMU21	0.582	0.509	0.874	0.397	0.248	0.625
22	DMU22	0.819	0.723	0.883	0.883	0.735	0.832

Source: Author's Computation

Year-wise efficiency scores for all the RRBs which are presented in table 2 clearly reveal that there is variation in level of efficiency among the RRBs during the study period. From the table, it is revealed that during 2014-15, out of 22 sample RRBs, only 8 RRB (36.36 percent) are found to be technically efficient with score equal to 1 ; however, during 2015-16, it has been reduced to 5 (22.73 percent). These fully-efficient banks together define the efficient frontier of Indian Regional Rural Banking industry, therefore, form the reference set for inefficient banks. The level of technical inefficiency (TIE)[ii] in the remaining inefficient banks of both the financial years can be calculated as the radial distance from this frontier. Fully efficient RRBs are DMU3, DMU4, DMU5, DMU8, DMU9, DMU10, DMU16 and DMU20 and the least efficient RRB is DMU21 during 2014-15 whereas DMU1, DMU5, DMU8, DMU16 and DMU20 are fully efficient RRBs and DMU6 is the least efficient RRB during 2015-16.

Regarding cost efficiency, it is revealed from table 1 that only 4 RRBs (18.18 percent) are cost efficient with CE score equal to 1 in both 2014-15 and 2015-16. Fully efficient RRBs during 2014-15 are DMU3, DMU5, DMU8 and DMU20 and the least efficient RRB is DMU21 whereas during 2015-16, fully efficient RRBs are DMU1, DMU5, DMU16 and DMU20 and the least efficient RRB is DMU6.

Regarding allocative efficiency, only 4 banks have been found to be efficient with AE score equal to 1 both during 2014-15 and 2015-16 . The level of allocative inefficiency (AIE)[iii] of the remaining 18 inefficient RRBs for both the financial years can be calculated as the radial distance from this frontier. The fully efficient RRBs during 2014-1 are DMU3, DMU5, DMU8 and DMU20 and the least efficient RRB is DMU16; and during 2015-16, fully efficient RRBs are DMU1, DMU5, DMU16 and DMU20 and the least efficient RRB is DMU21.

Table 3: Frequency Distribution of TE, CE and AE scores

Efficiency Scores	2014-2015						2015-2016					
	TE	%	CE	%	AE	%	TE	%	CE	%	AE	%
E< 0.5	0	0.00	0	0	0	0	5	22.73	5	22.73	0	0
0.5 ≤ E < 0.6	1	4.55	1	4.55	0	0	2	9.09	5	22.73	0	0
0.6 ≤ E < 0.7	1	4.55	3	13.64	0	0	5	22.73	3	13.64	1	4.55
0.7 ≤ E < 0.8	4	18.18	7	31.82	1	4.55	1	4.55	2	9.09	1	4.55
0.8 ≤ E < 0.9	6	27.27	4	18.18	8	36.36	3	13.64	1	4.55	2	9.09
0.9 ≤ E < 1	2	9.09	3	13.64	9	40.91	1	4.55	2	9.09	14	63.64
E=1	8	36.36	4	18.18	4	18.18	5	22.73	4	18.18	4	18.18

Source: Authors' Computation

Table 3 shows the frequency distribution of different efficiency score of the RRBs. It is observed that the distribution of technical efficiency scores is skewed towards the higher efficiency scores during 2014-15 whereas during 2015-16, efficiency scores is skewed towards the lower efficiency scores (more than 55 % RRBs score a relative efficiency less than 70 % and around 45 % of the sample RRBs with efficiency score is more than 70%). It is also observed that the distribution of cost efficiency scores is oscillated between 50% and 100% scores (around 31.82 pc which is one of the highest RRBs score lies between 70 pc to 80 pc) and cost efficiency scores indicate highest concentration of RRBs in the range 70-80 during 2014-15.

While, during 2015-16, it is also found that the distribution of cost efficiency scores is skewed between 20% and 70% scores (around 31.82 pc which is one of the highest RRBs score lies between 70 pc to 80 pc) and the distribution of allocative efficiency scores is fluctuated between 70% and 100% scores (maximum RRBs lies between 90 pc to 100 pc).

Table 4: Descriptive Statistics of TE, CE and AE Scores

	2014-2015			2015-2016		
	TE	CE	AE	TE	CE	AE
No. of DMUs	22	22	22	22	22	22
No. of Efficient DMU's	8	4	4	5	4	4
Percentage of the DMU in 1	36.36	18.18	18.18	22.73	18.18	18.18
Mean Efficiency	0.874	0.812	0.928	0.698	0.661	0.938
Mean Inefficiency	0.126	0.188	0.072	0.302	0.339	0.062
Median/Q2	0.888	0.791	0.953	0.647	0.630	0.976
Mode	1.000	1.000	1.000	1.000	1.000	1.000
Q1	0.802	0.726	0.869	0.571	0.554	0.926
Q3	1.000	0.959	0.985	0.930	0.902	0.995
Standard Deviation	0.131	0.143	0.066	0.246	0.256	0.092
Minimum	0.582	0.509	0.776	0.212	0.202	0.625
Maximum	1.000	1.000	1.000	1.000	1.000	1.000

Source: Authors' Computation

Table 4 provides descriptive statistics of technical efficiency, cost efficiency and allocative efficiency scores for RRBS for the study period. It is revealed from the above table that during 2014-15 the standard deviation result (0.131) shows that there is a moderate dispersion in terms of technical efficiency among the RRBs. The average level of technical inefficient in selected RRB is to the tune of about 12.6 percent. It can, therefore, be concluded that the same level of outputs in regional rural banking sector could be produced with 12.6 percent lesser inputs. During 2015-16, the standard deviation result (0.246) shows that there is higher dispersion in terms of technical efficiency among the RRBs as compare to 2014-15. The average level of technical inefficient in selected RRB is to the tune of about 30.2 percent. It can, therefore, be concluded that the same level of outputs in regional rural banking sector could be produced with 30.2 percent lesser inputs.

Regarding the cost efficiency, during both the financial year 2014-15 and 2015-16, the standard deviation result (0.143) shows that there is also less dispersion in terms of cost efficiency among the RRBs. The average level of cost inefficient is about 18.8 percent which can, therefore, be concluded that the same level of outputs in regional rural banking sector could be

produced with 18.8 percent lesser input costs. Regarding allocative efficiency result, during the study period, (2014-15 and 2015-16) the average computed standard deviation if found as 0.066 which shows that there is very low variation in terms of allocative efficiency among the RRBs. The average level of allocative inefficient in the RRB is to the tune of about 6.6 percent. It can, therefore, be concluded that the same level of outputs in regional rural banking sector could be produced with 6.6 percent lesser input costs in both the years.

Factors of responsible for Efficient and Inefficient

Tobit Regression analysis is carried out to test a series of hypotheses concerning the relationship between level of efficiency and other indicators related to RRBs Staff Productivity, Branch Productivity, Profitability (ROA), Size, Exposures to Off balance, Sponsors Bank. In the Tobit regression model, the efficiency scores from the first stage are (as dependent variable) regressed upon RRB's specific and environmental variables to determine what causes differences in efficiency levels across the DMUs under a given study period. Tobit model used in this study may be specified as:

$Y_i^* = \alpha + \beta_1(\text{Staff Productivity}) + \beta_2(\text{Branch Productivity}) + \beta_3(\text{Profitability\_ROA}) + \beta_4(\text{Size\_total Assets}) + \beta_5(\text{Exposures to off balance}) + \beta_6(\text{dummy \_Sponsor Bank}) + \varepsilon$

Table 5: Description and expected signs of the predictors included in the regression analysis

Variables	Description	Hypothesis
Staff Productivity	$\frac{\text{Business (i.e., Deposits + Advances)}}{\text{Total Staffs}}$	+
Branch Productivity	$\frac{\text{Business (i.e., Deposits + Advances)}}{\text{Total Branches}}$	+
Profitability(ROA)	$\frac{\text{Net Profit}}{\text{Total Assets}}$	+
Size	log(Total Assets)	+
Exposures to Off-balance Sheet Activities	$\frac{\text{Non-interest income}}{\text{Total Assets}}$ X100	+
Sponsors Bank	Dummy variable taking value 1 for PSBs and 0 for private and foreign banks (No a priori relationship is expected between ownership and efficiency)	$\pm$

Source: Authors' Compilation

In the second stage analysis, the DEA efficiency scores are regressed on RRBs' specific characteristics in order to identify sources of efficiencies/ inefficiency. Since level of efficiency scores range between 0 and 1, thus, Tobit model is employed. Positive coefficients show a rise in efficiency, whereas negative coefficients show fall in efficiency.

To control for the effects of sponsorship status of RRBs, we constructed two dummy variables, namely D_Nationalised Bank and D_SBI for Nationalised bank and state bank India respectively. We defined D_Nationalised Bank=1 for all nationalised sector banks and 0 for SBI. It is worth noting here that we expect no a priori relationship between sponsorship dummies and efficiency measures. The log-likelihood is the expression that it's value maximizes to determine optimal values of the estimated coefficients (β).

From table 6 & 7, the observations which have been made in TE 2014-15 are: the coefficients of explanatory variables staff Productivity, Size, and sponsor bank are found as statistically insignificant; however, the Branch productivity, Profitability (ROA), Exposure off Balance-sheet are observed as statistically significant. During 2015-16, Size, ROA, exposures to off balance and sponsor bank are found as statistically insignificant. However, the staff productivity and branch productivity are statistically significant.

The observations which have been made in CE are: during 2014-15, staff productivity, size, and sponsor bank are statistically insignificant; however, the branch productivity, profitability (ROA) and exposure off Balance-sheet are statistically significant. During 2015-16, the variables viz., size, ROA, exposures to off balance and sponsor bank are statistically insignificant; however, the staff productivity and branch productivity are statistically significant. And, the observations which have been made in AE are: during 2014-15, the coefficients of explanatory variables viz., staff productivity, branch productivity, and sponsor bank are statistically insignificant; however, the size, profitability (ROA), exposure off balance-sheet are statistically significant. This confirms our earlier findings that sponsorship does not have a strong link with the

efficiency of banks in the RRBs. During 2015-16, the variables viz., staff productivity, branch productivity, profitability (ROA) & size are statistically significant.

The most influential determinants of TE, CE and AE during the study period are ROA & OFFBALANCE. The findings also support our earlier findings that sponsor-ship does not have a strong link with the efficiency of banks in the RRBs (Chanu & Shibu, 2016). The result also supports the finding of Gulati R, (2011) that the RRBs with extensive exposure to off balance sheet activities are more efficient.

Table 6: Determinants of Efficiency of RRBs in India for the financial year 2014-2015

	Dependent Var. TE		**Dependent Var. CE**		**Dependent Var. AE**	
	Coefficient	**p-value**	**Coefficient**	**p-value**	**Coefficient**	**p-value**
Const	1.1078	0.2690	0.00236287	0.9974	0.0166177	0.9583
Staff Productivity	−6.10433e-09	0.2057	−4.58902e-09	0.1867	6.46009e-011	0.9655
Branch Productivity	2.35097e-09	0.0671*	2.17924e-09	0.0170**	5.63597e-010	0.1351
Profitability (ROA)	−8.4804	0.0555*	−6.91991	0.0190**	−2.75157	0.0553*
Size	−0.0351893	0.7155	0.0562561	0.4249	0.0744059	0.0143**
Exposures to Off balance	0.210579	0.0601*	0.177772	0.0176**	0.0740894	0.0423**
Sponsors Bank	0.0739858	0.3878	0.0584848	0.3556	0.0263177	0.3352
Log-likelihood	1.030756		10.01976		25.85020	
Sigma	0.15826		0.122393		0.0515751	

***, ** and * indicate coefficient is significant at 1, 5 and 10 pc level, respectively

Table 7: Determinants of Efficiency of RRBs in India for the financial year 2015-2016

	Dependent Var. TE		**Dependent Var. CE**		**Dependent Var. AE**	
	Coefficient	**p-value**	**Coefficient**	**p-value**	**Coefficient**	**p-value**
Const	0.630798	0.6260	−0.345245	0.6864	0.100812	0.7668
Staff Productivity	−9.58459e+06	<0.0001***	−6.61675e+06	<0.0001***	1.68752e+06	<0.0001***
Branch Productivity	9.58459e+06	<0.0001***	6.61675e+06	<0.0001***	−1.68752e+06	<0.0001***
Profitability (ROA)	−0.0888851	0.8779	0.0959699	0.3760	0.0843779	0.0508*
Size	0.000868222	0.9946	0.0820384	0.3295	0.0697426	0.0360**
Exposures to Off balance	0.00427503	0.9078	−0.0111591	0.8687	−0.00376897	0.8892
Sponsors Bank	0.00627623	0.9447	−0.345245	0.6864	0.100812	
Log-likelihood	−1.743749		7.380028		23.19084	
Sigma	0.174471		0.136234		0.054616	

***, ** and * indicate coefficient is significant at 1, 5 and 10 pc level, respectively

Conclusion and Future Research

The financial market has become more liberalised today, as a result, number of competitors have also been increasing day by day in this market. it has become a big challenge for the banks like RRBs which have been established with the social objectives rather than business objectives. However, many studies also reveal that the efficient banks can face whatever challenges brought by the market in any form. Hence, the efficiency studies have become an important area of research. In the present study, technical efficiency, cost efficiency and allocative efficiency of 22 Indian Regional Rural Banks for financial year 2014-2015 and 2015-2016 have been measured and found that the only few are efficient. Hence, it is suggested that the future reforms in the RRBs should be directed towards market-oriented policies and strengthening competitive. And inefficient banks should try to remodify their financial policies, managerial policies and cost policies which might help to increase level of efficiency

The future research might extend our work in several ways. Using data over a longer period, one may use the DEA BCC input and output oriented to measure efficiency of individual RRBs and one can measure the total factor productivity (TFP) growth in RRBs and decompose it into technical efficiency change and technological progress components using DEA-based Malmquist Productivity Index (MPI). One can also explore efficiency differences between SBI sponsored and other nationalised banks sponsored RRBs by using meta-frontier approach and super efficiency approach. This would enrich the existing literature on the efficiency of RRBs industry since all the existing studies estimated a common frontier for obtaining the efficiency estimates for selected RRBs.

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[i] List of Selected RRBs Banks and Their Notations

DMU	RRBs	DMU	RRBs
DMU1	Allahabad UP Gramin Bank	DMU12	Malwa Gramin Bank
DMU2	Andhra Pradesh Grameena Vikas Bank	DMU13	Narmada Jhabua Gramin Bank
DMU3	Andhra Pragathi Grameena Bank	DMU14	Pallavan Grama Bank
DMU4	Assam Gramin Vikash Bank	DMU15	Pandyan Grama Bank
DMU5	Bangiya Gramin Vikash Bank	DMU16	Puduvai Bharthiar Grama Bank
DMU6	Baroda Gujarat Gramin Bank	DMU17	Sarva Haryana Gramin Bank
DMU7	Jharkhand Gramin Bank	DMU18	Saurashtra Gramin Bank
DMU8	Karnataka Vikas Grameena Bank	DMU19	Telangana Grameena Bank
DMU9	Kaveri Grameena Bank	DMU20	Tripura Gramin Bank
DMU10	Langpi Dehangi Rural Bank	DMU21	Uttarakhand Gramin Bank
DMU11	Maharashtra Gramin Bank	DMU22	Vananchal Gramin Bank

[ii] *TIE= (1-TE)X100*
[iii] *AIE=(1-AE)X100*