Technical Efficiency of Banking Industry in India: A Longitudinal Analysis

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This paper examines technical efficiency and its correlates in respect of the banking industry in India during 1995-2016. Using Data Envelopment Analysis to the RBI dataset for 51 banks, it revealed that technical efficiency score for all the banks measured at 0.8949,in turn, meant that the inputs of these banks were required to be reduced by 10.51 per cent. Managerial under-performance (pure technical inefficiency) accounted for 5.27 percentage points and the remaining amount by scale inefficiency. Thus, both managerial and scale inefficiencies contributed almost equally in the technical inefficiency. Public sector banks, private sector banks and foreign banks were found to operate at 89.33, 87.64 and 97.76 per cent level of overall technical efficiency respectively.

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Introduction

The efficiency in general and technical efficiency in particular of an economic enterprise has come to be widely perceived as the crux of its performance in a modern market-driven economy. Rather, it is generally observed to be one of the most critical determinants of the economies' survival, growth and sustenance. It is also equally true for the survival, growth and sustenance of the Indian economy as well as of its sectors that the post-reform period has witnessed a great surge of interest in this area of Indian banking. Numerous studies such as by Kumbhakar and Sarkar (2003), Ram Mohan and Ray (2004), Shanmugam and Das (2004), Das et al. (2005), Sahoo et al.(2007),Sahoo and Acharya (2007), Saini (2009), Tabak and Tecles (2010), Sanyal and Shankar (2011), Das and Kumbhakar (2012), Casu et al. (2013), Fujii et al. (2014) and Arora et al.(2018) have been undertaken to explore the extent of efficiency and its various correlates. It is unquestionably true that these studies are important in their own right in terms of offering a variety of perspectives and conclusions regarding the performance of Indian banking industry due to their rich empirical content, sound

theoretical backing and methodological sophistication. As such, they make an important contribution to improving our understanding of various issues that they sought to explore. Regardless of this, however, these studies seem to suffer from various conceptual and measurement inadequacies. Moreover, since these studies cover different reference periods and have varying assumptions, they are not strictly comparable as well. There, thus, exist important research gaps in the existing body of literature on the theme under consideration. This, in turn, calls for unearthing if the observed technical inefficiency in the case of banking industry in India is on account of managerial underperformance or due to the choice of inappropriate scale or both. Needless to emphasize that addressing such issues through appropriate policy-mix assumes tremendous significance in the prevailing environment, particularly when survival, growth and sustenance not only of the banking sector per se, but also of the world's currently fastest growing Indian economy as a whole are at stake in view of close inter-connectedness between the two. It is against this backdrop that the present study seeks to approach the issue of technical efficiency of the banking industry in India in terms of the temporal behavioral pattern of efficiencies attendant to it for locating plausible explanations in respect of the same. More precisely, it makes an effort to estimate of Technical, Pure Technical and Scale efficiencies of the banking industry in India for the period 1995-2016.

The present study differs from the earlier ones on the theme under consideration in the following ways. First, it is extensive in coverage in that it encompasses in its fold information pertaining to 51 sample banks of different ownership categories. Second, it develops for itself a methodological framework that suits its analytical needs. Third, the choice of the reference period of the study (i.e. 1995-2016) is primarily dictated by the availability of relevant and reliable data in consonance with consistency tests.

Data, Input-Output Variables & Estimation Procedure

In order to meet its analytical needs, the present study draws upon data culled from RBI website (www.rbi.org.in). More precisely, our study is based on secondary data borrowed from the 'Statistical Tables Relating to Banks in India', which is brought out annually by the country's apex financial institution i.e., the Reserve Bank of India. These data pertain to the period falling in-between 1995 and 2016.

Input & Output Variables

In the matter of selection of inputs and outputs for measuring bank level efficiency of the banking sector in India, the present study has chosen the intermediation approach rather than its alternative. i.e, the production approach. While the first of these two approaches is widely viewed to be more appropriate for analyzing branch level efficiency, the latter on the other hand, does so at the overall level of a bank. Our choice in doing so is guided exclusively by the suitability criterion that envisions the fact that while the bank man-

agement generally seeks to reduce total costs and not just non-interest expenses at the level of the bank; at the branch level, on the other hand, there exists conspicuous absence of control of branches over the bank-funding and investment decisions due to the occurrence of a large number of customer service processing.

For computing the various efficiency scores in respect of categories of banks, our study uses 3 inputs, namely, (i) Physical capital (measured as the value of fixed assets), (ii) labor (measured as the number of employees), and (iii) loanable funds (measured as the sum of deposits and borrowings). As against this, the 3 selected output variables employed in the study are: (i) Advances, (ii) Investments, and (iii) Non-interest income.

It is not impertinent to mention that all the input (excepting labor which, as stated above, is measured in terms of number of employees) and output variables used in the present study are measured in terms of Rupees in lakhs (note that 10 lakhs=1million). All the current price figures have been deflated to the base price of 2004. Further, in order to get per branch figures and remove bank size specific heterogeneity, all the input-output variables have been divided by the number of branches. Thus, all the efficiency scores in respect of the various banks included in the present study represent per branch levels.

Estimation Procedure

Thanks to the growing recognition that all banks cannot be perceived to be equally efficient or successful in meeting their objectives, the literature on banking sector efficiency estimation in India through the increasing use of frontier efficiency techniques has tended to swell over the past couple of years. This notwithstanding for a while, what needs to be noted, in particular, in respect of these efficiency estimation techniques is that they seek to measure the performance of each bank in the industry in relation to the efficient frontier of the most efficient banks in the industry. Accordingly, a bank is labelled as fully efficient if it lies on the efficiency frontier, and inefficient if it deviates from it. The extent of inefficiency in this case is measured by the distance between the efficiency frontier of the most efficient bank and the actual location of the bank below it. The distance between the two bears a positive relationship with the level of inefficiency. That these techniques are superior to conventional ratio analysis as techniques of measurement of banking sector efficiency and have dislodged the latter is a widely documented fact and barely needs any fresh affirmation.

A bank is labelled as fully efficient if it lies on the efficiency frontier, and inefficient if it deviates from it.

The present study employs the Data Envelopment Analysis (DEA), which is a non-parametric technique and is often viewed as the most potent approach for measuring relative efficiency across banks due to its in-built advantages over its rival techniques. In more specific

terms, our study evolves for itself a two-stage Data Envelopment Analysis (DEA) methodology in the estimation of the efficiency scores of various categories of banks in India. In the first phase overall technical efficiency (OTE), pure technical efficiency (PTE) and scale efficiency (SE) scores for the three ownership categories of banks under consideration have been estimated by utilizing two famous DEA models, namely the CCR (Chames,Cooper & Rhodes) andBCC (Banker, Charnes & Cooper) models, involving only the conventional inputs and outputs. In the second phase, the overall technical efficiency (OTE) scores obtained in the first phase are Tobitly regressed on the environmental variables. The sign of the coefficients of the environmental variables indicates the direction of the influence, and standard hypotheses tests have been applied for assessing the strength of the relationship. We firmly believe that our methodological framework suits the analytical needs of our study in that, in addition to accommodating both the categorical and continuous variables, it does not require a priori assumptions regarding the direction of the influence of the categorical variables. Moreover, in addition to being transparent, it also combines in itself the simplicity of comprehension as well as that of convenience in its estimation.

The DEA, which was introduced by Charnes et al (1978) and based on Farrell's (1957) seminal contribution, is a linear programming technique that seeks to convert multiple incommensurable inputs and outputs of each decision making unit (DMU) into a scalar measure of operational efficiency, relative to its competing DMUs. As such, the DEA identifies 'peer' DMUs for an individual DMU and then estimates the efficiency of the DMU by comparing its performance with that of the best practice DMUs chosen from its peers. In DEA, the term technical efficiency (TE) can assume either of the two perspectives, namely, Input- Oriented Approach and Output –Oriented Approach. While the technical efficiency (TE) focuses on the possibility of reducing inputs to produce given output levels in the case of the former; in the case of the latter, on the other hand, it considers the possible expansion in outputs for a given set of input quantities.

The TE measure based on CRS (constant returns to scale) assumption represents overall technical efficiency (OTE) which measures inefficiencies due to the input/output composition and the size of bank's operations. Further more, the OTE measure has been decomposed into two mutually exclusive and non-additive components: pure technical efficiency (PTE) and scale efficiency (SE). This decomposition helps us in gaining an insight into the source of managerial and scale inefficiencies. Thus, the PTE based on VRS (variable returns to scale) assumption measure, in the present study, has been used as an index to capture managerial performance only and does not take into account scale efficiency in doing so.

The ratio of OTE to PTE in the present study provides SE measure. As such, the SE is a measure of the ability of the management to choose the opti-

mum size of resources, i.e., to decide on the bank's size or in other words, to choose the scale of production that will attain the expected production level. Implied in this measure is the belief that the inappropriate size of a bank either way, i.e., too large or too small may, at times, be a cause of technical inefficiency. This is referred to as scale inefficiency and assumes two types, viz., decreasing returns to scale (DRS) and increasing returns to scale (IRS).

The SE is a measure of the ability of the management to choose the optimum size of resources, i.e., to decide on the bank's size

The present study invokes two models, namely, CCR model, and BCC model, for the purpose of obtaining efficiency scores under two different sets of assumptions respectively.

The formal notations of used input-oriented DEA models for measuring TE scores for DMU *o*, under different scale assumptions are as follows:

$$minTE = \theta_0 - \in (\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+)$$

$$\theta_0, \lambda_1, \lambda_2, \dots \dots \lambda_n, s_i^-, s_r^+ \text{ .....(1)}$$

Subject to

$$\sum_{j=1}^{n} \lambda_i x_{ij} + s_i^- = \theta_0 X_{io} \text{ ..... (ii)}$$

$$\sum_{j=1}^{n} \lambda_i y_{rj} - s_r^+ = Y_{ro} \text{ ..... (iii)}$$

$$s_i^-, s_r^+ \geq 0 \text{ .....(iv)}$$

$\lambda_j \geq 0$, if constant return to scale.....(v)

$\sum_{j=1}^{n} \lambda_j = 1$, For BCC Model with variables return to scale.....(vi)

Where

X_{io} = amount of input *I* used by DMU o

Y_{ro} = amount of output *r* produced by DMU *o*

m = the number of outputs

s= the number of inputs

n=the number of DMUs,

$\in$ = a small positive number

The solution to problem [1] above is interpreted as the largest contraction of DMU *o*'s input that can be carried out, given that DMU *o* will stay within the reference technology. The restrictions (*ii*) and (iii) form the convex reference technology. The restriction (*iv*) restricts the input slack (s_i^-) and output slack (s_r^+) variables to be non-negative. The restriction (*v*) limits the intensity variables to be non-negative. The model involving (*i*) – (*v*) is known as envelopment form of CCR model and provides Farrell's input-oriented TE measure under the assumption of constant returns to scale (CRS). The measure of efficiency given by CCR model is known as overall technical efficiency (OTE) and denoted as $\theta_0 CCR$ The last restriction imposes variable returns to scale assumption on the reference technology. The model involving (*i*) –(i*v*) and (*vi*) is known as BCC model and yields Farrell's input-oriented TE measure under the assumption of variable returns to scale (VRS). The measure of efficiency provided by BCC model is known as pure technical

efficiency (PTE) and denoted as $\theta_0 BCC$. The ratio ($\theta_0 CCR$ / $\theta_0 BCC$) provides a measure of scale efficiency (SE). What is important to be noted is that all the afore-mentioned efficiency measures are bounded between one and zero.

Empirical Results & Discussion

This section forms the nucleus of the present study. In more specific terms, an attempt has been made herein to discuss the efficiency scores obtained by applying CCR and BCC models using input-oriented approach to find out the amount of input (s) that can be reduced without changing the output. The information presented in Table 1 regarding OTE scores of 51 sample banks in India, (i.e., 26 Public Sector Banks, 20 Private Sector Banks and 5 Foreign Banks) along with the magnitude of overall technical inefficiency (OTIE) helps in answering this important question.

Table 1 Pattern of Overall Technical Efficiency, Pure Technical Efficiency& Scale Efficiency Scores in Indian Banking

BANK NAME	AVERAGE OTE SCORE	OTIE (%)	AVERAGE PTE SCORE	PTIE(%)	AVERAGE SE SCORE	SIE(%)
ALLAHABAD	0.8471	15.29	0.9606	3.94	0.8817	11.83
ANDHRA BANK	0.9730	2.70	0.9963	0.37	0.9767	2.33
AXIS BANK	0.9199	8.01	0.9397	6.03	0.9786	2.14
BANK OF BARODA	0.8390	16.10	0.8779	12.21	0.9550	4.50
BANK OF INDIA	0.8556	14.44	0.8915	10.85	0.9594	4.06
BANK OF MAHARASHTRA	0.8815	11.85	0.9731	2.69	0.9045	9.55
CANARA BANK	0.8446	15.54	0.8683	13.17	0.9730	2.70
CATHOLIC SYRIAN BANK	0.7936	20.64	0.9843	1.57	0.8069	19.31
CENTRAL BANK OF INDIA	0.8231	17.69	0.9137	8.63	0.8995	10.05
CITI BANK	0.9770	2.30	0.9960	0.40	0.9809	1.91
CITY UNION BANK	0.8660	13.40	0.9339	6.61	0.9267	7.33
CORPORATION BANK	0.9622	3.78	0.9764	2.36	0.9854	1.46
DBS BANK	1.0000	0.00	1.0000	0.00	1.0000	0.00
DENA BANK	0.8568	14.32	0.9639	3.61	0.8884	11.16
DEUTSCHE BANK	1.0000	0.00	1.0000	0.00	1.0000	0.00
DEVELOPMENT CREDIT	0.8521	14.79	0.8712	12.88	0.9767	2.33
DHANLAXMI BANK	0.7991	20.09	0.9624	3.76	0.8314	16.86
FEDERAL BANK	0.8789	12.11	0.9240	7.60	0.9502	4.98
HDFC BANK	0.9337	6.63	0.9562	4.38	0.9757	2.43
HSBC	0.9515	4.85	0.9670	3.30	0.9833	1.67
ICICI BANK	0.9283	7.17	0.9481	5.19	0.9785	2.15
IDBI BANK	0.9659	3.41	0.9916	0.84	0.9741	2.59
INDIAN BANK	0.8463	15.37	0.8955	10.45	0.9463	5.37
INDIAN OVERSEAS BANK	0.8457	15.43	0.8833	11.67	0.9575	4.25
INDUSIND BANK	0.9107	8.93	0.9300	7.00	0.9779	2.21

ING VYSYA BANK	0.8189	18.11	0.8616	13.84	0.9567	4.33
JAMMU & KASHMIR BANK	0.8866	11.34	0.9024	9.76	0.9824	1.76
KARNATKA BANK	0.8806	11.94	0.9406	5.94	0.9355	6.45
KARUR VYSYA BANK	0.8634	13.66	0.9080	9.20	0.9499	5.01
KOTAK MAHINDRA BANK	0.9112	8.88	0.9575	4.25	0.9523	4.77
LAXSHMI VILAS BANK	0.8756	12.44	0.9733	2.67	0.8983	10.17
NAINITAL BANK	0.7900	21.00	1.0000	0.00	0.7900	21.00
ORIENTAL BANK OF COMMERCE	0.9399	6.01	0.9769	2.31	0.9611	3.89
PUNJAB & SIND BANK	0.8357	16.43	0.9410	5.90	0.8875	11.25
PUNJAB NATIONAL BANK	0.8539	14.61	0.8894	11.06	0.9590	4.10
RATNAKAR BANK	0.8224	17.76	0.9923	0.77	0.8296	17.04
SOUTH INDIAN BANK	0.8741	12.59	0.9859	1.41	0.8865	11.35
STANDARD CHARTERED	0.9593	4.07	0.9745	2.55	0.9836	1.64
STATE BANK OF BIKANER	0.9715	2.85	0.9881	1.19	0.9828	1.72
STATE BANK OF HYDERABAD	0.9606	3.94	0.9786	2.14	0.9810	1.90
STATE BANK OF INDIA	0.9159	8.41	0.9366	6.34	0.9778	2.22
STATE BANK OF MYSORE	0.9477	5.23	0.9587	4.13	0.9884	1.16
STATE BANK OF PATIALA	0.9628	3.72	0.9744	2.56	0.9878	1.22
STATE BANK OF TRAVANCORE	0.9725	2.75	0.9812	1.88	0.9908	0.92
SYNDICATE BANK	0.8780	12.20	0.9313	6.87	0.9425	5.75
TAMILNAD MERCANTILE	0.9465	5.35	0.9712	2.88	0.9738	2.62
UCO BANK	0.8617	13.83	0.9160	8.40	0.9404	5.96
UNION BANK OF INDIA	0.8638	13.62	0.9161	8.39	0.9427	5.73
UNITED BANK OF INDIA	0.8641	13.59	0.9357	6.43	0.9161	8.39
VIJAYA BANK	0.8564	14.36	0.9163	8.37	0.9353	6.47
YES BANK	0.9756	2.44	1.0000	0.00	0.9756	2.44
AVERAGE	0.8949		0.9473		0.9446	
PUBLIC SECTOR BANKS AVERAGE	0.8933		0.9397		0.9498	
PRIVATE SECTOR BANKS AVERAGE	0.8764		0.9471		0.9267	
FOREIGN SECTOR BANKS AVERAGE	0.9776		0.9875		0.9896	
Q1	0.8530		0.9162		0.9310	
Q2	0.8789		0.9575		0.9590	
Q3	0.9496		0.9778		0.9785	
CV	6.4841		4.2151		5.2788	
MAX	1.0000		1.0000		1.0000	
MIN	0.7900		0.8616		0.7900	

Notes: OTE= Overall technical efficiency;OTIE(Overall technical inefficiency)%=(1-OTE)×100, PTE= Pure technical efficiency; PTIE(Pure technical inefficiency)%=(1-PTE)×100; SE= Scale efficiency;and, SIE(Scale inefficiency)%=(1-SE)×100. Q1 (FIRST QUARTILE) ; Q2 (SECOND QUARTILE/MEDIAN) ; Q3 (THIRD QUARTILE) and CV (COEFFICIENT OF VARIATION). All figures are averages over the period1995-2016.

(i) Our results indicate that there exist large variations across banks in respect of their OTE scores that range between 79.0 per cent and 100 per cent during 1995-2016. The mean efficiency score in the case of 51 sample banks measured at 0.8949 (Table 1 for descriptive statistics of OTE scores) during the period under reference. This suggests that the banks in India needed on an average only 89.49 per cent of the inputs to produce their current level of output. In other words, they could save on resources such as physical capital, labor and loanable funds by at least 10.51per cent. Alternatively, the banking sector in India had the potential of producing 1.11 times (i.e., 1/ 0.8949) as much outputs from the same level of inputs during the said period.

The banking sector in India had the potential of producing 1.11 times (i.e., 1/0.8949) as much outputs from the same level of inputs.

(ii) Two foreign banks, namely, DBS Bank and Deutsche (Table 1) in our sample were found to be technically most efficient as their OTE score measured at 1. In DEA terminology, these banks are called 'peers' or the best practice banks or at times globally efficient banks. What needs to be underlined, in particular, in respect of these banks is that resource utilization process in their case was most optimal. As such, they can be labelled as role models for the inefficient banks and also form the reference set for them to emulate.As against this, the remaining 49 banks in our sample were found to be relatively technically inefficient in varying degree in that the OTE score in their case was noted to be less than unity. Our results, thus, signal towards a marked deviation of the banks from the best practice frontier. By implication, these inefficient banks can augment their efficiency by effecting reduction in their input(s) levels. Furthermore, the OTE scores amongst the inefficient banks range between 0.7900 for Nainital Bank and 0.9770 for Citi Bank. This implies that while the former needed to potentially reduce its current input levels by 21 per cent, the latter, on the hand, was required to do so just by 2.30 per cent, in order to realize their unchanged levels of output.

(iii) Two more banks, namely Nainital Bank and Yes Bank, which were earlier inefficient banks under CRS assumption, acquired the status of locally efficient banks with unit PTE score under the VRS assumption. The inefficiency in their case can be attributed to scale inefficiency because they did not seem to suffer from managerial inefficiency.

(iv) Four banks in our sample of 51 banks seemed to acquire the status of 'locally efficient' banks because their PTE score equaled 1 during the reference period. In the remaining inefficient 47 banks having Pure Technical Efficiency score less than unity,

managerial inefficiency seemed to exist, albeit in varying degree during 1995-2016. Since both PTE and SE scores were observed to be less than 1 in the case of these banks, OTIE, in their case, therefore, could safely be attributed both to PTIE and SIE. Furthermore, out of these 47 banks, the PTE scores in the case of 28 banks were observed to be lower than their corresponding SE scores. What this suggests is that the inefficiency in resource utilization (i.e., OTIE) in these 28 banks did not seem to result from scale inefficiency, but mainly due to managerial inefficiency.

(v) The Pure Technical Efficiency and Scale efficiency scores in the case of the banking industry as a whole are suggestive of the fact that OTIE in the case of banking industry in India could be attributed both to poor input utilization (i.e., managerial inefficiency) and to the failure to operate at most productive scale (i.e., scale inefficiency). The average Pure Technical Efficiency score for 51 banks included in our study was observed to be 0.9473 (Table 1 for descriptive statistics of OTE, PTE, and SE scores). The inappropriate scale of banking operations accounted for rest of the OTIE. Further, 5.27 percentage points of 10.51 per cent technical inefficiency could be attributed to managerial underperformance (pure technical inefficiency) and the remaining to scale inefficiency. What this implies in plain language is that both managerial and scale inefficiencies seemed to have been contributing equally towards the overall technical inefficiency in commercial banking in India during the 1995-2016 period.

Both managerial and scale inefficiencies seemed to have been contributing equally towards the overall technical inefficiency in commercial banking in India during the 1995-2016 period.

Classification of Inefficient Banks

An attempt has also been made in the present study to categorize the inefficient banks into four categories (Potential or Star Banks who are marginally inefficient, The Above Average Banks, The Below Average Banks and Laggard banks that are most inefficient banks. To do so, we utilized the quartile values of OTE scores obtained under CCR and VRS assumption as cut-off points to segregate the inefficient banks into four categories (Table 2 for the quartile values). The following observations are in order:

(a) 11 banks which account for 22.45 percent of all the inefficient banks can be labelled as Potentially Star banks as their OTE scores fall in between less than 1 but more than or equal to Q3(Q3<=EFF<1) under CRS assumption where Q3 is the value of the third quartile. These are the marginally inefficient banks which operate in close proximity to the efficient frontier. We believe that these banks can be transformed into best practice banks by introducing small improvements in their resource

utilization process. Since these banks seem to us to have enormous potential in the future, special attention in their case is required to be paid by the regulators to augment their efficiency.

(b) In sharp contrast to (a) above, there are 13 banks which account for 26.53 percent can be labeled as the Laggard banks. These banks belong to the 'most inefficient' category. This category includes those banks which attained the OTE score less than Q1 (EFF<Q1) where Q1 is the value of first quartile. The banks in this group could be labelled as worst performers in the sample and were required to be considered as 'target banks' in any probable recapitalization and consolidation exercise that the bank planners and policy makers envisaged in the case of the banking industry in India.

In between the Potential Star banks and Laggard banks , we have two more categories, The above Average category and the Below Average category based on the OTE score of inefficient banks.13 banks (26.53 percent) are categorized as the Above Average as their OTE score lies between less than Q3 but more than and equal to Q2 (Q2<=EFF<Q3) , where Q2 is median and Q3 is the value of third quartile while 12 banks (24.48), on the other hand, belongs to the Below Average category as their OTE score lies between less than Q2 but more than or equal to Q1 (Q1<=EFF<Q2). Likewise, the same concept can be applied for the purpose of categorization of PTE score and SE score respectively.

Table 2 Classification of Inefficient Public, Private and Foreign Banks of India on the basis of Quartile Values under CRS, VRS and SE, 1995 – 2016

EFFICIENCY=1			
BEST PRACTICE BANKS (EFFICIENCY=1)			
TE CRS	TE VRS	TE SCALE	
DBS BANK& DEUTSCHE BANK	DBS BANK, DEUTSCHE BANK, NAINITAL BANK & YES BANK	DBS BANK & DEUTSCHE BANK	
CATEGORY I (Marginally Inefficient) Q3<=EFF<1 POTENTIAL /STAR BANKS		CATEGORY II Q2<=EFF<Q3 ABOVE AVERAGE	
0.9496<=EFF<1	0.9778<=EFF<1	0.9785<=EFF<1	0.8789<=EFF<0.9496
TE CRS	TE VRS	TE SCALE	TE CRS
CITI BANK	ANDHRA BANK	STATE BANK OF	STATE BANK OF
0.9575<=EFF<0.9778	0.9590<=EFF<0.9785		
TE VRS	TE SCALE		
ORIENTAL BANK	INDUSIND BANK		

		TRAVANCORE	MYSORE	OF COMMERCE	
YES BANK	CITI BANK	STATE BANK OF MYSORE	TAMILNAD MERCANTILE	CORPORATION BANK	STATE BANK OF INDIA
ANDHRA BANK	RATNAKAR BANK	STATE BANK OF PATIALA	ORIENTAL BANK OF COMMERCE	STANDARD CHARTERED	DEVELOPMENT CREDIT
STATE BANK OF TRAVANCORE	IDBI BANK	CORPORATION BANK	HDFC BANK	STATE BANK OF PATIALA	ANDHRA BANK
STATE BANK OF BIKANER	STATE BANK OF BIKANER	STANDARD CHARTERED	ICICI BANK	LAXSHMI VILAS BANK	HDFC BANK
IDBI BANK	SOUTH INDIAN BANK	HSBC	AXIS BANK	BANK OF MAHARASHTRA	YES BANK
STATE BANK OF PATIALA	CATHOLIC SYRIAN BANK	STATE BANK OF BIKANER	STATE BANK OF INDIA	TAMILNAD MERCANTILE	IDBI BANK
CORPORATION BANK	STATE BANK OF TRAVANCORE	JAMMU & KASHMIR BANK	SKOTAK MAHINDRA BANK	HSBC	TAMILNAD MERCANTILE
STATE BANK OF HYDERABAD	STATE BANK OF HYDERABAD	STATE BANK OF HYDERABAD	INDUSIND BANK	DENA BANK	CANARA BANK
STANDARD CHARTERED	□	CITI BANK	JAMMU & KASHMIR BANK	DHANLAXMI BANK	ORIENTAL BANK OF COMMERCE
HSBC	□	AXIS BANK	BANK OF MAHARASHTRA	ALLAHABAD	BANK OF INDIA
□	□	ICICI BANK	KARNATKA BANK	STATE BANK OF MYSORE	PUNJAB NATIONAL BANK
□	□	□	FEDERAL BANK	SKOTAK MAHINDRA BANK	
CATEGORY III Q1<=EFF<Q2 BELOW AVERAGE			CATEGORY IV (Most Inefficient) EFF<Q1 LAGGARD BANKS		
0.8530<=EFF <0.8789	0.9162<=EFF <0.9575	0.9310<=EFF <0.9590	EFF<0.8530	EFF<0.9162	EFF<0.9310
TE CRS	TE VRS	TE SCALE	TE CRS	TE VRS	TE SCALE

SYNDICATE BANK	HDFC BANK	INDIAN OVERSEAS BANK	DEVELOPMENT CREDIT	UCO BANK	CITY UNION BANK
LAXSHMI VILAS BANK	ICICI BANK	ING VYSYA BANK	ALLAHABAD	CENTRAL BANK OF INDIA	UNITED BANK OF INDIA
SOUTH INDIAN BANK	PUNJAB & SIND BANK	BANK OF BARODA	INDIAN BANK	KARUR VYSYA BANK	BANK OF MAHARASHTRA
CITY UNION BANK	KARNATKA BANK	SKOTAK MAHINDRA BANK	INDIAN OVERSEAS BANK	JAMMU & KASHMIR BANK	CENTRAL BANK OF INDIA
UNITED BANK OF INDIA	AXIS BANK	FEDERAL BANK	CANARA BANK	INDIAN BANK	LAXSHMI VILAS BANK
UNION BANK OF INDIA	STATE BANK OF INDIA	KARUR VYSYA BANK	BANK OF BARODA	BANK OF INDIA	DENA BANK
KARUR VYSYA BANK	UNITED BANK OF INDIA	INDIAN BANK	PUNJAB & SIND BANK	PUNJAB NATIONAL BANK	PUNJAB & SIND BANK
UCO BANK	CITY UNION BANK	UNION BANK OF INDIA	CENTRAL BANK OF INDIA	INDIAN OVERSEAS BANK	SOUTH INDIAN BANK
DENA BANK	SYNDICATE BANK	SYNDICATE BANK	RATNAKAR BANK	BANK OF BARODA	ALLAHABAD
VIJAYA BANK	INDUSIND BANK	UCO BANK	ING VYSYA BANK	DEVELOPMENT CREDIT	DHANLAXMI BANK
BANK OF INDIA	FEDERAL BANK	KARNATKA BANK	DHANLAXMI BANK	CANARA BANK	RATNAKAR BANK
PUNJAB NATIONAL BANK	VIJAYA BANK	VIJAYA BANK	CATHOLIC SYRIAN BANK	ING VYSYA BANK	CATHOLIC SYRIAN BANK
□	UNION BANK OF INDIA		NAINITAL BANK	□	NAINITAL BANK

Notes: 1) The 'Most Inefficient' category includes those banks which have OTE score below the first quartile; 2) Those banks are included in the 'Below Average' category whose OTE score lies between first and second quartile; 3) The 'Above Average' category consists of the banks wherein OTE score lies between median and third quartile; 4) The banks with OTE scores above the third quartile are included in the 'Marginally Inefficient' category.

Thus the banks are underproducing the output levels and are suggested to enhance the per branch output to mitigate the scale inefficiency problem.

Since managerial and scale inefficiencies are equally responsible for overall technical inefficiency among Indian banks, it becomes pertinent to see the causes of scale inefficiency. The scale inefficiency arises due to non-operating at most productive scale size i.e. CRS.If the potential output levels are under achieved then scale inefficiency arises because of increasing return to scale and when over achieved the decreasing return to scale becomes the source of scale inefficiency. In the present context, the IRS dominated the frequency of its occurrence in Indian banking sector. In most of the banks,IRS frequency has been noticed as the highest frequency (i.e IRS prevails in the highest no of years .Thus the banks are under producing the output levels and are suggested to enhance the per branch output to mitigate the scale inefficiency problem.

Determinants of Inter-Bank OTE Differentials

The policy-related variables (or environment) are believed to play an important role in impacting efficiency performance of the banking sector anywhere and everywhere. What factors account for overall technical efficiency (OTE) differences across banks in India? In what follows, we seek to address this question by taking into account four such possible factors, namely, Ownership, Gross NPA, CAR and Number of Branches. These factors, we think, may exert an influence on the overall technical efficiency (OTE) of a bank. Table 3 presents the necessary details of the description of these factors and their expected effect on the efficiency of the sample banks. The following comments are in order from Table 3.

Table 3 Factors Affectingthe Efficiency of Banks, 1995-2016

OTE			PTE		SE	
VARIABLE	MARGINAL EFFECT	P Value	MARGINAL EFFECT	P Value	MARGINAL EFFECT	P Value
Ownership	0.0293989	0.119	0.0316107*	0.063	0.0124636	0.44
Gross NPA	0.000365	0.128	0.0004431	0.163	1.40E-04	0.127
CAR	-0.0014888	0.165	-0.0008535	0.412	-0.0010584	0.174
Number of Branches	-8.70E-06**	0.023	-3.49E-06	0.285	-9.62E-06***	0.001
Expected Value of Mean	0.91116059		0.98324395		0.95663075	

Note: *,** and *** represent Significance at 10%,5% and 1 % levels of Significance respectively
Source: Authors' Calculation using STATA 11

First, the numbers of branches are significantly affecting overall technical efficiency (OTE) levels. The impact of number of branches is negative because an increase in number of branches will reduce per branch output levels given that outputs remain constant. Thus, branch expansion at a higher rate than the rate of increase in output levels may yield reduction in per branch output level and consequently may affect OTE levels adversely.

Branch expansion at a higher rate than the rate of increase in output levels may yield reduction in per branch output level and consequently may affect OTE levels adversely.

Secondly, the variable ownership is positively and significantly affecting managerial efficiency levels.The change in ownership from Public to Private and from Private to Foreign is observed to exert a positive impact on the PTE levels.

Third, the number of branches is the only variable that seemed to impact the scale efficiency levels significantly during the period under consideration. This suggests that the horizontal expansion results in the deterioration of the scale efficiency in the case of the Indian banking sector.

Concluding Remarks

In this paper, we have presented evidence on technical efficiency and its correlates in the case of banking industry in India during 1995-2016. Our empirical findings suggest that overall technical efficiency score for all the sampled banks put together measured at 0.8949 during the afore-mentioned period and this, in turn, meant that the inputs of these banks, in an overall sense, could be reduced to the tune of 10.51 per cent without sacrificing output if they were to become efficient. All these indicated, in plain words, was that both Managerial and Scale inefficiencies had been contributing almost equally to the overall technical inefficiency (OTIE) that seemed to plague the banking sector in India during the period under reference. It is further observed that managerial underperformance (pure technical inefficiency) (PTIE) accounted for 5.27 percentage points of 10.51 per cent technical inefficiency and the remaining amount by scale inefficiency (SIE). Our results also revealed that across various ownership categories, the Public Sector Banks, Private Sector Banks and Foreign Banks were found to operate at 89.33, 87.64 and 97.76 per cent level of overall technical efficiency, implying thereby that inputs in their case could be decreased by 10.67, 12.36 and 2.23 per cent respectively without sacrificing output if they were to turn efficient. Overall, our results establish the primacy of the private Foreign Banks working in India over Private Sector and Public Sector Banks in that order in matters pertaining to technical efficiency and its various components.

In the light of the empirical findings, the paper argues that since both the banking industry and national economy tend to benefit from improvement of efficiency and always lose from ineffi-

ciency in whatever form it appears, the future strategies for promoting technical efficiency of laggard banks, therefore, accordingly need to focus on improved management practices and expansion of scale of operations, strengthening of institutions that govern the banking sector in India. In plain words, the future reforms in the banking sector in India need to reduce the variance in technical efficiency through appropriate policy-mix aimed at improving the management practices and adoption of measures as may help them in overcoming diseconomies of scale so that the laggard banks catch-up with the best practice banks. In addition, special efforts are also required to be made towards the augmentation of the technical efficiency of the banks with enormous potential. To this end, the whole of institutional structure of the banking sector needs to be so redesigned and strengthened that promotes professionalism and leaves little room for undue political intervention in the smooth and efficient functioning of the said sector in India. The sooner such a strategy is put in place, the better it would be for the banking sector as well as for the country's economy in its diverse set of manifestations.

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