



INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

An Analysis Of Productivity And Financial Performance Of Selected Major Ports In India

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Abstract: The present study analyzes the productivity and financial performance of selected major ports in India, namely Jawaharlal Nehru Port Trust (JNPT) and Visakhapatnam Port Trust (VPT), for a period of five years from 2019–20 to 2023–24. The study is based on secondary data collected from the annual reports of the respective ports. Various productivity and financial indicators such as labour productivity, capital productivity, expenditure efficiency, profitability, liquidity and return on capital employed are examined using ratio analysis. Descriptive statistical tools including mean, standard deviation, and coefficient of variation are used to assess consistency in performance, while ANOVA is applied to test the significance of differences in key indicators. The results reveal that certain productivity and financial measures exhibit variability, while some indicators show relative stability. The findings also indicate that significant differences exist in several performance indicators, whereas a few measures do not show statistical significance. The study highlights the importance of efficient resource utilization, cost control, and financial management in improving port performance and ensuring long-term sustainability.

Keywords: Productivity, Financial Performance, Ports, JNPT, VPT

1. INTRODUCTION

Ports play a crucial role in the economic development of India by facilitating foreign trade, supporting industrial growth and strengthening the country's integration with global markets. As a trade-oriented economy, India depends heavily on maritime transport, with a significant proportion of its export and import cargo handled through seaports. Efficient port operations contribute to reduced logistics costs, improved supply chain performance and enhanced trade competitiveness, thereby supporting overall economic growth.

India has a well-established port system consisting of major ports and non-major ports distributed along its extensive coastline. Major ports function under the administrative control of the central government and handle a substantial share of the country's maritime cargo traffic. Prominent major ports in India include Mumbai port, Jawaharlal Nehru Port Trust, Mormugao Port, New Mangalore Port, Cochin Port, Chennai Port, Kamarajar Port (Ennore), Visakhapatnam Port, Paradip Port, Syama Prasad Mookerjee Port (Kolkata-haldia), V.O.Chidambaranar port(Tuticorin), Deendayal Port Authority. These ports play a vital

role in handling containerized cargo, bulk commodities, petroleum products and general cargo and are critical to India's trade and industrial activities.

Jawaharlal Nehru Port Trust (JNPT) is one of the leading major ports in India and serves as a primary gateway for containerized cargo. Located on the west coast, JNPA has developed specialized container handling facilities supported by mechanization and private terminal operations. The port plays a crucial role in India's external trade and has been instrumental in handling a significant share of the country's container traffic. Its operational structure and revenue base make it an important case for analyzing productivity and financial performance.

Visakhapatnam Port (VPT), located on the east coast of India, is another prominent major port with a diversified cargo profile. The port handles bulk commodities such as coal, iron ore, petroleum products, fertilizers and general cargo, serving key industrial and hinterland regions. The multi-cargo nature of Visakhapatnam Port influences its operational processes, productivity levels, financial structure. Analyzing its performance provides valuable insights into the functioning of a diversified major port in Indian context.

In this background, the present study examines the productivity and financial performance of selected major ports in India, namely Jawaharlal Nehru Port Trust and Visakhapatnam Port, for a five-year period 2019-20 to 2023-24. The study employs standard financial performance indicators and partial productivity measures based on secondary data to analyze recent performance trends.

1.1 STATEMENT OF THE PROBLEM

Major ports are vital to India's trade and economic development. Jawaharlal Nehru Port Trust and Visakhapatnam Port Trust are among the key ports facilitating maritime commerce. In a rapidly changing environment marked by capacity expansion, technological advancement, policy reforms, these ports are required to improve both operational productivity and financial sustainability. There is a need to analyze productivity indicators to understand how effectively resources are utilized. It is also essential to examine financial performance to assess profitability, liquidity and sustainability. Therefore, this study focuses on evaluating the productivity and financial performance of JNPT and VPT to support informed managerial and policy decisions.

2. REVIEW OF LITERATURE

A literature review is a critical summary, analysis and synthesis of existing scholarly work (books, articles, etc.) on a specific topic, providing context, identifying gaps and showing how your research fits into the broader academic conversation. It's more than a list; it's a structured evaluation that highlights key findings, theoretical frameworks and research methods, serving as a foundation for new research by establishing what's known and what needs further investigation.

Vasumathi.T.et al. (2014), analyzed the financial performance of selected five ports in India using financial ratio analysis and trend analysis. The study focused on key financial indicators such as profitability, liquidity and operating efficiency. It revealed noticeable variations in financial performance among the selected ports. The findings indicated the some ports were financially stable, while others faced challenges in management for improving port sustainability.

Prabir De and Arpit Barman (2015), examined the performance and productivity of major ports in India in the context of trade growth and infrastructure development. The study assessed productivity trends and efficiency level of major ports over time. It highlighted the role of infrastructure expansion, technological improvement and policy reforms in influencing port productivity. The findings showed that productivity growth was not uniform across all major ports. The study stressed the need for systematic productivity assessment and efficiency enhancement. It's concluded that improving port performance is essential for enhancing trade competitiveness.

Mr.Sekar (2016), conducted a comparative analysis of the financial efficiency of major ports operating in western India using financial performance indicators. The study evaluated cost efficiency, revenue generation and surplus performance of the selected ports. It identified significant differences in financial efficiency among the ports. The findings suggested that variations in operational practices and financial management affected port efficiency. The study emphasized the importance of effective cost control and revenue optimization.

Rajasekar.T (2021), applied Data envelopment analysis (DEA) to examine the operational efficiency of selected major ports in India over a multi-year period. The study used DEA models to assess technical efficiency and determine whether port size influences efficiency levels among Indian major ports. The findings indicated that both larger and smaller ports can achieve high efficiency scores, suggesting that port size is not a decisive factor in efficiency outcomes. The study further highlighted the effectiveness of DEA as a non-parametric tool for bench-marking relative performance among port decision making units (DMUs).

Shafeeqe Abdul Kader (2022), examined the performance of major Indian ports using both inter-port and intra-port analysis. The study employed a composite performance index using both inter-port and intra-port analysis. The findings revealed significant variations in performance across ports, with some ports consistently outperforming others. The authors emphasized the need for port-specific strategies to improve efficiency and overall performance.

Existing studies on Indian ports largely focus on policy and infrastructure aspects, with limited emphasis on port-specific productivity and financial statements over multiple years. Consequently, there is inadequate empirical evidence on resource utilization efficiency and financial performance trends of individual major ports. Therefore, the present study addresses the lack of a comprehensive and systematic analysis of productivity and financial performance of Jawaharlal Nehru Port Trust and Visakhapatnam Port Trust by examining key productivity and financial indicators using secondary data from annual and administrative reports for a 5 year period. The study aims to provide meaningful insights into operational efficiency and financial sustainability of the selected ports.

3. OBJECTIVES

The following are the important objectives of the study.

- ❖ To measure the productivity performance of Jawaharlal Nehru Port Trust and Visakhapatnam Port using financial-statement based productivity ratios.
- ❖ To evaluate the financial performance of Jawaharlal Nehru Port Trust and Visakhapatnam Port using standard financial ratios computed from balance sheets and income statements.

3.1 RESEARCH METHODOLOGY

Research methodology refers to the systematic framework and procedures used to conduct a research study. It explains how the research is designed, how data are collected, how variables are measured, how statistical tools are applied to analyze the data. In simple terms, research methodology describes the step-by-step scientific process followed to achieve the objectives of the study and ensure the results are reliable and valid.

Sample Size: The study is based on two major port trusts in India, namely Jawaharlal Nehru port trust (JNPT) and Visakhapatnam port trust (VPT). These ports were selected to analyze productivity and financial performance.

Time Period: The study covers a period of 5 years from 2019-2020 to 2023-2024. Data for the analysis were collected for each year within this period.

Sampling Technique: Convenience sampling technique has been adopted for selecting the ports. The selection was based on availability and accessibility of data.

Data Type: The study relies entirely on secondary data. Data were collected from the annual and administrative reports of the respective ports.

Data Analysis Tool: The ratio analysis and the statistical tools like descriptive statistical tools and ANOVA were used to analyse and interpret the data in a systematic manner. They help in drawing meaningful conclusions from the collected data. All cargo values are expressed in tonnes and financial values are expressed in crore rupees.

4. DATA ANALYSIS AND INTERPRETATION

4.1 Cargo Handled Per Employee :

Cargo handled per employee is a key productivity indicators used to measure labour efficiency in ports. It shows how effectively human resources are utilized in cargo operations. A high ratio indicates better operational efficiency and optimal manpower utilization, while a lower ratio may suggest under utilization of workforce or operational inefficiencies.

$$\text{Labour Productivity} = \frac{\text{Cargo Handled}}{\text{No.of.Employees}}$$

If the ratio increases over time, it indicates improvement in labor productivity and operational efficiency. If the ratio decreases, it may imply inefficiency, excess manpower, or reduced cargo volume. Therefore, this ratio helps to assess how effectively a port converts its human resources into cargo throughput performance.

The analysis of Labour Productivity of Selected Ports has been presented in Table No.1

Table 1- Labour Productivity

Financial Year	JNPT			VPT		
	Cargo Handled (Tonnes)	No. of Employees	Cargo Handled Per Employee (Tonnes Per Employee)	Cargo Handled (Tonnes)	No. of Employees	Cargo Handled Per Employee (Tonnes Per Employee)
2019-20	68450000	1473	46469.78	72720000	1900	38273.68
2020-21	64810000	1403	46193.87	69840000	1850	37751.35
2021-22	76000000	862	88167.05	69030000	1850	37313.51
2022-23	83860000	788	106421.31	73750000	1800	40972.22
2023-24	85820000	681	126020.55	80500000	1750	46000
Mean			82654.51			40062.15
Standard Deviation			35758.12			3611.77
Coefficient of			43.27%			9.02%

Variation						
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Source :Compiled and Computed from the Annual Reports Of The Selected Ports

Interpretation

The cargo handled per employee at JNPT shows a higher average productivity of 82,654.51 tonnes but with a high coefficient of variation of 43.27%, indicating considerable fluctuations and lack of consistency over the study period. In contrast, VPT records a lower mean productivity of 40,062.15 tonnes, yet demonstrates a very low coefficient of variation of 9.02%, reflecting stable and consistent performance.

Thus, while JNPT exhibits variability in operational efficiency, VPT maintains steady productivity levels throughout the years.

Testing of Hypothesis

To test whether there is any significant difference in the cargo handled per employee of selected ports, the following null hypothesis is framed and tested. ANOVA is used for this purpose and the results are shown in Table 1(a)

Null hypothesis

Ho - There is no significant difference in the mean cargo handled per employee among the Selected Ports

Table 1(a) Anova-Cargo Handled Per Employee

	Sum Of Squares	Degree Of Freedom	Mean Square	F-Value	F-Critical Value	Significance
Between Groups	4535272826	1	4535272826	7.022	5.32	0.029
Within Groups	5166754993	8	645844374.1			
Total	9702027819	9				

Source :Computed

The ANOVA results show that the calculated F-value (7.022) is higher than the F-critical value (5.32) at the 5% level of significance. The significance value (0.029) is also less than 0.05, indicating statistical significance. Therefore, the null hypothesis is rejected, implying that there is a significant difference in the mean cargo handled per employee among the selected ports.

4.2 Cargo Handled Per Unit Of Capital Employed

Cargo handled per unit of capital employed is an important productivity indicators that measures how efficiently a port utilizes its capital investment to generate cargo throughput. It reflects the effectiveness of infrastructure, equipment and financial resources in supporting port operations. A higher ratio indicates better capital utilization and operational efficiency.

$$\text{Capital Productivity} = \frac{\text{Cargo Handled}}{\text{Capital Employed}}$$

This ratio measures how effectively capital assets are utilized to handle cargo. An increasing ratio indicates that the port is generating higher cargo output for every unit of capital invested, showing efficient asset utilization. A decreasing ratio suggests under utilization of capital, inefficiency or excess investment relative to cargo throughput. This ratio helps evaluate how effectively capital resources are converted into operational performance.

The table 2 shows information relating to the Cargo Handled per Unit of Capital Employed of selected ports for the period of 2019-20 to 2023-24.

Table 2 Cargo Handled Per Unit of Capital Employed

Financial Year	JNPT			VPT		
	Cargo Handled (Tonnes)	Capital Employed (Crore)	Cargo Handled Per Unit Of Capital Employed (Tonnes Per Crore)	Cargo Handled (Tonnes)	Capital Employed	Cargo Handled Per Unit Of Capital Employed (Tonnes Per Crore)
2019-20	68450000	9801.46	6983.65	72720000	1782.32	40800.75
2020-21	64810000	10029.64	6461.84	69840000	2156.80	32381.30
2021-22	76000000	10402.69	7305.80	69030000	2316.29	29801.96
2022-23	83860000	11055.62	7585.28	73750000	2682.20	27496.08
2023-24	85820000	11354.96	7557.93	80500000	3342.65	24082.68
Mean			7178.90			30912.55
Standard deviation			468.29			6314.39
Coefficient of Variation			6.52%			20.42%

Source :Compiled and Computed from the Annual Reports Of The Selected Ports

Interpretation

The above table shows JNPT shows a stable performance in terms of cargo handled per unit of capital employed, as indicated by a low coefficient of variation of 6.52%, reflecting consistency over the years. In contrast, VPT, despite having a higher average efficiency of 30,912.55 tonnes per crore, exhibits greater variability with a CV of 20.42%.

This indicates that JNPT maintains steady capital productivity, while VPT experiences moderate fluctuations during the study period.

Testing of Hypothesis

To test whether there is any significant difference in the cargo handled per unit of capital employed selected ports, the following null hypothesis is framed and tested. ANOVA is used for this purpose and the results are shown in Table 2(a).

Null hypothesis

Ho- there is no significant difference in the mean Cargo Handled Per Unit of Capital Employed among the Selected ports.

Table 2 (a) Anova - Cargo Handled Per Unit of Capital Employed

	Sum Of Squares	Degree Of Freedom	Mean Square	F-Value	F-Critical Value	Significance
Between Groups	1408215830	1	1408215830	70.251	5.32	0.000
Within Groups	160363737.1	8	20045467.14			
Total	1568579568	9				

Source: Computed

The ANOVA results show that the calculated F-value (70.251) is higher than the F-critical value (5.32) at the 5% level of significance. The significance value (0.000) is also less than 0.05, indicating statistical significance. Therefore, the null hypothesis is rejected, implying that there is a significant difference in the cargo handled per unit of capital employed among the selected ports.

4.3 Cargo Handled Per Operating Expenditure:

Cargo handled per operating expenditure is a key efficiency ratio that measures how effectively a port converts its operating expenses into cargo throughput. It reflects cost efficiency in day-to-day operations such as maintenance, administration and labor expenses. A higher ratio indicates better cost control and operational efficiency.

$$\text{Expenditure Productivity} = \frac{\text{Cargo Handled}}{\text{Operating Expenditure}}$$

This ratio evaluates operational efficiency by linking cargo output with operating costs. An increasing ratio indicates that the port is handling more cargo with relatively lower operating costs, showing improved cost efficiency. A decreasing ratio suggests rising operational expenses or reduced cargo volume, indicating possible inefficiencies.

Cargo handled per operating expenditure of selected ports during the study period along with descriptive statistics are shown in table 3

Table 3 - Cargo Handled Per Operating Expenditure

Financial Year	JNPT			VPT		
	Cargo Handled (Tonnes)	Operating Expenditure	Cargo Handled Per Operating Expenditure (Tonnes Per Crore)	Cargo Handled (Tonnes)	Operating Expenditure	Cargo Handled Per Operating Expenditure (Tonnes Per Crore)
2019-20	68450000	899.13	76129.14	72720000	662.55	109757.75
2020-21	64810000	1019.53	63568.50	69840000	654.15	106764.50
2021-22	76000000	1211.59	62727.49	69030000	740.16	93263.61
2022-23	83860000	1209.68	69324.11	73750000	798.03	92415.07
2023-24	85820000	958.33	89551.61	80500000	820.42	98120.47
Mean			72260.17			100064.28
Standard Deviation			11056.67			7864.38
Coefficient of Variation			15.30%			7.86%

Source: Compiled and Computed from the Annual Reports Of The Selected Ports

Interpretation

The table indicates JNPT records an average cargo handled per operating expenditure of 72,260.17 tonnes with a coefficient of variation of 15.30%, indicating moderate variability in operational efficiency over the study period. VPT shows a higher mean value of 100,064.28 tonnes per crore along with a lower CV of 7.86%, reflecting greater stability and consistency.

While JNPT experiences noticeable fluctuations in efficiency, VPT maintains a relatively steady performance. Overall, VPT demonstrates more consistent operational efficiency compared to JNPT during the period.

Testing of Hypothesis

To test whether there is any significant difference in the cargo handled per operating expenditure of selected ports, the following null hypothesis is framed and tested. ANOVA is used for this purpose and the results are shown in table 3(a).

Null hypothesis

Ho- there is no significant difference in the mean Cargo Handled Per Operating Expenditure among the Selected Ports.

Table 3(a) Anova- Cargo Handled Per Operating Expenditure

	Sum Of Squares	Degree Of Freedom	Mean Square	F-Value	F-Critical Value	Significance
Between Groups	1932671332	1	1932671332	20.996	5.32	0.002
Within Groups	736394621.9	8	92049327.74			
Total	2669065954	9				

Source: Computed

The ANOVA results show that the calculated F-value (20.996) is higher than the F-critical value (5.32) at the 5% level of significance. The significance value (0.002) is also less than 0.05, indicating statistical significance. Therefore, the null hypothesis is rejected, implying that there is a significant difference in the cargo handled per operating expenditure among the selected ports.

4.4 Asset Productivity Ratio:

The asset productivity ratio measures how efficiently a port utilizes its total assets to generate operational output. It reflects the effectiveness of infrastructure, equipment and other fixed assets in supporting port activities. A higher ratio indicates better utilization of assets and improved operational performance.

$$\text{Asset Productivity Ratio} = \frac{\text{Cargo Handled}}{\text{Total Asset}}$$

The asset productivity ratio measures the efficiency with which a port utilizes its total assets to generate cargo handling output. An increasing asset productivity ratio indicates efficient use of assets in generating operational output. A decreasing ratio suggests under utilization of assets or excess investment relative to performance.

Table 4 shows information relating to the asset productivity of selected ports for the period of 2019-20 to 2023-24.

Table 4 - Asset Productivity

Financial Year	JNPT			VPT		
	Cargo Handled (Tonnes)	Total Asset (Crore)	Asset Productivity (Tonnes per Crore)	Cargo Handled (Tonnes)	Total Asset (Crore)	Asset Productivity (Tonnes per Crore)
2019-20	68450000	13692.26	4999.17	72720000	4997.92	14550.05
2020-21	64810000	14104.22	4595.07	69840000	4934.94	15152.14
2021-22	76000000	14580.88	5212.30	69030000	5528.74	12485.66
2022-23	83860000	15459.78	5424.39	73750000	6299.34	11707.57
2023-24	85820000	15127.90	5672.96	80500000	7496.56	10738.25
Mean			5180.77			12926.73
Standard Deviation			411.89			1874.69
Coefficient			7.95%			14.50%

of Variation						
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Source :Compiled and Computed from the Annual Reports Of The Selected Ports

Interpretation

From the above table shows JNPT records an average asset productivity of 5,180.77 tonnes per crore with a coefficient of variation of 7.95%, indicating a high level of consistency and stable utilization of assets over the study period. VPT shows a mean asset productivity of 12,926.73 tonnes per crore with a coefficient of variation of 14.50%, reflecting moderate variability in asset utilization.

The results indicate that JNPT maintains steady performance with minimal fluctuations, while VPT exhibits some degree of variation in productivity across the years.

Testing of Hypothesis

To test whether there is any significant difference in the asset productivity ratio of selected ports, the following null hypothesis is framed and tested. ANOVA is used for this purpose and the results are shown in table 4(a).

Null hypothesis

Ho- there is no significant difference in the mean Asset Productivity Ratio among the Selected Ports.

Table 4(a) Anova - Asset Productivity Ratio

	Sum Of Squares	Degree Of Freedom	Mean Square	F-Value	F-Critical Value	Significance
Between Groups	149999585.9	1	149999585.9	81.430	5.32	0.000
Within Groups	14736574.94	8	1842071.868			
Total	164736160.8	9				

Source:Computed

The ANOVA results show that the calculated F-value (81.430) is higher than the F-critical value (5.32) at the 5% level of significance. The significance value (0.000) is also less than 0.05, indicating statistical significance. Therefore, the null hypothesis is rejected, implying that there is a significant difference in the asset productivity ratio among the selected ports.

4.5 PROFIT-BASED PRODUCTIVITY RATIO:

Profit -based capital productivity measures how effectively the capital employed in a port generates profits. It indicates the return earned on long-term funds invested in infrastructure, equipment, operational assets. This ratio is important for assessing financial efficiency, sustainability, the overall profitability of capital investments in port operations.

$$\text{Profit-based Capital Productivity} = \frac{\text{Net Surplus}}{\text{Capital Employed}}$$

Profit based productivity measure the efficiency with which a port converts its operational and financial resources into surplus or profits. An increasing ratio indicates that the port is generating higher profits from the capital invested, showing strong financial performance and efficient capital utilization. A decreasing ratio suggests lower profitability or inefficient use of capital. This ratio helps evaluate the effectiveness of investment decision and the financial strength of the port.

Table 5 revealed the descriptive statistics of the Profit-Based Capital Productivity of selected ports for the period of 2019-20 to 2023-24.

Table 5 Profit -Based Capital Productivity

Financial Year	JNPT			VPT		
	Net Surplus (Crore)	Capital Employed (Crore)	Profit Productivity	Net Surplus (Crore)	Capital Employed (Crore)	Profit Productivity
2019-20	1053.58	9801.46	0.108	274.40	1782.32	0.154
2020-21	803.85	10029.64	0.080	237.31	2156.80	0.110
2021-22	589.33	10402.69	0.057	275.56	2316.29	0.119
2022-23	1097.84	11055.62	0.099	380.71	2682.20	0.142
2023-24	1346.42	11354.96	0.199	724.27	3342.65	0.217
Mean			0.10860			0.14840
Standard Deviation			0.054188			0.042182
Coefficient of Variation			49.89%			28.42%

Source :Compiled and Computed from the Annual Reports Of The Selected Ports

Interpretation

JNPT records an average profit productivity of 0.10860 with a coefficient of variation of 49.89%, indicating a high degree of fluctuation and inconsistency in generating returns on capital employed over the study period. The relatively large standard deviation further supports the presence of significant variability in performance across the years. VPT shows a mean profit productivity of 0.14840 with a coefficient of variation of 28.42%, reflecting moderate variability in its financial performance. Although fluctuations exist, the variability is comparatively controlled, indicating a relatively stable trend in profit generation.

Overall, JNPT experiences considerable instability in profit productivity, whereas VPT maintains a moderate level of consistency during the study period.

Testing of Hypothesis

To test whether there is any significant difference in the profit based productivity ratio of selected ports, the following null hypothesis is framed and tested. ANOVA is used for this purpose and the results are shown in table 5(a).

Null hypothesis

Ho- there is no significant difference in the mean Profit Based Capital Productivity among the selected ports.

Table -5(a) Anova - Profit Based Productivity Ratio

	Sum Of Squares	Degree Of Freedom	Mean Square	F- Value	F-Critical Value	Significance
Between Groups	0.004	1	0.004	1.6840	5.32	0.231
Within Groups	0.019	8	0.002			
Total	0.023	9				

Source: Computed

The ANOVA results show that the calculated F-value (1.680) is lower than the F-critical value (5.32) at the 5% significance level. The significance value (0.231) is also greater than 0.05, indicating that there is no statistically significant difference between the groups in terms of the profit based productivity ratio. Therefore, the variation observed in the data is mainly due to random fluctuations rather than any meaningful group difference.

4.6 Operating Ratio:

The operating ratio measures the proportion of operating expenses to operating revenue and indicates the efficiency of a port's operations. It shows how well the port manages its operating costs relative to the income generated from its activities. This ratio is important for assessing cost control, operational efficiency and overall financial performance.

$$\text{Operating Ratio} = \frac{\text{Operating Expenditure}}{\text{Operating Revenue}} \times 100$$

A lower operating ratio indicates better operational efficiency, as a smaller portion of revenue is consumed by operating expenses. A higher ratio suggests increased operating costs and reduced efficiency. Therefore, this ratio helps evaluate how effectively a port manages its operating expenses in relation to its revenue generation.

Operating ratio of selected ports during the study period along with descriptive statistics are shown in table 6

Table6-Operating Ratio

Financial Year	Operating Ratio (Percentage %)	
	JNPT	VPT
2019-20	45.75	47.18
2020-21	53.07	45.25
2021-22	55.41	48.51
2022-23	47.51	46.21
2023-24	35.20	39.54
Mean	47.38	45.34
Standard Deviation	7.87	3.46
Coefficient of Variation	16.61%	7.63%

Source : Compiled and Computed from the Annual Reports Of The Selected Ports

Interpretation

JNPT records a mean operating ratio of 47.38% with a coefficient of variation of 16.61%, indicating moderate variability in operational efficiency over the study period. The higher standard deviation reflects noticeable fluctuations in managing operating expenses across the years. VPT shows an average operating ratio of 45.34% with a lower coefficient of variation of 7.63%, indicating a high level of consistency and stability in operational performance. The lower variability suggests effective control over operating costs.

Overall, JNPT experiences moderate fluctuations, while VPT maintains stable and consistent operational efficiency throughout the period.

Testing of Hypothesis

To test whether there is any significant difference in the operating ratio of selected ports, the following null hypothesis is framed and tested. ANOVA is used for this purpose and the results are shown in table 6(a).

Null hypothesis

Ho- there is no significant difference in the mean operating ratio among the selected ports.

Table 6(a) Anova -Operating Ratio

	Sum Of Squares	Degree Of Freedom	Mean Square	F- Value	F-Critical Value	Significance
Between Groups	10.506	1	10.506	0.284	5.32	0.608
Within Groups	295.722	8	36.965			
Total	306.229	9				

Source: Computed

The ANOVA results reveal that the calculated F-value (0.284) is lower than the F-critical value (5.32) at the 5% significance level. The significance value (0.608) is also greater than 0.05, indicating that there is no statistically significant difference between the groups with respect to the operating ratio. Hence, the observed variation is mainly due to chance rather than any significant group effect.

4.7 Net Surplus Ratio:

The net surplus ratio measures the proportion of net surplus to total revenue and indicates the overall profitability of a port. It reflects the port's ability to generate surplus after meeting all operating and non-operating expenses. This ratio is important for assessing financial stability, efficiency and long-term sustainability.

$$\text{Net Surplus Ratio} = \frac{\text{Net Surplus}}{\text{Total Revenue}} \times 100$$

A higher net surplus ratio indicates strong profitability and effective cost management, as a greater portion of revenue is retained as surplus. A lower ratio suggests reduced profitability or higher expenses. Therefore, this ratio helps evaluate the overall financial performance and earning capacity of the port. The table 7 shows net surplus ratio and its descriptive statistics of selected ports for the period of 2019-20 to 2023-24.

Table 7 Net surplus ratio

Financial Year	JNPT			VPT		
	Net Surplus (Crore)	Total Revenue (Crore)	Net Surplus Ratio (Percentage %)	Net Surplus (Crore)	Total Revenue (Crore)	Net Surplus Ratio (Percentage %)
2019-20	1053.58	2336.80	45.07	274.40	1511.83	18.15
2020-21	803.85	2320.61	34.64	237.31	1523.85	15.57
2021-22	589.33	2476.97	23.79	275.56	1609.86	17.12
2022-23	1097.84	2895.13	37.92	380.71	1862.55	20.44
2023-24	1346.42	3143.92	42.83	724.27	2434.19	29.76
Mean			36.85			20.21
Standard Deviation			8.36			5.03
Coefficient of Variation			22.68%			24.90%

Source: Compiled and Computed from the Annual Reports Of The Selected Ports

Interpretation

JNPT records a mean net surplus ratio of 36.85% with a coefficient of variation of 22.68%, indicating moderate variability in profitability over the study period. The fluctuations suggest some inconsistency in converting revenue into surplus. VPT shows an average net surplus ratio of 20.21% with a CV of 24.90%, reflecting slightly higher variability in profit performance.

Overall, both ports exhibit moderate fluctuations in profitability during the period.

Testing of Hypothesis

To test whether there is any significant difference in the net surplus ratio of selected ports, the following null hypothesis is framed and tested. ANOVA is used for this purpose and the results are shown in table 7(a).

Null hypothesis

Ho- there is no significant difference in the mean Net Surplus Ratio among the Selected Ports.

Table 7(a) Anova -Net Surplus Ratio

	Sum Of Squares	Degree Of Freedom	Mean Square	F-Value	F-Critical Value	Significance
Between Groups	692.390	1	692.390	13.626	5.32	0.006
Within Groups	406.498	8	50.812			
Total	1098.888	9				

Source: Computed

The ANOVA results show that the calculated F-value (13.626) is higher than the F-critical value (5.32) at the 5% level of significance. The significance value (0.006) is also less than 0.05, indicating statistical significance. Therefore, the null hypothesis is rejected, implying that there is a significant difference in the net surplus ratio among the selected ports.

4.8 Current Ratio:

This ratio assesses the short-term liquidity position of the port and indicates its ability to meet current obligations using current assets. It reflects the financial stability and working capital management of the organization. This ratio is important for assessing whether the port can efficiently handle its short-term liabilities without financial strain.

$$\text{Current Ratio} = \frac{\text{Current Asset}}{\text{Current Liability}}$$

A current ratio greater than 1 indicates that the port has sufficient current assets to cover its short-term liabilities. A ratio less than 1 suggests possible liquidity problems. An excessively high ratio may indicate under utilization of working capital. Therefore, this ratio helps evaluate the short-term financial strength and liquidity position of the port.

The table8 shows current ratio and its descriptive statistics of selected ports for the period of 2019-20 to 2023-24.

Table 8 Current Ratio

Financial year	Current Ratio	
	JNPT	VPT
2019-20	0.23	0.74
2020-21	0.21	0.89
2021-22	0.20	0.92
2022-23	0.19	1.03
2023-24	0.17	1.24
Mean	0.2000	0.9640
Standard Deviation	0.02236	0.18582
Coefficient of Variation	11.18%	19.27%

Source : Compiled and Computed from the Annual Reports Of The Selected Ports

Interpretation

JNPT records a mean current ratio of 0.2000 with a coefficient of variation of 11.18%, indicating relatively stable but consistently low liquidity position over the study period. The low ratio suggests potential difficulty in meeting short-term obligations. VPT shows an average current ratio of 0.9640 with a CV of 19.27%, reflecting moderate variability in liquidity.

Overall, JNPT maintains stability at a lower level, while VPT exhibits some fluctuations in its short-term financial position.

Testing of Hypothesis

To test whether there is any significant difference in the current ratio of selected ports, the following null hypothesis is framed and tested. ANOVA is used for this purpose and the results are shown in table 8(a).

Null hypothesis

Ho- there is no significant difference in the mean Current Ratio among the Selected Ports.

Table 8(a)Anova- Current Ratio

	Sum Of Squares	Degree Of Freedom	Mean Square	F- Value	F-Critical Value	Significance
Between Groups	1.459	1	1.459	83.314	5.32	0.000
Within Groups	0.140	8	0.018			
Total	1.599	9				

Source: Computed

The ANOVA results show that the calculated F-value (83.314) is greater than the F-critical value (5.32) at the 5% significance level. The significance value (0.000) is also less than 0.05, indicating that there is a statistically significant difference between the groups with respect to the current ratio. Therefore, the null hypothesis is rejected, showing that the groups vary significantly in terms of their liquidity position.

4.9 Efficiency Ratio:

This ratio measures how efficiently the port uses its assets to generate revenue. It reflects the effectiveness of asset management in producing income from investments in infrastructure, equipment and other operational facilities. This ratio is important for evaluating operational efficiency and the productivity of the asset base.

$$\text{Asset Turnover Ratio} = \frac{\text{Total Revenue}}{\text{Total Asset}}$$

A higher asset turnover ratio indicates efficient utilization of assets in generating revenue. A lower ratio suggests under utilization of assets or excess investment relative to income. Therefore, this ratio helps assess how effectively the port's asset contributes to revenue generation and overall financial performance.

Asset turnover ratio of selected ports during the study period along with descriptive statistics are shown in table 9

Table 9 Asset Turnover Ratio

Financial year	JNPT			VPT		
	Total Revenue (Crore)	Total Asset (Crore)	Asset Turnover Ratio	Total Revenue (Crore)	Total Asset (Crore)	Asset Turnover Ratio
2019-20	2336.80	13692.26	0.17	1511.83	4997.92	0.30
2020-21	2320.61	14104.22	0.16	1523.85	4934.94	0.30
2021-22	2476.97	14580.88	0.16	1609.86	5528.74	0.29
2022-23	2895.13	15459.78	0.18	1862.55	6299.34	0.29
2023-24	3143.92	15127.90	0.20	2434.19	7496.54	0.32
Mean			0.1740			0.3000
Standard Deviation			0.01673			0.01225
Coefficient of Variation			9.61%			4.08%

Source : Compiled and Computed from the Annual Reports Of The Selected Ports

Interpretation

JNPT records a mean asset turnover ratio of 0.1740 with a coefficient of variation of 9.61%, indicating a stable and consistent utilization of assets in generating revenue over the study period. The low variability reflects steady operational efficiency. VPT shows an average ratio of 0.3000 with a very low CV of 4.08%, indicating a high degree of consistency in asset utilization.

Overall, both ports maintain stable performance with minimal fluctuations in asset turnover.

Testing of Hypothesis

To test whether there is any significant difference in the efficiency ratio of selected ports, the following null hypothesis is framed and tested. ANOVA is used for this purpose and the results are shown in table 9(a).

Null hypothesis

Ho- there is no significant difference in the mean Efficiency Ratio among the selected ports.

Table 9(a) Anova- Efficiency Ratio

	Sum Of Squares	Degree Of Freedom	Mean Square	F- Value	F-Critical Value	Significance
Between Groups	0.040	1	0.040	184.605	5.32	0.000
Within Groups	0.002	8	0.000			
Total	0.042	9				

Source: Computed

The ANOVA results show that the calculated F-value (184.605) is greater than the F-critical value (5.32) at the 5% level of significance. The significance value (0.000) is also less than 0.05, indicating that there is a statistically significant difference between the groups with respect to the efficiency ratio. Therefore,

the null hypothesis is rejected, suggesting that the groups differ significantly in their efficiency performance.

4.10 Return On Capital Employed:

Return on capital employed measures the profitability and efficiency with which a port utilizes its long-term funds. It indicates how effectively capital employed in infrastructure, equipment, operations generates operating profit. This ratio is important for assessing overall financial performance and the effectiveness of investment decisions.

$$\text{ROCE (\%)} = \frac{\text{Operating Profit (EBIT)}}{\text{Capital Employed}} \times 100$$

Return on capital employed measures how efficiently an organization uses its long-term funds to generate operating profits. A higher ROCE indicates efficient utilization of capital and strong profitability. A lower ROCE suggests inefficient use of capital or lower operating profits. Therefore, this ratio helps evaluate the financial strength and long-term earning capacity of the port.

Table 10 revealed the descriptive statistics of the return on capital employed of selected ports for the period of 2019-20 to 2023-24.

Table 10 Return on Capital Employed

Financial Year	Return On Capital Employed (Percentage %)	
	JNPT	VPT
2019-20	25.10	15.40
2020-21	23.80	11.00
2021-22	14.61	11.90
2022-23	31.79	14.19
2023-24	33.28	21.67
Mean	25.7160	14.8320
Standard Deviation	7.44146	4.20636
Coefficient of Variation	28.93%	28.36%

Source :Compiled and Computed from the Annual Reports Of The Selected Ports

Interpretation

JNPT records a mean return on capital employed of 25.7160% with a coefficient of variation of 28.93%, indicating moderate variability in generating returns from capital over the study period. The relatively higher fluctuations suggest inconsistency in performance across the years. VPT records a mean return on capital employed of 14.8320% with a CV of 28.36%, reflecting a similar level of variability in capital efficiency.

Overall, both ports exhibit moderate fluctuations in their return on capital employed during the period.

Testing of Hypothesis

To test whether there is any significant difference in the return on capital employed of selected ports, the following null hypothesis is framed and tested. ANOVA is used for this purpose and the results are shown in table 10(a).

Null hypothesis

Ho- there is no significant difference in the mean Return on Capital Employed among the Selected Ports.

Table 10 (a) Anova- Return On Capital Employed

	Sum Of Squares	Degree Of Freedom	Mean Square	F-Value	F-Critical Value	Significance
Between Groups	296.154	1	296.154	8.106	5.32	0.022
Within Groups	292.275	8	36.534			
Total	588.429	9				

Source: Computed

The ANOVA results show that the calculated F-value (8.106) is higher than the F-critical value (5.32) at the 5% level of significance. The significance value ($p < 0.05$) indicates that the difference is statistically significant. Therefore, the null hypothesis is rejected, implying that there is a significant difference in the return on capital employed among the selected ports.

5. SUGGESTIONS

Based on the findings of the study and also in general, the following suggestions are made in the study:

- Reducing the turnaround time will help to increase productivity of both the ports. For this purpose, they have to implement digital operational technologies and also they can expand their capacities to handle the larger vessels.
- The ports can utilize the solar wind power for their internal needs and it help to reduce operational cost which in turn increases the profitability of both ports.
- Improving the cargo handling process will help to increase labour productivity of both the ports. For this purpose, they can implement RFID-based cargo tracking systems and adopt advanced technologies to monitor cargo movement efficiently, which will reduce delays and improve operational performance.
- Controlling operating expenses will help to improve the financial performance of both the ports. The ports can adopt cost control measures such as automation and energy-efficient systems, which will reduce operational costs and increase profitability.
- Adopting modern digital management systems will help to improve both operational and financial performance of the ports. The integration of digital technologies will enhance coordination, improve decision-making and support long-term sustainability of both the ports.

6. CONCLUSION

The present study analyzed the productivity and financial performance of the two selected major ports over the study period using various productivity and financial indicators. The results indicate that both the ports show differences in labour productivity, capital utilization, cost efficiency and financial performance, reflecting variations in operational practices and resource management. The analysis highlights that improving cargo handling efficiency and reducing operational delays can significantly enhance productivity levels. The adoption of modern technologies such as RFID systems and better planning of port operations can further strengthen labour and asset utilization. At the same time, effective management of working capital and control over operating expenses are essential to improve the financial position and profitability of the ports. Further, the study emphasizes that the integration of digital systems and sustainable practices can support better coordination, reduce costs and enhance overall efficiency. Therefore, by focusing on technological advancement, efficient resource utilization, and sound financial management, both the ports can improve their performance and ensure long-term sustainability.

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