Measuring Technical Efficiency of People's Bank of Sri Lanka: A Data Envelopment Analysis

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Abstract
The study measures the technical efficiency of People's Bank from2001 to 2015 by using Data Envelopment Analysis (DEA). The data was gathered from various Annual Reports of People's Bank. The study mainly used input oriented CCR and BCC model of DEA. The study selected one output variable (Net profit) and four inputs variables (No. of employees, investment, loans and advances, and liabilities). The study found that the average overall technical, pure technical and scale inefficiency of People's Bank were 27.9%, 4.7%, and 23.8% respectively during the study period. The main source of technical inefficiency of People's Bank was scale inefficiency. In the study period, there were full efficiency in 2011 and 2015 and there were technical inefficiency in other years. Further, technical efficiency score of People's Bank in Sri Lanka had been improved.

Keywords: People's Bank, Data Envelopment Analysis, Technical Efficiency,

Introduction

Measuring the level of efficiency of a firm or bank is important to making a decision about its future activities. Technical efficiency of a firm is a comparative measure of how well it actually processes inputs to achieve its outputs, as compared to its maximum potential for doing so, as represented by its production possibility frontier (Barros and Mascarenhas, 2005). The technical efficiency relates to the productivity of inputs (Sathye, 2001). A bank is said to be technically inefficient if it operates below the frontier A measure of technical efficiency under the assumption of constant returns-to-scale (CRS) is known as overall technical efficiency (OTE). The overall technical efficiency (OTE) measure has been decomposed into two mutually exclusive and non-additive components: pure technical efficiency (PTE) and scales efficiency (SE) (Sunil, 2008). The PTE measure is obtained by estimating the efficient frontier under the assumption of variable returns –to-scale. It is a measure of technical efficiency without scale efficiency and purely reflects the managerial performance to organize the inputs in the production process. Thus, PTE measure has been used as an index to capture the managerial performance. The ratio of OTE to PTE provides scale efficiency measure. The measure of SE provides the ability of the management to choose the optimum size of resources (Sunil, 2008). Data Envelopment Analysis (DEA) (see the methodology part for further details) provides the score of OTE, PTE, and SE.

The study measures the score of overall technical efficiency (OTE), pure technical efficiency (PTE), and scale efficiency of the People's Bank by using data envelopment analysis (DEA). The study has structured the following manner, introduction, overview of People's Bank, review of the literature, objective, and data, methodology, results and discussion, and finally a conclusion.

Overview of People's Bank in Sri Lanka

People's Bank is a commercial and public bank in Sri Lanka. It has the largest branches of the network in Sri Lanka. It was established in 1961 as a licensed Commercial Bank under the Banking Act. In 2014, it had 732 branches which are 26% of total branches of commercials banks of Sri Lanka. The total net profit (after tax) of People's bank was Rs. 12.6 billion in 2015.

Table.1 shows the non-financial highlight of People's Bank of Sri Lanka. The number of branches of it's has been increased since established. The number of branches of People's Bank increased to 740 from 300, even though the number of employees has decreased to 8368 from 10000 between 1982 and 2014. People's Bank had 330 ATM in 2010 and it was increased to 492 in 2015. Table.2 shows financial highlights of People's Bank for some selected years. Its deposit from customers was Rs. 115,007 million in 2000 and it was increased to Rs.899, 238 million in 2015. The both loans and advances given by People's Bank were Rs.87,087 million in 2000 and it was increased to Rs.768, 515 million in 2015. Its investment was increased to Rs. 307, 719 million from Rs.32, 079 million between 2000 and 2015. In 2000, People's Bank lost Rs. 1,268 million but, in 2015, it earned Rs. 19,520 million as a profit before taxation.

Table.1 Non-Financial Highlight of People's Bank

Year	No. of Branches	No. of ATM	No. of Employee
1982	300	na.	10000
2010	679	330	8399
2011	714	382	8249
2012	728	420	7823
2013	735	460	7409
2014	739	469	8156
2015	740	492	8368

Source: Annual Report of People's Bank

Table.2 Financial Highlight of People's Bank

Year	Deposits from Customers (Rs. Mn)	Loans and Advances (Rs.Mn)	Investment (Rs.Mn)	Profit before taxation (Rs.Mn)
2000	115,007	87,087	32,079	(1,268)
2003	157,310	101,072	43,792	2,127
2006	269,947	207,138	62,682	4,079
2009	396,158	283,760	84,809	6,076
2012	683,951	611,414	175,491	15,249
2013	762,249	619,830	226,075	10,304
2014	793,342	627,209	290,486	17,231
2015	899,238	768,515	307,719	19,520

Source: Annual Reports of People's Bank

Review of Literature

In this part, the study focused on technical efficiency, data envelopment analysis, and prior empirical studies in this field. The technical efficiency of a firm is a comparative measure of how well it actually processes inputs to achieve its outputs, as compared to its maximum potential for doing so, as represented by its production possibility frontier (Barros and Mascarenhas, 2005). The technical efficiency relates to the productivity of inputs (Sathye, 2001). A bank is said to be technically inefficient if it operates below the frontier.

A number of alternative frontier techniques have been used to measure the technical efficiency of the banks. The frontier approaches for measuring banking efficiency can be divided into two parts. One is

parametric approach another is the non-parametric approach. The parametric approaches are stochastic frontier analysis, thick frontier approach, and distribution-free approach. The non-parametric approaches are data envelopment analysis and free disposal hull. Among all the frontier techniques, Data Envelopment Analysis (DEA) has emerged over the years as a most potent approach for measuring relative efficiency across banks (Sunil Kumar et al, 2008).

Data envelopment analysis (DEA) introduced by Charnes et al. (1978) based on Farrell's work (Farrell, 1957), is a non-parametric technique for measuring the relative efficiency of a set of similar units, usually referred to as decision-making units (DMUs). It was initially used to assess the relative efficiency of not-for-profit organizations; however, gradually its application has been extended to cover for-profit organizations as well. Its first application in banking industry appeared with the work of Sherman and Gold (1985).

DEA has several advantages. First, it allows the estimation of overall technical efficiency and decomposes. Second, it identifies the banks that are operating under decreasing or increasing returns to scale. Third, it easily accommodates multiples of inputs and outputs of banks. Fourth, it provides a scalar measure of the relative efficiency of banks. Fifth, in DEA it is not necessary to provide values for associated with input and output factors. Sixth, DEA works particularly well with small samples (Sunil Kumar et al, 2008). This study used mainly basic DEA model to measure the technical efficiency of both Bank of Ceylon and People's Bank of Sri Lanka.

In basic DEA, there are two types of model, CCR and BCC model. The CCR model is named after its developers Charnes, Cooper, and Rhodes (1978), and is based on the assumption of constant returns-to-scale (CRS). The BCC model is named after its developers Banker, Charnes and Cooper (1984), and is based on the assumption of variable returns-to-scale (VRS). The study considered both CCR and BCC model. The CCR and BCC models can be divided into two categories, input-oriented and Output oriented models.

Empirical Studies

The publicly owned banks have been most efficient followed by foreign banks and domestic private banks in utilizing the resources at their disposal to deliver financial services to their customers (Bhattacharyya et al, 1997). Das (1997) found that the banks belonging to 'State Bank of India (SBI)' group are more efficient than nationalized banks. The main source of inefficiency was technical in nature, rather than allocative. Further, Das found similar results also in 2000.

Das et al (2004) found that Indian banks are not much differentiated in terms of input or output-oriented technical efficiency and cost efficiency, but differ sharply in respect of revenue and profit efficiencies. Median efficiency scores of Indian banks have improved during the post-reforms period.

Joseph,B (2015) shows that the foreign sector banks have obtained an excellent mean total factor productivity (TFP) of 1.06 and nine foreign sector banks has obtained an eligible score of one which depicts that foreign sector banks are doing well in India. The study has revealed that by enlarging the scope of foreign banks will obviously bring growth, development and technological advancement in the Indian banking Sector. Tahir, I.M. et al (2008) shows that domestic banks on average were relatively more efficient compared to foreign banks in Malaysia between 2000 and 2006.

Fernando J.M.R et al (2014) found that mean efficiency score of the Sri Lankan banking industry is 83 percent and the highest efficiency was recorded in the year 2011. The size factor is not a significant factor to achieve the highest efficiency size of the banks but the size mainly induced the scale efficiency not the technical. Further, ownership category clearly shows that the private banks are more efficient than the public banks. This implies that in a Sri Lankan context private banks are more efficient than the public banks since they have better balance on their operational process and also they have better policies on deposits, labor and assets utilizations. In public sector ownership, category banks have more inefficiency in their labor and assets utilizations.

Seelanatha, S.L. (2012) found that such variables as operational risk, a number of purchased funds, gross interest margins, ownership, and the banks' relative ages affected their technical efficiency (TE) of the Sri Lankan banking industry. Further, the study found that such variables as operational risk, inflation, and market capitalization had a positive effect on technical efficiency (TE) in asset transformation of banks.

Objective and Data

The main objective of the study is to measures the overall technical efficiency, pure technical efficiency, and scale efficiency of People's Bank by using data envelopment analysis. Data was gathered from various annual reports of People's Bank. The study period was fifteen years from 2001 to 2015. The study selected one output variable and four inputs variables. The output variable is profit (before taxation) and inputs variables are a number of employees, investment, loans and advances, and liabilities (deposits+ borrowing) of People's Bank.

Methodology

In basic DEA, there are two types of model, CCR and BCC model. The CCR model is named after its developers Charnes, Cooper, and Rhodes (1978), and is based on the assumption of constant returns-to-scale (CRS). The BCC model is named after its developers Banker, Charnes and Cooper (1984), and is based on the assumption of variable returns-to-scale (VRS). The study considered both CCR and BCC model. The CCR and BCC model divided into two categories, input and output oriented models. The study applied input oriented CCR and BCC model given below.

$$\min_{\theta,\beta} \theta_k$$ Subject to

1. $\sum_{j=1}^{n} \beta_j X_{ij} \leq \theta_k X_{ik}$ (i= 1, 2,…..,s)

2. $\sum_{j=1}^{n} \beta_j Y_{rj} \geq Y_k$

3. $\beta_j \geq 0$ (j=1,2,…….n)

4. $\sum_{j=1}^{n} \beta_j = 1$, if variable returns-to-scale

Where X_{ik} = amount of inputs *i* used in year *k*

Y_k = amount of output *Y* produced in year *k*

θ_k = technical efficiency score for year *k*

n = the number of years (j= 1,2,…….,n)

s =the number of inputs (i= 1,2,……...,s)

The CCR model's restrictions are 1, 2, and 3 and the BCC model's restrictions are 1, 2 and 4. The CCR model provides overall technical efficiency (OTE) score and BCC model provides the pure technical efficiency (PTE) score. The scale efficiency (SE) is a ratio of efficiency score of CCR to efficiency score of BCC model. The efficient score is one and the inefficient score is less than one in the CCR and BCC model. All results have estimated by using DEAP version 2.1(Coelli T.J, 1999). The DEAP is the data envelopment analysis (computer) program.

Results and Discussion

Table.3 Overall Technical Efficiency, Pure Technical Efficiency and Scale Efficiency of People's Bank

Year	Overall Technical Efficiency(OTE)	Mean of OTE score	Pure Technical Efficiency (PTE)	Scale Efficiency (SE)
2001	0.286	0.557	1.000	0.286
2002	0.398		1.000	0.398
2003	0.623		1.000	0.623
2004	0.642		1.000	0.642
2005	0.838		1.000	0.838
2006	0.583	0.691	0.929	0.627
2007	0.682		1.000	0.682
2008	0.674		0.989	0.681
2009	0.634		0.945	0.671
2010	0.884		1.000	0.884
2011	1.000	0.915	1.000	1.000
2012	0.960		1.000	0.960
2013	0.632		1.000	0.632
2014	0.983		1.000	0.983
2015	1.000		1.000	1.000
Mean	**0.721**	**0.721**	**0.953**	**0.762**

Source: Author's calculation by using DEAP version 2.1

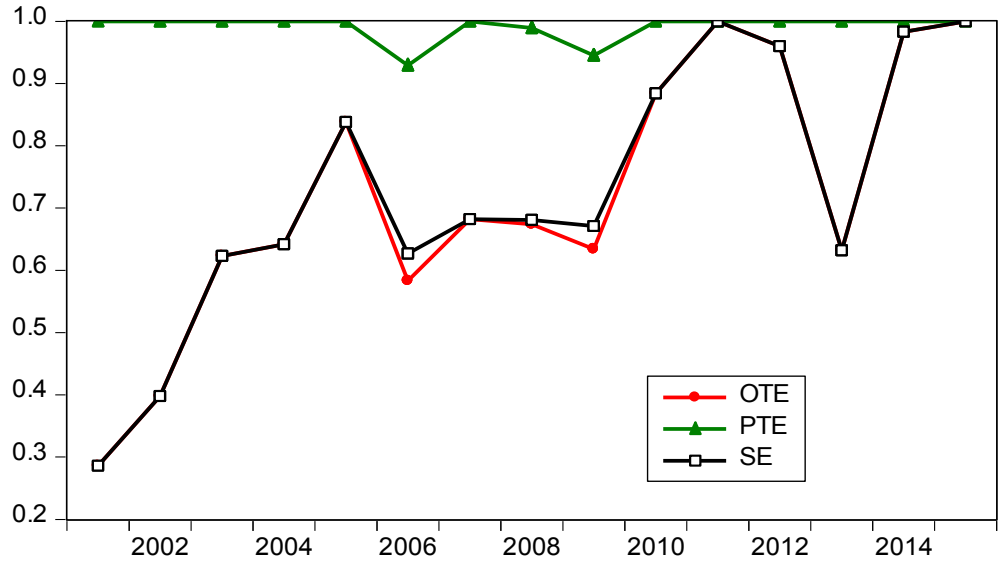

Figure.1 Trends of Efficiency Scores of People's Bank

Source: Table.3

Table.1 shows results of the score of overall technical efficiency, pure technical efficiency, and scale efficiency of People's Bank over the periods of study. The average overall technical efficiency (OTE), pure technical efficiency, and scale efficiency score were 0.721, 0.953, and 0.762 respectively. The full efficiency score is equal to one. The inefficiency at a percentage is calculated by the equation of (1-

efficiency score) x 100%. Therefore, overall technical inefficiency, pure technical inefficiency, and scale inefficiency were 27.9%, 4.7%, and 23.8% respectively over the period of study. Here, the scale inefficiency was greater than the pure technical inefficiency. Hence, the main source of technical inefficiency of People's Bank was scale inefficiency.

In the study period, there was full efficiency in 2011 and 2015 only and there was technical inefficiency in other years. The OTE and SE scores are same while PTE score is equal to one and OTE and SE differs if PTE score is less than one. In 2006, 2008, and 2009, PTE score was less than one. Therefore, the scale efficiency (SE) score was not equal to overall technical efficiency (OTE) score. Further, Table.3 shows that technical efficiency score of People's Bank had been improved over the period of study (see the column two of Table.3). The results of Table.3 is depicted by Figure.1 which shows the trends of overall technical, pure technical and scale efficiency of People's Bank in Sri Lanka. In Figure.1, the horizontal axis denotes years and vertical axis efficiency score.

Conclusions

The average overall technical, pure technical and scale efficiency scores were 0.721, 0.953, and 0.762 respectively in the study periods. This means that overall technical inefficiency, pure technical inefficiency, and scale inefficiency were 27.9%, 4.7%, and 23.8% respectively over the period of study. The main source of technical inefficiency of People's Bank was scale inefficiency. In the study period, there was full efficiency in 2011 and 2015 and there was technical inefficiency in other years. Further, technical efficiency score of People's Bank in Sri Lanka had been improved during the study period.

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