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Impact of Efficiency on the Value of Trade: Leadership Role of Major Ports in India

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Abstract

Ports and shipping of India still plays an important leadership role in international trade, despite the tremendous growth of the other alternative major mode and means of transport such as airways. This is because, it presently comprises almost 70% of the total value of trade of world trade, even in the post liberalisation period, despite the growth of air transport. However, in this era of globalisation, with a gradual shift to a more outward oriented trade regime, there has been a massive expansion in the volume of India's sea borne trade, together with a change in the composition of Indian port traffic from break bulk to liquid bulk, dry bulk and containerized cargo, with a decisive shift towards containerization in the mode of cargo delivery in post 1990s. In order to cope up with the above mentioned challenge, coupled with the growth of world class infrastructure in response to the emerging trend in global sea–trade and shipping trends, this paper therefore assess statistically how far the physical performance of the port, measured in terms of its productivity affects trade performance of the port of India, measured in terms of both the absolute and relative value of trade. While doing so, a comparative study between the ports of Western and Eastern coasts also has been attempted to judge the performance of the coasts in this respect from the leadership viewpoint.

Keywords: Efficiency of Ports, Value of Trade, Major Ports of India, Regression Model

Introduction

Ocean transport or shipping still plays an important role in international trade of India, despite the tremendous growth of the other alternative major mode and leading means of transport such as airways. Of India's international trade, ports and shipping still continue to be the major mode and means of transport to handle the bulk, both solid bulk cargo (iron ore, fertilizers, coal etc) and liquid bulk cargo (crude oil and other petrochemical products) of world trade, as, it presently covers about almost 70% of the total by value of trade, even in the post liberalisation period, despite the growth of air transport. However, with the era of Liberalization, Privatisation and Globalization (LPG) in post 1990s and a gradual shift to a more outward oriented trade regime, there was not only a massive expansion in the volume of India's sea borne trade, but also a change in the composition of Indian port traffic from break bulk to liquid bulk, dry bulk and containerized cargo, in response to the emerging trend in global sea–trade, with a decisive shift towards containerization in the mode of cargo delivery. Ports in India therefore, have assumed enormous importance in the era of globalization with a phenomenal expansion in world's trade. Not only that, to cope up with various aspects of global trade and shipping scenario such as growth of Hub Ports, mega ports, global container terminals, etc., however, maritime sector of India need to be equipped to take the challenges emerging from (i) large shipping vessels and deeper draft at ports (ii) hub and feeder operations at ports and along the coast respectively. Given the reality of transshipment and feedering, it is also important to focus on few ports on both the coasts with deep draft, so as to reduce total transport cost and enhance further trade prospects [1-3].

In order to meet the above challenge in the growth of world's sea-borne trade, looking at the current as well as the future global shipping trends and global container terminals in this era of containerization and also for future prospects of the growth of hub and mega ports, it is a major challenge that the Indian ports have to face from global ports like ports of Rotterdam, Sanghai, Singapore etc. in terms of their productivity performance [13-15].

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Productivity of any port is measured in terms of main physical performance or operational performance or efficiency indicator such as Average Turn Round Time (ATRT) (in terms of number of days), which measure the efficiency of ports. In port literature, Average Turn Round Time (ATRT) is defined as the average of total time spent by a ship since its entry at the anchorage (berth) till its departure from a berth. Now, it is known from the port literature that greater will be the port efficiency, the lower will be the value of Average Turn Round time (ATRT) of any port. Hence, higher the port efficiency, higher will be the value of trade at any port.

So, the main aim or the motive of this paper is to assess the impact of physical performance on the trade performance of any port against the above mentioned theoretical backdrop. The main objective of this study is, therefore, to analyse the impact of efficiency of the ports on the growth of the value of trade at Major ports in India during the period 1995-96 to 2018-19, with a view to study the same impact on both the absolute and relative growth of the value of trade. While doing so, this paper, also, attempts to make a comparative study between the absolute and relative growth of the value of trade, together, with a view, to compare between Western coast and the Eastern Coast of Major Ports in India during the said period, in order to judge the performance of the coasts in this respect from the leadership point of view.

Literature Review

It has been found that the port literature was a relatively neglected branch of Indian economic literature till mid-60s, as the studies available on the ports always had focused on the history and developmental issues, cargo handling aspects and on general role and functioning concerning CPT and other few major ports in India such as Haldia, Mumbai ports etc. In this connection, mention may be made of Banerjee, (1975) [7], Panda (1991) [16], Ray (1993) [8], Chakraborty (1995) (ed.) [10] and Sau (1997) [11], with the first major pioneer to write the history of Calcutta Port (CP) by Mukherjee, (1968) [6]. Besides them, various discussion papers such as those of Ghosh and De (1998) and (2001) [4-5] had emphasized on the different aspects of the CPT and Haldia Port responsible for the decline of the CPT and the need of Haldia Port. Apart from these books, very few authors such as Stutchey (1978) [17] and De (1999) [9] had dealt with various indicators of the port performance to judge the performance of the ports, with very little focus on the role of physical performance indicators on the trade performance of ports. Hence, this paper attempts to trace out the role of efficiency of the ports on both the absolute and relative growth of the value of trade during the period 1995-96 to 2018-19 between Western and Eastern coasts of India.

Methodology

Secondary data related to the study of this paper on value of trade [comprising both the values of the exports (loaded) and imports (unloaded)], measured in Rs'000, and also on the value of physical performance indicator of the port such as ATRT indicator (measured in number of days) are taken from two different sources. Data on the value of trade are taken mainly from the various issues and publications of Directorate General of Commercial Intelligence and Statistics (DGCIS) and also from its official website. While the value of efficiency indicator such as ATRT is taken from various issues and publications of the following sources such as Basic Ports Statistics of India, and Indian Ports Association and also from their official websites.

To test those above mentioned objectives and also their validity, this paper, as methodology, uses some statistical methods which includes Simple Regression Analysis (SRA), and that of Hypothesis testing of the Regression Coefficients (slope coefficients) to test the significance of the individual partial regression coefficients (slope coefficients). For our Simple Regression Model (SRM), Test of Significance Approach (TOSA) (t-test), yielding the same results and conclusions, and Analysis of Variance (ANOVA) Approach (F-test) are used for deciding to reject or accept the null hypothesis. In case of Simple Regression Analysis (SRA), the quantity known as Coefficient of Determination denoted by r^2 (2-variable regression) is used to analyze the measure of the goodness of the fit of our regression equations. In the language of Hypothesis testing, a stated hypothesis or

a null hypothesis (H_0) is constructed and usually tested against the alternative Hypothesis testing (H_1) in all the above tests [12].

In our study, a simple regression analysis is done evaluating the deterministic relationship (not a stochastic relationship) between a given variable, often called explained or dependent variable (y) and the other variable (x), often called explanatory or independent variable. 'y' can also be considered as target variable and 'x' as control variable. In our study, efficiency indicator (ATRT) is the independent variable or control variable (x) while value of trade is the dependent variable or target variable (y).

Underlying the main objective, over the period of 24 years (1995-1996 to 2018-19), this paper attempts to study impact of growth of port efficiency (i.e, ATRT) on the i) absolute performance of value of trade (VT) (i.e, average value of trade) over time, and also on the i) relative performance (i.e, growth rate) of value of trade (VT_1) over time between Western and Eastern Coasts of India.

For i), a time series analysis of a Classical Simple Linear Regression Model (CLSRM) is constructed over the given period, with the following regression equation structures:

$$VT_t = \alpha + \beta X_t + u_t$$

t = 1, 2, 3,…24; X denotes ATRT. Here slope coefficient (β) measures the absolute change in VT for the given absolute change in X over time.

However, the regression equation structure for the above SRM is given as follows separately for the ports of Western (WC) and Eastern (EC) coasts of Major ports in India respectively.

$$VT^{WC}t = \alpha + \beta X_t + u_t \quad (1)$$

$$VT^{EC}t = \alpha + \beta X_t + u_t \quad (2)$$

For ii) a time series analysis of a Semi-log-linear Regression Model is constructed over the same period, with the general exponential regression model of the form,

$$y_t = b_0.x_t b_1.e.^{ut}$$

so, taking the natural logarithm on the left hand side, the above equation will take the form of a semi log-linear equation as:

$$\log y_t = \log b_0 + b_1 x_t + u_t$$

or

$$Y_{1t} = B_0 + b_1 x_t + u_t$$

where, $Y_{1t} = \log Y_t$ and $B_0 = \log b_0$ respectively. Hence, for ii), the following regression equation structures:

$$VT_{1t} = \alpha_j + \beta_j X_t + u_t$$

t = 1, 2, 3,……24; X denotes ATRT. Here slope coefficient (β) measures the proportional change in VT_1 for the given absolute change in X over time.

However, the regression equation structure for the above SRM is again given as follows separately for the ports of Western (WC) and Eastern (EC) coasts of Major ports in India respectively.

$$VT_1^{WC}t = \alpha + \beta X_t + u_t \quad (3)$$

$$VT_1^{EC}t = \alpha + \beta X_t + u_t \quad (4)$$

Next, to test the individual partial regression coefficients (βs) the null hypotheses (H_0: βs = 0), are constructed, against the alternative hypotheses (H_1: βs ≠ 0) for the respective equations, which are given below.

For the above equation structures,

H_0^1: Changes in ATRT have no linear influence on VT respectively.

H_0^2: Changes in ATRT have no linear influence on VT_1 respectively.

Findings

In this section, regarding the impact of the efficiency of the ports on the absolute trade performance over time, summary statistics of Regression Analysis and ANOVA for the estimated regression equation structures [equations (1) and (2)] of the above SRM are given below as the major findings of this study in Table 1.

Table 1: Summary Statistics of Regression Analysis and Anova

Impact of Efficiency Indicator [ATRT] on Absolute Value of Trade							
Equation No.	*Variables*	*Coefficients*	*t Stat*	*P Value*	*F*	R^2	*Adjusted* R^2
1[WC]	ATRT	-244134.56	2.67	0.02	7.16	0.30	0.2545
2[EC]	ATRT	-128871.35	1.60	0.13	2.55	0.131	0.079

Source: www.shipping.nic.in; www.dgciskol.nic.in

Again, regarding the impact of the efficiency of the ports on the relative trade performance over time, summary statistics of Regression Analysis and ANOVA for the estimated regression equation structures [equations (3) and (4)] of the above SRM are given below as the major findings of this study in Table 2.

Table 2: Summary Statistics of Regression Analysis and Anova

Impact of Efficiency Indicator [ATRT] on Relative Value of Trade							
Equation No.	*Variables*	*Coefficients*	*t Stat*	*P Value*	*F*	R^2	*Adjusted* R^2
3[WC]	ATRT	-0.241	3.70	0.002	13.71	0.45	0.414
4[EC]	ATRT	-0.2056	2.43	0.03	5.89	0.26	0.2137

Source: www.shipping.nic.in; www.dgciskol.nic.in

Discussion and Recommendation

In this section, the estimated regression equation structures for the above SRMs are verified with the help of the Regression analysis. Next, under the Theory of Hypothesis Testing, the significance of the regression coefficients are also tested with the help of the above methods, TOSA (t-test) and ANOVA (F-test) respectively on the basis of summary statistics of Regression Analysis and ANOVA given above in Table 1 and Table 2 respectively.

Regarding the impact of port efficiency on the absolute value of trade performance, Table 1 reveals the summary statistics of Regression Analysis of Efficiency Indicator [ATRT] on the growth of the Average Value of trade at Major ports of Western and Eastern coasts respectively [Equations 1 and 2]. Corresponding to the above equations, it is found from the summary statistics of Regression Analysis from Table 1, that there has been a growth in the absolute average value of trade at both the Major ports of Western and Eastern coasts respectively, with respect to the change in the efficiency of those ports respectively, over the said period. This is evident from each of their high values of R^2 and also from their negative slope coefficients. This is because a negative slope coefficient implies that lower the value of ATRT, more will be the port efficiency and hence higher will be the value of trade at each port. However, $R^2 = 0.30$ of equation (1), as compared to $R^2=0.131$ of equation (2), implies a much greater variation in the absolute growth of VT as explained by the change in the value of ATRT, in case of ports of Western coast as compared to those at Eastern coast. Moreover, much higher values of the negative slope coefficients, also, has led to the higher growth of VT in case of ports of Western coast more than those at Eastern coast, as is evident from both the equations (1) and (2) from Table 1. Next, under the theory of Hypothesis testing, the same results are also supported by the above mentioned tests of significance (TOSA) analysis.

Regarding the performance of absolute value of trade, it is found from the summary statistics of Table 1, corresponding to the equations (1) and (2), β* of ATRT for VT of Western coast is much highly statistically significant at 5% level of significance than β* of ATRT for VT of Eastern coast. This is because the computed (absolute) t and F values of ATRT for VT [t=2.67, F=7.16] of Western coast are much higher than those for VT [t=1.60, F=2.55] of Eastern coast. Rather, β* of ATRT for VT of Eastern coast is highly statistically insignificant at 5% level of significance, given the critical value or table values of $t_{.025,22} = 2.07$ and $F_{.05,1,22} = 4.32$ respectively. Moreover, p values of t of VT of Western coast than that of Eastern coast is very much low, to reject H_0^1 for Western coast but to accept H_0^1 for Eastern coast respectively, so

as to accept H_1 to arrive at a greater statistical significance of absolute growth of VT for Western coast; but to reject H_1 to arrive at a greater statistical insignificance of that of VT for Eastern coast.

On the other hand, again, regarding the impact of the port efficiency on the relative value of trade performance, Table 2 reveals the summary statistics of Regression Analysis of Efficiency Indicator [ATRT] on the growth rate of the Average Value of trade at Major ports of Western and Eastern coasts respectively [Equations 3 and 4]. Corresponding to the above equations, it is found from the summary statistics of Regression Analysis from Table 2, that the growth rate of the average value of trade have increased significantly at both the Major ports of Western and Eastern coasts respectively, with respect to the change in the efficiency of those ports respectively, over the said period. This is also evident from each of their high values of R^2 and also from their negative slope coefficients. This is because a negative slope coefficient implies that lower the value of ATRT, greater will be the port efficiency and hence higher will be the growth rate of the value of trade at port of each coast, as mentioned above. However, R^2 = 0.45 of equation (3), as compared to R^2=0.26 of equation (4), implies a much greater variation in the relative growth of VT as explained by the change in the value of ATRT, in case of ports of Western coast as compared to those at Eastern coast. Moreover, much higher values of the negative slope coefficients, also, has led to the higher growth rate of VT in case of ports of Western coast more than those at Eastern coast, as is evident from both the equations (3) and (4) from Table 2. Again, under the theory of Hypothesis testing, regarding the performance of relative value of trade, it is found from the summary statistics of Table 2, corresponding to the equations (3) and (4), β* of ATRT for VT_1 of both Western and Eastern coasts are much highly statistically significant at 5% level of significance, with a slightly lower value of β* of ATRT for VT_1 of Eastern coast. This is because the computed (absolute) t and F values of ATRT for VT_1 [t=3.70, F=13.71] of Western coast are much higher than those for VT_1 [t=2.43, F=5.89] of Eastern coast, given the critical value or table values of $t_{.025,22}$ = 2.07 and $F_{.05,1,22}$ = 4.32 respectively. Moreover, p values of t of VT_1 of both the Western and Eastern coast are also very much low, with a much lower value for VT_1 of the Western coast, to reject H_0^2 respectively and accept H_1s in both cases, however, to arrive at a greater statistical significance of VT_1 for the Western coast.

Besides these, comparing equations (1) from Table 1 and (3) from Table 2, it is found that, R^2=0.30 of equation (1), as compared to R^2=0.45 of equation (3), explains a greater variation in the growth of VT_1 than VT as explained by the same change in the port efficiency in case of Western coast. Next, under the theory of Hypothesis testing, regarding the impact of port efficiency on both the absolute and relative performance of value of trade of Western coast, it is found that β*s of ATRT for VT and VT_1 of Western coast are much highly statistically significant at 5% level of significance, with a slightly lower value of β* of ATRT for VT_1. This is because the computed (absolute) t and F values of ATRT for VT [t=2.67, F=7.16] of Western coast are much lower than those for VT_1 [t=3.70, F=13.71] of Western coast, given the critical value or table values of $t_{.025,22}$ = 2.07 and $F_{.05,1,22}$ = 4.32 respectively. Moreover, p values of t for VT and VT_1 of the Western coast are also very much low, with a much lower value of VT_1 for the Western coast, to reject H_0^2 and accept H_1s respectively, in both cases, however, to arrive at a greater statistical significance of VT_1 than VT for the Western coast.

Similarly, comparing equations (2) from Table 1 and (4) from Table 2, it is found that, R^2=0.131 of equation (2), as compared to R^2=0.26 of equation (4), explains a greater variation in the growth of VT_1 than VT as explained by the same change in the port efficiency in case of Eastern coast. Again, under the theory of Hypothesis testing, regarding the impact of port efficiency on both the absolute and relative performance of value of trade of Eastern coast, it is found that β* of ATRT for VT_1 of Eastern coast is much highly statistically significant at 5% level of significance than VT, with a much lower value of β* of ATRT for VT_1. This is because the computed (absolute) t and F values of ATRT for VT_1 of Eastern coast are t=2.43, F=5.89; while the computed (absolute) t and F values of ATRT for VT of Eastern coast are t=1.60, F=2.55, which implies highly statistically insignificance of β* of ATRT for VT at 5% level of significance, given the critical value or table values of $t_{.025,22}$ = 2.07 and $F_{.05,1,22}$ = 4.32 respectively. Moreover, p value of t of VT_1 of Eastern coast is very much low, to reject H_0^1 but to accept H_1 to arrive at a greater statistical significance of VT_1 for Eastern coast; but p value of t of VT of Eastern coast is very much

greater to accept H_0 and to reject H_1 to arrive at a greater statistical insignificance of VT for Eastern coast.

Hence, as a summary, from the above analysis, it is found from the above equations (1) and (2) of Table 1, that higher is the value of ATRT, there is a fall in the absolute value of trade, with negative slope coefficients of β* for ATRT in both the coasts; however, there is a greater decline in case of Western Coast. This is also evident from higher values of R^2, F and t of equation (1), thus signifying more absolute growth of value of trade in Western coast. Similarly, negative coefficients of ATRT of both the coasts with much higher values of R^2, F and t of the equation (3) than those of (4), from Table 2, imply greater negative impact of the growth of the ATRT on the growth rate i.e, relative growth of the Average Value of trade in Western coast. This also reveals more efficiency for Western Coast. However relative growth of the Average Value of trade is higher than that of its absolute growth in both the coasts, as is evident from the higher values of negative slope coefficients of β*, R^2, F and t of equations (3) and (4) in Table 2 than those of (1) and (2) in Table 1.

Conclusion

Regarding the impact of the growth of physical performance or efficiency, measured in terms of growth of ATRT on total trade performance, measured in terms of growth of value of trade at Major ports of India, it has been found that both the absolute and the relative growth of value of trade have significantly increased more in case at ports of Western coast than those in Eastern coast with respect to the change in the value of ATRT, thus implying a greater efficiency of the ports of the Western coast than those of Eastern coast during the said period. It is also found that there has been a rise in both the absolute and the relative growth of the value of trade over time, but with a much significant growth in the relative growth of Value of Trade, as explained by the same change in the port efficiency at the ports of both the Western and Eastern coasts of Major ports of the country. In fact, lower growth in relative value of trade, coupled with almost sluggish growth in absolute value of trade at the ports of the Eastern coast as compared to higher growth in both the absolute and relative value of trade, coupled with a significant one in the relative growth of the value of trade at the ports of the Western coast of Major ports in India during the said period, moreover, reveals a much higher efficiency of the ports of the Western coast as compared to greater rising inefficiency of the ports of the Eastern coast, thereby, depicting the leadership role of ports of Western coast.

As a consequence, most of the ports of Eastern coast will fail to meet both intra–port and inter port competition with those of Western coast in the national front because of such poor physical performance. Not only in the domestic front, they will gradually lose their chance and fate, as well, in inter port competition with those of Western coast, too, in international front in the near future. Further, it will be almost a nightmare for the ports of Eastern coast, to handle such massive demand expansion to face such huge competition on the global front, as they either will lag behind their foreign counterparts in terms of most operational performance indicators or will be out of the business in the leading front, thus seriously undermining their competitiveness, in the international trade; as they were already being heavily plagued by problems of inadequate capacity on the one hand, operational inefficiency and non optimal use of existing infrastructural facilities on the other hand in the coming years.

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