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## RESEARCH ARTICLE

### MACROECONOMIC LINKAGES OF MAJOR PORT PERFORMANCE IN INDIA: AN EMPIRICAL CORRELATION ANALYSIS

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#### ABSTRACT

Ports as a significant pillar of India trade and logistics infrastructure have impressive large macroeconomic impacts as well. This research paper studies the factors of top operational indicators for major Indian ports along with its relationship with macroeconomic variables such as GDP, Exports & Imports in India from 2018–19 to 2022-23. A methodology Pearson's correlation analysis has been used to see whether operational efficiency indicators available can be correlated with their related possible national economic performance indicators for ports. The findings show that, as far as GDP and financial indicators (operating surplus, profit before tax and profit after tax) are concerned, the relationship is positive but mixed for exports and imports in operational indicators. Conclusion These inferences expose an exigency to improve port productivity & financial sustainability for long-term economic growth & trade prosperity in India.

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## INTRODUCTION

Ports are very critical links in international commerce and economic integration, all the more for a developing economy like India which is dependent almost entirely on maritime trade. The charterers' costs are a vital part in port administration which reduces logistic costs, increases the competitiveness of trade and favors upturns within the economy. India has been carrying out a series of port modernization initiatives over the years to improve productivity and efficiency. Nevertheless, the link of port performance indicators with macroeconomic factors has seldom been studied. This study seeks to bridge that gap, exploring the relationships between main port performance indicators and major macroeconomic variables including GDP together with exports and imports.

## REVIEW LITERATURE

Earlier research has highlighted the contribution of port efficiency to trade facilitation and economic development. Studies show that developing port infrastructure and enhancing operational efficiency effectively drive down

turnaround time and logistics costs, thus furthering the country's exports and imports. Even financial performance measures, like operating surplus or profitability, are shown to correlate with the economic impact of ports. However, the existing studies mostly analyse operational efficiency or financial performance separately. According to studies, efficient port operations are conducive to lowering logistics costs and enhancing supply chain performance that aid national economic development (Cullinane, Song & Wang, 2005). Common operational indicators, namely turnaround time and berth productivity, have been found associated with GDP levels especially in developing economies (World Bank, 2007). Research has indicated a positive impact of higher port productivity, cargo handling efficiency on export performance by decreasing delays and transaction cost (Tongzon, 2009). Export growth responds more to efficiency increases in ports in economies that have followed trade-led growth strategies (UNCTAD, 2022). Studies show that port capacity utilization and effective operation have significant impact on volume of import (Cullinane et al., 2005). Higher berth productivity and less congestion improve import flows and thus total trade efficiency (World Bank, 2007). The strong financial position of ports plays a key role in delivering economic growth via the increased operating surplus and profitability (UNCTAD,

2022). Still, very few studies have integrated the operational and financial ports' performance with GDP, exports, and imports specifically in an Indian context resulting in a research gap. The current literature extends by simultaneously assessing operational and financial metrics with macroeconomic performance.

### NEED FOR THE STUDY

Despite the strategic significance attached to ports in India's economic architecture, very few empirical studies are conducted to quantify their association with GDP, exports and imports. Policymakers and port authorities to govern effectively, need insights that are supported by evidence to help prioritize investments and reforms with changes in macroeconomic aggregates being driven by variations of a singular port, this study is essential to understand the relationship between performance indicators and macroeconomic outcomes for these ports to aid in sound decision making in policy.

### OBJECTIVES OF THE STUDY

- To examine the relationship between GDP and major port performance indicators in India.
- To analyse the correlation between port performance indicators and exports.
- To study the association between port performance indicators and imports.
- To compare the explanatory power of operational and financial port indicators on macroeconomic variables.

### HYPOTHESES OF THE STUDY

**H<sub>1</sub>:** There is a significant relationship between GDP and major port performance indicators.

**H<sub>2</sub>:** Port performance indicators are significantly related to exports.

**H<sub>3</sub>:** Port performance indicators are significantly related to imports.

**H<sub>4</sub>:** Financial performance indicators of ports have a stronger association with GDP than operational indicators.

## METHODOLOGY

The study adopts a descriptive and analytical research design based on secondary data. Data Source: Published port performance statistics and national macroeconomic data. Period of Study: 2018–19 to 2022–23

**Variables:** Operational indicators: Traffic handled, average turnaround time, average output per ship berth day. Financial indicators: Operating surplus, profit before tax, profit after tax. Macroeconomic indicators: GDP, exports, imports. Statistical Tool: Pearson's correlation coefficient and coefficient of determination

**Analysis of Correlation with Key Operating Port Performance Indicator:** There exists a strong relationship between GDP and the key performance indicators of port efficiency, as confirmed by correlation analysis. There is a strong positive correlation between the operating surplus, profit before tax (PBT), and profit after tax (PAT) and GDP

which indicates that the financial performance of major ports rises in step with GDP growth. That strong negative correlation between GDP and average turnaround indicates that improving port efficiency translates to greater economic output. In contrast, the negative relationship between GDP and traffic handled demonstrates that economic growth over the study period was not driven by volume of cargo but rather efficiency in terms of productivity and value. The outcomes expose an average beneficial association relating to sends out and traffic taken care of, demonstrating that port action bolsters send out development somewhat. Exports are negatively correlated with average turnaround time suggesting that delays in ports adversely impact export effectiveness. For exports and output per ship berth day, the relationship is actually a little stronger-and in part confirms the notion that productivity matters when it comes to boosting export growth. By contrast, the results of regression analyses show that relationships between exports and port profit measures are weak, implying that ports see growth in export activity not so much from returns but operational efficiency.

Average output per ship berth day has a very strong positive correlation with import outperformance; this suggests that greater productivity in the berth has a more potent direct effect on capacity to support flows. Weak positive relationships with operating surplus indicate under this set where, as import moves more the financial position of the port improves. Note that imports are inversely correlated with both traffic handled and turnaround time, indicating that this management to perform import permits contributes more in terms of efficiency and less bottleneck than total cargo volume. Overall, the findings of the study underscore how productivity based port operations can help increase imports. Correlation analysis shows that GDP is positively significantly correlated with financial indicators; specifically, operating surplus and profits strongly contributing to GDP, suggesting the same hand in glove correlation between financially strong ports and economic growth. Further, the GDP has a positively negative relation to average turnaround times as noted. This clarifies how a higher efficiency contributes to the economic output. Traffic handled and output per ship berth day have moderate positive relations to exports while there is a strong positive relation of imports with the amount of traffic processed. It follows from those findings that port operations focused more on productivity, provide greater support to trade flows than simple growth of volumes.

**Correlation between Port Performance Indicators and Macroeconomic Variables:** Correlation results between GDP and Financial Performance show a very strong statistically significant positive correlation for all indicators of financial performance for major ports, i.e., operating surplus; profit before tax and profit after tax. This means port financial performance tracks growth in the overall economy. While GDP is equally well correlated to operational metrics (turnaround time + traffic handled) as a statistically significant predictor of our dependent variable, in practical terms these relationships are not statistically significant due to the short period available for regression. The authors argue that financially robust ports align with economic expansion strongly overall. The correlation analysis highlights a moderate association between exports and commercial performance indicators like traffic throughput, output per ship berth day. All associations, however, are not statistically significant at the 5 per cent level.

**Table 1. Correlation of port performance parameter with GDP**

Year	GDP (INR Bn)	Traffic Handled at Major Ports (In Million Tonnes)	Average Turnaround Time (In Hours)	Average Output per Ship Berth Day (In Tonnes)	Operating Surplus (In Cr.)	Profit Before Tax (In Cr.)	Profit After Tax (In Cr.)
2018-19	1,88,997	54.49	56.89	17,391	534.40	534.40	248.69
2019-20	2,01,036	54.85	58.27	17287.92	562.98	562.98	362.73
2020-21	1,98,299	52.27	54.48	16367.17	585.15	585.15	337.98
2021-22	2,34,710	56.43	54.65	17171.83	629.32	629.32	326.84
2022-23	2,72,407	45.10	51.51	17896.33	767.72	767.72	612.84
r		-0.700	-0.833	0.613	0.977	0.878	0.905
Co-Efficient		0.4900	0.694	0.376	0.955	0.771	0.819

Source: - Annual Reports

**Table 2. Correlation of part performance parameter with export**

Year	Exports (G&S, ann. var.%)	Traffic Handled at Major Ports (In Million Tonnes)	Average Turnaround Time (In Hours)	Average Output per Ship Berth Day (In Tonnes)	Operating Surplus (In Cr.)	Profit Before Tax (In Cr.)	Profit After Tax (In Cr.)
2018-19	11.9	54.49	56.89	17,391	534.40	534.40	248.69
2019-20	-3.4	54.85	58.27	17287.92	562.98	562.98	362.73
2020-21	-9.1	52.27	54.48	16367.17	585.15	585.15	337.98
2021-22	29.3	56.43	54.65	17171.83	629.32	629.32	326.84
2022-23	13.6	45.10	51.51	17896.33	767.72	767.72	612.84
r		0.499	-0.308	0.514	0.350	0.350	0.069
Co-Efficient		0.250	0.095	0.264	0.123	0.123	0.005

Source: - Annual Reports

**Table 3. Correlation of port performance parameter Import**

Year	Imports (G&S, ann. Var.%)	Traffic Handled at Major Ports (In Million Tonnes)	Average Turnaround Time (In Hours)	Average Output per Ship Berth Day (In Tonnes)	Operating Surplus (In Cr.)	Profit Before Tax (In Cr.)	Profit After Tax (In Cr.)
2018-19	8.8	54.49	56.89	17,391	534.40	534.40	248.69
2019-20	-0.8	54.85	58.27	17287.92	562.98	562.98	362.73
2020-21	-13.7	52.27	54.48	16367.17	585.15	585.15	337.98
2021-22	21.8	56.43	54.65	17171.83	629.32	629.32	326.84
2022-23	17.1	45.10	51.51	17896.33	767.72	767.72	612.84
r		-0.403	-0.349	0.748	0.504	0.296	0.344
Co-Efficient		0.162	0.122	0.560	0.254	0.088	0.118

Source: - Annual Reports

**Table 4. Correlation With GDP**

Port Performance Indicator	r value	r <sup>2</sup> (Coefficient)	p-value	Significance
Traffic Handled	-0.700	0.490	0.188	Not Significant
Average Turnaround Time	-0.833	0.694	0.080	Not Significant
Output per Ship Berth Day	0.613	0.376	0.272	Not Significant
Operating Surplus	0.977	0.955	0.004	Significant
Profit Before Tax	0.878	0.771	0.049	Significant
Profit After Tax	0.905	0.819	0.035	Significant

**Table-5 Correlation with Exports**

Port Performance Indicator	r value	r <sup>2</sup> (Coefficient)	p-value	Significance
Traffic Handled	0.499	0.250	0.392	Not Significant
Average Turnaround Time	-0.308	0.095	0.613	Not Significant
Output per Ship Berth Day	0.514	0.264	0.374	Not Significant
Operating Surplus	0.350	0.123	0.565	Not Significant
Profit Before Tax	0.350	0.123	0.565	Not Significant
Profit After Tax	0.069	0.005	0.912	Not Significant

Source: Computed

**Table-6 Correlation with Imports**

Port Performance Indicator	r value	r <sup>2</sup> (Coefficient)	p-value	Significance
Traffic Handled	-0.403	0.162	0.502	Not Significant
Average Turnaround Time	-0.349	0.122	0.566	Not Significant
Output per Ship Berth Day	0.748	0.560	0.145	Not Significant
Operating Surplus	0.504	0.254	0.383	Not Significant
Profit Before Tax	0.296	0.088	0.628	Not Significant
Profit After Tax	0.344	0.118	0.571	Not Significant

Source: Computed

The negative relationship of exports and turnaround time indicates that the delays in ports could impact the export performance positively but cannot be statistically confirmed. These results suggest that although port performance contributes positively to export activity, export performance is also affected by other factors related to macroeconomics and government policy. The findings show a fairly strong positive correlation between imports and average output per ship berth day, highlighting the role of berth productivity in promoting import flows. Positive moderate relations are also found in case of imports and some financial indicators like operating surplus. However, all correlations are statistically non-significant, a likely reflection of the small sample size and short study period. Overall, the results imply that throughput oriented port operations are supportive to import performance.

## SCOPE AND LIMITATIONS

Limitations of the study is based on five years of data among major ports in India. On the one hand, correlation analysis does not imply causation and on the other side, external macroeconomic shocks are not explicitly included. These findings may not apply to smaller or private ports.

## FINDINGS OF THE STUDY

- The research shows the positive correlation between GDP and measures of profitability of large ports, though an operating surplus, profit before tax as well as profit after tax; in that financially well-off ports run alongside broader economic expansion.
- An unusually strong negative correlation can be found between GDP and the average turnaround time, indicating an essential factor for improving economic performance at ports is increasing efficiency in operation.
- The inverse correlation between GDP and traffic handled suggests that, from the perspective of the analyzed period, efficiency gains and value s emerged as more important than cargo expansion in driving economic growth;
- It is also only moderately positively correlated with traffic handled and average output per ship berth day, again pointing to the potential contribution of port activity and productivity to export performance.
- The negative net effect of turnaround time on exports reveals that ports' operational inefficiency is detrimental to their export performance and competitiveness.
- Import performance is positively correlated with average output per ship berth day indicating that more productive berths facilitate smooth import flows.
- Mostly positive links of imports with operating surplus, implying the more port activity through import leads to improve port financial position.
- In general, the results suggest that trade flows are impacted more significantly by port productivity measures in terms of efficiency than by common indicators such as changes in volume through cargo handling.

## SUGGESTIONS

- Port authorities should focus more on reducing average turnaround time through standardization, better coordination and digital solutions.

- It should be suggested that Capital investment to enhance productivity at the berth and improve cargo handling efficiency instead of solely boosting throughput capacity.
- With next-gen technology deployment (besides automation), operational efficiency can be significantly improved through real time monitoring systems and smart infrastructure at ports.
- It could be suggested to enhance financial Sustainability Ports may focus on using cost control while diversifying their grant base.
- Integrate national-level trade, logistics and infrastructure planning frameworks with port productivity metrics (policy-makers);
- Hence operational efficiency is critical to competitiveness in exports and ease of imports.
- A system to remain in continuous tracking and monitoring of KPIs is required to institutionalize the concept of continual improvement.

## CONCLUSION

The performance level of major ports in India vis-a-vis macroeconomic parameters is well matched particularly with GDP and while exports-imports, as reported by the study across port regions. To sum up, the findings are that ports operating surplus and profits scenario based on economic growth is closely linked. Operational efficiencies either in terms of reduction in turnaround time/ increasing berth productivity is a strong indicator of performance by trade. The analysis showed that productivity boosts have a far greater impact on trade flows than simply the amount of extra cargo moving through the system. Numbers tell us that, at least with respect to traffic only, efficiency and productivity gains are better aligned and undergo more favorably on a ratio basis—if we take them by line (race) between export performance (favorable) and import performance. In the final analysis this study demonstrates that improving operational and financial components of port performance will help towards consolidating both these forms of port performance to deliver sustainable economic growth whilst bolstering significantly India's trade competitiveness.

## REFERENCES

- Brigham, Eugene F., & Ehrhardt, Michael C.. (2017). Financial management: Theory and practice (15th ed.). Cengage Learning.
- Pandey, I. M. (2021). Financial management (12th ed.). Vikas Publishing House.
- Reserve Bank of India. (2023). Report on trend and progress of banking in India. Mumbai: RBI.
- World Bank. (2007). Port reform toolkit. Washington, DC: World Bank.
- UNCTAD. (2022). Review of maritime transport. United Nations.
- Cullinane, Kevin, Song, Dong-Wook, & Wang, Teng-Fei. (2005). The application of DEA windows analysis to container port production efficiency. *Review of Network Economics*, 4(2), 184–206.
- Ross, Stephen A., Westerfield, Randolph W., & Jaffe, Jeffrey F.. (2019). Corporate finance (12th ed.). McGraw-Hill Education.

Mishkin, Frederic S.. (2018). *The economics of money, banking, and financial markets* (12th ed.). Pearson Education.

Saunders, Anthony, & Cornett, Marcia Millon. (2020). *Financial institutions management: A risk management approach* (10th ed.). McGraw-Hill Education.

Sanjeevi, P., & Durga Prasad, J. S.. (2025). *Macroeconomic linkages of major port performance in India: An empirical correlation analysis*. Indian Maritime University.

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