

FINANCIAL EFFICIENCY MEASUREMENT OF INDIAN BANKING SYSTEM USING DATA ENVELOPMENT ANALYSIS

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Abstract: The main objective of this paper to analyse the efficiency of the selected ten Indian Banks. The efficiency analysis was performed by using of DEA method. DEA (Data Envelopment Analysis) is the optimization method of mathematical programming to generalize the Farrell(1957). Thus DEA become a new tool in operational research for measuring technical efficiency. This examination focused on the measure of the operation efficiency of the Indian banking sector in the period 2010-2016. Indian Banking Sector is contributing to the development of the Indian economy in a significant measure. Financial efficiency measurement in this aspect is very vital. The analysis was made of two ways: constant return to scale (CRS) and variable returns to scale (VRS). In DEA, the use of constant returns to scale models requires the assumption of full proportionality between all inputs and output. The country's leading banks should pay closer attention to the regulations and administrations. The studies also show to tenure the private sector banks is better than the public sector banks during this period as well foreign banks. The results are insightful to the financial policy planner as it identifies priority areas for different banks, which can improve the performance. This paper evaluates the performance of Banking Sectors in India. Being major banks in the country, they deserve better attention by the regulators and the administrators. All the banks are operating in India and are represented in three homogeneous categories as per their size. Out of 10 banks, there are 3 foreign banks, 3 banks are nationalized and 4 private Indian banks. In the variable return scale model the public sector banks state bank of India (SBI), Panjab National Bank (PNB) are performing well, they have good efficiency. Since this study attempts to maximize output, so the output oriented Data Envelopment Analysis is used. The most efficient bank is one that obtains the highest efficiency score.

Keywords: efficiency; DEA; constant return to scale; variable return to scale; bank performance.

JEL Classification: G21.

1. Introduction

The performance of any economy depends on the banking sector as it is the main component of the financial services industry. Many organisation of the several sectors have challenged the changing financial conditions what was focused to find a more effective way to manage their business functions. The efficient banking system contributes to the implementation of the monetary policy of the country. The primary purpose of this paper is to analyse bank efficiency using commercial bank

data from India. The examination methodology based on Data Envelopment Analysis (DEA). Over the past few years, financial institutions around the world have made significant changes. For instance, technological developments, reducing the cost of information, increasing competition in both banks and non-bank financial intermediaries what caused huge changes in numerous financial systems. Bank efficiency in this transition process becomes an important problem.

"Data envelopment analysis provides a means of calculating apparent efficiency levels within a group of organisations. The efficiency of an organisation is calculated relative to the group's observed best practice. This chapter explains the basic concepts behind DEA and provides a simple graphical example. Some extensions to the DEA model, allowing the sources of inefficiency to be identified, are also discussed." (Steering Committee for the Review of Commonwealth/State Service Provision, 1997).

From the beginning of the 1990s, Indian banks have reviewed several changes to improve their efficiency. With this initiative, the performance of the Indian Scheduled Commercial Banks (Mohan, 2006; Reddy 2002) has improved greatly. This development has resulted in competitive pressures in Indian banks (Barr and Siems, 1996). As a result, pressures have been made to work effectively on Indian banks, with competitive power, future challenges and a tougher regulatory framework. Gupta et al. (2008) stated that the existence and development of banks had increased efficiency during high standards of increased competition and customer-focused services. Therefore, in today's economy, efficiency analysis of banking sector attracts more and more attention of researchers.

2. Literature Review

During the period 1990-91 India was facing a significant economic crisis, the reserve bank of India launched major reforms in the Indian banking sector in 1991 expected to create a more profitable, efficient and sound banking system based on Narasimhan Committee recommendation of financial sector reforms. In order to improve the efficiency of various banks through entry regulation, branch deletion, interest rate control and diversification of public sector banks (PSBs), state-owned banks can raise their capital with 49 per cent from markets. These reforms targeted the bank to improve the profit through a reduction in cash reserve ratio (CRR) and statutory liquidity ratio (SLR) to strengthen the banking system by introducing micro practical measures (Bhide 2001; Prasad and Ghosh, 2003; Kumar and Charles 2011).

The performance of any firm is counted on its financial parameter with strong efficiency, and the efficiency of a firm is relative to the competences of firms in a sample. DEA has been used to identify banks with the given output range various inputs in their removal. Sakar (2006) analyzed 11 banks in Turkey using input variables: Branch number, Employee per branch, Assets, Loans, Deposits and output variables: ROA (Return on Assets), ROE (Return on Equity), and Interest income (assets), Interest income (operating income), and Non-interest income (assets).

In the Indian context, there are some studies that have focused on the efficiency of the public sector banks (PSBs) using the DEA. Das (1997) conducted various technical, allocated and scale efficiency of different PSBs using the DEA method during 1999-1996. According to the study, the overall efficiency decreased by time,

technological performance has decreased and efficiency has improved slightly. Kumbharkar and Sarkar (2003) determined the pricing efficiency of public and private sector banks in India. The Stochastic Cost Frontier Model, which explains translog cost function. Seyford and Zhu (1999) examined performance of 55 US banks using two-step DEA method. The results suggested relatively large scale bank while showing good performance on profitability. Wu, Yang et al. (2006) examined 142 banks in Canada and oversee the number and expenditure of employees for the input parameter, and some variables have been observed for output: deposit, income and bank loans.

Data Envelopment Analysis has been successfully used to measure the efficiency of commercial banks. The number of DEA's applications have appeared in the performance of the banks. Berger and Humphrey (1999) reviewed 130 operational studies of the financial sector with professional banks. There have been many attempts to study the efficiency and productivity of the banking sector in Developed countries - however, analysis of the efficiency of the banks of developing countries in India and related countries. Apart from the universal accounting mechanisms, RBI is also using data analysis to determine the effectiveness of the banking sector.

Many studies have been done on performance analysis using the DEA method in India. Bhattacharya et al. (1997) used the DEA method to measure the productive efficiencies of Indian commercial banks from 1980 to 1990 and impact of the policy on liberalizing measures taken in 1980 on the performance of the various category of the banks. He said that Indian public banks are the best performing banks because the banking sector has dominated Indian public sector banks and new private sector banks have not yet fully stood in the Indian banking scenario.

3. Research Methodology

Data envelopment analysis is a linear programming process for the range of analysis input and output. DEA model conception of variable return on the scale can be used for the calculation of input-oriented which allows a variable return to scale. In this article, it has been studied in private, public and foreign banks. The duration of the study is from 2010 to 2016. This study has used R software. This paper aims at analysing the technical efficiency of 10 major commercial banks in India in a very comprehensive manner using data envelopment analysis (DEA). For this, the present study has explored five areas of banking operational efficiency: income on the investment, interest income, Net NPAs, Interest Expended, operating expenses activities specified input-output data set of each of the areas. VRS, CRS (scale efficiency), DRS, IRS model of DEA technique has been utilized to review area wise relative technical efficiency of selected banks. In addition, the study also predicts efficiency as a complete average approach and product approach following the study.

4. Result

There is a mathematical approach to DEA that can be adopted which is illustrated using Linear Programming technique. In this paper, we have to take 10 scheduled commercial banks for FY 2010-2016.

Here, the findings for Multi-stage based constant returns to scale (CRS) are extracted and analysed and presented. The findings and the interpretations are by

input-oriented multi-staged CRS Data Envelopment Analysis. Input variables are interest expended and operating expenses while the output variables are interest income, income on investment and NPAs. Table 1 indicates the results of efficiency summary; PNB, CITI, DBS banks have an efficiency value of 1.000. Other banks have values less than 1.000 which indicates the need to improve their input variables. This is possible by either decreasing or increasing the input levels. For example, in the case of State Bank of India (SBI), they need to improve its efficiency by 05.85%. For example, in the case of Central bank of India (CBI), they need to improve its efficiency by 2.35%. In terms of other private banks, HDFC banks need to improve their efficiency by 13.71%, ICICI banks need to improve their efficiency by 40.58%. Another three private sector banks Axis, Yes and Standard Chartered Banks, banks need to improve their efficiency by 7.31%, 39.91% and 2.25% respectively.

Table 1. Constant return to scale (CRS) calculation

Banks	2010	2011	2012	2013	2014	2015	2016	Avg.
SBI	1.0000	1.0000	0.9156	0.9169	1.0000	1.0000	0.7583	0.9415
CBI	1.0000	0.9071	1.0000	1.0000	1.0000	1.0000	0.9283	0.9765
PNB	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
ICICI	0.4573	0.4524	0.4439	0.5927	0.6457	0.7688	0.7990	0.5942
HDFC	1.0000	0.7507	0.6448	0.9039	0.9074	0.9615	0.8719	0.8629
AXIS	0.9210	0.9068	0.7747	0.8855	1.0000	1.0000	1.0000	0.9269
YES	1.0000	0.4989	0.4317	0.4693	0.4884	0.6256	0.6922	0.6009
CITI BANK	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
STAD.CHRTD	1.0000	1.0000	0.8422	1.0000	1.0000	1.0000	1.0000	0.9775
DBS	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Source: Calculated by Author

Table 2. Variable return to scale (VRS) calculation

Banks	2010	2011	2012	2013	2014	2015	2016	Avg.
SBI	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
CBI	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9288	0.9898
PNB	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
ICICI	0.7788	1.0000	1.0000	1.0000	1.0000	0.9633	0.9121	0.9506
HDFC	1.0000	1.0000	1.0000	1.0000	0.9694	0.9987	1.0000	0.9954
AXIS	0.9921	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9989
YES	1.0000	0.5646	0.6825	0.8483	0.9313	0.8817	0.7661	0.8106
CITI BANK	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
STAD.CHRTD	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
DBS	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Source: Calculated by Author

Variable returns to scale (VRS) is a type of frontier scale used in data envelopment analysis (DEA). It helps to estimate efficiencies whether an increase or decrease in input or outputs. (Cooper, Seiford, & Zhu, 2011). This method includes both increasing and decreasing returns to scale. Hence, VRS may exhibit increasing, constant and decreasing returns to scale when working in Data Envelopment Analysis Program (DEAP). In contrast to CRS model, Table 2 shows the current VRS model explained banks as efficient, namely SBI, PNB, CITI BANK, STAD. CHRTD. and DBS bank while CRS showed only three efficient banks. In the

case of Central Bank of India (CBI), they need to improve its efficiency by 1.02%. In terms of other private banks, ICICI bank need to improve its efficiency by 4.94%, HDFC banks need to improve their efficiency by 0.46%, Another two private sector banks Axis and Yes banks, banks need to improve their efficiency by 0.11% and 18.94% respectively.

(Benicio & De Mello, 2015) has stated, "if output increases by less than proportional change in inputs, there are decreasing returns to scale". Thereby, it can be interpreted that the interest income, income on investment and NPAs of the bank has increased by a larger proportion of the given amount of the interest expended and operating expenses thus they need to increase or decrease its interest expended and operating expense to become efficient.

The company must set the DRS after overstepping the extension limit. Continuous increase in all inputs and therefore, the expansion in the size of a firm from a particular point extends to the emergence of the DRS. Managing disability is one of the reasons for the DRS incident to the extent of management work efficiency. As the firm's size increases, incapability increases and the chances of a large number of product degradation increase greatly.

5. Conclusion

According to the available literature, few researchers conducted a non-parametric approach to measure the efficiency of the Indian banks. De (2003) found some evidence that private banks in India are more profitable than public sector banks. Kumbhakar and Sarkar (2003) used a cost function approach to find efficiency. They reported the difference in the growth rate between the Indian banks public and private banks in the pre-deregulation as compared to post-deregulation period. The results indicate that the efficiency of interest margin is dependent on time whereas the efficiencies of other outputs-non-interest income, investments and credits are dependent on time. This study focuses on determining the efficiency score of 10 banks and also comparing their efficiencies from 2010 to 2016. All the banks are operating in India and are represented in three homogeneous categories as per their size. Out of 10 banks, there are 3 foreign banks, 3 banks are nationalized and 4 private Indian banks. In the variable return scale model the public sector banks state bank of India (SBI), Panjab National Bank (PNB) are performing well, they have good efficiency. And foreign banks also have good efficiency in a variable scale model. Banks like Central bank of India (CBI), AXIS, ICICI, HDFC and YES bank can be a matter of concern as their efficiency scores are below satisfactory level. The major factor resulting in the poor performance by these five banks is their huge amounts of interest expended and operating expenses. Either these banks possess blocked/non-performing assets or are not able to make a set off between the deposits and advances.

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Appendix - Table 3 Rank based on average efficiency scores of ten years

Rank	Average Efficiency	Banks
1	1.0000	PNB
1	1.0000	CITI BANK
1	1.0000	DBS
2	0.9887	STAD.CHRTD
3	0.9882	CBI
4	0.9708	SBI
5	0.9634	AXIS
6	0.9313	HDFC
7	0.7893	ICICI
8	0.7772	YES