Impact of Urban Connectivity on Economic Growth: Quantitative Study

by Jana Publication & Research

Submission date: 10-Sep-2025 04:20PM (UTC+0700)
Submission ID: 2690333448
File name: IJAR-53747.pdf (807.95K)
Word count: 3976
Character count: 20736

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Abstract

This paper examines the role of increased urban connectivity (via roads and railways) on economic growth in India. Effective road and railway infrastructure save time on trips, reduce transportation costs, improve access to markets, and improve economic productivity. Using data from 15 states for the time period 2011to 2019 the effect of highway and railway routes on regional economic growth has been found. This study employs a fixed effects panel regression model while commenting upon the relationship between the changes in connectivity and the Gross State Domestic Product (GSDP) of a state. The results of the regression analysis demonstrate a strong positive relationship between increased connectivity, through road and rail networks, on economic performance of the region. The research thus concludes that increase in investment for transport infrastructure is often viewed as a means of improving mobility as well as it can also provide an essential avenue through which regional disparity can be reduced. This finding supports the hypothesis that better connectivity reduces transaction costs, facilitates trade, enhances labour mobility, and encourages the diffusion of economic activities across regions. Thus, urban connectivity enables urbanization, and ultimately, ensures economic growth is sustained and spread across India.

Key words: urbanisation, growth, road infrastructure, productivity, railway routes.

Introduction

Economic growth is the increase in the production of goods and services by the nation over a period of time, leading to more income, a better quality of life and increased employment. Urbanization is defined as a population shift from rural to urban areas resulting in the growth of technology and

industry. Urbanization is spurred on by mostly market-based economic growth which is an important precursor to industrialization, innovation and ultimately economy of scale. As urban cities expand, it becomes even more necessary to have efficient infrastructure, particularly roadways, bridges and railways. Roadways help people transport goods and services from one place to another place. Roads link the market place with resource hubs, reducing transportation costs while increasing productivity and how smoothly products can enter the market. Door-to-door collection and delivery is possible in case of road transport only. Road infrastructure encourages trade, creation of jobs, investment opportunities and horizontal economic integration by local governments. Moreover, cities with effective road planning reduce road congestion, facilitate public transport in space-constrained areas, and provide a logistical competitive advantage making the city attractive to investment and other economic activities. This alone can contribute positively to the local economy in terms of expansion. By investing into roads infrastructure in urban areas, local governments can expand regional economies at taxpayer and corporate expense. Road infrastructure is one of the foremost ways governments can continue to economically grow regionally while ultimately growing the cities responsible for its economic and spatial boundary. Therefore, without roadinfrastructure urban and rural economic growth is stunted or limited.

On the other hand, railway infrastructure is essential for economic development, acting as a fundamental part of urban and regional development. Railway infrastructure initiates industrialization and makes trade faster and cheaper. It helps carrying heavy and bulky goods over a long distance. Besides, electrified railway network provides a faster, safer and pollution free transport at a lower cost. Along with this the metro railway projects accelerates the urbanisation process. Road and railway development extends to other social outcomes through increased access to schooling and education, quality healthcare, jobs and work opportunities, and other civic engagement opportunities. With urbanization, the vitality of cohesive road systems with interconnectivity is critical for sustainable development of local economies and regionally. As a result, continued investment in road and railway infrastructure is important for economic resilience, creating economic opportunity and equilibrium, which will advance economic development for the long term in both developed and developing regions.

In this research paper, our focus is to verify whether urban connectivity in each state is related to its economic growth. We have emphasised mainlyon 15 states named Maharashtra, Andhra Pradesh,Assam,WestBengal,Punjab,Gujarat, Karnataka,Uttar Pradesh,Rajasthan,Tamil Nadu,Himachal Pradesh,Madhya Pradesh, Manipur, Jammu& Kashmir, Kerala for the time period 2011-2019 to check the impact of urban connectivity on regional development.

Literature Review

Mishara (2019), discussed how transport systems like buses, metros, and roads help cities grow by connecting people, jobs, and businesses. The author says India needs to plan cities better, build more public transport, and keep housing and jobs close to each other. Moreover, he mentioned that if road

connectivity is developed in rural areas rural productivity will increase which in turn reduces the rural-urban migration.It explains that better transport makes cities more productive because people can reach places faster and businesses can work more smoothly. The paper also suggests how govt. can use tax revenue generated from land to pay for more transport projects.

Maparu & Mazumder (2017), found whether there is a two-way causal relation between economic growth and transport system of India. They explored that in most cases, when India's economy grows, the government spends more on transport. The study also highlighted how cities grow when people move in for jobs, which is linked to both the economy and transport options. Different types of transport (like roads, trains, ports, airports) affect city growth in different ways, and not all investments are equal. They found that investment on airways and railways positively affect economic growth in the short run and long run respectively. Investment to build highways or ports only influence urbanisation in the short run only.

Chakraborty & Guha (2009), looked at how having better infrastructure in villages — like roads, schools, and health centres — can improve quality of life and boost the rural economy of India. It highlighted about government projects like Bharat Nirman and NREGA that aim to improve roads, electricity, and water supply in villages.The authors created a ranking system to compare which Indian states have the best infrastructure in their villages and which ones are falling behind.It points out that states like Kerala and Haryana are doing well, while Bihar and Orissa need serious improvements.The study says both government and private partnership should work together to fix these gaps and help rural India grow.

Avery et al., (2017) explain how better connections between villages and cities (like roads, railways, and boats) can help poor rural areas develop faster.It says that when rural areas are better connected to cities, people get easier access to schools, hospitals, and markets to sell their products.The study gives examples from countries like India, China, and Vietnam, showing how good roads increased jobs, raised incomes, and reduced poverty.It also warns that just building roads isn't enough — poor people need affordable transport services too, or they'll stay left out.The authors say that to make development fair, governments must carefully plan where to build roads and make sure even the poorest areas are connected.

Research gap

The literature reviewed above focused mainly on how development of overall infrastructure in urban areas or connectivity of rural areas with urban areas help in economic growth. This paper will emphasise, especially, on the effect of road and railway connectivity of urban areas on regional economic growth

Research objective

How does increased urban connectivity measured by road network and length of railway route affect regional economic growth.

Methodology and Data source

To find the objective of the paper we undertake quantitative analysis by collecting secondary data for the time period 2011 to 2019. We have chosen 15 states (Maharashtra, Andhra Pradesh, Assam, West

Bengal, Punjab, Gujarat, Karnataka, Uttar Pradesh, Rajasthan, Tamil Nadu, Himachal Pradesh, Madhya Pradesh, Manipur, Jammu and Kashmir, Kerala) to check how urban connectivity improves economic growth. We have considered these 15 states as they consist of approximately 80% of India's GDP. So, these states contribute a significant amount to the GDP of the country. Length of national highways (NH_length, henceforth), state highways (SH_length, henceforth) and length of railway route (Rail_length, henceforth) are taken as the indicators of urban connectivity. Data of these indicators are collected from the Statistical Handbook of RBI for Indian states. The economic growth is measured by gross state domestic product (GSDP) at constant price 2011-12. The table containing data on all variables across the state over the given time period is given in appendix.

Findings

In order to find the objective, GSDP is taken as a dependent variable and NH_length, SH_length, Rail_length are taken as independent variables. The proposed multilinear panel regression model is:

$$GSDP_{it} = a + \beta_1 NH\_length_{it} + \beta_2 SH\_length_{it} + \beta_3 Rail\_length_{it} + e_{it}$$

Since the impact of urban connectivity on all states over the time will be observed, we have undertaken the fixed effect (FE, Henceforth) panel regression model. The FE model eliminates the effect of all state-specific constant factors, ensuring that the estimated coefficients (NH_length, SH_length, Rail_length) capture only the within-state variation over time. By controlling for these state-specific effects, the model estimates the impact of changes in national highways, state highways, and rail connectivity on GSDP within each state over time, providing more reliable and policy-relevant insights.To capture state fixed effect state dummy variables are included.

Testing for coefficients

Here the null hypothesis is

$\beta = 0$ (it means there is no relation between urban connectivity and GSDP)

Alternative hypothesis is

$\beta_1 > 0$ (it means there is a positive relation between length of national highway and GSDP)

$\beta_2 > 0$ (it means there is a positive relation between length of state highway and GSDP)

$\beta_3 > 0$ ((it means there is a positive relation between length of railway route and GSDP)

In this case test statistics is given by "t" $= \frac{\hat{\beta}}{SE\ OF\ \hat{\beta}}$ here we use "t" statistics as the standard deviation of population is unknown.

The null hypothesis will be rejected for the given observation if the observed value of t is greater than the tabulated value of t at 95% confidence interval i.e.

$t_{obs} > t(\alpha, n-3)$ here α is the level of significance

Analysis of data:

ANOVA table-1:

Source	sum_sq	df	F	p_value
C(State)	101,629,781,102,880,704.000	14.000	109.079922	0.000000000
NH_LENGTH	7,498,540,787,368,832.000	1.000	112.675274	0.000000000
SH_LENGTH	317,384,580,178,176.000	1.000	4.769114	0.030970250
RAIL_LENGTH	1,273,524,905,304,960.000	1.000	19.136365	0.000026567
Residual	7,786,351,890,686,312.000	117.000	nan	nan

Source: author's calculation

Table-2

variable	coefficient	std_error	t_stat	p_value
Intercept	-124,200,645.681	30,764,063.701	-4.037	0.000
NH_LENGTH	7,917.297	745.139	10.622	0.000
SH_LENGTH	124.082	56.737	2.186	0.030
RAIL_LENGTH	51,784.322	11,826.997	4.379	0.000
C(State)[Assam]	50,707,631.597	18,206,615.426	2.787	0.006
C(State)[Gujarat]	40,969,069.187	16,291,630.866	2.514	0.013
C(State)[Himachal]	-29,419,668.053	16,518,847.868	-1.781	0.077
C(State)[Jammu&kashmir]	-31,016,982.256	16,663,099.857	-1.861	0.065
C(State)[Karnataka]	33,493,668.720	15,827,256.024	2.116	0.036
C(State)[Kerala]	-49,325,418.241	18,041,794.658	-2.734	0.007
C(State)[Madhya pradesh]	-16,293,992.876	16,252,007.086	-1.002	0.318
C(State)[Maharashtra]	18,632,758.289	15,592,440.537	1.195	0.234
C(State)[Manipur]	-50,334,059.568	16,462,618.163	-3.056	0.003
C(State)[Punjab]	-21,401,325.882	16,099,795.926	-1.330	0.186
C(State)[Rajasthan]	-6,442,708.295	16,033,861.926	-0.402	0.688
C(State)[Tamil nadu]	33,242,064.019	15,957,581.528	2.083	0.039
C(State)[Uttar pradesh]	15,107,148.513	17,042,240.802	0.887	0.377
C(State)[West bengal]	-9,642,927.909	15,546,351.309	-0.620	0.537

Source: author's calculation

Goodness of Fit and overall fitness of model

- R-squared: 0.970518814
- Adjusted R-squared: 0.966235223
- F-statistic (model): 226.566635482
- Prob (F-statistic): 0.000000000 (displayed as 0.000)
- Number of observations: 135
- Degrees of freedom (model): 17
- Degrees of freedom (residual): 117

Using the above methodology, we get a statistically significant relation between urban connectivity and GSDP. The value of the coefficient (β) of length of national highway is 7,917.297. Now, as the P-value is less than 0.05, we will reject the null hypothesis and accept the alternative hypothesis i.e. there is positive and statistically significant relationship between length of national highway and GSDP. On the other hand, the value of coefficient of length of state highways is124.082. The p-value of this variable is also less than 0.05 which implies the probability of the null hypothesis for being true is less than 5%. So, null hypothesis can be rejected and positive relationship between length of state highways and GSDP is statistically proven. Moreover, the coefficient value of length of railway route is 51,784.322 with p-value less than 0.05. This implies the null hypothesis is rejected and the positive relationship between GSDP and length of railway route is statistically proven. The value of adjusted R square is 0.966 which shows the regressors can explain the model in 96.6% cases. The value of the F-statistics also suggests that the model is overall highly significant. Coefficients of many state dummies like Assam, Gujarat, Karnataka, Tamil Nadu show that road and railway infrastructure have positive impact on their GSDP than their reference state. On the other hand, roads and railway infrastructure of Kerala, Manipur have statistically significant negative on their GSDP than their reference states. Probably for these states geographical constraints and political instability couldn't translate the growth from urban connectivity.

Thus, it is empirically proved that urban connectivity has a positive impact on regional economic growth.The model confirms that improvements national highways and railwayare strongly associated with higher economic output (GSDP) across Indian states.

Conclusion

This study examines the impact of urban connectivity on regional economic growth in India by focusing on roads and railway connectivity. Collecting data from 15 states over the period of 2011–2019, and employing a fixed effect panel regression model, we analysed the relationship between indicators of urban connectivity—namely the length of railway routes, state highways, and national highways—and state-level economic performance. The results show robust evidence that development of transport infrastructure will have a positive and highly statistically significant effect on regional economic growth. Among the indicators considered, both highways and railways were found to be key drivers of growth. This implies that multimodal transport systems are necessary for sustained regional development.

From a policy perspective, these results underscore the critical role of infrastructure investment in stimulating economic activity and narrowing regional disparities. Strategic expansion and maintenance of road and rail networks can yield long-term growth dividends, particularly when integrated with policies promoting urbanization, industrialization and market access.Connecting

economies enables the integration of rural and urban economies and provides access points for regional development, alleviating spatial inequality.However, state specific conditions also matter a lot, meaning that infrastructure policies need to be complemented with broader regional development strategies for maximum impact. At last, but not the least, this research demonstrates that strengthening urban connectivity is not merely an infrastructural imperative but a vital economic strategy for accelerating inclusive and sustainable growth in India.

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Appendix

Table- 1.1

State	Year	NH_LENGTH	SH_LENGTH	RAIL_LENGTH	GSDP

Maharastra	2011	4191	410521	5602	128036944
Maharastra	2012	4257	396685	5602	135794185
Maharastra	2013	4498	228816	5725	145161464
Maharastra	2014	6249	279996	5725	154316487
Maharastra	2015	7048	288931	5725	165428361
Maharastra	2016	7435	289940	5745	180704575
Maharastra	2017	16239	342654	5784	188870619
Maharastra	2018	16239	363972	5733	195738075
Maharastra	2019	17757	365045	5819	204661365
Andhra pradesh	2011	4537	238001	5602	37940203
Andhra pradesh	2012	4537	256448	5602	38062901
Andhra pradesh	2013	5022	261657	5725	40711475
Andhra pradesh	2014	6590	178096	5725	44456428
Andhra pradesh	2015	4670	179022	5725	49860626
Andhra pradesh	2016	5465	174367	5745	54021177
Andhra pradesh	2017	6383	176474	5784	59473653
Andhra pradesh	2018	6383	218190	5733	62661420
Andhra pradesh	2019	6914	176351	5819	64981035
Assam	2011	2836	241789	2434	14317491
Assam	2012	2940	284232	2459	14734238
Assam	2013	2940	288135	2459	15452540
Assam	2014	3634	313621	2468	16521231
Assam	2015	3784	326512	2471	19110899
Assam	2016	3821	329520	2443	20208084
Assam	2017	3845	337777	2440	21991938
Assam	2018	3845	343609	2465	23103956
Assam	2019	3909	399122	2519	24070724
West bengal	2011	2578	299209	3937	52048504
West bengal	2012	2681	315404	4000	54219091
West bengal	2013	2681	309692	4037	55853544
West bengal	2014	2908	313750	4070	57436432
West bengal	2015	2910	295997	4070	60954479
West bengal	2016	2956	316730	4135	65341593
West bengal	2017	3004	322067	4139	69498050
West bengal	2018	3004	329126	4139	73892038
West bengal	2019	3665	283865	4230	76179371
Punjab	2011	1557	84193	2134	26662827
Punjab	2012	1557	93871	2156	28082285
Punjab	2013	1557	98442	2215	29944973
Punjab	2014	1699	104160	2269	31212533
Punjab	2015	2239	105368	2269	33005193
Punjab	2016	2769	108379	2269	35272056

Punjab	2017	3228	139492	2269	37540561
Punjab	2018	3228	142635	2269	39701889
Punjab	2019	3274	147862	2265	41329463
Gujarat	2011	3245	156188	5271	61560607
Gujarat	2012	4032	163149	5257	68265021
Gujarat	2013	3828	165640	5257	73428387
Gujarat	2014	4694	179063	5259	81142764
Gujarat	2015	4971	182287	5259	89446534
Gujarat	2016	4971	179144	5259	98134196
Gujarat	2017	5456	180927	5259	108656973
Gujarat	2018	5456	201742	5285	118301975
Gujarat	2019	6635	249373	5320	126527733
Karnataka	2011	4396	281773	3073	60600981
Karnataka	2012	4396	303128	3090	64303302
Karnataka	2013	4642	305448	3228	70446604
Karnataka	2014	6177	313184	3281	74842913
Karnataka	2015	6432	321808	3281	83132178
Karnataka	2016	6503	345515	3281	94177416
Karnataka	2017	6991	361041	3424	101972354
Karnataka	2018	6991	354505	3499	108510063
Karnataka	2019	7335	358300	3540	115139320
Uttar pradesh	2011	6744	390256	8763	72405044
Uttar pradesh	2012	7818	403102	8800	75820497
Uttar pradesh	2013	7818	435969	8832	80206969
Uttar pradesh	2014	7986	397224	8920	83443238
Uttar pradesh	2015	8483	415383	8950	90824133
Uttar pradesh	2016	8483	422412	9077	101150027
Uttar pradesh	2017	9017	428055	9167	105639893
Uttar pradesh	2018	9017	436333	10324	109735324
Uttar pradesh	2019	11737	442907	8823	114163019
Rajasthan	2011	5885	241318	5784	43483664
Rajasthan	2012	7130	248604	5822	45456434
Rajasthan	2013	7180	226124	5872	48623018
Rajasthan	2014	7646	241243	5870	52150893
Rajasthan	2015	7886	248156	5898	56333953
Rajasthan	2016	7906	254279	5893	59674551
Rajasthan	2017	8972	265599	5894	62802002
Rajasthan	2018	8972	313390	5929	64327828
Rajasthan	2019	10342	313469	5937	67831563
Tamil nadu	2011	4832	192339	4062	75148576
Tamil nadu	2012	4943	230200	3943	79182431
Tamil nadu	2013	4943	238004	4027	85197558

Tamil nadu	2014	4975	254205	4027	89391507
Tamil nadu	2015	5006	261100	4027	96756246
Tamil nadu	2016	4946	261035	4027	103676212
Tamil nadu	2017	5918	261436	4028	112579344
Tamil nadu	2018	5918	270007	4030	120466736
Tamil nadu	2019	6742	271137	4031	124383550
Himachal	2011	1409	47963	296	7271983
Himachal	2012	1506	50449	296	7738428
Himachal	2013	1506	53223	296	8284669
Himachal	2014	2196	54388	296	8906019
Himachal	2015	2466	55593	296	9627406
Himachal	2016	2642	55759	296	10305499
Himachal	2017	2643	62812	296	10940627
Himachal	2018	2643	61899	296	11641398
Himachal	2019	2607	73230	312	12122701
Madhya pradesh	2011	5027	197293	4955	31556159
Madhya pradesh	2012	5064	201261	4954	35168262
Madhya pradesh	2013	5116	228816	4955	36513394
Madhya pradesh	2014	5116	279996	4976	38394448
Madhya pradesh	2015	5184	288931	4979	41873574
Madhya pradesh	2016	5194	289940	5000	47066916
Madhya pradesh	2017	8053	342654	5113	49710165
Madhya pradesh	2018	8053	363972	4829	54327196
Madhya pradesh	2019	8772	365045	4899	56752504
Manipur	2011	959	19133	1	1291460
Manipur	2012	1317	19252	1	1299281
Manipur	2013	1317	20837	1	1411509
Manipur	2014	1452	21661	1	1524490
Manipur	2015	1746	24247	1	1642368
Manipur	2016	1746	24776	1	1708192
Manipur	2017	1746	27612	13	1875074
Manipur	2018	1746	29180	13	1826222
Manipur	2019	1750	32389	13	1918718
Jammu&kashmir	2011	1245	26980	256	7825555
Jammu&kashmir	2012	1245	36353	256	8076657
Jammu&kashmir	2013	1695	44597	256	8510179
Jammu&kashmir	2014	2319	39107	273	8237211
Jammu&kashmir	2015	2593	39096	298	9700134
Jammu&kashmir	2016	2601	49716	298	10020287
Jammu&kashmir	2017	2601	63386	298	10662414
Jammu&kashmir	2018	2601	108677	298	11506196
Jammu&kashmir	2019	2423	120034	298	11391908

Kerala	2011	1457	201220	1050	36404789
Kerala	2012	1457	215438	1050	38769346
Kerala	2013	1457	185030	1050	40278133
Kerala	2014	1700	193460	1050	41995555
Kerala	2015	1811	194854	1050	45121002
Kerala	2016	1812	200808	1045	48530154
Kerala	2017	1782	240562	1045	51618976
Kerala	2018	1782	257085	1045	55422831
Kerala	2019	1782	259932	1045	55919418

Source: Reserve Bank of India, Handbook of Statistics on Indian States, 2023-24

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