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IS THE EFFICIENCY OF BANKS DEGENERATING DUE TO THE MOUNTING OF NON-PERFORMING ASSETS? AN EMPIRICAL INVESTIGATION USING DEA

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Abstract

Indian banking system is saddled with bad loans which have resulted in huge losses. Profitability remains a concern due to the rise of NPAs. Investors should not expect high reporting profits from banks due to the ascending provision of the NPAs. Banks are not performing well and they may not be much efficient due to the rise of NPAs daily. Using data envelopment analysis, the present study intends to assess technical efficiency of banks. As the requirement of homogeneity is fulfilled, the input oriented CCR model is applied. The study finds that the number of efficient banks has shortened and the average overall technical efficiency of selected banks moves downward throughout the study period. It also reveals that the inefficiency is mostly due to the upward trend of NPAs. Asset quality plays the most crucial role toward the performance of banking sector. Thus, banks and regulators should control the upward trend of NPAs to enhance the efficiency level.

Keywords: *Non-performing asset, bank efficiency, scheduled commercial banks, data envelopment analysis.*

JEL Classification: *G21, G29.*

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Introduction

Indian banking sector has changed tremendously over the past few years. With the advent of liberalisation, privatisation and globalisation era in 1991, Indian banking industry experienced multiple and quick changes. Now banks are becoming much more competitive in all terms to have a global presence. As long as an asset creates positive cash flows, it will be good whereas if it fails to do so, it throws a negative impact on the overall performance (Malepati & Gowri, 2017). A healthy and sound banking system is necessary for an economy to grow and remain in the competitive environment (Swain, Sahoo & Mishra, 2017). The health of financial system has an important role as its failure can disrupt economic development (Das & Ghosh, 2007). In recent years, banks are facing distressing signals on durability and sustainability due to increased non-performing assets (NPAs). The growing poor quality of assets has given rise to fears about the stability of the financial system (Jayaraman & Sharma, 2018). NPAs have a deleterious influence on the return on assets (Karunakar et al., 2008) and it decreases new loan capacity (Psaila, Spiteri & Grima, 2019). It is argued that it will have a detrimental effect since such banks will exert additional managerial effort and give additional expense dealing with these loan problems.

Reasons behind the increasing NPAs in both the Private Sector Banks (PVBs) and the Public Sector Banks (PSBs) are almost similar like deterioration in the quality of loan portfolio (Messai & Jouini, 2013), the intentional loan defaults, poor credit management policies, loans sanctioned with no pre-inquiry, and most loans sanctioned for agricultural purposes. Singh (2013) emphasised that the reason for rising NPAs is the poor management of credit risk by banks. According to Malepati and Gowri (2017), the reason for higher NPA may be due to the factor that more advances might have been disbursed under the priority sector relative to the non-priority sector.

The NPAs are facing severe troubles and risks to the financial system because that tend to demolish the whole financial situation of banks and the economy (Srinivas & Naresh, 2020). NPAs are draining the capital and weakening the financial power (Joseph, 2014). A high-level of NPA affects net-worth and profitability negatively, thereby eroding the value of assets. Asset quality reflects potential credit risk that may affect the value of financial institutions (Banerjee, Verma & Jaiswal, 2018). Management spends a lot of their time, efforts and resources in administering their assets to minimise the risk associated with it. Weak credit risk management obstructs industrialisation and business expansion which underpins the economic growth and

development (Abiola & Olausi, 2014). In this situation by estimating the relationship between NPAs and bank efficiency, the present study attempts to determine the impact of NPAs on bank efficiency.

Literature Review

NPA has a destructive impact on banking business and disrupts economic development. Due to its importance and impact at large, many studies have been conducted by researchers to evaluate the role of NPA on the overall efficiency of banks. Karim, Chan and Hassan (2010) investigated the relationship between efficiency and the non-performing loans (NPLs) in Singapore and Malaysia. The cost-efficiency estimation indicates that banks are destroying 12.32 percent of their inputs due to NPLs. Altunbas, Liu, Molyneux and Seth (2000), and Podpiera and Weill (2008) found that the levels of NPL are positively related to bank inefficiency. Bad credit management of banking firms will result in banks inefficiency and affect the process of granting loans (Berger & DeYoung, 1997). According to Banerjee et al. (2018), NPAs have become a source of grave concern for almost all the banks during the past two decades. Indian banks have recognised the fact that NPAs affect profitability, net worth and value of banks negatively. The banks' performance in terms of profitability and expansion or growth has been affected a great deal due to the presence of NPAs.

Burgstaller (2013) in his studies considered total funds, fixed assets and total costs as inputs and outputs produced comprise total loans, other earning assets, and non-interest income to measure efficiency in the regional banking market through the data envelopment analysis (DEA). Das and Ghosh (2006) examined performance during the post-reform period of 1992 to 2002 in India. Medium-sized PSBs have been found to be performing at the higher level of technical efficiency (TE). To arrive at this, they have chosen three approaches namely the intermediation, value-added and production approach. Variation in technical efficiencies was then observed in relation to ownership, bank size, Capital Adequacy Ratio, NPA and quality of management. Using DEA, Maity and Sahu (2017) measured the performance of State Bank of India (SBI) and associates for 2011 to 2016 with three output variables (deposits, advance and total income) and four input variables (branches, automated teller machines, assets and gross NPA). They found that before mergers took place, most associate banks of SBI operated at an efficient level and the mergers will help to decrease unhealthy competition between SBI and its associate banks, mitigate risk and better focus on defaulter.

According to Satpal (2014), the levels of NPAs are higher in PSBs as compared to PVBs. The NPAs are not only a problem for banks but for the economy as well. He also highlighted that NPAs affect their profitability. It also focused on capital adequacy, liquidity, solvency, etc., of banks. Also, Khanna (2012) in her study opined that mounting of NPAs is a major cause of concern as a higher level of NPAs means more probability of credit defaults eroding profitability and net-worth of banks. Further, Prasad and Veena (2011) in their study stated that NPAs have a destructive impact on return on assets as NPAs do not generate any net interest income. Consequently, the profits of banks are reduced and limited to the recycling of funds. In another study, Shaban (2018) also found the same results between NPA and profitability and needed some corrective action to reduce NPA level as it affected the assets' quality.

Rajaraman and Vasistha (2002) in their study provided the evidence of a significant bivariate relationship between the loan problems and operating inefficiency of PSBs. Das and Ghosh (2007) empirically examined the non-performing loans of India's PSBs in terms of various indicators such as credit growth, asset size, macroeconomic condition, and operating efficiency indication. According to Abiola and Olausi (2014), credit risk management has a significant impact on banks' profitability in Nigeria. The study covered seven years period from 2005 to 2011.

In a study, Singh (2016) made an attempt to check NPAs position during 2001 to 2002, and during 2013 to 2014. The result found that NPA of PSBs was comparatively high than the other banks. Following this, Joseph (2014) analysed the trend in NPAs across PSBs and PVBs and concluded that NPAs act as an indicator of financial health of banking industry and can have a direct impact on profitability. Malepati and Gowri (2017) had undertaken a study of NPAs across the priority sector and non-priority sector in PSBs and PVBs in India. Their findings reveal that the priority sector lending in PVBs was lower than PSBs and as a result, the NPA position was rather better in PVBs when compared to PSBs. Further, Shaban (2018) in his investigation found that profitability of foreign banks is least affected by NPAs than PSBs and PVBs. Symss et al. (2018) in their study with the application of fixed effects regression model, found that the return on asset, lending rate, total loans and advances shows a negative relationship with NPA. Kumar and Vasanthi (2017) investigated the trend of gross and net NPA in foreign and PSBs for 2011-2012 to 2015-2016. According to them, profitability and efficiency are principally based on the stressed assets or NPA. Kaur and Singh (2011) in their study explored that NPAs are considered an important parameter to judge the financial health and performance of banks.

Numerous studies have been done to find out the reasons for NPAs, NPA management, banks' performance and recovery mechanism. But a limited number of studies have been made on the impact of NPAs on the overall efficiency. By considering the research gap, the present study investigates empirically, the impact of NPAs on the overall efficiency of banks.

Objective and Hypothesis of the Study

The study tries to reveal that, how the performance of Indian banks degenerate over the years due to the mounting of NPAs. The specific objectives of the present study are to study the present scenario and trend of gross NPAs and net NPAs of Scheduled Commercial Banks (SCBs), and to assess the impact of NPAs on the efficiency of banks. Based on the previous discussion and research objectives, the Null Hypothesis (H_0) is created: There is no impact of NPAs on bank efficiency.

Methodology

Data

The present study is based on five years of data from March 2013 to March 2017 covering 27 commercial banks with 21 PSBs and 6 PVBs which holds 97.88 percent of net NPAs and 96.69 percent of gross NPAs of SCBs on 31st March 2017. The data are collected from the database of Reserve Bank of India (RBI) and the website of the respective banks.

Description of Variables

To analyse the data using DEA, the present study considers four inputs and two output variables. After a careful review of earlier literature and considering present research objectives the study selects the following variables.

Input Variables

In line with several studies by Saha and Ravisankar (2000), Sathye (2003) Das and Ghosh (2006), Burgstaller (2013), Sinha and Jain (2015), and Maity and Sahu (2017) to measure efficiency, the present study also considers the gross NPAs, total assets, deposits and total expenses (sum of interest expenses and operating expenses) as input variables.

The increase of NPAs stops banks from taking the expansion decision and it is adjusted as expenses/ losses with the revenue generated. According to Sharma and Chhabra (2017), it does not generate any income. Due to the advances getting blocked, the credibility of banks decreases, and also the opportunity cost of profits foregone by doing same investment in other return earning projects. As the present study is to measure efficiency in regards to mounting of NPAs, gross NPA is considered one of the input variables.

Total assets represent the size of banking business which makes the revenue for the bank. Bank's total assets include cash, and investments including advances and fixed assets. Banks mobilise small deposits from the public and provide financial resources for economic development. In this regard, the level of deposits is considered another input variable. The key expense of bank is the interest on deposits (term or saving). Another major expense head is its operating expenses, that is, employee costs, administrative costs, advertisement, rent and stationery.

Output Variables

The present study also considers advance and total income (sum of interest and other income) as the output variables like other studies (Sathye, 2003; Das & Ghosh, 2006; Burgstaller, 2013; Sinha & Jain, 2015; Maity & Sahu, 2017). As the role of bank is to mobilise deposits and provide loans or advances. In this regard, advance is the output variable, as advances or loans are provided from the deposits collected. So considering this relationship, deposit is selected as the input variable and advance as the output variable.

Another output variable is interest and other income, which is also one objective of any profit maximisation business organisation. On the loans (advances), bank charges interest. This interest earned is the key revenue source of bank, that is, the interest income. Apart from the interest on advances, it also earns interest on investments and fees from various services it provides to the customers. So, expense is selected as the input and income as the output variable.

All the input variables considered in this study indicate the size of banks as well the capacity to provide advance and capacity of earnings. Expense is correlated with income and deposit is correlated with advance. The relationship is also sufficiently endorsed by a number of empirical investigations (e.g., Saha & Ravisankar, 2000; Sathye, 2003; Maity & Sahu, 2017).

Statistical and Econometric Tests Used

To analyse the present position and trend of gross and net NPA, simple tabular forms and diagrams are used for comparison and for drawing inferences. Further, to measure the impact of NPAs on the efficiency of PSBs and PVBs, the study uses DEA. The basic measures of efficiency with one input and one output can be written as follows:

$$\text{Efficiency} = \text{Output} \div \text{Input}$$

The method of DEA as introduced by Charnes et al. (1978) addressed the problem of efficiency measurement for decision-making units (DMUs) with many inputs and many outputs. Assuming that there are 'n' DMUs, each with 'm' inputs and 's' outputs, relative efficiency score of a test DMUo ("o" denotes a focal DMU) is acquired by solving the following model:

$$\max \frac{\sum_{r=1}^{s} v_r y_{ro}}{\sum_{i=1}^{m} u_i x_{io}}$$

subject to

$$\frac{\sum_{r=1}^{s} v_r y_{rj}}{\sum_{i=1}^{m} u_i x_{ij}} \leq 1; \ (j = 1, 2, ..., n);$$

$$u_i, v_r \geq 0$$

where, i =1, 2, …, m; r = 1, 2, …, s; = output "r" produced by DMU j; = input "i" utilized by DMU j; = weight of output r; = weight of input j. To evaluate each DMUs' relative efficiency score, it is transformed into a linear programming problem.

$$\max \sum_{r=1}^{s} v_r y_{ro}$$

subject to

$$\sum_{r=1}^{s} v_r y_{rj} - \sum_{i=1}^{m} u_i x_{ij} \leq 0; \ (j = 1, 2, ..., n);$$

$$\sum_{i=1}^{m} u_i x_{ij} = 1;$$

$$u_i, v_r \geq 0$$

A DMU is efficient if it achieves a score of one and inefficient for score < 1. In the present study, overall technical efficiency (OTE) equal to one

indicates, these banks are efficient and lie on the efficient frontier under constant return scale assumption based on Charnes Cooper Rhodes's (CCR) model. DEA approach using CCR model is applied to the unitary evaluation of homogeneous units (rather than organisations). The requirement of homogeneity is fulfilled by the units of branches, deposits and credit disbursement of the same business unit in which case CCR can be applied.

Another dilemma is whether to use the input orientation model (focuses on better utilisation of the inputs) or to use the output orientation model (focuses on the targets and outputs achieved). It is always within our control to better utilise the resources or inputs, and hence, setting a target for inputs or performance is feasible. However, as the outputs depend on many extraneous factors, they are not within our control. Setting the targets for outputs, therefore, is not feasible. Hence, the input-oriented constant return to scale CCR model measuring the OTE was found suitable (Pai et al., 2020).

MaxDEA 5.2 is used to assess TE through DEA under the CCR input-oriented model. The input-oriented models object at minimising the inputs consumed by the DMUs for the same target of output levels. Researchers have also run Pearson Correlation among all variables to check the assumptions of "isotonicity" relationship. Positive correlations among all of them satisfy the isotonicity assumptions to run the DEA.

Findings and Discussion

Non-performing Assets - Present Scenario and Trend Analysis

Bankers are the distributors and custodians of liquid capital. Banks need to be financially strong for this purpose. The important function of banking system is to mobilise savings and lending to the needy. The investment and lending activities are based on the sources of funds. Lending of money involves credit risk. In general, advances and loans given to its customers are assets. But, when repayment of principal and interest is overdue for 90 days, such asset is classified as NPA (RBI, Annual Report, 2000-2001).

Table 1

Gross NPAs of SCBs (₹ in billions)

Year	PSBs	PVBs	FBs	Total
2016-17	6847.320	932.092	136.291	7915.703
2015-16	5399.564	561.857	158.052	6119.473
2014-15	2784.679	341.062	107.610	3233.351
2013-14	2282.737	245.424	115.650	2643.811
2012-13	1650.057	210.705	79.771	1940.533

Source: Database on Indian Economy, RBI

The performance of banks in respect of their NPAs has shown deterioration in recent years. The gross NPAs of SCBs had increased to ₹ 7917.907 billion including Small Finance Banks (SFBs) of ₹ 2.205 billion on March 2017, from ₹ 6119.473 billion a year ago (Table 1). Net NPAs as on March 2017 had amounted to ₹ 4331.245 billion (including SFBs of ₹ 1.147 billion) compared with ₹ 3498.144 billion, on March 2016 (Table 2).

Table 2

Net NPAs of SCBs (*₹ in billions*)

Year	PSBs	PVBs	FBs	Total
2016-17	3830.889	477.802	21.406	4330.097
2015-16	3203.751	266.774	27.619	3498.144
2014-15	1599.511	141.283	17.617	1758.411
2013-14	1306.348	88.615	31.596	1426.559
2012-13	900.369	59.944	26.626	986.939

Source: Database on Indian Economy, RBI

As for the bank group-wise; the gross NPAs had increased to ₹ 6847.320 billion and ₹ 932.092 billion for PSBs and PVBs respectively, on March 2017 over the levels of ₹ 5399.564 billion and ₹ 561.857 billion respectively, on March 2016. The asset quality of foreign banks enhanced in 2016-17 over the previous year. The gross NPAs of foreign banks decreased to ₹ 136.291 billion in March 2017, from ₹ 158.052 billion a year ago. The bank group-wise also, the net NPAs had increased to ₹ 3830.889 billion and ₹ 477.802 billion for PSBs and PVBs, respectively, on March 2017 over the levels of ₹3203.751 billion and ₹ 266.774 billion, respectively, on March 2016. Net NPAs of foreign banks had decreased to ₹ 21.406 billion in March 2017, from ₹ 27.619 billion a year ago. Figure 1 and 2 reflect the trend of gross and the net NPAs of PSBs, PVBs and foreign banks (FBs).

Gross NPAs to advances as well net NPAs to advances position of banking system witnessed an improvement by the end-March 2017 *vis-à-vis* its position in end of March 2016 or other period considered in the study. In 2012 and 2013, the commercial banking system's gross NPA to advances ratio was 3.3 percent which increased to 9.76 percent in 2016-17. Net NPAs to gross advance increased to 5.34 percent in March 2017 from 1.68 percent in March 2013. The gross NPAs, as a percentage of total assets for SCBs increased from 2.02 percent in 2012 and 2013 to 5.59 percent in 2016 and 2017. Again the net NPAs increased to 3.06 percent in 2016 and 2017 from 1.03 percent in 2012 and 2013.

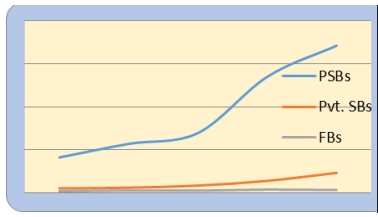

Figure 1. Trend of Gross NPAs (₹ in billion)

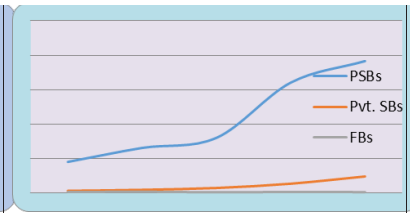

Figure 2. Trend of Net NPAs (₹ in billion)

Source: Statistical Tables Relating to Banks in India, RBI, 2016-2017

Table 1, 2 and 3 reflect the rise of NPAs level year by year. The progress in the asset quality was visible in FBs. PSBs and PVBs, however, witnessed a deterioration in the asset quality in 2016 to 2017 over the previous year. Joseph (2014) in his study found that compared to PVBs, PSBs are more at NPA level.

Table 3

Gross NPAs to Advance and Net NPAs to Advance Ratio of SCBs

Year	Gross NPAs to advance ratio	Net NPAs to advance ratio	Gross NPAs to total assets ratio	Net NPAs to total assets ratio
2016-17	9.76	5.34	5.59	3.06
2015-16	7.75	4.43	4.66	2.66
2014-15	4.38	2.38	2.69	1.46
2013-14	3.93	2.12	2.41	1.30
2012-13	3.30	1.68	2.02	1.03

Source: Statistical Tables Relating to Banks in India, RBI, 2016-2017

The Efficiency Measurement

By using DEA, this part of study investigates whether the rise of NPAs will affect the TE of banks. Table 4 displays the descriptive statistics of the variables. Before analysing the efficiency, the researchers have examined the assumptions of "isotonicity" relationship (Golany & Roll, 1989) among the factors. The results found positive correlations among all of them and satisfy the isotonicity assumptions. Table 5 provides the correlation among all the variables.

Table 4

Descriptive Statistics for Input and Output Factors of Sample Banks

Factors	Mean	Standard deviation	Minimum	Maximum
Gross NPAs	771.633	974.042	33.502	5158.826
Total Assets	3925.005	4892.170	777.161	26551.322
Deposits	3128.228	3780.606	682.332	20623.447
Expenses	269.538	323.675	54.901	1785.512
Advance	2409.181	3065.798	460.360	16670.826
Income	342.445	416.629	71.918	2270.405

Units of Measurement: In billion

Table 5

Correlation among Input and Output Factors

Factors	Gross NPAs	Total assets	Deposits	Expenses	Advance	Income
Gross NPAs	1					
Total Assets	0.9516	1				
Deposits	0.9597	0.9960	1			
Expenses	0.9510	0.9975	0.9936	1		
Advance	0.9514	0.9995	0.9963	0.9980	1	
Income	0.9375	0.9970	0.9886	0.9979	0.9970	1

The overall efficiencies of 27 banks are presented in Table 6. The input-oriented efficiency scores of 27 selected banks obtained from CCR model have been presented in the table from the year 2013 to 2017. The DMU is called efficient when OTE score is 1 and all slacks are 0 (Cooper et al., 2006). Bank with OTE score < 1 is relatively less efficient or inefficient. Year-wise, 11 banks in 2013, 10 banks in 2014, eight banks in 2015, seven banks in 2016 and eight banks in 2017 are overall efficient with average efficiency score (AES) of 0.9799, 0.9697, 0.9662, 0.9611 and 0.9432 respectively (Table 6). From the analysis, the present study found that among six PVBs (except JAKA), all five PVBs are efficient except the UTIB in 2017. These reflect the standard of asset quality of PVBs than PSBs. The results also reflect that the average overall efficiency in 2017 is less than 2016, the average of the overall efficiency in 2016 is less than 2015, while the average of the overall efficiency in 2015 is less than 2014, and the average of overall efficiency

in 2014 is less than 2013. These indicates that the efficiency level of banks degenerating and the efficient bank in number reduces due to the elapse of time.

Table 6

Efficiency Scores for the Period 2013 - 2017

DMUs	Efficiency score				
	2013	2014	2015	2016	2017
Allahabad Bank	0.9592	0.9635	0.9913	0.9721	0.9719
Andhra Bank	1	0.9771	1	1	0.9567
Axis Bank Limited	1	1	1	1	0.9973
Bank of Baroda	1	1	1	0.9643	1
Bank of India	0.9977	1	0.9766	0.9309	1
Bank of Maharashtra	1	0.9935	0.9946	1	0.9176
Canara Bank	0.9170	0.9355	0.9168	0.9148	0.9023
Central Bank of India	0.9500	0.9363	0.9081	0.9325	0.8370
Corporation Bank	0.9432	0.9378	0.9583	0.9295	0.9223
Dena Bank	0.9264	0.9404	0.9051	0.9323	0.8938
HDFC Bank Limited	1	1	1	1	1
ICICI Bank Limited	1	1	1	1	1
IDBI Bank Limited	0.9793	0.9444	0.9135	0.9049	0.8896
Indian Bank	0.9831	0.9783	0.9746	0.9708	0.9091
Indian Overseas Bank	0.9802	0.9647	0.9068	0.9605	0.9467
Jammu & Kashmir Bank Limited	0.9988	0.9707	0.9543	0.9707	0.9344
Kotak Mahindra Bank Limited	1	1	1	1	1
Oriental Bank of Commerce	0.9839	0.9707	0.9550	0.9519	0.9605
Punjab and Sind Bank	0.9822	0.9233	0.9723	0.9608	0.9403
Punjab National Bank	1	0.9863	0.9800	0.9907	1
State Bank of India	1	1	0.9843	0.9796	0.9049
Syndicate Bank	1	1	1	0.9990	1
UCO Bank	0.9699	1	0.9471	0.8526	0.8229

(continued)

DMUs	Efficiency score				
	2013	2014	2015	2016	2017
Union Bank of India	0.9932	0.9767	0.9910	0.9962	0.9775
United Bank of India	0.9441	0.8774	0.9134	0.8918	0.8344
Vijaya Bank	0.9495	0.9045	0.9430	0.9448	0.9476
YES Bank Limited	1	1	1	1	1
Average technical efficiency	0.9799	0.9697	0.9662	0.9611	0.9432
No. of efficient banks	11	10	8	7	8

Table 7

Benchmarking and Ranking of the Selected Banks based on DEA Model

No.	DMU	Symbol	Efficiency score	Benchmark	Times as a benchmark for another DMU	Ranking
1	Allahabad Bank	ALLA	0.9809	ANDB, HDFC, SYNB	0	13
2	Andhra Bank	ANDB	1	ANDB	13	2
3	Axis Bank Limited	UTIB	0.9979	BARB, HDFC, ICIC	0	8
4	Bank of Baroda	BARB	1	BARB	5	5
5	Bank of India	BKID	0.9936	BARB, ICIC, SYNB	0	9
6	Bank of Maharashtra	MAHB	0.9868	ANDB, KKBK, SYNB	0	12
7	Canara Bank	CNRB	0.9232	ANDB, HDFC, KKBK, SYNB	0	22
8	Central Bank of India	CBIN	0.8943	ANDB, KKBK	0	26

(continued)

No.	DMU	Symbol	Efficiency score	Benchmark	Times as a benchmark for another DMU	Ranking
9	Corporation Bank	CORP	0.9405	ANDB, HDFC, KKBK, SYNB	0	21
10	Dena Bank	BKDN	0.9188	ANDB, HDFC, KKBK, SYNB	0	25
11	HDFC Bank Limited	HDFC	1	HDFC	12	4
12	ICICI Bank Limited	ICIC	1	ICIC	4	6
13	IDBI Bank Limited	IBKL	0.9227	ICIC, KKBK, SYNB	0	23
14	Indian Bank	IDIB	0.9703	ANDB, HDFC, SYNB	0	16
15	Indian Overseas Bank	IOBA	0.9510	ANDB, KKBK	0	18
16	Jammu & Kashmir Bank Limited	JAKA	0.9445	ANDB, HDFC, KKBK	0	20
17	Kotak Mahindra Bank Limited	KKBK	1	KKBK	13	2
18	Oriental Bank of Commerce	ORBC	0.9712	ANDB, HDFC, KKBK	0	15
19	Punjab and Sind Bank	PSIB	0.9657	ANDB, KKBK, SYNB	0	17
20	Punjab National Bank	PUNB	0.9892	BARB, HDFC, SYNB	0	11
21	State Bank of India	SBIN	0.9793	BARB, HDFC, ICIC, SYNB	0	14

(continued)

No.	DMU	Symbol	Efficiency score	Benchmark	Times as a benchmark for another DMU	Ranking
22	Syndicate Bank	SYNB	1	SYNB	14	1
23	UCO Bank	UCBA	0.9200	BARB, HDFC, SYNB	0	24
24	Union Bank of India	UBIN	0.9935	ANDB, KKBK, SYNB	0	10
25	United Bank of India	UTBI	0.8769	HDFC, KKBK	0	27
26	Vijaya Bank	VIJB	0.9450	ANDB, KKBK, SYNB	0	19
27	YES Bank Limited	YESB	1	YESB	0	7

Table 7 demonstrates the efficiency scores calculated with the average value of variables from 2012 to 2013 and from 2016 to 2017. AES is 0.9654 and seven banks (i.e., ANDB, BARB, HDFC, ICIC, KKBK, SYNB, and YESB) are overall efficient with the average data of input and output variables for the period from 2012 to 2013 and from 2016 to 2017. The table also presents the benchmark, times as a benchmark for another DMU and ranking of banks.

As for the case of ALLA, this is an inefficient bank and it has three benchmarks of ANDB, HDFC, and SYNB. ALLA can follow any of these three efficient banks for improvement. The Ranking given for the efficient banks was based on the "times as a benchmark for another DMU" (Ordia & Bhanawat, 2018). The first rank of efficient bank is given to SYNB with the maximum of 14 times as a benchmark for another DMU. The Ranking of inefficient banks has been given according to the efficiency score. Consequently, SYNB is the most efficient bank and UTBI is the most inefficient among the selected banks consideres in this study.

The main reason behind the low efficiency is due to the rise of NPAs level. Further by analyzing radial and slack, present study makes it sure that among four input variables, originally NPAs affect the most. Radial is known as to whether all inputs need to be curtailed at equal proportions. With the radial dimension of inputs, the particular DMU reaches frontier level. Also, to reach the efficiency level without reduction of output if any further reduction

of any particular input is required then the same is known as slacks (Kumar and Gulati, 2008).

The analysis of slacks for inefficient banks reveals that among the input variables, 15 banks have non-zero slacks for gross NPAs and deposits, and further seven banks for expenses. Among the output variables, it observed that UTBI has non-zero slacks for advance and BKID for income. This suggests that most inefficient banks need to reduce the gross NPAs, deposits and expenses (with same level of output) for projecting themselves onto the efficient frontier.

Table 8

Radial and Slacks for Inefficient Public and Private Sector Banks

DMUs	Score	Radial (%) of all input variables	Slack - Input (%)				Slack - Output (%)	
			Gross NPAs	Total assets	Deposits	Expenses	Advance	Income
Allahabad Bank	0.9809	1.91	22.88	-	1.88	-	-	-
Axis Bank Limited	0.9979	0.21	7.05	-	0.42	-	-	-
Bank of India	0.9936	0.64	31.62	-	-	-	-	0.74
Bank of Maharashtra	0.9868	1.32	19.36	-	-	1.61	-	-
Canara Bank	0.9232	7.68	-	-	4.15	-	-	-
Central Bank of India	0.8943	10.57	35.21	-	6.88	1.57	-	-
Corporation Bank	0.9405	5.95	-	-	5.18	-	-	-
Dena Bank	0.9188	8.12	-	-	2.74	-	-	-
IDBI Bank Limited	0.9227	7.73	53.26	-	-	0.60	-	-
Indian Bank	0.9703	2.97	0.30	-	3.84	-	-	-
Indian Overseas Bank	0.9510	4.90	43.35	-	2.77	3.19	-	-
Jammu & Kashmir Bank Limited	0.9445	5.55	61.11	-	13.09	-	-	-

(continued)

DMUs	Score	Radial (%) of all input variables	Slack - Input (%)				Slack - Output (%)	
			Gross NPAs	Total assets	Deposits	Expenses	Advance	Income
Oriental Bank of Commerce	0.9712	2.88	7.69	-	3.49	-	-	-
Punjab and Sind Bank	0.9657	3.43	-	-	7.45	6.63	-	-
Punjab National Bank	0.9892	1.08	60.22	-	3.07	-	-	-
State Bank of India	0.9793	2.07	28.07	-	-	-	-	-
UCO Bank	0.9200	8.00	67.94	-	8.19	-	-	-
Union Bank of India	0.9935	0.65	18.78	-	-	0.59	-	-
United Bank of India	0.8769	12.31	69.40	-	17.60	-	2.39	-
Vijaya Bank	0.9450	5.50	-	-	9.61	4.45	-	-
Average			26.31	-	4.52	0.93	0.12	0.04

Table 8 presents the radial and slacks of inefficient banks. Adjustments are essential because of non-zero slacks. For interpreting the contents of the table, consider the case of a single bank, say, BKID. First, it has to reduce all inputs (including gross NPAs) by 0.64 percent (i.e., (1-OTE score) x 100). Second, gross NPAs by another 31.62 percent. Third, it has to augment interest and other income by 0.74 percent. In case of MAHB, first it has to reduce all inputs by 1.32 percent, second expenses by 1.61 percent and gross NPAs by 19.36 percent. The first type of adjustment is known as the radial adjustment while the remainders are known as the slack adjustments (Kumar and Gulati, 2008). Likewise, we may explain the same in case of the other inefficient banks.

According to input slacks, most inefficient banks should decrease the input resources to increase productivity for progressing their overall efficiencies. The results show that 15 inefficient banks should decrease their NPAs. It also shows that NPAs level should decrease with a maximum percentage (with average 26.31 percent) compared to other input variables. It reflects how important it is to enhance the efficiency level. According to the output slack values, one inefficient bank should increase its outputs of advance and one inefficient bank should increase the outputs of total income.

Conclusion

In order to focus on the efficiency level of the Indian banking sector due to the enhancement of NPAs, the present study has applied the DEA model. The results of this empirical analysis show that there is a downtrend in the efficiency level due to the rise of NPAs. It has been further observed that on an average 26.31 percent gross NPA can be theoretically reduced if all inefficient banks operate at same level as the efficient banks.

Due to the mounting of NPAs, the study finds that the number of efficient banks has reduced from 11 in 2012 and 2013 to eight in 2016 and 2017. Among the 11 efficient banks in 2012 and 2013, five banks are of PVBs and among eight efficient banks in 2016 and 2017, four banks are of PVBs. In précis, among 21 PSBs considered, only six are efficient in 2012 and 2013, five are efficient in 2013 and 2014, three are efficient in 2014 and 2015, two are efficient in 2015 and 2016, whilst four are efficient in 2016 and 2017. In the case of PVBs, five are efficient in 2012 and 2013 to 2015-16 and 4 are efficient in 2016-17 out of the total six banks considered in this study. The study also finds 0.9799 efficiency score (average) in 2012 and 2013 which was reduced to 0.9432 in 2016 and 2017.

After the Narasimham Committee recommendation in 1991, it was found that the banks were burdened with an enormous amount of NPAs and consequently the banks had gone financially weak (Swain et al., 2017). The NPAs affected not only the banks' performance but also caused irreparable harm to the economy (Sharma, 2005). The positive trend of gross NPAs to advance or net NPAs to advance ratio reveals that the growth rate in advances is decreasing and/or NPAs is rising (Banana & Chepuria, 2017). The impact of banks' profitability is negative on the level of NPL ratio and no bank can make its NPA at zero levels (Sahni & Seth, 2017). The bank authority itself must take the necessary steps to speed up the recovery process (Garg, 2016). The financial health, productivity and profitability can only be improved by reducing the NPAs (Banerjee et al., 2018; Jayaraman & Sharma, 2018). The NPAs affect profitability and growth of banking business (Banerjee et al., 2018). To make the Indian economic circumstances stronger, it desperately needs to avoid the NPAs in banking industry (Srinivas & Naresh, 2020). Thus an increase of NPAs lowers the credit growth which ultimately restricts the interest income which can be earned from the credit disbursement. The restriction of credit growth also restricts the industrial growth and economic growth. The ascending level of NPAs also overburdens the expenses book. Further, the target-oriented approach weakens qualitative aspect of lending. As such, the present study finds a negative relation between NPAs and bank efficiency. The high magnitude of NPAs is always a matter of concern as

they hampered profitability (Malepati & Gowri, 2017). The present study also concludes that among the four input variables, the NPA level should decrease with maximum percentage. The Minimization of NPA is essential for improving the bank efficiency since efficient banks are better at managing their credit risks (Berger & DeYoung, 1997). High risk loans signify lower returns to banks due to higher rate of unpaid loans (Miller & Noulas, 1997). Minimization of NPA is essential to elevate financial health in banking system (Rai, 2012).

Though there have been widely used of DEA applications to measures the efficiency of financial institutions, it has few limitations. Sample size and input-output selections could affect the DEA efficiency. In the present study, researchers have considered six variables to measure efficiency. Further study may be conducted with other factors also, for instance, number of branches or ATMs, number of employees, and profit. The study is also based on twenty-seven largest banks and the performance is based on them only. Further studies may be conducted with all SCBs, or regional rural banks, co-operative banks, microfinance institutions and others. Despite these limitations, this research can be used as the model by other researchers, banks, government, financial regulators, and policymakers for proper utilization of resources and escalate efficiency.

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