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Analysis of Comparative Performances of the Private Sector Banks Operating in Bangladesh: A Non-Parametric Approach

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Abstract *- Among the different types of Deposit Money Banks eight Private Banks have been selected randomly to compare their relative performances. The main objective of this study is to find out the most efficient bank and how much inefficient the other banks are compared to the most efficient bank. In the present study Data Envelopment Analysis technique has been applied which is nonparametric in nature. Input oriented three Data Envelopment Analysis models have been applied to workout relative efficiencies. For each of the models, attempts have been made to find out technical efficiency, scale efficiency, allocation efficiency and cost efficiency of each selected bank separately. After applying these measures Southeast bank has been found as the most efficient bank during the period of study.*

Key Words: Technical Efficiency, Scale Efficiency, Allocation Efficiency, Nonparametric, Data Envelopment

JEL Classification: G21, C51

1. INTRODUCTION

The analysis of performance is a subjective as well as a relative concept. The study of performance is necessary for further improvement of an organization. There are different types of commercial banks operating in Bangladesh such as; Nationalized Commercial Banks (NCBs), Private Commercial Banks (PCBs) and Foreign Commercial Banks (FCBs). Commercial banks have some social responsibilities but profit earning motive cannot be avoided. Banks are allowed to operate in private sector mainly to increase competition in the banking sector to expand and promote the development of a healthy banking system in the country. Most of the branches of NCBs are functioning in rural areas, FCBs are functioning only in urban areas and PCBs are functioning both in rural and urban areas. In a comparative study among different types of banks it has been shown that performance of FCBs is much better than performance of PCBs (Hossain, M. A. 2010). Therefore it is essential to increase efficiencies of PCBs to run their business in a competitive environment like Bangladesh. Before taking any policy decision regarding performance of PCBs, it is necessary to study their individual efficiencies and comparative efficiencies among them. In view of that sense, some PCBs have been chosen randomly for study in the present research.

The nonparametric programming approach used in this study to construct measures of technical, allocative and economic efficiency, and their changes over time are based upon the works of Farrel (1957), Fare, Grosskopf and Lovell (1985) and Fare, Grosskopf, Norris and Zhang (1994). The same methodology has been used for banks mainly in industrial countries, such as studies by Athanassopoulos (1995), Drake and Howcroft (1995), Drake and Weyman-Jones (1992) and Field (1990) for the UK banking industry;

There were some other studies relating to DEA techniques such as Saaid, Rosly, Ibrahim and Abdullah (2003) investigated efficiency regarding Sudanese Islamic banks. They showed that the Sudanese Islamic banks were not optimizing their inputs usage. They also showed that the inefficiency in the Sudanese Islamic banks could be more associated with inputs wasting rather than choosing the incorrect input combinations; In an empirical analysis of Islamic banks, Yudistira, D. (2004) showed that Islamic banks in a particular sample suffered from the global crisis in 1998-1999 but performed very well after the difficult periods; Primorac and Troscot (2005) dealt with the empirical measurement of relative technical efficiency of Croatian banks. It has been shown that the Malmquist index helps both central and commercial bank analysis to monitor trends within the banking sector; Hassan, Zubair (2005) provides an appraisal of some of the researches conducted in recent years for evaluating the recent year's efficiency of Islamic banks. He stated that stochastic frontier and data envelopment analysis models leave much to be desired and the conclusions they arrive at are of suspect validity for variety of reasons; Boshrabadi, Villano and Fleming (2006) reports on an analysis of technical efficiency and environment-technology gaps in wheat farming in Iran; Mattews and Ismail (2006) examined the technical efficiency and productivity of commercial banks in Malaysia. They found that foreign banks are more efficient than domestic banks. The main source of productivity growth is technical change rather than improvement in efficiency; Sufian (2006) showed an empirical evidence regarding efficiency of non-bank financial institutions of Malaysia by applying DEA method. His results suggest that the merchant banks have exhibited mean overall efficiency of 78.1% while the finance companies mean overall efficiency was 91.3%. Loukoianova (2008) analyzed the efficiency and profitability of Japanese banks. He used a non-parametric approach, the DEA, to analyze bank's cost and revenue efficiency. The results show that performance of Japanese banks has steadily improved since 2001, but there are significant differences within the banking sector, with regional banks being less cost and revenue efficient relative to both city and trust banks; Raphael, G. (2012) examined the relative efficiency of selected 20 commercial banks in Tanzania from 2008 to 2011. The findings were categorized based on two groups of commercial banks i.e., small and large groups. He observed that through make use of underutilized resources and reduce operating expenses most commercial banks will remain to be relative efficient in the productive frontier; In an efficiency analysis of commercial banks in East Africa, Raphael, G. (2013) concluded that inefficient utilization of input resources could be one of the reasons for the inefficiency of commercial banks in East Africa. There was a very limited study of efficiency analysis related to Bangladeshi commercial banks.

The broad objective of this study is to make a comparative analysis of performances of some selected Private Commercial Banks (PCBs) operating in Bangladesh Specific objectives of this study are as follows:

- To measure the technical efficiency (TE)
- To measure the scale efficiency (SE)
- To measure the allocative efficiency (AE)
- To measure the cost efficiency (CE) and
- To compare efficiencies among selected banks

Selection of banks along with methodologies has been discussed in the second section, empirical results have been worked out and shown in the third section and finally, conclusions have been incorporated in the fourth section.

2. SELECTION OF BANKS AND METHODOLOGIES

Eight private banks have been selected randomly out of thirty PCBs to study comparative performances among them. The brief name of the selected banks has been used within the parenthesis for use in analysis. The selected banks are (1) Dutch Bangla Bank (DBBL), (2) Islami Bank Bangladesh Ltd. (IBBL), (3) United Commercial Bank Ltd. (UCBL), (4) Prime Bank Ltd. (Prime), (5) Mercantile Bank Ltd. (Mercantile), (6) Pubali Bank Ltd. (Pubali), (7) Southeast Bank Ltd. (Southeast) and (8) Bank Asia Ltd. (Bank Asia). The period of study has been covered from 2007 to 2011. The efficiency analysis has been performed among the selected banks for each individual period. In this study two inputs have been used to produce a single output for each bank. The inputs are, deposits per branch (DPB) and manpower per branch (MPB). On the other hand, profit per branch (PPB) has been considered as output. The deposit costs per branch and manpower costs per branch have been considered as input costs.

Mainly there are two broad approaches to find out technical efficiencies namely, parametric approach and non-parametric approach. Stochastic Frontier Analysis (SFA) is one of the parametric approaches and Data Envelopment Analysis (DEA) is one of the non-parametric approaches. It is attempted to apply DEA in the present research. DEA is based on mathematical linear programming. This approach forms a convex hull of intersecting planes which envelope the data points and hence this is known as data envelopment analysis. There are many input and output oriented measures of DEA. In the present study four types of input oriented efficiency measures as mentioned above have been applied to test comparative performances of selected private commercial banks. Technical efficiencies will be worked out both under constant returns to scale (CRS) and variable returns to scale (VRS). In the CRS it is assumed that outputs will be fluctuated same proportion as per fluctuation of inputs. On the other hand, in the VRS, the proportion of the fluctuations of outputs and inputs will be different.

According to Farrell (1957) there are two types of broad measures of DEA, such as; *Input-Oriented Measures* and *Output-Oriented Measures*. The present study is attempted to apply input oriented measures. Let us consider there are K inputs and M outputs on each of N firms. If i-th firm's inputs and outputs represented by x_i and y_i respectively, then X represents the input matrix of order KxN and Y represents the output matrix of order MxN. For each firm we would like to obtain a measure of the ratio of all outputs over all inputs, such as $u'y_i/v'x_i$, where u is an Mx1 vector of output weights and v is a Kx1 vector of input weights. To select optimal weights, we specify the mathematical programming problem as follows:

$$\max_{u,v} (u'y_i/v'x_i)$$

(2.1)

st $u'y_j/v'x_j \leq 1, j=1, 2, \ldots \ldots, N$ (The notation "st" stands for subject to)

$u, v \geq 0$

This involves in finding values for u and v, such that the efficiency measure for the i-th firm is maximized, subject to the constraints that all efficiency measures must be less than or equal to zero.

According to Coelli (1996), using the duality in linear programming, equivalent envelopment form can be written as:

$$\min_{\theta,\lambda} \theta,$$

(2.2)

st $-y_i + Y\lambda \geq 0,$

$\theta x_i - X\lambda \geq 0,$

$\lambda \geq 0,$

where θ is a scalar and λ is a Nx1 vector of constants. The value of θ indicates the efficiency score for the i-th firm. According to the Farrell's (1957) definition the efficiency score satisfies the condition $\theta \leq 1$. λ indicates a vector $\lambda = (\lambda_1, \lambda_2, \lambda_3, \ldots, \ldots, \lambda_N)'$ where λ_i (i=1,2,3,…,…,N) shows the existence of linear combination of a firm with the i-th firm. In this stage i-th firm indicates the most efficient firm.

When all of firms are not operating in an optimal scale, CRS specification will be confounded by scale efficiencies (SE). The use of VRS specification will permit the calculation of these scale effects. The CRS linear programming problem can be easily modified to account for VRS by adding the convexity constraint, $N_1'\lambda = 1$ to equation 2.2 to provide;

$$\min_{\theta,\lambda} \theta,$$

(2.3)

st $-y_i + Y\lambda \geq 0,$

$\theta x_i - X\lambda \geq 0,$

$N_1'\lambda = 1$

$\lambda \geq 0,$

where N_1 is an Nx1 ordered vector of 1's. This approach forms a convex hull of intersecting planes which envelopes the data points more tightly than the CRS conical hull and thus provides technical efficiency which may be different from those obtained by using CRS model.

3. EMPIRICAL RESULTS

3.1 Technical Efficiency under CRS

As per table 1 and figure 1 it has been observed that Prime bank is the full efficient bank whereas, IBBL and Mercantile were the least efficient bank among eight banks in 2011.As the Prime Bank has been found as the full efficient bank in 2011 and hence this bank is the peer of other selected banks in 2011.

Table 1. CRS Input Oriented DEA Results: 2011

Firms	TECRS	λ_{DBBL}	λ_{IBBL}	λ_{UCBL}	λ_{Prime}	$\lambda_{Mercantile}$	λ_{Pubali}	$\lambda_{Southeast}$	$\lambda_{Bankasia}$
DBBL	0.929	---	---	---	0.633	---	---	---	---
IBBL	0.735	---	---	---	0.715	---	---	---	---
UCBL	0.839	---	---	---	0.805	---	---	---	---
Prime	1.000	---	---	---	1.000	---	---	---	---
Mercantile	0.735	---	---	---	0.689	---	---	---	---
Pubali	0.867	---	---	---	0.197	---	---	---	---
Southeast	0.949	---	---	---	1.061	---	---	---	---
Bank Asia	0.869	---	---	---	0.978	---	---	---	---

The table 1 also shows that efficiencies of IBBL, UCBL and Mercantile banks are lying below the mean efficiency and efficiencies of other banks lying above the mean efficiency level. The table 2 shows that seven banks excluding Prime bank are using more inputs to produce same level of output compared to Prime bank in 2011.

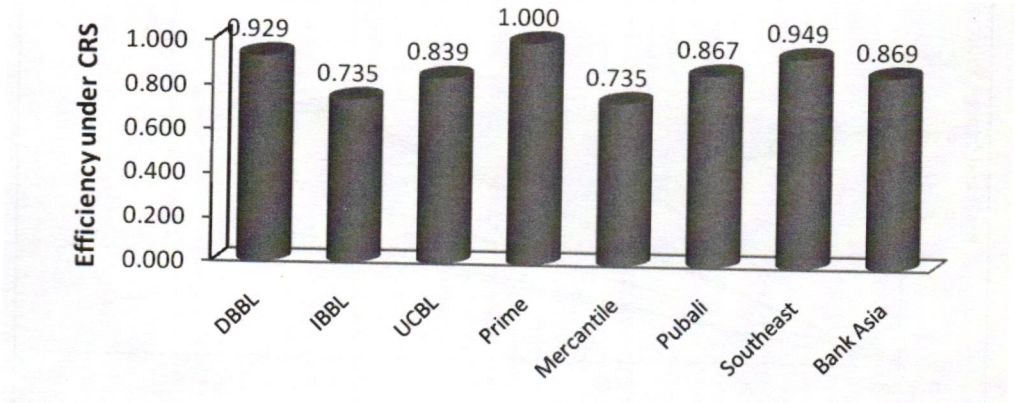

Figure1. CRS Input Oriented DEA Results-2011

Using the DEA, it is observed that mean of the mean technical efficie... CRS over period 2007-2011 is 84.7% (Table 2).This implies that there is suffi... room for improvements in technical efficiency in selected banks of Bangladesh. The table 2 also shows that mean technical efficiency for the Southeast is the highest (98.5%) and for IBBL is the lowest (65.7%).

Table 2. Mean Technical Efficiency Under CRS

Firms	2007	2008	2009	2010	2011	Mean
DBBL	0.650	0.827	0.799	0.799	0.929	0.801
IBBL	0.590	0.798	0.640	0.521	0.735	0.657
UCBL	0.908	0.980	0.808	0.663	0.839	0.840
Prime	0.879	0.973	1.000	0.894	1.000	0.949
Mercantile	0.691	0.752	0.691	0.612	0.735	0.696
Pubali	0.965	1.000	0.872	0.879	0.867	0.917
Southeast	1.000	0.975	1.000	1.000	0.949	0.985
Bank Asia	0.998	1.000	0.959	0.819	0.869	0.929
Mean	**0.835**	**0.913**	**0.846**	**0.773**	**0.865**	**0.847**

In case of graphical presentation of figure 2,the notations defined as; DB for DBBL, IB for IBBL, UC for UCBL, PR for Prime, MC for Mercantile, PU for Pubali, SE for Southeast and BA for Bank Asia. In 2011, the target point of all banks lies 10% in the frontier drawn from the point of PR (ZZ'). The target inputs and outputs of DBBL, IBBL, UCBL, Mercantile, Pubali, Southeast and Bank Asia are the coordinates of the points DB', IB', UC', MC', PU', SU' and BA' respectively (Figure 2).The figure 2 shows that only Prime bank falls in the frontier line and other banks fall outside of the frontier in 2011.

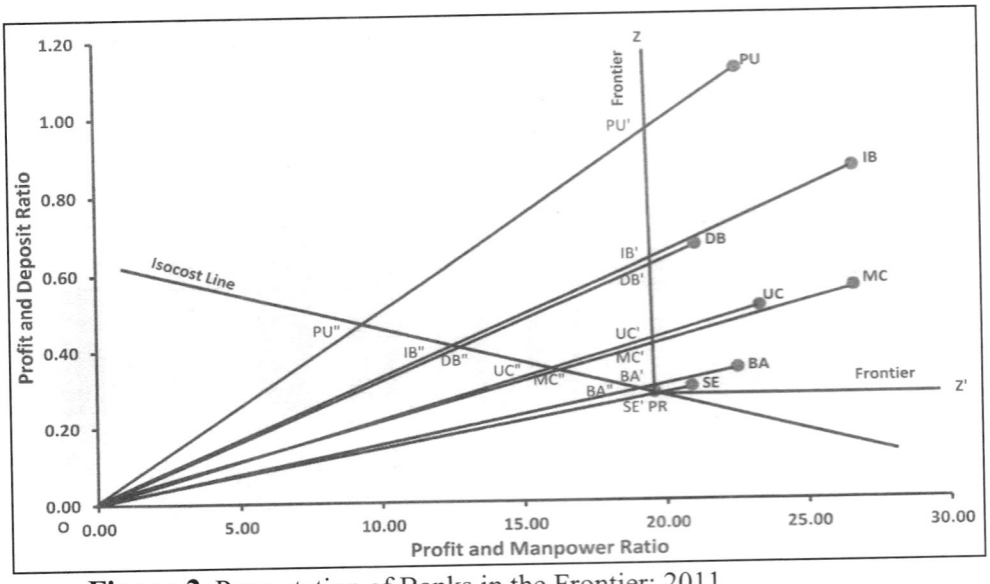

Figure 2. Presentation of Banks in the Frontier: 2011

3.2 Technical Efficiency under VRS

Variable Returns to Scale (VRS) is another input-oriented DEA analysis using same inputs and output which were used to calculate technical efficiency under CRS. The VRS and CRS input-oriented DEA results for the year 2011 are presented in Table 3.

Table 3.VRS Input Oriented DEA Results: 2011

Banks	CRSTE	VRSTE	SE
DBBL	0.929	0.950	0.979
IBBL	0.735	0.746	0.985
UCBL	0.839	0.847	0.991
Prime	1.000	1.000	1.000
Mercantile	0.735	0.748	0.983
Pubali	0.867	1.000	0.867
Southeast	0.949	1.000	0.949
Bank Asia	0.869	0.870	0.999
Mean	0.865	0.895	0.969

In term of VRS, Prime bank, Pubali bank and Southeast bank were found to be the full efficient bank in 2011 although only Prime bank has been found as the full efficient bank under CRS. It is also observed that Prime bank is the most scale efficient and Pubali is the least scale efficient. The scale inefficiencies for DBBL, IBBL, UCBL, Mercantile, Pubali, Southeast and Bank Asia are 2.1%, 1.5%, 0.9%, 1.7%, 13.3%, 5.1% and 0.1% respectively (Table 3).

3.3 Allocative and Cost Efficiency

CRS cost efficiency has been determined using two inputs and one output along with related cost data. In this case, the input and output variables remain same as in previous section. In this case, beside input data, input costs have also been considered. Allocative efficiencies and cost efficiencies have been worked out for each selected bank separately. Table 4 shows that, like CRS and VRS measures , Prime bank is the most efficient bank in terms of AE and CE in 2011.

Table 4. CRS Cost Efficiency DEA Results: 2011

DMUs	TECRS	AE	CE
DBBL	0.929	0.993	0.923
IBBL	0.735	0.996	0.732
UCBL	0.839	0.999	0.839
Prime	1.000	1.000	1.000
Mercantile	0.735	0.999	0.734
Pubali	0.867	0.990	0.858
Southeast	0.949	0.987	0.937
Bank Asia	0.869	1.000	0.869
Mean	0.865	0.996	0.862

Figure 2 shows that isocost line crosses through the point PR and hence it is the only cost efficient bank and all other banks have some cost inefficiency for the year 2011.

3.4 Overall Performance During 2007 -2011

Table 5 shows the mean TE (TECRS & TEVRS), SE, AE and CE for 2007-2011. Although Prime bank was the most efficient bank in terms of all measures of efficiency in 2011, based on average of 5 years, Southeast bank is found to be the most efficient bank in terms of TECRS.

While Pubali and Southeast are both most efficient banks in terms of TEVRS. On the other hand, Bank Asia is the most efficient bank in terms of scale efficiency, UCBL is the most efficient in terms of allocative efficiency and Southeast is the most efficient in terms of cost efficiency measures.

Table 5 Mean Efficiencies During 2007-2011

Banks	**TECRS**	**TEVRS**	**SE**	**AE**	**CE**	**Mean**
DBBL	0.801	0.883	0.916	0.990	0.792	0.876
IBBL	0.657	0.670	0.980	0.992	0.652	0.790
UCBL	0.840	0.853	0.984	0.993	0.833	0.901
Prime	0.949	0.976	0.971	0.991	0.940	0.966
Mercantile	0.696	0.746	0.935	0.992	0.690	0.812
Pubali	0.917	1.000	0.917	0.986	0.904	0.944
Southeast	0.985	1.000	0.985	0.980	0.966	0.983
Bank Asia	0.929	0.938	0.990	0.981	0.912	0.950
Mean	0.847	0.883	0.960	0.988	0.836	0.903

Figure 5. Overall Position of Selected Private Banks in Terms of Efficiency

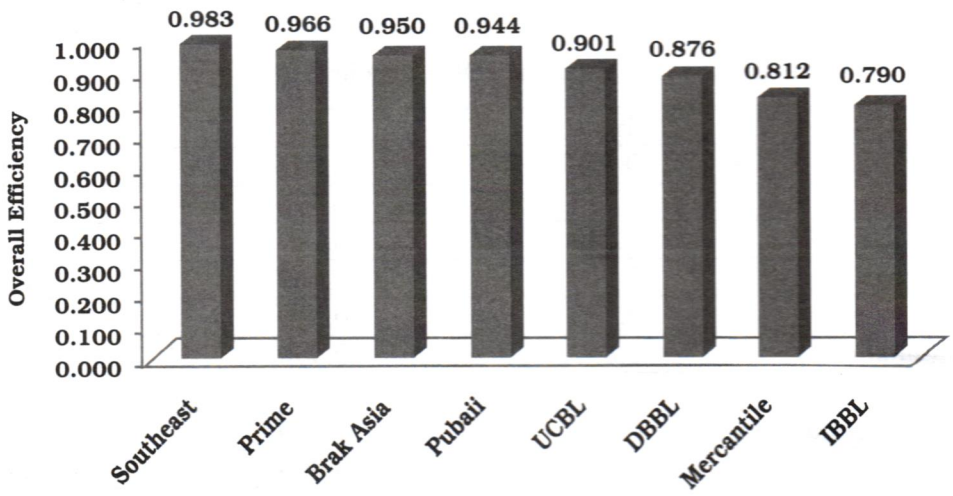

Table 6. Significance Test of Spearman's Correlation Coefficient among Different Efficiency Measures

	TECRS	TEVRS	SE	AE	CE
TECRS	1.000	---	---	---	---
TEVRS	0.943*	1.000	---	---	---
SE	0.471*	0.248	1.000	---	---
AE	0.040	-0.071	0.652*	1.000	---
CE	0.993*	0.936*	0.512*	0.116	1.000

*Significant at 5% level of significance

If we consider mean of all efficiency measures such as; TECRS, TEVRS, SE, AE and CE, it is observed that Southeast Bank is the most efficient bank (0.983) and IBBL is the least efficient bank (0.790) (Figure 3).The results of Table 5 could be validated by testing correlation at the 5% level of significance (2-tailed). The null hypothesis is that the rank correlation co-efficient between two efficient variables is zero. The empirical results of Table6 indicate that there is a satisfactory relationship among different efficiency measures. It has been observed that there is a strong association between TECRS & TEVRS, TECRS & CE and TEVRS & CE. On the other hand, there is a significant but weak association between TECRS & SE, AE & SE and CE & SE. As the various measures of banking efficiencies are satisfactorily associated with each other and hence there is a significance to work out average of all efficiency measures and interpret on it.

4. CONCLUSION

Five different measures have been applied in each of selected private banks separately. On an average, Southeast bank has been found to be the most efficient bank under constant returns to scale, Southeast and Pubali are most efficient banks under variable returns to scale, Bank Asia is the most efficient bank under scale efficiency, UCBL has been found as the most efficient in terms of allocative efficiency and finally, Southeast has been found as the most efficient in terms of cost efficiency. But no banks were found fully efficient under scale efficiency, allocative efficiency and cost efficiency measures.

It is recommended that selected private banks should minimize the use of input resources while maintaining the same level of output compared to efficient banks. By improving handling of operating expenses, advances, capital and by boosting banking investment operation, the less efficient banks can successfully endorse resource utilization efficiency. However the results of the analysis have important implications for management of the banks, policy makers and bank regulators in Bangladesh.

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