PORT DEVELOPMENT: RELATIONSHIP BETWEEN PORT TRAFFIC OF GUJARAT AND ITS HINTERLAND

Dr. K M Chudasama

ABSTRACT

The ports are nodal points that link the open economy with the global world and consequently port development and economic development are closely related. With the developments in multimodal transport and port operations, the benefit of ports percolates even in non coastal areas in far hinterland. In 1990's, India initiated economic reforms emphasizing on international trade and since then, its international trade has increased remarkably and almost 90% of India's international merchandise trade is handled by ports. In line with the initiatives of port development in India, Gujarat state has announced a separate port policy for port development as it has vast hinterland of developing northern states of India generating large volume of cargo for ports of Gujarat. This paper attempts to analyse the cargo traffic at ports of Gujarat in relation to the output (GSDP) of selected 8 states of India in its hinterland. Bi-variate Log Log Regression Model is applied to determine the relationship between GSDP of 8 hinterland states and the volume of cargo traffic handled by ports in Gujarat using the GSDP and Port Traffic data from 2011-2019. It is observed that increase in output in the hinterland states leads to significant increase in cargo traffic at ports of Gujarat depicting that 1 % increase in GSDP of Gujarat, Rajasthan, Haryana, Punjab, Himachal Pradesh, Jammu & Kashmir, Delhi and Madhya Pradesh lead to on an average 0.39 % to 0.55 % of increase in cargo traffic at ports of Gujarat which implies that cargo traffic at ports of Gujarat is highly affected by output in its hinterland states in addition to the output of Gujarat..

Keywords: International Trade, Port Traffic, Hinterland States, and Multimodal Transport

With the increasing world trade due to globalization, the ports have gained immense significance as the majority of global merchandise trade is handled by ports. The ports are nodal points that link the open economy with the global world. Moreover, port development and economic development are closely related. It has been generally conceded that coastal regions have usually benefited from the development of a port. However, with the developments in multimodal transport and changing pattern of port operations, the benefit of ports percolate even in non coastal areas in far hinterland and therefore economic development in an economy and port development are mutually related. On one hand economic development necessitates port development as part of infrastructure development and on other hand; port development facilitates import-export and attracts industries to its hinterlands, which in turn creates forward and backward linkages with the rest of the economy. Consequently, the development of port sector in the era of globalisation becomes the prime issue of concern for policy making in an economy.

In 1990's, India initiated economic reforms emphasizing on international trade and since then, its international trade has increased remarkably. As about 90% of India's international merchandise trade is handled by ports, the development of port sector becomes the necessary precondition to gain global competitiveness. In line with the initiatives of port development in India, Gujarat is the first among all the maritime states of India to announce a separate port policy for development of its port sector. Today, Gujarat ranks first in terms of port infrastructure, cargo handling capacity and volume of traffic at ports among all the maritime states of India. The state has vast hinterland of developing northern states of India and therefore it enjoys a natural monopoly of attracting large volume of cargo for foreign trade from its hinterlands. This paper attempts to analyse the cargo traffic at ports of Gujarat in relation to the output in hinterland area of ports of Gujarat.

The port sector did not receive the attention it deserved from economists till 1960's. The first generation of studies on ports were centred on the aspects pertaining to pricing port facilities, port capacity, and investment policies. Various studies have been initiated on maritime sector since 1970's. The first generation of studies on ports analyzed ports' production and cost structure to manage future investments.

Port costs and port demand was examined by Peston and Rees (1971), while Wanhill (1974) designed a model to determine the optimal number of berth minimizing the total port cost. Goss (1976) studied port pricing, port capacity and port investment, whereas, the port pricing and investment policies were formulated by Bennathan and Walters (1979) for developing economies. The analysis of investment in Nigerian ports was undertaken by Shneerson (1981), while De Monie (1987) proposed tools to measure port performance and productivity. Reker et al (1990) developed the production function for Melbourne container terminal, whereas Talley (1994) evaluated port performance using selected port performance indicators. Ghosh and De (2000) investigated the impact of performance indicator and labour endowment on Indian port traffic.

Haralambides (2002) studied port competition, excess capacity and the pricing of port infrastructure. Notteboom and Rodrigue (2005) advocated port regionalization model for port sector development. De (2006) assessed the total factor productivity growth of the Indian port sector using Cobb-Douglas production function. Roh et al (2007) designed a port logistics process model using the structured analysis. Mangan and Lalwani (2008) proposed port centric logistics for competitive gains, while Chudasama and Pandya (2008) evaluated efficiency of Indian major ports and examined the possibility of increase in output at inefficient ports, whereas Chudasama (2009a) analysed efficiency of Major Ports of India using DEA and identified scope of improvement. Pires et al. (2009) applied Data Envelopment Analysis (DEA) with Analytic Hierarchy Process (AHP) method in comparing the efficiency of 12 shipyards in Japan, South Korea, China and Europe; while Chudasama (2009b) analysed the performance of Indian major ports using Weighted Score Method by deriving weights from factor loadings of the Principal Component Analysis. Verhoeven (2010) reviewed port authority functions with an approach of renaissance, while Chudasama (2010a) analysed efficiency of major shipyards of India using DEA; whereas Zhang and Xu (2010) evaluated management efficiency of shipbuilding enterprises based on the DEA. Chudasama (2010b) reviewed Port-based Development in Gujarat state of India, whereas, He and Ji (2011) proposed Green Port Construction of Tianjin Port of China. Chudasama et al (2012) conducted Socio-Economic Impact Assessment (SEIA) of port based development in Gujarat State of India using Coherently Augmented Socio-Economic Status Scale, while

Rosa et al (2013) proposed Analytic Hierarchy Process (AHP) model to identify key factors of seaport competitiveness based on the stakeholder perspective, whereas, Cheng H. et al (2014) assessed port vulnerability from the critical infrastructure interdependency perspective and Dwarakish and Salim (2015) reviewed the role of ports in the development of a nation.

Chudasama (2016a) appraised efficiency of Indian major ports using DEA approach, while Park J and Seo Y (2016) analysed the impact of seaports on the regional economies in South Korea using augmented Solow model, whereas Chudasama (2016b) assessed efficiency of Indian Shipyards using DEA approach. Munim Z H and Schramm H J (2017) forecasted container shipping freight rates for the Far East – Northern Europe trade lane; while Button, K., T. Et al (2017) analysed economic implications for Adriatic seaport regions of further opening of the Northern Sea Route; whereas Gil-Saura et al (2018) studied satisfaction and loyalty in B2B relationships in the freight forwarding industry. Wiegmanns B I et al. (2018) analysed communication between deep sea container terminals and hinterland stakeholders; while, Huang S T et al. (2019) evaluated service quality of international freight forwarders in East Asia; whereas Rui Liang and Ziyang Liu (2020) examined the impact of port infrastructure connectivity, logistics performance, and trade on economic growth.

Despite the fact that Gujarat is a prime maritime state of India, no studies on port sector of Gujarat are undertaken. Thus, this paper attempts to review one of the aspects of ports in Gujarat by analysing the cargo traffic at ports of Gujarat in relation to the output in hinterland area of ports of Gujarat.

Port Hinterland Model

The port's hinterland is the region from which the port's customers are drawn. The hinterland of port is the market served by a port and the market reach of the port from which cargo originates, as well as the areas where cargo moving through the port is destined. During last few decades the role and functions of ports have undergone significant changes, with greater emphasis being placed on port hinterland development. With the development of land transport networks, ports compete for cargo from a larger hinterland. This extension of the hinterland is linked

to the development of intermodal transport. Since loading and discharging operations are fundamental components of intermodal transportation, the port market for cargo depend on the extent of value-added services like rail / road connectivity to port, on-dock rail transshipment facilities, inland terminal facilities, inland container depot, container freight stations, freight distribution centres, warehouses and availability of other maintenance facilities.

Figure 1: Port Functions and Hinterland

Source: Compiled from UNESCAP (2005)

The spatial relationship between the port and the hinterland has changed with the nature of cargo and facilities offered by ports. Better operating facilities at port and improved surface transportation network provides comparative economic advantage to customers and thus ports with such environment generally have vast hinterland.

Global Maritime Scenario

The world economy grew at 2.6% in last decade, while the world merchandise trade (Exports + Imports) grew by 5.75 % in last decade. The growth trend of world GDP and merchandise trade in Table 1 reveal that growth in merchandise trade significantly exceeded the growth in world GDP.

Table 1: World GDP, Merchandise Trade and Seaborne Trade

Yea	GDP	Merchandise Trade (% Growth in	Seaborne Trade (Million
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r	% Growth	Volume)		Tons)	
		Export	Import	Loaded	Unloaded
2011	2.8	5.9	5.0	8784.3	8797.7
2012	2.2	2.0	2.0	9196.7	9188.5
2013	2.4	2.6	2.3	9513.6	9500.1
2014	2.5	2.3	2.3	9841.7	9808.4
2015	2.6	1.4	1.9	10023.5	10016.4
2016	2.2	1.7	2.1	10286.9	10281.6
2017	3.1	4.1	4.8	10716.2	10702.3
2018	3.0	2.5	3.1	11005.0	11002.2

Source: Compiled from UNCTAD, Review of Maritime Transport (2011-2019)

The growth in world GDP and world merchandise trade have direct impact on maritime transport due to the observed positive correlation between these elements (UNCTAD, 2007). Despite the decrease in world GDP and declining exports and imports, the global seaborne trade has shown consistent increasing trend with the 2.85% CAGR in last decade.

Indian Port Sector

In 1990's, India initiated economic reforms emphasizing on international trade and since then, its international trade has increased remarkably. Since last decade, the growth of India's merchandise exports, imports and seaborne trade has always exceeded growth of India's GDP. During the last decade, India's economy grew at 6.7%, while the India's merchandise trade (Exports + Imports) grew by 10.25% in

last decade. With the increasing output and international trade of India, about 95% of India's international trade volume is handled by sea transport.

India possesses 12 major ports governed by the Ministry of Shipping and 200 non major ports controlled by respective State Maritime Boards / State Government in which they are located. In last decade, all the major ports together handled on an average 60% of cargo traffic, while all the non major ports together handled on an average 40% of cargo traffic. The cargo traffic at Indian ports has grown at 4.20% CAGR in last decade, while the cargo traffic at major ports and non major ports grew at 2.29% CAGR and 7.08% CAGR respectively during last decade.

Gujarat as a Maritime State

Gujarat lies on the west coast of India between 20.6° and 24.42° North latitude and 68.10° and 74.28° East longitude. Its total land area is about 1.96 lakh sq. km. with about 1600 km. long coastline. It is bounded by the Arabian Sea in the West, the States of Rajasthan in the North-East, Madhya Pradesh in the East and Maharashtra in the South East. Gujarat has an advantage of strategic location for the maritime developments. As Gujarat has vast hinterland of developing northern states of India, the state enjoys a natural monopoly of attracting large volume of cargo for foreign trade at its ports from its hinterlands. Gujarat is the only nearest out let to Middle East, African and European countries for foreign trade from the northern India.

Figure 2: Maritime State of Gujarat and its Hinterland

The state is experiencing a phenomenal increase in investments from industrial houses within the country and also from the top multinationals abroad. The industrial investment has been flowing towards the coastal belt of Gujarat in last decade. The logic of locating industries in coastal areas is that; the large business houses want to import the industrial raw materials and need access to the global market through sea routes, which is more viable than other mode of transport. Thus, there has been a shift in the development pattern of Gujarat towards the coastal area due to the potentials and opportunities available along the coastline of Gujarat.

Port Performance of Gujarat

Gujarat has almost one-third (1600 Kms.) of India's coastline. The state has one major port (Kandla Port named as Deendayal Port), under the jurisdiction of the Central Government (Ministry of Shipping, Government of India) and 48 non-major ports under the administrative control of Government of Gujarat through Gujarat Maritime Board (GMB). Gujarat handles highest port traffic amongst all the maritime states of India. In the year 2018-19, Gujarat handled 40.14% of total (major + non major) port traffic of India (i.e. 514.60 MT out of 1281.78 MT). Out of the total port traffic handled by the ports of Gujarat, the major port Kandla handled about 22.42% of traffic to Gujarat (i.e. 115.40 MT out of 514.60 MT), which accounts for about

16.50% (i.e. 115.40 MT out of 699.17 MT) of traffic of India's major ports and nearly 9.00% (i.e. 115.40 MT out of 1281.78 MT) of India's total port traffic in the year 2018-19 as shown in Table 2.

Table 2: Cargo Traffic at Ports of India and Ports of Gujarat (In Million Tons)

Year	India			Gujarat		
	Major Ports	Non Major Ports	All Ports	Major Ports	Non Major Ports	All Ports
2010-11	570.09	314.848	884.94	81.88	230.91	312.79
2011-12	560.19	353.181	913.37	82.50	259.05	341.55
2012-13	545.83	388.131	933.96	93.62	287.82	381.44
2013-14	555.49	417.224	972.71	87.00	309.95	396.95
2014-15	581.34	470.602	1051.94	92.50	336.10	428.60
2015-16	605.89	465.912	1071.80	99.46	339.78	439.24
2016-17	648.47	485.213	1133.68	105.44	345.74	451.18
2017-18	679.45	528.559	1208.01	110.10	370.77	480.87
2018-19	699.17	582.588	1281.76	115.40	399.20	514.60

Source: Compiled from Ministry of Shipping, GoI (2019)

Though Gujarat has only 24 % of non major ports of India (i.e. 48 ports out of 200), the share of these ports (under GMB), as a proportion of total traffic at India's non major ports was about 68.52% (i.e. 399.20 MT out of 582.59 MT) in 2018-19. During the same year, out of total port traffic handled by Gujarat, non major ports handled nearly 77.57% (i.e. 399.20 MT out of 514.60 MT) of traffic, which account for about

31.14% (i.e. 399.20 MT out of 1281.76 MT) of India's total port traffic. Thus, the non major ports of Gujarat handle significant volume of port traffic of Gujarat as well as India.

Cargo Traffic at Ports of Gujarat

It has been observed that since 2000, the majority of cargo traffic flowing towards ports of Gujarat is handled by non major ports of Gujarat. Figure 3 exhibits that the share of cargo traffic handled by non major ports of Gujarat have increased tremendously as compared to the traffic handled by major port Kandla. The increasing capacities of non major ports in Gujarat have led to shift in movement of cargo traffic in favour of specialized port activities at the non major ports of Gujarat.

Figure 3: Cargo Handled at Ports of Gujarat (in Million Tons)

The composition of cargo handled by ports of Gujarat reveals that Petroleum Oil and Lubricants (POL) and its products shares more than 55% in total volume of cargo, while thermal and other coal shares nearly 7 % of total cargo volume. This implies that majority of cargo handled at ports of Gujarat is the sources of energy for India. Iron ore and building materials together accounts for about 10 % of the total cargo volume. While, fertilisers and food grains together share about 6 % of the total cargo volume. The share of container cargo is merely 1.5 %, but other commodities increasing shares more than 19 % of the total volume of cargo as shown in Table 3.

Table 3: Composition of Cargo handled at Ports of Gujarat (In %)

Year	POL (Crude & Products)	Fertiliser & Raw Material	Iron Ore	Coal	Other	Total
2010-11	60.52	3.99	2.55	10.62	22.32	100

2011-12	58.10	3.88	2.32	12.47	23.24	100
2012-13	57.59	2.89	2.24	15.41	21.86	100
2013-14	55.10	2.41	1.45	18.17	22.87	100
2014-15	51.15	2.81	1.58	20.99	23.47	100
2015-16	52.33	3.38	1.93	18.42	23.94	100
2016-17	53.16	2.74	2.24	17.28	24.58	100
2017-18	51.76	1.91	2.69	16.58	27.05	100
2018-19	47.74	2.22	3.01	18.26	28.77	100

Source: Compiled from Ministry of Shipping, GoI (2019)

7. Empirical Analysis

As the port traffic (export / import) depends on production (output) activities in domestic economy, the analysis examines the relationship between the traffic handled by ports of Gujarat and the Gross State Domestic Product (GSDP) of the hinterland states namely Rajasthan, Haryana, Madhya Pradesh, Punjab, Himachal Pradesh, Delhi, Jammu & Kashmir and Gujarat itself. As ports of Gujarat are the nearest outlets to export / import for the northern states of India, majority of the trade cargo of these states is handled by ports of Gujarat. There can be various variables having impact on port traffic of Gujarat, but the analysis is limited to GSDP of hinterland states. Bi-variate Regression Analysis is applied to determine the relationship between GSDP of 8 hinterland states and the volume of cargo traffic handled by ports in Gujarat. The GSDP of 8 hinterland states is considered as independent variable, while the traffic handled by ports of Gujarat is considered as a dependent variable. The GSDP data of 8 hinterland states from 2011-2012 to 2018-2019 has been sourced from Central Statistical Organisation, Government of India and port traffic data for ports of Gujarat from 2011-2012 to 2018-2019 has been sourced from Ministry of Shipping, Government of Gujarat for regression analysis. The series of sourced data has been transformed into the series of natural log to interpret the outcome of the analysis more meaningfully in percentage terms.

7.1. The Analytical Model

Economic Model: - $TG = f(GSDP)$
Traffic at Ports of Gujarat = $f(GSDP \text{ of Hinterland State})$

Regression Function:- $\hat{y} = a + bX$

Econometric Model: - $\ln TG_i = \alpha + \beta \ln GSDP_{xi} + u_i$

Where,

‘ $\ln$ ’ is the natural log (i.e., log to the base ‘e’).

‘ TG_i ’ is Traffic at Ports of Gujarat in period ‘ i ’.

‘ α ’ is the intercept term and ‘ β ’ is the slope coefficient

‘ $GSDP_{xi}$ ’ is the GSDP of ‘X’ Hinterland State in period ‘ i ’.

‘ u_i ’ is the error term, capturing the effect of excluded variables.

The above mentioned econometric model is the ‘Log-Log Regression Model’. This model is most popular in applied work as the slope coefficient ‘ β ’ measures the elasticity of ‘ $\ln TG_i$ ’ with respect to ‘ $GSDP_{xi}$ ’. It measures the percentage change in ‘ $\ln TG_i$ ’ in response to a percentage change in ‘ $GSDP_{xi}$ ’.

7.2. Result of Analysis

7.3. Interpretation of the result

In case of Gujarat, 1 % increase in GSDP of Gujarat may lead to on an average about 0.42 % of increase in cargo traffic at ports of Gujarat. The Coefficient of determination R^2 implies that 98 % of variation in average cargo traffic at ports of Gujarat is explained by the GSDP of Gujarat.

In case of Rajasthan, 1 % increase in GSDP of Rajasthan may lead to an average about 0.48 % of increase in cargo traffic at ports of Gujarat. The Coefficient of determination R^2 implies that 97.78 % of variation in average cargo traffic at ports of Gujarat is explained by the GSDP of Rajasthan.

In case of Haryana, 1 % increase in GSDP of Madhya Pradesh may lead to on an average about 0.41 % of increase in cargo traffic at ports of Gujarat. The Coefficient of determination R^2 implies that 97.47 % of variation in average cargo traffic at ports of Gujarat is explained by the GSDP of Haryana.

In case of Punjab, 1 % increase in GSDP of Punjab may lead to on an average about 0.55 % of increase in cargo traffic at ports of Gujarat. The Coefficient of determination R^2 implies that 97.40 % of variation in average cargo traffic at ports of Gujarat is explained by the GSDP of Punjab.

In case of Himachal Pradesh, 1 % increase in GSDP of Himachal Pradesh may lead to on an average about 0.50 % of increase in cargo traffic at ports of Gujarat. The Coefficient of determination R^2 implies that 98.20 % of variation in average cargo traffic at ports of Gujarat is explained by the GSDP of Himachal Pradesh.

In case of Jammu & Kashmir, 1 % increase in GSDP of Jammu & Kashmir may lead to on an average about 0.54 % of increase in cargo traffic at ports of Gujarat. The Coefficient of determination R^2 implies that 94.97 % of variation in average cargo traffic at ports of Gujarat is explained by the GSDP of Jammu & Kashmir.

In case of Delhi, 1 % increase in GSDP of Delhi may lead to on an average about 0.46 % of increase in cargo traffic at ports of Gujarat. The Coefficient of

determination R^2 implies that 90 % of variation in average cargo traffic at ports of Gujarat is explained by the GSDP of Delhi.

In case of Madhya Pradesh, 1 % increase in GSDP of Madhya Pradesh may lead to on an average about 0.39 % of increase in cargo traffic at ports of Gujarat. The Coefficient of determination R^2 implies that 97 % of variation in average cargo traffic at ports of Gujarat is explained by the GSDP of Madhya Pradesh.

8. Summary

The ports have become nodal points that link the open economy with the rest of the world in the era of globalisation. With the developments in multimodal transport and changing pattern of port operations, the benefit of ports percolate even in non coastal areas in far hinterland. The relationship between the port and the hinterland strengthens with the better operating facilities at port and improved surface transportation network between port and hinterland. Therefore, economic development in the hinterland economy will impact the cargo traffic at competitive port supporting its trade.

As India initiated economic reforms emphasizing on international trade since 1990's, the international trade of economy has increased remarkably. Moreover, majority of India's international merchandise trade is handled by sea transport at ports of India and therefore, development of port sector becomes the major issue of concern for policy making in India. In line with the initiatives of port development in India, Gujarat has developed excellent port infrastructure and handles highest volume of cargo among all the maritime states of India.

The analysis of relationship between the output produced in the hinterland area and the cargo traffic generated for trade at ports of Gujarat reveal that increase in output in the hinterland states leads to significant increase in cargo traffic at ports of Gujarat. It is observed that in past few years/decade, 1 % increase in GSDP of Gujarat, Rajasthan, Haryana, Punjab, Himachal Pradesh, Jammu & Kashmir, Delhi and Madhya Pradesh lead to on an average 0.39 % to 0.55 % of increase in cargo traffic at ports of Gujarat.

This implies that cargo traffic at ports of Gujarat is highly affected by output in its hinterland states in addition to the output of Gujarat. Consequently, any economic development in hinterland states is bound to increase the cargo traffic at ports of Gujarat and better port facilities are bound to increasingly facilitate the cargo generated from hinterland states. Thus, there exist a significant relationship between port development in Gujarat and economic development in the hinterland states.

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Dr. K M Chudasama
Associate Professor
Department of Economics
Faculty of Arts
The Maharaja Sayajirao University of Baroda, Vadodara
E-mail: krishnakumar.m.c-eco@msubaroda.ac.in