GNA Journal of
Management & Technology

ISSN - 0974-5726
Vol. 16 No. 1, January-June, 2025

EFFICIENCY OF INDIAN BANKS: THE ROLE OF OWNERSHIP DYNAMICS

Nidhi Thakur[1] Dr. Sangeeta Arora[2]

[1]*Research Scholar, University School of Financial Studies, Guru Nanak Dev University, Amritsar, India.*
Email: nidhithakur30994@gmail.com,

[1]*Professor, University School of Financial Studies, Guru Nanak Dev University, Amritsar, India*
Email: Sukhsangeet@yahoo.com

ABSTRACT

The aim of current study is to empirically analyze and evaluate the extent of technical efficiency and its decomposition in managerial & scale efficiency of Indian Scheduled Commercial Banks (SCBs) across different ownership groups during 2015-2024. Efficiency of sampled SCBs is calculated through non-parametric frontier approach, i.e., data envelopment analysis (DEA). Thereafter, one-way ANOVA is used to compare the difference in relative efficiency levels among public, private and foreign banks in India. Public sector banks, as a group are ahead in terms of overall technical efficiency and its dimensions, followed by private bank and then foreign banks. The ownership structure is a significant factor responsible for difference in efficiency levels among Indian SCBs. This novel study provides valuable insights to banks, investors, policymakers and managers. Investors can use ranks as investment criteria, identifying high performers for optimal returns. Banks can streamline resources or expand operations using rankings and performance comparisons. The results will provide policy frameworks for a secure and steadily growing banking environment for all ownership groups. The current study is comprehensive reassessment of the Indian banking sector as Indian banking sector has transformed due to regulatory reforms, technological advancements, demonetization, competitive pressures, consolidations and rapid financial inclusion.

KEYWORDS: *Efficiency; Foreign banks(FBs); India; Public sector banks (PSBs); Private sector banks(PBs)*

1. INTRODUCTION

A well-functioning financial system supports the efficient operation of a nation's payment system and ensures the effective implementation of monetary policy. The efficiency of the financial system in resource generation and allocation is a significant medium for achieving higher economic growth. The banking system, as a key component of financial institutions in a developing country like India, plays a crucial role in promoting economic growth and national development (Maity et al., 2020) .

The significance of the banking system in the Indian economy is documented by the fact that aggregate deposits amounted to 72.6 % of the GDP in 2022 (Reserve Bank of India, 2022). Considering this crucial role, it is essential to develop a sound banking system which has direct implications for social welfare. Therefore, it becomes essential to evaluate the productivity and performance of banking institutions in contributing to economic growth and development using quantitative and effective methods. In the existing literature, the performance of the banking sector has primarily been assessed through two approaches: financial ratio analysis and efficiency measurement techniques (Tesfay, 2016) .

Besides using conventional financial ratios, frontier efficiency measures capture performance of banks in meaningful and reliable way and provide the foundation for study the reasons producing efficiency differences (Arora, 2014). Efficiency evaluates a firm's performance in relation to a benchmark at a certain point in time . Efficiency displays the optimal use of resources to produce the maximum level of output. For banks, efficiency means achieving higher profitability, utilizing funds in more effective ways, providing higher service quality for customers and ensuring greater safety through a larger capital buffer to absorb risk, ultimately maximizing revenue at minimum cost. (Bhatia & Mahendru, 2015a).

While countless studies have analyzed efficiency through different dimensions worldwide and in the Indian context in the extant literature, but in today's era, the Indian banking sector has witnessed many changes on account of regulatory reforms, technological advancements, competitive pressures, consolidations and rapid financial inclusion (Baral & Patnaik, 2021). In the past, PSBs dominated the Indian banking sector, comprising 72% of the total assets, while PBs held 21%, and FBs held a mere 7% share (Reserve Bank of India, 2013). However, the advent of new PBs has challenged the dominance of old PSBs (Gulati et al., 2023). Consequently, the market share of assets for PSBs declined to 58%, while the share of PBs increased to 35% (Reserve Bank of India, 2024). Thus, there is a dire need to reassessment of the Indian banking sector in recent times.

The present study contributes to the existing literature in several ways. First, this is a comprehensive study that considers ownership structures across PSBs, PBs and FBs separately, instead of focusing on a single bank group in India. Second, it uses the recent data to measure efficiency based on its availability. Third, this study conducts a holistic analysis of overall efficiency, differentiating between managerial and scale efficiencies. Fourth, it sheds light on the ranking of Indian scheduled commercial banks (SCBs) based on their comparative performance in terms of overall efficiency. Finally, multiple comparisons for average performance among SCBs have been conducted by considering ownership structure as an independent variable.

Thus, the main aim of the present study is to conduct an in-depth investigation of technical efficiency (TE at constant and variable returns to scale for Indian SCBs, aiming to understand the reasons for inefficiency within them. Additionally, the present study provides ranking for SCBs across different ownerships to set benchmark for them.

The findings of this study confirm that PSBs have outperformed PBs and FBs in terms of overall TE and its types. The managerial and scale efficiency of FBs as a group is paradoxically lower than domestic banks due to unfamiliarity with the local conditions. The ownership structure is an relevant factor, responsible for the difference in efficiency levels among Indian SCBs.

The present study is structured as: provides a brief systematic review of existing literature. defines the sample size & period; empirical techniques and inputs & outputs used for estimating efficiency. describes the summary of empirical results, while Section 5 concludes the findings, implications and limitations of the study.

2. LITERATURE REVIEW & EFFICIENCY TYPES

The performance of banks in terms of efficiency analysis has been substantially discussed in the existing literature, theoretically and empirically across different countries through various perspectives and methodological approaches. A brief review of noteworthy studies has been made in Table I.

Table I: Systematic review of literature on bank efficiency

Author	Country	Period	Sample	Efficiency measures	Approach	Inputs	Outputs	Findings
Sensarma (2006)	India	1986-2000	N.S	TE, TFP	SFA	Labour, Capital	Deposits, Loans & advances, Investment, Branches	Fbs are poor performers for cost efficiency and productivity as compared to Indian domestic banks.
Sufian (2009)	China	1997-2006	16	TE, PTE, SE	DEA, Tobit regression	FA , Deposits, Labour	Loans & Advances, Investments	Joint stock commercial banks have been more technically efficient than State-owned commercial banks due to higher PTE, SE.
Chrono -poulos et al. (2011	10 Accession Countries	2001-2007	N.S	CE, PE	DEA	Labour, Capital, Deposits	Loans , Off b/sheet items, other earning assets	Diversified banks are more profit and cost efficient.
Gulati (2011)	India (PSBs, PBs)	2007	51	TE, PTE, SE	DEA, Tobit regression	Employees, F.A,Loanable funds	Loans , Off b/sheet items, other earning assets	Diversified banks are more profit and cost efficient.
Nandi (2013)	India (PSBs, PBs)	2011-2012	20	TE, PTE, SE	DEA, Malmquist index	Interest cost, Operating cost	Interest income, Other income	PSBs outperformed PBs in terms of productivity and efficiency
Arora (2014)	India	1992-1993 to 2006-2007	54	TE	DEA	Wages, F.A, Deposits	Loans, Investments	Pbs are the most efficient bank group, followed by PSBs then by FBs. Banking reforms have improved the efficiency of SCBs in India.

Arrawatia et al. (2015)	India	1996-2011	53	RE	DEA, Granger causality test	Interest expenses, Operating expenses	Interest income, Non-interest income, Deposits	Competition positively affects efficiency in banks and vice-versa.
barman et al. (2015)	India (PSBs)	2002-2003	25	TE, PTE, SE	DEA	No. of employees, F.A, Loanable fund	Earning assets, Non-interest income	T.E of PSBs have improved over study period and managerialinefficiency is root cause of technical inefficiency.
Bhatia & Mahendru (2015)	India (PSBs)	2001-2013	Un balanced dataset	RE	DEA, Kruskal Wallis	Deposits, No. of employees, Borrowing, F.A	Loans & advances, Investments	PSBs tend to more revenue efficient than PBs and FBs
Tzeremes (2015)	India	2004-12	64	TE	DEA	Deposits, No. of employees, F.A	Loans & advances, Other earning assets	Fbs in India are most efficient, followed by PSBs and PBs.
Tesfay (2016)	Ethiopia	2003-12	8	TE	DEA, Tobit regression	Deposits, Interest expense	Interest income, Other income	Deposits and liquidity have positive relation with efficiency in Ethiopia
Nguyen Minh (2017)	Vietnam	2007-15	34	TE	DEA, Tobit regression	Deposits, Compensation to employees, F.A	Interest income, Non-interest income	Diversified banks are more operational efficient in Vietnam.
O. Singh & Bansal (2017)	India	2002-2013	27	TE	DEA, Tobit regression	Deposits, No. of employees, F.A	Loans & advances, Other earning assets	PSBs with high profitability, low NPAs, and larger size tend to have higher TE.
Bhatia & Mahendru (2018)	India	1992-2013	Unbala -nced dataset	CE	DEA	Deposits, Interest expense	Interest income, Loans	SCBs are not fully cost efficient during the study period. CE is lower in the post-reformatory era
Goswami et al. (2019)	India	2007-17	64	PTE	DEA, FE, RE	Deposits, Compensation to employees, F.A	Interest income, Non-interest income	PSBs and FBs are more efficient than PBs.
Dar et al. (2021)	India (PSBs, PBs)	2014-2020	Unbala -nced dataset	TE	DEA, Malmquist Index, SFA	Equity, No. of employees, Borrowing, F.A	Loans & advances, Investments, Non interest incomes	Pbs are more efficient than PBs under DEA approach and vice –versa in SFA. NPAs are main cause of inefficiency in Indian banks.
Patra et al. (2023)	India (PSBs, PBs)	2004-20	36	PE, BE, Z-Score efficiency	DEA, Tobit regression	No. of employees, No. of branches, Salaries expenses	Total business, Profit after tax, Z-Score	PSBs are, on an average, more efficient than domestic PBs

Note: T.E: Technical efficiency; C.E: Cost efficiency; PTE: Pure technical efficiency: SE: Scale efficiency; BE: Business efficiency DEA: Data envelop analysis; SFA: Stochastic frontier analysis; FE: Fixed effect; RE: Random effect: FA: Fixed assets; No.: Number; PAT: Profit after tax; NPA: Non-performing assets; N.S: Not specified in the study.

Source: Author's Compilation

The existing literature confirms an abundance of research on bank efficiency, including studies focused on India. However, there is a notable gap in attention towards assessing relative efficiency of individual banks under different ownership structures. Furthermore, detailed analyses of efficiency and its components on a yearly basis are lacking in the extant literature. Additionally, the Indian banking sector has undergone various transformations due to regulatory reforms, technological advancements, demonetization, competitive pressures, consolidations, rapid financial inclusion, and the COVID-19 pandemic. These transformations warrant a comprehensive reassessment of the Indian banking sector.

2.1 Types of efficiency

The Technical efficiency pertains to the productivity of inputs in terms of their optimum utilization for producing a given level of output (Sathye, 2001). TE of a unit is a relative assessment of how effectively it utilizes inputs to attain outputs, relative to its highest attainable level, as depicted by its production possibility frontier (Kumar & Gulati, 2008a). Technical inefficiency arises as a consequence of the managerial inabilities in input/output configuration as well as the inappropriate size of operations. Thus, TE measures overall economic performance of banks under constant returns to scale (CRS) assumption (Maity et al., 2020) .

When TE is calculated under variable returns to scale (VRS), it is known as pure technical efficiency (PTE, hereafter). It demonstrates managerial expertise and skills for converting the inputs to outputs to ensure minimum wastage of inputs to produce maximum outputs. It works as an index to measure managerial performance in terms of decreasing inputs or increasing outputs while still remaining within VRS frontier. Any bank is considered as pure technical efficient, if it is utilizing its inputs optimally and efficiently, without considering scale effects. The primary causes of pure technical inefficiency stem from controllable managerial factors and uncontrollable environmental factors (Kumar & Gulati, 2008a).

However, Scale efficiency (SE, hereafter) reflects optimal scale size that will attain the expected production level. When any bank is working at a non-optimal scale i.e., either at increasing/decreasing returns-to-scale, it indicates a presence of scale inefficiency. The inappropriate size of a bank leads to technical inefficiency (Kumar & Gulati, 2008a) . If a bank is operating at constant returns-to-scale, where its average productivity is maximum then it is considered as scale efficient. The difference in the TE score between CCR Model and BCC Model indicates scale inefficiency. SE score has been measured by dividing the ratio of TE Score CCR Model) to PTE Score (BCC Model) . Thus, overall TE is product of PTE and SE.

3. DATA BASE AND RESEARCH METHODOLOGY

3.1 Sample

The sample of the present study consists balanced panel dataset of a total 53 SCBs banks , including 12 PSBs, 17 PBs and 24 Fbs.

3.2 Time period

The data were gathered for 10 years during 2015 - 2024, from the official website of the Reserve Bank of India (www.rbi.org.in).

3.3 Empirical Methodology

3.3.1 Choice of estimation methodology

There are two approaches to measure efficiency i.e. parametric and non parametric approach. Parametric Approach specifies the functional forms for cost, profit or production frontier (Banker et al., 1984) . These approaches lie on the assumption that the difference between observed and optimal level of output arises due to uncontrollable random factors (noise) and inefficiency components (Arora, 2014). There is no specific assumption regarding particular functional form for cost or production frontier under non-parametric approaches but, it ignores any noise (random fluctuations) in the data and considers the leftover effect as inefficiency. It is based on properties like convexity and homogeneity for DMUs, implying they are operating under the same production technology (Megha, 2016). There are two popular non parametric techniques i.e. Data Envelopment Analysis (DEA) and Free Disposal hull methods. These approaches are suitable for social studies where multiple inputs and outputs are required to calculate the efficiency scores (Kumar & Gulati, 2008a) . Non-Parametric Approach is more advantageous because it follows less assumptions regarding underlying functional forms of production or cost function (Gardener et al., 2011) . In the present study, efficiency is calculated through non parametric approach, i.e., DEA.

DEA is based on a linear programming technique which measures relative performance of any unit/bank against the best-observed performance. In DEA, each firm or unit is known as decision making unit (DMU). DEA constructs the frontier based on input-output ratios from the most efficient DMUs and then estimates how far the inefficient DMUs are from the efficient frontier (Goswami et al., 2019). All DMUs lying on the frontier have an efficiency score equal to one (efficient firms), and all DMUs lying below the frontier have scores between zero and one (representing inefficient firms). The difference between the actual obtained outputs and optimal level of outputs displays degree of inefficiency. DEA provides weights or coefficients to inputs and outputs through linear programming technique. These weights are derived from the data with the objective to maximize the ratio of weighted output to weighted input. The sum of weighted inputs and outputs of all DMUs is known as virtual inputs and virtual outputs, respectively. Thus, relative efficiency under DEA is calculated based on the condition that efficiencies of all DMUs range between 0 and 1(Megha, 2016).

Preference for DEA

In present study, we use DEA technique for calculation of efficiency because of small sample sizes of SCBs under different ownership groups as application of SFA demands large size of sample (Ariff & can, 2008; Girardone et al., 2004). Furthermore, an application of DEA does not require functional forms in form of Cobb Douglas or production functions for efficiency frontier (Huang & Chen, 2006; Khan et al., 2020). Moreover, DEA deals with multiple outputs and inputs and more flexible than SFA . (Kumar & Gulati, 2008a). Thus, an inaccurate specification of functional form for efficiency frontier does not contaminate the efficiency results calculated through DEA (Das & Ghosh, 2006).

3.3.1(a) Orientation of DEA models

The input-oriented model aims to minimize the inputs at existing levels of outputs while the output-orientated model aims to maximize the outputs at existing levels of inputs (Goswami et al., 2019) . In this study, output-oriented DEA model is chosen in consonant with goals of Indian banks in today's competitive era i.e. to maximize interest as well as non interest income levels. The output-oriented method has been preferred over input-oriented model because banks are more concerned about bank output rather than input and tend to increase output to improve their productivity (Baral & Patnaik, 2021) . In the competitive market, banks' efficiency is directly measured in terms of controlling costs and generating revenue, thus banks aim to strengthen their lending to collect high amount of interest income from their loans and other assets (Tesfay, 2016) .

3.3.1(b) Data & Specification of Inputs & Outputs

In this study, consistent with the majority of recent literature, the selection of input and output variables are made on the basis of modified version of intermediation approach, where labour and loanable funds (deposits plus borrowings) are used as inputs and interest income and non-interest income are used as outputs. The output variables are selected in consonance with the objective of revenue maximization in the Indian banking industry during the recent period of globalization. However, the omission of non-interest income understates bank's output and has adverse statistical and economic effects on estimated efficiency (Alhassan & Tetteh, 2017; Gulati, 2011) . The inclusion of 'non-interest income' allows us to reflect recent changes in production of services as Indian banks become more active in non-traditional banking operations. The inputs and outputs are represented in Table II.

Table II: Description of Inputs and outputs

Variables	Measurement	Source
Inputs		
No. of Employees	Numbers	Dar et al., 2021; Patra et al., 2023; P. K. Singh & Thaker, 2020)

Loanable funds (Deposits & Borrowings	Lakhs	(Ariff & Can, 2008; Barman et al., 2015; Gulati & Kumar, 2016)
Outputs		
Interest Income	Lakhs	(Baral & Patnaik, 2021; Maity et al., 2020; O. Singh & Bansal, 2017)
Non-Interest Income (NII)	Lakhs	(Bhatia & Mahendru, 2018; Jayaraman & Srinivasam, 2019; Nguyen Minh, 2017)

Source: Author's Compilation

3.3.1(c) Prerequisites for selection of inputs and outputs

In the present study, we have 12 PSBs, 17 PBs and 24 FBs. The prerequisite of DEA demands, firstly, that the product of the number of inputs and outputs should be less than the sample size. Secondly, the sample size (DMUs) should be at least three times the total number of inputs and outputs (Bhatia & Mahendru, 2018; R. Goswami et al., 2019). The quantities of inputs and outputs are chosen to satisfy these conditions.

The prerequisite of DEA, which mandates a positive and statistically significant correlation between input and output variables , is satisfied in this study

3.3.1(d) Limitations on number of Inputs & Outputs

Though fixed assets, equity capital and investments are also taken as inputs in existing literature and significantly affect efficiency of banks. Due to small sample size (12 PSBs), we are constrained by number of inputs& outputs in this study as we do not able to ignore both II and NII, so option of choosing two inputs remains with us.

3.3.2 Analysis of Variance (ANOVA)

To determine whether there is a difference in average performance (TE) across different ownership groups, a One-Way ANOVA is applied with a sample of 53 SCBs over 10 years, comprising 530 observations. The null hypothesis states that "there is no significant difference in TE among SCBs in India". Subsequently, a post hoc test is conducted for multiple comparisons to check for mean differences among the groups and to what extent.

4. EMPIRICAL RESULTS

In following section, efficiency of PSBs, PBs and FBs are measured bank wise during sampled period from 2015 to 2024. Then efficiency is bifurcated into three parts, i.e., TE, PTE, and SE in table VI across different ownership groups. Then, ranking of SCBs is made on the basis of average efficiency of them during sampled period, followed by application of ANOVA to evaluate the significance of level of difference among efficiency of SCBs.

Table III: Performance of PSBs in India

	PSBs	2015	2016	2017	2018	2019	2020	2021	2022	2013	2024	No. of times of being efficient
1	Bank of Baroda	1	0.904	0.932	0.938	0.923	0.915	0.937	0.91	0.972	0.942	1
2	Bank of India (BOI)	1	1	1	0.902	0.938	0.905	0.888	0.917	0.886	0.896	3
3	Bank of Maharashtra	0.952	1	1	1	1	0.999	0.93	0.942	1	1	6
4	Canara Bank	1	0.984	0.954	0.927	0.974	1	0.917	0.94	0.938	0.964	2
5	Central Bank of India (CBI)	0.906	0.982	0.985	1	0.899	0.803	0.884	0.917	0.96	0.960	1
6	Indian Bank	1	0.987	0.98	0.927	0.969	1	1	1	1	1	5
7	Indian Overseas Bank (IOB)	0.98	0.981	0.966	0.871	1	0.882	1	1	1	1	5
8	Punjab & Sind Bank	1	1	1	1	1	0.988	1	1	1	1	9
9	Punjab National Bank (PNB)	1	0.962	0.957	0.851	0.906	0.841	0.905	0.942	0.997	0.943	1
10	SBI	1	1	1	1	1	1	1	1	1	1	10
11	UCO Bank	0.915	0.903	0.938	0.837	0.881	0.722	0.827	0.947	0.933	0.961	0
12	Union Bank of India	1	1	1	1	0.99	1	0.965	0.942	1	0.979	5
	Mean	0.98	0.98	0.98	0.94	0.96	0.92	0.94	0.95	0.97	0.97	5
	No. of efficient banks	8	5	5	5	4	4	4	4	6	5	

Source: Author's Compilation

Table III displays the year wise, TE score of PSBs from 2015 to 2024. UCO Bank consistently exhibits inefficiency as its TE is less than one throughout the sampled period. On the flip side, the State Bank of India (SBI, hereafter) consistently achieves a score of one in every year and is found to be efficient during the entire assessment period. Therefore, in terms of optimum utilization of inputs, SBI has outperformed the remaining PSBs and created a benchmark. On an average, the annual TE score of the PSBs ranges between 0.921 and 0.979

Table IV: Performance of PBs in India

	PSBs	2015	2016	2017	2018	2019	2020	2021	2022	2013	2024	No. of times of being efficient
1	IDBI Bank	1	1	1	1	1	1	1	1	1	1	10
2	Axis Bank	1	1	1	1	0.976	0.881	0.892	0.791	0.772	0.726	4
3	CSB Bank	0.873	1	1	1	1	0.999	0.913	0.8	0.924	0.663	0
4	City Union Bank	0.895	0.981	0.723	1	0.999	0.997	1	0.855	0.912	1	3
5	DCB Bank	0.789	0.873	0.498	0.998	0.961	0.943	1	0.92	1	0.67	2
6	The Dhanlakshmi Bank	0.847	0.85	0.594	0.98	0.906	0.908	0.926	0.796	0.791	0.634	0
7	Federal Bank	0.82	0.916	0.68	0.871	0.844	0.913	0.874	0.868	0.963	0.812	0
8	HDFC Bank	0.971	0.956	0.783	0.968	1	1	1	0.825	0.925	0.829	0
9	ICICI Bank	0.924	0.935	1	0.865	1	0.963	0.836	0.704	0.762	0.749	2
10	Indusind Bank	1	1	0.97	1	1	1	1	1	0.967	0.924	7
11	Jammu & Kashmir Bank	0.804	0.858	0.738	0.902	0.864	0.851	0.868	0.744	0.751	0.457	0
12	Karnataka Bank	0.833	0.856	1	0.915	0.877	0.88	0.862	0.75	0.824	0.599	1
13	Karur Vysya Bank	0.83	0.957	0.756	1	0.982	0.976	0.99	0.873	0.848	0.626	1
14	Nainital Bank	0.872	0.788	0.663	0.96	0.837	0.866	0.937	0.786	0.808	0.497	0
15	RBL Bank	0.687	0.515	0.718	0.85	0.93	0.979	1	1	1	1	4
16	South Indian Bank	0.859	0.892	0.687	0.922	0.864	0.9	0.847	0.785	0.864	0.59	0
17	Tamilnad Merchantile Bank	1	1	0.709	1	1	1	0.955	0.82	0.9	0.821	5
	Mean	.88	.90	.77	.95	.94	.94	.94	.84	.88	0.74	5
	No. of efficient banks	4	4	4	6	5	4	6	3	3	3	

Source: Author's Compilation

Table IV displays the year wise, TE score of PBs from 2015 to 2024. IDBI Bank is the only bank that is fully efficient (efficiency equals one) during the entire sample period, set as a benchmark for remaining banks. On the other hand, CSB Bank, The Dhanlakshmi Bank, Federal Bank, Jammu and Kashmir Bank, Nainital Bank, and South Indian Bank consistently exhibit inefficiency throughout the sampled period, as they were unable to attain an efficiency score of one in any year. On an average, the annual TE score of the PBs ranges between 0.741 and 0.953.

Table V: Performance of FBs in India

	PSBs	2015	2016	2017	2018	2019	2020	2021	2022	2013	2024	No. of times of being efficient
1	AB Bank Limited	0.862	1	1	1	1	1	0.92	1	1	1	8
2	Bank of America National Association	0.993	1	1	1	1	0.982	1	1	1	0.875	7
3	Bank of Bahrain & Kuwait B.S.C	0.574	0.546	0.523	0.422	0.186	0.181	0.458	0.382	0.452	0.374	0
4	Bank of Ceylon	0.867	0.953	0.895	0.93	0.393	0.345	1	0.52	0.661	0.513	1
5	Bank of Nova Scotia	1	0.934	1	0.796	0.478	0.475	0.58	0.501	0.561	0.486	2
6	Barclays Bank PLC	0.829	1	1	1	1	0.848	1	1	0.73	0.91	6
7	BNP Paribas	0.825	0.811	0.93	0.957	0.604	0.68	0.976	0.899	0.94	1	1
8	Citibank NA	0.585	0.624	0.766	0.561	0.433	0.456	0.619	0.808	0.595	0.535	0
9	Credit Agricole Corporate & Investment Bank	1	0.874	0.869	0.914	0.504	0.168	0.941	0.82	1	0.962	2
10	CTBC Bank Co. Ltd	0.706	0.498	0.667	0.49	0.188	0.18	0.483	0.35	0.459	0.347	0
11	DBS Bank India Ltd	0.716	0.738	0.667	0.401	0.359	0.211	0.047	0.38	0.33	0.258	0
12	Deutsche Bank AG	0.653	0.637	0.874	0.643	0.417	0.398	0.676	0.69	0.736	0.771	0
13	HongKong & Shanghai Banking Co. Ltd.	0.573	0.533	0.652	0.48	0.37	0.321	0.54	0.599	0.692	0.762	0
14	Krung Thai Bank Public Company Limited	0.542	0.646	0.666	0.577	0.177	0.136	0.607	0.458	0.396	0.662	0
15	Mashreq Bank PSC	1	1	1	1	1	1	1	0.859	0.789	0.637	7
16	Mizuho Bank Ltd	0.72	0.702	0.721	0.454	0.227	0.33	0.577	0.681	0.864	0.568	0
17	MUFG Bank Ltd	0.712	0.704	0.83	0.701	0.526	0.55	0.712	0.653	0.64	0.595	5

18	PT bank Maybank Indonesia TBK	1	1	1	1	0.358	0.581	1	0.438	0.707	0.192	5
19	NatWest markets PLC	0.578	0.926	0.816	1	1	1	1	0.875	0.95	0.809	4
20	SBM bank (India) Ltd	1	1	1	0.581	0.186	0.2	0.19	0.447	0.401	0.322	3
21	Shinhan Bank	0.715	0.848	0.723	0.451	0.198	0.163	0.515	0.421	0.483	0.367	0
22	Societe Generale	0.744	0.734	0.795	0.856	0.403	0.569	0.813	0.914	1	1	2
23	Sonali Bank	1	0.774	0.472	0.621	0.558	0.69	0.535	0.358	0.491	0.242	1
24	Standard Chartered Bank	0.681	0.737	0.819	0.54	0.269	0.245	0.567	0.619	0.588	0.5	0
	Mean	0.78	0.80	0.81	0.72	0.48	0.48	0.69	0.67	0.69	0.63	
	No. of efficient banks	6	6	7	6	5	3	6	4	5	4	

Source: Author's Compilation

Table V displays the year wise, TE score of FBs from 2015 to 2024. Not even a single FBs is fully efficient (efficiency equals one) during the sampled period. There are a total of 11 banks, namely Bank of Bahrain & Kuwait B.S.C, Citi Bank N.A, CTBC Bank Co. Ltd, DBS Bank India Ltd, Deutsche Bank AG, Hong Kong & Shanghai Banking Co. Ltd, Krung Thai Bank Public Company Ltd, Mizuho Bank, MUFG Bank, Shinhan Bank, and Standard Chartered Bank, which were unable to attain an efficiency score of one in any year. On an average, the annual TE score of the FBs ranges from 0.476 to 0.815.

Table VI: Average Technical, Pure Technical and Scale efficiency of SCBs

PSBs	TE	PTE	SE	Pbs	TE	PTE	SE	Fbs	TE	PTE	SE
Bank of Baroda	0.94	1.00	0.94	IDBI Bank	1	1	1	AB Bank Limited	0.98	0.98	0.99
BOI	0.93	0.97	0.96	Axis Bank	0.9038	1	0.915519	Bank of America National Association	0.99	1.00	0.99
Bank of Maharashtra	0.99	0.99	0.99	CSB Bank	0.8496	0.89	0.941045	Bank of Bahrain & Kuwait B.S.	0.41	0.51	0.80
Canara Bank	0.96	1.00	0.96	City Union Bank	0.94	0.94	0.991842	Bank of Ceylon	0.71	0.79	0.89
CBI	0.93	0.96	0.97	DCB Bank	0.87	0.89	0.973557	Bank of Nova Scotia	0.68	0.74	0.92
Indian Bank	0.99	0.99	1.00	The Dhanlakshmi Bank	0.82	0.91	0.900558	Barclays Bank PLC	0.93	0.96	0.97
IOB	0.97	0.98	0.99	Federal Bank	0.86	0.90	0.949956	BNP Paribas	0.86	0.96	0.90
Punjab & Sind Bank	1.00	1.00	1.00	HDFC Bank	0.93	0.97	0.958778	Citibank NA	0.60	0.94	0.64

PNB	0.93	1.00	0.93	ICICI Bank	0.87	1.00	0.876957	Credit Agricole Corporate & Investment Bank	0.81	0.82	0.98
SBI	1.00	1.00	1.00	Indusind Bank	0.99	1.00	0.986199	CTBC Bank Co. Ltd	0.44	0.50	0.87
UCO Bank	0.89	0.91	0.98	Jammu & Kashmir Bank	0.78	0.83	0.944672	DBS Bank India Ltd	0.41	0.76	0.54
Union Bank Of India	0.99	1.00	0.99	Karnataka Bank	0.84	0.86	0.979811	Deutsche Bank AG	0.65	0.98	0.66
				Karur Vysya Bank	0.88	0.90	0.980149	HongKong & Shanghai Banking Co. Ltd.	0.55	0.82	0.67
				Nainital Bank	0.80	1.00	0.8014	Krung Thai Bank Public Co. Ltd.	0.49	0.95	0.51
				RBL Bank	0.87	0.90	0.963905	Mashreq Bank PSC	0.93	0.98	0.95
				South Indian Bank	0.82	0.84	0.976916	Mizuho Bank Ltd.	0.57	0.75	0.76
				Tamilnad Merchantile Bank	0.92	0.93	0.986391	MUFG Bank ltd	0.66	0.78	0.85
								PT bank Maybank Indonesia TBK	0.73	0.94	0.77
								Natwest markets PLC	0.90	0.96	0.93
								SBM bank (India) Ltd.	0.53	0.65	0.82
								Shinhan Bank	0.49	0.63	0.77
								Societe Generale	0.78	0.86	0.91
								Sonali Bank	0.57	0.77	0.75
								Standard Chartered Bank	0.56	1.00	0.56
Mean	0.96	0.98	0.98	Mean	0.88	0.93		Mean	0.68	0.83	0.82

Source: Author's Compilation

Table VI demonstrates the components of TE, divided into PTE and SE. Table VI shows the year wise, average TE, PTE and SE for PSBs, PBs, and FBs during 2015-2024. Among the PSBs, Punjab and Sind Bank and SBI are fully technically efficient, while UCO Bank has the lowest TE. Out of the 17 PBs, only IDBI Bank is fully efficient, and Nainital Bank has the lowest TE. Among the 24 FBs, none of them are technically efficient. The TE (inefficiency) of all PSBs is 0.96 (0.04), followed by PBs with TE (inefficiency) of 0.88 (0.12), and then by FBs with TE (inefficiency) of 0.68 (0.32). Thus, Indian PSBs, PBs and FBs, on an average, waste the inputs to the tune of 4%, 12% and 32% respectively

According to Table VI, on the basis of PTE, among the 12 PSBs, 6 (50%) PSBs are technically efficient at variable return to scale, namely Bank of Baroda, Canara Bank, Punjab and Sind Bank, PNB, SBI, and Union Bank of India. Among the 17 PBs, 5 banks are fully efficient, namely IDBI Bank, Axis Bank, ICICI Bank, Indusind Bank, and Nainital Bank. However, Nainital Bank, that previously had the lowest TE, has now achieved efficiency equal to one at variable return to scale. Among the FBs, only two banks, namely Bank of America National Association and Standard Chartered Bank, are fully efficient. The average PTE (inefficiency) of all PSBs, PBs and FBs is 0.98 (0.02), 0.93 (0.07), and 0.83 (0.17), respectively.

According to Table VI, on the basis of SE, among the 12 PSBs, only 3 (25%) PSBs are operating at the optimum level of scale. The remaining PSBs are working at increasing or decreasing returns to scale. Among the 17 PBs, only IDBI Bank is operating at the optimum level of scale. None of the FBs are working at the optimum level of scale; all FBs are operating at increasing or decreasing returns to scale. The average SE (inefficiency) of all PSBs, PBs and FBs is 0.98 (0.02), 0.95 (0.05) and 0.82 (0.18), respectively.

Thus, PSBs have dominance with regard to TE, PTE and SE compared to PBs and Fbs (Bhattacharya et al., 1998). This is mainly because 51% of their shares are held by the Government of India which instills trust and confidence among customers as they are protected by the government. PSBs have a wide network of branches spread over rural and urban areas. Their old existence in the Indian economy helps them to earn better revenues. Moreover, they have tie-ups with the government companies and extend fee based services like bank assurance, mutual fund products, accelerating their income using existing resources (Gulati & Kumar, 2016).

In contrast, the PBs exhibit higher efficiency levels than FBs, primarily because majority of them have a presence in urban and semi-urban areas, operating with a profit maximization objective (Mahendru & Bhatia, 2017). These banks are known for adopting innovative technology, screened and monitored credits, providing quality services to customers, positioning themselves competitively in the market . (Gardener et al., 2011).

Furthermore, FBs primarily operate in metropolitan cities. Their operations as branches rather than as wholly owned subsidiaries (WOS) in India impede them to use their resources efficiently since crucial investment and loan disbursement decisions are sanctioned by executives at head office abroad (Mahendru & Bhatia, 2017). Further, the foreignness hypothesis in India favours that FBs face challenge in raising funds from the capital market and suggests domestic banks have advantages in terms of asset size, market share, local language, culture and regulations (Gulati & Kumar, 2016) . Consequently, FBs exhibit lower efficiency than PSBs and PBs.

Table VII: Ranking of SCBs based on overall efficiency

PSBs	TE	Ranks	Pbs	TE	Ranks	Fbs	TE	Ranks
Bank of Baroda	0.9373	8	IDBI Bank	1	1	AB Bank Limited	0.9782	2
BOI	0.9332	9	Axis Bank	0.9038	6	Bank of America National Association	0.985	1
Bank of Maharashtra	0.9823	5	CSB Bank	0.8396	12	Bank of Bahrain & Kuwait B.S.C	0.4098	24
Canara Bank	0.9598	7	City Union Bank	0.9362	3	Bank of Ceylon	0.7077	10
CBI	0.9296	11	DCB Bank	0.8652	10	Bank of Nova Scotia	0.6811	11
Indian Bank	0.9863	4	The Dhanlakshmi Bank	0.8232	14	Barclays Bank PLC	0.9317	3
IOB	0.968	6	Federal Bank	0.8561	11	BNP Paribas	0.8622	6
Punjab & Sind Bank	0.9988	2	HDFC Bank	0.9257	4	Citibank NA	0.5982	14
Punjab National Bank	0.9304	10	ICICI Bank	0.8738	8	Credit Agricole Corporate & Investment Bank	0.8052	7
State Bank of India	1	1	Indusind Bank	0.9861	2	CTBC Bank Co. Ltd	0.4368	22
UCO Bank	0.8864	12	Jammu & Kashmir Bank	0.7837	17	DBS Bank India Ltd	0.4107	23
Union Bank of India	0.9876	3	Karnataka Bank	0.8396	13	Deutsche Bank AG	0.6495	13
			Karur Vysya Bank	0.8838	7	HongKong & Shanghai Banking Co. Ltd.	0.5522	18
			Nainital Bank	0.8014	16	Krung Thai Bank Public Co. Ltd.	0.4867	21
			RBL Bank	0.8679	9	Mashreq Bank PSC	0.9285	4
			South Indian Bank	0.821	15	Mizuho Bank Ltd.	0.5727	16
			Tamilnad Merchantile Bank	0.9205	5	MUFG Bank ltd	0.6623	12
						PT bank Maybank Indonesia TBK	0.7276	9
						Natwest markets PLC	0.8954	5
						SBM bank (India) Ltd.	0.5327	19
						Shinhan Bank	0.4884	20

						Societe Generale	0.7828	8
						Sonali Bank	0.5741	15
						Standard Chartered Bank	0.5565	17

Source: Author's Compilation

Table VII makes ranking of SCBs on the basis of overall TE. Among, PSBs, SBI attained the first rank, followed by Punjab & Sind bank and Union bank of India. Indian bank secured fourth rank and UCO bank secured the last rank. Among PBs, IDBI bank got the first rank, followed by IndusInd bank, City Union bank and Jammu & Kashmir bank obtained the last rank. Among FBs, Bank of America National Association bank claimed the first rank and AB Bank Limited and City Union bank secured second and third ranks, respectively, while Bank of Bahrain & Kuwait B.S.C obtained the last rank.

Table VIII: Results of Analyses of Variance (ANOVA)

Banks	Mean Efficiency	Standard deviation	Computed F ratio	Significant F ratio at 5% level
Scheduled Commercial banks (Observations)	0.8372 (530)	0.1443	32.22	.000

Source: Author's Compilation

Table VIII makes comparative analysis of efficiency across distinct ownership groups through one-way ANOVA. The assumptions of 'normality of data' and 'homogeneity of means' are checked. The data are normal, but the assumption of homogeneity of means is not satisfied; therefore, Welch ANOVA is performed. The null hypothesis of 'equal average TE among PSBs, PBs and FBs is not accepted (F ratio less than 0.05). This confirms that the mean TE among these bank groups with different ownership groups is not the same . Therefore, further analysis through the post hoc test has been made.

Table IX: Results of Post Hoc Test

Banks codes	Mean Efficiency	Std. error	Sig.
Public-Private	.0802	.0239	.018**
Public-Foreign	.2831	.0381	.000***
Private-Foreign	.2029	.0441	.001***

Note: ***, ** are significant at 1%, 5% level, respectively

In Table IX, displays findings of post hoc test. The null hypothesis 'public-private', 'public-foreign' and 'foreign-private' banks are equally efficient, is not accepted because p-value is less than 0.05 in all cases. This confirms that ownership structure is an important factor which is responsible for difference in efficiency levels among SCBs in India. The mean differences for TE among 'public-private', 'public-foreign' and 'foreign-private' banks are 0.08, 0.28 and 0.21, respectively.

5. SUMMARY OF FINDINGS AND CONCLUSIONS

In the present study, we have analyzed the efficiency of a sample of SCBs in the emerging market of India from 2015 to 2024. The findings of the study reveal that on an average, PSBs outperformed their peer groups in terms of overall technical efficiency as well as its components, followed by PBs and then by FBs. The average TE of PSBs, PBs and FBs reveals 0.958, 0.871 and 0.815, respectively, suggesting that these SCBs, could have increased potential outputs to the extent of 4.2%, 12.9%, and 32.5%, respectively, either following best practices while using the same level of inputs (output focused) or by producing the same level of output with the smallest number of inputs (input oriented).

Concerning the components of TE, the average PTE score for PSBs, PBs and FBs is noted to be 0.98, 0.93, and 0.83, respectively, with the lowest being for FBs. This implies inappropriate management practices to maximize outputs i.e. interest and non-interest income through existing levels of inputs i.e. employees and loanable funds. During the study period, however, average SE for PSBs, PBs and FBs was around 0.98, 0.95, and 0.82, respectively, indicating that the scale inefficiency is due to the choice of the wrong size of operation. Consequently, the empirical findings of the present study conclude that PSBs have outperformed their peer groups due to their long and old existence. They have large customers base due to protection from the Government of India which holds 51% share in their share holding. PBs lagged behind PSBs but better performers than FBs in terms of technical, managerial and scale efficiency. However, the managerial and scale efficiency of FBs as a group is paradoxically lower than PSBs and PBs due to unfamiliarity with the local conditions.

In respect to the implications of the study, this recent analysis will be extremely useful for banks, investors, policymakers, bank managers and researchers in further understanding the dimensions of overall efficiency of banks. The results will enable banks to identify the sources of inefficiency among them such as wastage of inputs or managerial inefficiency in choosing the right scale of operation. Banks can prioritize their resources or scale their operations by using the rankings or comparing the performance with benchmarked banks (efficiency equals to one). SCBs can design long-term plans to ensure steady future growth by considering these ranking. The investors and other stakeholders can use these ranks as criteria for investment decisions to compare and decide the high performers to gain a high return on investment. The results of this study will provide policy frameworks to regulators and

policymakers to develop economic and monetary policy that create a safe, secure, and steadily growing banking environment for all ownership groups. The empirical findings of the current study suggest that FBs should concentrate more on income-generating areas to achieve a better position in terms of economic performance to compete with other peer groups. By extension, the study will also assist the bank managers in drafting better plans and policies to control expenses and disbursement cost in order to increase the interest and fee based incomes.

For the current study, only SCBs are taken as a sample for research purpose. This study focuses solely on the Indian banking industry to evaluate efficiency and the price of inputs and outputs is not considered due to data availability limitations. Consequently, future researchers can conduct a comparative analysis of the efficiency of banks with other financial institutions in various countries. They can employ different parametric techniques to calculate the efficiency. Future researchers can explore the various bank specific, industry specific and macro economic factors that affect efficiency performance in banks. Furthermore, it would be interesting to study different types of economic efficiencies i.e. cost, revenue and profit efficiencies in future studies.

REFERENCES

Alhassan, A. L., & Tetteh, M. L. (2017). Non-Interest Income and Bank Efficiency in Ghana: A Two-Stage DEA Bootstrapping Approach. *Journal of African Business, 18*(1), 124–142. https://doi.org/10.1080/15228916.2016.1227668.

Ariff, M., & Can, L. (2008). Cost and profit efficiency of Chinese banks: A non-parametric analysis. *China Economic Review, 19*(2), 260–273. https://doi.org/10.1016/j.chieco.2007.04.001.

Arora, P. (2014). Reforms, Ownership and Determinants of Efficiency: An Empirical Study of Commercial Banks in India. *Journal of Emerging Market Finance, 13*(1), 103–138. https://doi.org/10.1177/0974910114534026.

Arrawatia, R., Misra, A., & Dawar, V. (2015). Bank competition and efficiency: empirical evidence from Indian market. *International Journal of Law and Management, 57*(3), 217–231. https://doi.org/10.1108/IJLMA-03-2014-0029.

Banker, R. D., Charnes, A., & Cooper, W. W. (1984). Some Models for Estimating Technical and Scale Inefficiencies in Data Envelopment Analysis. *Management Science, 30*(9), 1078–1092.

Baral, R., & Patnaik, D. (2021). Bank efficiency and governance : Evidence from Indian banking. *Journal of Management and Governance,* 1–29. https://doi.org/10.1007/s10997-021-09610-9.

Barman, N., Adhikari, K., & Dey, N. B. (2015). Technical Efficiency of Public Sector Banks in India : An Empirical Study. *Journal of Commerce and Trade, 10(*1), 56–65.

Bhatia, A., & Mahendru, M. (2015a). Assessment of Technical Efficiency of Public Sector Banks in India Using Data Envelopment Analysis. Eurasian *Journal of Business and Economics, 8*(15),

115–140. https://doi.org/10.17015/ejbe.2015.015.06.

Bhatia, A., & Mahendru, M. (2015b). Revenue efficiency analysis of scheduled commercial banks in a dynamic environment :Empirical evidence from India. *Indian Growth and Development Review, 8*(2), 184–210. https://doi.org/10.1108/IGDR-04-2015-0015.

Bhatia, A., & Mahendru, M. (2018). Cost efficiency analysis of scheduled commercial banks : empirical evidence from India. *Journal of Management Development, 37*(7), 586–602. https://doi.org/10.1108/JMD-01-2017-0037.

Bhattacharyya, A., Lovell, C. A. K., & Sahay, P. (1998). The impact of liberalization on the productive efficiency of Indian commercial banks. *European Journal of Operational Research, 2,* 332–345.

Chronopoulos, D. K., Girardone, C., & Nankervis, J. C. (2011). Are there any cost and profit efficiency gains in financial conglomeration? evidence from the accession countries. *European Journal of Finance, 17*(8), 603–621. https://doi.org/10.1080/1351847X.2010.538300.

Dar, A. H., Mathur, S. K., & Mishra, S. (2021). The Efficiency of Indian Banks : A DEA , Malmquist and SFA Analysis with Bad Output. *Journal of Quantitative Economics, 19*, 653–701. https://doi.org/10.1007/s40953-021-00247-x.

Das, A., & Ghosh, S. (2006). Financial deregulation and efficiency : An empirical analysis of Indian banks during the post reform period. *Review of Financial Economics, 15*(3), 193–221. https://doi.org/10.1016/j.rfe.2005.06.002.

Gardener, E., Molyneux, P., & Nguyen-Linh, H. (2011). Determinants of efficiency in South East Asian banking. *Service Industries Journal, 31*(16), 2693–2719. https://doi.org/10.1080/02642069.2010.512659.

Girardone, C., Molyneux, P., & Gardener, E. P. M. (2004). Analysing the determinants of bank efficiency: The case of Italian banks. *Applied Economics, 36*(3), 215–227. https://doi.org/10.1080/0003684042000175334.

Goswami, R., Hussain, F., & Kumar, M. (2019). Banking Efficiency Determinants in India: A Two-stage Analysis. Margin: The Journal of Applied Economic Research, 13(4), 361–380. https://doi.org/10.1177/0301574219868373.

Gulati, R. (2011). Evaluation of technical , pure technical and scale efficiencies of Indian banks : An analysis from cross-sectional perspective. *Money and Finance in the Indian Economy,* 1–30.

Gulati, R., Charles, V., Hassan, M. K., & Kumar, S. (2023). COVID-19 crisis and the efficiency of Indian banks : Have they weathered the storm ? *Socio-Economic Planning Sciences, 88,* 101661. https://doi.org/10.1016/j.seps.2023.101661

Gulati, R., & Kumar, S. (2016). Assessing the impact of the global financial crisis on the profit efficiency of Indian banks. *Economic Modelling,* 58, 167–181. https://doi.org/10.1016/j.econmod.2016.05.029.

Huang, L.-W., & Chen, Y. (2006). Does Bank Performance Benefit from Nontraditional Activities ? A Case of Non-interest Incomes in Taiwan Commercial Banks. *Asian Journal of Management and Humanity Sciences, 1*(3), 359–378.

Jayaraman, A. R., & Srinivasan, M. R. (2019). Determinants of Indian banks efficiency: A two-stage approach. I*nternational Journal of Operational Research, 36*(2), 270–291. https://doi.org/10.1504/IJOR.2019.102414.

Khan, A., Hassan, M. K., Maroney, N., Boujlil, R., & Ozkan, B. (2020). Efficiency, diversification, and performance of US banks. *International Review of Economics and Finance, 67*, 101–117. https://doi.org/10.1016/j.iref.2019.12.010.

Kumar, S., & Gulati, R. (2008a). An Examination of Technical , Pure Technical , and Scale Efficiencies in Indian Public Sector Banks using Data Envelopment Analysis. *Eurasian Journal of Business and Economics, 1*(2), 33–69.

Kumar, S., & Gulati, R. (2008b). Evaluation of technical efficiency and ranking of public sector banks in India: An analysis from cross-sectional perspective. *International Journal of Productivity and Performance Management, 57*(7), 540–568. https://doi.org/10.1108/17410400810904029.

Mahendru, M., & Bhatia, A. (2017). Cost, revenue and profit efficiency analysis of Indian scheduled commercial banks: empirical evidence across ownership. *International Journal of Law and Management, 59*(3), 442–462. https://doi.org/10.1108/IJLMA-01-2016-0008.

Maity, S., Sahu, T. N., & Biswas, D. (2020). Assessing efficiency of private sector banks in India : an empirical investigation using DEA. International J*ournal Financial Services Management, 10*(2), 138–155. https://doi.org/https://doi.org/10.1504/IJFSM.2020.110223.

Megha. (2016). *Efficiency Evaluation of Banking Sector in India* [Guru Nanak Dev University]. http://hdl.handle.net/10603/170476.

Nandi, J. K. (2013). Efficiency Ananysis of Selected Public and Private Sector Banks in India through Data Envelopment Analysis. *Vidyasagar University Journal of Commerce,* 18.

Nguyen Minh, S. (2017). Income Diversification and Bank Efficiency in Vietnam. *Journal of Economics and Development, 19(*3), 52–67. https://doi.org/10.33301/jed.2017.19.03.04.

Patra, B., Padhan, P. C., & Padhi, P. (2023). Efficiency of Indian Banks – private versus public sector banks : A two-stage analysis. *Cogent Economics & Finance, 11*(1), 1–17. https://doi.org/10.1080/23322039.2022.2163081

Sathye, M. (2001). X -effciency in Australian banking : An empirical investigation. *Journal of Banking & Finance 25, 25*, 613–630.

Sensarma, R. (2006). Are foreign banks always the best? Comparison of state-owned, private and foreign banks in India. *Economic Modelling, 23*(4), 717–735. https://doi.org/10.1016/j.econmod.2006.04.002.

Singh, O., & Bansal, S. (2017). An Analysis of Revenue Maximising Efficiency of Public Sector Banks in the Post-Reforms Period. *Journal of Central Banking Theory and Practice, 6(*1), 111–125. https://doi.org/10.1515/jcbtp-2017-0006.

Singh, P. K., & Thaker, K. (2020). Profit efficiency and determinants of Indian banks ; A truncated bootstrap and data envelopment analysis. *Cogent Economics & Finance, 8*(1), 1–25. https://doi.org/10.1080/23322039.2020.1724242.

Sufian, F. (2009). The determinants of efficiency of publicly listed Chinese banks : evidence from two-stage banking models. *Macroeconomics and Finance in Emerging Market Economies, 2*(1), 93–133. https://doi.org/10.1080/17520840902726458.

Tesfay, T. (2016). Determinants of Commercial Banks Efficiency : Evidence from Selected Commercial Banks of Ethiopia. *International Journal of Scientific and Research Publications, 6*(5), 551–556.

Tzeremes, N. G. (2015). Efficiency dynamics in Indian banking: A conditional directional distance approach. *European Journal of Operational Research, 240*(3), 807–818. https://doi.org/10.1016/j.ejor.2014.07.029