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Revisiting the Efficiency of Indian Banking Sector: An Analysis of Comparative Models Through Data Envelopment Analysis

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Abstract
This study examines the efficiency of the overall Indian banking industry using Data Envelopment Analysis (DEA) and to perform a comparative efficiency analysis of public, private, and foreign banks using six varied forms. Also, providing ranks to the banks based on their efficiency. The study incorporates BCC output-oriented DEA model using a sample of 50 Indian banks (public banks = 17, private banks = 18, foreign banks = 15) for a period ranging from 2009-10 to 2018-19, hence incorporating the after-effects of the financial crisis and demonetization, this study uses panel data from 2009-10 to 2018-19. The results showed that most of the Indian banks fall on the efficient side or are near to full efficiency. However, public banks outperform private and foreign banks in terms of their average efficiency. Results also specify that the performance of banks is sensitive to input-output variables, units under evaluation, and choice of the model. The current study has just focused on the internal factors for analyzing the efficiency of Indian banks; however, certain external factors might also impact the banks' efficiency.

Keywords: Banking, DEA, Efficiency, Ownership.

I. Introduction
History of banking in India is as old as Vedic civilization where usury, as well as kusidin (money lender), has been commonly referred. In modern times the banking in India originated in the last decade of the 18th century and has evolved over the years to the present shape. After independence, India got a formal banking structure catering to the elite class of society comprising mainly traders, industrialists, and high net worth individuals. Banks act as a financial intermediary by converting deposits into productive investment, creating new capital, and thus accelerating economic development. Few significant events such as nationalization of scheduled banks, creation of Statutory liquidity ratio and Cash reserve ratio, entry of private banks, and introduction of income recognition and asset classification norms to determine Non-Performing assets led to greater competition and strengthening of the Indian banking sector. Reserve Bank of India has regulated the banking system from time to time to ensure that banks are resilient to global turmoil.

The working population of India is raising demand for banking services. Due to modernization and technological interference, banks have become accessible through mobile and internet. Mobile banking, internet banking, and ATMs have increased the volume of business for banks. Banks are also enjoying higher interest margins, which has led to competition. To curd competition and reduce NPAs, few public banks have decided to undergo a merger. Efficiency and productivity

analysis of banks became essential to reduce costs and increase profitability. This critical analysis has gained importance, mainly due to the speediest dynamic environment where banks are facing heavy competition, and survival has become difficult.

The soundness and effectiveness of a banking system are often measured by efficiency, profitability improvement, increasing volume of funds flowing from savers to borrowers, and better-quality services for the customers. The efficiency and productivity analysis have caught the eye of the researcher in recent times. Researchers have faced one major hitch while measuring the effectiveness of banks. Banks provide products and services which are intangible. It is challenging to measure input injected, and output generated out of it.

A plethora of models were developed to calculate performance and efficiency. One such model was introduced in 1978 by Charnes *et al.*, as Data Envelopment Analysis (DEA). DEA is a mathematical approach for evaluating the performance of a set of peer entities called Decision Making Units (DMU) that converts multiple inputs and multiple outputs. The simplicity of DEA over other models makes it a widely used method. In this model, its method and algorithm help in finding an optimization solution. Moreover, the input/output resulting in inefficiencies can be traced to every Decision-Making Unit.

Earlier, ratio analysis has been used as a cross-sectional technique to measure and compare the productivity of different industries. Ratio analysis is simple in use but also provides a limited explanation of results. Multiple data cannot be analyzed at once, limiting the use of ratio analysis. It loses its credibility when a comparison is made for firms having a different size. Results may also be ambiguous and incomplete. Data Envelopment overcame the limitations associated with ratio analysis.

DEA has been implemented to measure the performance of many other industries such as railways (Kwak *et al.*, 2016; George & Rangaraj, 2008); hospitals (Sharma & Dipasha, 2018); Airport (Keskin & Köksal, 2019); schools (Mante & O'Brien, 2002); communication (Kwon *et al.*, 2008; Sigala, 2003); Retail distribution network (Lau, 2012); Environment (Mehta *et al.*, 2019); and Energy (Ashuri *et al.*, 2019) etc.

In this research paper, an attempt is made to study efficiency analysis and performance benchmarking of Banks in India. The analysis is developed based on four areas of banking operational efficiency: deposit mobilization, fund conversion, non-core activities, and cost-revenue management. The efficiency of the bank as a whole is also estimated by following the intermediation approach and production approach. The BCC model of the DEA technique is implemented to evaluate the efficiency of banks.

The paper is comprised of an extensive literature review of DEA in banking, research methodology, sampling technique and data collection, the basis for selection of input and output, presentation and analysis of empirical findings, and conclusion.

2. Literature Review for DEA in Banking

DEA is a popular tool for the practitioner in deciding on a multidimensional framework. Initially, Charnes *et al.* (1978) extended Farrell's efficiency measurement model. Charnes *et al. (1978)* developed a method that can incorporate multiple inputs and multiple outputs to determine single firm efficiency assuming Constant Return to Scale (CRS). Later, Banker *et al.* (1984) further extend the *Charnes et al. (1978)* CRS to variable returns to scale (VRS). In their study, they split the technical efficiency into pure technical efficiency and scale efficiency.

The use of DEA in the banking industry helps management to benchmark different Decision-Making Units (DMUs). DEA is a widely used tool to evaluate the performance of banks based on multiple inputs and outputs. In prior studies on banking efficiency using DEA, researchers have used either a production approach or an intermediation approach. In the production approach, the bank is viewed as a producer of products and services using physical labor, physical assets, and other resources as inputs while deposits, loans granted and the number of transactions done is treated as output (Ferrier & Lovell, 1990; Fried *et al.*, 1993; Sherman & Gold, 1985). Whereas, the intermediation approach views the bank as an intermediate that transforms and transfers financial assets from saver to borrowers (Elyasiani & Mehdian, 1995; Rangan *et al.*, 1988; Mercan *et al.*, 2003). The production approach and an intermediation approach became the foundation for the selection of inputs and outputs.

The application of the DEA technique in recent literature is very vast. Wanke *et al.* (2019) studied the banking industry of MENA using Dynamic Network DEA. They tried to develop a relationship between financial and accounting indicators in banks used under the study. The banking industry is affected by the cultural and regulatory heterogeneity of MENA countries. Ownership, origin, and type of banks are also factoring that led to variation in efficiency scores of MENA banks.

Wang *et al.* (2019) estimated the efficiency of 18 large banks from all over the world by a dynamic slacks-based measure model in DEA. The Dynamic SBM model developed a new structure for interpreting the inputs and outputs. The findings of the study reveal the accurate efficiency of 18 banks to position them in the global market. Jreisat *et al.* (2018) undertake 14 Egyptian banks to investigate productivity changes using Malmquist indices in DEA model. Determinants of productivity change were further investigated using regression model. Maturity of banks, size of banks and higher loan to deposit ratio reflected higher potential for productivity.

Kamarudin *et al.* (2019) studied the revenue efficiency, cost efficiency, and profit efficiency of the domestic Malaysian Islamic banks and Malaysian foreign Islamic banks. The study revealed that Malaysian domestic banks are relatively revenue and cost-inefficient as compare to foreign banks operating in Malaysia. Profit inefficiency is influenced by higher revenue inefficiency. Further, Bank specific and external factors are analyzed to derive their relationship with domestic Malaysian

Islamic banks' efficiency. The factors such as bank size, liquidity, and management quality have a positive effect on efficiency whereas, bank market power has negatively influenced the efficiency of banks in Malaysia.

Zhou *et al.* (2019) developed a three-stage model to examine the efficiency of Listed Chinese banks for the year 2014-16. Inefficiencies of banks in three stages and different periods are evaluated. Unused assets were carried forward in this model. Employees' cost and fixed assets are termed as shared inputs because these can be used as inputs for multiple outputs. Credit risk is reflected by NPAs that are treated as undesired output in the study. The study indicated that increasing business scale and identifying sensitive banks can improve the performance of banks in the future. Grmanová & Ivanová (2018) analyzed the efficiency of banks based in the Slovak Republic for the years 2009 and 2013. In the year 2009, most banks suffered the effects of the financial crisis. By the end of year 2013 most banks were able to overcome the ill-effects of the financial crisis. The efficiency of banks is determined using a combination of inputs and outputs.

Ofori-sasu *et al.* (2019) studied the effect of the funding structure of 25 Ghana banks on technical efficiency. Deposit funding and non-deposit funding have a positive influence on technical efficiency. Ghana banks are generally inefficient as managers are unable to exploit technology, and optimally utilize inputs to generate outputs.

Yannick *et al.* (2016) addressed the difficulty faced by banks of Côte d'Ivoire to convert deposits into credit. After investigating 25 banks, it is found that banks are inefficient in loan allocation due to incompatibility of production scale. Foreign Private banks are more efficient as comparative to pubic banks. Janet *et al.* (2015) examined the performance and productivity of state-owned commercial banks in China. Big four banks are analyzed from 1990 to 2008 to study the banks' reaction to bank reform. The banks under study reacted positively during the reform period in terms of technical efficiency, scale efficiency, and productivity change. The results also indicate that protection, support, and intervention of the government has reduced innovation and motivation among employees.

Desta (2016) has shown various applications of the DEA model.The DEA model can be used to determine the firm's efficiency, ranking of firms based on efficiency scores, and selecting the most efficient banks. Jemric & Vujcic (2002); Hauner & Peiris (2005); Matthews & Ismail (2006); Isik (2007) studied the efficiency of banks based on their ownership structure and revealed that foreign banks are more efficient and productive than domestic banks. On the other hand, Hadad *et al.* (2008); Sufian (2009); Tahir *et al.* (2009); Fethi *et al.* (2011) results presents that domestic banks are more efficient than foreign banks.

2.1 Literature Review on DEA in Indian Banking

Several studies have been carried out on Efficiency Analysis using DEA approach on Indian banking. Bhattacharyya *et al.* (1997) used DEA and stochastic frontier approach (SFA) to analyze the technical efficiency of banks and reasons for variations in efficiency scores, respectively. The results reveal that public sector banks performed way better than private and foreign banks in terms of technical efficiency. The performance is hindered by operational constraints, capital adequacy norms, and priority sector lending requirements.

The study of Kumar & Gulati (2009) showed that the technical efficiency of Indian public banks has improved in the post-reform period. Most banks exhibit improvement in efficiency after the first phase of reform. By using the concept of convergence, it is discovered that the inefficient banks performed reasonably well, and few overtake the already existing efficient banks. The noteworthy reasons for the increase in performance are heightened competition due to entry of private sectors, increase in operational efficiency, reduction in the cost of financial transactions, rightsizing of the labor force, use of technology, and recovery of NPAs. A study conducted by Ray & Das (2010) during the post-reform period indicates that the profit efficiency of public banks is higher than private banks. The estimates of non-parametric kernel density manifest rightward-shift in the distribution of efficiency. The cause of inefficiency is the ineffective scale of economy, bank size, and product mix.

Sathye (2003); Mohan & Ray (2004) undertake banks of a developing country, i.e., India, in the research. The productive efficiency of banks is measured, and the efficiency scores demonstrate that public sector banks and foreign banks perform better than private banks. The study recommends that efforts should be made to bring down NPAs and the cost of operations. However, the study of (Shanmugam & Das, 2004) indicated the supremacy of deposits input in generating outputs. The output of banks such as non-interest income, investments, and credits has shown steady improvement over a period of time. Progress in the productivity of Indian banks proclaims the success of the implementation of reforms.

Sanjeev (2006, 2009) studied the Indian banks during the reform period to ensure the improvement in the efficiency of banks. The average efficiency scores of public and private sector banks have increased significantly. A few banks in the public sector have declined in their performance due to increased competition. The competition has risen with liberalization policy, giving a green signal for entry of private sectors in the banking industry. An increase in NPAs has shown an inverse relationship with the efficiency of banks. Likewise, Tamatam *et al.* (2019) proves that Public sector banks had less efficiency and improvement in technology when compared with private banks.

Zhao *et al.* (2008) examined Indian banks based on ownership, where foreign banks have higher technical efficiency scores in the first phase of deregulation than private and public banks. In the second phase, public banks performed better than others due to the rise in competition and the advancement of technology. The NPLs are taking into consideration to determine the output efficiency. It is, however, observed that priority sector lending affected the credit quality of banks.

Rezvanian *et al.* (2008) conducted a study on the Indian banking industry covering the period between 1998 and 2003. An attempt is made to examine the effect of ownership, technological progress, and productivity growth on the efficiency of banks. Based on the efficiency scores calculated for three types of banks, foreign-owned banks ranked one in the efficiency,

whereas private banks ranked two, and public banks stood last in the ranking. The rationalization for inefficiency is the under-optimal scale of operations of most of the banks.

Das & Ghosh (2009) assessed that banks are cost-efficient in India and can control the wastage and underutilization of resources. However, in terms of profit efficiency, banks lie inside the efficient profit frontier. Higher capital and less Non-performing loans exhibit an increase in the efficiency of most banks.

Jagwani (2012) studied the pure technical and scale efficiency of Indian banks. The inefficiency of banks is justified by managerial sub-performance. Management is incapable of converting inputs into outputs optimally. Other than management quality, the sub-optimal scale of operation caused inefficiencies in the banking sector. The study of Mukherjee *et al.* (2002) showed the positive outcome of liberalization on banking sector performance measures. With the implementation of a multi correlation clustering method, a strategic group of banks is identified based on efficiency measure. This approach will help bank managers to recognize their key competitors and plan for future strategies.

2.2 Literature Review on Input and Output

It is essential in DEA methodology to select appropriate inputs-outputs for estimating the efficiency of banks. There is no consensus on the choice of input-output, and input-output variables affect the derived efficiency level. For the banking industry, there are two approaches, mainly: the production approach and the intermediation approach. The selection of deposit as an input variable or out variable is the only difference between the two approaches. For the production, approach deposit is treated as output, while for the intermediation approach, the deposit is treated as input. Various inputs and outputs used by authors for deriving the efficiency of banks are given under in table 1.

Table 1. Summary of Input-Output Literature

S. No	Author and Year	Input	Output	No. of banks	Country
1.	Kantor & Maital (1999)	Labour costs, services, area	Number of demand deposits, customer services transactions, credit cards, commission on import-export, commercial accounts activity	250	Mid-East
2.	Golany & Storbeck (1999)	Labour, area, marketing	Loans, deposits, number of accounts per customer, satisfaction	182 branches	USA
3.	Mukherjee *et al.* (2002)	Net worth, borrowings, operating expenses, number of employees, number of bank branches	Deposits, Net Profits, advances, non-interest income, interest spread	68 banks	India
4.	Sathye (2003)	Interest expense, non-interest expense	Interest income, non-interest income	94	India
5.	Ho & Zhu (2004)	Assets, employees, branches, capital stocks	Sales, deposits	41	Taiwan
6.	Howland & Rowse (2006)	Non sales FTE, sales FTE, size, city employment rate	Loans, deposits, average number of products/customers, customer loyalty	162	Canada
7.	Ariff & Can (2008)	Deposits and other funds, number of employees, physical capital	Loans, investments	28	China
8.	Das & Ghosh (2009)	Deposits, number of employees, capital-fixed asset, equity	Loans and advances, investments, other income	71	India
9.	Olson & Zoubi (2011)	Deposits, labour, physical capital	Net loans, dollar value of securities and other earning assets	80	MENA
10.	Jagwani (2012)	Net fixed assets, staff, deposits and borrowings, net worth, operating expenses, Non-performing assets, payments and provisions related to employees, other liabilities and provisions	Net interest income, non-interest income, investments, net profits, advances	42 banks	India
11.	Řepková (2013)	Labour, deposits	Loans, net interest income	11 banks	Czech Republic
12.	Malhotra *et al.* (2011)	Efficiency ratio, Interest expensed to interest earned ratio, Loan to total fund ratio	Return on asset, Interest income relative total fund, Interest spread, Asset utilization ratio, Capital adequacy	35 banks	India
13.	Yannick *et al.* (2016)	Deposits, Fund borrowed	Volume of loan granted	14 banks	Côte d'Ivoire
14.	Desta (2016)	Interest expense, Non-interest expense, Transaction deposit, Non-transaction deposit	Gross loan, Other earning assets, Interest income, Non-interest income	19 banks	Africa

15.	Grmanová & Ivanová (2018)	Liabilities to banks and customers, operating cost	Loans and advances to banks and customers, non-interest income.	13 banks	Slovakia
16.	Ofori-Sasu *et al.* (2019)	Total cost, Total deposits	Total loans, Other earnings	25 banks	Ghana
17.	Kordrostami *et al.* (2016)	Employees (The number of staffs and the manager of each branch), Expenses (Personnel, office, and other expenses)	Deposits (Long term investment deposits, saving deposits and current deposits of government) Loans (The aggregation of short- and long-term personal loans)	20 branches	Iran
18.	Kamarudin *et al.* (2019)	Deposits, labour	Loans, income	17 banks	Malaysia
19.	Zhou *et al.* (2019)	Interest payments, Employees' salaries, Fixed assets	Net interest incomes, Non-performing loans	16 banks	China
20.	Wanke *et al.* (2019)	Net Loans, Total Earning Assets, Non-Earning Assets, Loan Loss Provisional Costs	Net Interest Margin, Equity, Income	82 banks	MENA
21.	Wang *et al.* (2019)	Assets (tangible and intangible), capitalization (net worth) and liabilities	Revenue as output and net interest income as good link	18 banks	All over the world

3. Theoretical Framework and Methodology

Over the past two decades, several parametric and non-parametric frontier models have received considerable attention for measuring the efficiency of various financial and non-financial institutions. Among these, a non-parametric performance assessment technique termed as data envelopment analysis (DEA) has increasingly become accessible for undertaking benchmarking studies concerning the banking sector (Kamarudin *et al.*, 2019; Paradi *et al.*, 2018). Charnes *et al.* (1978) originally designed the DEA technique for measuring the relative efficiencies of decision-making units (DMUs) or organizational units using the input-output dataset, also known as the CCR model which assumed a constant return to scale. Further, Banker *et al.* (1984) extended the CCR model for technologies exhibiting a variable return to scale. These DEA approaches involve constructing an efficient production frontier by applying linear programming techniques based on best practices over the data set. The efficiency of each DMU is then measured with this frontier. The DMUs with efficiency scores as '1' will lie on the frontier and would be efficient, and DMUs not lying on the frontier would be inefficient with scores less than 1. Most popularly, organizations involving multiple inputs for producing multiple outputs have been using the DEA technique for evaluating their organizations' efficiency.

The available literature on DEA models has used various mathematical approaches. Essentially, these models establish which DMUs govern the efficient frontier or best practice frontier or envelopment surface. Mainly, there are two types of models - input-oriented and output-oriented. Input oriented model aims at reducing the number of inputs keeping the output levels at the same levels. The objective of the Output-oriented model is maximizing the level of output, following the same level of inputs. The present study incorporates specific DEA model as prescribed by Kumar & Gulati (2009). It uses the BCC output-oriented model for identifying the banks on the output frontier provided with several inputs at their disposal. Considering varying economies of scale in the practical scenario, using the BCC model for the analysis is more suitable.

The following expression illustrates the DEA BCC model:

max φ

subject to

$\sum_{j=1}^{n} \lambda_j * x_{ij} \leq x_{i0}$

$\sum_{j=1}^{n} \lambda_j * y_{rj} \geq \varphi y_{r0}$

$$\sum_{j=1}^{n} \lambda_j = 1$$

Where,

- i = 1,2, 3,……..,m;
- r = 1,2, 3,……..,s;
- j ≠ 0

and,

- φ signifies efficiency scores
- λ_j denotes the weight of DMU (decision-making unit) j
- x_{ij} denotes the i input of DMU j
- y_{rj} denotes the r input of DMU j

There are m inputs and s outputs for all N decision-making units.

3.1 Sampling and Data

The present study selects 50 banks in India, consisting of 17 Public Banks, 18 private sector banks, and 15 foreign banks; the list is given Appendix 1. The selection of banks is made as per the availability of data for years 2010-2019. The data collected for the research paper is annual and collected from the secondary source. Annual bank-level data is obtained from 'Capitaline Plus' for the financial year 2009-2010 to 2018-2019, i.e., for 10 years. The time period taken in the study covers the post-financial crisis period and demonetization period effects. Therefore, the period is sufficient to study the drastic changes that occur in the economy.

3.2 Selection of Input and Output

The input and output variables selected for the study pertain to the existing literature. Mainly the input-output is guided by the operational pattern, performances, and objectives of the banks functioning in India. The input-output variables have been segregated in two headings: Area wise and Approach wise. Area-wise selection of input & output variables is further divided into four sets based on performance-based efficiency, whereas, Approach-wise selection of input & output variables is divided into two sets. The table 2 and table 3 shows the choice of input-output variables in the study.

Table 2. Area wise four sets of input & output variables

S.No	Performance base efficiency	Input	Output
1.	Deposit Mobilization Efficiency (DME)	Fixed Assets, Employee Cost, Interest expense on deposits	Deposits
2.	Fund Conversing Efficiency (FCE)	Fixed Asset, Employee Cost, Loanable fund	Earning Assets
3.	Off-Balance Sheet Activities Efficiency (OBE)	Fixed Assets, Employee Cost	Total Non- Interest Income
4.	Cost- Revenue Management Efficiency (CRE)	Total Interest Expense, Total Non-Interest Expense	Net total Income Profit After Tax (PAT)

Table 3. Approach wise two sets of input & output variables

S. No	Approach based efficiency	Input	Output
1.	Intermediation Approach Efficiency (IAE)	Loanable funds, Operating Expenses	Earning Assets, Total Income, Profit After Tax (PAT)
2.	Production Approach Efficiency (PAE)	Fixed Assets, Employee Cost	Deposits, Earning Assets

DME and FCE capture traditional functions of banks, whereas OBE measures the efficiency of the bank for non-traditional activities. CRE depicts the cost minimization and revenue maximization efficiency of banks. In the production approach, a bank is treated as a producer of services, while in the intermediation approach, it is treated as a facilitator.

In previous researched fixed assets and Number of employees were taken as a proxy for physical capital and labor. Here, in the present study, Fixed assets and Employee costs have been used instead. Here is a detail for inputs and outputs:

(a) Deposit = saving deposits + demand deposits + term deposits
(b) Loanable fund = deposits + borrowings
(c) Earning Assets = Investments + Advances
(d) Total Non-Interest Income = Commission & Brokerage + Other non-interest income
(e) Total Interest Expense = Interest expense on Deposits + Interest paid on borrowings
(f) Total Non-Interest Expense = Operating Expenses + Non-operating expenses
(g) Total Income = Interest income + Non-interest Income
(h) Net total Income = Non- Interest Income + Net Interest Income (Interest income – interest expense)

The study has undertaken six types of efficiency for each bank selected for 10 years using the VRS (BCC) model. The banks are segregated further based on ownership, i.e., public banks, private sector banks, and foreign banks. The purpose of the study is to find efficient banks as per the ownership structure based on all six types of efficiency and composite scores derived from the average of the above six types.

4. Results and Discussion

4.1 Private Sector Banks

The study was conducted on 18 private banks, and efficiency scores were calculated based on six sets of Input & Output variables. From the descriptive analysis of statistic of efficiency, it was revealed that private banks were most efficient in Intermediation Approach Based Efficiency (97.35%), followed by Fund Conversion Efficiency (96.99%), Cost- Revenue Efficiency (88.41%), Deposit Mobilization Efficiency (81.56%), Production Approach Based Efficiency (71.54%). The

lowest efficiency of banks was found in Off-Balance sheet Activity Efficiency, i.e., 36.36%. The inefficiency of the bank also reveals that there is further scope for banks to increase output from the same inputs.

Table 4. Summary Statistics of efficiency of private banks

The summary statistics of different efficiency	IAE	PAE	DME	FCE	OBE	CRE	Composite Score
No. of DMU	18	18	18	18	18	18	18
Average efficiency	0.9735	0.7154	0.8156	0.9699	0.3636	0.8841	0.7870
SD	0.0275	0.2259	0.1488	0.0257	0.3336	0.0997	0.1113
Maximum efficiency	1	0.9751	0.9838	1	0.9972	1	1
Minimum efficiency	0.9061	0.3447	0.3589	0.9040	0.0390	0.6548	0.5819
No. of efficient banks	3	1	1	2	1	1	1

The table 5 shows the list of banks that were fully efficient in six types of efficiency calculated.

Table 5. List of fully efficient private banks

Type of efficiency	Name of the bank
IAE	HDFC, Nainital Bank, RBL Bank Ltd
PAE	HDFC
DME	Jammu & Kashmir Bank
FCE	HDFC, Nainital Bank
OBE	ICICI Bank
CRE	Nainital Bank

It was observed that no bank was fully efficient in all six types of efficiencies. The composite score has been calculated by taking the average of IAE, PAE, DME, FCE, OBE, and CRE. The most efficient bank as per composite score is ICICI bank, followed by Axis bank, HDFC bank, IndusInd Bank, and Federal Bank.

Just after the financial crisis, the performance of most banks in the private sector is inefficient. However, few banks recovered in a later period, and their performance has also accelerated. During the demonetization phase 2016-17, the business of banks has undoubtedly flourished, which is reflected in their performance. Excess deposit growth in the banking system during this period has increased the performance of most of the banks in the private sector.

If we talk about non-traditional activities, then private banks are still lagging. Traditional activities generate a large portion of revenue, and non-traditional activities contribute a very insignificant amount.

Figure 1 shows the efficiency score of private banks. The average score for 10 years has been taken to determine the efficiency score for IAE, PAE, DME, FCE, OBE and CRE.

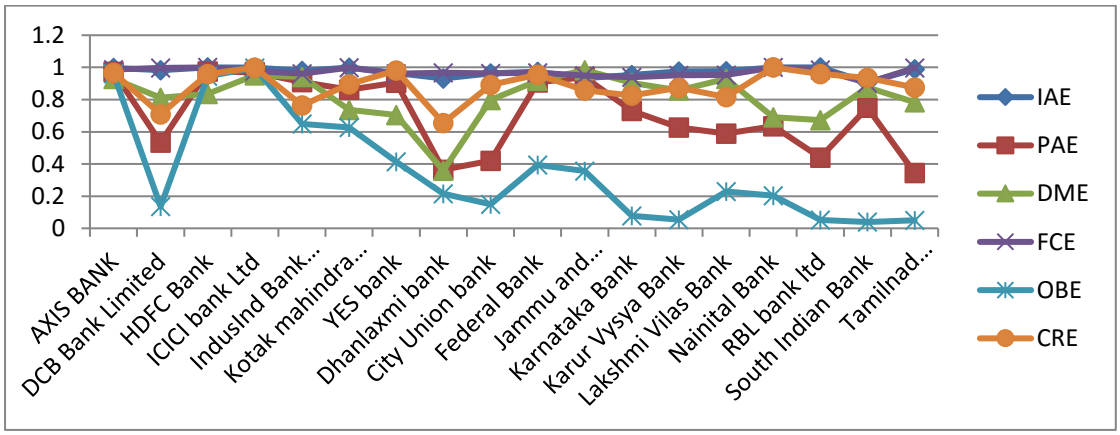

Figure 1. Efficiency score of private banks (average of 10 years)

4.2 Public Sector Banks

Likewise, the analysis was conducted on 17 Public sector banks, and the results were similar to private sector banks. The efficiency of banks is highest in IAE with 98.58%, followed by FCE - 98.28%, CRE - 94.36%, DME- 92.32%, PAE – 84.94%, OBE- 78.92%. This analysis shows that the performance of banks is still based on traditional functions. Still, the

off-balance-sheet activity efficiency of Public banks is significantly better than private and foreign banks. Public banks deal in insurance, brokerage, and generate fair revenue.

Table 6. Summary statistics of efficiency of public sector banks

The summary statistics of different efficiency	IAE	PAE	DME	FCE	OBE	CRE	Composite score
No. of DMU	17	17	17	17	17	17	17
Average efficiency	0.9858	0.8494	0.9232	0.9828	0.7892	0.9436	0.9124
SD	0.0158	0.1240	0.0668	0.0175	0.1594	0.0446	0.0554
Maximum efficiency	1	1	1	1	1	1	1
Minimum efficiency	0.9363	0.5913	0.7884	0.9472	0.4813	0.8761	0.8312
No. of efficient banks	3	4	3	4	2	2	2

The table 7 shows the list of banks that were fully efficient in six types of efficiency calculated.

Table 7. List of fully efficient public sector banks

Type of efficiency	Name of the bank
IAE	Indian Bank, Punjab & Sind Bank, State Bank of India
PAE	Bank of Baroda, Corporation Bank, Punjab & Sind Bank, State Bank of India
DME	Bank of Baroda, Corporation Bank, Punjab & Sind Bank, State Bank of India
FCE	Andhra Bank, Corporation Bank, Punjab & Sind Bank, State Bank of India
OBE	Punjab & Sind Bank, State Bank of India
CRE	Punjab & Sind Bank, State Bank of India

State bank of India and Punjab & Sind Bank are fully efficient in all six types of efficiencies – IAE, PAE, DME, FCE, OBE, and CRE. The most efficient bank as per composite score is again State bank of India and Punjab & Sind bank. Apart from them, other efficient banks with rank 2, 3, 4 & 5 are Corporation Bank, Bank of Baroda, Andhra Bank, and Canara bank, respectively.

The efficiency of Public sector banks is generally stagnant even after the crisis. Most banks have recovered at a faster pace due to the governmental policies to revive the economy.

During demonetization, Public sector banks have lion share in deposits leading to lower cost of funds, yet the performance of banks has declined. Most banks were not able to discharge their day to day operations during the demonetization phase. There was excess deposit but also withdrawals from banks. Most banks were busy exchanging banned currency notes as per the RBI guidelines and could not perform their regular work. These events led to a decline in the performance of banks.

Figure 2 represents the efficiency score of public sectors banks. The average score for 10 years has been taken to determine the efficiency score for IAE, PAE, DME, FCE, OBE and CRE.

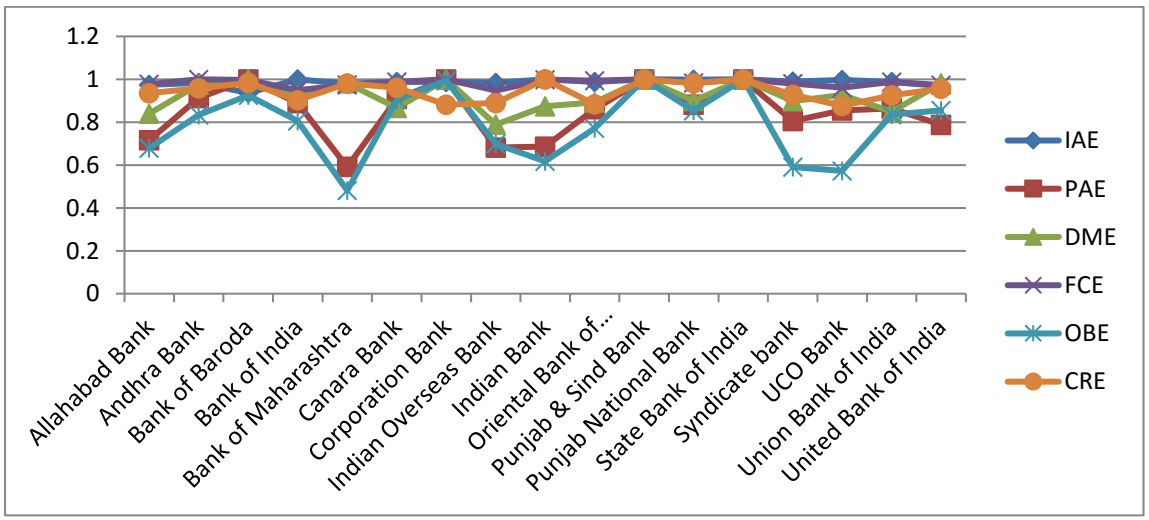

Figure 2. Efficiency score of public sector banks (Average of 10 years)

4.3 Foreign Sector Banks

Foreign banks also showed a similar pattern of efficiency when compared with Public banks and Private Banks. Banks are highly efficient for IAE – 92.83% and least efficient in OBE – 55.88%.

Table 8. Summary Statistics of efficiency of foreign banks

The summary statistics of different efficiency	IAE	PAE	DME	FCE	OBE	CRE	Composite Score
No. of DMU	15	15	15	15	15	15	15
Average efficiency	0.9283	0.7871	0.8696	0.9374	0.5588	0.8532	0.8224
SD	0.0911	0.2354	0.1567	0.0906	0.3323	0.1394	0.1192
Maximum efficiency	1	1	1	1	1	1	1
Minimum efficiency	0.7409	0.2443	0.5257	0.6863	0.0943	0.6134	0.6369
No. of efficient banks	4	4	5	6	4	4	1

The table 9 shows the list of banks that were fully efficient in six types of efficiency calculated.

Table 9. List of fully efficient foreign banks

Type of efficiency	Name of the bank
IAE	Standard Chartered Bank, Barclays, Bank of Ceylon, American Express
PAE	Standard Chartered Bank, Barclays, Shinhan Bank, Krung Thai Bank Public Company Ltd
DME	Standard Chartered Bank, Barclays, AB Bank, Mashreq bank, PSC, Krung Thai Bank Public Company Ltd
FCE	Standard Chartered Bank, Barclays, Bank of Ceylon, American Express, AB Bank, Krung Thai Bank Public Company Ltd
OBE	Standard Chartered Bank, American Express, AB Bank, Krung Thai Bank Public Company Ltd
CRE	Bank of Ceylon, American Express, Mashreq bank, Standard Chartered Bank

There is only one bank which is fully efficient in all six types of efficiency i.e., Standard Chartered Bank. When composite efficiency is calculated and banks are ranked, then also standard Chartered bank is ranked first. Banks that secured rank 2, 3, 4, and 5 are Krung Thai bank Public Company Ltd, AB Bank, Barclays, and Mashreq bank respectively. Figure 3 represents the efficiency score of foreign sectors banks.

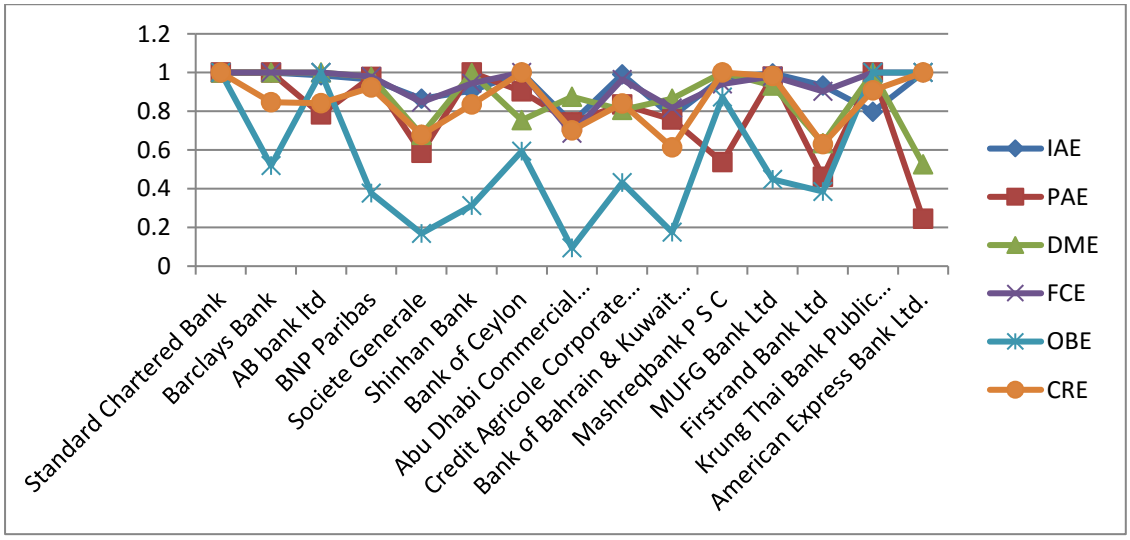

Figure 3. Efficiency score of foreign banks (Average of 10 years)

4.4 Ownership Based Analysis

From the tables provide above on descriptive statistics of efficiency based on IAE, PAE, DME, FCE, OBE, and CRE for Private, Public and Foreign banks, a summary table is derived which shows the most efficient, moderately efficient and least efficient banking sector.

The analysis shows that Public sector banks are leading private and foreign banks in all six types of efficiency. In contrast, private banks are moderately efficient for IAE, FCE, and CRE and least efficient for PAE, DME, and OBE. As for Foreign banks, they are moderately efficient for PAE, DME, and OBE.

Table 10. Ownership-wise efficiency of banks

Efficiency level	IAE	PAE	DME	FCE	OBE	CRE
Most efficient	Public bank	Public bank	Public bank	Public bank	Public bank	Public bank
Moderately efficient	Private bank	Foreign bank	Foreign bank	Private bank	Foreign bank	Private bank
Least efficient	Foreign bank	Private bank	Private bank	Foreign bank	Private bank	Foreign bank

Later based on composite scores, it was revealed that public banks are leading, followed by private banks and foreign banks. Ownership of banks has a significant impact on the productivity and efficiency of banks. Public banks are more efficient than private and foreign banks (Jagwani, 2012). The efficiency of Public sector banks is 91.23%, Private bank – 78.71%, and Foreign Bank – 82.24%. Though the efficiency of foreign banks is significantly more than Private banks yet when compared with standard deviation, Private bank shows lesser deviation. The dispersion amongst the public banks is very less when compared with private and foreign banks, which reflects the single ownership of government. Moreover, Public banks generally follow identical practices and policies. The competition has also contributed towards increased efficiency of Public banks as they thrive for their survival with expansion of private and foreign sector banks (Zhao *et al.*, 2008; Sanjeev, 2006, 2009; Kumar & Gulati, 2009). Rationalization of staff and branches has reduced cost burden on banks. The higher value of standard deviation in private and foreign banks indicates that the methods of banks might differ due to diverse management and ownership.

Minimum dispersion in public sector banks is consistent with the results of Bhattacharyya *et al.* (1997); Sathye (2003). Public sector banks are more familiar with the regulatory system as compared to foreign banks. Bhattacharyya *et al.* (1997) justified the greater variability in the efficiency of foreign banks by showing that they depend on less stable wholesale or corporate resources, interbank borrowings, and refinance of assets. On the other hand, the domestic banks have an extensive network of branches and rely on a more stable retail banking business.

Table 11. Summary of statistics based on ownership

Summary of statistics	Public bank	Private bank	Foreign bank
No. of DMU	17	18	15
Mean	0.9124	0.7871	0.8224
SD	0.0554	0.1112	0.1191
Maximum	1	1	1
Minimum	0.8312	0.5819	0.6369
No. of efficient banks	2	1	1
coefficient of variation	0.0607	0.1415	0.1449

4.5 Overall Analysis

Lastly, the efficiency score of all 50 banks without segregating them sector-wise was calculated, and the results are unique. The top five banks for overall efficiency are State Bank of India, ICICI, YES Bank, Axis Bank, and HDFC. Fully efficient banks for IAE, PAE, DME, FCE, OBE and CRE is shown in the table 12 below:

Table 12. List of fully efficient banks in six types of efficiency

IAE	PAE	DME	FCE	OBE	CRE
State Bank of India	Bank of Baroda	Bank of Baroda	State Bank of India	State Bank of India	State Bank of India
Barclays	Bank of Ceylon	State Bank of India	Barclays	AB Bank Ltd	HDFC
Bank of Ceylon	Krung Thai Bank Public Company	AB Bank Ltd	AB Bank Ltd	Krung Thai Bank Public	Standard Chartered

	Ltd			Company Ltd	
American Express	-----	Mashreqbank	Bank of Ceylon	-----	Bank of Ceylon
-----	-----	Krung Thai bank Public Company Ltd	Krung Thai bank Public Company Ltd	-----	American Express
-----	-----	-----	American Express	-----	Mashreqbank

5. Conclusion

The paper studies 50 banks operating in India for the period 2009-10 to 2018-19, segregated them based on ownership into Public, Private and foreign banks. The study is very comprehensive in a manner as it uses different inputs and outputs to calculate the efficiency of banks. It is noted that the DEA technique is sensitive to inputs and outputs, CCR and BCC model, Number of DMUs, and the number of inputs and outputs. The results in the study proved that by changing inputs and outputs, the efficiency score of banks has also fluctuated. The efficiency scores are based on technical efficiency in this study.

Here in this study, efficiency is calculated using four key performance areas. The choice of Input and Output changes the efficiency scores each performance area, i.e., DME, FCE, OBE, and CRE. The model has also determined overall efficiency scores of banks using intermediation and production approach (IAE and PAE). Analyzing the efficiency in such a broader way made it possible to capture the multidimensional performance of banking. It provides insight for banks to improve performance in their weak areas of efficiency. Banks can also improve their productivity by bringing down the Non-Performing Loans, reducing the cost in fixed assets, and reducing the number of branches (Sathye, 2003; Chaluvadi *et al*., 2018). Digitalization and online banking have the potential to reduce both fixed asset cost and employee cost.

The analysis depicts that the technical efficiency of Private Banks is relatively less in Off-balance sheet efficiency (OBE) and Production Approach efficiency (PAE) as compared to other efficiencies. Banks can improve performance by focusing more on commission-based activities, increasing brokerage income, and other non-interest income. The results are similar for public banks and foreign banks. All banks are relatively efficient in the Intermediation approach (IAE). Merger and Acquisition can also play a significant role in increasing the efficiency of banks. Many studies, like Ishwarya (2019); Patel (2018); Singh & Gupta (2015) have found significant positive impact on the productivity of banks. Through mergers & acquisitions, banks were able to pool resources and minimize cost.

Generally, all banks have shown an increasing trend in efficiency scores with few exceptions. The efficiency score of Dhanlaxmi Bank, Tamilnad Bank, RBL Bank Ltd, and DCB (from private sector banks) has shown a decreasing trend in most of the types of efficiency. As for public banks, the performance of banks as accelerated over the period, but banks like Bank of India, Andhra Bank, and bank of Maharashtra performed poorly in OBE. In foreign banks, the growth is seen in most of the banks apart from a few. The poor-performing bank is Societe Generale. Over a while, the efficiency of a few banks declined due to intense competition as banks fight for resources.

There are a few limitations of this study, which can become a further scope of research. The relevance of the inputs and outputs can be examined by using regression analysis. Moreover, in this study, only the internal factors affecting the performance of banks are taken whereas, environmental factors could also be used to test their influence on efficiency. The analysis may go further by decomposing technical efficiency change and technological progress using the DEA-based Malmquist productivity index. Also, scale efficiency can be calculated for further refinement of analysis. Data for 10 years for each bank was unavailable; therefore, many banks are dropped in the sample. Data for a few inputs, such as the number of employees and branches of banks for 10 years, is not available, resulting in either the dropping off input or used with modification. More inputs and outputs can be used, but as the DEA model suggests that the Number of DMUs should be greater than 3(m+n) or (m*n); therefore, we have refined inputs and outputs in the model.

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Appendix -A

Table 1. List of banks

S.No.	Private banks	Public banks	Foreign bank
1	Axis bank	Allahabad Bank	Standard Chartered Bank
2	DCB Bank Ltd.	Andhra Bank	Barclays Bank
3	HDFC Bank	Bank of Baroda	AB bank Ltd.
4	ICICI bank Ltd.	Bank of India	BNP Paribas
5	IndusInd Bank Ltd.	Bank of Maharashtra	Societe Generale
6	Kotak mahindra bank Ltd.	Canara Bank	Shinhan Bank
7	YES bank	Corporation Bank	Bank of Ceylon
8	Dhanlaxmi bank	Indian Overseas bank	Abu Dhabi Commercial bank
9	City Union bank	Indian Bank	Credit Agricole Corporate bank
10	Federal Bank	Oriental Bank of Commerce	Bank of Bahrain & Kuwait bank
11	Jammu and Kashmir bank	Punjab & Sind Bank	Mashreqbank P S C bank
12	Karnataka Bank	Punjab National Bank	MUFG Bank Ltd
13	Karur Vysya Bank	State Bank of India	Firstrand Bank Ltd
14	Lakshmi Vilas Bank	Syndicate bank	Krung Thai Bank Public bank
15	Nainital Bank	UCO Bank	American Express Bank Ltd.
16	RBL bank Ltd.	Union Bank of India	
17	South Indian Bank	United Bank of India	
18	Tamilnad Mercantile bank		

Appendix -B

Table 2. Average Efficiency score of private sector banks (10 years)

DMU	IAE	PAE	DME	FCE	OBE	CRE	Composite score	composite rank
Axis bank	0.9960	0.9738	0.9289	0.9869	0.9614	0.9668	0.9690	2
DCB Bank Ltd.	0.9834	0.5335	0.8124	0.9974	0.1360	0.7078	0.6951	15
HDFC Bank	1	0.9752	0.8349	1	0.9449	0.9588	0.9523	3
ICICI bank Ltd	0.9999	0.9688	0.9517	0.9761	0.9972	0.9997	0.9822	1
IndusInd Bank Ltd.	0.9798	0.9092	0.9409	0.9621	0.6480	0.7640	0.8673	4
Kotak mahindra bank	0.9988	0.8611	0.7360	0.9988	0.6259	0.8947	0.8525	6
YES bank	0.9657	0.9060	0.7042	0.9614	0.4144	0.9813	0.8222	8
Dhanlaxmi bank	0.9305	0.3642	0.3590	0.9677	0.2154	0.6549	0.5819	18
City Union bank	0.9635	0.4209	0.7985	0.9627	0.1497	0.8919	0.6979	14
Federal Bank	0.9739	0.9071	0.9182	0.9679	0.3933	0.9550	0.8526	5
Jammu & Kashmir bank	0.9335	0.9391	0.9839	0.9490	0.3557	0.8568	0.8363	7
Karnataka bank	0.9525	0.7310	0.9030	0.9387	0.0779	0.8249	0.7380	11
Karur Vysya bank	0.9753	0.6274	0.8567	0.9508	0.0537	0.8734	0.7229	13
Lakshmi Vilas bank	0.9764	0.5899	0.9301	0.9532	0.2284	0.8162	0.7490	10
Nainital bank	1	0.6345	0.6913	1	0.2031	1	0.7548	9
RBL bank Ltd	1	0.4404	0.6728	0.9856	0.0518	0.9589	0.6849	16

South Indian bank	0.9061	0.7505	0.8762	0.9040	0.0391	0.9350	0.7352	12
Tamilnad Mercantile Bank	0.9884	0.3448	0.7839	0.9963	0.0495	0.8751	0.6730	17

Note: Composite score = IAE+PAE+DME+FCE+OBE+CRE / 6

Appendix -C

Table 3. Average Efficiency score of public sector banks (10 years)

DMU	IAE	PAE	DME	FCE	OBE	CRE	Composite score	composite rank
Allahabad Bank	0.9745	0.7154	0.8397	0.9768	0.6787	0.9350	0.8533	14
Andhra Bank	0.9835	0.9125	0.9753	1	0.8343	0.9574	0.9438	4
Bank of Baroda	0.9363	1	1	0.9961	0.9244	0.9836	0.9734	3
Bank of India	0.9993	0.8897	0.9223	0.9486	0.8061	0.9031	0.9115	8
Bank of Maharashtra	0.9790	0.5913	0.9811	0.9750	0.4813	0.9797	0.8312	16
Canara Bank	0.9878	0.9090	0.8672	0.9880	0.9050	0.9607	0.9363	5
Corporation Bank	0.9880	1	1	1	0.9932	0.8818	0.9772	2
Indian Overseas Bank	0.9832	0.6820	0.7885	0.9472	0.6979	0.8896	0.8314	15
Indian Bank	1	0.6866	0.8742	0.9987	0.6169	1	0.8627	13
Oriental Bank of Commerce	0.9874	0.8604	0.8915	0.9935	0.7719	0.8838	0.8981	10
Punjab & Sind Bank	1	1	1	1	1	1	1	1
Punjab National Bank	0.9987	0.8823	0.9004	0.9833	0.8527	0.9822	0.9333	6
State Bank of India	1	1	1	1	1	1	1	1
Syndicate bank	0.9895	0.8052	0.8983	0.9804	0.5911	0.9278	0.8654	11
UCO Bank	0.9960	0.8542	0.9260	0.9612	0.5724	0.8761	0.8643	12
Union Bank of India	0.9875	0.8638	0.8486	0.9880	0.8355	0.9244	0.9080	9
United Bank of India	0.9687	0.7876	0.9819	0.9725	0.8547	0.9566	0.9203	7

Appendix -D

Table 4. Average Efficiency score of foreign banks (10 years)

DMU	IAE	PAE	DME	FCE	OBE	CRE	Composite score	composite rank
Standard Chartered Bank	1	1	1	1	1	1	1	1
Barclays Bank	1	1	1	1	0.5192	0.8471	0.8944	4
AB bank ltd	0.9862	0.7845	1	1	1	0.8423	0.9355	3
BNP Paribas	0.9635	0.9766	0.9766	0.9789	0.3777	0.9225	0.8660	8
Societe Generale	0.8656	0.5855	0.6774	0.8466	0.1692	0.6774	0.6369	15
Shinhan Bank	0.9069	1	0.9967	0.9448	0.3134	0.8343	0.8327	9
Bank of Ceylon	1	0.9030	0.7542	1	0.5935	1	0.8751	7
Abu Dhabi Commercial Bank	0.7409	0.7419	0.8742	0.6863	0.0943	0.7016	0.6399	14
Credit Agricole Corporate Bank	0.9910	0.8346	0.8072	0.9637	0.4313	0.8400	0.8113	10
Bank of Bahrain & Kuwait Bsc	0.7744	0.7578	0.8649	0.8165	0.1755	0.6134	0.6671	12
Mashreqbank P S C	0.9730	0.5375	1	0.9409	0.8737	1	0.8875	5
MUFG Bank Ltd	0.9951	0.9794	0.9320	0.9807	0.4486	0.9817	0.8862	6
Firstrand Bank Ltd	0.9322	0.4616	0.6352	0.9021	0.3860	0.6305	0.6579	13

Krung Thai Bank Public Co. Ltd	0.7963	1	1	1	1	0.9071	0.9506	2
American Express Bank	1	0.2443	0.5258	1	1	1	0.7950	11

Appendix -E

Table 5. Average Efficiency score of all banks without segregation (10 years)

DMU	IAE	PAE	DME	FCE	OBE	CRE	Composite score	Composite rank
AXIS BANK	0.9632	0.9745	0.9135	0.9985	0.9958	0.9320	0.9629	4
DCB Bank Limited	0.8725	0.4363	0.6764	0.7869	0.1934	0.6851	0.6084	48
HDFC Bank	0.9994	0.8694	0.9286	0.9989	0.9334	1.0000	0.9549	5
ICICI bank Ltd	0.9875	0.9522	0.9897	0.9782	0.9896	0.9776	0.9791	2
IndusInd Bank Limited	0.9710	0.6729	0.7292	0.9199	0.7726	0.8666	0.8220	17
Kotak mahindra Bank	0.9797	0.4698	0.7968	0.9729	0.5232	0.9591	0.7836	27
YES bank	0.9935	0.9335	0.9213	0.9969	0.9741	0.9586	0.9630	3
Dhanlaxmi bank	0.7995	0.4011	0.6483	0.7059	0.1251	0.6145	0.5491	50
City Union bank	0.9185	0.8029	0.8317	0.8781	0.3652	0.7850	0.7636	29
Federal Bank	0.9501	0.7264	0.8084	0.9315	0.4039	0.8883	0.7848	26
Jammu&Kashmir Bank	0.9849	0.5429	0.8220	0.8851	0.2222	0.8699	0.7212	38
Karnataka Bank	0.9294	0.6908	0.7781	0.9004	0.4001	0.7810	0.7466	34
Karur Vysya Bank	0.9548	0.6836	0.7353	0.9059	0.3646	0.8217	0.7443	35
Lakshmi Vilas Bank	0.9214	0.6361	0.7020	0.8169	0.2514	0.6778	0.6676	43
Nainital Bank	0.9093	0.6709	0.8312	0.5953	0.1013	0.7409	0.6415	46
RBL bank ltd	0.8810	0.5598	0.7421	0.8391	0.3074	0.7481	0.6796	42
South Indian Bank	0.9113	0.6515	0.7327	0.8702	0.2462	0.8715	0.7139	39
Tamilnad Mercantile Bank	0.9790	0.7116	0.7945	0.8670	0.3243	0.8485	0.7541	32
Allahabad Bank	0.9488	0.6896	0.7652	0.9226	0.3850	0.7753	0.7478	33
Andhra Bank	0.9596	0.8159	0.8869	0.9425	0.5114	0.8081	0.8207	18
Bank of Baroda	0.9118	1.0000	1.0000	0.9471	0.4908	0.8685	0.8697	12
Bank of India	0.9887	0.8751	0.9058	0.8907	0.4034	0.7899	0.8090	20
Bank of Maharashtra	0.9312	0.5676	0.7864	0.8845	0.2622	0.7688	0.7001	41
Canara Bank	0.9770	0.8886	0.8540	0.9211	0.4313	0.8920	0.8273	16
Corporation Bank	0.9693	0.9785	0.9805	0.9781	0.7143	0.7616	0.8971	8
Indian Overseas Bank	0.9623	0.6564	0.7347	0.8900	0.3558	0.7565	0.7260	36
Indian Bank	0.9922	0.6579	0.7638	0.9356	0.2978	0.8790	0.7544	31
Oriental Bank of Commerce	0.9737	0.8329	0.8446	0.9434	0.3906	0.7503	0.7892	22
Punjab & Sind Bank	0.9819	0.6107	0.7135	0.8898	0.1816	0.8599	0.7062	40
Punjab National Bank	0.9946	0.8186	0.8726	0.9307	0.5097	0.8615	0.8313	15
State Bank of India	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1
Syndicate bank	0.9811	0.7065	0.8232	0.9249	0.3321	0.8018	0.7616	30
UCO Bank	0.9828	0.8295	0.8620	0.9203	0.3338	0.7183	0.7744	28
Union Bank of India	0.9782	0.8383	0.8229	0.9338	0.4175	0.8394	0.8050	21

United Bank of India	0.9400	0.6266	0.7956	0.8810	0.3938	0.6992	0.7227	37
Standard Chartered Bank	0.9946	0.4601	0.9700	0.9813	0.6425	1.0000	0.8414	14
Barclays Bank	1.0000	0.9353	0.9098	1.0000	0.5638	0.8416	0.8751	10
AB bank ltd	0.9862	0.7715	1.0000	1.0000	1.0000	0.8423	0.9333	7
BNP Paribas	0.9209	0.7404	0.8763	0.9785	0.3510	0.8652	0.7887	24
Societe Generale	0.8630	0.5250	0.6279	0.8466	0.1692	0.6708	0.6171	47
Shinhan Bank	0.9017	0.9626	0.9497	0.9441	0.3134	0.8285	0.8167	19
Bank of Ceylon	1.0000	0.8785	0.7476	1.0000	0.5935	1.0000	0.8699	11
Abu Dhabi Commercial Bank	0.7312	0.6280	0.8401	0.6630	0.0943	0.6897	0.6077	49
Credit Agricole Corporate Bank	0.9794	0.7409	0.7992	0.9428	0.4313	0.8400	0.7889	23
Bank of Bahrain & Kuwait Bsc	0.7717	0.6658	0.8223	0.8157	0.1755	0.6105	0.6436	45
Mashreqbank P S C	0.9730	0.5292	1.0000	0.9409	0.8737	1.0000	0.8861	9
MUFG Bank Ltd	0.9819	0.9175	0.8967	0.9742	0.4471	0.9781	0.8659	13
Firstrand Bank Ltd	0.9314	0.4453	0.6348	0.9021	0.3860	0.6305	0.6550	44
Krung Thai Bank Public Company Ltd	0.7960	1.0000	1.0000	1.0000	1.0000	0.9071	0.9505	6
American Express Bank Ltd.	1.0000	0.2113	0.5224	1.0000	0.9871	1.0000	0.7868	25