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Assessing the Financial Efficiency of Indian Banks during its Merger and Acquisitions using Data Envelopment Analysis Approach

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Abstract: Mergers and acquisitions (M&A) are a foundation stone of growth and market expansion for Indian banks, yet empirical evidence of their impact on technical efficiency remains mixed. This study utilises a non-parametric Data Envelopment Analysis (DEA) approach namely the Variable Return to Scale (VRS) model to evaluate the financial efficiency of four major Indian banks (State Bank of India, Kotak Mahindra Bank, Indian Overseas Bank, and ICICI Bank). By analyzing seven key performance metrics across a ten-year window (five years pre- and post-merger), the research identifies distinct efficiency trajectories. Results indicate that while private sector institutions and smaller public units like Indian Overseas Bank achieved efficiency stability (score of 1.0) following consolidation, the largest public entity, State Bank of India, experienced post-merger volatility and a marginal efficiency decline. These findings suggest that while M&A is an effective tool for stabilizing weak banks, large-scale public mergers face significant integration hurdles. This study provides vital insights for bank managers and policymakers on the necessity of proper post-merger monitoring to ensure long-term financial health.

Keywords: Merger and Acquisition, Indian Banking Sector, Data Envelopment Analysis, Financial Efficiency, Performance Evaluation

1. Introduction:

Recent years have witnessed a paradigm shift in the Indian banking environment, characterized by an increase in merger and acquisition (M&A) activity among the financial institutions. The M&A activities help the banks gain economies of scale, expand their market presence, and handle the intricacies of a constantly changing financial landscape. The main objectives instigating the merger and acquisitions plan is for gaining 'cost efficiency' by improving performance, increasing 'profit efficiency', and maximizing the shareholder's wealth. In such a scenario it becomes necessary to assess how M&A deals affect the banks' financial performance, a factor that is critical to maintaining stability and competitiveness over time. M&A has emerged as a crucial tool in recent years for improving a country's financial and economic standing globally. It gives businesses the synergy they need to meet the difficulties posed by heightened global competitiveness and rapidly expanding markets (Distler, 2018). The terms "merger" and "acquisition" are not the same but they are frequently used synonymously. (Scot, 2012) defined merger as "combination or consolidation of two or more companies, either the same size or different companies into one company". Merger can also be defined as the union of two or more businesses, each of which has the same number of shares and a clear function within the combined business (Snow, 2011). In a merger, two or more businesses come together to form a single business, but in an acquisition, a large, financially stable business buys out a smaller one (Georgios and Georgios, 2011).

In India, the banking industry has seen a sharp increase in mergers and acquisitions. This was evident in 2017 when State Bank of India acquired majority of the public sector banks, forcing other public banks, including Punjab National Bank and Bank of Baroda, to follow suit in order to meet the challenges. The primary goals of the Banks' going for mergers and acquisitions are to maximise the profit by reducing fierce competition and planning to achieve "cost efficiency" through improved performance. Current research on mergers and acquisitions' effects on bank efficiency paints a contradictory picture. According to several research,

there have been advances in cost reduction, income creation, and overall efficiency following mergers (Jagwani, 2012; Sufian, 2009). Some draw attention to possible hazards that could result in a drop in efficiency, such as difficulties integrating, conflicts between cultures, and the loss of synergies (Berger & Humphrey, 1992; Sufian, 2009). Notably, conventional econometric techniques are frequently used in this research, which may make it difficult to fully capture the intricate interactions among variables affecting bank efficiency following M&As.

This research gap highlights the need for a more sophisticated method to evaluate how M&As affect Indian banks. Using Data Envelopment Analysis (DEA), a non-parametric frontier technique that makes it easier to compare decision-making units (DMUs) based on their relative efficiency. In contrast to conventional techniques, DEA openly includes a variety of inputs and outputs into the analysis and does not make any constrictive assumptions about the production function. Because of this, it is especially appropriate for assessing the complex relationship between resource use, profitability, and risk management in banks.

The objectives of this study include measuring the efficiency in long term financial performance of acquiring banks under merger in Indian banking industry and to evaluate and compare the pre- merger and post-merger financial efficiency of acquiring banks.

1.1. Merger and Acquisition in Indian Banking Sector:

During last few decades, India's banking industry, which is a key contributor to the nation's economic expansion, has experienced a spectacular shift. The Indian banking industry has responded to the constantly shifting demands of the nation's population and economy by adapting and evolving from its modest origins in the 18th century to its current state as a sophisticated and diverse financial system. Banking in India can be traced back to ancient Indus Valley Civilization, where money lending and rudimentary forms of financial transactions existed. The first modern bank in Indian banking system was Bank of Hindustan opened for business in 1770 to assist the colonial authority in transferring funds. Consequently, the British East India Company's charter was used to establish the Bank of Bombay in 1840, the Bank of Calcutta in 1840, and the Bank of Madras in 1843. The first bank mergers in India occurred in 1921 when the Imperial Bank of India was formed by the combination of these four institutions (Dhameja and Arora, 2020). Following the Narasimha Committee's 1988 recommendation for mergers among strong banks, mergers and acquisitions have gained pace in India's banking industry (Rajamani & Ramkrishnan, 2015). One of the examples in recent times happened with merger of Vijaya Bank and Dena Bank with the Bank of Baroda, which came into effect on April 1, 2019, making Bank of Baroda the third largest bank and the second largest public sector bank in India (Kashyap, 2021). Bank mergers in India gained pace in 2000 when HDFC Bank Ltd acquired Times Bank Ltd. This was followed by the acquisitions of Bank of Madura by ICICI Bank (2001), ICICI Ltd by ICICI Bank (2002), IDBI by IDBI Bank Ltd (2004), Centurion Bank by Bank of Punjab (2005), Lord Krishna Bank by Centurion Bank (2006), Sangli Bank by ICICI Bank (2006), and Bharat Overseas Bank by Indian Overseas Bank (2007) (Source: RBI Publication). In addition, numerous voluntary bank mergers occurred in 2017 when SBI took over the majority of public sector banks, posing a challenge to other banks to adopt the M&A strategy in order to ensure survival and growth.

2. Literature Review

The most common inorganic growth technique utilized globally for firm consolidation and restructuring is mergers and acquisitions. A significant amount of research in the fields of strategic management and corporate finance has focused on the motivations behind M&A transactions. The wealth of shareholders is affected differently by M&A for different reasons. The recent times has seen many research activities in the field of M & A. The existing research paper also shows the impact of mergers and acquisitions on the performance of Indian banks, highlighting the ongoing debate on the subject (Smita and Pushpender, 2014; Naveen and Upadhyay, 2022). Many theories on market power, synergy, managerial effectiveness, economy of scale, production, and productivity development were supported by the majority of studies on the motivations behind M&A transactions between 1970 and 1980 (Chevalier & Redor, 2008). The study also shows that the performance of M&A is influenced by a number of elements, including firm size, age, leverage, profitability, culture, deal value, management control, operating activities, tax implications, and microeconomic conditions (Erdogan, 2012; Ismali and Krause, 2010). (Mousumi & Sarit, 2021) studied 28 bank mergers that are listed with the NSE in order to find the impact of

mergers and acquisitions on the stock price and financial performance of the acquiring banks. (Agarwal & Garg, 2022) looked at mergers that occurred during the fiscal years 2007–2008 and 2011–2012 to examined the effects of mergers and acquisitions on the accounting-based performance of acquiring enterprises in India. Using a comparison analysis and sample t test, they analyzed the liquidity, profitability, and solvency for three years prior to and following mergers. Their findings showed that while the liquidity and profitability positions had a substantial favorable impact, they did not have a significant impact on solvency. (Hassan, 2016) has observed that merger and acquisition of firms can increase synergy and can decrease the risk of solvency but merger and acquisition is not significant for the shareholders' wealth. (Lal Singla, 2015) studied six cases of merger occurred between 2000 and 2006 in the Indian Banking Sector. The observations include M&A is the useful tool for growth and expansion in the Indian banking sector. It is helpful for survival of weak banks by merging into larger bank but no guarantee to enhance the profitability, liquidity, efficiency and capital base.

Though many financial and accounting methods were employed to find the effect of M&A, the following section reviews the application of Data Envelopment Analysis (DEA) in the merger and acquisition studies.

2.1. Application of Data Envelopment Analysis (DEA) in Merger and Acquisition Studies:

(Kaur and Kaur, 2010) used DEA to study how mergers affected Indian commercial banks' cost- effectiveness. They noted that while the merging of stronger and financially troubled banks did not result in any appreciable efficiency benefits, the merger of merged institutions raised their degree of cost efficiency. Additionally, they believed that stronger banks shouldn't combine with smaller banks because doing so would negatively impact the stronger banks' asset quality. (Jayaraman et.al., 2014) investigated, the effectiveness and impact of Indian banks after mergers and acquisitions using DEA. Three years prior to and following the merger, the efficiency of the combined banks was compared in the study. They contrasted the efficiency of the combined banks with the efficiency of the separate banks in order to verify the efficiency. Interval estimation makes use of the efficient frontier. Using DEA, they discovered that while banks' technical efficiency declines right away following a merger, it improves after three years. Additionally, they discovered that there is little to no impact of mergers and acquisitions on the combined bank's profitability or operating expenses. (Rahman et.al., 2016) attempted to assess US commercial banking industry's post-merger marketing effectiveness. They used Data Envelopment Analysis (DEA) to quantify the efficiency utilising two input and two output variables through an empirical analysis of 20 M&A deals. They discovered that, regardless of the merged firm's size, mergers and acquisitions had a beneficial impact on its marketing effectiveness. (Henriques et al., 2018) carried out a study with DEA to assess bank efficiency in the Brazilian banking sector between 2012 and 2016. The study involved thirty-seven Brazilian banks and attempted to identify the root causes of the inefficiencies. The study involved CCR and BCC models, it was determined that measures aimed at encouraging the involvement of smaller banks in the sector could boost the industry's efficiency. (Shah et.al., 2019) assessed the productivity and performance of sustainable banks and made an effort to investigate the relevant practical concerns by supplying corroborating documentation. To assess sustainable bank performance and productivity over a nine-year period, they used DEA and MPI. The study revealed that sustainable banks exhibit higher levels of efficiency and productivity. It was also stated that internal and external factors have a significant influence on the productivity of both sustainable and non-sustainable banks. Using DEA, (Chiu et al. (2020) looked at the technical efficacy of 14 Taiwanese financial holding institutions between 2015 and 2019. To assess the technical efficiency, they employed the Resample Slack-Based Measure and Merger potential Gain model along with the premerger evaluation idea. They discovered benefits in efficiency both before and after the merger, but they also proposed that there would be no assurance that these gains would continue to support the business.

From the above discussion we find that there are numerous studies focusing on bank mergers and acquisitions, as well as comparisons between private and public banks. There is a dearth of research on mergers and acquisitions in the Indian banking sector utilising the DEA as research methodology tool, despite the fact that numerous studies on the subject employ the camel model and event study methodology. There isn't many research that use DEA to examine pre and post-merger conditions in relation to the financial performance and shareholder wealth of the Indian banking industry.

3. Research Methodology:

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In this study, based on market capitalization, four Indian bank mergers that occurred between 2006 and 2019 were included. Merger of the four banks has been taken for this study. State Bank of India, Kotak Mahindra Bank, Indian Overseas Bank and ICICI Bank have been chosen as the study's sample units. Using financial ratios such as the net profit margin ratio, asset yield, return on equity, return on assets, earnings per share, dividend per share, and profit per share, the research was conducted by analysing five years prior to and following the merger of the chosen public and private banks in India. The effect of M&A on the financial efficiency of the banks is being analysed by comparing their performance with five years before and five years after the merger. Data have been divided into two groups: pre- and post-merger group, according to each individual bank's merger period. If the merger was before the middle of financial year, then that financial year is considered as starting period for post-merger analysis and if the merger was after the middle of financial year, then that financial year is considered as pre-merger period (Ravichandran et al., 2010). Table-1. Below shows the different merger happened during the study period in Indian banks.

3.1. Data Description and Classification:

The study uses seven variables identified through the literatures considered. These variables reflect the financial health and performance of the banks. The DEA application requires the variables to classified into two categories viz. inputs and outputs. The table 2 below gives the variable description and classification.

Table 1: Description list of Indian Bank Mergers from 2006-2019

Sl.	Anchor Banks	Merged Banks	Date Of Merger	Headquarters
1	Bank of Baroda	Dena Bank Vijaya Bank	01-Jan-19	Vadodara
2	State Bank of India	State Bank of Bikaner and Jaipur State Bank of Hyderabad State Bank of Mysore State Bank of Patiala State Bank of Travencore	01-Apr-17	Mumbai
3	Kotak Mahindra Bank	ING Vysya Bank	20-Nov-14	Mumbai
4	ICICI Bank	Bank of Rajasthan Ltd.	23-May-10	Mumbai
5	HDFC Bank	Centurion Bank of Punjab	23-May-08	Mumbai
6	State Bank of India	State Bank of Saurashtra	13-Aug-08	Mumbai
7	ICICI Bank Ltd	Sangli Bank	19-Apr-07	Mumbai
8	Indian Overseas Bank	Bharat Overseas Bank	31-Mar-07	Chennai
9	IDBI Ltd	United Western Bank	03-Oct-06	Mumbai
10	Federal Bank	Ganesh Bank of Kurandwad	09-Jan-06	Kerala

Source: Compiled from various sources

Table-2: Data Description and Classification

Inputs	Definition	Output	Definition
Profit Margin	The percentage of profit on total income	Dividend/ share	Dividend distributed per share
Asset Yield	Ratio of interest received on relative assets	Net Profit/Share	Net profit per share.
Return on Asset	Ratio of net profit on total asset		
Return on Equity	Profit after tax on share holders' fund		
Earnings per Share	Return of profit to shareholders per share.		

Source: Compiled from various sources

3.2. Data Envelopment Analysis:

The basic concept of Data Envelopment Analysis (DEA) can be traced back to the traditional efficiency measurement techniques through the seminal work of M.J. Farrell (Farrell, 1957). The first DEA model developed by Charnes Cooper and Rhodes (Charnes et al

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,1978). Since DEA is a technical efficiency measurement technique, we discuss below briefly the concept of efficiency.

The efficiency can be defined as the ratio of output to the input i.e.

$$\boldsymbol{Efficiency} = \frac{\boldsymbol{Output}}{\boldsymbol{Input}} \qquad (\mathbf{1})$$

Using the above concept, evaluating a unit's efficiency when there are several inputs and outputs

becomes challenging. If there is a complex relationship and uncertain tradeoff between the inputs and outputs, the problem gets more challenging. Such circumstances frequently arise in real-world problems. The "weighted cost approach" provided by can be used to determine the efficiency score when there are several input and output sources.

$$\boldsymbol{Efficiency} = \frac{\textbf{weighted sum } \boldsymbol{Output}}{\textbf{weighted sum } \boldsymbol{Input}} \qquad (\mathbf{2})$$

The problem with this is that it assumes that all the weights are uniform. Mathematically equation

(2) can be expressed as

$$\boldsymbol{Efficiency} = \frac{\sum_{r=1}^{n} \boldsymbol{u_r y_r}}{\sum_{i=1}^{m} \boldsymbol{v_i x_i}}$$

Where, u_r = weight attached to r;

y_r = quantity of output r;

x_r = quantity of input i;

v_r = weight attached to input i

A value equal to unity implies complete efficiency. The weights are specific to each unit so that:

0 < Efficiency ≤ 1.

Data Envelopment Analysis (DEA) is an approach for comparing the relative efficiency of Decision-Making Units (DMUs) such as schools, hospitals, libraries, banks etc. (Kleine, 2004). The DMUs under investigation often have a vector with numerous inputs and several outputs. Direct comparison of DMUs is therefore typically challenging. DEA uses fractional and equivalent linear programmes (as well as their duals) to measure the relative performance of DMUs in order to compute data regarding input and output quantities (Charnes et.al., 1994). The first DEA model was developed by Charnes Cooper and Rhodes (CCR) (Charnes et.al., 1978). The detailed reviews of the methodology are presented by Seiford and Thrall, Ali and Seiford, Charnes et al, Norman and Stoker (Seiford et.al., 1990; Norman & Stocker; 1991, Seiford, 1996).

The ratio methodology, which is employed in conventional efficiency measurement methods, is expanded upon by the CCR model. Any DMU's efficiency can be calculated as the maximum of the weighted output to weighted input ratio, provided that comparable ratios for each DMU must be less than or equal to unity.

The CCR model can be given as

$$\begin{aligned} \max h_{j_0}(\boldsymbol{u},\boldsymbol{v}) = \frac{\sum_{r=1}^{s} \boldsymbol{u_r y_{rj_0}}}{\sum_{i=1}^{m} \boldsymbol{v_i x_{ij_0}}} &\sum_{r=1}^{s} \boldsymbol{u_r y_{rj}} - \sum_{i=1}^{m} \boldsymbol{v_i x_{ij}} \\ &\leq \mathbf{0} \quad \boldsymbol{j} \\ &= \mathbf{1}, \mathbf{2}, \dots, \boldsymbol{n} \qquad (\mathbf{4}) \\ \boldsymbol{u_r}, \boldsymbol{v_i} &\geq \mathbf{0} \; \forall \; \boldsymbol{r}, \boldsymbol{i} \end{aligned}$$

The variables of the above problem are the weights and the solution produces the weights most favorable to unit j_0 and also produces a measure of efficiency. The decision variables u = (u_1, u_2, ..., u_r, ..., u_s) and v = (v_1, v_2, ..., v_i, ..., v_m) are respectively the weights given to the s outputs and to the m inputs.

The numerator of the objective function in (4) is the weighted sum of the output and the denominator is the weighted sum of input for j_0 DMU respectively. In the constraint part we write the difference of weighted sum of output and weighted sum of input one by one for all the n DMUs. To obtain the relative efficiencies of all the units, the model is solved n times, for one unit at a time.

The CCR model makes a constant return to scale (CRS) assumption. This is appropriate when all the DMUs are operating at an optimal scale. Imperfect competition, constraints on finance etc. may cause a DMU to be not operating at optimal scale. Banker, Charnes, Cooper (Banker, Charnes & Cooper, 1984) suggested an extension of the CRS DEA model to account of Variable Return to Scale (VRS) situations. The way returns to scale are handled in the BCC and CCR models differs primarily from one another. Constant returns to scale serve as the evaluation basis for the CCR version. Variable returns to scale are permitted in the more adaptable BCC version. The BCC model which uses variable returns to scale (VRS) is shown as follows.

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$$\min \theta$$

$$subject\ to \sum_{i=1}^{n} \lambda_i x_{ji} - \theta x_{jj_0} \leq 0 \forall j \sum_{i=1}^{n} \lambda_i y_{rj} - y_{jj_0} \geq 0\ \forall k \qquad (5)$$

$$\lambda_i \geq 0\ \forall\ i$$

$$\sum \lambda_i = 1$$

$$where\ \theta = Efficiency\ Score$$

$$\lambda_s = Dual\ Variable$$

The fact that the λ_j' s are now limited to summing to one distinguishes the BCC model (model 5) from the CCR model (model 4). This has the consequence of removing the requirement for scale efficiency in DMUs from the CCR model. As a result, the BCC model just evaluates each DMU's technical efficiency and permits varying returns to scale. In other words, a DMU needs to be both technically and scale efficient in order to qualify as CCR efficient. A DMU merely needs to be technically efficient in order to qualify as BCC efficient. The paper uses BCC model as suggested in equation no. 5 to compute the efficiency.

4. Data Analysis and Interpretation:

Along with DEA approach, different financial ratios are used for the study. The ratios used are net profit margin ratio, Earning Per Share (EPS), Return on Equity (ROE), Return on Assets (ROA), asset yield ration, dividend per share and profit per share. These ratios are computed from the financial statements of the banks under study.

Researchers conducted this study to measure the impact of merger on efficiency enhancement on financial performance of acquiring banks in post-merger period. For this objective, the Hypothesis that is taken is "there is no change in efficiency on financial performance of anchor bank in post- merger period as compared to pre-merger period".

4.1. Efficiency Analysis of State Bank of India (SBI)

Table 3: Dataset of State Bank of India (SBI)

Variables	Pre-Merger					Post-Merger				
	2013	20	20	20	20	20	20	20	20	20
Profit Margin	11.78	7.98	8.59	6.06	5.97	-2.19	0.35	5.65	7.69	11.49
Asset Yield	8.65	8.63	8.54	8.13	7.79	7.67	7.54	7.65	6.79	6.33
ROA	0.9	0.6	0.63	0.42	0.38	-0.18	0.02	0.36	0.45	0.63
ROE	14.26	9.2	10.2	6.89	6.69	-3.37	0.39	6.95	8.86	12.33
EPS	222.86	16.37	19.04	15.01	16.02	-4.07	0.97	19.94	26.59	39.13
Dividend per Share	41.5	3	3.5	2.6	2.6	0	0	0	4	7.1
Net Profit/Share	206.2	14.59	17.55	12.82	13.15	-7.34	0.97	16.23	22.87	35.49

Table 4: Descriptive Statistics on Input/Output Data (SBI)

		Profit Margin	Asset Yield	Return on Asset	Return on Equity	Earnings per Share	Dividend per share	Net Profit/ Share	Score
MEAN	Pre-Merger	8.08	8.35	0.59	9.45	57.86	10.64	52.86	0.97
	Post-Merger	4.60	7.20	0.26	5.03	16.51	2.22	13.64	0.96

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STDEV	**Pre-Merger**	2.37	0.38	0.21	3.08	92.25	17.26	85.74	0.04
	Post-Merger	5.53	0.60	0.33	6.40	17.96	3.23	17.10	0.06

The Table-4 shows the descriptive statistics of State Bank of India. It's noted that the dividend per share and net profit per share, the two outputs considered in the study is coming down post-merger. The similar observation is made for all the input variables under study.

The efficiency score of SBI over the period of ten years is calculated using VRS model. The five- year pre-merger period is 2013 to 2017 and the five-year post-merger period is from 2018 to 2022. The table 5 shows the efficiency score for pre-merger and the post-merger period from 2013 to 2022.

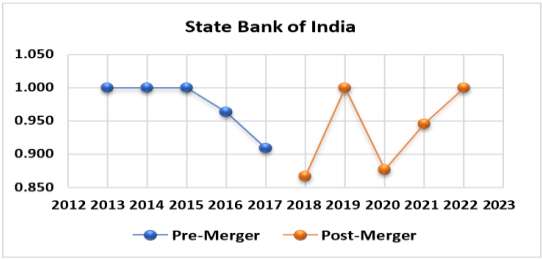
Table 5: Efficiency Score of State Bank of India

	Year	Efficiency Score		Year	Efficiency Score
Pre-Merger	2013	1.000	Post-Merger	2018	0.867
	2014	1.000		2019	1.000
	2015	1.000		2020	0.877
	2016	0.963		2021	0.946
	2017	0.909		2022	1.000

The table-5, indicates that the unit was efficient for the period 2013-2015 and then become inefficient prior to the merger. The post-merger the efficiency score is fluctuating. The SBI has become efficient unit in the year 2019 and the year 2022. The table-4 shows that there is marginal decrease in efficiency score post-merger case.

The figure 1. Below shows the efficiency score plot in two segments i.e. pre-merger and post- merger. We can see fluctuation in the efficiency score during the post-merger period.

Figure 1: Efficiency Score of SBI



The figure-1, shows the efficiency score plot of SBI Bank during the pre-merger and post-merger period. It may be noted that there is a fall in efficiency score during the pre-merger period i.e. during the year 2015 to 2017. During the post-merger period the efficiency score is fluctuating, which is fluctuations the score of 1.

Efficiency Analysis of Kotak Mahindra

Table 6: Dataset of Kotak Mahindra Bank

Variables	**Pre-Merger**					**Post-Merger**				
	2011	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Profit Margin	19.52	17.55	16.91	17.13	19.19	12.75	19.27	20.68	20.32	20.68
Asset Yield	9.76	10.89	10.98	11.59	11.07	9.887	9.886	8.997	9.133	8.996
ROA	1.6	1.665	1.662	1.771	1.776	1.108	1.558	1.554	1.555	1.665
ROE	11.97	13.59	1.662	12.23	13.19	8.772	12.35	10.89	11.47	12.25
EPS	12.44	16.23	20	21.65	26.66	12.96	20.11	23.02	27.41	33.03
Dividend per	0.5	0.6	0.7	0.8	0.9	0.5	0.6	0.7	0.8	0.0

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share										
Net Profit / Share	11.1	14.65	18.23	19.51	24.16	11.39	18.53	21.43	25.49	31.09

Table 7: Statistics on Input/Output Data (Kotak Mahindra)

		Profit Margin	Asset Yield	Return on Asset	Return on Equity	Earnings per Share	Dividend per share	Net Profit / Share	Score
MEAN	Pre-Merger	18.06	10.86	1.67	10.52	19.40	0.70	17.53	1.00
	Post-Merger	18.74	9.36	1.48	11.14	23.31	0.52	21.59	1.00
STDEV	Pre-Merger	1.21	0.67	0.07	5.02	5.40	0.16	4.95	0.00
	Post-Merger	3.40	0.47	0.23	1.48	7.56	0.31	7.40	0.00

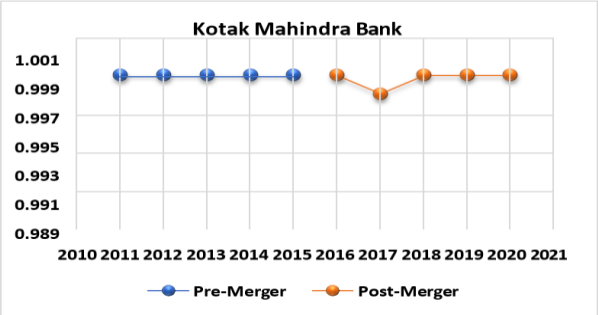
The Table 7 shows the descriptive statistics of Kotak Mahindra. It's noted that unlike SBI the important output net profit/share is increasing during the post-merger scenario. However, the other output dividend/share has gone down marginally. The inputs viz. profit margin, return on equity and earnings per share has also gone up during the post-merger period. From table 7, it is observed that there is no significant change in efficiency score during the pre- merger and post-merger case.

The table-8, shows the efficiency score during five-year pre-merger period i.e. from 2011 to 2015 and five-year post-merger period i.e. from 2016 to 2020. It is interesting to see that this banking unit was efficient throughout the pre-merger study period from 2011 to 2015. The efficiency during the post-merger is observed to be efficient for all the post-merger period from 2016 to 2020 excepting for the year 2019. Even for the year 2019 the efficiency score is almost nearing unity.

Table 8: Efficiency Score of Kotak Mahindra

	Year	Efficiency Score		Year	Efficiency Score
Pre-Merger	2011	1.000	Post-Merger	2016	1.000
	2012	1.000		2017	0.999
	2013	1.000		2018	1.000
	2014	1.000		2019	1.000
	2015	1.000		2020	1.000

Figure 2: Efficiency Score of Kotak Mahindra



The figure 2, shows the plot of efficiency score for the pre-merger and post-merger period. The graph shows that the efficiency score of Kotak Mahindra remains nearly un effected in the pre- merger and post-merger with a fall of 0.001 in the year 2017 i.e. post-merger year.

4.2. Efficiency Analysis of Indian Overseas Bank (IOB)

Table 9: Dataset of Indian Overseas Bank (IOB)

Variables	Pre-Merger					Post-Merger				
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Profit Margin	10.38	11.40	13.71	15.25	19.25	16.18	13.94	11.87	06.14	08.04
Asset Yield	09.70	09.55	09.34	08.77	08.37	08.61	07.25	06.27	08.44	08.90

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ROA	01.01	01.08	01.28	01.32	01.36	01.27	01.17	00.53	00.59	00.47
ROE	27.73	34.18	52.22	43.42	28.52	25.97	25.35	22.31	11.13	13.13
EPS	09.35	10.40	11.96	14.38	18.51	14.18	24.34	12.98	19.03	14.57
Dividend per share	01.75	02.50	02.00	04.38	05.60	06.45	07.45	06.95	05.00	04.50
Net Profit/Share	09.35	09.41	08.34	07.83	10.08	12.30	14.50	15.78	17.33	13.18

Table 10: Statistics on Input/Output Data (Indian Overseas Bank)

		Profit Margin	Asset Yield	Return on Asset	Return on Equity	Earnings per Share	Dividend per share	Net Profit/ Share	Score
MEAN	Pre-Merger	14.00	9.15	1.21	37.21	12.92	3.25	9.00	0.77
	Post-Merger	11.23	7.89	0.81	19.58	17.02	6.07	14.62	0.98
STDEV	Pre-Merger	3.50	0.56	0.16	10.47	3.65	1.67	0.90	0.16
	Post-Merger	4.13	1.10	0.38	6.97	4.69	1.27	2.01	0.04

The Table-10, shows the descriptive statistics of Indian Overseas Bank (IOB). It's observed that the both the output, dividend per share and net profit per share has shown significant increase during the post-merger period. It is interesting to note that the other variables like profit margin, asset yield, return on asset, return on equity all has gone down during the post-merger period, but the earnings per share have gone up. It can also be observed that the average efficiency score of IOB has gone up during the post-merger period.

Table 11: Efficiency Score of Indian Overseas Bank

	Year	Efficiency Score		Year	Efficiency Score
Pre-Merger	2003	1.000	Post-Merger	2008	0.921
	2004	0.839		2009	1.000
	2005	0.597		2010	1.000
	2006	0.625		2011	1.000
	2007	0.778		2012	1.000

The table-11 shows the efficiency score of IOB for the pre-merger period of 2003 to 2007 and post-merger period of 2008 to 2012. It may be observed that the bank was not operating in an efficient way during the pre-merger period. The efficiency of IOB has gone up during the post- merger period, and the unit is operating with highest efficiency score of 1 from the year 2009 onwards i.e. post-merger period. This indicates that the efficiency score of Indian Overseas pre- merger was unstable whereas the post-merger resulted in stability in efficiency of Indian Overseas Bank.

Figure 3: Efficiency Score of Indian Overseas Bank

The figure-3, shows that the efficiency score plot of Indian Overseas Bank. Prior to merger it was below 1. However, after 1 years after the merger, the efficiency score became 1 and remains stable. This indicates the positive impact of merger in the bank increasing the performance efficiency.

Efficiency Analysis of ICICI Bank

Table 12: Data set for the ICICI Bank

Variables	Pre-Merger					Post-Merger				
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Profit	12.	16.	21.3	18.	13.	13.5	10.8	14.	16.	19.

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Margin	06	37		42	52			27	68	87
Asset Yield	11	10	8.1	8	8.5	9.4	9.1	7.9	11.53	11.02
ROA	1.1	1.4	1.4	1.3	1.1	1.1	0.7	0.86	1.14	1.26
ROE	18.3	21.8	17.9	16.4	13.41	11.1	7.53	8.28	11.01	12.47
EPS	19.68	26.66	27.55	32.49	34.59	37.59	33.78	36.14	61.28	74.68
Dividend per share	4.6	5.44	6.33	7.59	10.2	11.03	12.25	13.38	14	16.5
Net Profit/Share	6.76	7.01	7.06	8.45	9.01	12.28	24.62	34.2	54.85	68.68

The Table-13, shows the descriptive statistics of ICICI Bank. It's noted that the dividend per share and net profit per share, the output considered for the study has gone up during the post-merger period. It is interesting to see that the net profit per share has increased by more than five times in the post-merger period. The other parameters like profit margin, asset yield, return on equity and earnings per share has increased post-merger for the ICICI bank. It is interesting to see that the earning per share has increased more than two times on an average during the post-merger period. However, on an average the return on asset has reduced drastically during post-merger period.

Table 13: Statistics on Input/Output Data (ICICI Bank)

		Profit Margin	Asset Yield	Return on Asset	Return on Equity	Earnings per Share	Dividend per share	Net Profit/ Share	Score
MEAN	**Pre-Merger**	15.51	8.62	11.95	11.16	32.35	10.12	12.28	0.93
	Post-Merger	19.40	10.41	1.36	12.03	74.54	17.38	69.34	1.00
STDEV	**Pre-Merger**	4.25	0.61	6.69	3.15	4.34	1.60	7.16	0.10
	Post-Merger	3.92	1.44	0.16	2.49	27.73	4.08	26.44	0.00

Table 14: Efficiency Score of ICICI Bank

	Year	Efficiency Score		Year	Efficiency Score
Pre-Merger	2005	1.000	Post-Merger	2010	1.000
	2006	1.000		2011	1.000
	2007	0.809		2012	1.000
	2008	0.827		2013	1.000
	2009	1.000		2014	1.000

The table-14 shows the efficiency score of ICICI bank during the pre-merger period of 2005 to 2009 and post-merger period of 2010 to 2014. It may be observed here that the efficiency score is fluctuating during the pre - merger period but during the post-merger period the ICICI bank is performing consistently well with efficiency score of 1.

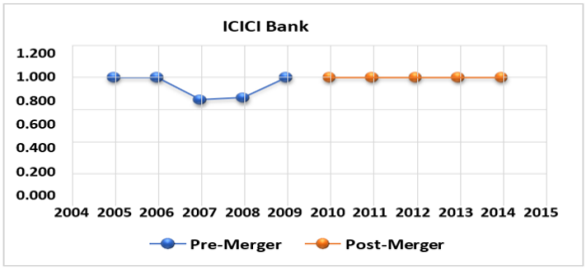

Figure 4: Efficiency Score of ICICI Bank

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The figure-4, shows the efficiency score plot of ICICI Bank during the pre-merger and post-merger period. It may be noted that there is a fall in efficiency score during the pre-merger period i.e. during the year 2007 and 2008. During the post-merger period the efficiency score is consistent, without any fluctuations with highest possible score of 1.

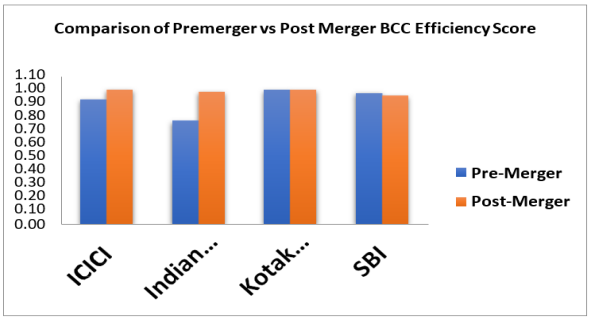
Efficiency Analysis of all banks:

The table-15, shows the efficiency score for the pre-merger period and the post-merger period for all the four banks under study. The study above leads us to the conclusion that every merger affects banks in some way, both favorably and unfavorably. The efficiency score of Kotak Mahindra Bank is almost identical before and after the merger. The efficiency score of SBI has come down during the post-merger period. The post-merger efficiency score of Indian Overseas Bank and ICICI Bank is higher than the pre-merger score. Only four Indian bank mergers make up the sample size, and the data collection period was ten years, comprising five years of pre-merger and five years of post-merger data, respectively. This may be a short time period. The outcomes may vary if a longer time period is used for the analysis.

Table 15: Efficiency Score of all Banks

	ICICI	Indian Overseas	Kotak Mahindra	SBI
Pre-Merger	0.927	0.768	1.000	0.974
Post-Merger	1.000	0.984	1.000	0.956

Figure 5: Efficiency Score of all Bank



The figure-5 shows the efficiency plot of all the four banks under study in a comparative way for the pre-merger and post-merger period. We can observe that the efficiency score of three out of four banks has increased post-merger. The efficiency score of only one bank has come down post- merger. This may be a positive pointer in favor of merger of Indian banks.

4.5.1 Sector-wise Efficiency Comparison: Public vs. Private Sector Banks

A comparative analysis reveals a distinct trend between public and private sector units following their respective mergers.

Private Sector Banks (Kotak Mahindra & ICICI): Both banks demonstrated high resilience and efficiency. Kotak Mahindra remained consistently efficient with a score near 1.0 throughout the study, while ICICI Bank achieved a perfect stable efficiency score of 1.0 immediately following its merger.

Public Sector Banks (SBI & IOB): The results for public banks were more varied. While Indian Overseas Bank (IOB) successfully utilized the merger to stabilize its operations and reach a peak efficiency score of 1.0, State Bank of India (SBI) faced significant post-merger fluctuations and a marginal decline in its overall efficiency score.

5. Conclusion

The paper did a comprehensive analysis of the financial efficiency of selected Indian banks during periods of mergers and acquisitions, using the Data Envelopment Analysis (DEA) approach. Our investigation sought to shed light on the impact of these strategic endeavors on the overall performance and efficiency of the banking sector. The DEA approach suggests that the efficiency dynamics of the sampled banks varied across the study period. The findings imply that while some banks may have had difficulties reaching comparable results, others may have been able to successfully increase their financial efficiency following the merger. The paper examines the key performance metrics viz. Profit Margin, Asset Yield, Return on Asset, Return on Equity, Earnings per Share, Dividend per share and Net Profit/Share, and distinguished the patterns indicative of the multifaceted nature of mergers and acquisitions in the banking sector. The paper observes that the dividend per share and net profit per share, the two outputs considered in the study is coming down post-merger for SBI. The similar observation is made for all the input variables under study for SBI. For the, Kotak Mahindra the important output net profit/share is increasing but the other output dividend/share has gone down marginally during the post-merger scenario. However, the inputs viz. profit margin, return on equity and earnings per share

has also gone up during the post- merger period for Kotak Mahindra. It's observed that for IOB, both the output, dividend per share and net profit per share has shown significant increase during the post-merger period. It's noteworthy to notice that while earnings per share have increased over the post-merger period, other factors like profit margin, asset yield, return on equity, and return on asset have all decreased. For, the ICICI Bank over the post-merger period, the dividend per share and net profit per share have increased. Following the merger, the ICICI bank's other metrics, including as profit margin, asset yield, return on equity, and earnings per share, also increased. Kotak Mahindra Bank's efficiency rating was nearly the same before and after the merger. There has been a decline in SBI's efficiency score since the merger. Indian Overseas Bank and ICICI Bank both have greater post- merger efficiency scores than pre-merger scores.

The study concludes that ownership structure influences merger outcomes. Private sector banks (ICICI and Kotak Mahindra) showed seamless efficiency maintenance or growth. Conversely, public sector results were mixed; while mergers stabilized weaker units like IOB, they introduced temporary efficiency stresses for larger entities like SBI.

6. Managerial Implications and Future Scope of the Study

The study uses DEA as a methodology to assess the impact of merger and acquisition in Indian banking sector through the study of selected Indian banks. The study can be very useful for the managers involved in the decision-making processes of mergers and acquisitions. Understanding the key factors that influence financial efficiency post-merger can guide the strategic decisions. The managers shall ensure that the integration process addresses critical aspects contributing towards the financial health of the banking sector. Continuous monitoring of the variables under the study can provide insights into the success of integration efforts and helps in identifying areas that may require adjustments or improvements. The study can help the managers in setting up a robust and reliable monitoring mechanism to track the effectiveness of the integration operations. They shall also be adaptable when it comes to changing plans in response to continuing evaluations. The findings of this study can provide an insight for managerial decision-making in the context of mergers and acquisitions in the Indian banking sector.

The present study attempts to throw light on Indian banks' immediate post-merger financial efficiency, a thorough study to understand the long-term effects can be very helpful. The long term study can broaden the scope of the analysis will be useful in doing the scrutiny of long-term enhancements in efficiency and possible obstacles that might emerge in the aftermath of mergers and acquisitions. The main focus of this study are operational efficiency and financial measures. Subsequent investigations may examine the effects of mergers and acquisitions on stakeholder perceptions and customer satisfaction. The future study may also consider the qualitative factors which may get affected by the merger and acquisition in Indian banking sector like cultural integration, impact on employee morale, human dynamics, organizational culture etc. Now a days lot of emphasis is given on ESG considerations in the business world. The future study may look into the way how mergers and acquisitions impact environmental, social, and governance metrics.

References:

1. Agarwal, P. & Garg, S. (2022). Impact of Mergers and Acquisitions on Accounting – based Performance of Acquiring firms in India. Global Business Review, 23(1), 218-236.
2. Banker, R.D., A. Charnes, and W.W. Cooper. 1984, "Some models for estimating technical and scale inefficiencies in data envelopment analysis." Management Science. Vol. 30, No. 9, pp. 1078 - 1092.
3. Berger, A. P. & Humphrey, D. B. (1992). Efficiency of financial institutions: Past, present, and future. Journal of Banking and Finance, 16(2), 369-399.
4. Charnes A, Cooper W W, Lewin A Y, Seiford L M, (1994), Data envelopment Analysis, Dordrecht, Kluwer.
5. Charnes A., Cooper W W, Rhodes E. (1978). Measuring the efficiency of decision-making units. European Journal of Operations Research. Vol. 2, pp. 429 - 444.
6. Chevalier, A., & Redor, E. (2008). The choice of payment method in mergers and acquisitions. Hand book of Financial Engineering, (385-430). Springer, Boston, MA.
7. Chiu, Y., Lin, T., Chang, T., Lin, Y., & Chiu, S. (2020). Pre-valuating efficiency gains from

potential mergers and acquisitions in the financial industry with the resample past-present-future data envelopment analysis approach. Managerial and Decisions Economics, 42 (2), 369-384.

8. Dhameja L Nand and Arora Shilpa. (2020). Banking in India: Evolution, Performance, Growth and Future, Indian Journal of Public Administration, pp. 1-15, DOI: 10.1177/0019556120953711
9. Distler, J. (2018). Acquisitions by Emerging Multinational Corporations. Dubai, United Arab Emirates: Springer Gabler
10. Erdogan, A. I. (2012). The determinants of mergers and acquisitions: Evidence from Turkey. International Journal of Econometrics and Finance, 27(2), 149 -176.
11. Farrell, M.J. (1957). The measurement of productive efficiency. Journal of Royal Statistical Society. Vol-120, Part III, pp.1, 254 - 290.
12. Georgios, K., & Georgios, H. (2011). Du Pont Analysis of a Bank Merger and Acquisition between Laiki Bank from Cyprus and Marfin Investment Group from Greece. Is there an increase of profitability of the new bank? Kyriazopoulos - Hadjimanolis, MIBES 2011 – Oral,157-176.
13. Hassan, A. (2016). Analysis of Factors Causing Merger and Acquisition: Case Study of Banking Sector in Pakistan. IBT Journal of Business Studies,12(1), 328–346. https://doi.org/10.46745/ilma.jbs.2016.12.01.19
14. Henriques, C., Sobreiro, V. A., Kimura, H., and Mariano, E. B. (2018). Efficiency in the Brazilian banking system using data envelopment analysis. Future Business Journal, 4(2), 157 – 178.
15. Ismali, A., & Krause, A. (2010). Determinants of the method of payment in mergers and acquisitions. The Quarterly Review of Economics and Finance, 50(4), 471 -484.
16. Jagwani, B. (2012). Efficiency measurement in the Indian banking industry: An application of Data Envelopment Analysis. Vision, 16(4), 40-48.
17. Jayaraman, A.R., Srivasan, M.R., & Arunachalam, R. (2014). Impact of mergers and acquisition on the efficiency of Indian banks: a pre-post analysis using data envelopment analysis. Journal of Financial service management, 7(1), 1-18.
18. Kashyap, Chetan. (2021). Merger and Acquisition in Indian Banking Sector: A Case Study of Bank of Baroda (December 8, 2021). Available at SSRN: https://ssrn.com/abstract=3980653 or http://dx.doi.org/10.2139/ssrn.3980653
19. Kaur, P. and Kaur, G. (2010). Impact of mergers on the cost efficiency of Indian commercial banks, Eurasian Journal of Business and Economics, Vol. 3, No. 5, pp.27–50.
20. Kleine (2004). A general model framework for DEA, Omega, The International Journal of Management Science, Omega 32, 17-23.
21. Lal Singla Madan. (2015). Merger and Acquisition in Indian Banking Industry. International Journal of Research in Management, 662(4), 77–94.
22. Mousumi, B. & Sarit, B. (2021). Mergers and Acquisition and Value Creation: A Banking Industry Perspective. IUP Journal of Accounting Research and Audit Practices, 20(4), 32-46.
23. Naveen K. Kumar and Upadhyay Manali (2022). A Study on Mergers and Acquisitions In Indian Services Industry- With Special Reference to Banking Companies, International Journal of multidisciplinary Educational ResearchVol:11, Iss:4(6), pp.34-46
24. Norman M, and Stoker B, 1991, Data Envelopment Analysis: An assessment of Performance, Wiley.
25. Rahman, A., Lambkin, M., & Hussain, D. (2016). Value Creation and appropriation following M&A: A data envelopment analysis. Journal of Business Research, 69 (12), 5628-5635.
26. Rajamani, M., & Ramakrishnan, P. R. (2015). A Study on Impact of Merger of Centurian Bank of Punjab on the Financial Performance of HDFC Bank. IOSR Journal of Humanities and Social Science, 20(5), 28–31.
27. Ravichandran, K, Fauzias, M. N and Rasidah, M.S. (2010). Market based mergers in Indian banking institutions, International Research Journal of Finance and Economics, Vol. 37, pp.30–39.
28. Scott DL. (2012). Wall Street Words: An A to Z Guide to Investment Terms for Today's Investor
29. Seiford L M, Thrall R M, 1990, Recent Developments in DEA: The Mathematical Approach to frontier Analysis, Journal of

Econometrics- 46,7-38.

30. Seiford LM, 1996, Data Envelopment Analysis: The Evolution of the State of the Art (1978- 1995), Journal of Productivity Analysis, 7, 99-138.
31. Shah, A. A., Wu, D., & Korotkov, V. (2019). Are Sustainable Banks Efficient and Productive? A data Envelopment Analysis and Malmquist Productivity Index Analysis. Sustainability, 11(8), 2398.
32. Smita Meena, Pushpender Kumar. (2014). Mergers and Acquisitions Prospects: Indian Banks Study, International Journal of Recent Research in Commerce Economics and Management (IJRRCEM), Vol. 1, Issue 3, pp: 10-17.
33. Snow B. (2011). Merger and Acquisition for Dummies, Canada. Wiley Publishing Inc.
34. Sufian, F. (2009). Determinants of bank efficiency during unstable macroeconomic environment: Empirical evidence from Malaysia. Research in International Business and Finance, 23(1), 54-77.