

**AN ANALYSIS OF PROFITABILITY AND  
MARKETABILITY EFFICIENCIES OF INDIAN BANKS  
DURING COVID-19 (2018–2022)**

**Course of Independent Study Report**

Submitted by

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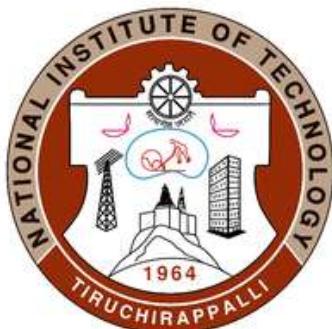
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**MAY 2025**

## **INSTITUTE BONAFIDE CERTIFICATE**

This bonafide is to certify that the project entitled "**AN ANALYSIS OF PROFITABILITY AND MARKETABILITY EFFICIENCIES OF INDIAN BANKS DURING COVID-19 (2018–2022)**" is a bonafide record of the work done by **SREERAG K (215123082)** in partial fulfilment for the award of **MASTER OF BUSINESS ADMINISTRATION** in **DEPARTMENT OF MANAGEMENT STUDIES**, National Institute of Technology, Trichy, during the year 2023-2025.

I declare that I have carried out the work presented in the report and that I have not submitted the results in any form previously for the award of any degree or diploma.

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## **ACKNOWLEDGEMENT**

I would like to express my sincere gratitude to my project guide, Dr. B Senthil Arasu, Head of the Department in the Department of Management Studies at the National Institute of Technology, Tiruchirappalli. His expertise and guidance were instrumental in shaping this project and enhancing my understanding of the subject matter.

I am extremely thankful to express my sincere gratitude and appreciation to Mr. Udayakumar Thiyagarajan for unwavering support, guidance and feedback throughout the research period.

I also express my sincere gratitude and appreciation to all those who contributed to the completion of my CIS Project.

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## **ABSTRACT**

This study investigates the profitability and marketability efficiencies of Indian public and private sector banks over the period 2018 to 2022, with a special focus on the impact of the COVID-19 pandemic. Using the two-stage Data Envelopment Analysis (DEA) model, the research evaluates banks' internal performance (profitability) and their external market recognition (marketability), adopting a methodology originally proposed by Seiford and Zhu (1999). The study further utilizes the BCG Matrix to classify banks into strategic quadrants-Stars, Cows, Sleepers, and Dogs-based on their efficiency scores.

The results reveal that private sector banks consistently outperform public sector banks in both profitability and marketability dimensions. While profitability efficiency remained high across all years, marketability efficiency was notably lower, with a particularly sharp decline during 2020—the peak of the pandemic. Although profitability rebounded in the post-COVID period, market perception and valuation recovered at a slower pace, especially for public sector banks. The analysis also highlights that ownership structure plays a significant role in determining a bank's ability to withstand and recover from external shocks like COVID-19.

The findings underscore the need for public sector reforms, enhanced investor engagement, and alignment of internal performance with market-facing strategies. This study contributes to the literature on banking efficiency and offers strategic insights for policymakers, regulators, and banking institutions aiming to optimize both financial and market outcomes in a post-pandemic economy.

# **Chapter 1. INTRODUCTION**

## **1.1. Background of the research**

The banking sector plays a pivotal role in the economic development of any country by acting as a financial intermediary that mobilizes savings and channels credit to productive sectors. In a dynamic environment characterized by regulatory changes, economic shocks, and increased competition, it becomes imperative to assess the efficiency of banks in utilizing their resources and generating both financial returns and market value.

Efficiency analysis of banks has long been a subject of interest among academicians, policymakers, and investors. While profitability efficiency reflects a bank's operational strength in generating returns using internal resources, marketability efficiency evaluates the bank's ability to create value as perceived by external stakeholders, especially in the stock market.

In India, several studies have focused on cost, profit, and technical efficiencies of banks, particularly around the periods of financial liberalization and reforms. However, research on the marketability aspect of bank performance remains limited. One of the pioneering works in this area was conducted by Thota Nagaraju (2014), who employed Data Envelopment Analysis (DEA) to evaluate the profitability and marketability efficiencies of Indian public and private sector banks for the period 2006-2010. His study revealed that while banks showed relatively better performance in terms of profitability, they significantly lagged in terms of marketability. Moreover, the study emphasized that inefficiencies were better explained by ownership structure rather than bank size and found only limited impact of the 2008 financial crisis on Indian banks.

Building upon this foundation, the current research aims to extend the analysis into the Covid-19 period (2018-2022), a time of unprecedented economic disruption. The Covid-19 pandemic posed significant challenges for the global financial system, with implications for profitability, credit growth, non-performing assets, and investor sentiment. It offers a unique opportunity to examine how Indian banks responded to the crisis, how their efficiency levels evolved, and whether ownership played a significant role in moderating the impact.

This study, by adopting the same DEA methodology as the previous work, seeks to provide updated insights into the Indian banking sector's resilience and adaptability during one of the most turbulent periods in modern history.

## **1.2. Industry profile**

The Indian banking sector stands as a cornerstone of the nation's financial system, playing a pivotal role in economic development by mobilizing savings, extending credit, and promoting financial inclusion. As of early 2025, the sector comprises 135 scheduled commercial banks, including 12 public sector banks (PSBs), 21 private sector banks, 46 foreign banks, and numerous regional rural and cooperative banks .

Recent years have witnessed significant transformations within the industry. The COVID-19 pandemic posed unprecedented challenges, but the sector demonstrated resilience, aided by regulatory support and rapid digital adoption. By March 2024, the gross non-performing asset (GNPA) ratio had declined to a 13-year low of 2.7%, indicating improved asset quality. Profitability metrics also showed positive trends, with return on assets (RoA) at 1.4% and return on equity (RoE) at 14.6% for the first half of FY 2024-25 .

The sector's evolution is further characterized by consolidation efforts, technological advancements, and a focus on sustainable growth. Initiatives like the "Viksit Bharat" mission underscore the banking industry's critical role in achieving India's ambitious economic goals by 2047. However, challenges persist, including the need for enhanced risk management, cybersecurity measures, and addressing rising defaults in certain loan segments.

In this dynamic landscape, assessing the profitability and marketability efficiencies of Indian banks provides valuable insights into their operational effectiveness and market perception. Such analysis is crucial for stakeholders aiming to understand the sector's trajectory and formulate strategies for sustained growth.

### 1.3. Research Questions

1. What are the levels of profitability and marketability efficiencies of Indian public and private sector banks during the period 2018-2022?
2. How does the ownership structure (public vs. private) influence the efficiency levels of Indian banks?
3. What is the impact of the COVID-19 pandemic on the profitability and marketability efficiencies of Indian banks?
4. How do the efficiency scores of Indian banks vary across the pre-COVID, during COVID, and post-COVID periods?

### 1.4. Research Objectives

- **Evaluate Efficiency:** To assess the profitability and marketability efficiencies of Indian public and private sector banks during the period 2018-2022 using Data Envelopment Analysis (DEA).
- **Impact of Ownership:** To examine the influence of ownership structure (public vs. private) on the efficiency levels of Indian banks.
- **Impact of COVID-19:** To analyze the effect of the COVID-19 pandemic on the profitability and marketability efficiencies of Indian banks.
- **Comparative Analysis:** To compare the efficiency scores across different time frames; pre-COVID (2018-2019), during COVID (2020-2021), and post-COVID (2022)-to identify trends and shifts in performance.

### 1.5. Scope of the study

This study focuses on evaluating the profitability and marketability efficiencies of Indian public and private sector banks during the period 2018 to 2022, with a particular emphasis on understanding the impact of the Covid-19 pandemic on bank performance. The analysis includes a sample of commercial banks operating in India for which complete financial and market data are available for the study period.

The scope of the research is limited to:

- Commercial banks listed on stock exchanges in India, as stock market performance is essential to assess marketability efficiency.
- The period 2018-2022, which allows for a comparative efficiency analysis across pre-Covid (2018-2019), during Covid (2020-2021), and post-Covid (2022) years.
- Two performance dimensions:
  - Profitability Efficiency - measuring operational and financial performance.
  - Marketability Efficiency - measuring the bank's ability to generate investor value.

- Application of Data Envelopment Analysis (DEA), using a two-stage input-oriented model under both constant returns to scale (CCR) and variable returns to scale (BCC) approaches.
- Evaluating the impact of ownership (public vs. private banks) on efficiency levels during the crisis and recovery phases.

The study does not cover cooperative banks, small finance banks, regional rural banks, or foreign banks due to limitations in data availability or market presence. Also, external macroeconomic and policy-level factors affecting the banking sector are considered only to the extent that they influence bank-level efficiency indicators.

Through this study, stakeholders such as policymakers, investors, bank management, and researchers can gain deeper insights into how Indian banks adapted to one of the most disruptive global crises and what efficiency gaps remain to be addressed in the future.

## Chapter 2. LITERATURE REVIEW

While generating revenue remains a fundamental function of banks, creating market value has gained increasing importance, especially from the perspective of investors. Strong marketability, reflected through metrics such as earnings per share (EPS), stock price, and market capitalization, is crucial in enhancing shareholder wealth. Consequently, the evaluation of both profitability and marketability efficiencies has become central to assessing overall bank performance.

An early and influential study in this domain was conducted by *Lawrence M. Seiforda and Joe Zhu (1999)*, who proposed a two-stage production framework using Data Envelopment Analysis (DEA) to assess the performance of 55 major U.S. commercial banks as listed in Fortune magazine (1996). Their findings suggested a notable pattern: larger banks excelled in profitability, while smaller banks tended to be more marketable, indicating that operational efficiency and stock market performance do not necessarily move in tandem.

Building on this model, *Xueming Luo (2001)* expanded the scope by examining a broader sample of 245 large U.S. banks. His findings reinforced the earlier conclusions, noting that around 14% of banks exhibited high profitability but low marketability, illustrating the divergence between internal performance and external valuation.

In the European context, *Ioannis E. Tsolas (2010)* applied a similar DEA-based two-stage model to 13 commercial banks listed on the Athens Stock Exchange. His study found no significant positive correlation between profitability efficiency and market-based performance, suggesting that good financial performance may not always be reflected in stock valuations.

In the Asian context, *Shih-Fang Lo and Wen-Min Lu (2006)* studied 14 Taiwanese financial holding companies (FHCs). Their research highlighted that larger institutions demonstrated superior efficiency in both profitability and marketability dimensions, supporting the case for further consolidation and mergers among smaller FHCs to achieve technical efficiency and economies of scale.

Turning to the Indian scenario, a substantial body of work has focused on evaluating bank efficiency across the pre- and post-liberalization periods. Studies by *Bhattacharyya; Lovell & Sahay (1997); Chatterjee (2006); Das (1997); Das & Ghosh (2006) ; Das, Nag, & Ray (2005); Ray & Da, (2010); Sensarma (2008)* have assessed the cost, profit, and technical efficiency of Indian banks. These studies often highlighted the role of government ownership as a constraint on efficiency in the pre-reform era. Following economic liberalization, subsequent research showed improvements in efficiency, though public sector banks continued to lag behind private banks in certain performance dimensions.

In a significant contribution to this line of research, *Thota Nagaraju (2014)* extended the two-stage DEA model to Indian banks for the period 2006-2010. Analyzing a sample of 34 public and private sector banks, the study revealed that Indian banks, while relatively efficient in terms of profitability, showed lower efficiency in marketability. Importantly, the study found that ownership structure, rather than size, was a key determinant of efficiency. Moreover, despite the global financial crisis of 2008, the Indian banking system showed only a temporary dip in marketability efficiency, with a strong recovery by 2010. Nagaraju's work remains one of the earliest and most comprehensive applications of the two-stage DEA approach to Indian banks, and it laid the foundation for subsequent studies, including the current research, which aims to evaluate how these efficiencies evolved during the Covid-19 crisis period (2018-2022).

<b>Authors</b>	<b>Samples</b>	<b>Input variables</b>	<b>Intermediate variables</b>	<b>Output variables</b>
Seiford& Zhu (1999)	Top 55 US commercial banks	Assets, Employees, Stockholders' equity	Revenues, Profits	EPS, Market value, Total returns to investors
Luo (2003)	245 US large banks	Assets, Employees, Stockholders' equity	Revenues, Profits	EPS, Market value, Stock price
Ho and Zhu (2004)	41 Taiwan's commercial banks	Assets, Branch employees, Capital stock	Deposits, Sales	Net income, Interest income, Non-Interest income
Lo and Lu (2006)	14 Taiwan's FHCs	Assets, Employees, Stockholders' equity	Revenues, Profits	EPS, Market value, Stock price
Kao and Hwang (2008)	24 Taiwan's non-life insurance	Business and administrative expenses, Commissions and acquisition expenses	Direct premiums written, Reinsurance premiums received	Net underwriting income, investment income
Tsolas (2011)	13 Athens Exchange listed commercial banks	Total interest expense, Loan loss provision	Net interest income after loan, loss provision, Burden	Market capitalization
Thota Nagaraju (2013)	34 banks listed in Indian Stock Exchanges	Assets, Employees, Operating expenses, Equity	Revenues, Profit margins, ROA, ROE	EPS, Market value, P/E ratio, M/B ratio

Table 1. Summary Related Literature Based on Two-stage DEA to Measure Performance.

## Chapter 3. RESEARCH METHODOLOGY

### 3.1. Research Methodology

The present study employs the two-stage performance (efficiency production process) model to assess the performance of Indian banks during the period 2018 to 2022, with a specific focus on the impact of the Covid-19 pandemic on profitability and marketability efficiencies. This methodological framework has been adopted from the study by *Thota Nagaraju (2014)*, which analyzed Indian public and private sector banks using Data Envelopment Analysis (DEA).

The two-stage DEA model evaluates bank efficiency across two distinct but interrelated dimensions:

- Stage 1: Profitability Efficiency - This stage measures the operational and financial performance of banks using internal inputs and output.
- Stage 2: Marketability Efficiency - In this stage, the outputs from the profitability model are used as inputs to assess a bank's performance in the stock market and its ability to generate market value.

**The underlying logic of this model is causal: it assumes that a bank's internal performance (profitability) contributes positively to its external valuation (marketability).** Thus, the outputs from the first stage are operationalized as the inputs to the second stage. This structure enables the analysis of how efficiently banks convert internal financial strength into shareholder value in the market.

The model follows an input-oriented DEA approach under both Constant Returns to Scale (CRS) and Variable Returns to Scale (VRS) assumptions. The CCR (Charnes, Cooper, Rhodes) and BCC (Banker, Charnes, Cooper) models are used to compute:

- Overall Technical Efficiency (OTE)
- Pure Technical Efficiency (PTE)
- Scale Efficiency (SE)

This methodology enables a structured and comparative analysis of bank performance across pre-Covid (2018-2019), during-Covid (2020-2021), and post-Covid (2022) periods, while also facilitating a distinction between the efficiency levels of public and private sector banks.

### 3.2. Specification of Data Envelopment Analysis (DEA)

To evaluate the efficiency of Indian banks during the period 2018-2022, this study employs the Data Envelopment Analysis (DEA) technique-a non-parametric method widely used to assess the relative efficiency of Decision Making Units (DMUs) such as banks, especially when multiple inputs and outputs are involved.

DEA allows for the construction of an efficiency frontier and compares each DMU against this benchmark. Efficiency scores range between 0 and 1, where a score of 1 indicates that the DMU is on the efficiency frontier, while scores less than 1 reflect inefficiency relative to best performers in the sample.

This study applies two DEA models:

1. CCR Model (Charnes, Cooper, and Rhodes, 1978) - Assumes constant returns to scale (CRS) and estimates Overall Technical Efficiency (OTE).

2. BCC Model (Banker, Charnes, and Cooper, 1984) - Assumes variable returns to scale (VRS) and estimates Pure Technical Efficiency (PTE).

From these, Scale Efficiency (SE) is derived as:

$$SE = \frac{OTE}{PTE}$$

### DEA Model Orientation

An input-oriented DEA approach is used, which focuses on minimizing input usage while maintaining current output levels. This orientation is suitable for the banking sector, where banks typically have more control over their inputs (like assets, equity, and workforce) than their outputs (like revenue or profit).

### Two-Stage DEA Framework

Following the model in Nagaraju (2014), this study uses a two-stage DEA approach:

#### Stage 1 - Profitability Efficiency

- Inputs: Total Assets, Equity, Operating Expenses, Number of Employees
- Outputs: Revenue, Profit Margin, Return on Assets (ROA), Return on Equity (ROE)

#### Stage 2 - Marketability Efficiency

- Inputs: Revenue, Profit Margin, ROA, ROE (outputs from Stage 1)
- Outputs: Earnings Per Share (EPS), Market Value, P/E Ratio, Price-to-Book (P/B) Ratio

The causal assumption is that financial performance (profitability) positively influences market performance (marketability), and hence, outputs from the first stage serve as inputs in the second stage.

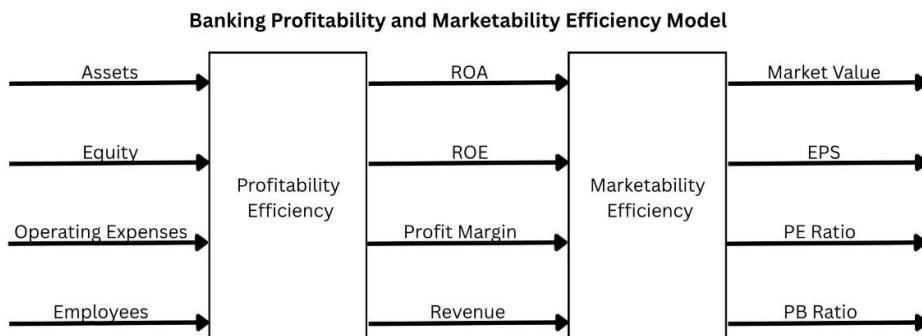


Figure 1

### Returns to Scale Classification

Returns to scale are interpreted as follows:

CRS:  $OTE = PTE \Rightarrow$  The bank operates at optimal scale.

Increasing Returns to Scale (IRS):  $PTE > OTE$  and  $\sum \lambda^* < 1 \Rightarrow$  Indicates potential benefits from scaling up operations.

Decreasing Returns to Scale (DRS):  $PTE < OTE$  and  $\sum \lambda^* > 1 \Rightarrow$  Indicates inefficiencies due to size; bank may benefit from scaling down.

These classifications help in understanding whether inefficiencies are due to operational management or sub-optimal scale of operations.

### 3.3. Data Collection and Procedure

This paper examines a sample of 30 Indian public and private banks considering the time period from 2018 to 2022. These 30 banks are listed according to the ownership group to which they belong:

Nationalized Banks	Private Banks
State Bank Of India	H D F C Bank Ltd.
Bank Of Baroda	I C I C I Bank Ltd.
Punjab National Bank	Kotak Mahindra Bank Ltd.
Bank Of India	Axis Bank Ltd.
Canara Bank	Indusind Bank Ltd.
Bank Of Maharashtra	Yes Bank Ltd.
Central Bank Of India Ltd	A U Small Finance Bank Ltd.
Indian Overseas Bank	I D F C First Bank Ltd.
Indian Bank	Federal Bank Ltd.
Uco Bank	Bandhan Bank Ltd.
Punjab & Sind Bank	Karur Vysya Bank Ltd.
Union Bank Of India	City Union Bank Ltd.
	R B L Bank Ltd.
	Jammu & Kashmir Bank Ltd.
	Karnataka Bank Ltd.
	South Indian Bank Ltd.
	D C B Bank Ltd.
	Dhanlaxmi Bank Ltd.

Table 2. Banks ownership based classification

Input and output variables for both profitability and marketability models are selected based on those used in the original Nagaraju (2014) study, with necessary adjustments to reflect current data availability and relevance during the Covid-19 period. These variables are collected from CMIE Prowess database and Banks' annual reports. Only those banks that are listed currently in any of the Indian stock exchanges (NSE/BSE) and for whom the data were available for the period 2018-2022 were included in the study. The fiscal year ending for all the banks in the study is March 31. Note that Assets, Equity, Revenue and Operating expenses are measured in "Crore rupees", whereas Profit margin (PM), ROA, and ROE are presented as percentage, EPS and Market value are given as "rupees", the P/E and M/B are presented as ratio and Employees given as numeric count.

## Chapter 4. ANALYSIS AND INTERPRETATION

### 4.1. Descriptive results

Due to the complexity of whole data only 3 years' (2018, 2020 and 2022) information is studied. The descriptive statistics of all input and output variables of these banks from the year 2018 to 2022 is given below in Table 3.

	2018			2019			2020		
	Mean	SD	Min	Mean	SD	Min	Mean	SD	Min
<b>OTE<sub>p</sub></b>	0.971	0.036	0.900	0.962	0.057	0.790	0.949	0.056	0.790
<b>PTE<sub>p</sub></b>	0.980	0.028	0.911	0.970	0.056	0.795	0.957	0.053	0.805
<b>SE<sub>p</sub></b>	0.990	0.017	0.938	0.992	0.014	0.950	0.991	0.014	0.942
<b>OTE<sub>m</sub></b>	0.454	0.371	0.016	0.454	0.370	0.019	0.442	0.384	0.018
<b>PTE<sub>m</sub></b>	0.567	0.350	0.021	0.602	0.375	0.022	0.641	0.363	0.030
<b>SE<sub>m</sub></b>	0.734	0.280	0.232	0.680	0.292	0.129	0.613	0.321	0.172

Table 3.1. Descriptive Statistics of all input and output variables 2018-2020

	2021			2022		
	Mean	SD	Min	Mean	SD	Min
<b>OTE<sub>p</sub></b>	0.967	0.048	0.796	0.971	0.035	0.866
<b>PTE<sub>p</sub></b>	0.972	0.044	0.815	0.972	0.035	0.869
<b>SE<sub>p</sub></b>	0.995	0.010	0.953	0.999	0.002	0.992
<b>OTE<sub>m</sub></b>	0.383	0.349	0.008	0.516	0.325	0.085
<b>PTE<sub>m</sub></b>	0.513	0.374	0.037	0.689	0.308	0.180
<b>SE<sub>m</sub></b>	0.686	0.256	0.123	0.729	0.231	0.198

Table 3.2. Descriptive Statistics of all input and output variables 2021-2022

Note: OTE<sub>p</sub> = overall technical profitability efficiency; PTE<sub>p</sub> = pure technical efficiency in profitability stage; SE<sub>p</sub> = scale efficiency in profitability stage; OTE<sub>m</sub> = overall technical efficiency in marketability stage; PTE<sub>m</sub> = pure technical efficiency in marketability stage; SE<sub>m</sub> = scale efficiency in marketability stage.

### Profitability and Marketability Efficiency Scores for the Year 2018

Bank	Profitability_2018				Marketability_2018			
	OTE_2018	PTE_2018	SE_2018	RTS	OTE_2018	PTE_2018	SE_2018	RTS
A U Small Finance Bank	1.000	1.000	1.000	CRS	1.000	1.000	1.000	CRS
Axis Bank	0.900	0.928	0.970	DRS	0.213	0.230	0.927	DRS
Bandhan Bank	1.000	1.000	1.000	CRS	1.000	1.000	1.000	CRS
Bank Of Baroda	0.901	0.958	0.941	DRS	1.000	1.000	1.000	CRS
Bank Of India	0.901	0.937	0.962	DRS	0.048	0.121	0.395	IRS
Bank Of Maharashtra	0.948	0.953	0.995	DRS	0.098	0.422	0.232	IRS
Canara Bank	0.972	1.000	0.972	DRS	0.162	0.173	0.931	IRS
Central Bank Of India	1.000	1.000	1.000	CRS	0.110	0.174	0.628	IRS
City Union Bank	1.000	1.000	1.000	CRS	0.680	0.682	0.997	IRS
D C B Bank	0.961	0.985	0.975	IRS	1.000	1.000	1.000	CRS
Dhanlaxmi Bank	1.000	1.000	1.000	CRS	1.000	1.000	1.000	CRS
Federal Bank	0.913	0.914	0.999	IRS	0.374	0.454	0.824	IRS
H D F C Bank	1.000	1.000	1.000	CRS	0.306	1.000	0.306	DRS
I C I C I Bank	0.902	0.911	0.990	DRS	0.109	0.116	0.933	IRS
I D F C First Bank	0.946	0.947	0.999	IRS	0.185	0.501	0.370	IRS
Indian Bank	0.950	0.967	0.982	DRS	0.410	0.502	0.818	DRS
Indian Overseas Bank	0.998	1.000	0.998	DRS	0.152	0.370	0.411	IRS
Indusind Bank	1.000	1.000	1.000	CRS	0.962	1.000	0.962	DRS
Jammu & Kashmir Bank	1.000	1.000	1.000	CRS	0.141	0.444	0.317	IRS
Karnataka Bank	0.999	1.000	0.999	DRS	0.522	0.569	0.919	IRS
Karur Vysya Bank	1.000	1.000	1.000	CRS	0.465	0.604	0.769	IRS
Kotak Mahindra Bank	0.976	0.977	0.999	IRS	0.702	1.000	0.702	DRS
Punjab & Sind Bank	0.973	0.973	1.000	IRS	0.153	0.645	0.237	IRS
Punjab National Bank	1.000	1.000	1.000	CRS	0.028	0.077	0.361	IRS
R B L Bank	0.988	0.990	0.998	IRS	1.000	1.000	1.000	CRS
South Indian Bank	1.000	1.000	1.000	CRS	0.517	0.564	0.918	IRS
State Bank Of India	0.938	1.000	0.938	DRS	0.016	0.021	0.754	IRS
Uco Bank	0.950	0.952	0.998	IRS	1.000	1.000	1.000	CRS
Union Bank Of India	1.000	1.000	1.000	CRS	0.045	0.125	0.358	IRS
Yes Bank	1.000	1.000	1.000	CRS	0.210	0.223	0.940	IRS

Table 4. Profitability and Marketability Efficiency Scores for the Year 2018

### Profitability and Marketability Efficiency Scores for the Year 2019

Bank	Profitability_2019				Marketability_2019			
	OTE_2019	PTE_2019	SE_2019	RTS	OTE_2019	PTE_2019	SE_2019	RTS
A U Small Finance Bank	1.000	1.000	1.000	CRS	1.000	1.000	1.000	CRS
Axis Bank	0.955	0.977	0.978	DRS	0.187	0.202	0.922	DRS
Bandhan Bank	1.000	1.000	1.000	CRS	1.000	1.000	1.000	CRS
Bank Of Baroda	0.949	0.960	0.989	DRS	0.038	0.091	0.414	IRS
Bank Of India	0.850	0.862	0.987	DRS	0.043	0.119	0.365	IRS
Bank Of Maharashtra	1.000	1.000	1.000	CRS	1.000	1.000	1.000	CRS
Canara Bank	1.000	1.000	1.000	CRS	0.082	0.103	0.801	IRS
Central Bank Of India	0.967	1.000	0.967	DRS	0.054	0.197	0.274	IRS
City Union Bank	1.000	1.000	1.000	CRS	0.790	1.000	0.790	IRS
D C B Bank	1.000	1.000	1.000	CRS	0.828	0.981	0.844	IRS
Dhanlaxmi Bank	1.000	1.000	1.000	CRS	0.592	1.000	0.592	IRS
Federal Bank	0.968	0.968	1.000	IRS	0.275	0.404	0.682	IRS
H D F C Bank	1.000	1.000	1.000	CRS	0.359	1.000	0.359	DRS
I C I C I Bank	0.868	0.871	0.996	DRS	0.240	1.000	0.240	DRS
I D F C First Bank	0.812	0.816	0.995	DRS	1.000	1.000	1.000	CRS
Indian Bank	0.931	0.932	0.999	DRS	0.368	0.370	0.996	IRS
Indian Overseas Bank	0.968	0.988	0.980	DRS	0.075	0.255	0.295	IRS
Indusind Bank	1.000	1.000	1.000	CRS	1.000	1.000	1.000	CRS
Jammu & Kashmir Bank	1.000	1.000	1.000	CRS	0.585	0.590	0.992	IRS
Karnataka Bank	0.993	0.993	1.000	CRS	0.679	0.861	0.789	IRS
Karur Vysya Bank	0.987	0.988	0.999	IRS	0.860	0.875	0.983	DRS
Kotak Mahindra Bank	0.968	0.971	0.996	DRS	0.796	1.000	0.796	DRS
Punjab & Sind Bank	1.000	1.000	1.000	CRS	0.053	0.414	0.129	IRS
Punjab National Bank	0.950	1.000	0.950	DRS	0.027	0.082	0.331	IRS
R B L Bank	1.000	1.000	1.000	CRS	0.905	0.954	0.949	IRS
South Indian Bank	1.000	1.000	1.000	CRS	0.195	0.470	0.416	IRS
State Bank Of India	0.956	1.000	0.956	DRS	0.019	0.022	0.870	IRS
Uco Bank	0.790	0.795	0.993	DRS	0.234	0.587	0.399	IRS
Union Bank Of India	0.961	0.984	0.976	DRS	0.040	0.124	0.325	IRS
Yes Bank	1.000	1.000	1.000	CRS	0.296	0.346	0.855	IRS

Table 5. Profitability and Marketability Efficiency Scores for the Year 2019

## Profitability and Marketability Efficiency Scores for the Year 2020

Bank	Profitability_2020				Marketability_2020			
	OTE_2020	PTE_2020	SE_2020	RTS	OTE_2020	PTE_2020	SE_2020	RTS
A U Small Finance Bank	1.000	1.000	1.000	CRS	1.000	1.000	1.000	CRS
Axis Bank	0.898	0.915	0.981	DRS	1.000	1.000	1.000	CRS
Bandhan Bank	1.000	1.000	1.000	CRS	1.000	1.000	1.000	CRS
Bank Of Baroda	0.947	0.949	0.997	DRS	0.137	0.194	0.707	IRS
Bank Of India	0.883	0.887	0.996	DRS	0.028	0.158	0.176	IRS
Bank Of Maharashtra	0.968	0.969	0.999	IRS	0.152	0.448	0.339	IRS
Canara Bank	0.942	1.000	0.942	DRS	0.045	0.129	0.351	IRS
Central Bank Of India	0.917	0.931	0.985	DRS	0.059	0.265	0.223	IRS
City Union Bank	0.978	1.000	0.978	DRS	1.000	1.000	1.000	CRS
D C B Bank	0.986	1.000	0.986	DRS	0.719	0.997	0.721	IRS
Dhanlaxmi Bank	1.000	1.000	1.000	CRS	0.535	1.000	0.535	IRS
Federal Bank	1.000	1.000	1.000	CRS	0.253	0.425	0.595	IRS
H D F C Bank	1.000	1.000	1.000	CRS	0.274	1.000	0.274	DRS
I C I C I Bank	0.900	0.909	0.990	DRS	0.130	0.145	0.894	IRS
I D F C First Bank	0.934	0.935	0.999	IRS	0.222	0.531	0.418	IRS
Indian Bank	1.000	1.000	1.000	CRS	0.292	0.400	0.730	IRS
Indian Overseas Bank	0.790	0.820	0.964	DRS	1.000	1.000	1.000	CRS
Indusind Bank	1.000	1.000	1.000	CRS	1.000	1.000	1.000	CRS
Jammu & Kashmir Bank	0.892	0.892	0.999	DRS	0.172	1.000	0.172	IRS
Karnataka Bank	0.994	1.000	0.994	DRS	0.744	0.811	0.917	IRS
Karur Vysya Bank	0.948	0.951	0.996	IRS	0.226	0.761	0.297	IRS
Kotak Mahindra Bank	0.958	0.972	0.986	DRS	1.000	1.000	1.000	CRS
Punjab & Sind Bank	0.959	0.961	0.998	IRS	0.198	1.000	0.198	IRS
Punjab National Bank	0.909	0.914	0.994	DRS	0.027	0.117	0.228	IRS
R B L Bank	0.962	0.973	0.988	IRS	0.601	0.811	0.741	IRS
South Indian Bank	1.000	1.000	1.000	CRS	0.097	0.505	0.192	IRS
State Bank Of India	1.000	1.000	1.000	CRS	0.018	0.030	0.622	IRS
Uco Bank	0.805	0.805	0.999	DRS	1.000	1.000	1.000	CRS
Union Bank Of India	0.895	0.939	0.953	DRS	0.033	0.173	0.190	IRS
Yes Bank	1.000	1.000	1.000	CRS	0.296	0.342	0.865	IRS

Table 6. Profitability and Marketability Efficiency Scores for the Year 2020

## Profitability and Marketability Efficiency Scores for the Year 2021

Bank	Profitability_2021				Marketability_2021			
	OTE_2021	PTE_2021	SE_2021	RTS	OTE_2021	PTE_2021	SE_2021	RTS
A U Small Finance Bank	1.000	1.000	1.000	CRS	1.000	1.000	1.000	CRS
Axis Bank	0.917	0.922	0.995	DRS	0.159	0.206	0.771	DRS
Bandhan Bank	1.000	1.000	1.000	CRS	0.608	0.758	0.802	DRS
Bank Of Baroda	0.939	0.960	0.977	DRS	0.664	1.000	0.664	DRS
Bank Of India	0.950	0.950	1.000	IRS	0.068	0.088	0.776	IRS
Bank Of Maharashtra	0.983	0.988	0.994	DRS	0.491	0.598	0.821	DRS
Canara Bank	1.000	1.000	1.000	CRS	0.060	0.068	0.879	IRS
Central Bank Of India	0.919	0.920	0.999	DRS	0.035	0.131	0.264	IRS
City Union Bank	1.000	1.000	1.000	CRS	1.000	1.000	1.000	CRS
D C B Bank	1.000	1.000	1.000	CRS	0.556	0.806	0.691	IRS
Dhanlaxmi Bank	1.000	1.000	1.000	CRS	1.000	1.000	1.000	CRS
Federal Bank	1.000	1.000	1.000	CRS	0.178	0.265	0.673	IRS
H D F C Bank	1.000	1.000	1.000	CRS	0.123	1.000	0.123	DRS
I C I C I Bank	0.944	0.945	1.000	IRS	0.085	0.122	0.695	DRS
I D F C First Bank	1.000	1.000	1.000	CRS	0.141	0.198	0.711	IRS
Indian Bank	0.994	0.995	0.999	DRS	0.180	0.329	0.547	DRS
Indian Overseas Bank	0.996	1.000	0.996	DRS	0.376	0.483	0.778	DRS
Indusind Bank	1.000	1.000	1.000	CRS	0.388	1.000	0.388	DRS
Jammu & Kashmir Bank	0.993	0.994	1.000	DRS	0.189	0.369	0.512	IRS
Karnataka Bank	1.000	1.000	1.000	CRS	0.521	0.594	0.876	IRS
Karur Vysya Bank	0.956	0.957	0.999	IRS	0.531	0.555	0.958	IRS
Kotak Mahindra Bank	1.000	1.000	1.000	CRS	1.000	1.000	1.000	CRS
Punjab & Sind Bank	0.796	0.815	0.977	IRS	1.000	1.000	1.000	CRS
Punjab National Bank	0.937	0.984	0.953	DRS	0.008	0.037	0.210	IRS
R B L Bank	0.934	0.941	0.992	IRS	0.798	1.000	0.798	DRS
South Indian Bank	1.000	1.000	1.000	CRS	0.058	0.280	0.209	IRS
State Bank Of India	1.000	1.000	1.000	CRS	0.037	0.047	0.785	DRS
Uco Bank	0.896	0.897	0.999	IRS	0.060	0.208	0.291	IRS
Union Bank Of India	0.983	1.000	0.983	DRS	0.034	0.046	0.725	IRS
Yes Bank	0.884	0.893	0.989	IRS	0.130	0.208	0.626	IRS

Table 7. Profitability and Marketability Efficiency Scores for the Year 2021

## Profitability and Marketability Efficiency Scores for the Year 2022

Bank	Profitability_2022				Marketability_2022			
	OTE_2022	PTE_2022	SE_2022	RTS	OTE_2022	PTE_2022	SE_2022	RTS
A U Small Finance Bank	1.000	1.000	1.000	CRS	1.000	1.000	1.000	CRS
Axis Bank	0.963	0.963	1.000	DRS	0.456	0.569	0.800	DRS
Bandhan Bank	1.000	1.000	1.000	CRS	1.000	1.000	1.000	CRS
Bank Of Baroda	0.970	0.970	1.000	CRS	0.187	0.189	0.990	DRS
Bank Of India	0.931	0.931	1.000	IRS	0.085	0.202	0.423	IRS
Bank Of Maharashtra	1.000	1.000	1.000	CRS	0.208	0.348	0.599	IRS
Canara Bank	1.000	1.000	1.000	CRS	0.679	0.887	0.766	DRS
Central Bank Of India	0.926	0.927	1.000	IRS	0.129	0.319	0.405	IRS
City Union Bank	1.000	1.000	1.000	CRS	0.907	1.000	0.907	IRS
D C B Bank	0.972	0.973	0.999	DRS	0.563	1.000	0.563	IRS
Dhanlaxmi Bank	1.000	1.000	1.000	CRS	0.482	1.000	0.482	IRS
Federal Bank	1.000	1.000	1.000	CRS	0.270	0.443	0.610	IRS
H D F C Bank	1.000	1.000	1.000	CRS	0.546	1.000	0.546	DRS
I C I C I Bank	0.983	0.983	1.000	DRS	0.392	0.544	0.719	DRS
I D F C First Bank	1.000	1.000	1.000	CRS	0.337	0.486	0.694	IRS
Indian Bank	0.993	1.000	0.993	DRS	0.282	0.328	0.860	IRS
Indian Overseas Bank	0.963	0.964	1.000	DRS	0.312	0.403	0.774	IRS
Indusind Bank	1.000	1.000	1.000	CRS	1.000	1.000	1.000	CRS
Jammu & Kashmir Bank	0.960	0.961	0.999	IRS	0.283	0.632	0.448	IRS
Karnataka Bank	0.980	0.981	0.999	DRS	0.833	1.000	0.833	IRS
Karur Vysya Bank	0.976	0.976	1.000	DRS	0.387	0.800	0.483	IRS
Kotak Mahindra Bank	1.000	1.000	1.000	CRS	1.000	1.000	1.000	CRS
Punjab & Sind Bank	0.936	0.944	0.992	IRS	1.000	1.000	1.000	CRS
Punjab National Bank	0.921	0.927	0.994	DRS	1.000	1.000	1.000	CRS
R B L Bank	0.924	0.928	0.996	IRS	1.000	1.000	1.000	CRS
South Indian Bank	1.000	1.000	1.000	CRS	0.198	1.000	0.198	IRS
State Bank Of India	1.000	1.000	1.000	CRS	0.268	0.549	0.488	DRS
Uco Bank	0.900	0.900	1.000	CRS	0.200	0.387	0.517	IRS
Union Bank Of India	0.979	0.979	1.000	CRS	0.179	0.180	0.991	IRS
Yes Bank	0.866	0.869	0.997	DRS	0.309	0.406	0.761	IRS

Table 8. Profitability and Marketability Efficiency Scores for the Year 2022

### **Interpretation of Efficiency Scores for the Year 2018**

In the year 2018, under profitability efficiency assessment, 14 banks achieved pure technical efficiency ( $PTE_p = 1$ ) using the BCC model, while 13 banks were found to be technically efficient ( $OTE_p = 1$ ) under the CCR model. Furthermore, 12 banks were scale efficient ( $SE_p = 1$ ), indicating they were operating at an optimal scale. When compared with the average efficiency values for profitability ( $OTE_p = 0.971$ ,  $PTE_p = 0.980$ ,  $SE_p = 0.990$ ), 21 banks exceeded the mean  $OTE_p$ , 21 exceeded the mean  $PTE_p$ , and 19 banks exceeded the mean  $SE_p$ , reflecting strong internal operational performance across a majority of the banks.

In contrast, marketability efficiency for the same year showed significantly lower efficiency scores across banks. Only 6 banks were technically and purely technically efficient, and just 6 were scale efficient. When compared with the marketability average values ( $OTE_m = 0.454$ ,  $PTE_m = 0.567$ ,  $SE_m = 0.734$ ), 11 banks had  $OTE_m$  above the mean, 12 banks exceeded the mean  $PTE_m$ , and 14 banks exceeded the mean  $SE_m$ . This gap between profitability and marketability efficiency highlights the disparity between internal financial performance and external market valuation.

Overall, the 2018 results reflect that while a majority of Indian banks were operationally strong and efficient in converting inputs into profits, their ability to convert those profits into shareholder value and market recognition was limited. This aligns with earlier studies that suggest profitability does not always translate into marketability.

### **Interpretation of Efficiency Scores for the Year 2019**

In 2019, Indian banks demonstrated robust performance in terms of profitability efficiency. Out of the total banks studied, 16 were pure technically efficient ( $PTE_p = 1$  under the BCC model), 15 were technically efficient ( $OTE_p = 1$  under the CCR model), and 15 were scale efficient ( $SE_p = 1$ ). Relative to the mean values ( $OTE_p = 0.962$ ,  $PTE_p = 0.970$ ,  $SE_p = 0.992$ ), 21 banks had  $OTE_p$  scores above the mean, 22 exceeded the average  $PTE_p$ , and 20 banks recorded  $SE_p$  values greater than the average, highlighting a strong overall operational profile for most banks in the pre-Covid period.

On the other hand, marketability efficiency continued to lag, consistent with previous years. While 7 banks were technically and purely technically efficient and 7 were also scale efficient, fewer banks performed well in terms of external, market-based performance. When benchmarked against the mean values ( $OTE_m = 0.454$ ,  $PTE_m = 0.602$ ,  $SE_m = 0.680$ ), 12 banks exceeded the average  $OTE_m$ , 13 outperformed the average  $PTE_m$ , and 15 banks recorded  $SE_m$  above the mean, indicating slightly better market sentiment compared to 2018 but still a considerable gap between profitability and market performance.

These results reflect a persistent divergence between internal operational efficiency and market valuation of Indian banks. Despite solid profitability metrics, investor confidence and market value remained relatively low for a significant number of banks, suggesting that strong financial performance alone may not be sufficient to drive market appeal.

### **Interpretation of Efficiency Scores for the Year 2020**

The year 2020, which marked the peak of the Covid-19 pandemic, witnessed a slight dip in the number of banks achieving full efficiency under profitability analysis. Of the banks studied, 12 were pure technically efficient, 10 were technically efficient, and 10 were scale efficient. Yet, despite the challenging economic environment, 19 banks had  $OTE_p$  scores above the mean (0.967), 20 banks had  $PTE_p$  scores above the mean (0.972), and 19 had  $SE_p$  scores above the mean (0.995), indicating notable resilience in operational efficiency.

In terms of marketability efficiency, the impact of the pandemic was more pronounced. Only 6 banks were purely technically efficient and 5 were technically and scale efficient. Compared to the average scores ( $OTE_m = 0.383$ ,  $PTE_m = 0.513$ ,  $SE_m = 0.686$ ), 10 banks exceeded the mean  $OTE_m$ , 11 exceeded  $PTE_m$ , and 12 surpassed  $SE_m$ . These figures suggest a significant deterioration in how investors perceived and valued banks in the stock market during the pandemic, despite many banks maintaining financial strength.

Thus, the findings for 2020 reinforce the view that the pandemic had a more severe effect on investor confidence and market performance than on internal bank operations. While operational efficiency remained relatively stable, marketability efficiency declined, underlining the sensitivity of market perception to external shocks.

### **Interpretation of Efficiency Scores for the Year 2021**

In 2021, during the ongoing pandemic recovery phase, profitability efficiency among Indian banks remained strong. A total of 16 banks achieved pure technical efficiency, while 14 were technically efficient and 14 were scale efficient. Against the descriptive statistics ( $OTE_p$  mean = 0.967,  $PTE_p$  mean = 0.972,  $SE_p$  mean = 0.995), 20 banks had  $OTE_p$  scores above the mean, 21 exceeded the  $PTE_p$  average, and 19 surpassed the mean  $SE$ , confirming that the banking sector maintained high levels of internal performance despite the external disruptions caused by Covid-19.

Marketability efficiency, however, remained low for many banks. Only 6 banks were pure technically efficient, 5 were technically efficient, and 6 were scale efficient. When compared to the mean scores ( $OTE_m = 0.383$ ,  $PTE_m = 0.513$ ,  $SE_m = 0.686$ ), 11 banks exceeded the average  $OTE_m$ , 12 banks scored above the average  $PTE_m$ , and 13 surpassed the mean  $SE_m$ . While some improvement in market perception was visible, the gap between financial and market efficiency persisted.

The 2021 results underline a recurring theme: profitability resilience in contrast with sluggish market performance. Despite banks regaining and maintaining strong financial efficiency during the second year of the pandemic, investors remained cautious, reflecting uncertainty in the broader economy and highlighting the delayed response of market-based indicators to financial recovery.

### **Interpretation of Efficiency Scores for the Year 2022**

By 2022, post-pandemic conditions saw further improvements in the operational efficiency of Indian banks. A total of 17 banks were pure technically efficient, 15 were technically efficient, and 15 were scale efficient under the profitability model. Moreover, 22 banks had  $OTE_p$  scores above the mean (0.967), 23 had  $PTE_p$  scores above the mean (0.972), and 22 had  $SE_p$  scores above the mean (0.995). These results reflect a strong post-pandemic recovery in banks' internal financial performance and optimal use of resources.

Marketability efficiency, while still lagging behind profitability, showed modest improvement. Six banks remained fully efficient ( $OTE_m$ ,  $PTE_m$ , and  $SE_m = 1$ ), and a reasonable number of banks scored above the average ( $OTE_m = 0.383$ ,  $PTE_m = 0.513$ ,  $SE_m = 0.686$ ). Specifically, 11 banks had  $OTE_m$  above the mean, 13 exceeded  $PTE_m$ , and 14 surpassed  $SE_m$ . These figures indicate that while profitability was restored, marketability efficiency was still stabilizing in the aftermath of the pandemic.

Overall, the 2022 results highlight a recovery trend in both profitability and marketability efficiencies, with operational efficiency returning to pre-Covid levels or better in many banks.

However, the relatively lower marketability scores suggest that investor sentiment and market confidence, while improving, continued to lag behind financial performance.

## 4.2. Analysis

### Year-wise Analysis of Profitability Efficiency Variables (2018–2022)

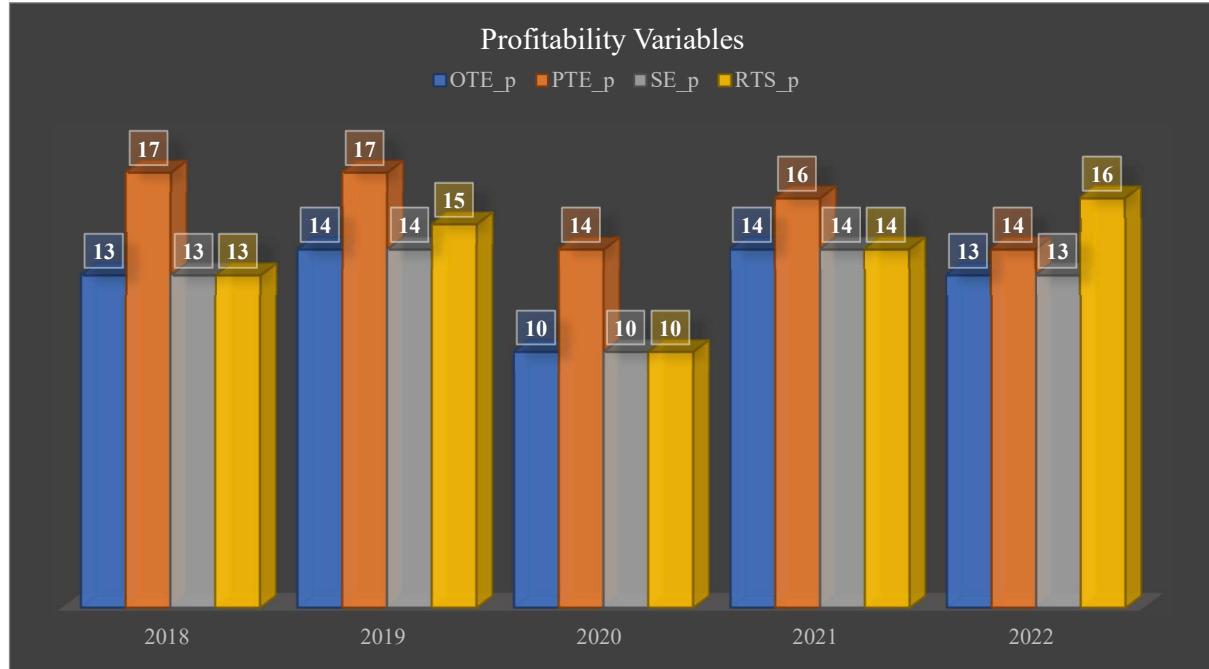


Figure 2

The analysis of profitability-related DEA efficiency measures over the five-year period from 2018 to 2022 (*as shown in figure 1*) reflects a generally strong and resilient performance by Indian banks. The variables considered include Overall Technical Efficiency (OTE<sub>p</sub>), Pure Technical Efficiency (PTE<sub>p</sub>), Scale Efficiency (SE<sub>p</sub>), and the number of banks operating under Constant Returns to Scale (RTS<sub>p</sub>).

In 2018, 13 banks were technically efficient (CCR model), and 17 achieved pure technical efficiency (BCC model), while 13 banks were also found to be scale efficient. Notably, 17 banks were operating under CRS, indicating optimal operational scale.

In 2019, performance continued at a high level with 14 banks achieving OTE<sub>p</sub> = 1, 17 banks achieving PTE<sub>p</sub> = 1, 14 being scale efficient, and 15 operating under CRS. This suggests 2019 was one of the most efficient years in the pre-Covid period.

However, in 2020, a sharp decline is observed across all profitability efficiency metrics. Only 10 banks were technically efficient (CCR), with the same number achieving PTE and SE scores of 1. The number of banks operating under constant returns to scale also fell to 10. This reflects the impact of the Covid-19 pandemic, which temporarily disrupted bank operations and reduced resource utilization efficiency.

By 2021, the sector demonstrated a strong recovery. The number of banks achieving OTE<sub>p</sub> = 1 and PTE<sub>p</sub> = 1 increased to 14 and 16 respectively, with 14 scale efficient banks and the same number operating under CRS. This reflects the sector's adaptability and effective crisis management.

In 2022, efficiency levels remained stable with 13 banks each achieving OTE and PTE efficiency. Scale efficiency was restored in 14 banks, and 16 banks returned to CRS, indicating continued optimization in scale operations.

Overall, these trends suggest that Indian banks have largely maintained strong internal operational efficiency, with only a temporary dip in 2020 due to the pandemic. The quick rebound by 2021 and 2022 underscores the resilience of the Indian banking sector in terms of profitability efficiency.

### Year-wise Analysis of Marketability Efficiency Variables (2018–2022)

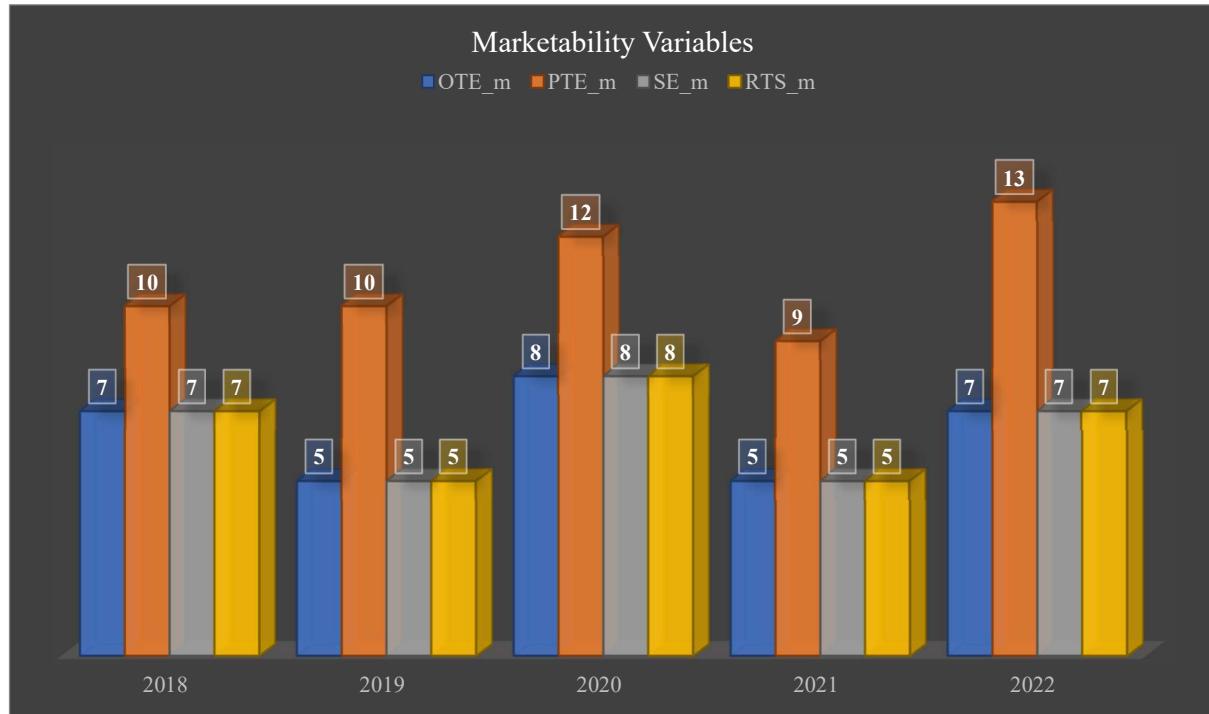


Figure 3

The year-wise changes in marketability efficiency variables—Overall Technical Efficiency (OTE<sub>m</sub>), Pure Technical Efficiency (PTE<sub>m</sub>), Scale Efficiency (SE<sub>m</sub>), and the number of banks operating under Constant Returns to Scale (RTS<sub>m</sub>) (*as shown in figure 2*)—paint a contrasting picture compared to profitability. While internal efficiency was generally strong, external market recognition and valuation of banks remained subdued across all five years.

In 2018, only 7 banks each achieved OTE<sub>m</sub>, PTE<sub>m</sub>, SE<sub>m</sub>, and operated under CRS. In 2019, this declined further to only 5 banks in each category, suggesting a drop in investor confidence or market underperformance, despite stable profitability in the same year.

In 2020, during the height of the pandemic, marketability efficiency showed mixed signals. While OTE<sub>m</sub>, SE<sub>m</sub>, and CRS counts rose to 8, PTE<sub>m</sub> peaked at 12 banks, possibly due to a few banks maintaining positive investor sentiment or expectations despite overall economic uncertainty.

However, 2021 again saw a fall, with just 5 banks each achieving OTE<sub>m</sub>, SE<sub>m</sub>, and CRS status, and 9 achieving PTE<sub>m</sub>. This suggests continued hesitation in market response, even though banks had started to recover operationally.

In 2022, there was modest improvement in market recognition. The number of technically efficient banks (OTE<sub>m</sub>) remained at 7, but PTE<sub>m</sub> peaked at 13, with SE<sub>m</sub> and CRS banks also increasing to 7.

This could indicate a gradual restoration of market confidence, though it still lags behind profitability performance.

The data indicates a consistent gap between profitability and marketability efficiency. While Indian banks efficiently managed their operations and scale, this was not equally reflected in market perception or investor valuation. The relatively lower number of banks achieving CRS in marketability further suggests that many are still operating at suboptimal scale from a market standpoint.

This analysis reinforces the idea that strong internal performance needs to be supported by strategic market engagement, investor communication, and improvements in stock market metrics (such as EPS, PE ratios, and Market Value) to enhance overall value and market positioning.

### 4.3. BCG Matrix Classification

The BCG (Boston Consulting Group) Matrix is a strategic tool used to assess the position of business units or institutions based on two key parameters: Profitability Efficiency and Marketability Efficiency. It helps in identifying where an entity stands in terms of performance and market appeal. The matrix classifies entities into four categories:

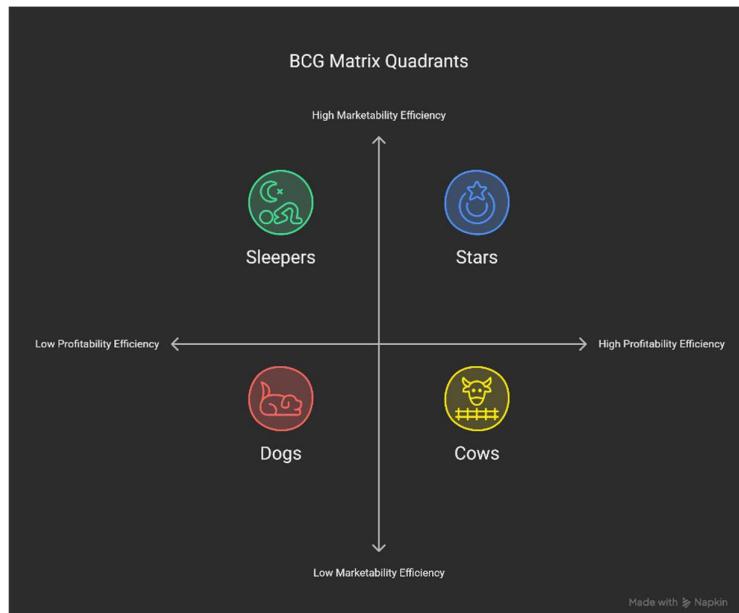


Figure 4

1. **Stars:** High profitability and high marketability. These banks are top performers and have strong growth potential.
2. **Cows:** High profitability but low marketability. These are stable institutions that generate steady returns with minimal investment needs.
3. **Sleepers:** Low profitability but high marketability. They hold market promise but require strategic efforts to improve profitability.
4. **Dogs:** Low profitability and low marketability. These banks may struggle to grow and often need restructuring or exit strategies.

This framework aids decision-making by helping organizations allocate resources effectively and plan for growth, maintenance, or exit strategies.

## Interpretation of BCG Matrix – Year 2018

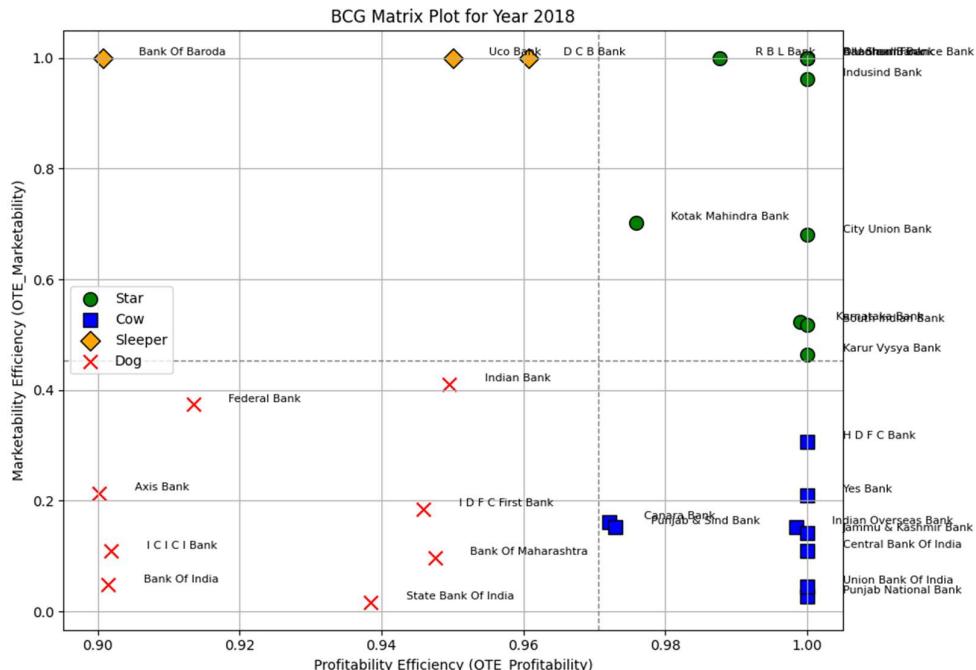


Figure 5

In 2018, a notable number of Indian banks were positioned in the Star quadrant, indicating that several banks demonstrated both high profitability and high marketability efficiencies. These included RBL Bank, AU Small Finance Bank, Bandhan Bank, Dhanlaxmi Bank, IndusInd Bank, and City Union Bank, which were well-regarded both operationally and by the market.

The Cow quadrant, representing banks that were efficient operationally but not well-valued by the market, included major players like HDFC Bank, Yes Bank, Central Bank of India, and Union Bank of India. This suggests a gap between their internal performance and investor perception.

Banks such as Bank of Baroda, DCB Bank, and UCO Bank were found in the Sleeper quadrant, performing relatively better in market efficiency despite lower profitability, potentially due to external factors such as legacy reputation or market speculation.

A considerable number of banks, including ICICI Bank, Axis Bank, Bank of India, and State Bank of India, were in the Dog quadrant, indicating poor performance in both profitability and marketability in 2018. This raises concern about inefficiencies and limited shareholder value generation during the pre-Covid period for these banks.

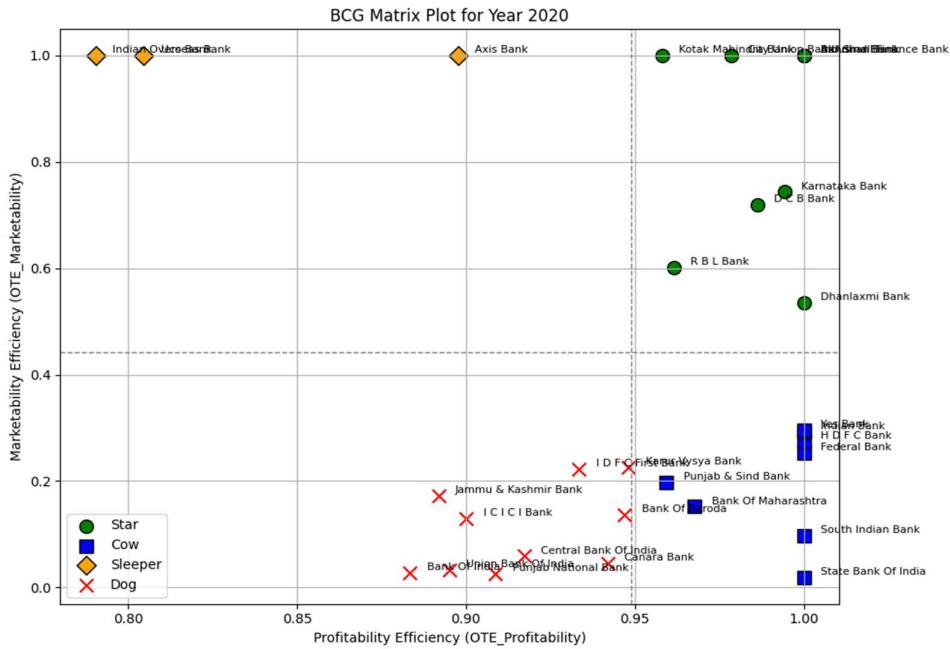
## Interpretation of BCG Matrix – Year 2020

The 2020 BCG Matrix, which captures performance during the peak of the COVID-19 pandemic, reflects noticeable shifts. Stars remained limited but included strong performers like Kotak Mahindra Bank, AU Small Finance Bank, IndusInd Bank, and Bandhan Bank, which managed to maintain both profitability and market reputation during the crisis.

The Cow quadrant retained banks like HDFC Bank, Yes Bank, and Federal Bank, reflecting operational strength but underperformance in market perception due to pandemic-related uncertainties.

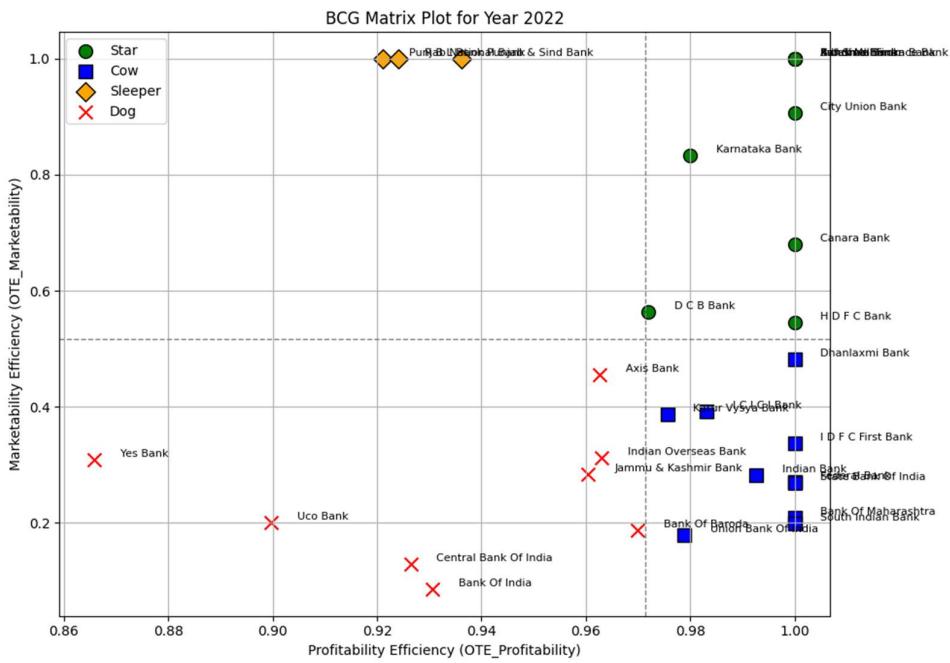
Interestingly, Axis Bank, Indian Overseas Bank, and UCO Bank shifted to the Sleeper quadrant, indicating relatively higher marketability despite lower profitability efficiency—possibly driven by

policy reforms, government backing, or speculative investor behavior. The Dog quadrant saw a rise in membership, including many large public sector banks such as State Bank of India, Bank of Baroda, Canara Bank, Punjab National Bank, and Central Bank of India. This confirms the significant operational and reputational impact that COVID-19 had on major banks during 2020.



*Figure 6*

## **Interpretation of BCG Matrix – Year 2022**



*Figure 7*

In 2022, post-COVID recovery was evident in the improved clustering of banks in the Star quadrant. Banks like Bandhan Bank, Kotak Mahindra Bank, RBL Bank, IndusInd Bank, AU Small Finance Bank, and City Union Bank sustained high performance in both profitability and market perception. This reflects strong adaptation and strategic alignment with market expectations.

The Cow quadrant featured well-established banks such as HDFC Bank, Dhanlaxmi Bank, and Canara Bank, signaling operational recovery but lagging in market sentiment restoration. These banks still need to bridge the gap between financial recovery and investor confidence.

Interestingly, banks like Punjab National Bank, Union Bank of India, and Punjab & Sind Bank shifted to the Sleeper quadrant, indicating improved marketability but underwhelming profitability. This might be driven by temporary market optimism or restructuring efforts.

The Dog quadrant saw banks such as Yes Bank, Axis Bank, Bank of India, and UCO Bank, indicating they continued to face issues in both operational efficiency and market acceptance even post-Covid, despite overall sectoral recovery.

#### **Longitudinal Analysis: Bank Positioning from 2018 to 2022**

Over the period from 2018 to 2022, the BCG Matrix revealed important efficiency transitions among Indian banks. Many private sector banks consistently appeared in the Star quadrant, showing resilience in both operational and market performance—particularly **AU Small Finance Bank, Bandhan Bank, and Kotak Mahindra Bank**, which were consistently among the top performers across years.

The Cow quadrant remained populated with operationally strong banks like HDFC Bank and Dhanlaxmi Bank, suggesting they maintained financial strength but could not fully convert it into shareholder value. Their consistent presence in this quadrant reflects a persistent market perception gap.

A notable fluctuation was seen in public sector banks, many of which shifted between the Dog and Sleeper quadrants. Banks like Bank of Baroda, Punjab National Bank, and UCO Bank struggled to maintain consistent efficiency, often facing challenges in regaining pre-Covid performance levels even by 2022.

The Dog quadrant remained densely populated during the pandemic year (2020), highlighting the adverse operational and reputational impact of Covid-19. While profitability efficiency recovered post-Covid, marketability efficiency improved at a slower pace, as seen in 2022 with some movement from Dogs to Cows or Sleepers but not fully into Stars.

In conclusion, the BCG analysis demonstrates that while many banks recovered operationally post-Covid, few succeeded in aligning profitability with investor sentiment. The findings underscore the need for strategic market positioning, investor engagement, and operational excellence to achieve balanced performance across both profitability and marketability dimensions.

#### **4.4. Key results about each objective or research question**

##### **Results on Research Questions**

This study aimed to evaluate the profitability and marketability efficiencies of Indian banks using a two-stage DEA model across the five-year period from 2018 to 2022. The analysis incorporated ownership structure, the impact of the COVID-19 pandemic, and a comparative assessment of efficiency trends across pre-, during-, and post-Covid periods. The key findings corresponding to each research question and objective are summarized below:

##### **1. What are the levels of profitability and marketability efficiencies of Indian public and private sector banks during the period 2018-2022?**

The DEA analysis clearly revealed that Indian banks consistently performed well in profitability efficiency throughout the 2018–2022 period. Most banks, especially private sector ones, maintained

high Overall Technical Efficiency (OTE) and Pure Technical Efficiency (PTE), even during the pandemic. However, marketability efficiency lagged across the years. While 2022 showed improvement post-COVID, the number of banks with high marketability efficiency was still limited. The BCG matrix for each year further confirmed this discrepancy: in 2018 and 2022, more banks qualified as “Cows” (high profitability, low marketability) than as “Stars,” reflecting strong internal performance not fully matched by market perception.

## **2. How does the ownership structure (public vs. private) influence the efficiency levels of Indian banks?**

Ownership structure significantly influenced the efficiency outcomes. Private sector banks like AU Small Finance Bank, Bandhan Bank, Kotak Mahindra Bank, and IndusInd Bank consistently appeared in the “Star” quadrant across years, indicating high efficiency in both dimensions. In contrast, public sector banks were frequently in the “Dog” or “Sleeper” quadrants, especially during the pandemic years. While some public banks showed operational strength, they struggled to generate positive investor sentiment, highlighting structural inefficiencies and a need for strategic repositioning in the market.

## **3. What is the impact of the COVID-19 pandemic on the profitability and marketability efficiencies of Indian banks?**

The year 2020 reflected the most significant decline in both profitability and marketability efficiencies. Several banks shifted to the “Dog” quadrant, with notable examples including State Bank of India, Bank of Baroda, and Central Bank of India, suggesting deep-rooted operational and reputational challenges triggered by the pandemic. The 2020 BCG matrix displayed an increased concentration of banks in the lower-left quadrant (low in both efficiencies), but a few private banks like Kotak Mahindra Bank and AU Small Finance Bank retained Star status, showcasing resilience. Marketability recovery lagged even as profitability rebounded by 2021.

## **4. How do the efficiency scores of Indian banks vary across the pre-COVID, during COVID, and post-COVID periods?**

- Pre-COVID (2018-2019): Profitability efficiency was at its highest with many banks being scale-efficient and technically sound. Marketability efficiency was modest; only a handful of banks were perceived well in the market, leading to fewer Stars in the BCG matrix.
- During COVID (2020-2021): Operational disruptions caused a decline in profitability efficiency in 2020, while marketability deteriorated sharply. 2021 showed operational recovery, with more banks regaining OTE and PTE efficiency. However, only marginal improvement was seen in marketability scores.
- Post-COVID (2022): Most banks recovered profitability efficiency levels, with several returning to CRS. Marketability efficiency improved slightly, reflected in the movement of some banks from “Dogs” to “Cows” or “Sleepers.” However, the number of Stars remained limited, underlining that market perception still lagged behind internal recovery.

### **Results on Research Objectives**

- Evaluate Efficiency: Indian banks maintained strong profitability efficiency overall, especially private sector banks. However, marketability efficiency remained a challenge, suggesting that operational performance was not always reflected in stock market outcomes.
- Impact of Ownership: Ownership structure significantly influenced efficiency outcomes. Private sector banks were generally more efficient and more likely to be positively perceived by the market compared to public sector counterparts.

- Impact of COVID-19: The pandemic had a negative impact on both profitability and marketability, with 2020 showing the lowest efficiency scores. While operational recovery was evident by 2021, market confidence improved only modestly by 2022.
- Comparative Analysis: There were distinct patterns across pre-Covid, Covid, and post-Covid phases. A V-shaped recovery was observed in profitability, while marketability followed a slower, flatter trajectory. These findings emphasize the importance of aligning internal reforms with external market strategy.

## Chapter 5. FINDINGS AND DISCUSSION

### 5.1. Discussion on results

The study aimed to evaluate the performance of Indian public and private sector banks by measuring their profitability and marketability efficiencies using a two-stage DEA approach across five critical years (2018-2022). The findings offer key insights into the efficiency dynamics, impact of external shocks, and the role of ownership structure in shaping performance outcomes.

One of the most consistent results is the strong operational (profitability) efficiency exhibited by a majority of banks, especially private sector players. Despite macroeconomic and regulatory challenges, many banks were able to manage resources effectively, as evidenced by high Overall Technical Efficiency ( $OTE_p$ ) and Pure Technical Efficiency ( $PTE_p$ ) scores. This suggests well-structured internal processes, cost control, and sound financial management.

In contrast, marketability efficiency remained considerably weaker across the years. While profitability rebounded quickly post-COVID, market efficiency—measured through stock performance variables like EPS, market value, and P/E ratios—lagged behind. This implies that investor confidence did not immediately align with financial recovery, especially for public sector banks, which continued to be undervalued in the market despite improvements in profitability.

The BCG Matrix analysis across 2018, 2020, and 2022 added another layer of insight. Private sector banks such as AU Small Finance Bank, Bandhan Bank, and Kotak Mahindra Bank consistently appeared in the Star quadrant, maintaining both profitability and market recognition. On the other hand, many public sector banks remained in the Dog or Sleeper quadrants, indicating inefficiencies and low investor appeal. Even by 2022, these banks had not fully shifted into higher-performing categories, emphasizing the need for deeper structural reforms and stronger stakeholder communication.

The impact of the COVID-19 pandemic was clearly visible in 2020, where there was a marked decline in both DEA efficiencies and a surge in banks classified as Dogs. This disruption was more pronounced in public sector banks, reflecting limited flexibility and slower adaptability. However, by 2021 and 2022, most private banks had not only recovered but improved, while public banks showed only modest gains.

Ownership structure thus emerged as a significant determinant of performance. Private banks consistently outperformed public banks, both in terms of recovering from the pandemic shock and in sustaining dual efficiency. This may be attributed to greater managerial autonomy, technological agility, and focused investor relations.

In summary, while profitability efficiency has remained the strength of Indian banks, marketability efficiency continues to be a weakness—especially among public sector banks. Bridging this gap will require not only operational improvements but also strategic steps toward transparency, governance reforms, market communication, and brand repositioning in the post-COVID era.

### 5.2. Implementation and suggestions

- **Bridging the Profitability-Marketability Gap:** Many banks with strong internal efficiency failed to reflect similar success in market performance. This suggests a need for enhanced investor communication, transparency in disclosures, and stronger brand positioning to translate profitability into improved marketability.

- **Focus on Strategic Investor Relations (IR):** Public sector banks, in particular, should strengthen their IR practices to build investor confidence. Regular earnings calls, forward-looking statements, and shareholder engagement can help improve stock market perceptions.
- **Improve Market-Driven Performance Metrics:** Banks should align their strategic objectives with market-based performance indicators like EPS, ROE, and market-to-book ratios. A focus on value creation for shareholders will improve marketability efficiency.
- **Leverage Digital Transformation for Scale Efficiency:** Many banks operating under variable returns to scale (IRS/DRS) must prioritize scalable digital solutions and process automation to move toward Constant Returns to Scale (CRS) and achieve better scale efficiency.
- **Public Sector Bank Reforms:** Given their consistent underperformance in marketability, public sector banks must undergo governance and structural reforms, including autonomy in decision-making, improved risk management, and performance-linked management incentives.
- **Post-COVID Strategic Realignment:** The post-pandemic era calls for a re-evaluation of business models. Banks must balance traditional branch banking with fintech partnerships, digital lending platforms, and customer-centric innovations.
- **Periodic Efficiency Monitoring:** Implementing DEA-based internal dashboards can help management monitor both profitability and marketability efficiency at regular intervals and take timely corrective actions.
- **BCG Matrix for Strategic Planning:** Banks should use the BCG Matrix classification not just for analysis but as a tool for portfolio management, deciding which segments to grow (Stars), stabilize (Cows), restructure (Sleepers), or potentially divest (Dogs).

## **Chapter 6. CONCLUSION**

### **6.1. Concluding remarks of the project**

This study provided an in-depth evaluation of the profitability and marketability efficiencies of Indian public and private sector banks during the period 2018-2022, using the two-stage Data Envelopment Analysis (DEA) model. The analysis revealed that while banks—especially in the private sector—consistently achieved high operational efficiency, a significant gap existed in marketability efficiency, particularly among public sector banks.

The BCG Matrix added strategic insights by categorizing banks based on their dual performance, highlighting the resilience of private banks and the structural challenges faced by many public sector institutions. The impact of the COVID-19 pandemic was clearly evident in the dip observed in 2020, followed by a gradual recovery, especially in profitability dimensions.

Overall, the findings underscore the need for banks to not only sustain internal efficiency but also enhance their external market presence and investor engagement. The study offers valuable inputs for banking strategists, policymakers, and financial analysts aiming to improve institutional performance and shareholder value in a dynamic post-pandemic financial environment.

## References

- Thota Nagaraju. (2013). An Analysis of Profitability and Marketability Efficiencies of Indian Public and Private Banks. *Indian Journal of Finance*.
- Lawrence M. Seiford & Joe Zhu. (1999). Profitability and Marketability of the Top 55 U.S. Commercial Banks. *Institute for Operations Research and the Management Sciences (INFORMS)*.
- Xueming Luo. (2001). Evaluating the profitability and marketability efficiency of large banks an application of data envelopment analysis. *Journal of Business Research* 56 (2003) 627 - 635.
- Chien-Ta Ho & Dauw-Song Zhu. (2004). Performance measurement of Taiwan's commercial banks. *International Journal of Productivity and Performance Management Vol. 53 No. 5, 2004 pp. 425-434.*
- Chiang Kao & Shiu-Nan Hwang. (2006). Efficiency decomposition in two-stage data envelopment analysis: An application to non-life insurance companies in Taiwan. *European Journal of Operational Research* 185 (2008) 418-429.
- Shih-Fang Lo & Wen-Min Lu. (2005). Does Size Matter? Finding The Profitability And Marketability Benchmark Of Financial Holding Companies. *Asia Pac. J. Oper. Res.* 2006.23:229-246.
- I Oannis E. T Solas. (2010). Relative profitability and stock market performance of listed commercial banks on the Athens Exchange: a non-parametric approach. *IMA Journal of Management Mathematics* (2011) 22, 323-342.
- Arunava Bhattacharyya, C.A.K. Lovell & Pankaj Sahay. (1997). The impact of liberalization on the productive efficiency of Indian commercial banks. *European Journal of Operational Research* 98 (1997) 332-345.
- Biswajit Chatterjee & Ram Pratap Sinha. (2006). Cost Efficiency and Commercial Bank Lending: Some Empirical Results. *The Indian Economic Journal*.
- Abhiman Das & Saibal Ghosh. (2006). Financial deregulation and efficiency: An empirical analysis of Indian banks during the post reform period. *Review of Financial Economics* 15 (2006) 193 - 221.
- Abhiman Das, Ashok Nag & Subhash C Ray. (2005). Liberalisation, Ownership and Efficiency in Indian Banking A Nonparametric Analysis. *Economic and Political Weekly*.
- Subhash C. Ray & Abhiman Das. (2009). Distribution of cost and profit efficiency: Evidence from Indian banking. *European Journal of Operational Research*.
- Rudra Sensarma. (2008). Deregulation, ownership and profit performance of banks: evidence from India. *Applied Financial Economics*, 2008, 18, 1581-1595.
- CMIE ProwessIQ Database.
- Company Annual Reports from 2018-2022.

## Appendix

### R code for DEA CCR model:

```
# Load required libraries
library(readxl)
library(Benchmarking)
library(writexl)

# Step 1: Load the data from Excel through import dataset option and give the name below
data <- X2018 #update the uploaded file name in the workspace here

# Step 2: Select input and output variables for PROFITABILITY stage
# Inputs: Assets, Employees, Operating Expenses, Equity
# Outputs: Revenue, Profit Margin, ROA, ROE

inputs <- as.matrix(data[, c("Assets", "Employees", "Operating Expenses", "Equity")])
outputs <- as.matrix(data[, c("Revenue", "Profit Margin", "ROA", "ROE")])

# Step 3: Run DEA using CCR (constant returns to scale)
dea_result <- dea(X = inputs, Y = outputs, RTS = "crs", ORIENTATION = "in")

# Step 4: Add the OTE scores to the original data
data$CCR_OTE <- dea_result$eff

# Step 5: Export the updated data with efficiency scores to Excel
write_xlsx(data, "DEA_CCR_Efficiency_Output.xlsx")
```

### R code for DEA BCC model:

```
# Load required libraries
library(readxl)
library(Benchmarking)
library(writexl)

# Step 1: Load the data from Excel through import dataset option and give the name below
data <- X2018 #update the uploaded file name in the workspace here

# Step 2: Select input and output variables (same as CCR model)
inputs <- as.matrix(data[, c("Assets", "Employees", "Operating Expenses", "Equity")])
outputs <- as.matrix(data[, c("Revenue", "Profit Margin", "ROA", "ROE")])

# Step 3: Run DEA using BCC (variable returns to scale)
dea_bcc <- dea(X = inputs, Y = outputs, RTS = "vrs", ORIENTATION = "in")

# Step 4: Add the BCC PTE scores to the original data
data$BCC_PTE <- dea_bcc$eff

# Step 5: Export the updated data with PTE scores to Excel
write_xlsx(data, "DEA_BCC_Efficiency_Output.xlsx")

# Done! The output file will be saved in your working directory.
```

**R code used for finding returns to scale of each DMU:**

```
library(readxl)
library(Benchmarking)
library(writexl)

# Load data
data <- X2018

# Prepare inputs and outputs
inputs <- as.matrix(data[, c("Revenue", "Profit Margin", "ROA", "ROE")])
outputs <- as.matrix(data[, c("EPS", "Market Value", "PE ratio", "MB ratio")])

# DEA under CRS
dea_crs <- dea(X = inputs, Y = outputs, RTS = "crs", ORIENTATION = "in")

# DEA under VRS
dea_vrs <- dea(X = inputs, Y = outputs, RTS = "vrs", ORIENTATION = "in")

# DEA under IRS
dea_irs <- dea(X = inputs, Y = outputs, RTS = "irs", ORIENTATION = "in")

# DEA under DRS
dea_drs <- dea(X = inputs, Y = outputs, RTS = "drs", ORIENTATION = "in")

rts_labels <- rep(NA, nrow(data))

for (i in 1:nrow(data)) {
  if (abs(dea_crs$eff[i] - dea_vrs$eff[i]) < 1e-4) {
    rts_labels[i] <- "CRS"
  } else if (abs(dea_irs$eff[i] - dea_vrs$eff[i]) < 1e-4) {
    rts_labels[i] <- "IRS"
  } else if (abs(dea_drs$eff[i] - dea_vrs$eff[i]) < 1e-4) {
    rts_labels[i] <- "DRS"
  } else {
    rts_labels[i] <- "Unclassified"
  }
}

data$CRS_TE <- dea_crs$eff
data$VRS_TE <- dea_vrs$eff
data$RTS_Type <- rts_labels
```