

Assessing the Nexus between Bank Efficiency and Stock Returns: Evidence from Indian Nationalized Banks.

Abstract:

This study assesses the nexus between efficiency metrics and stock returns of Indian nationalized banks over a decade from 2014-15 to 2023-24. Based on twelve nationalized banks operating in the country, the study employs Data Envelopment Analysis (DEA) approach to measure efficiency levels. To examine the impact of efficiency metrics on stock returns, regression analysis using panel data was carried out while controlling for banks' profitability, size and earnings diversification. The findings exhibit that changes in efficiency metrics do not have a statistically significant positive impact on stock performance. Alternatively, profitability measures, especially Return on Assets (ROA), persistently and significantly describe stock prices, emphasizing the markets' priority on bank profitability over operational performance. Furthermore, the results reveal structural shortcomings among the publicly owned banks in India.

Keywords: bank efficiency, stock returns, DEA, nationalized banks

JEL Classification: D61; G21

1. Introduction

The banking institutions constitute a foundational pillar of an economy's financial system, shaping the movement of capital from money savers towards activities that generate economic value (Tsolas and Charles 2015; Levine, 1997). Through the mobilization and strategic allocation of financial resources, banks facilitate investment, enable seamless payments, extend credit and strengthen the mechanisms through which financial capital is transformed into broader economic development (Youssef, 2024; Mishkin, 2007; Levine, 2005). In developing economies such as India, banks assume an even more significant role because of their contribution to financial intermediation, investment and inclusive economic development (Chakrabarty, 2011; Sufian, 2011; Das & Ghosh, 2006; Burgess & Pande, 2005). The banking sector in India has undergone substantial structural and regulatory transformation over the past several decades with the aim to enhance competitiveness, bring policy regulations, increase accountability together with governance, and improve efficiency

(Ghosh, 2016; Kumar & Gulati, 2009; Mukherjee et al., 2002). Following the nationalization of major commercial banks in July 1969, the policymakers sought to extend administratively directed credit to priority sectors and previously underserved regions of the country (Reserve Bank of India, 2008). Nationalized, or public sector banks have since remained the dominant segment in Indian banking, and their operational soundness continues to have a bearing on the stability of the country's financial system as a whole (Department of Financial Services, 2024; Reserve Bank of India, 2023).

The efficiency with which banking institutions transform their financial and operational resources into desirable outputs is, therefore, an important determinant of the sustainability and competitiveness of the banking system in India (Kumar & Singh, 2013; Reddy & Nirmala, 2013; Sarkar & Sahu, 2011). In this context, bank efficiency has attracted considerable attention from researchers, regulators, policymakers and investors because inefficient utilisation of resources can adversely affect profitability, financial stability and the ability of banks to create value for their stakeholders (Wani & Shrotriya, 2026; Shaban et al., 2013; Das & Ghosh, 2006). Empirical evidence from the post-reform period indicates that efficiency levels among Indian banks vary considerably according to ownership, size, risk profile and managerial characteristics (Wani & Shrotriya, 2026; Kumbhakar & Sarkar, 2003; Bhattacharyya et al., 1997).

Bank efficiency is generally concerned with the relationship between the resources employed by a bank and the outputs generated from those resources (Cviliakas & Jurkonyte-Dumbliauskiene, 2016; Sathye, 2001). Unlike conventional financial-ratio analysis, efficiency analysis using parametric and non-parametric techniques can simultaneously incorporate multiple inputs and outputs and thereby provide a more comprehensive assessment of relative performance (Paradi & Zhu, 2013; Zhu, 2000; Bauer et al., 1998). Data Envelopment Analysis (DEA) has emerged as one of the most widely used non-parametric techniques for evaluating the efficiency of financial institutions (Wu et al., 2006). DEA constructs an efficiency frontier from observed decision-making units and evaluates individual banks in relation to the best-performing banks within the sample (Farrell, M.J., 1957). Its ability to accommodate multiple inputs and outputs without requiring an explicit functional form makes it particularly suitable for analysing banking institutions (Sanjeev, 2006; Saha & Ravisankar, 2000). Previous studies have consequently employed DEA to examine technical, cost, profit and productive efficiency in the Indian banking sector (Wani & Shrotriya, 2026; Ray & Das, 2010; Das, 2006).

The importance of bank efficiency, however, extends beyond the internal operations, as improvements in efficiency may enhance equity value, while stock prices can potentially reflect information regarding banks' underlying efficiency and financial condition (Beccalli et al., 2006). From an investor's perspective, a bank that transforms its resources into revenues and profits more effectively may be perceived as having stronger fundamentals and greater potential for value creation (Sharma, D., 2018). Thus, examining whether banking efficiency is reflected in stock returns provides an important bridge between internal bank performance and external market valuation.

Despite the growing literature on bank efficiency in India, comparatively less attention has been devoted specifically to Indian nationalized banks as a distinct group, particularly in examining whether differences in their operational efficiency are associated with differences in stock-market performance (Wani&Shrotriya, 2025).Against this background, the present study seeks to examine the relationship between bank efficiency and stock performance of Indian nationalized banks. Such an investigation is expected to contribute to the existing literature by providing focused empirical evidence on the efficiency–stock performance relationship within the Indian nationalized banking segment.

2. Review of the related studies

The literature on linking banking efficiency with stock returns has been extensively studied in the academic corners using both parametric (Data Envelopment Analysis) and non-parametric (Stochastic Frontier Approach) techniques focusing specifically on most advanced economies (Wani&Shrotriya, 2025; Janoudi, 2014; Pasiouras et al., 2008; Chu & Lim, 1998). Later on, few studies on emerging economies were also undertaken in the same direction(Alsharif, 2021; Tuffour et al., 2020; Sharma, D., 2018; Gu&Yue, 2011; Sufian&Majid, 2009). Although such studies have enriched our knowledge about this relationship, it is worth to note that the findings vary across different studies. For example, Chu and Lim (1998) while investigating Singaporean banking institutions reveal that changes in stock prices are influenced by profit efficiency rather than cost efficiency as shareholders are more inclined towards dividends, a part out of profits rather than whatever comes out of incomes. Contrary to this, Beccalli et al. (2006) examined European banking firms and reported that stock prices are influenced by cost efficiency scores as shareholders perceive cost effective banks more profitable, thereby generating more value to them. However, Sufian and Majid (2007) while analysing Malaysian banks found a minor variation in the movement of stock prices lead by

cost efficiency scores, thereby implying that cost effective banking institutions perform better than cost ineffective banking institutions vis-à-vis stock performance. Along similar lines, Liadaki and Gaganis (2010) investigated listed banks in European markets and found that changes in profit efficiency had a positive and significant influence on stock prices, although the relationship between cost efficiency and stock returns was not significant.

Alsharif (2021) studied public sector banks in Saudi Arabia and found a positive correlation between bank efficiency and stock returns exhibiting efficient banks connote superior share value compared to inefficient banks. In Jordanian context, Alomari et al. (2020) found that efficiency scores have a positive impact on banks' share performance. Sarpong et al. (2017) studied the association between efficiency metrics and share performance of Ghanaian banks. The findings exhibit that variations in both cost and profit efficiency correspond to stock returns, suggesting the impact of efficiency metrics on share prices. Contrary to this, Sumantyo and Tresna (2017) examined the efficiency levels of Indonesian banks alongside its impact on stock performance. The results reveal that bank efficiency has no statistically significant influence on share performance. Overall, these findings suggest that efficiency may contain information relevant to investors and consequently have implications for market-based measures of bank performance.

In the Indian context, however, the empirical investigation of the efficiency-stock performance nexus remains comparatively limited. Sharma (2018) specifically examined the relationship between bank efficiency and stock-market performance in the Indian banking sector using DEA-based efficiency measures and panel-data regression. The study reported a statistically significant association between operational efficiency and market performance, suggesting that operationally efficient banks are capable of creating greater value and returns for investors. Earlier research has also examined profitability and marketability efficiency among Indian public and private banks, indicating that banks' profitability efficiency did not necessarily translate proportionately into stock-market or marketability efficiency (Nagaraju, 2014).

Although numerous studies have been undertaken linking bank efficiency with stock returns particularly in the most developed economies (Kale et al., 2020; Aygoren et al., 2015; Janoudi, 2014). However, few research works have explored the relationship between bank efficiency and stock returns in developing economies (Alsharif, 2021; Alomari et al., 2020; Tuffour et al., 2020). In Indian context, limited research has been undertaken in the same direction involving public and private banks (Sharma, D., 2018; Nagaraju, 2014). Till date,

we have not come across any study specifically studying Indian nationalized banks. Consequently, this study is undertaken to explore how efficiency translates into market outcomes within a homogeneous group of nationalized banks.

3. Methodology

This study is carried out in three stages. First, efficiency scores have been measured using DEA approach. Then, stock returns of nationalized banks have been measured by annual average return of market prices. And finally, the association between underlying variables have been studied using regression analysis.

3.1 Dataset

Based on twelve Indian nationalized banks listed on the country's major bourses – National Stock Exchange (NSE) and Bombay Stock Exchange (BSE), the study covers a period of ten financial years ranging from 1st April, 2014 to 31st March, 2024. The annual data have been extracted from the official website of Reserve Bank of India (www.rbi.org.in). The daily stock price data are obtained from the NSE's official website (www.nseindia.com).

3.2 Empirical Tools

3.2.1 DEA Model Specification

Data Envelopment Analysis (DEA) is a linear (mathematical) programming model which uses multiple inputs to produce multiple outputs to gauge the relative efficiency of decision-making units (DMUs). This study employs two DEA approaches; CCR model (Charnes, Cooper, and Rhodes, 1978) and BCC model (Banker, Charnes, and Cooper, 1984) to assess efficiency measures under different presumptions with regard to scale effects. Under the assumption of constant returns to scale (CRS), the CCR model measures overall technical efficiency (OTE) scores to represent DMU's efficiency in converting available resources into desired outputs while accounting for scale efficiency effects. Under the assumption of variable returns to scale (VRS), the BCC model measures pure technical efficiency (PTE) scores to separate DMU's management and operational-related efficiency, thus excluding the effects attributable to scale inefficiencies.

The CCR DEA model is represented as follows:

$$\text{Maximise } \sum_{r=1}^t u_r y_{ir} \quad (1)$$

Subject to

$$\sum_{r=1}^t u_r y_{jr} - \sum_{s=1}^m v_s x_{js} \leq 0, \quad j = 1, \dots, n \quad (2)$$

$$\sum_{s=1}^m v_s x_{is} = 1 \quad (3)$$

$$u_r, v_s \geq \varepsilon \quad (4)$$

Where,

n = number of DMUs,

t = number of outputs,

m = number of inputs,

x_{is} = value of the input s for the DMU _{i} ,

y_{ir} = value of the output r for the DMU _{i} ,

h_i = efficiency score of the DMU _{i} (generally, index 0 indicates the assessed DMU),

u_r = relative importance of the output r ,

v_s = relative importance of the input s , and

ε = small positive real number.

The BCC DEA model is represented as follows:

$$\text{Maximise } \sum_{r=1}^t u_r y_{ir} - u_0 \quad (5)$$

Subject to

$$\sum_{r=1}^t u_r y_{jr} - \sum_{s=1}^m v_s x_{js} - u_0 \leq 0, \quad j = 1, \dots, n \quad (6)$$

$$\sum_{s=1}^m v_s x_{is} = 1 \quad (7)$$

$$u_r, v_s \geq \varepsilon \quad (8)$$

These DEA models determine and measure inefficiency sources by converting the CCR and BCC models into corresponding dual models. For example, the dual model equivalent to the CCR input-oriented approach is as follows:

$$\text{Minimise } \theta = z_0 - \varepsilon \left(\sum_{i=1}^m s_i^- + \sum_{r=1}^t s_r^+ \right) \quad (9)$$

Subject to

$$x_{ij0}z_0 - \sum_{j=1}^n \lambda_j x_{ij} - s_i^- = 0, \quad i = 1, \dots, m \quad (10)$$

$$\sum_{j=1}^n \lambda_j y_{rj} - s_r^+ = y_{rj0}, \quad r = 1, \dots, t \quad (11)$$

In the above equations, the parameters λ_j ($j = 1, \dots, n$) determine the benchmark DMUs and explain an envelope for the evaluated DMU₀; θ_0 is the efficiency ratio of the evaluated DMU₀; z_0 exhibits the proportion of inputs for an inefficient DMU needed to produce outputs equivalent to its benchmark DMUs; and s_i^- and s_r^+ correspond to the slacks associated with the inputs i and the outputs r , respectively. Correspondingly, the dual representation concerning BCC oriented input model is derived by incorporating the convexity constraint to the CCR dual oriented input model as follows:

$$\sum_{j=1}^n \lambda_j = 1 \quad (12)$$

To determine the extent to which a DMU's efficiency is affected by its scale of operations (scale efficiency – SE), the ratio of OTE score to PTE score for each DMU is used (Banker et al. 1984). This is mathematically expressed as:

$$SE = OTE/PTE$$

Where,

SE reflects the extent to which the overall inefficiency indicated by OTE score is attributable to scale effects. An SE score close to 1 implies that the DMU operates at an optimal scale, whereas a lower SE score suggests the presence of scale inefficiencies contributing to its overall inefficiency.

Variables

The study incorporates deposits, interest expenses, non-interest expenses and personnel expenses as inputs. Further, advances, interest income and non-interest income are considered as outputs (Sharma, D., 2018).

3.2.2 Stock returns

The second stage involves estimation of the stock returns of Indian nationalized banks. To obtain the estimates, annual stock returns of banks are added to the daily returns of each bank over the study period. This approach of using daily returns is more accurate as it helps to reduce volatility present in monthly or yearly returns (Beccalli et al., 2006; Fama, 1976).

Control Variables

To separate the efficiency impact on stock returns, certain control variables are considered. Total Assets (LNTA) denotes bank size, Non-Interest Income to Total Assets (NIITA) represents the extent of income diversification, and Return on Assets (ROA) exhibits overall profitability.

3.2.3 Linking Bank Efficiency with Stock Returns

The final stage of the study employs regression models to establish the relationship between efficiency and stock returns among Indian Nationalized banks.

Model I

$$R_{jt} = \alpha + \beta_1 CRSTE_{jt} + \beta_2 LNTA + \beta_3 NIITA + \beta_4 ROA + \varepsilon$$

Model II

$$R_{jt} = \alpha + \beta_1 VRSTE_{jt} + \beta_2 LNTA + \beta_3 NIITA + \beta_4 ROA + \varepsilon$$

Model III

$$R_{jt} = \alpha + \beta_1 SE_{jt} + \beta_2 LNTA + \beta_3 NIITA + \beta_4 ROA + \varepsilon$$

Where,

R_{jt} = return on bank j's stock for the annual period ending at time t;

$CRSTE_{jt}$ = Constant returns to scale technical efficiency of bank j's for the annual period ending at time t;

$VRSTE_{jt}$ = Variable returns to scale technical efficiency of bank j's for the annual period ending at time t;

SE_{jt} = Scale efficiency of bank j's for the annual period ending at time t;

LNTA= Natural Log of Total Assets

NIITA= Non-Interest Income to Total Assets

ROA= Return on Assets

4. Analysis and discussion

The efficiency analysis covers the overall technical efficiency (CRSTE), pure technical efficiency (VRSTE), and scale efficiency (SE) of twelve public sector banks from 2014-15 to 2023-24, as presented in Table 4.1.

Table 4.1: Overall Technical Efficiency , Pure Technical Efficiency and Scale Efficiency Status of Public Sector Banks, 2014–2023				
Bank	CRSTE: Efficient Years	VRSTE: Efficient Years	SE: Efficient Years	Overall Efficiency Status
Bank of Baroda	7	7	7	High
Bank of India	3	4	4	Moderate
Bank of Maharashtra	10	10	10	Fully Efficient
Canara Bank	2	2	1	Low
Central Bank of India	7	9	7	High
Indian Bank	6	8	6	High
Indian Overseas Bank	6	7	6	High
Punjab and Sind Bank	10	10	10	Fully Efficient
Punjab National Bank	3	5	2	Moderate
State Bank of India	10	10	10	Fully Efficient
UCO Bank	8	10	8	High
Union Bank of India	5	7	6	Moderate

The results indicate considerable variation in efficiency performance across the banks. Among the selected banks, Bank of Maharashtra, Punjab and Sind Bank, and State Bank of India emerge as the most efficient institutions, achieving efficiency in all ten years under CRSTE, VRSTE, and SE. Their consistent performance indicates effective utilization of resources, sound managerial practices, and an appropriate scale of operations. These banks can, therefore, be regarded as fully efficient throughout the study period.

Bank of Baroda, Central Bank of India, Indian Bank, Indian Overseas Bank, and UCO Bank demonstrate relatively strong efficiency performance. Bank of Baroda achieved efficiency in seven years across all three measures, while Central Bank of India recorded seven efficient years under CRSTE and SE, and nine under VRSTE. Indian Bank and Indian Overseas Bank achieved six efficient years under CRSTE and SE, with higher VRSTE efficiency of eight and seven years, respectively. UCO Bank performed particularly well under VRSTE, achieving efficiency in all ten years, although its CRSTE and SE scores were efficient in eight years. These differences suggest that managerial efficiency was relatively stronger than overall technical efficiency for some banks, with scale factors contributing to inefficiency.

Bank of India, Punjab National Bank, and Union Bank of India show moderate efficiency. Their VRSTE-efficient years exceed their CRSTE-efficient years, indicating that managerial efficiency was comparatively better than overall technical efficiency. This suggests that improvements in the scale of operations could contribute to enhancing their overall efficiency.

Canara Bank records the weakest efficiency performance, with only two efficient years under CRSTE and VRSTE and one under SE. This indicates comparatively greater inefficiencies in both resource utilization and scale of operations.

Overall, the findings demonstrate that public sector banks differed substantially in their efficiency levels during the period of study. A key observation is that VRSTE efficiency is generally higher than CRSTE efficiency, indicating the presence of scale-related inefficiencies in several banks. Thus, improving managerial practices alone may not be sufficient; achieving an optimal operating scale is also important for enhancing overall technical efficiency. These findings provide a useful foundation for subsequently examining whether differences in banking efficiency are associated with variations in stock market performance.

The year-wise efficiency performance of public sector banks over the period from 2014-15 to 2023-24 is presented in Table 4.2, highlighting variations in the number of banks achieving efficiency across the study period.

Table 4.2: Year-wise Efficiency Status of Public Sector Banks, 2014–2023			
Year	CRSTE – Efficient Banks	VRSTE – Efficient Banks	SE – Efficient Banks
2014	9	10	8
2015	7	8	8
2016	10	10	10
2017	7	8	7
2018	8	9	8
2019	8	9	8
2020	10	10	8
2021	8	9	8
2022	5	6	5
2023	8	8	8

In 2014, 9 banks were efficient under CRSTE, 10 under VRSTE, and 8 under SE, indicating relatively higher overall efficiency. Efficiency improved substantially in 2016, when all 12 banks were efficient under CRSTE, VRSTE, and SE, representing the strongest performance

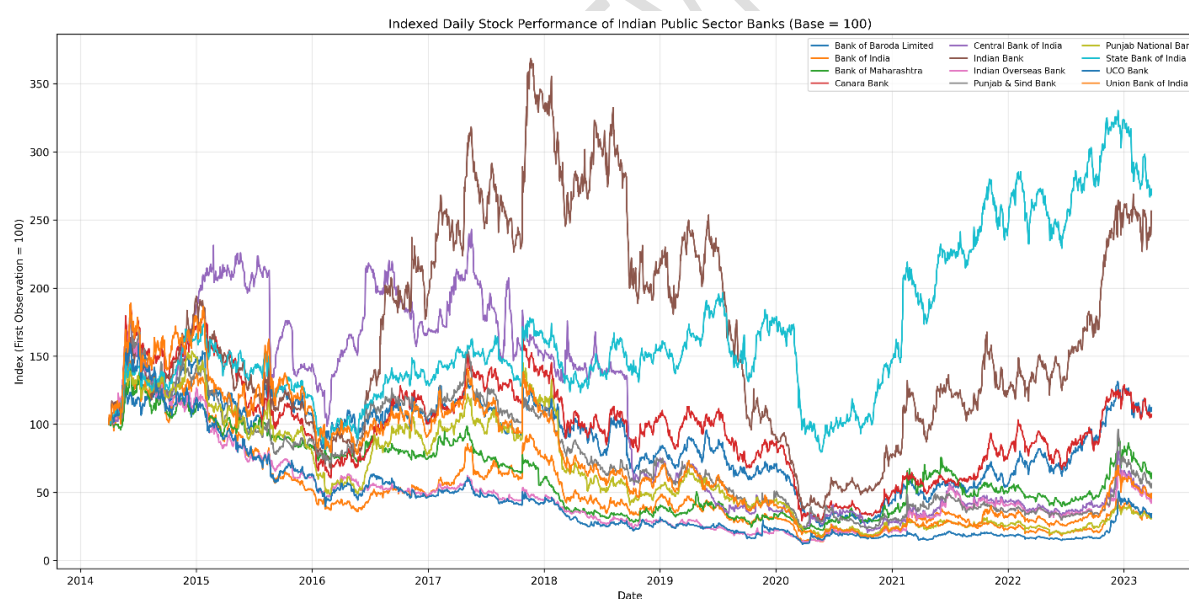
during the study period. However, efficiency declined in 2015 and again during 2017–2019, although VRSTE efficiency remained generally higher than CRSTE and SE.

In 2020, CRSTE and VRSTE efficiency reached their maximum, with 10 banks operating efficiently under each measure, while 8 achieved scale efficiency. This suggests strong technical and managerial efficiency but some scale-related inefficiencies. Efficiency remained relatively stable in 2021, with 8 CRSTE-, 9 VRSTE-, and 8 SE-efficient banks.

The lowest efficiency was observed in 2022, when only 5 banks were efficient under CRSTE and SE and 6 under VRSTE. Efficiency recovered in 2023, with 8 banks efficient under all three measures.

Overall, the findings indicate that VRSTE efficiency consistently exceeded or equalled CRSTE and SE efficiency, highlighting the importance of scale-related factors in explaining inefficiency among public sector banks.

Fig. 1 shows the indexed daily stock prices of nationalized banks in India from the financial years 2014-15 to 2023-24.



The regression analysis presented in Table 4.3 examines the relationship between stock performance and three efficiency measures namely Technical Efficiency (CRSTE), Pure Technical Efficiency (VRSTE), and Scale Efficiency (SE) for nationalised banks.

Table 4.3: Regression results for Stock Performance and independent variable– CRSTE, VRSTE & SE of Nationalised Banks

Model Specification	Estimate	t-value	p-value	Estimate	t-value	p-value	Estimate	t-value	p-value
CRSTE (Technical Efficiency)	-2.255	-0.251	0.18	-	-	-	-	-	-
VRSTE (Pure Technical Efficiency)	-	-	-	-4.917	-0.906	0.267	-	-	-
SE (Scale Efficiency)	-	-	-	-	-	-	9.546	0.249	0.18
Bank Size (LNTA)	-1.783	-0.481	0.063	-3.304	-0.572	0.268	-2.432	-0.421	0.167
Income Diversification (NIITA)	5.586	2.437	0.016*	3.99	2.356	0.020*	6.403	2.492	0.014*
Profitability (ROA)	4.149	3.981	0.000*	3.616	3.892	0.000*	4.364	4.027	0.000*
Constant	14.89	0.183	0.186	9.665	0.639	0.224	-6.121	-0.072	0.198
Adjusted R ²	0.535			0.54			0.535		
F-statistic	5.650**			5.877**			5.650**		

Notes: **Significant at $\alpha = 0.01$ level; *Significant at $\alpha = 0.05$ level.

The results indicate that none of the three efficiency measures has a statistically significant effect on stock performance. CRSTE has a negative coefficient of -2.255 with $p = 0.180$, while VRSTE has a negative coefficient of -4.917 with $p = 0.267$. In contrast, SE has a positive coefficient of 9.546 with $p = 0.180$. However, all three p-values exceed the 5% significance level, indicating that technical, pure technical, and scale efficiency do not significantly explain variations in stock performance during the study period.

Among the control variables, income diversification (NIITA) has a positive and statistically significant relationship with stock performance in all three models. Its coefficients are 5.586 with $p = 0.016$, 3.990 with $p = 0.020$, and 6.403 with $p = 0.014$, respectively. This suggests that greater diversification of income sources is associated with better stock performance. Profitability (ROA) is also consistently positive and highly significant across all models, with coefficients ranging from 3.616 to 4.364 and p-values of 0.000 . This indicates that profitability is an important determinant of stock market performance and that investors may respond more strongly to the banks' profitability than efficiency levels. Bank size (LNTA) is statistically insignificant in all three models. The adjusted R^2 values of approximately 0.535 - 0.540 indicate that the models explain around 54% of the variation in stock performance. The significant F-statistics confirm the overall significance of the regression models.

Overall, the findings suggest that efficiency alone does not significantly influence stock returns, but income diversification and profitability are more important determinants for nationalised banks in India.

5. Summary and Conclusion

The study evaluated the efficiency performance of twelve public sector banks in India during the period 2014-15 to 2023-24 using DEA approach, considering CRSTE, VRSTE, and SE, and subsequently examined their relationship with stock returns.

The bank-wise results indicate substantial differences in efficiency levels. Bank of Maharashtra, Punjab and Sind Bank, and State Bank of India achieved efficiency in all ten years under CRSTE, VRSTE, and SE, indicating consistently strong technical, managerial, and scale efficiency. In contrast, Canara Bank recorded the lowest efficiency performance, with only two efficient years under CRSTE and VRSTE and one under SE.

The year-wise analysis shows that efficiency varied considerably over the study period. 2016 was the strongest year, with all twelve banks achieving efficiency under all three measures. Efficiency was also relatively high in 2020, whereas 2022 recorded the lowest efficiency, with only five banks efficient under CRSTE and SE and six under VRSTE. Overall, VRSTE efficiency was generally higher than CRSTE efficiency, indicating the presence of scale-related inefficiencies.

The regression results show that CRSTE, VRSTE, and SE do not have a statistically significant relationship with stock returns. However, income diversification and profitability (ROA) have positive and statistically significant effects on stock performance in all three models. Bank size was found to be statistically insignificant.

The findings demonstrate that efficiency levels among Indian public sector banks are heterogeneous. While some banks consistently operate efficiently, others face persistent technical and scale inefficiencies. The higher VRSTE scores compared with CRSTE suggest that improving the scale of operations remains important for enhancing overall efficiency.

Importantly, the regression results indicate that operational efficiency does not necessarily translate into higher stock returns. Investors appear to respond more strongly to observable financial fundamentals, particularly profitability and income diversification. Thus, efficiency improvements, although important for internal performance, may not independently determine market valuation.

The study suggests that public sector banks should focus on improving scale and managerial efficiency, optimise resources and adopt effective digital and cost-control practices. Banks should also strengthen income diversification and profitability through sustainable non-interest income, better asset utilisation, and effective credit management. Further, they should

communicate their financial and efficiency improvements clearly to investors and benchmark their practices against consistently efficient banks to enhance overall performance and competitiveness.

References

- Alomari, M. W., Bashayreh, A., & Abdelhadi, S. (2020). Jordanian banking system: Analysis of technical efficiency and performance. *Financial Studies*, 24(3 (89)), 23-40.
- Alsharif, M. (2021). The efficiency of banks and stock performance: Evidence from Saudi Arabia. *Cogent Economics & Finance*, 9(1), 1953726.
- Aygören, H., Yeşilyurt, M. E., Güloğlu, B., & Küçükkaplan, İ. (2015). The relationship between stock performance and the efficiency in Turkish banking sector. *Doğuş Üniversitesi Dergisi*, 16(2), 203-215.
- Banker, R. D., Charnes, A., and Cooper, W. W. (1984). Some models for estimating technical and scale inefficiencies in data envelopment analysis. *Management Science*, 30(9), 1078-1092.
- Bauer, P. W., Berger, A. N., Ferrier, G. D., & Humphrey, D. B. (1998). Consistency conditions for regulatory analysis of financial institutions: a comparison of frontier efficiency methods. *Journal of Economics and business*, 50(2), 85-114.
- Beccalli, E., Casu, B., & Girardone, C. (2006). Efficiency and stock performance in European banking. *Journal of Business Finance & Accounting*, 33(1–2), 245–262.
- Bhattacharyya, A., Lovell, C. A. K., & Sahay, P. (1997). The impact of liberalization on the productive efficiency of Indian commercial banks. *European Journal of Operational Research*, 98(2), 332–345.
- Burgess, R., & Pande, R. (2005). Do rural banks matter? Evidence from the Indian social banking experiment. *American Economic Review*, 95(3), 780–795.
- Chakrabarty, K. C. (2011). *Financial inclusion and banks: Issues and perspectives*. Reserve Bank of India.
- Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European Journal of Operational Research*, 2(6), 429–444.
- Chu, S. F., & Lim, G. H. (1998). Share performance and profit efficiency of banks in an oligopolistic market: evidence from Singapore. *Journal of Multinational Financial Management*, 8(2-3), 155-168.

374 Cvilikas, A. & Jurkonyte-Dumbliauskiene, E. (2016). Assessment of Risk Management
 375 Economic Efficiency Applying Economic Logistic Theory. *Transformations in Business &*
 376 *Economics* 15, 207–19.

377 Das, A. (2006). Financial deregulation and efficiency: An empirical analysis of Indian banks
 378 during the post reform period. *Review of Financial Economics*, 15(3), 193–221.

379 Das, A., & Ghosh, S. (2006). Financial deregulation and efficiency: An empirical analysis of
 380 Indian banks during the post-reform period. *Review of Financial Economics*, 15(3), 193–221.

381 Department of Financial Services. (2024). *Banking analytics*. Ministry of Finance,
 382 Government of India.

383 Fama, E. F. (1976). *Foundations of finance*. Basic Books.

384 Farrell, M. J. (1957). The measurement of productive efficiency. *Journal of the Royal*
 385 *Statistical Society, Series A*, 120(3), 253-281.

386 Ghosh, S. (2016). Productivity, ownership and firm growth: evidence from Indian
 387 banks. *International Journal of Emerging Markets*, 11(4), 607-631.

388 Gu, H., & Yue, J. (2011). The relationship between bank efficiency and stock returns:
 389 evidence from Chinese listed banks. *World Journal of Social Sciences*, 4(1), 95-106.

390 Janoudi, S. (2014). Banking efficiency and stock performance in the EU markets: The impact
 391 of the world financial crisis. Available at SSRN 2513272.

392 Kale, S., Eken, M. H., & Kaya, İ. G. (2020). Bank efficiency and stock returns in the Turkish
 393 stock market: A two-stage analysis approach.
 394 *Eskişehir Osmangazi Üniversitesi İktisadi ve İdari Bilimler Dergisi*, 15(3), 1001-1018.

395 Kumar, S., & Gulati, R. (2009). Measuring efficiency, effectiveness and performance of Indian
 396 public sector banks. *International Journal of Productivity and Performance*
 397 *Management*, 59(1), 51-74.

398 Kumar, S., and Singh, N. (2013). Performance of nationalized banks in India: A comparative
 399 study. *Asian Economic and Financial Review*, 3(2), 223-235.

400 Kumbhakar, S.C. and Sarkar, S. (2003). Deregulation, ownership and productivity growth in
 401 the banking industry: evidence from India. *Journal of Money, Credit and Banking*, 35(3),
 402 403-424.

403 Levine, R. (1997). Financial development and economic growth: Views and agenda. *Journal*
 404 *of Economic Literature*, 35(2), 688–726.

405 Levine, R. (2005). Finance and growth: Theory and evidence. In P. Aghion & S. N. Durlauf
 406 (Eds.), *Handbook of Economic Growth* (Vol. 1A, pp. 865–934). Elsevier.

407 Liadaki, A., &Gaganis, C. (2010). Efficiency and stock performance of EU banks: Is there a
408 relationship? *Omega*, 38(5), 254–259.

409 Mishkin, F. S. (2007). *The economics of money, banking, and financial markets*. Pearson
410 education.

411 Mukherjee, A., Nath, P., & Pal, M. (2002). Performance benchmarking and strategic
412 homogeneity of Indian banks. *International Journal of Bank Marketing*, 20(3), 122–139.

413 Nagaraju, T. (2014). An analysis of profitability and marketability efficiencies of Indian
414 public and private banks. *Indian Journal of Finance*, 8(1), 15–28.

415 Paradi, J. C., & Zhu, H. (2013). A survey on bank branch efficiency and performance research
416 with data envelopment analysis. *Omega*, 41(1), 61–74.

417 Pasiouras, F., Liadaki, A., & Zopounidis, C. (2008). Bank efficiency and share performance:
418 Evidence from Greece. *Applied Financial Economics*, 18(14), 1121–1130.

419 Ray, S. C., & Das, A. (2010). Distribution of cost and profit efficiency: Evidence from Indian
420 banking. *European Journal of Operational Research*, 201(1), 297–307.

421 Reddy, K. S., & Nirmala, V. (2013). Profit efficiency and its determinants: Evidence from
422 Indian commercial banks. *Journal of Transnational Management*, 18(2), 125–163.

423 Reserve Bank of India. (2008). *Report on currency and finance 2006–08: The banking sector
424 in India—Evolution, reforms and outlook*. Reserve Bank of India.

425 Reserve Bank of India. (2023). *Report on trend and progress of banking in India 2022–23*.
426 Reserve Bank of India.

427 Saha, A., & Ravisankar, T. S. (2000). Rating of Indian commercial banks: A DEA approach.
428 *European Journal of Operational Research*, 124(1), 187–203.

429 Sanjeev, G. M. (2006). Data envelopment analysis (DEA) for measuring technical efficiency
430 of banks. *Vision: The Journal of Business Perspective*, 10(1).

431 Sarkar, S., and Sahu, S. (2011). Efficiency and performance of Indian nationalized banks: An
432 empirical analysis. *International Journal of Financial Studies*, 2(1), 25–38.

433 Sarpong, D. J., Winful, E. C., & Ntiamoah, J. (2017). Bank efficiency and stock returns.
434 *Journal of Economics and International Finance*, 9(2), 12–18.

435 Sathye, M. (2001). X-efficiency in Australian banking: An empirical investigation. *Journal of
436 Banking & Finance*, 25(3), 613–630.

437 Shaban M., Kavida V., and Shah A., (2013). Evaluating Efficiency of Commercial Banks in
438 India: Using DEA Model. *Pacific Business Review International*, 5, 9–18.

- Sharma, D. (2018). Stock market performance and efficiency of banks in a developing economy: Evidence from the Indian banking sector. *IIM Kozhikode Society & Management Review*, 7(2), 178–193.
- Sufian, F. (2011). Banks' total factor productivity change in a developing economy: Does ownership and origins matter? *Journal of Asian Economics*, 22(1), 84–98.
- Sufian, F., & Majid, M. Z. A. (2007). Banks' efficiency and stock prices in emerging markets: evidence from Malaysia. *Journal of Asia-Pacific Business*, 7(4), 35-53.
- Sufian, F., & Majid, M. Z. A. (2009). Bank efficiency and share prices in China: empirical evidence from a three-stage banking model. *International Journal of Computational Economics and Econometrics*, 1(1), 23-47.
- Sumantyo, R., & Tresna, W. N. A. T. (2017). Bank Efficiency Analysis and Stock Return in Indonesia Stock Exchange (IDX). *Jurnal Ekonomi Pembangunan: Kajian Masalah Ekonomi dan Pembangunan*, 18(2), 256-264.
- Tsolas, I. E., & Charles, V. (2015). Incorporating risk into bank efficiency: A satisficing DEA approach to assess the Greek banking crisis. *Expert systems with applications*, 42(7), 3491-3500.
- Tuffour, J. K., Ofori-Boateng, K., & Ohemeng, W. (2020). Efficiency of listed banks operations and stock price movements. *International Journal of Economics and Financial Issues*, 10(1), 219-227.
- Wani, I. A., & Shrotriya, V. (2026). Benchmarking Efficiency in Indian Banking: Insight from a DEA Analysis. *Pacific Business Review (International)*, 19(1), 37-51.
- Wani, I., & Shrotriya, V. (2025). *Bank Efficiency and Stock Performance: A Review. Innovative Multidisciplinary Approaches to Global Challenges: Sustainability, Equity, and Ethics in an Interconnected World (IMASEE 2025)*, 336-348.
- Wu, D. D., Yang, Z., & Liang, L. (2006). Using DEA-neural network approach to evaluate branch efficiency of a large Canadian bank. *Expert systems with applications*, 31(1), 108-115.
- Youssef, O. (2024). The role of commercial banks in economic development and financial inclusion. *Academy of Accounting and Financial Studies Journal*, 28(5), 1-3.
- Zhu, J. (2000). Multi-factor performance measure model with an application to Fortune 500 companies. *European journal of operational research*, 123(1), 105-124.