

The Status of Physical Infrastructure in Punjab: An Inter-District Analysis

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Abstract

The paper aimed to study the status of physical infrastructure in Punjab and to compare growth rates achieved by the districts of Punjab for 21 years i.e. from the period 1995-96 to 2015-16. For the purpose of study six variables of physical infrastructure are undertaken. Stepwise regression is used to carry out the results. The study found that the status of physical infrastructure in Punjab get better with the passage of time, except in case of number of post offices. The study revealed that the most significant variable affecting economic growth is number of banking offices, followed by number of motor vehicles registered and number of electric consumers. The study concluded that the government should carry out various new projects in order to increase the infrastructural facilities and ultimately to enhance the level of economic development.

Keywords: Physical infrastructure, Punjab, Growth, districts, economic development.

Infrastructure is generally an arrangement of interconnected basic components that provide the outline assistant to the whole structure. Infrastructure is a framework that included, but not limited to bridges, telephone services, electricity, transportation, water supply and so on (World Bank, 1994). The great accent should be placed on infrastructural facilities as these play a vital role in the process of development. It is impossible for any economy to grow without adequate and sound infrastructure. Infrastructure is considered to be a prerequisite to economic development of any nation; thus said to be the backbone of any economy. Infrastructural facilities are categorized into three types:

- Physical Infrastructure: it includes transportation, telecommunications, power, irrigation etc. and these are crucial for any economy to move autonomously.
- Social Infrastructure: it incorporates housing, education, health, sanitation and drinking water supply etc.; which represents the standard of living of human capital.
- Financial Infrastructure: it includes money market and capital market.

The present paper focuses on the status of physical infrastructure in Punjab. Physical Infrastructure refers to the basic physical infrastructure required for any economy to function and endure. Physical infrastructure is a comprehensive term and it embraces the facilities like electricity, piped gas, telecommunication, piped water, sanitation, sewerage system, solid waste collection, roads, railways, airports, seaports, irrigation etc. Physical infrastructure provides basic facilities for the smooth functioning of economic activities. Thus, physical infrastructure in terms of roads, transportation, communication and power have a significant role in promoting economic development by providing a base on which the various economic activities can be performed.

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Literature Review

In this section an attempt is made to review the studies dealing with the infrastructure and economic growth.

Prakash (1977) attempted to analyze the regional inequalities in terms of infrastructural facilities in India for the period of 20 years i.e. from 1951-1971. The study revealed that there were disparities in the states of India in terms of infrastructure and the regions with stronger infrastructural base have the potential to grow more rapidly as compared to others. Looney & Fredericksen (1981) tried to examine the effect of infrastructure on Gross Domestic Product in Mexico. The study found that for the intermediate region's economic overhead capital like public telephone, electrical generating capacity and surfaced road length had a significantly positive effect when GDP was taken as dependent on these variables. Ghosh & De (1998) examined the impact of public investments and physical infrastructure on both private investment behavior and regional development in the states from 1961-1995. The study found that there existed a positive and significant relationship between physical infrastructure and regional development of the states of India. Kumar and Singla (2013) analyzed the regional inter-state disparities to observe the pattern of economic performance across 15 major Indian states for pre-reform and post-reform period i.e. from 1980-81 to 2010-11. The study found that regional disparities had reduced in indicators such as Gross State Domestic Product growth rate, cash-deposit ratio, literacy rate and population growth rate from pre-reform period (1980-81) to post-reform period (2010-11). Bala (2017) made an attempt to study role of education, health and physical infrastructure in economic development of Punjab and Haryana from 1971 to 2012. The study found that the overall economic development index of the Punjab state is better than that of the Haryana state. The study showed that the education index of the Punjab has better performance than Haryana, yet the growth rate in the education index of the Punjab state is recorded negative as against the positive growth rate in the Haryana state.

Objectives of the study

- To study the status of physical infrastructure in Punjab for the period 1995-2016.
- To compare growth rates achieved by the districts of Punjab during the time period 1995-2016.
- To examine the inter-relationship between economic growth and physical infrastructure in Punjab.

Data and Methodology

Data on different variables used in the study have been obtained from various issues of Statistical Abstract of Punjab for 21 years i.e. from the period 1995-96 to 2015-16. For the purpose of the analysis the following variables have been included in the study:

- Per Capita Income at constant prices (Y)
- Net irrigated area to net area sown (X1)
- Number of motor vehicles registered (X2)
- Number of electricity consumers (X3)
- Roads length maintained by PWD (X4)
- Number of banking offices (X5)

- Number of post offices (X6)

Compound Growth Rate

Compound Growth Rate of these indicators for different districts of Punjab have been calculated by fitting the the exponential function of the type

$$Y_t = AB^t e^u$$

Where,

Growth rate =

Y= value of dependent variables

t=time variable

A & B = constants

Durbin –Watson Test

The Durbin-Watson test is a test statistic used to detect the presence of autocorrelation in the residuals from a regression analysis. The Durbin- Watson statistic is always between 0 and 4. The values toward 0 indicate +ve autocorrelation and value towards 4 indicate –ve autocorrelation.

$$DW = \frac{\sum_{t=2}^n (P_t - P_{t-1})^2}{\sum_{t=1}^n P_t^2}$$

Coefficient of Determination (R²)

Coefficient of determination which is ratio of explained variation to total variation in Y (Per capita income) i.e. dependent variable has also been computed. R² indicates the percent of variation. The formula for this is:

$$R = \frac{b \sum XY}{\sum Y^2}$$

Where, $b \sum XY$ is explained variations in Y

$\sum Y^2$ is total variations in Y

R² shows the goodness of fit. This means the value of R², better the fit.

t-test

To check whether the estimated parameters of regression equations and growth rates of different variables are significant or not, t-test of significance has been used. All parameters are tested at 5% or 0.05 level of significance with (n-k) degree of freedom.

Stepwise Regression Analysis

To study the impact of infrastructural indicators on per capita income, stepwise regression analysis has been used. Regression equations were fitted by regressing dependent variables on the independent variables. The regression equation is of following form:

$$Y_t = a + b X_t + U_t$$

Where, Y_t - Per Capita income at current prices in period t

a – intercept term

X_t - Independent variable

b- Regression Coefficient

U_t – Disturbance Term

The Status of Physical Infrastructure in Punjab

It is observed from table 1 that Net Irrigated area to net area sown (X1) was 3844 hectares in 1995-96, which increased to 4068 hectares in 2007-08 and in 2015-16, the Net Irrigated area to net area sown increased to 4137 hectares. During the study period the figures relating to irrigation facilities are showing increasing trend, which shows that irrigation is improving in Punjab and ultimately it is boon to agricultural produce at a large scale.

Source : Various Issues of Statistical Abstract of Punjab

In Power sector, it is clear from the table that number of electricity consumers in 1995-96 was 4508643, in the year 2007-08 there were 6231240 number of electric consumers and in 2015-16,

Table 1 Pattern of Various Infrastructural Indicators in Punjab (1995-96 to 2015-16)

Year	Net irrigated area to net area sown (hectares)-X1	No. of motor vehicles registered-X2	No. of electricity consumers-X3	Road length by PWD (Kms)-X4	No. of banking offices-X5	No. of post offices-X6
1995-1996	3844	1915059	4508643	39950	2345	3892
1996-1997	4022	2095619	4668348	39950	2409	3915
1997-1998	4004	2295917	4778805	39950	2478	3931
1998-1999	3950	2506519	4919458	42757	2523	3941
1999-2000	4001	2716630	5029990	44063	2564	3941
2000-2001	4021	2910233	5210917	45931	2582	3956
2001-2002	4057	3087207	5372863	50389	2613	3964
2002-2003	4035	3307804	5372863	51321	2657	3970
2003-2004	4028	3529100	5543462	51321	2686	3957
2004-2005	4035	3776106	5705745	51321	2737	3980
2005-2006	4019	4035164	5897583	51321	2815	3952
2006-2007	4072	4298962	6033633	55658	2940	3952
2007-2008	4068	4572579	6231240	57571	3051	3911
2008-2009	4064	4831331	6373890	59847	3320	3904
2009-2010	4071	5274254	6631407	61634	3580	3877
2010-2011	4070	5711715	6918145	63384	3823	3804
2011-2012	4086	6256808	7320637	67258	4231	3849
2012-2013	4115	6783614	7604645	68879	4726	3850
2013-2014	4141	7517683	7885077	68605	5413	3853
2014-2015	4118	8287500	8112285	70165	5887	3856
2015-2016	4137	9064476	8340358	70961	6210	3861

the number of electric consumers rose to 8340358. However in Transport sector, it is recorded that in Punjab road length maintained by PWD in 1995-96 was 39950 Kilometers, in 2007-08 it increased to 57571 Kilometers and which in 2015-16 was recorded 70961 Kilometers. The number of motor vehicles registered in Punjab was 1915059, which increased to 4572579 and number of registered motor vehicles was noted 9064476 in 2015-16. On the other hand in Banking sector, it is noticed that In Punjab the number of banking offices were 2345 in 1995-96, which rose to 3051 in 2007-08 and the number of banking offices was recorded 6210 in 2015-16. It is depicted from the table 1 that the number of banking offices is increasing, which indicates the good and strong sign of financial market.

In case of Post Offices in Punjab it is recorded that in 1995-96, the number of post offices in Punjab was 3892 and in 2007-08, the number of post offices increased to 3911; whereas the number of post offices declined to 3861 in 2015-16. The reason behind declining the number of post offices is that with the new emerging techniques such as internet facilities; of telecommunication the use Post Offices reduced.

Growth of Various Infrastructural Facilities in Punjab

Table 2 shows that growth rate of various indicators of physical infrastructure. It is clear from table 2 that the growth rate of net irrigated is highest in Rupnagar (1.607%), followed by Hoshiarpur (1.51%) and Gurdaspur (1.479%); while lowest growth rate is recorded in Ludhiana (0.002%), Fatehgarh Sahib (0.006%) and Kapurthala (0.021%). In number of motor vehicles registered the highest rank is bagged by Muktsar (27.24%), followed by SBS Nagar (26.42%), Moga (13.91%) and Fatehgarh Sahib (11.85); whereas Faridkot (1.19%), Firozpur (1.99%) and Sangrur (4.12%) were at the bottom. The highest rank in roads maintained by PWD, is bagged by Bathinda (15.53%), Mansa (14.34%) and SBS Nagar (12.94%); whereas Amritsar (-0.28%), Ludhiana (-0.77%) and Faridkot (-0.44%) recorded negative growth. In banking offices, Fatehgarh Sahib (5.02%) was at the top, followed by Moga (4.47%), Kapurthala (4.47%) and Muktsar (4.45%); on the other hand, Rupnagar (-0.64%), Firozpur (-0.97%) and Sangrur (-0.93%) showed the negative growth. In sale of electricity per consumer, Bathinda (3.71%) was at the top, followed by Moga (3.04%) and Muktsar (2.00%), while Gurdaspur (-0.47%) and Rupnagar (-1.06%) recorded negative growth.

Figures in parenthesis are respective t-values. Author's calculation

Interrelationship between economic growth and physical infrastructure in Punjab

For calculating the results of interrelationship between economic growth and physical

Table 2
Growth of Various Infrastructural Facilities in Punjab (1995-96 to 2015-16)

Districts	Net irrigated area to net area town (hectares)	No. of motor vehicles registered	Sale of Electricity per consumer	Road length by PWD (Km)	No. of banking offices
Gurdaspur	1.48 (7.09)	4.86 (1.93)	-0.47 (1.98)	2.06 (4.43)	1.98 (7.77)
Amritsar	0.041 (2.22)	4.70 (1.97)	0.88 (0.94)	-0.28 (-0.62)	1.69 (2.56)
Kapurthala	0.021 (2.07)	4.19 (1.72)	0.27 (0.36)	2.75 (13.22)	4.47 (17.98)
Jalandhar	0.037 (0.44)	4.71 (2.01)	1.74 (0.15)	2.41 (8.7)	3.84 (10.95)
SBS Nagar	0.566 (2.63)	26.42 (3.03)	1.97 (0.22)	12.94 (1.52)	3.24 (11.59)
Hoshiarpur	1.51 (6.31)	5.27 (2.15)	0.42 (0.45)	2.87 (10.83)	3.62 (8.95)
Rupnagar	1.607 (6.21)	3.23 (2.58)	-1.06 (0.84)	-0.77 (-1.58)	-0.64 (-0.83)
Ludhiana	0.002 (1.34)	5.06 (2.28)	1.78 (-0.17)	2.52 (15.58)	4.69 (15.66)
Firozpur	0.114 (2.02)	1.99 (0.83)	0.97 (0.82)	-0.44 (-0.69)	-0.97 (-2.2)
Faridkot	0.246 (2.54)	1.19 (0.42)	1.13 (-0.23)	1.04 (0.98)	2.34 (2.62)

Muknaar	0.159 (2.22)	27.24 (3.31)	2.00 (0.65)	15.53 (2.58)	4.45 (10.17)
Moga	0.143 (1.85)	13.91 (2.81)	3.04 (0.19)	14.34 (2.45)	4.47 (16.24)
Bathinda	0.181 (7.24)	4.81 (1.71)	2.71 (-0.71)	2.89 (18.86)	4.13 (9.79)
Mansa	0.189 (4.47)	9.49 (3.81)	2.26 (-0.32)	3.43 (0.55)	3.93 (11.64)
Sangrur	0.055 (0.92)	4.12 (1.63)	2.48 (-0.038)	1.48 (4.01)	-0.93 (-0.51)
Faridkot	0.268 (6.15)	4.33 (1.81)	1.57 (0.43)	1.90 (9.57)	3.07 (8.84)
Fatehgarh Sahib	0.006 (1.48)	11.83 (4.55)	0.93 (-0.175)	2.23 (9.83)	3.02 (10.17)

infrastructure in Punjab, Stepwise regression has been carried out. Per capita income has been considered as a variable of economic growth and above discussed six variables is taken under physical infrastructure. Table 3 shows the results show that the most significant variable of physical infrastructure affecting economic growth is number of banking offices (X5). It has found that number of banking offices has a significant positive effect on per capita income at constant prices. The regression coefficient (24.24) indicates that 1% increase in number of banking offices leads to 24.24 % increase in per capita income. The next to enter into model is number of motor vehicles registered (X2). It is observed that the value of R² has increased to 93.6% from 93.3%. Its regression coefficient (.003) is positive, indicates that one percent increase in X2 leads to 0.003 percent increase in per capita income. The third variable to enter into the model is number of electric consumers (X3), it results increase in the value of R² to 96.3%. The regression coefficient (0.48) indicates that one percent increase in X3 leads to 0.48 percent increase in per capita income. The other remaining variables have not been considered because of their non- significant effect on per capita income.

Where, Y= Per Capita Income at constant prices

X5= Number of banking offices

X2= Number of motor vehicles registered

Table 3

Sr. No.	Equation	Constant	X5	X2	X3	R ²	DW
1.	Y= P(X5)	-40430.055	24.248 (16.25)			.933	1.198
2.	Y=P(X5, X2)	-36.207.99	18.61 (2.80)	.003 (.870)		.936	1.229
3.	Y= P(X5, X2, X3)	-220632.583 (-4.25)	32.043 (5.019)	-0.32 (-3.097)	.048 (3.575)	.963	1.719

X3= Number of electricity consumers

Conclusion

It is observed from this study that the physical infrastructure variables improved during the study period. However, inter district disparities have been recorded which depicts that some

districts are having better infrastructural facilities as compare to the others.

From table 3 it is clear that the banking sector plays a vital role in economic development of the country, followed by number of motor vehicles registered and number of electric consumers.

Policy Implications

- The government should carry out various new infrastructure projects in order to increase the level of economic development
- Proper allocation of funds should be made in infrastructural sector in Five Years Plans.
- Policies and projects should be undertaken to encourage the infrastructural investment.
- The Government should promote PPP (Public Private Partnership) for infrastructural development in order to encourage and enhance the quality and quantum of infrastructural services.

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