Efficiency Measurement of Indian Banking Industry: An Empirical Comparative Analysis

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Abstract

The following study is conducted to measure and compare the performance of 32 Indian banks, 21 public banks, and 11 private banks, at two tiers during the period of 2008–2018. Industrial analysis of both the public and private banking sectors is conducted in the first tier, followed by an individual bank-level analysis at the second tier. Data analysis consists of deposits, assets, and equity as inputs to measure the outputs practicing data envelopment analysis techniques. The empirical results portray a mixed trend in various elements of efficiency. They reveal that with the common pledge to expand market share and performance, public and private banks have been improving and covering the highest efficiency level. However, at the industry level, the private banking industry has slightly better technical and pure technical efficiency results compared to the public banking industry. On the other hand, the public banking sector performed well compared to the private banking industry in the stipulated study period based on mean scale efficiency results.

Generally, many studies on Indian Banking Industry focus on determinants of industrial banking growth indicators. Further, we examine Indian banking performance at the individual bank level by incorporating the latest available data. In terms of technical and pure technical efficiency, Kotak Mahindra Bank Ltd., a private bank, scored the highest at the individual bank level. The State Bank of Bikaner & Jai has the highest score in terms of scale efficiency and thus is the best example of a public sector bank. Despite the improvement in income and deposits in both types of banking, there is still room for public banks to redirect their short-term and long-term marketing and communication strategies to focus on targeting customers and enhancing management skills at the branch level.

Keywords: Indian banking industry, efficiency measurement, data envelope analysis, bank performance

1. Introduction

Banks play an important role in the economic development of developing countries by facilitating business houses. They collect funds from individuals and lend them to business houses. These Business houses use the borrowed money from banks for the operation of their business. Banks also help countries grow by capital formation. Banking is defined as accepting, for. Lending or investment of money deposits from the public, repayable on demand or otherwise, and withdrawals by cheque, draft, order, or. Otherwise, according to the Indian Banking Companies Act of 1949, It also defines Banks as an institution dealing with money and credit. It safeguards the savings of the public and gives loans and advances.

The banks generally provide liquidity for a country's economic growth and act as the main pillar of the financial system as a whole. Banks offer safety for the depositors and liquidity for the borrowers, both on a short and long-term basis based on their needs. It provides credit or loan to dealers, householders, small as well as large business houses while also helping to manage all financial transactions between different parties and providing the government with the flexibility to reach the masses across the country.

The banking sector in India was developed during the British era. The East India Company established three banks; Bank of Bengal (established in 1809), Bank of Bombay (established in 1840), and Bank of Madras (established in 1843). These three banks later amalgamated and came to be known as the Imperial Bank, taken over by SBI (State Bank of India) in 1955. The Reserve bank of India was established in 1935 with its main objectives being to manage

the monetary and credit system of the country, to stabilize the internal and external value of rupee, to develop banking in the country systematically, to help in the development of an organized money market in the country, to properly arrange Agriculture and Industrial Finance, to establish monetary relations with other countries of the world as well as to establish international financial institutions and lastly to contribute to the proper management of public debts as well as for centralization of cash reserves of commercial banks.

The Reserve Bank of India (RBI) supervises all banks of India. It is an apex monetary authority that regulates the banking sectors of India. The Indian banking sector is classified into two broad categories; public and private sector banks. It mainly consists of 27 public sector banks and 21 private sector banks. The Public sector banks in India alone account for about 75 percent of the total advances in the Indian banking industry, and thus the Indian banking sector is dominated by the Public Sector banks. State Bank of India, Bank of Baroda, Syndicate Bank, and Canara Bank are examples of Public sector banks. These are controlled and managed by the Government of India. These banks have been serving the nation for over centuries and are well known for being affordable and having quality services. Public sector banks have shown remarkable growth over the last five decades. The first fully-owned Indian bank was the Allahabad Bank, which was founded in 1865.

Banks like HDFC Bank, ICICI Bank, UTI Bank, and IDBI Bank are examples of Indian Private Banks. The concept of private banking is rather contemporary, having only been introduced 15 years ago. Private Sector Banks do not have any government stakes. These have had a strong grip in the Indian banking industry for the last few years because of their optimum technology use. IndusInd Bank was the first private bank in India. Currently, this bank is the fastest growing Private Bank in the country.

1.1 The Importance of Commercial Banks in India

The commercial banking sector has been a dominant element in the Indian financial system. By serving as a source of credit to households, government, business, small scale industries, and agriculture, it has greatly contributed to the country's economic development. For the economic growth of developing and underdeveloped countries, a proper financial system has great importance, and the commercial banking system acts as the backbone of the financial sector. Without a sound commercial banking system, there is virtually no progress for underdeveloped countries. The importance of commercial banking for a developing country can be seen in the following perspectives:

In developing countries, commercial banks are considered a source of capital formation since saving is usually low in an underdeveloped country due to the existence of poverty among people. The potential savings are not even realized because of inadequate banking facilities in such a country. Thus, the development of a sound system of commercial banking becomes essential for a developing economy to mobilize the dormant savings and make them available to the entrepreneurs for productive purposes. Generally, the existence of non-monetized sectors is found in underdeveloped countries, especially in the country's remote and rural areas; such sectors are considered a hindrance in the country's economic development. To overcome such obstacles, commercial banks promote the monetization process in the economy by opening branches in rural and backward areas of the country. Innovations are an essential prerequisite for economic progress. In developed countries, these innovations are mostly financed by bank credit. But in underdeveloped countries, entrepreneurism rarely brings innovations due to the lack of adequate bank credit. The commercial banks can help finance these business innovations by providing adequate and cheap credit to entrepreneurs. Generally, the commercial banks in underdeveloped countries hesitate to finance the agricultural and small scale industries due to its risk. However, since these sectors play a vital role in a country's economic development, commercial banks must take risks to provide credit facilities to these sectors. The provision of medium and long term loans should be made by commercial banks. The banks should also adopt a cheap money policy to stimulate economic activities. These Cheap money policies can promote the economic growth of an underdeveloped country.

The current study attempts to measure and compare the three types of efficiencies of the Indian public and private banking industries: Technical, Pure Technical, and Scale. Technical Efficiency is the ability of a firm to obtain maximal output from a given set of inputs; Pure Technical Efficiency is a performance-based measuring approach that examines the managerial performance of an organization while Scale Efficiency provides the insight to the management to choose the optimum quantity of the resources to be allocated to the bank size or to choose the scale of production that attains the expected production level.

Due to data constraints, 32 commercial banks are selected (21 public banks and 11 private banks) in this study to compare the efficiency between the two groups. Indian public banks here refer to those banks where the Government holds the majority stake (more than 50% of the shares), and those where individuals hold more than 50% of the shares are known as private banks. The selected banks for the current study are listed below:

Table 1. List of banks

Serial No.	Bank Name	Category
1	ALLAHABAD BANK	Public
2	ANDHRA BANK	Public
3	BANK OF BARODA	Public
4	BANK OF INDIA	Public
5	BANK OF MAHARASHTRA	Public
6	CANARA BANK	Public
7	CENTRAL BANK OF INDIA	Public
8	CORPORATION BANK	Public
9	DENA BANK	Public
10	IDBI BANK LTD	Public
11	INDIAN BANK	Public
12	INDIAN OVERSEAS BANK	Public
13	JAMMU & KASHMIR BANK LTD	Public
14	ORIENTAL BANK OF COMMERCE	Public
15	PUNJAB NATIONAL BANK	Public
16	STATE BANK OF BIKANER & JAI	Public
17	STATE BANK OF MYSORE	Public
18	STATE BANK OF TRAVANCORE	Public
19	SYNDICATE BANK	Public
20	UCO BANK	Public
21	VIJAYA BANK	Public
1	AXIS BANK LTD	Private
2	CITY UNION BANK LTD	Private
3	DHANLAXMI BANK LTD	Private
4	FEDERAL BANK LTD	Private
5	HDFC BANK LIMITED	Private
6	ICICI BANK LTD	Private
7	KARNATAKA BANK LTD	Private
8	KARUR VYSYA BANK LTD	Private
9	KOTAK MAHINDRA BANK LTD	Private
10	LAKSHMI VILAS BANK LTD	Private
11	SOUTH INDIAN BANK LTD	Private

Source: Author's compilation.

2. Literature Review

There exists a noticeable distinction between Conventional and Islamic banks in terms of their profitability, credit risk, capitalization, efficiency, liquidity, and contribution to economic development, according to a study conducted by Alghfais (2017) who examined eight commercial and four Islamic banks in Saudi Arabia between 1988 and 2016. The study uses a Binary Logistic Regression Approach. It concludes that the Islamic banks are more profitable, have

higher capitalization, has lower risk, and contribute more to economic growth. Conventional banks, on the other hand, are more efficient and have more diverse investment portfolios. While Islamic banks can use their high capitalization to increase profitability, conventional banks still remain more efficient. This is likely due to the paucity of standardized products across Islamic Banks in the country. There is a clear need for diverse investment portfolios in the Saudi Arabian Islamic Bank. In another study, India's efficiency and private banking sector were measured from 2008 through 2010.

In the study, Joshi and Bhalerao (2011) examined ten banks, five public, and five private banks. The study made use of Data Envelope Analysis with four input variables (viz. Deposits, Interest expenses, Operating expenses, and Assets) and four output variables (Advances and Loans, Investments, Net-interest income, and non-interest income). He found that the average performance of the banking sector ranges above 80%, which suggests the appropriate conversion of inputs into outputs. The public and the private sector have been found to be equally efficient, with the private sector having a slight margin over the public sector. SBI and ICICI, however, are two banks that may be a cause for concern as their efficiency scores are not up to par. Although, ICICI has shown noteworthy improvement in the previous year. The cause for their unsatisfactory performance lies behind their hefty amount of deposits, advances, and other assets.

From 1975 to 1988, Bamakhramah (1992) measured the banking structure and its impact on banking performance by using the Concentration Ratio and Regression Equation. The study found that the Saudi Arabian banking system's degree of concentration is relatively low due to the Saudization and the Branching process, which brought about higher levels of deposits to the formerly smaller-sized Non-Saudi banks. The capital requirement does not seem to have a significant potency as a hindrance to entry to the banking sector. The potential barrier to entry is the licensing regulation. The Structure of the Saudi banking sector and the performance level of the banking units may enhance if the financial sector is given time to develop at the same pace as the real sector.

"Foreign Ownership and Bank Performance Metrics in Saudi Arabia" is a paper written by Abraham Abraham (2013), which concludes that banks with foreign ownership are more aggressive in terms of capital structure, loan portfolios, and regulatory tier-1 capital; however, they are unable to transpose these into performances with higher outcomes. Goyal & Joshi (2012), in their paper "Indian Banking Industry: Challenges and Opportunities," discussed various challenges and opportunities like the rural market, transparency, customer expectations, management of risks, growth in the banking sector, the human factor, global banking, environmental concern, social, ethical issues, employee and customer retention. Banks are striving to withstand the competition they face from global banks and technological innovation, and it has compelled the banks to rethink their policies and strategies. According to them, the banks must cut their cost of services, adopt product innovation and technology up-gradation to compete in the gamut of competition. Another study, by Habib (2015), used the Financial Ratio Analysis to compare the performance of the Banking industry in Pakistan from 2009 to 2013. The study was based on comparing banking sectors within the sectors by classifying the banks based on operation, ownership, and nationality. The banking industry is classified into Private Commercial Banks, Public Commercial Banks, Specialized Banks, and Foreign Banks. The banks were ranked based on Total Average Sets, Total Operating Fixed Assets, Total Average Equity, and Returns on the Respective Variables. His study concludes that Private Sector Banks perform the best in Pakistan as they rank number one and are followed by Specialised Banks, Public Sector Banks rank third and with Foreign Banks at number four.

Xin, et. al., (2018) studied the banking proficiency of both Pakistan and China using Regression Analysis during 2010-2018. The sample size of the study consisted of forty-four Chinese and twenty-one Pakistani Banks. The Chinese banking profitability, which was measured through the Return on Assets (ROA) and Return on Equity (ROE), is positively influenced by the net interest income, deposits, Capital adequacy ratio, and GDP growth while non-performing loans also significantly contribute to the performance of Chinese banking, this relationship is also exhibited in Pakistan's banking industry. However, the study found that Chinese banks perform better than Pakistani banks because of their large size, higher GDP growth, and government ownership. The most common descriptive issue was found in non-performing loans. Pakistani banking is generating an abundance of non-performing loans, which poses an obstacle for Pakistani banking growth.

The performance of the Saudi banking industry was also examined by Khan, et. al., (2018), during the period of 2007-2016, in terms of Technical, Pure Technical, and Scale Efficiencies by using the method of the Data Envelopment Analysis (DEA). He measured the efficiency and then compared the two types of banking institutions, i.e., Islamic and conventional. The empirical results reveal some interesting insights into the Saudi Arabian banking industry. The study showed that conventional banks exhibit high scores in all three test types of efficiency compared

to Islamic banks. However, only one Islamic bank, named Al-Rajhi bank, stands at first position along-with two conventional banks by the name of National Commercial, Saudi Hollandi bank. The study pointed out that there is room for improvement in the Islamic banking management when it comes to the allocation of resources but also that all banks, especially the larger ones, need to improve to reach a higher level of efficiency through the best allocation of resources, employing effective management techniques and optimal use of resources.

Data Envelopment Analysis (DEA) was also used by Singh, et. al., (2012) to examine eighteen different private and public banks from 2002 to 2011. These banks were supervised against different sets of efficiency parameters, for instance, efficiency factors related to employees, branch, liquidity, profitability, and operations. The independent variables of this study were assets, deposits, and profits. They conclude that the State Bank of India, IDBI, ICICI, and Canara Bank have been the most efficient, and the cause of their efficiency lies in their efficient use of input resources. Again with the application of Data Envelopment Analysis (DEA), Kaur and Gupta (2015) measured the efficiency of fifty-six banks from 2009-2013. The study found that the average efficiency of Indian banks has, in fact, increased during the last few years when this study was conducted. The State Banks were most efficient in all these years and were followed by the Private Banks. The State Bank Group was further revealed to be 2.5% more efficient than Private Banks, and Private Banks were found to be 5% more efficient than Nationalized Banks. The efficiency of commercial banks operating in India was examined by Seshadri, et. al.,

(2014) from 2008 to 2013 by utilizing the Data Envelopment Analysis (DEA). The study found that large Commercial banks have less control over the industry's operations than their smaller counterparts. Smaller banks are efficient and control their operations to provide modern banking and financial services and update technological services. Private sector banks, however, are more advanced and generate revenue from non-traditional methods and services.

Although there have been a few comparative studies about the efficiency of public sector banks in India and their private sector counterparts, there is a scarcity of academic literature on the subject in recent years. In the context of India, this paper aims to: examine the technical efficiencies (TE), pure technical efficiencies (PTE), and scale efficiencies (SE) of public and private sector banks, and how they changed between 2008 to 2018 in the first tier, followed by an individual bank-level analysis at the second tier and rank all banks according to their technical efficiencies (TE), pure technical efficiencies (PTE), and scale efficiencies (SE) by using Data Envelopment Analysis models.

3. Methodology

3.1 Non-parametric Approach: Data Envelope Analysis (DEA)

First, it was proposed by Charnes et al. In 1978, Data Envelope Analysis (DEA) was a non-parametric process and regress analysis technique that evaluated the relative efficient performance and management or decision-making unit (DMU) with the same various inputs and outputs. DEA evolves a role, the shape of which is decided by the most productive producers. This approach varied from the Ordinary Least Squares (OLS) or the regression focused on a relative contrast with the typical producer. As the regression study focuses exclusively on core patterns, which do not include a detailed and robust observation of managerial efficiency output at the highest or optimum stage, we use the DEA method to focus on external observations. DEA defines a boundary that is defined as an extreme point approach that implies that if a firm can generate a certain output level using a certain input level, another firm of the same size should be capable of doing the same thing. The most effective producers may shape a composite producer, enabling an optimal solution to be computed for any input or output stage. Besides, the regression method implies that a single approximate regression equation relates to each observation variable or managerial efficiency performance (MPP) or decision-making unit (DMU), the DEA study of each vector (MPP or DMU) separately. DEA can manage multiple inputs and multiple output models and does not need the presumption of a functional type that links inputs to outputs (Berg 2010).

A linear programming technique is used to ensure the performance of every institution under the presumption of a variable return to scale. The higher quality of production is generally determined in this organization or decision-making unit (DMU) by the highest output amount of a certain input level. The DEA employs two methods: a formula for output orientation, which provides the optimal output of a given input level, and input orientation, which provides minimal input to a given output level. A benefit of utilizing a non-parametric technique such as DEA is that it does not need an explicit optimization target regardless of the institution's size and scope. Considering the reality that this analysis takes the input-based efficiency approach on a comparable basis.

In order to calculate the results of the scale, the constant return to scale (CRS) and the variable return to size (VRS). The scale utility values based on the VRS model in most situations varied from 0 to 1 and are higher than the CRS based on the existence of close-fitting data points. The score obtained from the VRS model often supports policymakers to assess when the organization is working to raise, decrease, or constant return to scale. On the other hand, the CRS occurs primarily in situations where both the effectiveness slope and the input/output ratio are identical (Cooper et al., 2000).

It is advised to adopt a single-year analysis approach rather than a multi-year efficiency analysis for any organization or individual decision-making unit (DMU) to achieve the most reliable and precise results (Isik and Hassan, 2002). This analysis, therefore, calculates each bank's efficacy on an annual basis separately. This strategy also manages to produce the strongest results over the years in the most volatile Banking market.

The discussion above opens up the path to the following equations. Supposedly, under the following model definition, there are "n" number of decision-making units (DMUs).

$$z = \sum_{i=1}^{n} u_i \, y_i \tag{1}$$

Subject to

$$\sum_{j=1}^{m} v_j \, x_j = 1 \tag{2}$$

$$\sum_{i=1}^{n} u_i \, y_{i-} \sum_{j=1}^{m} v_j \, x_j - \leq 0 \tag{3}$$

$$u_i \, , v_j \; \geq 0$$

Where,

z = Efficiency of DMU under consideration

u_i = n output coefficients of DMU under consideration

y_i = n output weighting coefficients for DMU under consideration

v_j = m input coefficients for DMU under consideration

x_j = m input weighting coefficients for DMU under consideration

Above equation (1) provides the efficiency score for DMU I, equation (2) transforms the weighted inputs of DMU I equal to 1, and equation (3) confirms that the weighted outputs cannot be more than the weighted inputs for all DMUs (capping efficiency to 1).

3.2 Input and Output Specification

As the banking institutions are considered as an intermediate industry that mobilizes the excessive resources to the production or manufacturing industry. The intermediation method is most appropriate for this study as the sample institutions or DMUs are banks which transform inputs i.e., deposits, assets and capital into output i.e., investment, advances and net income (Sealey and Lindley, 1977; Favero and Papi, 1995, and Kwan, 2002). As can be observed in Table 2, this study uses deposits, assets, and capital as input variables and investment, advances, and income as outputs.

Table 2. Description of the variables

Variables	Notation	Description
Deposits	X1	Deposits of customers
Assets	X2	Total assets include cash and balance with treasury and other banks, due from financial institutions, investment, financing, and other related assets, operating fixed assets, deferred taxed
Equity	X3	Equity is the summation of all funds that banks used to raise by issuing shares.
Loans	Y1	Financing and other related assets
Income	Y2	Total bank income and subtracting the costs of doing business such as depreciation, interest, taxes, and other expenses.

4. Data Analysis and Result Discussion

The data required for this empirical study is obtained via annual disclosure and the financial statements of the Indian banking industry's listed public and private banks in the 2008-2018 period. All banks included in this study were formed at various periods, so their amount and scale are different. In the duration 2008-2018, INR 2,228,370 and INR 146,811 million were on average overall deposits, assets, and equity, respectively, for public banks.

While, the private banking sector is relatively smaller than the public banking sector as its total Deposits, Assets, and Equity are INR 1,126,051, INR 1,786,335, and INR 178,069 million, respectively.

Table 3. Descriptive statistics of variables in Indian rupees millions (Period 2008 -2018)

Variables	Input			Output	
Public Banks	Deposits	Assets	Equity	Loans	Profit
Mean	1,806,097	2,228,370	146,811	1,339,503	4,543
Standard Deviation	1,330,708	1,684,942	223,799	1,051,778	22,487
Private Banks					
Mean	1,126,051	1,786,335	178,069	1,052,727	22,582
Standard Deviation	1,528,320	2,627,052	275,663	1,537,325	36,272

Source: Authors' compilation

Similarly, this study's output variables, like loans and profit for the public banks, are INR 1,339,503 and INR 4,543 million. On the other side, its counterpart, private banks, have average Loans of INR 1,052,727 and profit INR 22,582 in the same study period.

Table 4. Banks efficiency scores

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Mean	SD
Public Banks													
Technical efficiency	0.90	0.73	0.92	0.87	0.88	0.93	0.84	0.80	0.82	0.86	0.89	0.86	0.06
Pure technical efficiency	0.92	0.75	0.95	0.87	0.89	0.94	0.86	0.82	0.84	0.87	0.91	0.87	0.06
Scale efficiency	0.98	0.87	0.97	0.99	0.99	0.99	0.98	0.98	0.94	0.96	0.98	0.97	0.04
Private Banks													
Technical efficiency	0.86	0.80	0.89	0.90	0.92	0.90	0.88	0.88	0.95	0.93	0.98	0.90	0.05
Pure technical efficiency	0.88	0.82	0.93	0.92	0.95	0.95	0.93	0.93	0.98	0.96	1.00	0.93	0.05
Scale efficiency	0.97	0.92	0.96	0.98	0.97	0.95	0.94	0.95	0.98	0.97	0.98	0.96	0.02

Source: Authors' own compilation

Table 4 elaborates on a mixed trend in all the efficiencies among public banks and private banks of India over the period of study.

In general, private banks can be considered more efficient than the public banks as the average score of the private banks in technical efficiency is 90 percent compared to 86 percent for the public banks. However, in the years 2008, 2010, and 2013, public banks showed more technical efficiency than private banks. In the rest of the years, private banks have more technical efficiency than public banks. So it entails that overall private banks perform well at the given input and generate the maximum output compared to the public banks in the study time span.

Private Banks are the best performers in terms of pure technical efficiency (0.93), as compared to public banks that are relatively less performing (0.87). This implies that public banks could avoid wasting 13% of their inputs on average if it improves its management policies and operational practices. Based on the mean values of scale efficiency scores, public banks are the best performers (0.97), whereas the private banks are relatively less performing (0.96). Thus, both public and private banks could save 3% and 4% of the resources, respectively, if applied in the best way.

Table 5 reports the ranking of Indian banks on technical efficiency. Kotak Mahindra Bank Ltd (Private) is on the top, followed by State Bank of Bikaner & Jai (Public) and City Union Bank Ltd (Private). In the top ten top performers' banks, 6 are private banks, and 4 public banks are included. On the other hand, among the ten least performing banks based on the technical efficiency scores, 7 are public banks and 3 private banks. The least three performing banks are the Central Bank of India (Public), Indian Bank (Public), and Dhanlaxmi Bank Ltd (private).

Table 5. Ranking on average basis of technical efficiency (2008-2018)

Top Ten Performing Banks			Bottom Ten Performing Banks		
Bank	ES	Type	Bank	ES	Type
KOTAK MAHINDRA BANK LTD	0.983	2	CANARA BANK	0.846	1
STATE BANK OF BIKANER & JAI	0.968	1	KARNATAKA BANK LTD	0.837	2
CITY UNION BANK LTD	0.948	2	FEDERAL BANK LTD	0.837	2
STATE BANK OF MYSORE	0.936	1	ANDHRA BANK	0.808	1
KARUR VYSYA BANK LTD	0.935	2	BANK OF INDIA	0.798	1
STATE BANK OF TRAVANCORE	0.929	1	INDIAN OVERSEAS BANK	0.796	1
ORIENTAL BANK OF COMMERCE	0.920	1	DENA BANK	0.786	1
SOUTH INDIAN BANK LTD	0.920	2	DHANLAXMI BANK LTD	0.782	2
HDFC BANK LIMITED	0.918	2	INDIAN BANK	0.727	1
AXIS BANK LTD	0.914	2	CENTRAL BANK OF INDIA	0.698	1

Source: Authors' Own Calculation Based On DEA; ES= Efficiency Score, 1=Public, 2=Private

Table 6 reports the ranking of Indian banks based on pure technical efficiency. Evidently, Kotak Mahindra Bank Ltd (Private) leads the top ten banks, followed by ICICI Bank Ltd (Private) and State Bank of Bikaner & Jai (Public). In 10 top-performing banks, 6 banks are private. In contrast, among the ten worst performing banks based on the pure technical efficiency scores are Andhra Bank, Indian Overseas Bank, and Dena Bank that all of our public banks. 8 public banks can be observed in the list of ten least performing banks.

Table 6. Ranking on basis of average pure technical efficiency (2008-2018)

Top Ten Banks			Bottom Ten Banks		
Bank	ES	Type	Bank	ES	Type
Kotak Mahindra Bank Ltd	0.991	2	Corporation Bank	0.876	1
ICICI Bank Ltd	0.981	2	Jammu & Kashmir Bank Ltd	0.856	1

State Bank of Bikaner & Jai	0.969	1	Bank of India	0.852	1
Bank of Baroda	0.961	1	Federal Bank Ltd	0.847	2
Punjab National Bank	0.961	1	Karnataka Bank Ltd	0.843	2
City Union Bank Ltd	0.959	2	Andhra Bank	0.813	1
Lakshmi Vilas Bank Ltd	0.950	2	Indian Overseas Bank	0.809	1
HDFC Bank Ltd	0.948	2	Dena Bank	0.788	1
Karur Vysya Bank Ltd	0.943	2	Indian Bank	0.740	1
State Bank Of Mysore	0.939	1	Central Bank of India	0.710	1

Source: Authors' Own Calculation Based On DEA; ES= Efficiency Score, 1=Public, 2=Private

Table 7 reports the ranking of Indian banks based on scale efficiency. State Bank of BikJair & Jai (public) leads the top ten banks, followed by Bank of Maharashtra (public) and Dena Bank (public). In the 10 top-performing banks, 6 are public banks. At the same time, Dhanlaxmi Bank Ltd. (private) is the first on the bottom ten lists, followed by the Central Bank of India (public) and Bank of India (public). In the 10 least performing banks, 3 are private banks, whereas 7 banks are public.

Table 7. Ranking on average scale efficiency basis (2008-2018)

Top Ten Performing Banks			Least Ten Performing Banks		
Bank	ES	Type	Bank	ES	Type
State Bank of Bikaner & Jai	0.999	1	Punjab National Bank	0.949	1
Bank of Maharashtra	0.998	1	Andhra Bank	0.946	1
Dena Bank	0.998	1	Canara Bank	0.943	1
South Indian Bank Ltd	0.997	2	Bank Of Baroda	0.935	1
State Bank of Mysore	0.996	1	Federal Bank Ltd	0.930	2
State Bank of Travancore	0.996	1	ICICI Bank Ltd	0.929	2
Jammu & Kashmir Bank Ltd	0.994	1	Indian Overseas Bank	0.905	1
Karnataka Bank Ltd	0.993	2	Bank of India	0.902	1
Karur Vysya Bank Ltd	0.992	2	Central Bank of India	0.861	1
Kotak Mahindra Bank Ltd	0.991	2	Dhanlaxmi Bank Ltd	0.846	2

Source: Authors' Own Calculation Based On DEA; ES= Efficiency Score, 1=Public, 2=Private

5. Conclusion

The current study examined the Indian banking industry's performance over a decade (2008 – 2018) in terms of technical, pure technical, and scale efficiencies. By Technical Efficiency, we mean the ability of a firm to obtain maximum output from a given set of inputs, whereas in Pure Technical Efficiency, we measure the managerial performance of an organization. Scale Efficiency provides insight into the organizational management that indicates the optimal quantity of allocated resources needed to maintain the bank's scope /size to choose the scale of production that attains the expected production level. The following empirical analysis demonstrates interesting results about the Indian banking industry:

Generally, the Technical Efficiency of private banks has the edge over public banks. As a result, on average, the Kotak Mahindra Bank Ltd (a private bank)'s technical efficiency takes the first position in all over India. It is followed by the State Bank of Bikaner & Jai (public bank) and City Union Bank Ltd. (a private bank). At the same time, the three least performing banks of India include Dhanlaxmi Bank Ltd. (a private bank), Indian Bank (public bank), and Central Bank of India (Public Bank).

This mediocre performance of the public banking industry can be attributed to their lack of efficiency in delivering services; it can also be caused due to the fact that these banks suffer from cost inefficiencies and that they have consistently higher rates of delinquencies than private banks. On the other hand, private banking performance in this frontier may be attributed to efficient financing activities. Most importantly, in terms of Pure Technical Efficiency, private banks also performed better than their competitor. Kotak Mahindra Bank Ltd (a private bank), ICICI Bank Ltd. (a private bank), and the State Bank of Bikaner & Jai (public bank) are the three top-performing banks with regards to Pure Technical Efficiency.

Next, in Scale Efficiency, the results conclude that public banks are better in managing their branches with strength and full capacity whereas, in private banking, the management needs to be more harmonious to bridge the gap between Technical and Scale efficiency. The results further show a converging trend in the characteristics of inputs and outputs, where income has become the most efficient element even though human capital should be given top priority. Private banks are no less than Public banks in terms of banking services and customer satisfaction; they provide all the sophisticated banking services to their customers such as e-banking, internet-banking, mobile-banking, phone-banking, SMS-banking services, and so on. However, there is still a gap between the demand and supply of skilled human capital in the Indian banking industry that is needed to enhance efficiency as well as efficacy.

In brief, the findings of this study provide many interesting insights into the Indian banking industry and suggest policy implications. The variations in the outcomes of banking performance are due to difference in banking history, experience, size, prudence in decision-making, governance and operational processes at the bank level. There is room at bank level for improvement in all banks, especially the largest banks. In order to improve their efficiency at scale and from the current level to higher level by best allocation of resources, effective management techniques and optimal use of resources. There is also need for competitive and innovative product development. It is also suggested that banks with inefficiencies are laggards that must be improved by restructuring banks or by merger laggards with leaders, i.e. high-ranking banks. Foe the regulators, a dedicated legal framework are essential for the development and growth of India's banking industry as a whole. Furthermore, a more favorable banking environment and incentives should be developed for local banks to promote private banking at regional level, strengthening the position of the country in the global banking sector.

Within the limitations of this study, it is suggested that additional research be carried out after taking into account cost and allocative efficiencies, resilience factors, and risk exposures in order to conduct a comprehensive comparative efficiency analysis of public and private banks in the Indian context.

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