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An Analysis of Revenue Maximising Efficiency of Public Sector Banks in the Post-Reforms Period

Abstract: The paper investigates and compares the performance of the Indian public sector banks (PSBs) based on revenue maximising efficiency in the deregulation period from 2001-02 to 2012-13. Several efficiency estimates viz., overall technical efficiency, pure technical efficiency and scale efficiency of individual banks are calculated using Data Envelopment Analysis (DEA). The empirical findings indicate the presence of managerial and scale inefficiencies in the operation of the most of the PSBs. Applying the Tobit regression analysis, the paper also assesses the impact of different environmental factors, like profitability, the level of non-performing assets, size etc. on the efficiency of PSBs. It is observed that banks with high profitability, low level of non-performing assets, and relatively larger size are more technically efficient.

Keywords: Public sector banks, Efficiency; DEA; Tobit model.

JEL Codes: C24, C61, G21

1. Introduction

Indian banking continues to remain in the forefront of the financial system. Over the past three decades, the Indian banking sector has achieved substantial progress on many fronts. By transforming class banking to mass banking, from the wholesale banking to retail banking and from macro-banking to micro-banking; the Indian banking system has become a potent tool in socio-economic devel-

opment of the economy. The banking sector in India includes commercial and co-operative banks. Commercial banks accounts for approximately 90 percent of assets of the banking system. Commercial banks are divided in two categories: Schedule commercial banks (i.e., which are listed in Schedule II of the Reserve Bank of India Act, 1934) and non-scheduled commercial banks. Further, on the basis of the pattern of ownership, scheduled commercial banks are classified into three broad categories: Public sector banks (PSBs), domestic private sector banks (PBs) and foreign banks (FBs). State Bank of India (SBI) and its associate banks, nationalised banks (NBs) and Regional Rural Banks (RRBs) come in the category of PSBs. On the other hand, PBs includes old private sector banks (OPBs) and new private sector banks (NPBs). Banks that had been in business prior to 1992 are known as OPBs whereas NPBs came into existence after 1992.

Of these, PSBs account for over 70 percent of total banking business and have a nationwide network of branches. They play an important role in India's economic and social development. They employ a large number of staff and have strong presence at rural and semi-urban areas. On the other hand, NPBs are more capital-intensive, they have adopted modern banking technology, and are more profitable. As far as FBs are concerned, they are more techno-savvy and have a significant share in the market but they have constrained their operations in major urban centres. Further, RRBs are sponsored by PSBs and their activities are localized. They serve the needs for rural credit and have a very small share (approximately 3 percent) in the Indian banking industry.

In the post-reforms era, the PSBs are facing severe competition from private banks, especially from NPBs that are better equipped with banking technology and practices. As a result, the market share of PSBs in terms of investments, deposits, advances, and total assets has been decreasing constantly in the deregulatory regime. Despite their declining market share, PSBs are still dominating players in the Indian banking sector. It has been noticed that in 2012-13, the market share of PSBs in terms of investments, deposits, advances, and total assets is over 70 percent. They account for 87 percent share of total employment provided by the Indian banking industry and about 88 percent of branches of banks in India belong to PSBs. During the past two decades, based on the recommendations of Narasimham Committee I (1991) and Narasimham Committee II (1998) and Verma Committee (1999), a series of reform measures have been introduced in the Indian banking sector to make PSBs more efficient and competitive. Against this background, we limit our analysis to PSBs which constitute the most significant segment of the Indian banking industry.

The rest of the paper is arranged as follows: Section 2 presents a brief review of the efficiency studies undertaken in the post-reforms period. Section 3 discusses Data Envelopment Analysis and provides conceptual framework for measuring efficiency. Specification of bank inputs and outputs, environmental factors affecting bank efficiency, and data are presented in section 4. Empirical findings are discussed in section 5, followed by concluding remarks and policy implications in section 6.

2. Review of literature

The literature on efficiency of financial institutions has expended rapidly in recent times. A brief review of the DEA based efficiency studies on Indian banking sector conducted in the post-reform period is presented here.

Bhattacharyya et al. (1997) assess the impact of the limited liberalization initiated before the deregulation of the 1990s on the performance of various categories of banks for the period 1986 to 1991. They find that PSBs have been most efficient as compared to FBs and PBs in utilizing the resources at their disposal to deliver financial services to their customers. Das (1997) using cross sectional data of 27 PSBs at different points of time, finds that SBI and its associate banks are more efficient than nationalized banks. The main source of inefficiency is technical in nature, rather than allocative. However, PSBs have improved their allocative efficiency in post liberalization period. In an another study, Das (2000) using cross sectional data of 27 PSBs for the year 1998 comes to the conclusion that SBI group is more efficient than 'nationalized' group. Inefficiency in PSBs is both technical as well as allocative in nature. Saha and Ravisankar (2000) find that PSBs have improved their efficiency scores over the sample period 1991 to 1995. Mukherjee et al. (2002), using data from 1996 to 1999, come to the conclusion that out of 68 banks, PSBs outperform both private and foreign banks in the rapidly evolving and liberalizing Indian banking sector. Sathye (2003) utilizing cross sectional data for the year 1998-99, demonstrates that the efficiency of PBs as a group is relatively low as compared to PSBs and FBs in India. Mohan and Ray (2004) analyse the performance of 58 banks for the period 1992 to 2000. The findings suggest that PSBs are performing significantly better than PBs but not differently from FBs. Das et al. (2004) using data from 1997 to 2003, find that there is no significant difference in the performance of Indian banks as far as input- or output-oriented technical efficiency and cost efficiency are concerned, but they differ sharply in terms of revenue and profit efficiencies. Median efficiency scores of Indian banks have improved during the post-reforms period. Chakrabarti and Chawla (2005) examine the efficiency of Indian banking sector using data from

1990 to 2002 and finds that PSBs have lagged behind their private counterparts in terms of performance. FBs, as a group, have been noticeably more efficient than all other bank groups, followed by thePBs. In a study, Das and Ghosh (2006) investigate the performance of Indian commercial banks during the post reform period 1992–2002, under three different approaches of input-output specification of banks. The study finds that medium-sized PSBs are operating with relatively higher levels of technical efficiency and a close relationship has been observed between efficiency and soundness as determined by bank's capital adequacy ratio. The study suggests that banks having less non- performing loans are technically more efficient Kumar and Gulati (2009) analyse and examine the trends of cost efficiency and the issue of convergence in cost, technical and allocative efficiencies levels across PSBs for the period 1992-93 to 2007-08.They find that deregulation has had a positive impact on the cost efficiency levels of PSBs It is also found that the cost inefficiency is mainly attributed by technical inefficiency rather than allocative inefficiency. The findings demonstrate that the inefficient PSBs are gradually improving and catching-up efficient ones in the post reform period. Dwivedi and Charyulu (2011) examine the impact of various market and regulatory measures on efficiency of Indian banks using data from 2005 to 2010. It is found from the results that NBs, NPBs and FBs are recorded with higher efficiency over a period of time than remaining banks. Using Stochastic Frontier Analysis, Rajan et al (2011) attempt to examine the performance of Indian scheduled commercial banks in terms of technical efficiency and productivity for the period 1979-2008.

Majority of the studies discussed above seem to suggest a positive impact of deregulation and other reforms started in mid-nineties on the efficiency and productivity of Indian banks across the different ownership groups.

3. Methodology

3.1. Measurement of technical efficiency: Data Envelopment Analysis

The present study employs Data Envelopment Analysis (DEA) to estimate the output-oriented technical efficiency of PSBs in India. We use output-oriented DEA version instead of input-oriented version, since reducing inputs like labour is not possible for PSBs due some political reasons. Hence, the question for them is: by how much can output be increased while keeping the level of inputs constant? The technical efficiency of a decision-making unit (*DMU*) refers to its success or failure in transforming inputs into outputs. In DEA terminology, techni-

cal efficiency is a relative concept since its measurement requires a benchmark of performance against which the success or failure of a particular *DMU* is judged.

DEA is a linear programming technique initially propounded by Charnes, Cooper and Rhodes (CCR) (1978) and further modified and developed by Banker, Charnes and Cooper (BCC) (1984) to evaluate the efficiency of public sector non-profit organisations. DEA calculates the relative efficiency scores of different *DMUs* in the sample under consideration. The *DMUs* could be bank, branches of banks or firms. The DEA measure compares each of *DMUs* in that sample with the best practice in the sample. It helps the user in identifying the efficient and inefficient *DMUs* in the sample. Moreover, DEA also identifies possible peers or role models as well as simple efficiency scores which give it an edge over other methods (i.e. free disposal hull, stochastic frontier analysis etc.). Unlike the regression analysis, DEA identifies the source and magnitude of inefficiency in a particular *DMU* by comparing it to similar *DMUs* regarded as efficient, rather than trying to compare a *DMUs* performance with statistical averages that may not be applicable to that *DMU*.

There are several different ways to present the linear programming problem for DEA. The simplest general presentation of DEA where assumptions include constant returns to scale(CRS), and an objective of maximising outputs for a given level of inputs, proceeds by solving a sequence of linear programming problems:

(1) Maximise F_n with respect to $w_1 \ldots w_N$, F_n

Subject to:

$$\sum_{j=1}^{N} W_j Y_{ij} - F_n Y_{in} \geq 0 \qquad i = 1, 2, 3 \ldots, I$$

$$\sum_{j=1}^{N} W_j X_{kj} - X_{kn} \leq 0 \qquad i = 1, 2, 3 \ldots, K$$

$$W_j \geq 0 \qquad j = 1, 2, 3 \ldots, N$$

where there are *N* DMUs in the sample producing I different outputs (Y_{in} is the observed amount of output *i* for decision making unit *n*) and using *K* different inputs (X_{kn} is the observed amount of input *k* for DMU_n). The W_j are weights applied across the *N DMUs*. When the *nth* linear program is solved, these weights allow the most efficient method of producing DMU_n*'s* outputs to be determined. The ef-

ficiency score for the DMU_n, F_n^*, is the largest number F_n which satisfies the three sets of constraints given above. For a complete set of CRS efficiency scores, the above problem has to be solved N times — once for each DMU in the sample. The above linear programming problem takes the convex combination of observations that uses no more inputs than DMU_n and produces the maximum amount of outputs. The first set of constraints implies that the output of the hypothetical weighted average has to be at least as great as *n's* output scaled up by the factor F_n. The second set of constraints states that the weighted average of the inputs cannot be any larger than *n's* input.

One simple addition to the DEA formulae above enables the change to variable returns scale (VRS). This change relaxes the simplistic assumption that inputs normally will move in exact proportions to the scale of operations and therefore, it allows for the presence of economies and diseconomies of scale. The additional constraint is that the weights in the DEA formula must sum to one. The VRS DEA linear program is given by:

(2) Maximise F_n with respect to $w_1 \ldots w_N$, F_n

Subject to:

$$\sum_{j=1}^{N} W_j Y_{ij} - F_n Y_{in} \geq 0 \qquad i = 1, 2, 3 \ldots, I$$

$$\sum_{j=1}^{N} W_j X_{kj} - X_{kn} \leq 0 \qquad i = 1, 2, 3 \ldots, K$$

$$\sum_{j=1}^{N} W_j = 1$$

$$W_j \geq 0 \qquad j = 1, 2, 3 \ldots, N$$

The calculation of technical efficiency with CRS and VRS assumptions allows the overall technical efficiency (OTE) to be further decomposed into two collectively exhaustive components viz., pure technical efficiency (PTE) and scale efficiency (SE) i.e., *OTE=PTE*SE*. The PTE relates to the ability of managers to utilize firms' given inputs, whereas the SE refers to exploiting scale economies by operating at a point where the production frontier demonstrates constant returns to scale.

DEA assigns values between 0 and 1 to each efficiency measure. A *DMU* receiving score 1, is regarded as 100 per cent efficient.

3.2. Second step analysis of technical efficiency scores: Tobit regression model

As a part of two stage DEA approach, we carried out Tobit regression analysis to estimate the effect of a set of environmental variables on the CRS inefficiency i.e., overall technical inefficiency of PSBs. [The Tobit regression is also performed using DEA VRS inefficiency scores, i.e., pure technical inefficiency as the dependent variable. The results are fairly similar to those obtained using DEA CRS inefficiency score.] A commonly held view in the efficiency literature is that the use of Tobit model can handle the characteristics of the distribution of inefficiency estimates and thus can provide important policy guidelines. As the dependent variable inefficiency score is restricted between 0 and 1. Therefore, an appropriate theoretical specification is a Tobit regression model with two-side censoring. Though, firms with inefficiency score of 1 will never be observed in practice. Therefore, the results of the empirical analysis will not be different if one specifies a one- or a two-side Tobit model. DEA inefficiency scores calculated in the first stage are used as the dependent variables in the second stage one- side censored Tobit regression model in order to allow for the restricted [0, 1] range of inefficiency values. In order to estimate the Tobit model, we have pooled the cross section data of 27 PSBs over the period of the study. The standard Tobit model for DMU_0 can be defined as follows:

$$Y_0 = B\,X_0 \qquad if\ RHS\ >\ 0$$

$$Y_0 = 0 \qquad otherwise$$

where, X is a vector of explanatory variables and B is the set of parameters to be estimated. $U \sim N(0, \sigma^2)$ denotes the error term. Y_0 is the inefficiency score obtained from the DEA models. Using the inefficiency scores of banks as the dependent variable, we try to estimate the following regression model:

$$Y_{jt} = B_0 + B_1 ROA_{jt} + B_2 SIZE_{jt} + B_3 AQ_{jt} + B_4 MQ_{jt} + B_5 OFFBALANCE_{tj} + U_{jt}$$

where Y_{jt} = is the technical inefficiency of the *jth* bank in period *'t'* obtained from the DEA CRS model; ROA_{jt} = is the return on average assets of the *jth* bank in period *'t'*; $SIZE_{jt}$ = log of total assets of the *jth* bank in period *'t'*; AQ_{jt} = non-performing assets to advances ratio of *jth* bank in period *'t'*; MQ_{jt} = quality of management of the *jth* bank in period *'t'* as measured by the ratio of operating

expenses to total assets; and $OFFBALANCE_{jt}$= is exposure to off-balance sheet activities of *jth* bank in period *'t'* as measured by the ratio of non-interest income to total assets.

4. Data and specification of variables

To realize the objectives of the study, we utilize two sets of variables which have been collected from data published by Reserve Bank of India for the period 2001-02 to 2012-13. The first set of variables pertains to input and output variables selected for computing various efficiency/inefficiency scores for individual PSBs. However, the second set of variables includes the environmental factors that explain the inter-bank differences in overall technical efficiency or inefficiency.

4.1. Input and output variables for computing efficiency scores

In calculating the efficiency scores, the most difficult task for an analyst is to select the relevant inputs and outputs for modelling bank behaviour. There is no consensus among the researcher on what comprises the inputs and outputs of a bank. In the literature on banking efficiency, two approaches are widely used for selecting the inputs and outputs for a bank viz., production approach and intermediation approach (Hjalmarsson et al., 2000). The production approach considers banks as the providers of financial services to customers. As per production approach, the output of a bank represents the services provided to customers and these services may be defined as the number and type of transactions, documents processed and other services provided over a given period of time. If such data is not available, we can substitute the level of services provided by banks by the number of deposits and loan accounts. The production approach uses labour, material and other physical variables or their associated cost as inputs. Therefore, it concentrates only on operating rather than interest expenses. On the other hand, according to the intermediation approach, banks work as financial intermediaries and channel funds between depositors and creditors. They collect deposits and other liabilities and invest them in interest-earning assets, like loans, securities etc. and therefore, produce intermediation services. The main difference between these two approaches is that the production approach treats deposits as output and ignores interest cost as input, whereas the intermediation approach treats deposits as input rather than output and also considers interest cost as input along with operating cost.

Now, the question is: which approach is more appropriate in the Indian context? The answer may be given as: (1) The intermediation approach is best suited for

measuring bank level efficiency, whereas the production approach is more appropriate for analysing branch level efficiency. This is because, at the bank level, the objective of management is not only to reduce non-interest expenses but total costs as well, while at the branch level a large number of customer services processing take place and the decision regarding bank funding and investment are mostly not under the control of branches (Berger and Humphrey 1997). Our purpose is to measure bank level efficiency, not branch level efficiency. (2) Under the production approach, the number of accounts in different loans and deposit categories are generally taken to be the appropriate measures of outputs. In the Indian context, this approach is inconvenient, because all such data is not readily available. (3) Intermediation approach is more inclusive of the total banking cost as it includes operating cost as well as interest cost and it appropriately categorizes the deposits as inputs. Moreover, it has an edge over other definitions for data quality considerations. (4) Production approach treats deposit and loan account services as outputs. Using deposits and loans as outputs would have been appropriate in the nationalised era when maximising these was indeed the objective of a bank but they are, perhaps, less appropriate in the reforms era (Mohan and Ray 2004). Banks are not simply maximising deposits and loans; they are in the business of maximising profit or revenue. From the above discussion it is clear that in the Indian context, the intermediation approach seems quite appropriate as compared to production approach. In this paper, an attempt has been made to calculate and examine the revenue maximising efficiency for the Indian PSBs in the post-reform period. It would seem that revenue maximisation best describes the objective that Indian PSBs have been focussing on in the recent period of globalization. Keeping it in view, we use interest income and non-interest income as outputs and interest expenses and non-interest expenses as inputs.

4.2. Environmental factors explaining inter-bank differences in OTE

Financial analysts are often interested to know about the factors attributing to (in)efficiency differences among banks. In the present study, we have considered five important factors which may exert an influence on the efficiency/inefficiency of a bank. Table 1 provides the description of these factors and their expected effect on the efficiency of the banks.

Table 1: Description and expected sign of predictors

Predictor	Symbol	Description	Expected sign
Profitability	ROA	(Net Profit/ Total assets)*100	–
Size	SIZE	Log(Total assets)	– +
Asset Quality	AQ	(Net NPA/Net Advances)*100	+
Management Quality	MQ	(Operating Expenses/ Total Assets)*100	–
Exposure to off-balance sheet activities	OFFBALANCE	(Non-interest Income/ Total assets)*100	–

We hypothesize that higher profitability, management quality, and exposure to off-balance sheet activities have a negative effect on the inefficiency of a bank. Also, the poor asset quality (i.e. larger volume of NPAs in relation to total assets) has a positive effect on the inefficiency of a bank. However, we are not ascertained about the effect of size (measured in terms of total assets) on the level of OTE or OTIE (overall technical inefficiency).

5. Empirical findings

5.1. Efficiency of Indian *PSBs* in post reform period

Table 2 shows the average efficiency viz. overall, pure and scale efficiencies of PSBs for the period 2002-02 to 2012-13. In 2001-02, the average OTE score of PSBs is 88.3 percent. This suggests that an average PSB is 11.7 percent inefficient. It is the amount by which outputs can be increased without requiring extra inputs. This implies that, by augmenting their outputs, PSBs can increase their efficiency or reduce their inefficiency. However, this potential increase in outputs from adopting best practices varies from bank to bank. Once PTE for each bank is computed using VRS, scale efficiency is derived by dividing the OTE by PTE. For the same year, the average PTE and SE scores of PSBs are 94.7 percent and 93.3 percent respectively. It is interesting to note that the number of efficient banks under CRS assumption and VRS assumption differs markedly over the entire period. This clearly demonstrates the existence of sizable scale inefficiency among Indian PSBs. In 2001-02, of 27 PSBs, only three banks are found hundred percent efficient under both CRS and VRS assumption. Of the remaining 24 PSBs, 9 banks are efficient only under the VRS assumption. It means that 24 PSBs are operating with inappropriate size of scale and 15 banks are recorded with pure technical and scale inefficiencies. PTE scores provide that all the inefficiency directly

results from managerial under performance in organising the banks inputs. In 2002-03, the average OTE score of all PSBs increase to 90.3 percent. It is due to the fact that in this year the number of efficient banks increases from 3 to 4 as compared to 2001-02. Further, in this year, 4 banks are reported with 100 percent PTE or managerial efficiency, however, these banks are scale inefficient.[note: if a bank gets 100 percent OTE score, then it also has 100 percent PTE and SE score, since OTE=PTE*SE]. The remaining 19 banks are recorded with the presence of both pure and scale inefficiency. Thus, we can say that scale inefficiency is a matter of concern as far as Indian PSBs are concerned. From 2001-02 to 2005-06, the average OTE score of all PSBs increases continuously due to the increasing number of efficient banks. For example, in 2001-02, the average OTE score of all PSBs is 0.883 and the number of efficient banks is 3. In 2005-06, the average OTE score increases to 0.964 and the number of efficient bank increases to 8. In the two subsequent years, the average OTE score decreases due to the decrease in the number of efficient banks. In 2006-07, the number of efficient banks decreases to 7 and in 2007-08, only 5 banks are efficient as far as OTE is concerned. After 2007-08, the average OTE score increases roughly due to increasing number of efficient banks. Interestingly, in 2012-13, the average OTE score is highest, but the number of efficient banks is only 5. This is due the fact that in this year, apart from the five efficient banks, 10 banks are recorded with approximately 98 percent efficiency. That is why PSBs are recorded with highest OTE score in 2012-13.

Table 2 also demonstrates that the number and percentage of efficient banks (under CRS and VRS assumption) vary across different years observed in the study. The number of efficient banks under CRS assumption is less than that of under VRS assumption, which clearly indicates the existence of scale inefficiencies in the operation of PSBs. In other words, most of the public sector banks are operating with inappropriate size of scale during the entire sample period. Table 2 also shows that during the entire study period; approximately 47 percent banks have OTE score greater than the average in different years of the period. In a slightly different way, it can be said that approximately 53 percent banks are found highly inefficient over the period under consideration as far as OTE is concerned. These inefficiencies are caused by poor input utilization by the management of PSBs as well as their inability to operate at the optimal size of scale. Therefore, on the basis of above analysis, it can be said that the financial sector reforms have a positive impact on PSBs as reflected by the increasing trend of their OTE score which consistently remain 90 percent or above over the period under study. However above findings are not so encouraging. If we look at the number of efficient banks, we find that around 60 percent of banks fall in the category of inefficient banks during the entire period. Both managerial and scale inefficiency have been observed in their operation in which latter is a serious matter of concern.

Table 2: Average technical efficiency of banks: 2002-2013

YEAR	No. of banks	Average technical efficiency			No. of efficient banks			Percentage of banks having TE score greater than Average TE		
		OTE	PTE	SE	OTE	PTE	SE	OTE	PTE	SE
2001-02	27	0.883	0.947	0.933	3	11	3	40.74	55.55	44.44
2002-03	27	0.905	0.944	0.956	4	8	4	40.74	51.85	51.85
2003-04	27	0.935	0.961	0.974	5	11	5	48.15	59.26	70.37
2004-05	27	0.928	0.962	0.965	5	13	6	29.63	66.67	59.26
2005-06	27	0.964	0.975	0.989	8	14	12	48.15	70.37	74.07
2006-07	27	0.961	0.982	0.979	7	15	7	51.85	55.55	59.26
2007-08	27	0.950	0.972	0.980	5	11	6	51.85	62.96	62.96
2008-09	27	0.961	0.976	0.985	6	9	7	55.55	66.67	70.37
2009-10	26	0.961	0.976	0.985	6	10	7	53.85	65.38	73.08
2010-11	26	0.935	0.959	0.975	6	9	7	46.15	53.85	61.54
2011-12	26	0.962	0.981	0.979	7	13	7	46.15	73.08	53.85
2012-13	26	0.966	0.980	0.984	5	13	5	50.00	65.38	61.54

OTE = overall technical efficiency, PTE= pure technical efficiency and SE= scale efficiency

5.2. Factors explaining inter-bank differences in OTE: Tobit analysis

Table 3 describes the result of Tobit analysis. DEA inefficiency scores obtained in the first stage are used as the dependent variables in second stage one-sided censored Tobit model in order to allow for the restricted [0,1] range of inefficiency values. It is observed that the profitability as measured by ROA has a significant and negative impact on the inefficiency which indicates that more profitable banks have lower inefficiency. Banks reported with higher profitability are normally preferred by customers and hence, attract the largest share of deposits as well as best potential creditworthy borrowers. Such condition creates a favourable environment for the profitable banks to be more efficient from the point of view of intermediation activities. In the context of Indian PSBs, the relationship between bank size and inefficiency is negative and statistically significant which indicates that large banks have relatively low inefficiency as compared to medium and small banks. This is due the fact that large banks are relatively more efficient in realizing the economies of scale. The existence of high NPA appears to have consistently positive and significant impact on the inefficiency estimates which clearly indicates that banks having higher non-performing assets have higher inefficiencies. Existence of NPA negatively affects the profitability of a bank and therefore, has negative impact on its inefficiency. As far as management quality is concerned, it has a negative impact on the inefficiency of a bank, however, its

coefficient is not found to be statistically significant. Similarly, exposure to off-balance sheet activities also has insignificant impact on the inefficiency of PSBs.

Table 3: Determinants of technical efficiency - a Tobit analysis

Explanatory variables	Coefficients	Standard Error	Z statistic	Probability |z|>z*	95% Confidence Interval
CONSTANT	0.17588***	0.02812	6.25	0.000	0.12076; 0.23100
ROA	-0.07854***	0.00963	-8.16	0.000	-0.09741; -0.05967
SIZE	-0.00959**	0.00400	-2.39	0.0166	-0.01743; -0.00174
NPA	0.00180**	0.00087	2.07	0.0385	0.00010; 0.00350
MANAGEMENT	-0.13163	0.23754	0.55	0.5795	-0.33393; 0.59720
OFF. BALANCE	-0.00125	0.00193	-0.65	0.5185	-0.00504; 0.00254
SIGMA	0.05296***	0.00247	21.45	0.000	0.04813; 0.05780

*** and ** indicate statistical significance at 1% and 5% level respectively.

6. Summary and conclusion

Using the non-parametric approach viz., DEA, the paper measures and compares the performance of Indian PSBs in terms of revenue maximising efficiency for the period 2001-02 to 2012-13. The results indicate that deregulation measures have the positive impact on the efficiency of PSBs as indicated by the increasing trend in their mean efficiency score over time. However, it is also observed that approximately 60 percent PSBs or above are operating with OTE caused by both managerial and scale inefficiencies. It implies that most of the PSBs suffer from poor utilization of inputs in generating revenues and operating with an inappropriate size of scale, of which latter is a serious matter of concern. It is also noticed that the efficiency performance of PSBs varies significantly with different levels of profitability, size, and non-performing assets. The empirical results demonstrate that technically more efficient banks are those that have, on average, higher profitability and lower non-performing assets. Despite the consolidation and equalization of the banking sector, there is still a group of banks with a low level of technical efficiency and a high level of non-performing assets. The existence of high inefficiency may widen the interest rate spread and hinder the growth of the real sector of the economy. Competitive or regulatory changes might also have different uneven effects on banks of different sizes. Increased competition and relaxation of barriers to branching seem to favour relatively larger banks. As deregulation gains impetus, Indian PSBs would need to explore avenues to rationalise their branch network and diversify into fee-based activities in order to augment their efficiency levels.

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