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A Study on the Contribution of the Indian Railways to the Indian Logistics Industry

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ABSTRACT

The Indian railways have been a vital mode of transportation for goods and people for over a century, with a vast network spanning the length and breadth of the country. This study aims to analyze the contribution of the Indian railways to the Indian logistics industry, focusing on the period from 2010 to 2020. Using a combination of quantitative and qualitative methods, including data analysis and interviews with industry experts, the study examines the key factors driving the growth of the railways in the logistics sector, such as the development of dedicated freight corridors and the adoption of new technologies. The study also explores the challenges faced by the Indian railways, including infrastructure constraints and the need for greater private-sector participation. Overall, the study highlights the significant contribution of the Indian railways to the logistics industry, while also identifying opportunities for further growth and improvement.

Keywords - Indian railways, Logistic industry, Economic growth.

Introduction

The logistics industry in India is evolving rapidly due to the development of infrastructure and technology in the twenty-first century.   The new types of service providers industry is able to help its customers reduce their logistics costs and provide effective services (which are also growing). At the same time changing government policies on taxation and regulation of service providers are going to play an important role in this process. Coordination across various government agencies requires approval from multiple ministries and is a road block for multi-modal transport in India.

Logistics has a huge impact on the domestic and global economy of India. As such, the role and importance of logistics have been elevated in many business environments. The logistics industry is a critical enabler of India's economic development. Recognizing the pivotal role logistics infrastructure spending has been increased to multifold from 2010 and in the year 2021 4 percent of GDP was spent. In this context logistics industry is assuming greater importance in tecent years because it is directly connected with the country's production and employment.

Logistic Industry in India

India is one of the countries with the largest population and an expansive geographical coverage which contributes to many of the factors that influence logistics in the country. The pandemic has seen a shift with countless challenges unique to each region. The logistics industry is seeing its fair share of ups and downs but trends suggest better growth for this sector in the coming year.

The year 2022 was a hit-and-miss for many of the key players in the industry. ICRA's reports suggested a growth rate of 14-17 % for the 21-22 fiscal year. Moreover, around 14.4 % of the GDP is accounted for by the logistics industry. A substantial amount of the population that are employed work in this sector.

The value of the logistics industry stands at $250 billion as of 2021 and is expected to reach $380 billion by 2025. This suggests there's a good potential for this industry to see robust growth if challenges are well handled.

Factors Affecting Logistic Industry

- **Digitization:** Indian Government has shifted its focus to AI and Big Data to accelerate the demand for digital logistics as per Mordor Intelligence's report.

- **Sustainable supply chain:** According to the Council on Energy, Environment and Water, freight service will see an increase in demand from 2,000 tkm in 2020 to 10,000 tkm by 2050. Moreover, the logistics sector is expected to contribute the highest amount of carbon emissions by 2050.

- **Increase in cloud-based systems:** The era of the internet has brought better security, storage and data encryption that smoothens the process of logistics. Use of cloud-based systems by organizations for ease in regulating the supply chain. Will help improve visibility across multiple networks and works on creating scalable options that meet market demands.

- **Use of blockchain:** A lot of businesses have been using blockchain to transform their supply chain management. Blockchain tools help improve customer service by integrating automation to ensure customer needs are met with minimal hindrance.

So logistics industry has a tremendous growth set for 2023 and in the coming years with AI, Big Data, IoT and other advance solutions available.

The Golden Quadrilateral road network coupled with two more diagonal highway networks linking Mumbai, Chennai, Delhi, and Kolkata host 50 per cent of India's total freight movement, half of which passes through the roadways and the balance by rail and a tiny component on water.

India once had a high share of rail freight but that gradually lost out to roadways starting 1951 due to the challenges of imbalanced capacity distribution, over utilization, track sharing, lower speeds, and lack of arrangements to aggregate smaller loads. Imbalanced capacity distribution challenge highlights the issue of seven main routes contributing 60 per cent of freight traffic but constituting only 16 per cent of railways route network, resulting in overuse and not programmed to handle high traffic density. Similarly, two-thirds of India's railway lines are already over 100 per cent utilization, exceeding 80 per cent usage regarded as ideal.

Track sharing challenge involves the use of the same set of tracks for both passenger trains and freight trains with the former being more prioritized, ending up raising the lead times for rail freight and its reliability. Further, freight trains in India carry smaller loads and ply at lower speeds than global standards, resulting in stretched out lead times and reducing the capacity of the network. Moreover, lack of arrangement to aggregate smaller loads requires a shipper to contract a full train to move freight, including not having a standardized process to aggregate smaller loads for booking individual or partial wagons. As a result, non-bulk commodities like consumer goods, electronics, automobiles, and others are transported through trucks.

For a country with low coast-to-landmass ratio, India needs a massive freight transport transition from roadways to railways. Projected to grow five-fold by 2050,India's logistics realm must usher in international competitiveness and standards to achieve savings worth Rs 10 trillion (Rs 10 lakh crore), a goal set for 2022.

Review of Literature

Pinar Hayaloglu (2015) considered Logistic sector as an important interface of increased international trade in consequence of globalization, plays an important role on countries'economic growth and development. A development in logistic sector facilitates the international trade, increases the competitiveness in countries and thus appears to be an important determinant of growth and development. In this study, the impact of developments in the logistic sector on economic growth has been investigated for 32 OECD countries covering the period 1994-2011.

Gunjan Malhotra, Sita Mishra (2019) attempted to explore the effect of selected economic growth indicators on the net profits in the logistics sector in India. The research type used is causal research. The paper established the relationship among the independent variables such as the change in taxes, change in inflation rate and the change in GDP of Indian services sector on the dependent variable as profits of the Indian logistics industry.

Deepti Chhabra (2017) had focused on green logistics of production system in today's world. It combines various efforts to quantify and control the environmental effect of production activities in an enterprise. It is imperative to focus on the green practices in context of Indian automobile sector as the volume of vehicles in India has increased considerably during last few decades.

Deepti Chhabra and Rajesh kr. Singh (2022) studied Industry 4.0 era and emphasized that in the circular economy, green logistics have become necessary for being sustainable. Adopting green logistics practices is a challenging task for the manufacturing industry, specifically in developing countries like India. So manufacturing organizations should develop strategies for implementing green logistics to achieve long-term sustainability.

Shailendra Kumar Singh and Suprivo Roy (2022) Environmental concerns have drawn extensive attention around the globe. Consequently, logistics firms are looking for means and methods to green their business operations because of an inherent negative relationship between logistics operations (LO) and the natural environment. Considering the sustained economic growth and logistics challenges in India, the present study aims at developing and empirically validating a scale for green logistics practices (GLPs).

David Bensman (2008) presented a vision of an information-intensive logistics system which brought goods to market from far-off suppliers on schedule. In the documentary, when a customer purchases a product at Wal-Mart, the cashier's computer scans the sale and sends information to the company's inventory control internet data-base so that orders for new supplies of that product can be transmitted to suppliers in China. **Samir k. Srivastava (2016)** sought to comprehensive examination of current logistics and supply chain practices in India. It was analyzed and assessed that logistics and supply chain practices in order to discern important issues such as emerging trends and areas of concern.

Syed Mithun Ali Asraf Arafin (2017) found researchers and practitioners are paying attention to reverse logistics (RL) issues due to growing environmental concerns, competitive advantage, promising financial potential, legislative reasons and social responsibility. This study aims to examine the contextual relationship and interactions among barriers to implement RL practices in the computer supply chain of Bangladesh

Srinivas Kollur Srinivas Kolluru (2014) For any industry, use of Information Technology (IT) and innovation is necessary in order to stay ahead in the competition. The logistics industry is a classic example of the birth and development of a vital new service-based industry. The industry has been transformed from the business concept of transportation to that of serving the entire logistical needs.

Rong-Her Chu and Yu-Chang Lin, (2012) concluded that the relationship of the transport industry in Taiwan is stronger in absorbing related industrial products than the products used as inputs in other industries. Road, rail and air transport have a strong ability to attract other industries. The effects of the transport sector triggered production high enough and increased from 2.80% in 1991 to 19.41% in 2006. The highest effect was road transport whereas the lowest was water transport, but water transport had the highest effect on job creation, followed by the air transport and warehousing sectors.

Seetanah Boopen, 2009, A study finds empirical evidence of the importance of developing transport infrastructure in accelerating productivity and economic development, particularly for African countries.

 Akanbi Bosede, et al, 2013, found that transportation infrastructure has a statistically significant and positive relationship with economic growth in Nigeria. This means that improving the transport infrastructure will boost economic growth.

Glen Weisbrod, 2009, Transport infrastructure investment in economic development is important as a means to facilitate the mobility of goods and services that facilitate the relationship between remote and growth centers. Smooth flow of goods and services will stimulate economic activity resulting in an increase in household income (

Jin Wang, Michael B, and Charles, (2006) studied that the rail and water transport sectors resulted in a significant change in sectoral prices in the energy resources sector. This reflects the high dependence of these sectors on the rail and water transport sectors.

Mohan in 2013, it was showed that the logistics management has effect on global competitiveness. Furthermore, the paper also examined the salient features of Indian logistics systems. Indian companies need to opt for 4PL services, should bring in savings through usage of high technology tools, systems and collaborations. Finally, the logistics service provider should bring down the logistics cost to clients, while concurrently improving the service standart (Mohan 2013).

E.Sandberg and M.Abrahamsson explore how to generate sustainable competitive advantage in the best two Swedish practice-companies that successfully exploit logistics as a source of competitive advantage. By using a theoretical framework based on the resource results from review of a firm, the research elaborates the link between operational and dynamic logistics capabilities and sustainable competitive advantage. The study identified the five dynamic capabilities, namely managerial knowledge and presence, cross-functional teamwork, control, learning and supply chain relationships. Those all are vital for the continuous development of the bundling of logistics process and Information Technology (IT) systems. (Sandberg &Abrahamson 2011).

NEED FOR THE STUDY

The pandemic time has changed the game for many economic activities and logistics is no different. Consumer demands are always on the rise. During the pandemic, there has been a hike in demand for goods with a shortage of supply. Thus, we can say that logistics is one sector that has the potential to see a substantial increase in 2023. It is also evident that over the last sixty years, limited planning and investment in freight transport have resulted in numerous inefficiencies. Hence the study is aimed to analyze the importance and role of logistics in Indian economy.

OBJECTIVES

- To collect data on selected macroeconomic indicators
- To collect data on transport sector value addition to Indian economy.
- To find out the effect of growth of transport sector value addition on selected economic indicators

Research Methodology

Research design

Analytical research design is used in this study.

Methodology

The growth of logistic industry is substantial after COVID 19 pandemic situation. The technology growth also ensures free factor mobility that may induce perfect competition for the consumer goods. But in India, it is found that the product cost increases due to logistics. It is estimated that 14% of product cost is attributed to the total price of the product. When this is compared with other countries, it was found that it was only 6% to 8% according

to the World Bank report. Hence to analyse and formulate policies to bring down this cost it essential to measure the effect of growth of logistics industry and its effect on selected macro-economic indicators such GDP, Unemployment rate, inflation rate and indirect taxes for the period of 2012 to 2021 were collected and analyzed. It is also evident that rail transport cost per unit per kilometer is lower compared to road transport. But the golden quadrilateral project increases the strength of road transport and inefficiency on the part of railways in time consumption, railroad length and utilization factors lead the people to use alternative mode of road transport. But the world bank report stated that in India 14% of the cost of a product is attributed to road transport system. The next major challenge is green house effort. To meet out these challenges Indian economy has to concentrate upon increasing the efficiency of railway system by establishing new rail roads for increased connectivity and better carrying capacity of rail wagons. So ten years data were collected about various macro economic variables and performance variables of Indian railways for analysis.

Sampling Technique

Since the study is based on chronological data 10 years data were used for this study.

Type of Data

The study is mainly based on secondary data. The usage of primary data is very limited.

Statistical Tools used

1. Linear regression model

2. Quadratic model

3. Growth rate model

4. Compound Growth rate model

5. Annual growth rate

6. Line chart

Limitation of the study

The study period is only ten years and the data may represent a skewed estimation which cannot be used for generalization purpose. So the application of study requires more variables and other external variables which can also contribute qualitatively.

Results and Analysis

Table 1- Transport related services value addition –

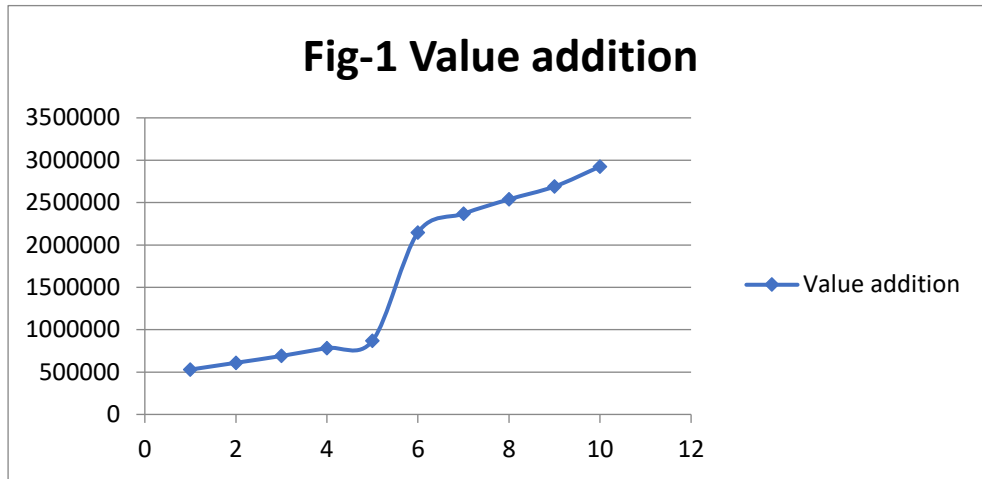| Year	Value addition (Rupees in crores)	Annual Change in percentage
2011-12	529534	12.2534
2012-13	609453	15.09233
2013-14	689906	13.20085
2014-15	783819	13.61243
2015-16	868438	10.79573
2016-17	2146379	147.154
2017-18	2368419	10.34486
2018-19	2538757	7.192055
2019-20	2689726	5.946571
2020-21	2925346	8.76

Fig-1 Value addition

Table 1 shows the historical data of transport services value addition in the economy. We interpret that value of the transport services had growth trend year by year expect 2021 -2021. It had fallen during the period with the effect of covid 19. After the pandemic situation its growth return to its trend. The compound annual growth rate is 24.8%.

Effect of Logistics on Indian Economy

To find out the effect of logistics industry on Indian economy, transport value addition for 10 years data were taken as proxy. The transport value addition contribution to GDP , tax collection, unemployment and inflation rate were measured using linear regression and the results were presented below.

Table-2 Effect of Transport value addition on GDP

Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Linear	.916	86.809	1	8	.000	1706.505	.035

From the above table it is observed that

GDP = 1706.51+0.035*** (transport value addition)

Where the model validity is proved by F value (86.809) significant at 1% level and the coefficient of determination = 0.916.

Table-3 Effect of Transport value addition on Unemployment

Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Linear	.035	.290	1	8	.605	5.795	-.004

Table-4 Effect of Transport value addition on Inflation rate

Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Linear	.125	1.138	1	8	.317	6.341	-.019

As for as unemployment and inflation is considered the contribution of transport value additions showed insignificant values and lower coefficient of determination. So these two macroeconomic values were not affected by this logistic industry even though the contribution of logistic industry is significant in collection of taxes and GDP.

Table-5 Effect of Transport value addition on Tax collection

Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Linear	.924	97.788***	1	8	.000	1706.505	.035

From the table it is concluded that

Tax Collection = 1239600+0.822*** (transport value addition)

Where the model validity is proved by F value (97.79***) significant at 1% level and the coefficient of determination = 0.924.

The following data explains the capital at charge that is investment in reproductive assets for ten years. The data were fitted with four models of time series and the results were also given in table no 2

Table No.6   Capital at charge

YEARS	Capital at a charge (in crore)	Annual growth rate
2011-2012	161447.97	11.28
2012-2013	183488.08	13.65
2013-2014	208844.28	13.82
2014-2015	242116.97	15.93
2015-2016	275135.23	13.64
2016-2017	302457.78	9.93
2017-2018	324725.64	7.36
2018-2019	348601.77	7.35
2019-2020	374591.87	7.46
2020-2021	387689.69	3.5
2021-2022	466718.71	20.38

Table no.7 Model Summary and Parameter Estimates For Capital at charge

Equation	Model Summary					Parameter Estimates		
	R Square	F	df1	df2	Sig.	Constant	b1	b2
Linear	0.983	527.304	1	9	0	128549.1	28208.75	
Quadratic	0.984	252.163	2	8	0	137594.3	24034.03	347.893
Compound	0.977	385.473	1	9	0	156118.6	1.105	
Growth	0.977	385.473	1	9	0	11.958	0.1	

From the table 1 and 2 it is under stood that the capital at charge growth is showing a higher level during 2011-12 to 2015-16. After that slowly the annual growth rate touches single digit and in the last year 2021-22 it showed a growth rate of 20.38 percent. The annual compound growth rate is 10.5 percent. The model fitting summary resulted in a higher R square value for quadratic model show the growth equation is given as

Estimated value = $137594.343 + 24034.032X + 347.893 X^2$

Where X indicates the time value and growth shows a positive trend.

In table.11 the total investment made by railways in the last ten years were shown.

Table No.8 Total investment made by Indian Railways

YEARS	Total investment (in core)	Annual growth rate
2011-2012	161448	13.26
2012-2013	289374.9	79.24
2013-2014	324662.4	12.19
2014-2015	368758.2	13.58
2015-2016	419123.6	13.66
2016-2017	471776.4	12.56
2017-2018	517324.2	9.65
2018-2019	573641.7	10.89
2019-2020	640408.3	11.64
2020-2021	670725.8	4.73
2021-2022	53449.91	-92.03

From table.8 it is known that total investment suddenly rose to a higher level in the year 2012-13. It is also observed that it falls to lowest level to -92.03 percent in 2021-2022. The fall in the level in the year 2021-22 is attributed to the conversion of non productive assets to productive assets in the effort to nullify the pandemic effect caused to railways. The annual compound growth rate was calculated at 0.9 percent.

Table – 9 Model Summary and Parameter Estimates for Total Investment of Indian railways

|	Model Summary					Parameter Estimates		
Equation	R Square	F	df1	df2	Sig.	Constant	b1	b2
Linear	.144	1.516	1	9	.249	275120.200	22187.440	
Quadratic	.505	4.077	2	8	.060	-51582.584	172973.341	-12565.492
Compound	.002	.014	1	9	.908	324609.707	1.009	
Growth	.002	.014	1	9	.908	12.690	.009	

From table -12 it is inferred that the best fitting model is quadratic model since R^2 is 0.505 the highest among other models. It is explained through the equation

Estimated value = -51582.584+ 172973.341 X + -12565.492X^2

The table no.13 explains the Total No. of passengers originating (in millions) in Indian Railways for ten years.

 Table No.10 Total No. of passengers originating (in millions) in Indian Railways

YEARS	No. of passengers originating (in millions)	Annual growth rate
2011-2012	8224	1.3
2012-2013	8421	2.4
2013-2014	8397	-0.29
2014-2015	8224	-2.06
2015-2016	8107	-1.42
2016-2017	8116	0.11
2017-2018	8286	2.09
2018-2019	8439	1.85
2019-2020	8086	-4.18
2020-2021	917	-88.66
2021-2022	2169	136.53

Fig No 2. No. of passengers originating (in millions)
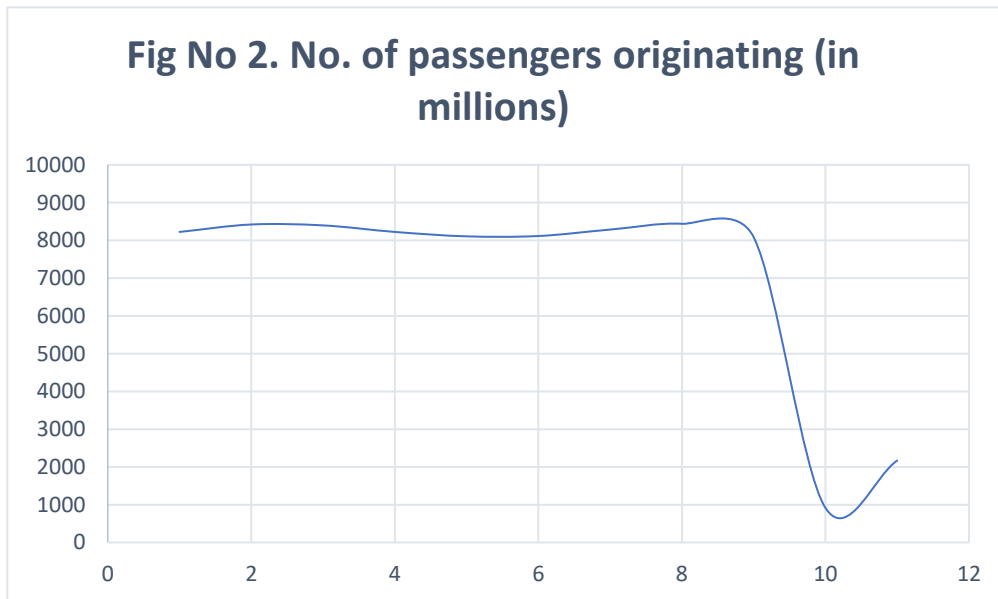
From table no.10 it is shown that the average number of customers originating is almost uniform for 10year period and during corona pandemic the number (917 million) had fallen down to the lowest level and again it reached only one fourth of the previous years population. The analysis of the data is done.

Table No. 11 Model Summary and Parameter Estimates for No. of passengers originating (in millions)

|	Model Summary					Parameter Estimates		
Equation	R Square	F	df1	df2	Sig.	Constant	b1	b2
Linear	.447	7.284	1	9	.024	10341.364	-551.045	
Quadratic	.724	10.514	2	8	.006	6303.939	1312.381	-155.286
Compound	.402	6.055	1	9	.036	13998.435	.868	
Growth	.402	6.055	1	9	.036	9.547	-.142	

Table. No 10 explained that the quadratic model is best suited to explain the detail since the R^2 (0.724) is the highest for this model. Hence the model resulted in

Estimated value = 6303.939+ 1312.381 X -155.286 X^2

From table.11 it is known that total investment suddenly rose to a higher level in the year 2012-13. It is also observed that it falls to lowest level to -92.03 percent in 2021-2022. The fall in the level in the year 2021-22 is attributed to the conversion of non productive assets to productive assets in the effort to nullify the pandemic effect caused to railways. The annual compound growth rate was calculated at -13.2 percent.

In table no.12 the passenger traveling distance in millions of Kms is given

Table No.12   Passenger Kms. (in millions) in Indian Railways

YEARS	Passenger Kms (in millions)	Annual growth rate
2011-2012	1046522	2.35

Fig 3 Passenger Kms. (in millions)
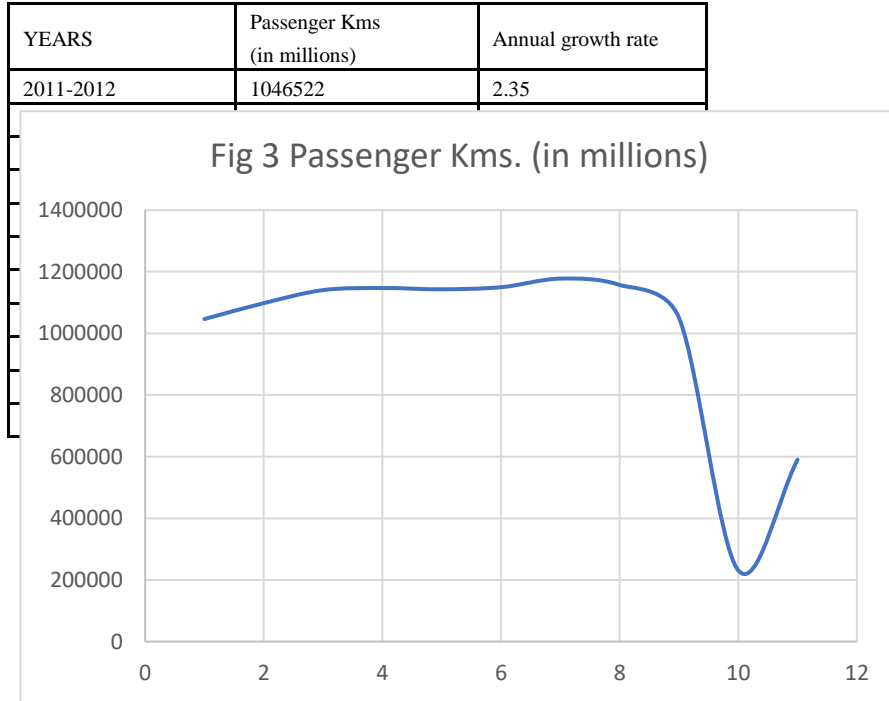
From table no.12 it is portrayed that the usage of trains is very high for travelling since the distance was ranging from 1046522 million kms to 1177699 during the past seven years and it started decreasing in the subsequent years due covid-19 effect and again it started raising in 2021-22. The annual compound growth rate was calculated at -8.1 percent

Table No. 13 Model Summary and Parameter Estimates for Passenger Kms(in millions)

	Model Summary					Parameter Estimates		
Equation	R Square	F	df1	df2	Sig.	Constant	b1	b2
Linear	.354	4.930	1	9	.054	1319122.836	-54216.609	
Quadratic	.675	8.325	2	8	.011	838035.958	167823.489	
Compound	.317	4.182	1	9	.071	1522716.808	.919	
Growth	.317	4.182	1	9	.071	14.236	-.085	

From table.13 it is known that quadratic model was best suited the explain the given phenomenon since the coefficient of determination value is 0.675 the highest when compared to other models.

The estimating equation is given as Y = 838035.958+ 167823.489 X -18503.341 X^2

The following data explains the Passenger earnings (in core) by Indian Railways for ten years.

Table No.14 Passenger earnings (in core) Indian Railways

YEARS	Passenger earnings (in core)	Annual growth rate
2011-2012	28246.43	9.78
2012-2013	31322.84	10.89
2013-2014	36532.25	16.63
2014-2015	42189.61	15.49
2015-2016	44283.26	4.96
2016-2017	46280.46	4.51
2017-2018	48643.14	5.11
2018-2019	51066.65	4.98
2019-2020	50669.09	-0.78

| 2020-2021 | 15248.49 | -69.91 |
| 2021-2022 | 39214.39 | 157.17 |

Fig 4 Passenger earnings (in core)
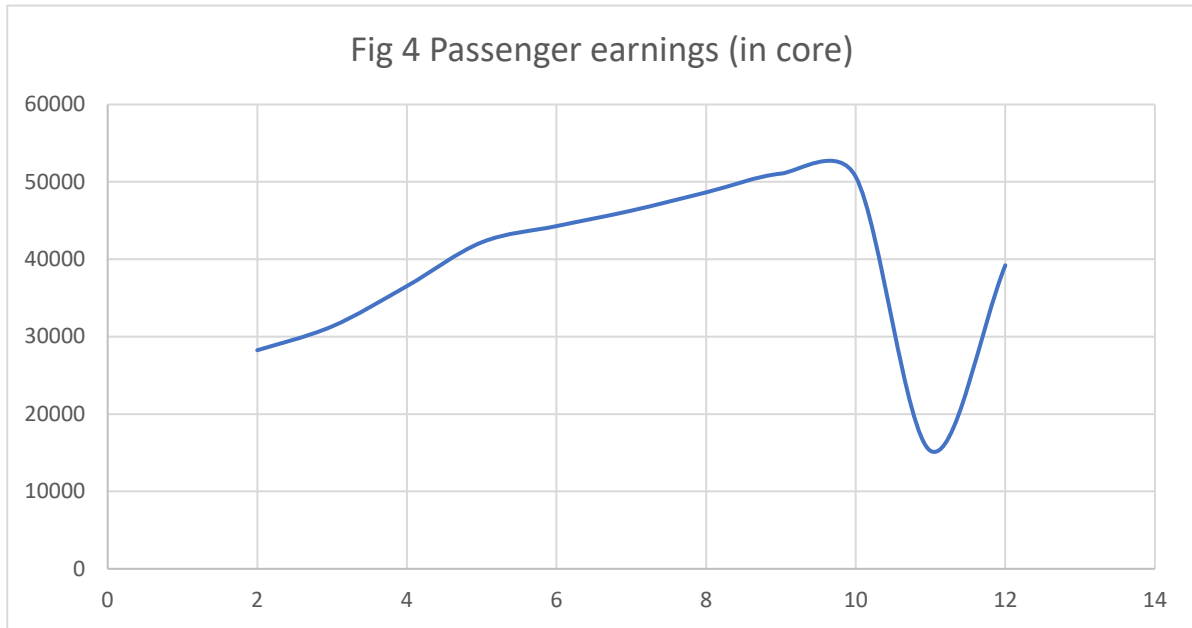
Table No. 15 Model Summary and Parameter Estimates For Passenger earnings (in core)

Equation	Model Summary					Parameter Estimates		
	R Square	F	df1	df2	Sig.	Constant	b1	b2
Linear	.023	.210	1	9	.658	36423.317	500.608	
Quadratic	.436	3.091	2	8	.101	16588.746	9655.025	-762.868
Compound	.000	.003	1	9	.957	37123.106	1.002	
Growth	.000	.003	1	9	.957	10.522	.002	

From table.15 it is observed that the passenger earnings raise from 2011-12 to 2019-20. During the last two years it falls down due pandemic effect. The passenger earnings showed an annual compound growth rate of only 0.2%

From table 14 the analysis results showed that quadratic model was best suited the explain the given phenomenon since the coefficient of determination value is 0.436 which is a higher when compared to other models.

The estimating equation is given as $Y = 16588.746 + 9655.025X - 762.868 X^2$

The table no 15. Explains the Earnings from freight carried excl. wharf age & demurrage charges (in core) by Indian Railways for ten years.

Table No.16 Earnings from freight charges (in core) by Indian Railways

YEARS	Earnings from freight carried excl. wharf age & demurrage charges (in core)	Annual growth rate
2011-2012	67743.62	15.23
2012-2013	83478.83	23.23
2013-2014	91570.85	9.69
2014-2015	103100.2	12.59
2015-2016	106940.6	3.72
2016-2017	102027.8	-4.59
2017-2018	113523.5	11.27
2018-2019	122580.3	7.98
2019-2020	111472.3	-9.06
2020-2021	115738.4	3.83
2021-2022	1317.41	-98.86

fig 6 Earnings from freight carried excl. wharfage & demurrage charges (in core)
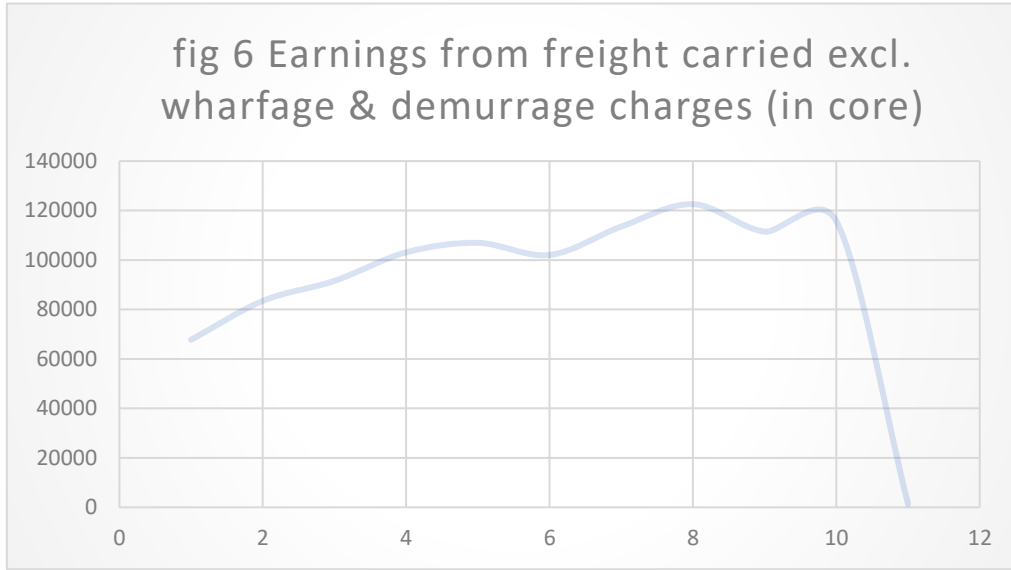
From table.16 it is known that the freight earning rose to a higher level in the year 2018-19 The annual compound growth rate was calculated at -14.6 percent. The negative growth is attributed to pandemic effect.

Table No .17 Model Summary and Parameter Estimates for Earnings from freight carried (in core)

|	Model Summary					Parameter Estimates		
Equation	R Square	F	df1	df2	Sig.	Constant	b1	b2
Linear	.007	.068	1	9	.801	98018.273	-889.503	
Quadratic	.550	4.888	2	8	.041	27401.236	31702.976	-2716.040
Compound	.158	1.695	1	9	.225	174969.188	.854	
Growth	.158	1.695	1	9	.225	12.072	-.158	

From table 17 the analysis results showed that quadratic model was best suited the explain the given phenomenon since the coefficient of determination value is 0.550 which is a higher when compared to other models.

The estimating equation is given as $Y = 27401.236 + 31702.976X - 2716.040X^2$

The following data explains the Gross revenue receipts in Indian Railways for ten years.

Table No.18 Gross revenue receipts Indian Railways

YEARS	Gross revenue receipts	Annual growth rate
2011-2012	106245	12.36
2012-2013	126180.4	18.76
2013-2014	143213.9	13.5
2014-2015	161017.3	12.43
2015-2016	168379.6	4.57
2016-2017	165382.5	-1.78
2017-2018	178929.6	8.19
2018-2019	190507.4	6.47
2019-2020	174695.7	-8.3
2020-2021	138236.1	-20.87
2021-2022	191206	38.32

Fig 7 Gross revenue receipts
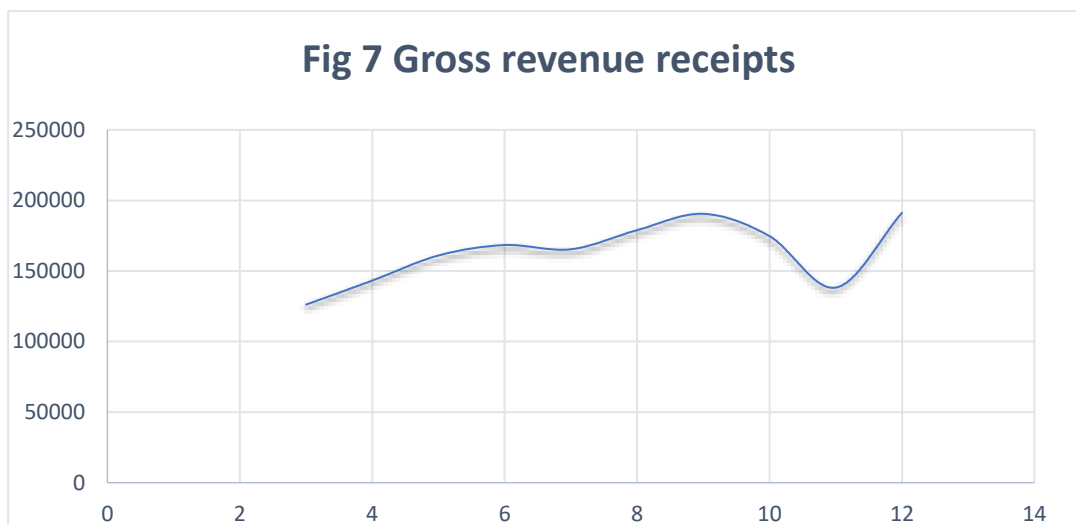
From table.18 it is known that the freight earning rose to a higher level in the year 2018-19 the annual compound growth rate was calculated at 4.0 percent. The negative growth is attributed to pandemic effect.

Table No 19 Model Summary and Parameter Estimates for Gross revenue receipts

| Equation	Model Summary					Parameter Estimates		
	R Square	F	df1	df2	Sig.	Constant	b1	b2
Linear	.502	9.082	1	9	.015	123799.224	5790.940	
Quadratic	.715	10.045	2	8	.007	88696.145	21992.361	-1350.118
Compound	.497	8.891	1	9	.015	123605.840	1.040	
Growth	.497	8.891	1	9	.015	11.725	.039	

From table 21 the analysis results showed that quadratic model was best suited the explain the given phenomenon since the coefficient of determination value is 0.715 which is a higher when compared to other models.

The estimating equation is given as $Y = 88696.145 + 21992.361X - 1350.118X^2$

The following data explains the Net revenue receipts Indian Railways for ten years.

Table No.20 Net revenue receipts Indian Railways

YEARS	Net revenue receipts	Annual growth rate
2011-2012	6781.6	14.024
2012-2013	13615.19	100.77
2013-2014	11749.07	-13.71
2014-2015	16838.49	43.32
2015-2016	19228.48	14.19
2016-2017	4913	-74.45
2017-2018	1665.61	-66.1
2018-2019	3773.86	126.58
2019-2020	1589.62	-57.88
2020-2021	2547.48	60.26
2021-2022	15025	489.8

Fig 8 Net Revenue Receipts
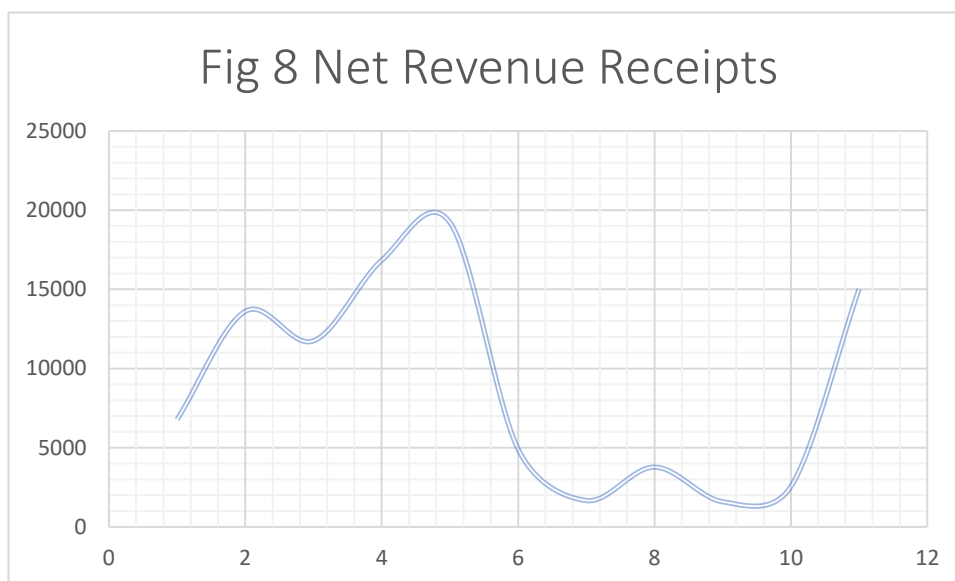
From table.20it is observed that the net revenue receipts showed a fluctuating pattern since the middle years more reforms were made to modernize the existing system and to introduce new trains. The annual compound growth rate is estimated at -12.1%

Ta Model Summary and Parameter Estimates for Net revenue receipts

Equation	Model Summary					Parameter Estimates		
	R Square	F	df1	df2	Sig.	Constant	b1	b2
Linear	.126	1.297	1	9	.284	13096.545	-702.039	
Quadratic	.133	.612	2	8	.566	14608.224	-1399.737	58.142
Compound	.208	2.365	1	9	.158	13719.147	.879	
Growth	.208	2.365	1	9	.158	9.527	-.129	

From table no .23 the analysis results showed that compound and growth model was best suited the explain the given phenomenon since the coefficient of determination value is 0.208 for both which are higher when compared to other two models.

The estimating equation is given as Y = 88696.145+ 21992.361X -1350.118X

CONCLUSION

The Indian railways have historically played a significant role in the development of India's logistics industry. The vast network of railways covers a large geographical area, making it an essential mode of transportation for goods and people. The Indian railways have contributed to the growth of several industries, including agriculture, mining, and manufacturing, by providing cost-effective and efficient transportation solutions. The railways have also played a critical role in the development of trade and commerce within India. The availability of reliable and affordable transportation has helped to connect various parts of the country, leading to increased economic activity and growth. Despite facing challenges such as aging infrastructure and inadequate funding, the Indian railways continue to be a vital contributor to the logistics industry. With ongoing efforts to modernize and upgrade the railway infrastructure and systems, the Indian railways are poised to play an even more significant role in the future growth of the Indian economy.

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