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Efficiency of Indian banks in fostering financial inclusion: an emerging economy perspective

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Abstract

Financial inclusion paves the path towards inclusive growth. The Government of India launched the Pradhan Mantri Jan-Dhan Yojana (PMJDY) in 2014 with a similar aim. The present study measures efficiency of 25 banks using the data envelopment analysis to ascertain how the banks have functioned under the PMJDY scheme. The study has been conducted for a duration of 7 years beginning from the year the scheme was introduced in 2014–2015 till 2020–2021. Results of the empirical analysis have indicated that the performance of public sector banks has been better than the private banks in expanding financial inclusion under the PMJDY programme. Additionally, measurement of projection and shortfall of the outputs of banks has shown that very few banks have performed efficiently in furthering the objectives of PMJDY scheme. Thus, the overall evidences derived from the analysis suggest that the inefficient banks need to expand their banking services for the deprived. Regular assessment of efficiency would assist in identifying and thereby implementing necessary steps to overcome the obstacles in achieving the financial inclusion goals. This would also improve the efficiency level of the banks having low-efficiency scores. Moreover, banks have a social responsibility to properly implement the schemes initiated by the government.

Keywords Financial inclusion · Bank efficiency · PMJDY · Data envelopment analysis · Technical efficiency

Introduction

The Pradhan Mantri Jan-Dhan Yojana (PMJDY) was launched as "A National Mission on Financial Inclusion" with a development philosophy of 'Everyone's Support, Everyone's Development', i.e. inclusive growth. Initial achievements made under PMJDY were extraordinary, so much so that it was recognized by Guinness World Records (for opening the maximum number of bank accounts in a week). However, mere opening of bank accounts does not ensure financial inclusion (Sarma 2016). The true essence of financial inclusion lies in the fact that financial services provided by the banking sector are accessed by every member of a nation. Owning a bank account does not indicate that the account is utilized adequately (Kempson et al. 2004). Barriers such as lack of proximity of bank branches, or other psychological and physical barriers may lead to financial exclusion of people, in spite of possessing a bank account (Sarma 2016). Thus, financial inclusion is a broad term which does not simply imply owning a bank account, rather it measures the frequency and efficiency with which the banking facilities are used by the beneficiaries (Banerjee and Gupta 2019).

Financial inclusion has been gaining the attention of policymakers in India for three main reasons. First, to provide a platform (for people with lower income) to inculcate the habit of saving. Second, to create affordable formal credit channels for the unbanked population and, third, to seal leaks and gaps in public welfare programmes (Chowhan and Pande 2014). Accordingly, a step was taken by the Government of India in the year 2014 to encourage financial inclusion through the scheme, PMJDY. This scheme offered zero balance accounts through minimum documentation, because of which it attained massive success in attracting the poor and destitute households. The scheme also entailed opening

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banking outlets and ATMs (Shetty and Deokar 2014) to penetrate the unbanked rural centres. The success of this scheme requires the banking sector to be efficient in their ability to operate and optimally employ the resources (made available by the government under the PMJDY programme) to ensure accessibility of financial services throughout India (Agarwala et al. 2022).

Efficiency of the baking sector is crucial for the economic growth of a nation. Progress in an economy's development is desirable as it would assist the government to serve country's needs better (Hussain et al. 2021a, b, c). In the increasingly competitive environment of the financial services industry, the odds of survival will be higher for the banks with higher efficiency than for those with lower efficiency (Tamatam et al. 2019). Moreover, poor efficiency of the banking sector can lead to substantial unfavourable outcomes. An understanding of the level of efficiency at which the Indian banking sector is operating at present is of utmost necessity. Measuring efficiencies may be significant in establishing metrics that may assist in refreshing the PMJDY needs (Titus 2018).

Though the PMJDY scheme achieved great success initially, it has also brought to light the challenges, predominantly, the large number of dormant accounts and financial illiteracy among the rural population (Shafi and Reddy 2016). This calls for an investigation to comprehend the extent of success achieved by banks in bringing the unbanked population under the formal banking arena through PMJDY. Hence, the present study has endeavoured to examine the efficiency of Indian banks in fostering financial inclusion under the PMJDY programme. The PMJDY scheme was introduced in the year 2014, and yet studies explaining the progress made under this mega scheme are extremely limited. The intent is to evaluate the progress made by the Indian Public Sector Banks (PSBs) and Private Sector Banks (PVBs), in terms of expanding the accessibility of banking services, under the PMJDY scheme. A study of the current level of efficiency of the Indian banks would reveal the limitations that the government, regulatory bodies, and the bank owners need to overcome to ensure financial inclusion for everyone, including the people belonging to the 'bottom of the pyramid'.

Literature review

Various studies have been conducted in the past to study the level of accomplishment attained by the PMJDY programme. According to the RBI (2019) report, named- 'National Strategy for Financial Inclusion 2019–2024', PMJDY has been able to create the requisite infrastructure that would ensure access to basic financial services for every adult, i.e. Basic Savings Bank Deposit Account (BSBDA), credit facilities,

a micro life and non-life insurance and pension. In order to get a better understanding about the efficiency of banks in ensuring financial inclusion through PMJDY scheme, the extant literature has been studied.

Financial inclusion through the PMJDY scheme

Khuntia (2014) has claimed PMJDY to be "a big bang action plan" which would reduce the level of financial untouchability, fight poverty, accelerate growth and ensure that even the last person, standing in the last row can be empowered in the Indian economy. Agarwal (2018) has expected the scheme to unleash the unused potential of the people belonging to the bottom of the pyramid. However, Banerjee and Gupta (2019) have found that although PMJDY has led to an arithmetic rise in ownership of bank accounts, it has not been able to ensure financial inclusion of people in the true sense. This has been said because the number of account-holders (under this scheme) availing themselves of the financial services is immensely low. Analogous claims have been made by Dutta and Mehta (2021) who have examined the impact of PMJDY on poor households in Bihar. The study stated that the PMJDY programme was broadly successful in opening bank accounts for the poor; particularly for the illiterate and the casual labourers of Bihar. Still, the poor households were found to depend on the money lenders and SHGs for credit facilities. Very few poor households had awareness regarding the insurance and overdraft facilities offered by the scheme. In addition, Singh et al. (2021) found that poor utilization of financial services led to rise in dormant accounts following the launch of PMJDY programme. Thus, Dutta and Mehta (2021) suggested that emphasize needs to be given on financial literacy programmes and appropriate saving products so as to enhance the functioning of the PMJDY scheme. Satpathy et al. (2015) have opined that to realize the objectives of PMJDY, bureaucratic support, political will and constant involvement of RBI are needed. Additionally, the diverse operating models used by various banks in rolling out the scheme have clearly shown that while some banks have shown aggressive growth, others have been steadier and a few others have been slow (Titus 2018). This shows that there is a difference in the efficiencies and cost structure of banks which needs to be explored.

Further, studies like Maity and Sahu (2020) have strived to examine the PSBs' efficiency in enhancing financial inclusion. The researchers performed a comparative analysis, wherein the efficiency of banks was studied pre- and post-PMJDY programme's introduction. The results have disclosed a significant variation in the level of efficiency between the two phases. On average, banks' efficiency towards financial inclusion increased post-implementation of PMJDY. Similarly, Shylaja (2021) has also observed that PMJDY has significantly augmented the accessibility of

financial services (in terms of the number of households covered under the scheme) and has brought about improvements in the banking habits of the newly banked population (reflected through rise in the deposits of the BSBDA accounts). Additionally, Günther (2017) has also claimed that post-PMJDY, bank account ownership and active usage of account (although to a small extent) have increased significantly for the disadvantaged. Distance to the nearest bank and distrust in accessing formal finance have also smoothened.

Measurement of bank efficiency

The extant literature reveals that the non-parametric frontier technique, i.e. the data envelopment analysis (DEA) is generally applied to determine the efficiency of banks (Arshinova, 2011; Liu et al., 2009). For instance, Titko et al. (2014) have applied DEA for calculation of efficiency scores of Latvian banks. Similarly, using the DEA method, the efficiency has been estimated for the banks of Egypt (Jreisat and Hassan 2016), Brazil (Staub et al. 2010), Saudi Arabia (Assaf et al. 2011), Africa (Mostafa 2008), Greece (Pasiouras 2008), China (Xu et al. 2015; Ariff and Can 2008), etc. Again, past empirical studies conducted to examine the efficiency of banks in the Indian sector (like Maity and Sahu 2020, 2017, 2019; Sathye 2003; Kumar and Dhingra 2016; Kumar and Gulati 2009etc.) have also applied the DEA method.

Zhu et al. (2021) have studied the productivity and operational efficiency of Pakistan's public, private and foreign banks through DEA. They found that both mean and pure technical efficiency scores of foreign banks were better than that of the domestic banks; but, the average scale efficiency scores of domestic banks were relatively higher than the foreign banks. Another study on Indonesian banks by Chowdhury et al. (2022) has also ascertained the efficiency of all types of banks, i.e. the public, private, and commercial banks using DEA method. The researchers observed that the overall technical efficiency of the Islamic banks was better than the others. Similarly, Milenković et al. (2022) have used the output-oriented DEA model to determine the efficiency of banks (of Western Balkan countries) in performing their intermediate functions. The findings showed that the efficiency level of banks between and within the countries was different.

Aghimien et al. (2016) examined the efficiency of Gulf Cooperation Council (GCC) banks using DEA method and have found that the banks were operating within an optimum scale of efficiency. However, the results have also indicated that the banks' management was inefficient in proper utilization of resources. Similar results were observed by Hussain et al. (2021a, b, c) while examined the efficiency of Asian microfinance institutions. The researchers noted that the institutions were operating relatively on an optimal scale, but were confronted with inefficiency from managerial side. Sufian et al. (2017) computed the efficiency of Malaysian banks using DEA method and noticed that external factors like cultural proximity and information flows improve efficiency (Hussain et al. 2021a, b, c). Sufian and Kamarudin (2016) used the return on assets ratio to measure banks' performance and found that banks of economically globalized nations perform better. Another study by Sufian and Kamarudin (2017) applied the Malmquist productivity index (MPI) method to investigate the productivity and efficiency of the Malaysian banks pre- and post-merger. The study revealed that productivity level of the banks was higher post-merger owing to technological advancement. Further, an investigation on the cost and revenue efficiency of Islamic and conventional banks has been conducted by Saw et al. (2020) across 18 countries. The results have indicated that banks from Malaysia, Singapore and Qatar have relatively higher profit efficiency, while banks from Iraq, Indonesia and Jordan were comparatively inefficient.

Kumar and Dhingra (2016) have studied the efficiency of Indian Public Sector Banks (PSBs) using DEA (CCR and BCC models). The CCR model, used to measure overall technical efficiency, indicated only two banks to be efficient and the BCC model, which measures pure technical efficiency, showed nine banks to be efficient. Similarly, Kumar and Gulati (2009) also found that out of the 51 Indian banks, only nine were efficient. According to the researchers, managerial inefficiency was the main reason for technical inefficiency. Again, Tamatam et al. (2019) have found that during the FY 2016–2017, out of the 38 sample banks only nine were overall technically efficient and the whole sample had 5 per cent mean overall technical efficiency. The study has also argued that Indian private banks (PVBs) are more efficient than PSBs. Nevertheless, a recent study by Sangeetha (2020) which has also measured the technical efficiency of Indian PSBs with the help of DEA has indicated the technical efficiency of PSBs to range from 97 to 100%. The study believes that the PSBs have put in efforts to optimally utilize their resources and become the best in financial intermediation.

Research gap

The PMJDY programme has been able to initiate gradual penetration through an increased number of bank branches and bank accounts (Shafi and Reddy, 2016). However, the competence of banks in continuing the process of inclusion is yet to be explored. It has been seven years since the introduction of the PMJDY scheme and yet studies explaining the efficiency of the Indian banks in improving financial inclusion under this mega scheme are extremely limited. Moreover, empirical studies examining banks' efficiency solely towards enhancing financial inclusion are handful. For instance, several studies like Kumar and Dhingra (2016),

Kumar and Gulati (2009), Thagunna and Poudel (2013), Karray and Chichti (2013), Hoque and Rayan (2012), Nigmonov (2010), Shahooth and Battall (2006) have examined the efficiency of banks by considering output variables such as interest and non-interest incomes, loans, operating profit, and net credits. These output factors assist in assessing the efficiency of banks based on only their financial performance. Thus, from the review of literature, it is evident that although a wide combination of input–output variables has been considered by the existing studies, most have ignored the financial inclusion parameters. Financial inclusion is one of the crucial roles assumed by banks. Thus, a bank's efficiency should also be judged based on their ability to augment financial inclusion.

The present study mainly focuses on examining the efficiency of Indian banks in fostering financial inclusion under the PMJDY programme. The intent is to evaluate the progress made by the Indian PSBs and PVBs (in terms of expanding the accessibility of banking services) under the PMJDY scheme. Thus, the study first explores the efficiency trend of the Indian PSBs and PVBs since the inception of the PMJDY scheme. Next, a comparison between the efficiency levels of PSBs and PVBs has been made, and finally, we examine the projection and shortfall of the demand-side financial inclusion dimension.

On the basis of the earlier discussions and the objectives set by the study, the null hypothesis (H_0) states that there is no significant difference in the efficiency levels between the two bank groups (the PSBs and the PVBs).

Data and methodology

Data

To measure the efficiency of the Indian banking sector, the study has considered a total of 25 banks. The sample includes all the 12 PSBs currently operating in the country and 13 PVBs. The data have been collected from the database of RBI, performance reports of the PMJDY scheme and the annual reports of the sample banks made available on the official websites. The sample has been collected for a period of 7 years, i.e. from 2014 to 2015 (as the scheme was launched in the year 2014) till 2020–2021 to estimate the level of efficiency achieved by the banks (in enhancing financial inclusion) under the PMJDY scheme.

Variable used in the study

Measurement of efficiency through the DEA method requires the selection of appropriate input and output variables. Based on the extant literature, the study has considered

a set of four input and three output variables. The description of these variables is as follows:

Input variables

Number of branches Financial inclusion requires access to banks which can be achieved by expanding banks' reach through increased number of bank branches. Therefore, the study has considered number of bank branches as an input variable to evaluate the efficiency of banks in facilitating financial inclusion.

Number of ATMs Another variable that would help in assessing the efficiency of banks in expanding their reach would be, number of ATMs. ATMs allow the account holders to carry on basic transactions without the help of a bank representative. It not only makes transactions easier, but also saves the customers from a visit to the bank. As ATMs provide easy access to baking services, its availability enhances financial inclusion. Hence, number of ATMs have been considered as another input variable.

Operational expenses Operating expenses are one of the major expense heads. Operational costs include administrative costs, costs related to employees, rent and stationery, advertisements, etc. Selection of this input variable is based on the various existing studies such as, Maity and Sahu (2021), Sathye (2003), Saha and Ravisankar (2000), Kumar and Dhingra (2016), Maity and Sahu (2020), and Nigmonov (2010).

Number of employees The PMJDY scheme focusses on bringing the unbanked population under the formal banking arena. The unbanked population is unaware of the availability of banking services and of the various benefits provided by the formal banking sector. Therefore, the presence of trained workforce would enhance customer relations and encourage the beneficiaries to avail banking services.

Output variables

Number of beneficiaries PMJDY scheme was introduced with the main aim to increase the level of financial inclusion in the country. For this purpose, the scheme has offered various attractive facilities such as zero balance accounts, Direct Benefit Transfer (DBT), credit facilities, and insurance cover. Hence, examining the number of beneficiaries would help us to understand banks' efficiency in banking the unbanked and in promoting financial inclusion under the PMJDY programme.

Deposits in accounts Simply owning a bank account does not ensure financial inclusion. It is important that the bank

accounts receive deposits as it would indicate that the beneficiaries are utilizing the financial services provided by the banks. Dormant accounts indicate lack of efficiency among banks in convincing the disadvantaged section to access financial services from the formal banking sector. Therefore, deposits made by beneficiaries under the PMJDY scheme are another factor which the study has considered as the output variable.

Number of RuPay debit cards provided to beneficiaries Under the PMJDY scheme every account holder is provided with a RuPay Debit card. Hence, to assess banks' efficiency in promoting financial inclusion under the PMJDY programme, number of RuPay Debit cards issued under this scheme has been considered as an output variable.

Statistical and econometric tests used

To estimate efficiency of decision-making units (DMUs), a number of parametric and non-parametric tests have been developed by various researchers. DEA, one of the latter techniques, is a linear programming method developed by Charnes et al. (1978) to estimate the efficiency of non-profit (public sector) organizations such as banking, education, healthcare, and manufacturing plants. (Tamatam et al. 2019). Under this technique, the efficient DMUs have scores equal to 1 and the relatively inefficient units have scores below 1. The traditional models, CCR (developed by Charnes et al. 1978) and the BCC model (developed by Banker et al. 1984) are based on the assumptions of constant (CRS) and variable returns to scale (VRS), respectively. CCR model assists in the generation of the overall technical efficiency (OTE), and the BCC model generates the pure technical efficiency (PTE).

Let us assume there are 'n' DMUs and each DMU has 'm' inputs and 's' outputs. The relative efficiency score of a test DMUo ("o" represents a focal DMU) has been acquired using the following model:

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

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

$$u_i, v_r \geq 0.$$

Here, $i = 1, 2, \ldots, m$; $r = 1, 2, \ldots, s$; y_{rj} denotes output "r" produced by DMU j; x_{ij} signifies input "i" employed by DMU j; v_r is the weight of output r and u_i is the weight of input j. To evaluate relative efficiency score of each DMU, it is transformed into a linear programming problem.

$$\max \sum_{r=1}^{s} v_r y_{ro}$$
subject to
$$\sum_{r=1}^{s} v_r y_{rj} - \sum_{i=1}^{m} u_i x_{ij} \leq 0; (j = 1, 2, \ldots, n); \tag{2}$$
$$\sum_{i=1}^{m} u_i x_{ij} = 1;$$
$$u_i, v_r \geq 0$$

Several past studies have followed the input-oriented approach for analysing efficiency. Perhaps, the DMUs examined in such studies had inputs as the primary decision variables. However, this may not hold true in the case of all institutions. There may be organizations where resources are fixed and using the limited resources outputs have to be maximized. In such case, output-oriented model would prove to be more appropriate. As the present study aims to investigate the banks' level of efficiency in fostering financial inclusion and maximizing their reach (measured through the selected output factors) under the PMJDY programme, we follow the output-oriented approach.

Before conducting the DEA analysis, the descriptive statistics of the variables have been computed to understand the features of the data. The researchers have also performed the 'isotonicity' test to comprehend whether the input and output factors satisfy the isotonicity assumptions (Golany and Roll 1989). The efficiency scores (OTE and PTE) of each sample PSB and PVB have been calculated for the period 2014–2015 to 2020–2021. Banks have also been assigned ranks on the basis of efficiency scores and consistency coefficient (CC). Further, the projections and shortfalls of the output variables have been computed. This gives us an overview of the banks that have performed well in maximizing outputs and those that are lagging. Next, the study has tested the hypothesis using the Welch t test.

Analysis and findings

Table 1 depicts the results of the descriptive statistics and the isotonicity test. The researchers inspect the assumptions of 'isotonicity' to increase the soundness of the results (Golany and Roll 1989). Descriptive statistics has been assessed for all the input and output factors of the selected 25 banks, for the study period of seven years (175 observations). The table gives information about the average, the maximum and minimum values, the standard deviation as well as the kurtosis and skewness of the data. Also, to verify the 'isotonicity' relations assumed for DEA [which states that increase in input should not lead to decrease in output and vice-versa (Golany and Roll 1989)], correlation has been computed. As the correlation is positive for all variables (Table 1), it is evident that the data satisfy the assumption of isotonicity.

Table 1 Descriptive statistics and 'isotonicity' test. *Source*: Researcher's Calculation

	Operating expenses (in billions)	Number of branches	Number of ATMs	Number of employees	Number of total beneficiaries	Deposits in accounts (in millions)	Number of RuPay debit cards issued to beneficiaries
Symbol	OEXP	NBRN	NATM	NEMP	NBNF	DACC	NRDC
Observations	175	175	175	175	175	175	175
Mean	99.968	4664.006	7855.149	48,197.983	10,019,886.709	25,972.065	8,113,199.554
Minimum	5.079	193	341	3465	11,109	5.875	0
Maximum	826.522	25,840	62,617	284,633	128,517,334	368,343.992	120,159,412
SD	130.431	5255.964	11,664.420	54,841.738	20,605,200.255	53,427.448	17,419,994.104
Kurtosis	12.695	5.934	12.288	7.906	16.596	14.685	20.366
Skewness	3.267	2.288	3.358	2.576	3.857	3.515	4.174
OEXP	1						
NBRN	0.895	1					
NATM	0.965	0.924	1				
NEMP	0.957	0.948	0.971	1			
NBNF	0.882	0.880	0.869	0.830	1		
DACC	0.758	0.764	0.687	0.676	0.913	1	
NRDC	0.881	0.861	0.858	0.816	0.989	0.919	1

Having tested the isotonicity assumptions, the study proceeds to measure the efficiency scores of the DMUs (PSBs and PVBs) under the CCR and BCC models in Tables 2 and 3, respectively. Table 2 presents the OTE scores of the DMUs from the year 2014–2015 to the year 2020–2021. The last column shows the mean OTE score obtained by the DMUs. It can be seen from the table that five PSBs, i.e. BARB (0.956), BKID (0.982), PUNB (0.977), SBIN (0.991) and UCBA (0.998), have revealed high mean efficiency scores. The PVBs have attained relatively lower scores. The year-wise mean depicted in the last row of Table 2 shows that the overall technical efficiency had decreased initially in the year 2015–2016, following which it has remained more or less steady. The same can be seen in Fig. 1.

Table 3 of the study shows the PTE scores of the DMUs. The mean PTE scores of SBIN, UCBA, CIUB, and RATN are 1, which implies that these banks have the highest pure technical efficiency. Table 2 and table 3 both have confirmed that SBIN and UCBA have high efficiency, among other DMUs. Again, the year-wise mean PTE score has shown a trend which is similar to the one shown by the mean OTE scores in Table 2. The efficiency of the DMUs have decreased in the year 2015–2016, then increased slightly in the year 2016–2017, and has remained stable thereafter (Figure 2).

Further, the rank for DMUs is calculated in Table 4 based on the efficiency scores and the consistency coefficient (ratio of AM to standard deviation). Table 4 discloses that when the rank was computed based on the AM values, UCBA captured the top position, followed by SBIN in the second and BKID in the third position. The DMU, UTIB, settled for the last position. Additionally, the ranks determined with the help of the CC values indicated that UCBA, SBIN, and BKID occupied the first, second and third positions, respectively, and YESB received the last position. Finally, the combined score revealed that UCBA received the first place, SBIN second place, BKID third place, and YESB the last place.

Details of the efficient banks (under OTE) are summarized year-wise in Table 5. The table has shown that throughout the study period, none of the PVBs were efficient. Among the PSBs, only 3 to 6 banks were found to be efficient every year. The trend of efficiency, as shown in Figs. 1 and 2, has also portrayed that the efficiency level of PVBs is much below the PSBs.

Next we have tested our hypothesis (H_0) using Welch's *t* test (Table 6) wherein the mean efficiency of two independent groups, PSBs and PVBs, have been compared based on the OTE and PTE scores. As the sample size and variances of the two groups are unequal, the study has opted for the Welch *t* test. It is clear from Table 6 that the t-statistics are statistically significant at 1 per cent level. Thus, the null hypothesis (H_0) gets rejected. This implies that a significant difference is present between the efficiency levels of the PSBs and PVBs.

Under the output-oriented approach, focus lies on the targets (or outputs) achieved by the DMUs. Therefore, projections and shortfall of outputs have been measured for each DMU in Table 7. The table helps to ascertain if the Indian banks are efficient in maximizing their outputs. A DMU is efficient if it has no output shortfall (Marschall and Flessa 2011). According to Table 7, out of 25 DMUs, only 5 (i.e.

Table 2 Efficiency scores (OTE) of DMUs (PSB & PVB). *Source*: Researcher's Calculation

DMUs	2014–2015	2015–2016	2016–2017	2017–2018	2018–2019	2019–2020	2020–2021	Mean of DMU
BARB	0.937	0.907	0.920	0.926	1	1	1	0.956
BKID	0.937	0.934	1	1	1	1	1	0.982
MAHB	0.677	0.800	1	1	0.979	1	0.921	0.911
CNRB	0.708	0.490	0.393	0.369	0.344	0.358	0.342	0.429
CBIN	0.800	0.674	0.779	0.869	1	0.831	0.882	0.833
IDIB	0.743	0.675	0.987	0.928	0.885	0.836	0.819	0.839
IOBA	0.598	0.480	0.533	0.480	0.494	0.473	0.416	0.496
PSIB	1	0.620	0.469	0.389	0.473	0.462	0.294	0.530
PUNB	1	1	1	1	1	1	0.839	0.977
SBIN	1	1	1	1	1	1	0.937	0.991
UCBA	1	1	0.985	1	1	1	1	0.998
UBIN	0.659	0.491	0.482	0.485	0.499	0.469	0.519	0.515
UTIB	0.114	0.084	0.068	0.058	0.050	0.040	0.033	0.064
CIUB	0.101	0.062	0.061	0.053	0.047	0.042	0.033	0.057
FDRL	0.243	0.158	0.136	0.120	0.123	0.130	0.114	0.146
HDFC	0.316	0.186	0.153	0.134	0.156	0.152	0.114	0.173
ICIC	0.352	0.294	0.228	0.247	0.245	0.187	0.165	0.245
IBKL	0.348	0.223	0.191	0.122	0.124	0.098	0.089	0.171
INDB	0.141	0.130	0.135	0.088	0.077	0.054	0.039	0.095
JAKA	0.880	0.640	0.636	0.504	0.514	0.597	0.515	0.612
KVBL	0.105	0.083	0.072	0.067	0.066	0.062	0.048	0.072
KKBK	0.103	0.055	0.039	0.033	0.026	0.021	0.016	0.042
RATN	0.337	0.206	0.124	0.101	0.100	0.078	0.067	0.145
SIBL	0.078	0.049	0.090	0.074	0.067	0.051	0.044	0.065
YESB	0.011	0.007	0.005	0.003	0.003	0.003	0.002	0.005
Mean of the year		0.527	0.450	0.459	0.442	0.451	0.438	0.410

BARB, BKID, PUNB, SBIN, and UCBA) are efficient. All the efficient banks are PSBs. The results have validated the study's earlier findings, affirming that the PVBs are inefficient.

Results and discussion

Our findings have shed light on the efficiency of the Indian banks in achieving the dream of 'banking the unbanked' envisaged by the Government of India. Overall, the evidences derived from the analysis suggest that the Indian banks still have a long way to go. We have found evidences indicating that very few banks have performed efficiently in furthering the objectives of PMJDY scheme.

The study has endeavoured to investigate threefold objective. First, the study pursued to understand the efficiency trend of the Indian PSBs and PVBs since the inception of the PMJDY scheme. The findings have indicated that the technical efficiency of the PSBs and PVBs declined initially, following which the PSBs recovered slightly and has maintained a more or less stable performance. However,

the efficiency of PVBs did not improve, rather it declined a bit more in the subsequent years. Typically, the private banks are profit oriented and thus are reluctant to participate actively in social governmental schemes like PMJDY. Yet, as the fall is not drastic, it can be stated that private banks have strived to preserve a steady performance. The overall performance of all the DMUs followed a similar trend where the curve fell in the year 2015–2016, rose a little in 2016–2017 and has remained almost stable since. The initial decline may be a result of incompetence of banks in conveying and convincing the benefits of the PMJDY scheme to the targeted population. Also, the poor banking habits of the target population may have resulted in lower deposits in the PMJDY accounts, thereby lowering the efficiency scores of the banks (Agarwala et al. 2022).

Efficiency scores computed by the study also assisted in performing a comparative analysis which has revealed that a significant difference is present in the efficiency levels of PSBs and PVBs. The PSBs have shown higher efficiency in endorsing financial inclusion than the PVBs. Perhaps, the reason is that the PSBs are more likely to expand in underserved areas with prominent levels of financial exclusion.

Table 3 Efficiency scores (PTE) of DMUs (PSB & PVB). *Source*: Researcher's Calculation

DMUs	2014–2015	2015–2016	2016–2017	2017–2018	2018–2019	2019–2020	2020–2021	Mean of DMU
BARB	1	1	0.972	1	1	1	1	0.996
BKID	0.947	0.954	1	1	1	1	1	0.986
MAHB	0.802	0.945	1	1	1	1	1	0.964
CNRB	0.830	0.527	0.408	0.374	0.357	0.373	0.350	0.460
CBIN	0.829	0.679	0.785	0.873	1.000	0.862	0.910	0.848
IDIB	0.921	0.733	0.999	0.947	0.897	0.848	0.844	0.884
IOBA	0.614	0.502	0.606	0.570	0.649	0.668	0.684	0.613
PSIB	1	1	0.999	1	1	1	1	1
PUNB	1	1	1	1	1	1	0.860	0.980
SBIN	1	1	1	1	1	1	1	1
UCBA	1	1	1	1	1	1	1	1
UBIN	0.729	0.555	0.495	0.486	0.501	0.470	0.521	0.537
UTIB	0.162	0.138	0.134	0.127	0.137	0.143	0.140	0.140
CIUB	1	1	1	1	1	1	1	1
FDRL	0.450	0.476	0.527	0.576	0.597	0.594	0.597	0.545
HDFC	0.337	0.220	0.198	0.184	0.215	0.218	0.185	0.223
ICIC	0.381	0.316	0.265	0.287	0.306	0.260	0.239	0.294
IBKL	0.444	0.381	0.422	0.398	0.424	0.422	0.454	0.421
INDB	0.292	0.288	0.311	0.283	0.306	0.303	0.296	0.297
JAKA	1	0.843	0.950	0.971	0.966	1	1	0.961
KVBL	0.541	0.593	0.673	0.720	0.784	0.852	0.845	0.715
KKBK	0.297	0.192	0.195	0.229	0.251	0.276	0.289	0.247
RATN	1	1	1	1	1	1	1	1
SIBL	0.578	0.600	0.770	0.843	0.875	0.925	0.908	0.786
YESB	0.321	0.258	0.256	0.291	0.316	0.389	0.442	0.325
Mean of the year		0.699	0.648	0.679	0.686	0.703	0.704	0.703

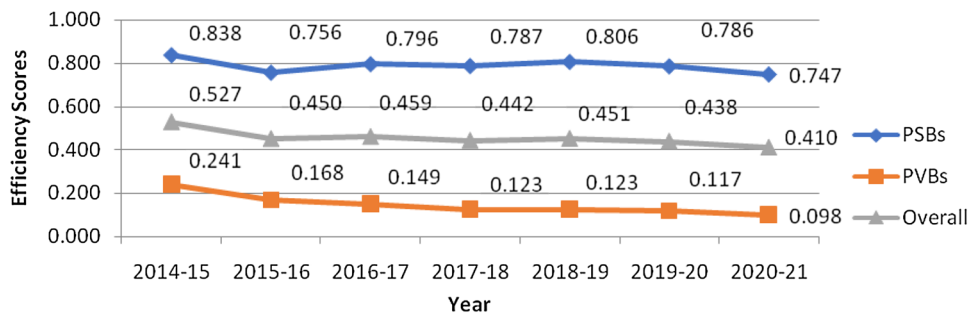**Fig. 1** Overall mean efficiency scores (OTE). *Source*: Prepared by Researchers

Fig. 2 Overall mean efficiency scores (PTE). *Source*: Prepared by Researchers
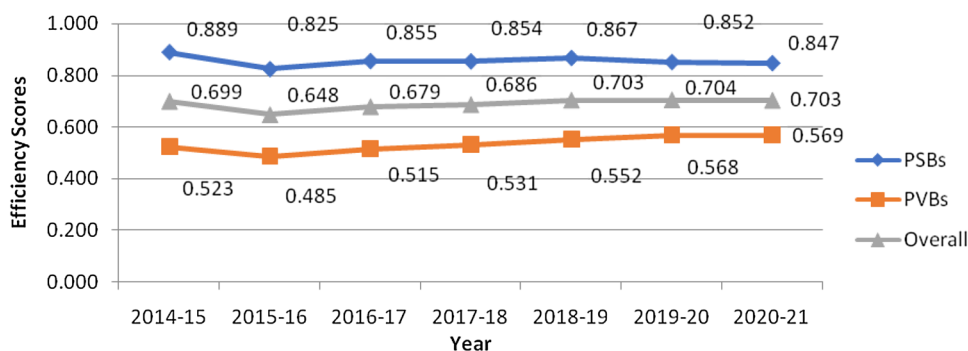
Table 4 Measures of rank based on efficiency scores and consistency coefficient. *Source*: Researcher's Calculation

DMUs	AM (BCC & CCR)	SD	CC	Rank based on AM	Rank based on CC	Sum of rank	Final efficiency rank
BARB	0.976	0.036	26.851	5	4	9	4.5
BKID	0.984	0.027	36.376	3	3	6	3
MAHB	0.937	0.103	9.085	6	6	12	6
CNRB	0.444	0.150	2.971	15	14	29	13
CBIN	0.841	0.097	8.670	8	8	16	8
IDIB	0.862	0.096	8.957	7	7	14	7
IOBA	0.555	0.083	6.646	12	10	22	10
PSIB	0.765	0.290	2.640	10	15	25	12
PUNB	0.979	0.055	17.865	4	5	9	4.5
SBIN	0.996	0.017	59.185	2	2	4	2
UCBA	0.999	0.004	253.009	1	1	2	1
UBIN	0.526	0.076	6.930	14	9	23	11
UTIB	0.102	0.044	2.296	25	16	41	23
CIUB	0.529	0.489	1.080	13	24	37	18.5
FDRL	0.346	0.213	1.619	18	19	37	18.5
HDFC	0.198	0.063	3.124	21	13	34	16
ICIC	0.270	0.059	4.560	20	11	31	14
IBKL	0.296	0.145	2.039	19	17	36	17
INDB	0.196	0.109	1.805	22	18	40	22
JAKA	0.787	0.205	3.830	9	12	21	9
KVBL	0.394	0.344	1.144	17	22	39	20.5
KKBK	0.144	0.112	1.285	24	20	44	24
RATN	0.572	0.449	1.276	11	21	32	15
SIBL	0.425	0.387	1.099	16	23	39	20.5
YESB	0.165	0.172	0.955	23	25	48	25

AM, arithmetic mean; SD, standard deviation; CC, consistency coefficient

Table 5 Summary of efficient banks (under OTE)—2014–2015 to 2020–2021. *Source*: Researcher's Calculation

Year	DMUs	Number of DMUs			Descriptive Statistics			
		Evaluated	Efficient	Inefficient	Mean	Max	Min	SD
2014–2015	PSB	12	4	8	0.838	1	0.598	0.156
	PVB	13	0	13	0.241	0.880	0.011	0.225
2015–2016	PSB	12	3	9	0.756	1	0.480	0.210
	PVB	13	0	13	0.168	0.640	0.007	0.164
2016–2017	PSB	12	4	8	0.796	1	0.393	0.251
	PVB	13	0	13	0.149	0.636	0.005	0.159
2017–2018	PSB	12	5	7	0.787	1	0.369	0.268
	PVB	13	0	13	0.123	0.504	0.003	0.129
2018–2019	PSB	12	6	6	0.806	1	0.344	0.266
	PVB	13	0	13	0.123	0.514	0.003	0.133
2019–2020	PSB	12	6	6	0.786	1	0.358	0.264
	PVB	13	0	13	0.117	0.597	0.003	0.154
2020–2021	PSB	12	3	9	0.747	1	0.294	0.273
	PVB	13	0	13	0.098	0.515	0.002	0.133

Table 6 Welch *t* test. *Source*: Researcher's Calculation

	Value of Welch' *t* test	D.F.	*p* value	Hypothesis testing
Under OTE scores	8.222	19.307	0.000	H_0: There is no significant difference in efficiency level between the two groups
Under PTE scores	3.035	20.430	0.006	**Result: H_0 can be rejected**

Table 7 Projection of output factors. *Source*: Researcher's Calculation

DMUs	Projection			Shortfall		
	Number of total beneficiaries (in millions)	Deposits in accounts (in millions)	Number of RuPay debit cards issued to beneficiaries (in millions)	Number of total beneficiaries (in millions)	Deposits in accounts (in millions)	Number of RuPay debit cards issued to beneficiaries (in millions)
Symbol	NBNF	DACC	NRDC	NBNF	DACC	NRDC
BARB	30.464	87,957	27.122	–	–	–
BKID	17.799	46,953	15.890	–	–	–
MAHB	4.803	13,051	4.284	0.094	486	2.682
CNRB	30.413	92,297	24.770	18.654	56,610	16.334
CBIN	12.314	33,040	9.852	1.851	10,670	2.189
IDIB	12.517	33,970	9.227	0.774	3,147	0.571
IOBA	9.137	24,103	8.157	4.743	14,830	4.035
PSIB	2.745	11,530	2.240	1.556	5,851	1.137
PUNB	31.434	137,095	25.396	–	–	–
SBIN	94.615	181,699	78.570	–	–	–
UCBA	7.188	19,893	4.509	–	–	–
UBIN	27.239	78,179	23.222	12.999	43,708	13.100
UTIB	13.017	33,032	11.316	12.273	31,143	10.669
CIUB	1.641	4,660	1.292	1.558	4,523	1.227
FDRL	3.493	14,936	2.825	3.018	12,905	2.478
HDFC	14.007	53,247	11.755	12.030	44,296	9.779
ICIC	18.561	35,645	15.414	14.800	33,095	11.662
IBKL	6.387	18,440	5.686	5.439	16,391	4.878
INDB	4.963	12,013	4.337	4.559	11,718	3.960
JAKA	2.559	10,528	2.087	1.075	4,423	0.877
KVBL	2.729	7,025	2.421	2.556	6,860	2.256
KKBK	5.029	12,502	4.423	4.863	12,309	4.331
RATN	0.986	2,602	0.881	0.886	2,560	0.781
SIBL	2.809	8,029	2.354	2.633	7,615	2.264
YESB	3.439	8,588	3.028	3.426	8,570	3.018
Total				109.788	331,711	98.226

Conversely, PVBs mostly cater to urban areas and are less likely to open branches in financially excluded areas where the population would majorly consist the lower income group (Agarwal et al. 2017). This explains the poor performance of the PVBs.

Finally, the examination of the projection and shortfall of the demand-side financial inclusion dimensions have signalled that PVBs need to manage the shortfall to improve efficiency. Especially, those banks which have shown a very high level of shortfall. For instance, banks like CNRB, ICIC and UBIN need to take necessary steps to reduce shortfall and reach their target. The projection and shortfall analysis has unveiled the actual picture of the baking sector showing that only five banks had zero output shortfall, i.e. only five banks were efficient in promoting financial inclusion by maximizing their outputs (by means of the given inputs).

Conclusion

The PMJDY programme was brought into force to fulfil India's quest for financial inclusion. The responsibility for the success of this scheme rests majorly on the shoulders of the public and private banks. Therefore, measuring the efficiency of these banks becomes vital. The present study has measured efficiency of 25 banks using the DEA model to ascertain how the banks have performed under the PMJDY scheme. The empirical analysis indicates that the PSBs have performed better than the PVBs in expanding financial inclusion under PMJDY.

Indian PSBs have time and again been appreciated for their enthusiastic participation in social welfare schemes (Maity and Sahu 2021). The findings also validate the same, depicting that PSBs are more efficient in accomplishing the financial inclusion objective of the Government than the PVBs. The PVBs are usually more profit-oriented. Hence, implementation of schemes like PMJDY is poor among PVBs. To ensure holistic development, especially for those belonging to the bottom of the income pyramid, it is incredibly important for all banks to participate actively in programmes like PMJDY (Agarwala et al. 2022). Moreover, unprecedented times like the COVID-19 pandemic challenge the competence of the banking sector. An efficient banking system is essential to keep the economy running by assuring that the flow of financial services does not get interrupted.

However, simply ensuring accessibility of bank accounts to the disadvantaged does not seem to be sufficient. Policies should be formulated to encourage its usage. The findings of the study have led us to believe that hesitance among people to use the formal banking system may be largely due to ignorance and inexperience. Efforts should be made to catalyse the learning process and create awareness regarding the benefits offered by PMJDY accounts (Singh and Ghosh 2021). Post-account opening policies would play a significant role in boosting economic activity. Policymakers could introduce incentives on a certain number of initial transactions to augment usage of accounts. Regular users of savings accounts could be rewarded with financial products such as health or other general insurance. Also, the coverage amount of existing insurance policies (associated with PMJDY) could be increased. A widespread network of access points could be set up to reduce the opportunity costs associated with using a bank account. These implications drawn from the study could assist in expanding financial inclusion.

The study contributes significantly to the extant literature by bringing to light the efficiency of Indian public and private banks in realizing the targets of the PMJDY scheme and the deficiencies that needs to be worked upon. However, as the present study has considered only the public and private banks, the performance of other financial institutions such as the regional rural banks, the cooperative banks and the small finance banks remains unknown. These could be covered in the future researches. This would help in broadening the knowledge about the efficiency of the Indian banking industry on the whole. Further studies may also take into account the impact of the COVID-19 pandemic on banks' efficiency. A pre- and post-pandemic comparison of banks' efficiency would provide a clearer picture regarding the efficacy of Indian banks.

Appendix 1

Name of banks and their symbols

Sr. No.	DMUs	Symbol
1	Bank of Baroda	BARB
2	Bank of India	BKID
3	Bank of Maharashtra	MAHB
4	Canara Bank	CNRB
5	Central Bank of India	CBIN
6	Indian Bank	IDIB
7	Indian Overseas Bank	IOBA
8	Punjab & Sind Bank	PSIB
9	Punjab National Bank	PUNB
10	State Bank of India	SBIN
11	UCO Bank	UCBA
12	Union Bank of India	UBIN
13	Axis Bank Ltd	UTIB
14	City Union Bank Ltd	CIUB
15	Federal Bank Ltd	FDRL
16	HDFC Bank Ltd	HDFC
17	ICICI Bank Ltd	ICIC
18	IDBI Bank Ltd	IBKL
19	IndusInd Bank Ltd	INDB
20	Jammu & Kashmir Bank Ltd	JAKA
21	Karur Vysya Bank	KVBL
22	Kotak Mahindra Bank Ltd	KKBK
23	RBL Bank Ltd	RATN
24	South Indian Bank Ltd	SIBL
25	Yes Bank Ltd	YESB

Declarations

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