International Journal of Economics, Commerce and Management
United Kingdom Vol. II, Issue 8, 2014
http://ijecm.co.uk/ ISSN 2348 0386

EVALUATING THE EFFICIENCY OF INDIAN BANKING INDUSTRY USING DATA ENVELOPE ANALYSIS

Arora, Gurpreet Kaur
IP University, Delhi, India
gurpreetkaur31@gmail.com

Abstract

The banking sector plays a very crucial role in the economic growth of a country. The efficient banking sector is thus the fundamental requirement for smooth functioning of any economy. In the present study an attempt has been made to assess the efficiency of Indian Banking Sector. Using data envelopment analysis (DEA), the study aims to measure the extent of technical, pure technical and scale efficiencies of the Indian banks across different ownership categories for the period 2011-12. Ten out of the 44 banks selected lie on the efficiency frontier and form the reference set for their peers. The result indicates that contribution of scale inefficiency in overall technical inefficiency has been observed to be smaller than what been observed due to managerial inefficiency (i.e., pure technical inefficiency). Further, it is observed that efficiency scores do not vary much across public sector, private sector and foreign banks. Performance of public sector and private sector banks is almost at par with respect to technical efficiency whereas in the case of foreign banks, there lays scope for improving scale efficiency.

Keywords: Data Envelope Analysis, Overall Technical Efficiency, Pure Technical Efficiency, Scale Efficiency, Reference Set

INTRODUCTION

Banking sector is an integral part of this financial system and plays a fundamental role in economic development. Thus a healthy and smooth functioning financial system has become the requirement of any efficient economy. It not only boosts up the domestic demand and savings but also is an important pull factor for attracting foreign investments contributing to the very essential capital formation and further development and deepening of financial markets. The recent global financial crisis and its ripple effects spreading across the globe have reemphasized the importance of an efficient as well as a regulated banking system. The performance of the banking sector is more closely linked to the economy than perhaps that of any other sector. The presence of a crisis in the banking system in terms of its insolvency has

the potential to push the economy into a slump, in what is the most extreme form of credit driven macroeconomic cycle (Caprio and Honohan 2002). Hence the study of efficiency of banking sector in particular becomes relevant as the information so generated can be utilized both by the government in designing policy framework as well as by the banks in evaluating their performance. The Indian Banking industry is governed by the Banking Regulation Act of India, 1949 and can be broadly classified into two major categories, non-scheduled banks and scheduled banks. Scheduled banks comprise of commercial banks and the co-operative banks. In terms of ownership, commercial banks can be further grouped into nationalized banks, the State Bank of India and its group banks, regional rural banks and private sector banks.

Since independence, banking industry in India has undergone structural changes to cope up with the evolving social and economic context of development. It has moved gradually from a regulated environment to a deregulated market economy. The pace of transformation has been even more significant in recent times with technology acting as a catalyst. Advances in information and communication technology have enabled banks to introduce new products and delivery channels, and strengthen their internal control systems. All these changes are expected to have significantly affected the way banks combine inputs to produce and deliver their products and services having a bearing on their efficiency and productivity. With the eruption of the global financial crisis in 2007, growth rate of the Indian economy came under arrest notwithstanding the sound banking system, negligible exposure of Indian banks to sub-prime assets and relatively well-functioning financial markets. The Indian banking sector emerged relatively unscathed from the headwinds of the west, but high inflation and depreciating rupee at the domestic front have created a challenging operational environment for Indian banks.

The present study has been undertaken to study and analyze the comparative efficiency of nationalized, private and foreign banks for the period 2011-12 using Data Envelopment Analysis (DEA). The first part of the study focuses on measuring the overall technical efficiency (OTE), pure technical efficiency (PTE) and scale efficiency (SE) of the sample 44 banks. The second part examines if there is any significant impact of ownership on the efficiency scores (as calculated in part one) of banks.

LITERATURE REVIEW

"Data Envelopment Analysis is a nonparametric deterministic methodology for determining the relatively efficient production frontier, based on the empirical data on chosen inputs and outputs of a number of entities called Decision Making Units (DMUs)". Accordingly DEA, from the set of available data, would identify the relatively efficient units fitted on the efficiency frontier and would define all other inefficient units that are below the efficiency frontier. A DMU is an entity

that produces outputs and uses up inputs, in this study, each bank constitutes a DMU. A number of attempts in the recent years have been made by the researchers to analyze the efficiency of the banking sector using DEA. However, in the literature concerning efficiency of banks operating in India during the period 2011-2012, hardly any attention has been paid to examining technical and pure technical efficiency of banks. This research is an attempt to study the already existing literature on the efficiency appraisal of banks in India and provide a methodological framework which uses the technique of DEA to analyze the technical-scale efficiency scores for improving future performance and examining the impact of ownership of the efficiency score. Below mentioned is a succinct overview of domestic and international studies conducted in the banking sector using DEA.

Ayadi (1998) examined bank performance in Nigeria by using DEA. The inputs variables used were the interest paid on deposits, as well as expenses on personnel, administration etc and total deposits, while outputs variables were defined as total loans, interest income and non-interest income. He concluded that the weakness of Nigerian banks is attributed mainly to poor management which manifests in excessive credit and liquidity risk, poor loan quality and sluggish ability to generate capital internally. He also found that the relatively efficient Nigerian banks are those that have been in existence for a long period of time.

Al-Shammari and Salimi(1998) have examined the comparative operating efficiency of Jordanian commercial banks from 1991-1994 by using a modified version of DEA in which no inputs are specified. The only variables considered were the financial ratios, these ratios were return on investment, return on equity, earnings per share, credit to total assets, credit to deposits and cash and portfolio investments to deposits. The results obtained suggest that the majority of banks investigated were fairly inefficient over the period 1991-1994. The study results also revealed the composite reference set and their shadow prices, major determinants of banks' relative performance, and the target financial ratios.

Mukerjee et al. (2002) explored the linkage between performance benchmarking and strategic homogeneity of Indian commercial banks. They used five parameters as output variables in the DEA model namely, deposits, net profits, advances as given by each individual bank, non-interest income, interest spread, while the input parameters include net worth of the banks, borrowings of the banks, operating expenses, number of employees in the country and number of bank branches in the country. They found that the public sector banks generally outperform the private and foreign banks.

Al-Faraj et al. (2006) investigated the performance of the Saudi commercial banking industry using DEA to evaluate the technical efficiency of Saudi banks for the year 2002 and compared with world mean efficiency scores. Their study revealed that the mean efficiency score of Saudi commercial banks compares very well with the world mean efficiency scores.

They recommends that Saudi banks should continue their efforts of adapting new technologies and providing more services in order to sustain competitive advantages as Saudi Arabia continues to deregulate the banking industry.

Bonin, Hasan, Wachtel (2004) investigated the effects of ownership on bank efficiency in six transition countries. The efficiency measures are computed from stochastic frontier for the largest banks in transition countries and then used in ownership and privatization regressions having dummy variable for bank type. The study supported that the foreign owned bank are most efficient. In addition, the importance of attracting a strategic foreign owner in privatization is confirmed.

Sathye (2005) examined the impact of bank privatization on bank performance and efficiency using data of banks in India for five year period— 1998- 2002. Statistical analysis was performed using the difference of means test for three groups of banks- partially privatized, fully state owned and those already in private sector. The partially privatized banks (PPBs) showed a significant positive difference in financial performance and efficiency when compared to the fully public sector banks (FPBs). Also, the financial performance of banks already in the private sector is not significantly different from those that are partially privatized. With partial privatization of banks showing encouraging results, the study suggested that the proposal of the Government of India to bring down its stake from the capital may further help in improving the performance and efficiency of these banks.

OBJECTIVE OF STUDY

1. To undertake a comparison of efficiency gains across different groups of banks for the period 2011-2012.
2. To identify the efficient banks and inefficient banks as per DEA approach.
3. To measure the efficiencies and inefficiencies in the Indian banking sector by overall technical efficiency, Pure Technical efficiency and Scale efficiencies.

METHODOLOGY

Design and Data

The study is carried out across 19 nationalized banks, 15 private sector banks and 10 foreign banks for the period 2011-2012. The selection of private and foreign banks has been based upon their average asset size for the period 2011-12. Also the study confines itself to 19 nationalized banks and excludes State Bank of India (SBI) & it's associates as the latter is constituted under separate legislation i.e. SBI Act 1955. The data collected is secondary in nature and has been collected from the publications of Reserve Bank of India and Indian Banking Association. The research design used here is descriptive and analytical in nature.

The study is divided into two parts as discussed. Part one deals with calculating overall technical efficiency, pure technical efficiency and managerial efficiency for different categories of banks. Max DEA version 5 software is used here for analyzing the efficiencies of banks using DEA. Part two further proceeds with hypothesis testing so as to find out if there is any difference in the efficiency of different banks with respect to their ownership structure.

DEA Framework

DEA is a linear programming model that measures the efficiency of DMUs in multiple-inputs, multiple-outputs setting. Typically, each of the DMUs in a given population use the same multiple inputs in varying quantities to produce varying quantities of the same multiple outputs. Using the actual observed values for the inputs and outputs for each DMU, DEA constructs a piecewise linear production surface, which in economic terms represents the revealed best-practice production frontier, referred to as the empirical production function or the efficient frontier. Units that lie on the surface are deemed efficient in DEA, while those units that do not, are termed inefficient. DEA provides a comprehensive analysis of relative efficiencies for multiple input-multiple output situations by evaluating each DMU and measuring its performance relative to an envelopment surface composed of other DMUs. Those DMUs forming the efficiency reference set are known as the peer group for the inefficient units. As the inefficient units are projected onto the envelopment surface, the efficient units closest to the projection and whose linear combination comprises this virtual unit form the peer group for that particular DMU. The targets defined by the efficient projections give an indication of how this DMU can improve to be efficient.

Speaking broadly, the DEA technique defines an efficiency measure of a production unit by its position relative to the frontier of the best performance established mathematically by the ratio of weighted sum of outputs to weighted sum of inputs. This ratio is normalized according to best practical peers and efficiency is calculated to be between 0 and 1, as 1 representing efficient unit.

The standard DEA models have an input and output orientation. An input orientation identifies the efficient consumption of resources while holding outputs constant. An output orientation identifies the efficient level of output give existing resource consumption. The output orientation provides estimates of the amount by which outputs could be proportionally expanded given existing input levels. In addition, DEA models can be either constant or variable returns to scale (Banker et al., 1984). The original formulation of the DEA model introduced by Charnes, Cooper and Rhodes(1978), also denoted as CCR hereafter, assume Constant Returns to Scale (CRS)and the production frontier is a piecewise linear envelopment surface. This model was further extended by Banker, Charnes and Cooper (1984), hereafter referred to as BCC, to take

into account impact of returns to scale within the group of DMUs to be analyzed. The measure of efficiency obtained from the CRS model consists of technical efficiency of a firm which 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). A measure of technical efficiency under the assumption of CRS is known as a measure overall technical efficiency (OTE). The OTE measure helps to determine inefficiency due to the input/output configuration as well as the size of operations. In DEA, OTE measure has been decomposed into two components: pure technical efficiency (PTE) and scale efficiency (SE). This decomposition allows an insight into the source of inefficiencies. 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 managerial performance. Scale efficiency is the ratio of CRS technical efficiency to VRS technical efficiency i.e. the ratio of OTE to PTE. If the ratio is equal to one, the firm exhibits CRS. If scale efficiency is less than one the respective firm exhibits VRS (increasing/decreasing). The measure of SE provides the ability of the management to choose the optimum size.

The present study undertakes the measurement of efficiency scores of banks using the input-oriented approach under both CCR and BCC models

Variable selection

There are two common approaches to variable selection in bank performance evaluation in DEA: intermediation approach and production approach. In the intermediation approach, the banks are considered as intermediaries using deposits as an input in the production process. The production approach, on the other hand considers banks as service providers, thus this approach considers deposits as an output involving the creation of value added for which customers bear an opportunity cost, following Berger and Humphrey (1997), the research will be based on the intermediation approach under the DEA model to evaluate the productivity as well as the technical efficiency of the different banks. The performance will be assessed on both the Constant Returns to Scale i.e. CRS as well as Variable Returns to Scale assumption i.e. VRS. In the present study, the output sector will consist of two output variables: (i) spread, and (ii) noninterest income. The output variable ‘spread’ is also known as the ‘net-interest income’ and is computed by subtracting ‘interest expenses’ from ‘interest income’. This variable connotes the net income received by the banks from their traditional activities like advancing of loans and investment in government and other approved securities. The output variable ‘non-interest income’ accounts for income from off-balance sheet items, such as commission, exchange and

brokerage, and so on. The choice of output variables is consistent with the goals pursued by the Indian banks. In this study, the inputs that are identified for computing the efficiency scores comprise of (i) physical capital, (ii) labor, and (iii) loanable funds. The number of fulltime staff will be used as a measure of labor input. The input variable physical capital will represent the book value of premises and fixed assets net of depreciation. The input variable loanable funds will include both deposits and borrowings.

ANALYSIS AND FINDINGS

The DEA model has been run for all general insurance companies so considered in study, both for computing the technical efficiency under CCR model and pure technical and scale efficiency for BCC model.

Table 1: Efficiency Score

OTE ,PTE AND SE IN BANKS								
S. No	**DMU NAME**	**OTE (CRS)**	**OTIE**	**PTE (VRS)**	**PTIE**	**SE (VRS)**	**SIE**	**RTS**
Public Sector Banks								
1	Allahabad Bank	0.946684	0.053316	0.96366	0.03634	0.98238	0.01762	Decreasing
2	Andhra Bank	1	0	1	0	1	0	Constant
3	Bank of Baroda	0.81565	0.18435	0.84837	0.15163	0.96143	0.03857	Decreasing
4	Bank of India	0.818927	0.181073	0.86022	0.13978	0.95199	0.04801	Decreasing
5	Bank of Maharashtra	0.94627	0.05373	0.9958	0.00421	0.95027	0.04973	Increasing
6	Canara Bank	0.88789	0.11211	0.95073	0.04927	0.9339	0.0661	Decreasing
7	Central Bank of India	0.949379	0.050621	0.9867	0.0133	0.96217	0.03783	Decreasing
8	Corporation Bank	0.931721	0.068279	0.96026	0.03974	0.97028	0.02972	Increasing
9	Dena Bank	0.923923	0.076077	1	0	0.92392	0.07608	Increasing
10	Indian Bank	1	0	1	0	1	0	Constant
11	Indian Overseas Bank	0.926166	0.073834	0.94434	0.05566	0.98076	0.01924	Decreasing
12	Oriental Bank of Commerce	0.977309	0.022691	1	0	0.97731	0.02269	Decreasing
13	Punjab & Sind Bank	0.935603	0.064397	1	0	0.9356	0.0644	Increasing
14	Punjab National Bank	1	0	1	0	1	0	Constant
15	Syndicate Bank	0.952411	0.047589	0.97156	0.02844	0.98029	0.01971	Decreasing
16	UCO Bank	0.904848	0.095152	0.92366	0.07634	0.97964	0.02036	Decreasing
17	Union Bank of India	0.916512	0.083488	0.95324	0.04676	0.96147	0.03853	Decreasing
18	United Bank of India	0.917644	0.082356	0.94925	0.05075	0.96671	0.03329	Increasing
19	Vijaya Bank	0.926536	0.073464	0.96928	0.03072	0.9559	0.0441	Increasing
	MEAN EFFICIENCY	0.930393	0.069606	0.96195	0.03805	0.96705	0.03295	

	Foreign Banks							
20	Bank of America NA	1	0	1	0	1	0	Constant
21	Barclays Bank PLC	1	0	1	0	1	0	Constant
22	BNP Paribas	0.8286	0.1714	1	0	0.8286	0.1714	Increasing
23	Citibank N.A.	0.71929	0.28071	1	0	0.71929	0.28071	Decreasing
24	DBS Bank Ltd.	0.62877	0.37123	0.74595	0.25405	0.84292	0.15708	Increasing
25	Deutsche Bank AG	0.9201	0.07991	1	0	0.9201	0.07991	Decreasing
26	JPMorgan Chase Bank	0.89008	0.10992	0.91466	0.08535	0.97313	0.02687	Increasing
27	Standard Chartered Bank	0.75137	0.24863	1	0	0.75137	0.24863	Decreasing
28	The Hongkong and Shanghai Banking Corpn.Ltd.	0.70341	0.29659	0.93049	0.06951	0.75595	0.24405	Decreasing
29	The Royal Bank of Scotland	1	0	1	0	1	0	Constant
	MEAN EFFICIENCY	0.84416	0.15584	0.95911	0.04089	0.87914	0.12086	
Private Sector Banks								
30	Axis Bank Ltd.	1	0	1	0	1	0	Constant
31	City Union Bank Ltd.	0.981599	0.018401	1	0	0.9816	0.0184	Increasing
32	HDFC Bank Ltd.	0.945009	0.054991	1	0	0.94501	0.05499	Decreasing
33	ICICI Bank Ltd.	1	0	1	0	1	0	Constant
34	Indusind Bank Ltd.	0.986624	0.013376	0.99754	0.00246	0.98906	0.01094	Increasing
35	ING Vysya Bank Ltd.	0.965612	0.034388	1	0	0.96561	0.03439	Increasing
36	Kotak Mahindra Bank Ltd.	1	0	1	0	1	0	Constant
37	Tamilnad Mercantile Bank Ltd.	1	0	1	0	1	0	Constant
38	The Federal Bank Ltd.	0.927777	0.072223	0.95525	0.04475	0.97124	0.02876	Decreasing
39	The Jammu & Kashmir Bank Ltd.	0.864214	0.135786	0.8905	0.1095	0.97048	0.02952	Decreasing
40	The Karnataka Bank Ltd.	0.879391	0.120609	0.89728	0.10273	0.98007	0.01993	Decreasing
41	The KarurVysya Bank Ltd.	0.923661	0.076339	0.94067	0.05933	0.98192	0.01808	Decreasing
42	The Lakshmi Vilas Bank Ltd.	0.942954	0.057046	1	0	0.94295	0.05705	Increasing
43	The South Indian Bank Ltd.	0.87611	0.12389	0.89468	0.10532	0.97925	0.02075	Decreasing
44	YES Bank	0.814198	0.185802	0.83087	0.16913	0.97994	0.02006	Decreasing
	MEAN EFFICIENCY	0.940477	0.0595234	0.96045	0.03955	0.97914	0.02086	

Where
OTE= Overall technical efficiency, OTIE=Overall technical inefficiency= (1-OTE),
PTE= Pure technical efficiency,PTIE=Pure technical inefficiency= (1-PTE),
SE= Scale efficiency, SIE=Scale inefficiency= (1-SE),
RTS=returns-to-scale, IRS= increasing returns-to-scale,
CRS=constant returns-to-scale; and DRS=decreasing returns-to-scale

Of the 19 PSBs, 3 banks were found to be technically efficient since they had OTE score of 1. The remaining 16 banks have OTE score less than 1 which means that they are technically inefficient. The efficient banks in Indian public sector banking industry are Andhra Bank, Indian bank and Punjab National Bank. The PSBs results indicate that 3 efficient banks (i.e., 15.78 %) are operating at most productive scale size and experiencing CRS. Further, 6 banks (i.e., 31.57%) are operating above their optimal scale size and thus, experiencing IRS. The remaining 10 (i.e., 52.63%) banks have been observed to be operating in the zone of DRS. Of the 10 Foreign sector Banks, 3 banks were found to be technically efficient. The remaining 7 banks are technically inefficient. The efficient banks in Indian Foreign sector banking industry are Bank of America NA ,Barclays Bank PLC and The Royal Bank of Scotland. The foreign banks results indicate that 3 efficient banks (i.e.,30 %) are experiencing CRS. Further, 3 banks (i.e.,30%) are, experiencing IRS. The remaining 4 (i.e.,40 %) banks have been observed to be operating in the zone of DRS . Of the 15 Private sector Banks, 4 banks were found to be technically efficient. The efficient banks in Indian Private sector banking industry are Axis Bank Ltd., ICICI Bank Ltd., Kotak Mahindra Bank Ltd. and Tamilnad Mercantile Bank Ltd. The remaining 11 banks are technically inefficient. The Private banks results indicate that 4 efficient banks (i.e.,26.66%) are experiencing CRS. Further, 4 banks (i.e.,26.66%) are experiencing IRS. The remaining 7 (i.e.,46.68 %) banks have been observed to be operating in the zone of DRS.

Hypothesis Testing

The next part of the study is designed to test the following hypothesis:

> *H_0 : There is no significant difference in the efficiency of public sector banks, private sector banks and foreign banks.*

The statistical tests that can be relied upon for testing the above hypothesis would either be parametric or non-parametric depending upon the normality of data. Broadly speaking, parametric tests assume the data is normally distributed while non–parametric tests do not go with the underlying assumption of normality. Accordingly, ANOVA (i.e. Analysis of Variance) is used under parametric category and Kruskal-Wallis test is used under non-parametric category.

At this stage, it becomes relevant to check the data for normality Null hypothesis assumes that data is normally distributed and following test statistics in Table 2 rejects the null hypothesis:

Table 2: Test of Normality

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	df	Sig.
Mean OTE	.155	44	.010	.847	44	.000
Mean PTE	.212	44	.000	.793	44	.000
Mean SE	.253	44	.000	.712	44	.000
a. Lilliefors Significance Correction						

Observing the test statistic in Table 2, it can be concluded that data is not normally distributed (95% confidence level), hence, the study proceeds with application of Kruskal-Wallis test to find out if there is any significant difference between the efficiency of public sector banks, private sector banks and foreign banks.

Table 3: Kruskal-Wallis Test

Banks			
	Banks	**N**	**Mean Rank**
Mean OTE	Public Sector Banks	**19**	**22.89**
	Private Sector Banks	**15**	**25.53**
	Foriegn Sector Banks	**10**	**17.20**
	Total	**44**	
Mean PTE	Public Sector Banks	**19**	**20.76**
	Private Sector Banks	**15**	**23.40**
	Foriegn Sector Banks	**10**	**24.45**
	Total	**44**	
Mean SE	Public Sector Banks	**19**	**21.89**
	Private Sector Banks	**15**	**27.60**
	Foriegn Sector Banks	**10**	**16.00**
	Total	**44**	

Table 4: Test of Statistics

Test Statistics[a,b]			
	Mean OTE	Mean PTE	Mean SE
Chi-Square	**2.567**	**.673**	**4.987**
Df	**2**	**2**	**2**
Asymp. Sig.	**.277**	**.714**	**.083**
a. Kruskal Wallis Test			
b. Grouping Variable: banks			

Interpreting the test statistics in Table 4, as the *p value* in case of all the three efficiency score is more than 0.05, so we fail to reject the null hypothesis (95% confidence level) and hence it can be conveniently inferred from the above data that there is no significant difference in the performance of public sector banks, private banks and foreign banks.

CONCLUSION, LIMITATIONS AND FUTURE SCOPE

The study examines the performance of Indian banks under different ownership structure for the period 2011-2012. DEA technique is used to evaluate the efficiency scores and it is observed that only 10 out of 44 selected banks are efficient. These 10 banks define the *efficiency frontier.* Out of these efficient banks, three banks are from the nationalized category (Andhra Bank, Indian bank and Punjab National Bank), the other four from private sector (Axis Bank Ltd., ICICI Bank Ltd., Kotak Mahindra Bank Ltd. and Tamilnad Mercantile Bank Ltd.) and remaining three from foreign sector (Bank of America NA ,Barclays Bank PLC and The Royal Bank of Scotland).The OTE score is found to be the least for foreign banks whereas the private sector banks have marginally outperformed the public sector banks. However, the difference in the efficiency scores is not found to be statistically significant. PTE of nationalized, private and foreign banks in the post financial crisis period is robust at more than 90% for all category of banks included in the study. Thus it is believed that with respect to managerial efficiency, the banks across different ownerships are equally competitive.SE is again the least for foreign banks and at par for nationalized and private banks.

Overall, the study concludes that difference in the efficiency scores of these different categories is not statistically significant and performance of nationalized and private sector banks has been robust with average OTE score of more than 90 per cent during the post global financial crisis period. The results obtained from the study are in close conformity with the previous studies. Kumar and Charles (2012) in their paper conclude that the performance of PSBs is at par with private sector banks in terms of efficiency. Dwivedi and Charyulu (2011) in their study state that banks across different categories have performed equally well. Gulati (2011) in her study reports that ownership structure has a weak effect on the performance of banks as the efficiency differences between public and private sector banks are not statistically significant. With liberalization of the banking sector, PSBs have witnessed gradual reduction in government control and a fresh orientation towards improved profitability thus making them more competitive. Moreover, factors such as stringent RBI norms, adoption of improved risk management practices, superior role of information technology, focus on improved customer service quality etc. have ensured a satisfactory performance for Indian banks successfully withstanding the crisis.

The present study is carried out for one year i.e 2011-2012, the results may differ if longer period of time is taken. Also the study considered two input variables and two output variables, however there are many other input and output variables that can be used for evaluating the efficiency. The study is concerned with computing efficiency score and impact of ownership, which can further be used to identify the variables that affect the efficiency score so computed by using regression which is not covered in the study.

The results of this study shall further be investigated by expanding the magnitude of inputs and outputs. Also the study can be carried out over a longer period of time and can incorporate returns to scale and Malmquist indices of Total Factor productivity change (TFP).

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