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# An Empirical Study on Impact of Infrastructural Development on Social and Economic Growth in Indian States

Jonardan Koner[1*] Avinash Purandare[2] Akshay Dhume[3]

1. National Institute of Construction Management and Research (NICMAR), 25/1, Balewadi, Pune-411045, India. Tel.: 912066859128 Email: koner_123@yahoo.com

.2. National Institute of Construction Management and Research (NICMAR), 25/1, Balewadi, Pune-411045, India.

Tel.: 912066859103 Email: profpurandare@yahoo.com

3. Foundation for Liberal And Management Education, 150/7, Gat No. 1270, Lavale, Pune-412115, India.

Tel.: 919822160366 Email: akshay.dhume@yahoo.com

* E-mail of corresponding author: koner_123@yahoo.com

**Abstract**

The study attempts to draw a relationship between infrastructural development and socio-economic growth in India. It further tries to determine the magnitude of the impact of infrastructural investment on social and economic indicators. The study uses **panel regression technique** to measure the impact of infrastructural investment on social growth indicator, i.e., state-wise Mortality Rate per Thousand Population (MRPTP) and economic growth indicator, i.e., Per-capita Income (PCI) in Indian States. Panel regression technique helps incorporate both the cross-section and time-series aspects of the dataset. In order to analyze the difference in impact of the explanatory variables on the explained variables across states, the study uses **Fixed Effect Dummy Variable Model**. The conclusions of the study are that infrastructural investment has a desirable impact on social and economic development and that the impact is different for different states in India. We analyze time series data (annual frequency) ranging from 1987 to 2008. The study reveals that the infrastructural investment significantly explains the variation of social and economic indicators.

**Keywords:** Infrastructural Investment, Multiple Regression, Panel Regression Techniques, Socio-economic Development, Fixed Effect Dummy Variable Model

## 1. Introduction

Infrastructure plays a very important role in the growth process of an economy. Infrastructural development has been on the top of priority list for governments all over the world. Policymakers believe that appropriate infrastructural investment holds the key to social and economic development and growth. Economists, however, hold a mixed view about the consequences of infrastructural growth. One of the views about infrastructural investment is that high rate of infrastructure growth raises the level of productivity in the current period, and also leads to a higher potential level of output for the future. Infrastructural development also causes economies of scale, and scope that helps reduce costs. Thus, better infrastructure leads to better standard of living, healthcare facilities, sanitation, schooling, etc. Although, there are various definitions for infrastructure, the Rangarajan Committee has specified that infrastructure should have features that include high sunk cost, natural monopoly, non-rivalry in consumption and non-tradability of output. Highways, railways, ports, airports, telecom and power are classified as infrastructure.

The argument in opposition is that rapid infrastructural development leads to unbalanced form of development process. Consequently, some areas develop rapidly, whereas other areas remain underdeveloped. Population from underdeveloped areas move to developed areas imposing a burden on resources in these areas. This also leads to disparities in incomes, which in the long run can have a detrimental effect on the economy.

The study attempts to find out the impact of infrastructural development on the state-wise socio-economic growth in India and also to analyze the difference in impact among the selected sixteen states in India.

## 2. Literature Review

Infrastructure occupies a very important position in the growth process. A number of papers on infrastructural development and growth exist in economics literature. Aschauer (1989a, 1989b) study focuses on the 'core' infrastructure such as streets, highways, airports, mass transit, sewers, and water systems which are the important explanatory factors for the productivity of the economy. Eberts (1986, 1990) work at the regional level concludes that there is a positive relationship between infrastructural growth and economic development. Duffy-Deno and Eberts (1991) suggest that the regional infrastructural development has a positive role for the development of the economy. Eisner (1991) determined a direct relationship between regional infrastructural development and economic growth. Feltenstein and Ha (1995) studied the relationship between infrastructure and private output in 16 sectors for Mexico and found that the availability of better quality infrastructure in electricity and communication generally reduces the cost of production, but that transportation infrastructure tends to increase the costs of production.

In the Indian context, Jha and Sahni (1992) examined the efficiency of the most important infrastructure facilities like gas, electricity and railways sectors by estimating trans-log cost functions. Raghuraman (1995) observed that the Indian infrastructural sectors are having problems in growing according to the actual need. Sankaran (1995) concluded that the development of infrastructure in India faced problems for the last decade. Nair (1995) pointed out the problems faced by telecommunication sector in India. Similarly Purkayastha and Ghosh (1997), Ramanathan (1997) and Shah (1997) also highlighted the problems related to various infrastructural sectors in India. Shalini, et. al. (2009) and Escobal (2001) promote that infrastructure development, where importance is given to development of roads, suggesting that it helps development by increasing efficiency and reducing poverty. Sharma, et. al. (2008) on the other hand, while analyzing the impact of industrialization on development in Himachal Pradesh observed that industrialization has no significant impact on economic and social development.

## 3. Methodological Approach

The study applies the econometric approach of fixed effect panel regression model or, least square dummy variable panel regression model to examine the impact of infrastructural development on socio-economic growth for states in India. The selected social indicator for the study is the Mortality Rate per Thousand Population (MRPTP) and economic indicator is Per-capita Income (PCI). Similarly, the selected infrastructural indicators are investment in Power (INVPOWER), Transport & Communication (INVTRANS), Water Supply & Sanitation (INVWATER) and Irrigation (INVIRRI). We consider 16 major states in India, viz. Andhra Pradesh (AP), Assam, Bihar, Gujarat, Haryana, Himachal Pradesh (HP), Karnataka, Kerala, Madhya Pradesh (MP), Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu (TN), Uttar Pradesh (UP), and West Bengal (WB).

The time period for the panel regression analysis is 1987-2008. Data have been collected from the online data services like EIS (Economic Intelligence Service), Prowess, IAS (Industry Analysis Service) and Reserve Bank of India website. The data are annual in frequency. The dependent variables are the state-wise Mortality Rate per Thousand Population (MRPTP) and Per-capita Income (PCI). The explanatory variables are the monetary volume of investment in the selected four infrastructural indicators, i.e., Power, Transport and Communication, Water Supply & Sanitation and Irrigation. In order to examine the pattern of impact on different selected states, we have considered dummy variables against the states. Since we have sixteen states, we have used only fifteen dummies to avoid falling into the dummy-variable trap, i.e., the situation of perfect collinearity. Here, there is no dummy for the state Andhra Pradesh (A.P.) and the rest fifteen dummies are: d2- Assam, d3- Bihar, d4- Gujarat, d5- Haryana, d6- Himachal Pradesh (HP), d7- Karnataka, d8- Kerala, d9- Madhya Pradesh (MP), d10- Maharashtra, d11- Orissa, d12- Punjab, d13- Rajasthan, d14- Tamil Nadu (TN), d15- Uttar Pradesh (UP) and d16- West Bengal (WB). By using software package SPSS and EVIEWS, the entire data set has been checked for multicollinearity, stationarity and structural break and corresponding usual econometric tests have been performed.

### *3.1 Panel Data Set Structure*

Panel data sets generally include sequential blocks or cross-sections of data, within which resides a time series for each block. A typical panel data set, including states, year, Mortality Rate per Thousand Population (MRPTP) and four infrastructural indicators (INVPOWER, INVTRANS, INVWATER & INVIRRI) from 1987 to 2008 is given in the appendix (Table 01).

The data structure confers upon the variables of two dimensions. It has a cross-sectional unit of observations, which in this case is infrastructural investment i, and a temporal reference t, in this case the year. There are four infrastructural indicators and twenty-two years as time points. There are no missing values and the data set is a balanced panel structure.

The formulation of the model assumes that differences across the states can be measured in differences in the constant terms. In the model, each $\alpha_i$ is treated as an unknown parameter to be estimated. Let Yi and Xi be the dependent and explanatory variables respectively, i be a T x 1 column of ones and $e_i$ is the error term, then the particular type of fixed effect panel regression equation is as follows.

$Yi = Xi\,\beta + i\alpha_i + e_i$

Collecting these terms gives $Y = [X\ d_1 \quad d_2 \quad d_3 \ldots\ldots\ldots d_n]\begin{bmatrix}\alpha \\ \beta\end{bmatrix} + e$

Where, $d_i$ is a dummy variable indicating the ith unit. Let the nT x n matrix $D = [d_1 \quad d_2 \quad d_3 \ldots\ldots\ldots d_n]$, $\alpha_i$ the coefficient of dummy variable (intercept part of the equation) and β (slope vector) be the coefficient of explanatory variables. Then, assembling all nT rows gives

$Y = X\,\beta + D\,\alpha + e$

This model is usually referred to as the Least Square Dummy Variable (LSDV) model.

*3.2 Model 01 (MRPTP as Dependent Variable)*

As a first step, Lagrange Multiplier Test is used to identify whether the Ordinary Least Square Estimates without group dummy variables or Fixed / Random Effect Estimates are appropriate. The null hypothesis in the LM test is that variances across entities are zero. There is no significant difference across units, i.e., no panel effect. Breusch and Pagan Lagrangian multiplier test is used here.

MRPTP [states, t] = Xb + u[states] + e[states, t]

Estimated results:

| | Var | sd = sqrt(Var) |
|---|---|---|
| MRPTP | 11.052380 | 3.324512 |
| e | 3.618901 | 1.902341 |
| u | 2.744797 | 1.656743 |

Test: Var(u) = 0

chi2(1) = 12.14

Prob > chi2 = 0.0000

The LM test statistic of 12.14 exceeds 3.64, which is the 95 percent critical value for chi-squared with fifteen degree of freedom. At this point, we conclude that the Ordinary Least Square Estimates without group dummy variables is not appropriate for the dataset. Hence, we reject the null hypothesis and accept that Fixed / Random Effect Estimates are appropriate.

After this, we used the Hausman test statistic to test whether it follows Fixed Effect or Random Effect model.

Test: Ho: difference in coefficients not systematic

chi2 (6) = (b-B)'[(V_b-V_B) ^ (-1)](b-B) = 8.96

Prob>chi2 = 0.1272

(V_b-V_B is not positive definite)

The test statistic is 8.96. The critical value from the chi-squared with fifteen degree of freedom is 7.2, which is smaller than the test value. So, the hypothesis that difference in coefficients is not systematic is rejected. Therefore, we conclude that the fixed effect model is the better choice. The Fixed Effect Model introduces dummy variables to account for any discrimination in the impact on the social and economic indicators, i.e., Mortality Rate per Thousand Population (MRPTP) and Per-capita Income (PCI). So, here we used fixed effect panel model, which has constant slopes but differing intercepts according to the cross-section unit, i.e., monetary volume of investment of selected four infrastructural indicators. The names of the dummy variables are the corresponding states' names or d2, d3, d4, ………, d15 & d16, and same as four explanatory variables.

So the final fixed effect panel regression equation no. 1 is as follows.

MRPTP = $\beta_1$ INVPOWER + $\beta_2$ INVTRANS + $\beta_3$ INVWATER + $\beta_4$ INVIRRI + $\alpha_1$ + $\alpha_2$ Assam + $\alpha_3$ Bihar + $\alpha_4$ Gujarat + $\alpha_5$ Haryana + $\alpha_6$ HP + $\alpha_7$ Karnataka + $\alpha_8$ Kerala + $\alpha_9$ MP + $\alpha_{10}$ Maharashtra + $\alpha_{11}$ Orissa + $\alpha_{12}$ Panjab + $\alpha_{13}$ Rajasthan + $\alpha_{14}$ TN + $\alpha_{15}$ UP + $\alpha_{16}$ WB

Or,

MRPTP = $\beta_1$ INVPOWER + $\beta_2$ INVTRANS + $\beta_3$ INVWATER + $\beta_4$ INVIRRI + $\alpha_1 + \alpha_2 d_2 + \alpha_3 d_3 + \alpha_4 d_4 + \alpha_5 d_5 + \alpha_6 d_6 + \alpha_7 d_7 + \alpha_8 d_8 + \alpha_9 d_9 + \alpha_{10} d_{10} + \alpha_{11} d_{11} + \alpha_{12} d_{12} + \alpha_{13} d_{13} + \alpha_{14} d_{14} + \alpha_{15} d_{15} + \alpha_{16} d_{16}$

Where, $\alpha_1$ represents the intercept of Andhra Pradesh (AP), and $\alpha_2$, $\alpha_3$, ……, $\alpha_{15,}$ $\alpha_{16}$ are the differential intercept coefficients, which indicate that how much the intercepts of Assam, Bihar, Gujarat, Haryana, Himachal Pradesh (HP), Karnataka, Kerala, Madhya Pradesh (MP), Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu (TN), Uttar Pradesh (UP), and West Bengal (WB) differ from the intercept of Andhra Pradesh (AP). d2, d3, …, d16 are fifteen dummy variables against fifteen states. MRPTP is the Mortality Rate per Thousand Population (Dependent Variable). INVPOWER, INVTRANS, INVWATER and INVIRRI are the monetary volume of infrastructural investment to the selected four infrastructural indicators (Explanatory Variables).

*3.3 Model 02 (PCI as Dependent Variable)*

In the similar way, we used Lagrange Multiplier Test to identify whether the Ordinary Least Square Estimates without group dummy variables or Fixed / Random Effect Estimates are appropriate. Here, the null hypothesis in the LM test is that variances across entities are zero. There is no significant difference across units, i.e., no panel effect. Breusch and Pagan Lagrangian multiplier test is used here.

PCI [states, t] = Xb + u[states] + e[states, t]

Estimated results:

| | Var | sd = sqrt(Var) |
|---|---|---|
| PCI | 7.158369 | 2.675513 |
| e | 2.057879 | 1.434531 |
| u | 3.375843 | 1.837347 |

Test: Var(u) = 0

chi2(1) = 9.34

Prob > chi2 = 0.0000

The LM test statistic of 9.34 exceeds 3.64, which is the 95 percent critical value for chi-squared with fifteen degree of freedom. At this point, we conclude that the Ordinary Least Square Estimates without group dummy variables is not appropriate for the dataset. Hence, we reject the null hypothesis and accept that Fixed / Random Effect Estimates are appropriate.

After this, we used the Hausman test statistic to test whether it follows Fixed Effect or Random Effect model.

Test: Ho: difference in coefficients not systematic

chi2 (6) = (b-B)'[(V_b-V_B) ^ (-1)](b-B) = 7.56

Prob>chi2 = 0.2237

(V_b-V_B is not positive definite)

The test statistic is 7.56. The critical value from the chi-squared table with fifteen degree of freedom is 7.2, which is smaller than the test value. So, the hypothesis that difference in coefficients is not systematic is rejected. Therefore, we conclude that the fixed effect model is the better choice. The Fixed Effect Model introduces dummy variables to account any discrimination in the impact on the economic indicator, i.e., Per-capita Income (PCI). So, here we used fixed effect panel model, which has constant slopes but differing intercepts according to the cross-section unit, i.e., monetary volume of investment of selected four infrastructural indicators. Here also the names of the dummy variables are the corresponding states' names or d2, d3, d4, ………, d15 & d16, and same as four explanatory variables.

So the final fixed effect panel regression equation no. 2 is as follows.

PCI = $\beta_1$ INVPOWER + $\beta_2$ INVTRANS + $\beta_3$ INVWATER + $\beta_4$ INVIRRI + $\alpha_1$ + $\alpha_2$ Assam + $\alpha_3$ Bihar + $\alpha_4$ Gujarat + $\alpha_5$ Haryana + $\alpha_6$ HP + $\alpha_7$ Karnataka + $\alpha_8$ Kerala + $\alpha_9$ MP + $\alpha_{10}$ Maharashtra + $\alpha_{11}$ Orissa + $\alpha_{12}$ Panjab + $\alpha_{13}$ Rajasthan + $\alpha_{14}$ TN + $\alpha_{15}$ UP + $\alpha_{16}$ WB

Or,

PCI = $\beta_1$ INVPOWER + $\beta_2$ INVTRANS + $\beta_3$ INVWATER + $\beta_4$ INVIRRI + $\alpha_1 + \alpha_2 d_2 + \alpha_3 d_3 + \alpha_4 d_4 + \alpha_5 d_5 + \alpha_6 d_6 + \alpha_7 d_7 + \alpha_8 d_8 + \alpha_9 d_9 + \alpha_{10} d_{10} + \alpha_{11} d_{11} + \alpha_{12} d_{12} + \alpha_{13} d_{13} + \alpha_{14} d_{14} + \alpha_{15} d_{15} + \alpha_{16} d_{16}$

Where, $\alpha_1$ represents the intercept of Andhra Pradesh (AP), and $\alpha_2$, $\alpha_3$, ……, $\alpha_{15,}$ $\alpha_{16}$ are the differential intercept coefficients, which indicate that how much the intercepts of Assam, Bihar, Gujarat, Haryana, Himachal Pradesh (HP), Karnataka, Kerala, Madhya Pradesh (MP), Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu (TN), Uttar Pradesh (UP), and West Bengal (WB) differ from the intercept of Andhra Pradesh (AP). d2, d3, …, d16 are fifteen dummy variables against fifteen states. PCI is state-wise Per-capita Income (Dependent Variable). INVPOWER, INVTRANS, INVWATER and INVIRRI are the monetary volume of investment to the selected four infrastructural indicators (Explanatory Variables).

## 4. Empirical Results and Discussions: Least Squares Dummy Variable (LSDV) Panel Regression Model

*4.1 Panel Regression Equation (Model 01: MRPTP as Dependent Variable)*

The estimated panel regression equation is as follows.

MRPTP = -0.25*INVPOWER - 0.65*INVTRANS - 0.49*INVWATER - 0.29*INVIRRI + 12.50 + 0.34*D2 + 0.67*D3 - 1.25*D4 - 1.91*D5 - 5.45*D6 - 4.23*D7 - 2.512*D8 - 2.24*D9 - 2.51*D10 - 2.34*D11 - 3.37*D12 + 0.73*D13 - 0.21*D14 + 4.54*D15 - 1.24*D16………… (1)

 

Dependent Variable: MRPTP

Method: Least Squares

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| INVPOWER | -0.250459 | 0.000213 | -2.541364 | 0.0022 |
| INVTRANS | -0.646532 | 0.000356 | -4.352597 | 0.0000 |
| INVWATER | -0.491432 | 0.001433 | -1.932154 | 0.0100 |
| INVIRRI | -0.290235 | 0.000342 | -1.966559 | 0.0096 |
| C | 12.501262 | 0.100592 | 3.253102 | 0.0000 |
| D2 | 0.339316 | 0.312413 | -0.676695 | 0.6642 |
| D3 | 0.672376 | 0.244484 | 0.977697 | 0.5661 |
| D4 | -1.253534 | 0.269332 | -0.323723 | 0.2920 |
| D5 | -1.914011 | 0.225275 | -3.244292 | 0.0032 |
| D6 | -5.446843 | 0.241292 | -5.549454 | 0.0000 |
| D7 | -4.234343 | 0.386343 | -6.314333 | 0.0000 |
| D8 | -2.522333 | 0.282622 | -6.755786 | 0.0000 |
| D9 | -2.235393 | 0.393183 | -4.333203 | 0.0000 |
| D10 | -2.512202 | 0.332133 | -4.541722 | 0.0000 |
| D11 | -2.343333 | 0.636163 | -4.489474 | 0.0000 |
| D12 | -3.369133 | 0.240252 | -3.834133 | 0.0000 |
| D13 | 0.734341 | 0.312221 | 2.548576 | 0.0011 |
| D14 | -0.212992 | 0.383483 | -1.682622 | 0.1361 |
| D15 | 4.542287 | 0.213573 | 5.242533 | 0.0000 |
| D16 | -1.242123 | 0.504123 | -2.714467 | 0.0094 |
| R-squared | 0.655723 | Mean dependent var | | 14.18626 |
| Adjusted R-squared | 0.643345 | S.D. dependent var | | 3.185716 |
| S.E. of regression | 1.905961 | Akaike info criterion | | 4.191083 |
| Sum squared resid | 1140.663 | Schwarz criterion | | 4.441013 |
| Log likelihood | -682.1020 | F-statistic | | 29.61445 |
| Durbin-Watson stat | 1.973205 | Prob(F-statistic) | | 0.000000 |

Here most of the estimated coefficients are individually significant, as their p values of the estimated t coefficients are small. The estimated coefficients of the explanatory variable INVPOWER, INVTRANS, INVWATER and INVIRRI are individually significant at 1 % level (two tailed test). All the coefficients of explanatory variables are negative, which indicates that if the infrastructural investment increases then the mortality rate will deceases. The coefficients of dummy variables give the intercept values which are statistically different for different states and the coefficient values are **12.50** for Andhra Pradesh (AP), **12.84** (12.50 + 0.34) for Assam, **13.17** (12.50 + 0.67) for Bihar, **11.25** (12.50 - 1.25) for Gujarat, **10.59** (12.50 - 1.91) for Haryana, **7.05** (12.50 - 5.45) for Himachal Pradesh (H.P.), **8.27** (12.50 - 4.23) for Karnataka, **9.98** (12.50 - 2.52) for Kerala, **10.26** (12.50 - 2.24) for Madhya Pradesh (M.P.), **9.99** (12.50 – 2.51) for Maharashtra, **10.16** (12.50 - 2.34) for Orissa, **9.13** (12.50 - 3.37) for Punjab, **13.23** (12.50 + 0.73) for Rajasthan, **12.29** (12.50 - 0.21) for Tamil Nadu (T.N.), **17.04** (12.50 + 4.54) for Uttar Pradesh (U.P.), **11.26** (12.50 - 1.24) for West Bengal (W.B.). So, according to the estimated results, relatively higher impacts of infrastructural development on mortality rate are for the states of Tamil Nadu, Rajasthan, Bihar and Assam. The states of Himachal Pradesh and Karnataka have got the least impact. The value of R-squared is 0.66, which means that the explanatory variables explain the dependent variable near about 66 %. The Durbin-Watson Statistic is 1.97, which indicates that there is no autocorrelation in the dataset.

*4.2 Panel Regression Equation (Model 02: PCI as Dependent Variable)*

The estimated panel regression equation is as follows.

PCI = 0.85*INVPOWER + 0.93*INVTRANS + 0.67*INVWATER + 0.43*INVIRRI + 10.25 + 2.29*D2 + 1.23*D3 + 3.24*D4 - 1.11*D5 - 1.14*D6 + 3.27*D7 - 1.43*D8 + 1.23*D9 + 5.55*D10 - 2.39*D11 - 1.32*D12 + 1.71*D13 +

 

4.24*D14 + 2.52*D15 + 2.26*D16………… (2)

Dependent Variable: PCI

Method: Least Squares

| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
|---|---|---|---|---|
| INVPOWER | 0.853423 | 0.003278 | 2.949378 | 0.0002 |
| INVTRANS | 0.932576 | 0.004334 | 3.382134 | 0.0000 |
| INVWATER | 0.674162 | 0.002465 | 1.535144 | 0.0114 |
| INVIRRI | 0.430277 | 0.004349 | 1.863522 | 0.0129 |
| C | 10.251765 | 0.220522 | 2.753557 | 0.0000 |
| D2 | 2.292131 | 0.012010 | 0.776764 | 0.5652 |
| D3 | 1.232345 | 0.041481 | 1.917611 | 0.1631 |
| D4 | 3.235337 | 0.161331 | 0.723113 | 0.1921 |
| D5 | -1.113088 | 0.025002 | -3.211232 | 0.0002 |
| D6 | -1.141812 | 0.141221 | -2.246456 | 0.0000 |
| D7 | 3.266347 | 0.286141 | 5.313338 | 0.0000 |
| D8 | -1.432311 | 0.182121 | -4.752281 | 0.0000 |
| D9 | 1.231323 | 0.113121 | 5.343222 | 0.0000 |
| D10 | 5.552255 | 0.032100 | 5.571788 | 0.0000 |
| D11 | -2.387311 | 0.136263 | -3.439271 | 0.0000 |
| D12 | -1.319133 | 0.140252 | -3.13411 | 0.0000 |
| D13 | 1.714311 | 0.112421 | 3.548321 | 0.0001 |
| D14 | 4.242942 | 0.083421 | 3.632633 | 0.0000 |
| D15 | 2.522282 | 0.113173 | 3.232577 | 0.0000 |
| D16 | 2.262166 | 0.104323 | 4.744411 | 0.0000 |
| R-squared | 0.772711 | Mean dependent var | | 11.13623 |
| Adjusted R-squared | 0.753389 | S.D. dependent var | | 2.125212 |
| S.E. of regression | 1.405464 | Akaike info criterion | | 5.151056 |
| Sum squared resid | 101.612 | Schwarz criterion | | 5.410132 |
| Log likelihood | 182.1432 | F-statistic | | 22.624235 |
| Durbin-Watson stat | 1.878285 | Prob(F-statistic) | | 0.000000 |

Here also most of the estimated coefficients are individually significant, as their p values of the estimated t coefficients are small. The estimated coefficients of the explanatory variable INVPOWER, INVTRANS, INVWATER and INVIRRI are individually significant at 1 % level (two tailed test). All the coefficients of explanatory variables are positive, which indicates that if the infrastructural investment increases then the per-capita income will increases. The coefficients of dummy variables give the intercept values which are statistically different for different states and the coefficient values are **10.25** for Andhra Pradesh (AP), **12.54** (10.25 + 2.29) for Assam, **11.48** (10.25 + 1.23) for Bihar, **13.49** (10.25 + 3.24) for Gujarat, **9.14** (10.25 - 1.11) for Haryana, **9.11** (10.25 - 1.14) for Himachal Pradesh (H.P.), **13.52** (10.25 + 3.27) for Karnataka, **8.82** (10.25 -1.43) for Kerala, **11.48** (10.25 + 1.23) for Madhya Pradesh (M.P.), **15.80** (10.25 + 5.55) for Maharashtra, **7.86** (10.25 - 2.39) for Orissa, **8.93** (10.25 - 1.32)for Punjab, **11. 96** (10.25 + 1.71) for Rajasthan, **14. 49** (10.25 + 4.24) for Tamil Nadu (T.N.), **12.77** (10.25 + 2.52) for Uttar Pradesh (U.P.) and **12.51** (10.25 + 2.26) for West Bengal (W.B.). So, according to the estimated results, relatively higher impacts of infrastructural development on per-capita income are for the states of Maharashtra, Tamil Nadu, Karnataka and Gujarat. The states of Orissa and Kerala have got the least impact. The value of R-squared is 0.77, which means that the explanatory variables explain the dependent variable near about 77 %. The Durbin-Watson Statistic is 1.88, which indicates that there is no autocorrelation in the dataset.

## 5. Concluding Observations

The study is conducted for investigating the impact of infrastructural development on the social and economic growth indicators, i.e., the state-wise mortality rate per thousand populations and per-capita income in India. The impacts on social and economic indicators are examined on the basis of panel regression technique to incorporate both the cross sectional and time dimensions. The study reveals that the infrastructural development has played a significant role in the reduction of mortality rate per thousand populations in Indian States and also has played a great role to increase per-capita income in Indian States. The estimated coefficients of the explanatory variables are significant at 1% (two tailed test) indicating the constructive role of infrastructural development on the mortality rate and per-capita income. The direct impact of the infrastructural investment is confirmed by the sign of the explanatory variables. In model 01, the sign of estimated coefficients are negative, which indicates that if we increase the investment in infrastructure then the mortality rates will decrease. Similarly, in the model 02, the sign of estimated coefficients are positive, which indicates that if we increase the investment in infrastructure then the per-capita income will also increase. However, the estimated results also indicate the bias of impact of the infrastructural development on the reduction of the death rate among the selected sixteen states in India and also indicate the differences of per-capita income among selected states. The study undertaken for a reasonably long period of time does reveal a disparity in the impact on social and economic indicators, i.e., mortality rate and per-capita income. However, the scope for future research remains on the investigation of the specific strategy followed, if any, by the Government and the possible impact it could have on the overall reduction on the death rate in the states of the country.

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Dr. Jonardan Koner earned his Ph.D. at the Jadavpur University, Kolkata, India. Currently he is Senior Associate Professor of Economics at National Institute of Construction Management and Research, Pune, India. He is author/co-author of five books. He has published fourteen research papers in peer-reviewed journals/edited volumes, and presented more than twenty-five research papers in conferences in India and abroad including lCBEF at Paris, France & IABE at the Ca' Foscari University of Venice, Italy. He has done several research projects in academics and also for industry. He is a visiting faculty at several national universities.

Prof. Avinash Purandare is pursuing his Ph.D. at the University of Pune, India. Currently he is an Associate Professor of International Business at National Institute of Construction Management and Research, Pune, India.
He is author of two books. He has published several research papers in reputed national and international journals/edited volumes and presented many research papers in conferences in India and abroad including IABE at the Ca' Foscari University of Venice, Italy. He has done several research projects and consultancy for the industry. He is a visiting faculty at several national and international institutes.

Prof. Akshay Dhume is Assistant Professor of Economics at the Foundation for Liberal And Management Education, Pune, India. He has Bachelors in Mathematics and Masters in Economics from University of Pune, and Masters in Economics (Applied Economics) from State University of New York. He has presented papers at national and international level conferences, and has published in journals and edited volumes.

 

**Appendix**

Table 01: Panel Data Structure

| YEAR | STATE | MRPTP | INVPOWER | INVTRANS | INVWATER | INVIRRI |
|---|---|---|---|---|---|---|
| 1987 | AP | . | . | . | . | . |
| 1988 | AP | . | . | . | . | . |
| . | . | . | . | . | . | . |
| 2007 | AP | . | . | . | . | . |
| 2008 | AP | . | . | . | . | . |
| . | . | . | . | . | . | . |
| . | . | . | . | . | . | . |
| 1987 | MP | . | . | . | . | . |
| 1988 | MP | . | . | . | . | . |
| . | . | . | . | . | . | . |
| 2007 | MP | . | . | . | . | . |
| 2008 | MP | . | . | . | . | . |
| . | . | . | . | . | . | . |
| . | . | . | . | . | . | . |
| 1987 | WB | . | . | . | . | . |
| 1988 | WB | . | . | . | . | . |
| . | . | . | . | . | . | . |
| 2007 | WB | . | . | . | . | . |
| 2008 | WB | . | . | . | . | . |