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EFFICIENCY ANALYSIS OF PUBLIC SECTOR BANKS IN INDIA AFTER THE MERGERS IN APRIL 2020 A DEA APPROACH

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Abstract: The study is a novel idea aimed at evaluating the quarterly performance of public sector banks in India in the last year (FY 2020-21). There has been a major revamp of the public sector banks in the country in the last year, after the central government has announced the merger of ten (10) nationalized banks in the country, which has come into effect from April 1st, 2020. This has resulted in monitoring closely the performance of the banks at regular intervals for taking any necessary measures for betterment in their efficiency levels. Evaluating and assessing the efficiency will help banks to recognize the areas of inefficiency and frame appropriate strategies to increase its position in the market. The present study focuses on the analysis of the quarterly efficiencies of all the 12 public sector banks in India for the most recent three-quarters of FY 2020-21 using the non-parametric performance evaluation technique of Data Envelopment Analysis (DEA). The total population of 12 public sector banks was taken for the study. The contribution is a novel thatch demonstrates that an efficiently performing bank may not always remain efficient and vice versa and management has to continuously monitor the performance. The study also recommends target input levels for underperforming banks to become efficient. The input slacks give direction for bank management to identify the areas of optimization viz. minimisation of inputs for efficient performance.

Index Terms - Performance evaluation, efficiency, benchmarking bank, DEA, Slack Variables.

I. INTRODUCTION

The banking industry in any country acts as a backbone of its economy. A strong and efficient banking system boosts in strengthening the economy of a country. Many studies have shown that the development of the banking sector has a high positive correlation with the level of economic development. The banking sector contributes to the biggest part of gross domestic product (gdp) and plays a crucial role in the country's economy. Any changes in the banking system will have a crucial effect on the economy of the country. On the other hand, the banking industry is one of the highly competitive industries in which even foreign banks compete for their share in the industry. One of the key performance indicators is efficiency. A relative measure of efficiency provides a good indicator of performance in a competitive market. Under such circumstances, evaluating the efficiency will help banks to identify the areas of inefficiency and formulate suitable strategies to improve its relative position in the market. It can also provide a framework to the regulators to assess the financial soundness of individual banks and to work out appropriate interventions to prevent systemic failures.

II. REVIEW OF LITERATURE

In India, several studies have been carried out on Efficiency Analysis using the DEA approach. Noulas and Ketkar (1996)¹ have analysed the efficiency of public sector banks Data Envelopment Analysis approach. They analysed 18 public sector banks for their study. They concluded that 1.5% of the banks were operating with pure technical efficiency and displayed a scaling efficiency of 2.25%. Their study also concluded that none of the banks under the study were operating with decreasing returns to scale (DRS).

Bhattacharya et al (1997)² used DEA to measure the productive efficiency of Indian commercial banks between the 1980s and 1990s. Their study focussed on the impact of liberalized policy measures of 1980s on the performance of various categories of banks. Their results identified that Public Sector banks were performing better than private sector banks. They also concluded that the new private sector banks were yet to emerge fully into the Indian Banking system.

Sathye (2001)³ studied the relative efficiency of Indian banks in the late 1990s and compared the efficiency of Indian banks with that of foreign banks. His study concluded that the public sector banks had a higher mean efficiency score than the private sector banks in the country. But his study displayed mixed results with respect to the foreign banks operating in India.

Rammohan and Ray (2004)⁴ compared the revenue-maximizing efficiency of public, private, and foreign banks in India using physical quantities of inputs and outputs in the 1990s. They used the deposits and operating costs as input variables and loans, investment, and other income as output variables for their study. They concluded that the public sector banks had better revenue maximization efficiency than private sector banks, though the significance was very minor.

Sanjeev (2006)⁵ studied the efficiency of private, public, and foreign banks operating in India during the period 1997-2001 using DEA. His study focused on the establishment of a relationship between the efficiency and non-performing assets (NPAs) of the bank. The study concluded that there is an increase in efficiency in post-reform period and that non-performing assets (NPAs) and efficiency are negatively related.

Kumar and Gulati (2008)⁶, studied 27 public sector banks in India for the FY 2004-05. They analysed various efficiencies of all the banks and identified 7 public sector banks as most efficient. Their empirical findings showed that the public sector banks had an average overall technical efficiency of 88.5%. However, their results generalized on the input reduction of 11.5% (input slacks) with reference to the benchmarked banks.

Rajput & Gupta (2011)⁷ studied the technical efficiency of public sector banks in India during the post-reforms period from 1992-93 to 2009-10. Their analysis concluded that there was a positive impact of efficiency on 20 out of the 27 public sector banks.

Kumar and Gulati (2016)⁸ analysed the performance of the Indian banks based on the ownership groups, namely, public sector, private sector and foreign banks. They analysed and compare the performance in terms of efficiency using DEA approach. Their study concluded that foreign banks were highly profiting efficient than their counterparts, namely, public sector and private sector banks. Their study also concluded that the foreign banks employed superior methods in their operations which was attributed to their superior profitability and efficiency.

Problem Statement

Although companies publish quarterly results and the performance indicators for all quarters in a year, the results shown are based on only simple ratios analysis, which considers single input and a single output. Further, research publications have also focused on either time-series analysis or ratio analysis. There are very few studies on efficiency analysis using non-parametric tests. This is one of the gaps identified which motivated the researcher to take up the study. Moreover, there are nil studies conducted on the public sector banks after the major revamp of the banks under government control in April 2020.

With this problem identified, the research attempts to answer the question of how much is the variation in quarterly performance efficiencies of public sector banks in India?

Objectives

To answer the above research question, the objectives of the study are two-fold. They are:

- a. to evaluate the quarterly efficiency indicators of public sector banks in India during FY 2020-21;
- b. to identify the optimum value for inputs to maximize output, based on slack variables.

This paper is organized as follows: Section 2 explains the research methodology adopted for efficiency evaluation, focusing on the DEA methodology and the model adopted for the study. The data and estimation procedure are also explained in this section. Section 3 describes the results and discussion based on the analysis, and finally, Section 4 summarizes the findings and concludes the paper with final comments.

III. RESEARCH METHODOLOGY

The study focuses on the efficiency evaluation of banks employing DEA methodology. This efficiency measure indicates whether a bank uses the minimum quantity of inputs to produce a given number of outputs or maximizes the output quantity. Several studies have been carried out in the area of measuring the efficiency of firms, companies, banks and other decision-making units. Studies in the past used conventional ratios such as return on assets to evaluate efficiency. Most of these studies which look at efficiency concentrate on cost, profit income or revenue efficiencies. Later research in the area used various measures of performance which include a financial index, a non-parametric approach- Data Envelopment Approach (DEA), Stochastic Production Approach (SPA), etc. DEA is frequently used as a measure of the relative efficiency of decision-making units (DMUs). DEA is defined by Charnes et al. (1978)⁹ as a mathematical programming model applied to observe data that provides a new way of obtaining an empirical estimate of relations such as the production functions or efficient production frontier, which are considered to be the cornerstone of modern economics. It is a non-parametric, multiple input-output efficiency technique that measures the relative efficiency of decision-making units (DMUs).

Avkiran (2006)¹⁰ has stressed on the ability of DEA to handle multiple inputs and outputs even without making any judgment on their importance. Efficiency is defined with multiple inputs and multiple outputs as

$$\text{Efficiency} = \frac{\text{weighted sum of outputs}}{\text{weighted sum of inputs}}$$

Further, the efficiency considering the multiple outputs and multiple inputs mathematically was described by Ramanathan (2003)¹¹ as given in the model.

$$\max E_m = \frac{\sum_{j=1}^J v_{jm} y_{jm}}{\sum_{i=1}^I u_{im} x_{im}}$$

where
 E_m is the efficiency of the m th DMU,
 y_{jm} is j th output of the m th DMU,
 v_{jm} is the weight of that output,
 x_{im} is i th input of the m th DMU,
 u_{im} is the weight of that input, and
 y_{jn} and x_{in} are j th output and i th input

subject to

$$0 \leq \frac{\sum_{j=1}^J v_{jm} y_{jn}}{\sum_{i=1}^I u_{im} x_{in}} \leq 1; \quad n = 1, 2, K, N$$

$$v_{jm}, u_{im} \geq 0; \quad i = 1, 2, K, I; \quad j = 1, 2, K, J$$

The core aspect of the DEA analysis is deciding on the number of inputs and outputs. DEA is conducted with an assumption of constant returns to scale (CRS), or variable returns to scale (VRS). CRS-based DEA was proposed in a seminal paper by Charnes *et al.* (1978)¹², and the efficiency was called overall technical efficiency (OTE). OTE takes into account the size of the bank as well as inefficiencies because of the input–the output relationship. Later, VRS based DEA approach was proposed by Banker *et al.* (1984)¹³ which decomposes OTE into two components, pure technical efficiency (PTE) and scale efficiency (SE). PTE relates to the ability of a firm to utilize the available resources, and SE refers to taking advantage of economies of scale. Thus, the linear programming problem (LPP) based model for output maximization with CRS is given as:

$$\text{Maximize } \theta_o = \sum_{r=1}^s u_r y_{ro}$$

subject to:

$$\sum_{i=1}^m v_i x_{io} = 1 \quad i = 1, \dots, m$$

$$\sum_{r=1}^s u_r y_{rj} - \sum_{i=1}^m v_i x_{ij} \leq 0 \quad r = 1, \dots, s$$

$$u_r, v_i \geq 0 \quad j = 1, \dots, n$$

The LPP based, input-minimising model with VRS was developed by Banker *et al.* (1984)¹⁴ as:

$$\theta^* = \min \theta$$

subject to

$$\sum_{j=1}^n \lambda_j x_{ij} \leq \theta x_{io} \quad i = 1, 2, \dots, m;$$

$$\sum_{j=1}^n \lambda_j y_{rj} \geq y_{ro} \quad r = 1, 2, \dots, s;$$

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

$$\lambda_j \geq 0 \quad j = 1, 2, \dots, n.$$

where,

- θ is the dual variable corresponding to equality constraint that normalizes weighted sum of inputs
- λ is the dual variable corresponding to the other inequality constraints of the primal

3.1.Data Sources and Sample

For evaluating the quarterly performance of banks during the year 2020-21, all the 12 Public Sector Banks in India after the major merger of Public Sector banks were selected for the study. The data is collected from the published quarterly financial results and press releases of banks on their respective websites.

The DEA approach was adopted to study and analyse the efficiency performance. This requires input and output variables to be selected. In this study, the input variables are, Total expenses (excluding employee expenses), Employee Expenses and Net NPAs. The output variables used in the study are Total Income and Operating Profit.

3.2. Estimation Procedure

The efficiency scores of banks are calculated using DEAP 2.1 software package. Since the methodology adopted is a non-parametric approach, there are no assumptions such as normality, linearity, and so on for the variables. The study was conducted for the first three-quarters of Financial Year 2020-21. Since Quarter 4 data was not available for all the banks under the study, it was not considered in efficiency scores calculation.

As the study is to evaluate the efficiency levels of the banks, only pure technical efficiency (PTE) is calculated for each bank, called as DMU in DEA. In this study, the Input-Oriented approach with variable returns to scale (VRS) model is used for PTE evaluation using the BCC model.

IV. RESULTS AND DISCUSSION

Based on the data collected from the quarterly performance results published, the efficiency scores are calculated under the input-oriented VRS assumption. The slacks existent with the input variables are also analyzed. This gives an insight into how the selected input variables impact the efficiency levels of the banks considered for the study. The analysis also identifies the benchmarked banks which can act as best practice banks for others to follow their practices under similar working conditions. The analysis also highlights the variation in the efficiency scores among the different banks under the study. This enables us to compare the efficiency scores more deeply. The results are tabulated and graphically represented for a better understanding of the efficiencies as shown under:

It can be observed from Table 4.1 that, out of 12 public sector banks Punjab & Sind Bank, SBI and UCO Bank are benchmarked banks since all three banks showed consistent performance in all the three-quarters of the study period and have also shown zero percent variation in efficiency.

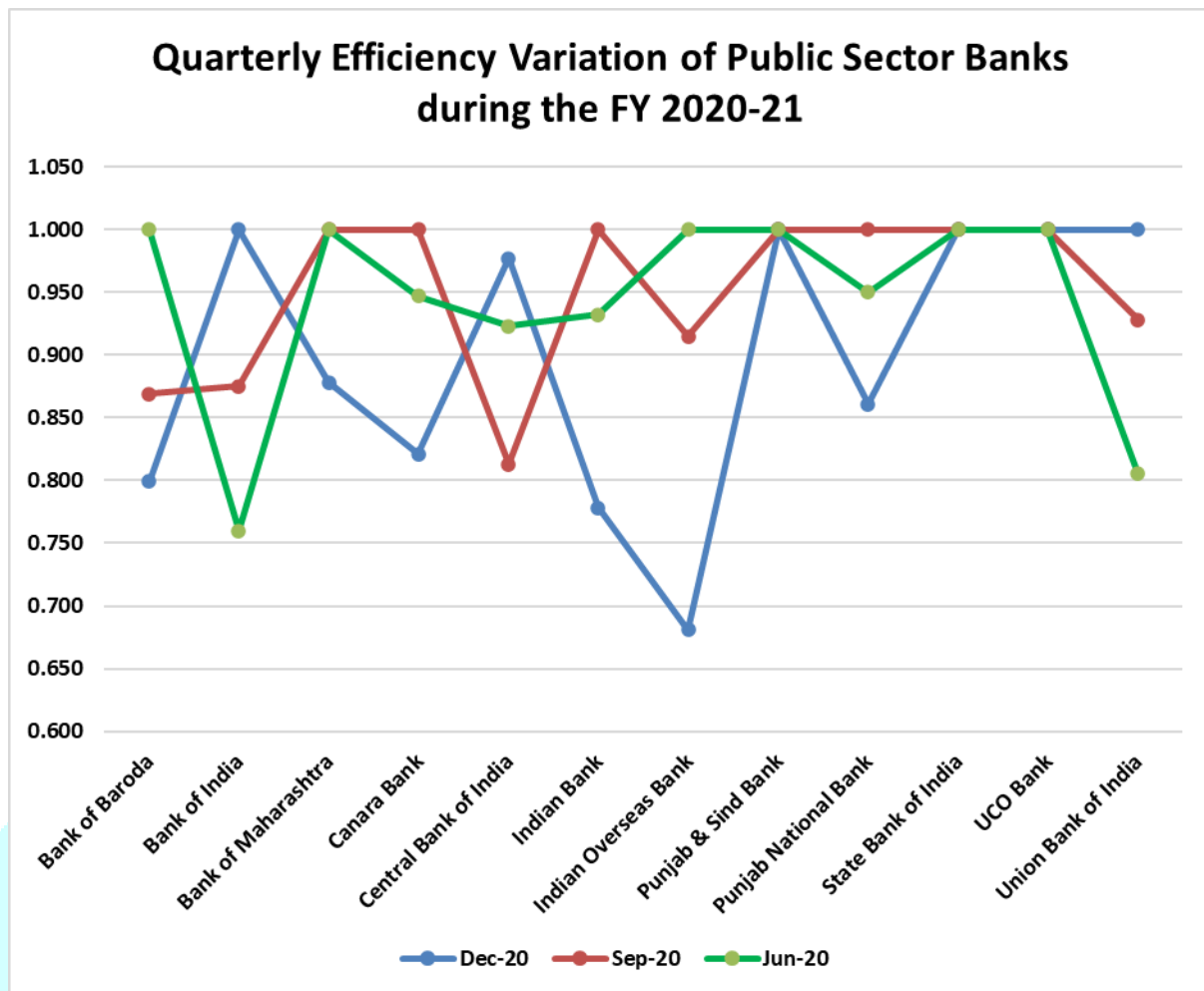
Table 4.1 Efficiency scores & Descriptive Statistics of banks for Q1, Q2, and Q3 of FY2020-21

Banks	Q3 Dec-20	Q2 Sep-20	Q1 Jun-20	Mean Efficiency	CV of Efficiency
Bank of Baroda	0.799	0.869	1.000	0.889	11.48
Bank of India	1.000	0.875	0.760	0.878	13.67
Bank of Maharashtra	0.878	1.000	1.000	0.959	7.34
Canara Bank	0.821	1.000	0.947	0.923	9.96
Central Bank of India	0.977	0.813	0.923	0.904	9.25
Indian Bank	0.778	1.000	0.932	0.903	12.60
Indian Overseas Bank	0.681	0.915	1.000	0.865	19.10
Punjab & Sind Bank	1.000	1.000	1.000	1.000	0.00
Punjab National Bank	0.861	1.000	0.950	0.937	7.51
State Bank of India	1.000	1.000	1.000	1.000	0.00
UCO Bank	1.000	1.000	1.000	1.000	0.00
Union Bank of India	1.000	0.928	0.805	0.911	10.82

The table also shows that Bank of Baroda, Bank of India, and Indian Overseas Bank are the least efficient among the 12 with mean efficiency in the last three-quarters at 0.889, 0.878, and 0.865 respectively. Hence it can be stated that they are only around 90% efficient relative to the other efficient banks mentioned above.

In addition, the coefficient of variation of efficiency of Indian Overseas Bank is the highest at about 19.10% indicating high degree of fluctuation and variation in the efficiency performance and low consistency, followed by Bank of India at 13.67% and Indian Bank at 12.60%.

Figure 4.1: Quarterly Efficiency Variation of Banks for Q1, Q2, and Q3 of FY 2020-21



From Table 4.2, the input levels (since input-oriented model is adopted) for each of the banks, termed as slacks in DEA can be assessed and analysed. With a view to raise the efficiency, the table results indicate that the banks should reduce their input-level to the suggested slack level.

Table 4.2: Input Slacks for Q1, Q2, and Q3 of FY 2020-21

Banks	Rank	Efficiency		Input Slacks		
		Score	% Efficiency	Total Expenses	Employee Expenses	Net NPAs
Bank of Baroda	10	0.889	88.90	79.102	4.767	0.000
Bank of India	11	0.878	87.80	0.556	30.085	0.000
Bank of Maharashtra	4	0.959	95.90	0.000	0.000	7.148
Canara Bank	6	0.923	92.30	4.952	74.425	0.000
Central Bank of India	8	0.904	90.40	2.840	195.245	0.000
Indian Bank	9	0.903	90.30	1.354	184.330	0.000
Indian Overseas Bank	12	0.865	86.50	0.096	0.000	0.000
Punjab & Sind Bank	1	1.000	100.00	0.000	0.000	0.000
Punjab National Bank	5	0.937	93.70	10.500	8.341	0.000
State Bank of India	1	1.000	100.00	0.000	0.000	0.000
UCO Bank	1	1.000	100.00	0.000	0.000	0.000
Union Bank of India	7	0.911	91.10	2.801	192.149	0.000

From Table 4.2, it is very evident that the major input slacks are suggested for Employee Expenses followed by Total Expenses, which should be interpreted as the major cause of inefficiency of banks. This can be due to the existence of increased employee expenses. The management should find ways to control the expenses, especially on its employees to the respective slack amount identified, which will make the banks efficient similar to existing efficient banks which are on the efficiency frontier.

V. CONCLUSION

The quarterly efficiencies of public sector banks in India after the merger in April 2020 were analysed for the recent three-quarters of FY 2020-21. The non-parametric approach of DEA was used for the analysis. All the 12 Public Sector Banks (referred to as DMUs) were considered for the study. From the results, it can be concluded that,

- Only 25% of the banks (Punjab & Sind Bank, State Bank of India, and UCO Bank) were consistent in their performance during the study period and they lie on the Efficient Frontier with an efficiency score of 1 in all three-quarters of the study. These banks can be regarded as the benchmark banks for other banks to emulate their practices.
- Out of the remaining banks, 66% of the banks were consistent with 90% efficient performance (their efficiency scores lie between 0.903 to 0.937). The remaining 33% of the banks were in the range of 0.865 to 0.889 scores.
- Target input levels for underperforming banks (the 75% of the banks with less than 1.000 efficiency score) have been suggested in terms of input slacks, specifically the Employee Expenses and Total Expenses, keeping highly efficient banks under study as benchmarks.

The contribution is a novel idea that demonstrates that an efficiently performing bank may not always remain efficient and vice versa and management have to keep a check on its performance on a continuous basis. The input slacks help the managers in giving direction for identifying the areas of optimization viz. minimization of inputs for efficient performance or efficiency improvement.

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