The Relationship between Railway Route and Industrial Output of Different Indian States and Union Territories

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Abstract

Indian Railway stands out to be the life line of the transport sector of the country. On one hand, a huge number of Indian people depend on the railways for travelling and on the other hand, Indian Railways carries a large amount of goods within the territory for different purposes. The railways are the most preferred mode of transportation for the suburban areas where a large number of passengers need to be moved to and from the metropolitan cities within certain fixed time. This paper aims at studying the relationship between the railway route of different Indian states and union territories and the amount of industrial output by them. The study uses conventional techniques on panel data econometrics, taking data on Gross Value Added of industrial sector, railway route, other state specific control variables like industrial employment, capital formation, amount of industrial credit and using a dummy for a coordination between state Governments and central Government for different states and union territories. The results show that the railway route does not contribute to the Gross Value Added of industrial sector but it has indirect interaction effects with the other control variables.

Keywords: *Indian Railway, Gross Value Added, Railway Route.*
JEL Classification*: E0, C4, R4*

1. Introduction

Economic activities of an economy depend heavily on infrastructure. An economy with a well-developed infrastructure can increase its production rapidly. Transportation is one of the major components of infrastructure. Well-developed transport facilities help an economy to expand its trade by widening the market for both agricultural and industrial products. Transport helps in interaction between producers and consumers as it reduces the time and space gap. Transport is mainly of two types: Passenger Transport and Goods Transport. Transport serves as input to other productive services in the economy. So, it can be thought of as an intermediate good (Bonavia, 1988). The transport network in India constitutes of mainly Roadways, Railways, waterways and Airways. The road transport is covered by several formal and informal transports whereas the railways is owned and served by Indian railways, owned by government of India. Indian Railway (IR) is the largest transport network in India and one of the largest railway networks in the world. It plays a significant role in movement of both passenger and goods within the country. IR is responsible for carrying different goods especially coal, Iron and Steel, mineral etc. On the other hand, a huge number of passengers are carried by IR every

day. The passenger service of IR can be divided into suburban and non-suburban. The suburban railway runs local trains travelling short distance covering the urban and suburban part of the country. It acts as the life line in terms of transportation in a number of small towns, cities and metro cities. Every day a large number of people called as daily passengers use this for travelling to and from their workplaces, vendors use it for going to the marketplaces. The non-suburban counterpart, on the other hand, consists of express and mail trains travelling long distances and covering even the interior areas of villages. People most often travel in these trains for vacation trips, though some for business trips and some for trips for medical emergencies travel in these trains as well. Another type of railroad network operated in metro cities is metro railway. Metro Railway provides transportation to the passengers of cities especially to the daily passengers. The World Bank Development Report (1994) demonstrates the relationship between infrastructure on economic growth. The report finds a variety of empirical result, where in some cases, no effects were found and in some other extreme cases more than 100% returns were found (Canning et al. 1999). Indian Transport sector serves a land of almost 3.3 million kilometres and a population more than 1.21 billion (TERI Energy and Environment Data Diary and Yearbook, 2014-15). This sector contributes 6% to India's GDP (Statistics Times, 2015) and is also the second highest energy consuming sector after industrial sector (NITI Aayog, 2015) (Irfan et al. 2018). Evidences from United States show that, transportation infrastructure causes emergence of new cities which become engines of growth for the whole economy ("Reshaping Economic Geography", World Development Report 2009, World Bank). But there are also such possibilities that the development in infrastructure benefits only some big cities while the small ones fail to reap the benefit. The Indian economy is divided into 29 states and 8 union territories (UT). All the states have differences among themselves in terms of size, geographical and climatic conditions, socio-political factors, availability of labor force along with transport facilities. 23 states and union territories have railway network. Economic Growth of the country is indicated by its ability to produce. The productivity of the entire economy depends on economic performance of its respective states and UTs. The availability of railway network in different states along with several other factors helps in economic activities of the states.

2. Literature Review

Several literatures have been found that focus on the relationship between the economic activities or economic growth of an economy with the development of transport infrastructure particularly railway transport of an economy. Jenks (1944), using Schumpeter's theory of innovation shows that railroad contributed directly to the generation of National Income in America, through the rendering of transportation services. Munnell. and Cook (1990) taking data on English economy for the period 1970-1988 studied the impact of public capital on output, employment growth and private investment both at the state and the regional level. The paper estimated the aggregate production function to find the impact of public capital on output and then moves from steady state to the adjustment process to investigate the relationship between public investment and private investment. The results show that public expenditure in infrastructure has a positive and significant impact on the productivity of an economy. Robbles (1998), in a study on Latin American countries over the period 1970-1992, tried to find the relationship between infrastructure and economic growth. The study explains some new indicators of infrastructure investment employing physical units of infrastructure and found them to be positively correlated with economic growth. Shipros et al. (1999) find that for a couple of countries, for which investment in infrastructure is optimal, there exists a positive relationship between the level of infrastructure and volume of trade. Canning (1999) estimated

an aggregate production function of Cobb-Douglas type using a panel data set of 77 countries for the period 1960-1990.The production function incorporated labor, physical capital, human capital and infrastructure variables. The study found that the elasticity of output with respect to physical capital is around 0.37. However, no significant impact of transportation structure was found on growth. But the study also mentions that, since these types of infrastructure capital have already been included in his physical capital stock, they have positive impact on growth. Canning and Pedroni (1999) in a study over the period 1950-1992 found that on an average, paved roads are provided to the extent of growth maximizing level but there are incidences of undersupply as well as oversupply in some countries. Kulshrestha, et al. (2001), in a study, taking data for the period 1960-1995, found a high GDP elasticity of freight transport demand and a low price elasticity of freight transport demand. The study also concludes that, any short run disequilibrium in the system is likely to be corrected in the long run via adjustment of GDP and freight transport demand. Boopen (2006), in an empirical study of both cross sectional and panel data analyses the impact of transport capital on economic growth, taking data for sub–Saharan African Countries and Small Island Developing States for the period of 1980- 2000. The study concluded that transport capital plays an important role in the economic progress of these countries. Further, the for the SSA set, the productivity of transport capital was found to be greater compared to the overall capital. Pradhan (2010), in a study on Indian Economy, over the period 1970-2007, tried to investigate the relationship between transport infrastructure, energy consumption and economic growth. Using Cointegration and Granger causality tests, the study finds unidirectional causalities from transport infrastructure to economic growth, economic growth to energy consumption and transport infrastructure to energy consumption in India.Sahoo and Dash (2010), in a study on Indian economy, found a unidirectional causality from infrastructure, both physical and social, to output growth in India. Hong et al. (2011) developed a comprehensive index to measure both qualitative and quantitative features of transport infrastructure for Chinese economy. The study finds that transport infrastructure has an important role in economic growth. The impact of both land and water transport is strong while that of the air transport is relatively weak. The study also shows that uneven distribution of transport infrastructure acts as one of the factors behind regional economic disparities in China. Banerjee et al. (2012), taking data on Chinese economy over the period 1986-2006 estimated the impact of access to transportation on regional economic outcomes. The paper provided a simple theoretical model and empirical verification of the predictions. The results show that, proximity to transportation network has a positive causal effect on per capita GDP levels. Ding (2012) with data on Chinese economy for the period 1996-2004 studied the relationship between transport costs and economic concentration and tried to investigate the point effect and the network effect of transport. The study finds that development of urban roads leads to rising GDP shares in the city for both manufacturing and service sectors and there is a point effect for both urban roads and major regional roads in GDP. Further, the paper concludes that different types of transports have different economic impacts. Bogart and Chaudhary (2012), find that within the time period 1874 to 1912 gradual shift of ownership of Indian Railways from private to Government reduced the operational cost. The authors suggest that the colonial Government of India were successful in reducing the operation cost by cutting the labor cost. Pradhan and Bagchi (2013) taking data on Indian economy over the period 1970-2010, studies the effect of transport infrastructure on economic growth. The paper used Vector Error Correction approach to study the same. Rail and Road Transport was considered here. The study finds a unidirectional causality from rail transport to economic growth, from rail transport to capital formation, bidirectional causality between road transport and economic growth as well as between road transport and capital formation. Dave and Hornbeck (2016) taking U.S. data from 1870 to 1890 found that as railroads expansion has caused a substantial rise in the agricultural land values during the time period considered. The

study further finds that removal of all railroads in 1890 caused a fall in the total value of U.S. agricultural land by 60 per cent. Irfan et al. (2018) in a working paper of Madras School of Economics studied the long run structural relationships of tonne kilometer and passenger kilometer of IR with various macroeconomic variables. This study on Indian economy, taking time series data for the period from 1990-91 to 2013-14, uses cointegration and Vector Error Correction Analyses and finds that there exist long run relationships of Tonne kilometer and Passenger kilometer with the macro variables considered like GDP, mineral oil price index, urban population growth, and index of industrial production. The result show, while the passenger kilometer is determined by GDP and mineral oil price index, the tonne kilometer is not caused by the industrial growth. Panda (2018), taking data for the period 1980-2015, found a long run causality from railway demand and railway supply to economic growth, consumption and investment.

3. Research gap and Objective of the study

3.1 Research gap

Study of existing literature finds that there is no study on how the railway is related to economic performance of industrial sector of different states and UTs of India in the recent years.

3.2 Objective of the study

The objective of this paper is to find out the relationship between Gross Value Added (GVA) from Industrial sector and railway route of different states taking some other state specific control variables and considering the interaction between different factors.

4. Data and Methodology

4.1 Data

The study has been done using secondary data only. Data have been collected for the study from Handbook of Statistics of Indian States published by Reserve Bank of India on relevant variables for different states and union territories of India from the period 2005 to 2019.

4.2 Methodology

Methods of panel data econometrics have been used for the analysis.

4.2.1 Econometric Model

The regression model is specified as:

$$\ln Y_{it} = \alpha + \beta_1 \ln X_{1it} + \beta_2 \ln X_{2it} + \beta_3 \ln X_{3it} + \beta_4 \ln X_{4it} + \beta_5 \ln X_{5it} + \epsilon_{it} \quad (1)$$

Where:

Y is the dependent variable and stands for Gross Value Added (GVA) at constant prices (2011-12=100) of the industrial sector.

Explanatory variables:

X_1: Length of railway route

X_2: Length of Road

X_3: Number of workers in the industrial sector.

X_4: Gross Capital Formation in the industrial sector

X_5: Total amount of credit given to industrial sector by scheduled commercial banks.

All the variables are considered in their natural logarithmic values.

i= 1,2,…,23 and t=2005 to 2019.

€ is the disturbance term and βs are the coefficients to be estimated for respective variables. Since Indian Railway is owned and operated by the Central Government, and the states need a coordination with the central Government in terms of such operation, a dummy has been created to incorporate this central-state coordination factor.

D: A dummy where D=1 if the state government and the central government are of same political party.

$$\ln Y_{it} = \alpha + \beta_1 \ln X_{1it} + \beta_2 \ln X_{2it} + \beta_3 \ln X_{3it} + \beta_4 \ln X_{4it} + \beta_5 \ln X_{5it} + \beta_6 D_{it} + €_{it} \quad (2)$$

All the explanatory variables can have the individual effects as well as interactive effects on the dependent variable. Since the main focus of this study is to find out the effect of railway on the GVA, the interaction terms of X_1 with the other variables have been considered and equation (1) has been rewritten as

$$\ln Y_{it} = \alpha + \beta_1 \ln X_{1it} + \beta_2 \ln X_{2it} + \beta_3 \ln X_{3it} + \beta_4 \ln X_{4it} + \beta_5 \ln X_{5it} + \beta_6 D_{it} + \beta_7 (\ln X_1 * \ln X_3)_{it}$$
$$+ \beta_8 (\ln X_1 * \ln X_4)_{it} + \beta_9 (\ln X_1 * \ln X_5)_{it} + \beta_{10} (\ln X_1 * D)_{it} + €_{it} \quad (3)$$

At first Hausman test have been performed to choose between the Fixed Effect Model (FE) and the Random Effect Model (RE).

This test assumes the null hypothesis as H_0: Both the estimatedβ^{FE} and estimatedβ^{RE} are consistent but estimatedβ^{FE} is inefficient, against the alternative hypothesis

H_1: estimatedβ^{FE} is consistent and efficient but estimatedβ^{RE} is inconsistent.

The Hausman test statistic follows a $\chi 2$ distribution with degrees of freedom k, where k is the number of explanatory variables. (Bhaumik, 2015)

In this study, the null hypothesis is rejected and concluded that there is no significant presence of random effect in the data. (Table 1). The Hausman test finds Fixed Effect model to be appropriate for this case. After estimating the regression equation (3) using fixed effect model, the median value of GVA has been determined and the states with a GVA value lower than the median has been marked as Comparatively industrially backward states (Subgroup A) and those with a GVA value more or same as the median value have been considered comparatively industrially developed states (Subgroup B).

Then equation (3) has been written for the two subgroups as

$$\ln Y_{it} = \alpha + \gamma_1 \ln X_{1it} + \gamma_2 \ln X_{2it} + \gamma_3 \ln X_{3it} + \gamma_4 \ln X_{4it} + \gamma_5 \ln X_{5it} + \gamma_6 D_{it} + \gamma_7 (\ln X_1 * \ln X_3)_{it}$$
$$+ \gamma_8 (\ln X_1 * \ln X_4)_{it} + \gamma_9 (\ln X_1 * \ln X_5)_{it} + \gamma_{10} (\ln X_1 * D)_{it} + €_{it} \quad (4), \text{ and}$$

$$\ln Y_{it} = \alpha + \delta_1 \ln X_{1it} + \delta_2 \ln X_{2it} + \delta_3 \ln X_{3it} + \delta_4 \ln X_{4it} + \delta_5 \ln X_{5it} + \delta_6 D_{it} + \delta_7 (\ln X_1 * \ln X_3)_{it}$$
$$+ \delta_8 (\ln X_1 * \ln X_4)_{it} + \delta_9 (\ln X_1 * \ln X_5)_{it} + \delta_{10} (\ln X_1 * D)_{it} + €_{it} \quad (5)$$

Equations (4) and (5) have now been estimated for subgroup A and subgroup B respectively.

5. Results and interpretation

5.1 Results

The results of the estimation mentioned in the previous section are discussed in this section.

The result shows for the entire data that β_2 ,β_3 ,β_5 ,β_8 andβ_{10} are significant and positive while β_4 is significant and negative and the other coefficients are insignificant. (Table 2)

For Subgroup A, γ_5 and $\gamma_7$are significant and positive while γ_1 and γ_3 are significant and negative and the other coefficients are insignificant. (Table 3)

For Subgroup B, δ_2 ,δ_5 andδ_{10} are significant and positive while δ_6 is significant and negative and the other coefficients are insignificant. (Table 4)

5.2 Interpretation

The above results imply that when all the 23 states and UTs are considered, the railways route has no significant effect on the Gross Value Added but it has some significant positive interaction effect through capital formation and the government factors. If capital formation of a particular state or UT is higher at any period of time, then the railway route has a significant positive impact. This means that expansion of railway is beneficial for a state if it has a large investment in capital formation. Furthermore, for the states where the state is ruled by the same political party that is in the power of the central Government or its ally then the railway route contributes positively to the Output of the industrial sector. This further implies that the states with the same political party in their Government as the party ruling the union Government can get the capital outlay etc. of the railways easily. In case of the states where the industrial output is comparatively lower, the individual effect of railway route on GVA is negative but it has a positive impact if the industrial sector employment is higher. For the states with comparatively higher industrial output, the availability of railway fails to generate any significant contribution on GVA of industrial sector individually but its impact is significant and positive if the coordination between the central and state Government is considered.

6. Conclusion

This paper concludes that the expansion of railway, apparently does not come out to be beneficial for a state for its industrial production as the individual effect of railway route is insignificant. But in real sense it is beneficial for the same if more investment is done in capital goods and if the state-central coordination works well. So, in order to reap the benefit of such a large and well extended transport network like railway, the Governments should focus on the capital formation and a proper coordination between the states and the union Government. Furthermore, the states with relatively lower industrial output, should create enough scope for employment generation in the industrial sector in order to take advantage of the expansion of railway route. These facts imply that the benefit of expansion of railway route is heavily dependent on the state specific factors and those factors should be taken care of to make the expansion of railway route meaningful or fruitful.

Appendix

Table 1: Result of Hausman Test

Chi square	P> Chi square
52.92	0.000

Source: Authors' estimation based on RBI data

Table 2: Results of estimation of equation (3), using fixed effect model

Coefficients	Estimated Values	Standard Error	t	P-Value (p>|t|)
β_1	0.1970721	0..2492071	0.79	0.430
β_2	0.1984713	0.0505088	3.93	0.000
β_3	0.7978968	0.1947805	4.10	0.000
β_4	-0.1625457	0. 0729052	-2.23	0.026
β_5	0.4263347	0.102853	4.15	0.000
β_6	-0.26092	.1613901	-1.62	0.107
β_7	-0.0457405	0.0295613	-1.55	0.123
β_8	0.0218865	0.0108582	2.02	0.045
β_9	-0.0171303	0.0150272	-1.14	0.255
β_{10}	0.0404308	0.021014	1.92	0.055
α (Constant)	3.291017	1.757135	1.87	0.062

Source: Authors' estimation based on RBI data

Table 3: Results of estimation of equation (4), using fixed effect model

Coefficients	Estimated Values	Standard Error	t	P-Value(p>|t|)
γ_1	-1.863237	0.3765726	-4.95	0.000
γ_2	-0.041097	0.0563566	-0.73	0.467
γ_3	-0.7137207	0.2636103	-.2.7	0.008
γ_4	-0.0883326	0.0679635	1.30	0.196
γ_5	0.3463499	0. 1059389	3.27	0.001
γ_6	0.2793872	0.1798453	1.55	0.123
γ_7	0.2220522	0. .0452094	4.91	0.000
γ_8	0.009272	.0111335	0.83	0.406
γ_9	-0.0126706	0. 0184277	0.69	0.493
γ_{10}	-0.0385317	0.0262179	-1.47	0.144
α (Constant)	16.93211	2.420858	6.99	0.000

Source: Authors' estimation based on RBI data

Table 4: Results of estimation of equation (5), using fixed effect model

Coefficients	Estimated Values	Standard Error	t	P-Value(p>|t|)
δ_1	-1.365735	1.610765	-0.85	0.398
δ_2	0.2624474	0.0851674	3.08	0.002
δ_3	0.091956	1.073737	0.09	0.932
δ_4	-0.0901557	0.5349848	-0.17	0.866
δ_5	1.487538	0.6034029	2.47	0.015
δ_6	-1.578375	0.4731175	-3.34	0.001
δ_7	0.0591698	0.1341357	0.44	0.660
δ_8	0.0073786	0.0670467	0.11	0.913
δ_9	-.1448948	.0728093	0.99	0.408
δ_{10}	0.1989694	0.0575045	3.46	0.001
α (Constant)	14.0247	13.14211	1.07	0.288

Source: Authors' estimation based on RBI data

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