EFFICIENCY MEASUREMENT OF REGIONAL RURAL BANKS IN INDIA USING CROSS SECTIONAL DATA

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ABSTRACT

Efficiency measurement is a key issue in every business organization and banking is no exception. A lot of studies have been conducted in banking sector using the modern technique such as Data Envelopment Analysis (DEA) but Regional Rural banks (RRBs) are rarely studies using this technique. The study under consideration attempts to examine the Technical Efficiency (TE) of Indian RRBs for a cross-sectional data of 24 RRBs for the year of 2015-16 using DEA. The Technical Efficiency has been decomposed between pure technical efficiency (PTE) and scale efficiency (SE). As per the findings of the study, the inefficiency in these sample banks is primarily caused by the pure technical inefficiency instead of scale inefficiency; the same has been witnessed by studies as conducted by Aghimien et al. (2016) and Fukuyama (1993). As indicated by the results of Mann-Whitney U Test, the large and small banks are found to be the same in essence of technical efficiency (TE), pure technical efficiency (PTE) and scale efficiency (SE).

Keywords: Regional Rural Banks, DEA, DMUs, Technical Efficiency.

Introduction

Banking Commission (1972) felt the need to have some special type of rural banks with rural focus and orientation for providing credit to the rural poor people. Later on, Narasimham Group (1975) reviewed the recommendations of Banking Commission (1972) and urged for the establishment of Regional Rural Banks (RRBs). These Regional Rural Banks would be a hybrid type of institutions which will have the local feel and familiarity possessed by cooperative banks but operational and management efficiency possessed by the commercial banks. The main objective of Regional Rural Banks is to provide credit to the small and marginal farmers, agriculture labourers, rural artisans and small businesses in the rural area. These banks are owned by Government of India, concerned state government and sponsor bank in the ratio of 50:15:35 respectively and the sponsor bank is a public sector commercial bank. In the initial stage, only five Regional Rural Banks have been established on October 2, 1975, under the promulgation of Regional Rural Bank Act 1976.

These banks are the right kind of institutions to provide credit in rural area (Dantawala Committee, 1978). In the initial stage, Regional Rural Banks were mainly focused on outreach rather than viability (Bose, 2005). These banks expanded their wings between 1975 and 1988 (Velayudham and Sankaranayanan, 1990), and total number of these banks reached to 196 in 1988.

The period of 1975-1990 is considered as inception and expansion phase of Regional Rural Banks. Regional Rural Banks are suffering from low profitability, poor recovery and nonviability (Khusro Committee, 1989). But Regional Rural Banks should be profitable, solvent and viable to be effective and efficient in the delivery of credit to the rural area (Narasimham Committee, 1998). In view of the above, many committees and groups suggested for the restructuring and amalgamation of Regional Rural Banks to improve the viability and profitability of these institutions. The Narasimham Committee (1991) urged for the enlargement of business of Regional Rural Banks by allowing them for doing all kind of banking functions and be freed to decide the interest rate charged on lending. For improving viability, Khusro Committee (1989) recommended amalgamating Regional Rural Banks with the sponsor bank. But regional Rural Banks should not be amalgamated with their sponsor bank because it will deteriorate their very purpose of rural orientation (Vyas Committee, 2004).

Banking Reforms of 1991 and 1998 has proved beneficial for the Regional Rural Banks (Mohinder 2014), but these banks are still suffering from the problems of non-viability, low profitability and non-recovery of loans. To improve viability and efficiency, the Government of India accepted the recommendations of Vyas Committee (2004) for restructuring to amalgamate Regional Rural Banks in two phases from September, 2005. In the first phase, to amalgamate all the Regional Rural Banks sponsored by a bank to make one Regional Rural Bank under a sponsor bank. In the second phase, to amalgamate all the Regional Rural Banks within the state to form one Regional Rural Bank for a state. There existed 196 Regional Rural Banks till 2005 which reduced to only 56 in 2014. In June 2014, the NDA Government put on hold any further amalgamation of these banks. Kumar (2008) presented a negative view on the amalgamation of Regional Rural Banks and described that the pre-amalgamation performance was far better than the post-amalgamation performance of these banks. But some of the studies found a good impact of amalgamation on the functioning of Regional Rural Banks (Ibrahim, 2010; Makander, 2013; Amuthan, 2015).

The literature evidenced the focus of many studies on the liquidity and profitability aspects of the banks. Operating efficiency is neglected issue which can ultimately help to improve the profitability of a bank (Sherman and Gold, 1985). The Regional Rural Banks are also not alien to this issue as very little attention has been paid to these banks for efficiency measurement using modern techniques such as Data Envelopment Analysis (DEA). So, the main objective of present study is to measure the efficiency of Regional Rural Banks in India using Data Envelopment Analysis (DEA) technique of nonparametric frontier approach.

Review of literature

Since its invention, application of Data Envelopment Analysis (DEA) is in vogue to measure the efficiency of decision-making units (DMUs). Sherman and Gold (1985) had made the first move to apply the DEA in banking which opened the way for this technique towards banking. Avkiren (1999) is also among the early adopters of DEA in banking. Sufian (2011) found that the efficiency of Korean banks is mainly caused by the scale inefficiency (SE) instead of pure technical efficiency (PTE). Contrary to this, Aghimien et al. (2016) found that the inefficiency is primarily owed to pure technical inefficiency instead of scale inefficiency which is consistent with the result of the study by Fukuyama (1993). Al-Khasawneh et al. (2012) investigated the cost and revenue efficiency of Islamic banks in four countries and found that both types of banks are approximately same in context of cost efficiency, but differs in terms of revenue efficiency.

In Indian context, very few studies employed the DEA to measure the efficiency in the banking industry. One vital study by Bhattacharyya et al. (1997) enriches the existing literature on Indian banking by investigating the productive efficiency of 70 Indian commercial banks using DEA and SFA. The study observed that the public owned banks are more efficient in comparison to their private and foreign counterparts. The study also observed that the foreign banks were improving their efficiency during the period of study. Ram Mohan and Ray (2004) noticed no significant difference in productivity growth between the Indian public and private sector banks. Das et al. (2005) came across with a broad view to investigate the technical, cost, revenue and profit efficiency of Indian banks and found no significant difference between these banks in terms of technical and cost efficiency but alos observed that the banks differ in revenue and profit efficiency. Debnath and Shankar (2008) conducted a study to analyze the performance of 50 Indian banks, and concluded that the large and small banks performed well than the medium size banks during the study period. The study recommended that the inputs usage needs to be improved and the banks should focus on the rural area. Arrawatia et al. (2015), by studying the Indian banks, found that the competition level is positively related to the bank efficiency. Malhotra et al. (2015) observed that only 5 banks out of total 35 considered under study performed well as per the result of DEA efficiency score.

Despite the growing application of DEA in banking, efficiency measurement in case of the Regional Rural Banks (RRBs) using DEA studied seldom. Most of the studies on RRBs are based on some conventional techniques such as financial ratio analysis and CAMEL rating. In spite of the wide usage to measure the performance of banks, these traditional parameters namely financial ratios and CAMEL rating are suffering from several limitations (Sherman and Gold 1985). The empirical literature on RRBs based on these parameters encompasses Pal and Sura (2006), Kumar (2008), Ibrahim (2010), Soni and Kapre (2011), Ahmed (2013), Mohinder (2014), Amuthan (2015). Ibrahim (2010) and Amuthan (2015) studied the performance of RRBs to examine the impact of amalgamation of RRBs initiated in 2005 and found a positive effect of amalgamation. But Kumar (2008) presented a negative view on the amalgamation of RRBs as the pre-amalgamation performance was far better than the post-amalgamation performance of these banks. No study

considered the DEA based efficiency analysis of RRBs except the study of Khankhoje and Sathye (2008). Khankhoje and Sathye (2008) observed that the restructuring of RRBs initiated in 1993-94 proved fruitful as the efficiency score increased significantly in the post restructuring period. This alienation of RRBs from DEA based efficiency analysis required our attention to examine the efficiency of these banks by applying DEA.

Objectives of the Study

The main objective of this study is to examine the relative Technical Efficiency of Regional Rural Banks (RRBs) in Indian with the following explicit sub objectives given below:-

- To measure Technical Efficiency of RRBs in India and decompose it into Pure Technical Efficiency (PTE) and Scale Efficiency (SE).
- To examine the effect of size of bank on Technical Efficiency (TE), Pure Technical Efficiency (PTE) and Scale Efficiency (SE). To attain this objective, following hypotheses has been framed
- H_1: There is a significant difference between the large banks and small banks in terms of technical efficiency score.
- H_2: There is a significant difference between the large banks and small banks in terms of pure technical efficiency score.
- H_3: There is a significant difference between the large banks and small banks in terms of scale efficiency score.

Research Methodology

Data Envelopment Analysis

Data Envelopment Analysis is formerly invented by Charnes et al. (1978) by extending the initial work of Farrell (1957) to measure the efficiency of Decision Making Units (DMUs). DMUs are the units with same type of inputs and outputs (Charnes et al. 1978). DEA is a linear programming technique which compares each DMU with all the DMUs in the sample to construct a frontier with the prior assumption that all the DMUs under evaluation lie on or under the frontier. All DMUs on frontier are the efficient ones and the DMUs below the frontier are the inefficient. Our choice of DEA over other technique of efficiency measurement is influenced by some benefits provided by this technique. First benefit is the non requirement of functional form between inputs and outputs used, second, it is data oriented technique and finally, it gives consideration to several inputs and outputs used (Kumar and Gulati 2009).

The ratio DEA model for efficiency measurement as developed by Charnes, Cooper and Rhodes (1978) is based on the constant return to scale assumption which seems an unrealistic assumption. Banker, Charnes and Cooper (1984) expanded the model further by dropping the constant return to scale assumption and added an addition convexity constraint to allow for variable return to scale. For this study, we are considering the VRS assumption and the BCC output oriented model is used to examine the technical efficiency. In BCC model, the following fractional linear programming problem is to be solved for efficiency measurement:-

Let there are *n* numbers of homogeneous DMUs with *m* inputs and *s* outputs. y_j and x_i are the output and input vector, respectively, for the j^{th} DMU. u and v, respectively, are the weights of outputs and inputs to be assigned by the model. The subscript o in the equation denotes the DMU_o under evaluation.

$$\text{Max } z = \frac{\sum_{r=1}^{s} u_r y_{ro} + u_o}{\sum_{i=1}^{m} v_i x_{io}}$$

Subject to

$$\frac{\sum_{r=1}^{s} u_r y_{rj} + u_o}{\sum_{i=1}^{m} v_i x_{ij}} \leq 1,\ j = 1,\ldots\ldots\ldots,\ n$$

$u_r, v_i \geq 0,\ i = 1,\ldots\ldots\ldots m:\ r = 1,\ldots\ldots\ldots s.$

The above equation is a fractional problem having infinite solution. To solve this problem, It should be converted to a linear programming problem by using the transformation as suggested by Charnes *et al* (1978). For this, the following constraint has imposed as below:

$$\sum_{i=1}^{m} v_i x_{io} = 1$$

Now, we have a unique solution :-

$$\text{Max } \sum_{r=1}^{s} u_r y_{ro} + u_o$$

Subject to :

$$\sum_{i=1}^{m} v_i x_{io} = 1$$

$$\sum_{i=1}^{m} v_i x_{io} + \sum_{r=1}^{s} u_r y_{ro} + u_o \leq 0,$$

$j = 1,\ldots\ldots\ldots n,\ u_r, v_i \geq 0,\ u_o$ is sign free

The constraint u_o is added to take into account the VRS (BCC Model) for Technical Efficiency (TE) measurement in terms of Pure Technical Efficiency (PTE) and Scale Efficiency (SE). Technical Efficiency can be found by multiplying the pure technical efficiency with the scale efficiency.

$TE = PTE \times SE$

Accordingly,

$SE = TE/PTE$

Defining the Variables (Inputs and Outputs)

In DEA, the most crucial task is to choose the input and output variables for the measurement of technical efficiency score. The results obtained from DEA is receptive to the selection of input and output variables because efficiency score obtained from DEA may vary across the different approach of input and output selection (Sufian 2011). There are mainly two approaches namely production approach and intermediation approach for the selecting the input and output of a bank. Production approach considers the bank as the producer of many kinds of services for its customers and intermediation approach defines a bank as a financial intermediary.

Production approach is best suited for branch level efficiency measurement unlike the intermediation approach which is considered as best for bank level efficiency measurement (Berger and Humphrey 1992). For the present study, intermediation approach is considered for choosing the input and output variables. Interest expenses and operating expenses are the input variables, and interest income and non interest income are chosen as output variables.

Adequacy of Sample Size and Sources of Data

To discriminate between efficient and inefficient DMUs, effectively, the size of the sample should be substantially outsized the product of number of output and number of input (Avkiran 1999). One rule of thumb claims that the sample size should be large enough to satisfy the condition: 3(m+s), where m and s denote the number of inputs and outputs respectively. We use a sample of 24 RRBs for the present study satisfying the above condition for sample size. The Data for the present is collected from the annual reports of concerned banks.

Limitations of the Study

The present study is based on only one year data that may be considered as a limitation. Another drawback is related to the methodology used in the present study as the results of the DEA are more sample specific. Therefore, the results of this sample study of 24 banks may or may not be generalized to the population. Even in the presence of above limitations, the present study provides a rigorous examination of technical efficiency of select RRBs and helps the policy makers of these institutions for devising policies to improve the performance. With regard to the future research scope, productivity change can be measured for the Regional Rural Banks using panel data.

Results and Discussion

The empirical results of the study are discussed in this section. The technical efficiency score obtained from the output oriented VRS Model has been shown in table 1.

Table 1: Technical, Pure Technical and Scale efficiency of Regional Rural Banks

BANKS	TE	PTE	SE	RETURN
Allahabaad Up Grameen Bank	0.922	0.924	0.998	IRS
Andhra Pradesh Grameena Vikas Bank	1.000	1.000	1.000	CRS
Arunachal Pradesh Rural Bank	1.000	1.000	1.000	CRS
Assam Gramin Vikas Bank	0.983	0.984	0.999	DRS
Bangiya Gramin Vikash Bank	0.981	1.000	0.981	DRS
Baroda Gujarat Gramin Bank	0.822	0.844	0.974	IRS
Baroda Rajasthan Kshetriya Gramin Bank	0.935	0.935	1.000	CRS
Gramin Bank Of Aryavart	1.000	1.000	1.000	CRS
Jharkhand Gramin Bank	0.831	0.863	0.962	IRS
Kerala Gramin Bank	0.857	0.932	0.919	DRS
Madhya Bihar Gramin Bank	0.944	0.945	0.999	IRS
Maharashtra Gramin Bank	0.940	0.941	0.999	IRS
Pallavan Grama Bank	0.991	1.000	0.991	DRS
Saptagiri Grameena Bank	1.000	1.000	1.000	CRS
Sarva Haryana Gramin Bank	1.000	1.000	1.000	CRS
Uttar Bihar Gramin Bank	0.840	0.906	0.927	DRS
Vidharbha Konkan Gramin Bank	0.934	0.945	0.989	IRS
Odisha Gramya Bank	0.827	0.827	1.000	CRS
Puduvai Bharathiar Grama Bank	1.000	1.000	1.000	CRS
Punjab Gramin Bank	0.951	0.951	1.000	CRS
Chattisgarh Rajya Gramin Bank	0.972	0.974	0.997	DRS
Dena Gujarat Gramin Bank	0.858	0.862	0.996	IRS
J & K Grameen Bank	0.868	0.896	0.969	IRS
Karnataka Vikas Grameena Bank	0.990	1.000	0.990	DRS

Source : Self Computed using DEAP 2.0.

It has been observed that the total technical efficiency score varies between 0.820 and 1 with an average of 0.935 implying that the sample banks have the potential to increase output by 6.5 percent (1-0.935) with the current level of inputs. Hence, there is a scope of performance improvement of these banks by eliminating the inefficiency. The total technical efficiency score has been segregated into pure technical efficiency and scale efficiency. The former and latter can be attributed to managerial efficiency and efficiency caused by the size of the firm, respectively. The average pure technical efficiency (PTE) score is 0.947. This implies a pure technical inefficiency of 5.3 (1-0.947) percent caused by managerial inefficiency. The average scale efficiency of the sample banks is 0.987 evidencing the existence of 1.3 percent (1-0.987) scale inefficiency. The implication of the above discussion is that the inefficiency is primarily contributed by the pure technical inefficiency (5.3 percent) whereas the scale inefficiency is marginal (1.3 percent).

Table 2: Descriptive Statistics of Efficiency Scores of RRBs

STATISTICS	TE	PTE	SE
Average	0.935	0.947	0.987
SD	0.065	0.056	0.023
Min.	0.820	0.830	0.920
Max.	1.000	1.000	1.000

Source : Self Computed

As observed from table 1, only six banks account for 100 percent of efficiency and operating at optimum scale size (constant return to scale). A fascinating outcome of the model is that there are three banks namely Baroda Rajasthan Kshetriya Gramin Bank, Odisha Gramya Bank and Punjab Gramin Bank operating at optimum scale size albeit carrying pure technical inefficiency. The implication for these banks is to improve the managerial efficiency to achieve 100 percent efficiency.

Table 1 also contains the details of the return to the scale of sample banks. Total eight banks are operating at increasing the return to scale (IRS) and seven banks are operating at decreasing return to scale (DRS). The connotation of this finding of the study is that the banks working at IRS need to improve their operation by efficiently exploiting the inputs to attain the optimum scale size (CRS). Whereas, those banks operating at DRS need to scale down their operation to reach the optimum scale size (CRS).

Effect of Size: Large vs. Small Banks

In addition to measure efficiency score in terms of TE, PTE, and SE, we contemplate to examine the effect of bank size on these efficiency measures. To this end, all the 24 RRBs is divided into large banks and small banks. Large banks and small banks are defined in terms of volume of total business (deposits + advances). Large banks are those banks whose total business surpasses the median of the total business of entire sample banks and small banks are defined as having total business below the median of the total business of entire sample banks. Out of total 24 banks, 12 banks are distinguished as large banks and remaining 12 banks as small banks. Table 2 contains the details of summary statistics the efficiency score of large and small banks. As observed from the table, a difference exists between the efficiency scores (TE, PTE and SE) of large and small banks.

Table 3: Summary Statistics of Size Wise Efficiency score of RRBs.

Statistics	Large Banks, n = 12			Small Banks, n = 12		
	TE	PTE	SE	TE	PTE	SE
Mean	0.939	0.954	0.984	0.931	0.939	0.989
Median	0.963	0.965	0.999	0.946	0.948	0.997
S.D.	0.065	0.054	0.029	0.068	0.059	0.014
Min.	0.827	0.827	0.919	0.822	0.844	0.962
Max.	1.000	1.000	1.000	1.000	1.000	1.000

Source : Self Computed

To portray a more conclusive inference, three hypotheses have been framed as described earlier, to test the difference between the efficiency scores (TE, PTE and SE) of large and small banks. Mann Whitney U Test can be used to test the difference in efficiency score across two groups (Cooper *et al*. 2007). Therefore, to test the hypotheses, the present study employs Mann Whitney U Test. Table 4 depicts the results of the Mann Whitney U Test.

Table 4: Result of Mann Whitney U Test for Large and Small Banks

	U-statistics	Z-value	p-value	Implication
TE	68.500	-0.204	0.839	Reject H_1
PTE	64.500	-0.445	0.656	Reject H_2
SE	65.000	-0.416	0.678	Reject H_3

Source : Self Computed

The outcomes of the test indicate that there exist no significant difference between large and small banks in context of Technical Efficiency Score (TE), Pure Technical Efficiency Score (PTE) and Scale Efficiency score (SE) at 5 percent (0.05) significance level. Consequently, the study concluded that both the group of RRBs are not different from each other significantly in terms of TE, PTE and SE.

Conclusion

In the present study, an attempt has been made to measure the efficiency of 24 Regional Rural Banks spread across India by employing DEA model as developed by Charnes *et al.* (1978). BCC Model developed by Banker et al. (1984) has been used assuming variable return to scale (VRS) for the measurement of technical efficiency, pure technical efficiency (PTE) and scale efficiency (SE). Pure technical efficiency (PTE) and scale efficiency (SE) can be attributed to management efficiency and efficiency caused by scale size of firm respectively. The study unearths that the average technical efficiency, pure technical efficiency and scale efficiency scores are 0.935, 0.947 and 0.987 respectively. This implies that, of the total technical inefficiency of 6.5 (1-0.935), 5.3 percent is attributed to managerial inefficiency and 1.3 percent is attributed to scale inefficiency. The inefficiency due to scale size is very meagre and the foremost fraction of inefficiency is originated from managerial inefficiency (pure technical inefficiency). Thus, the study concluded that the inefficiency of RRBs is mainly caused by the pure technical inefficiency which is attributed to the managerial inefficiency. The results of our study are identical with the studies conducted by Aghimien et al. (2016) and Fukuyama (1993).

The study also examines the effect of the size of banks on the efficiency score of RRBs making the study more insightful and informative. The entire sample of banks has been bifurcated between large and small banks. Out of 24 banks, 12 banks has found as large banks and remaining 12 as small banks. The study has observed that, as per the results of Mann Whitney U Test, both groups of RRBs do not differ in terms of Technical Efficiency (TE) Pure Technical Efficiency (PTE) and Scale Efficiency (SE).

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