

## **Social sector expenditure, economic growth, and multidimensional poverty in India: evidence from panel data analysis**

**Balaram ROULA**

Pondicherry University, India  
roulabalaram1993@pondiuni.ac.in

**Dr. N. KUBENDRAN**

Pondicherry University, India  
Kubendran.eco@pondiuni.ac.in

**Abstract.** *This study examines the impact of education expenditure, health expenditure, and Gross State Domestic Product (GSDP) on the Multidimensional Poverty Index (MPI) across selected Indian states during 2000–01 to 2022–23. The empirical analysis employs panel data techniques including Fixed Effect, Random Effect, Hausman specification test, and Driscoll–Kraay Fixed Effect estimator using an unbalanced panel dataset of 322 observations. The findings reveal that health expenditure has a negative and statistically significant effect on multidimensional poverty, indicating that higher public healthcare expenditure reduces deprivation across states. In contrast, GSDP shows a positive and significant relationship with MPI, suggesting that economic growth alone may not reduce poverty without inclusive development policies. However, education expenditure was found to be statistically insignificant during the study period. The study emphasizes the importance of strengthening social sector expenditure, particularly healthcare investment, for achieving inclusive and sustainable development across Indian states.*

**Keywords:** Multidimensional Poverty Index, Health Expenditure, Education Expenditure, GSDP, Panel Data, Driscoll–Kraay Estimator, Indian States.

**JEL Classification:** I32, H51, H52, O47.

## 1. Introduction

Multidimensional poverty has emerged as one of the major developmental challenges in both developing and underdeveloped economies. Unlike income poverty, multidimensional poverty reflects deprivation in various aspects of human life such as education, health, living standards, sanitation, housing, and access to basic services. The Multidimensional Poverty Index (MPI), developed by the United Nations Development Programme (UNDP) and Oxford Poverty and Human Development Initiative (OPHI), has become an important indicator for measuring the intensity and extent of deprivation among households. In recent years, policymakers and researchers have increasingly emphasized that economic growth alone is insufficient to reduce poverty unless supported by effective social sector expenditure and inclusive development policies.

India has experienced significant economic growth during the post-reform period, accompanied by substantial increases in Gross State Domestic Product (GSDP). However, despite rapid economic expansion, multidimensional poverty continues to persist across several Indian states due to unequal access to healthcare, education, sanitation, nutrition, and social welfare services. Considerable interstate disparities remain visible in poverty reduction and human development outcomes. States with better social infrastructure and welfare expenditure have generally performed better in reducing poverty compared to economically backward states.

Public expenditure on the social sector, particularly education and health expenditure, plays a crucial role in improving welfare conditions and reducing multidimensional deprivation. According to Wagner's theory of public expenditure, government expenditure tends to increase with economic development due to rising welfare and social needs. Similarly, endogenous growth theories highlight the importance of investment in human capital through education and healthcare for achieving long-term socio-economic development. Expenditure on health improves productivity, life expectancy, and quality of life, while education expenditure contributes to literacy, skill development, and employment generation.

Several empirical studies have examined the relationship between social sector expenditure and poverty reduction in India. Goswami and Bezbaruah (2011) found that social sector expenditure positively contributes to human development outcomes across Indian states. Agarwal (2015) observed that public expenditure on education and health significantly improves welfare indicators and reduces regional disparities. Reddy and Reddy (2019) concluded that expenditure on health, education, and welfare programmes contributes toward poverty reduction and human development improvement in India. Similarly, Das, Mandal, and Patra (2021) identified a long-run relationship between social sector expenditure and developmental outcomes across Indian states.

Although numerous studies have examined the relationship between social sector expenditure and human development, limited studies have specifically analysed the impact of education expenditure, health expenditure, and economic growth on multidimensional poverty across Indian states using robust panel data estimation techniques. Further, many earlier studies did not adequately address econometric issues such as heteroskedasticity, autocorrelation, and cross-sectional dependence in panel datasets.

In this context, the present study attempts to examine the impact of education expenditure, health expenditure, and Gross State Domestic Product on Multidimensional Poverty Index across selected Indian states during the period 2000–01 to 2022–23. The study employs panel data estimation techniques including Fixed Effect, Random Effect, Hausman specification test, and Driscoll–Kraay Fixed Effect estimator to obtain robust and reliable empirical estimates. The findings of the study are expected to provide important policy implications regarding the role of social sector expenditure in reducing multidimensional poverty and promoting inclusive development across Indian states.

## 2. Review of Literature

A large number of empirical studies have examined the relationship between social sector expenditure, economic growth, and poverty reduction in both developed and developing economies. In the Indian context, social sector expenditure has increasingly been recognised as an important instrument for improving welfare conditions, reducing deprivation, and promoting inclusive development. Public expenditure on education, health, sanitation, nutrition, and welfare programmes plays a significant role in enhancing human capabilities and reducing multidimensional poverty across states.

Goswami and Bezbaruah (2011) analysed the impact of social sector expenditure on Human Development Index (HDI) across Indian states during the post-reform period. The study found that although social expenditure increased over time, interstate differences in human development were influenced more by per capita income than by expenditure itself. Agarwal (2015) examined the relationship between social sector expenditure and human development in India and observed that education and health expenditure positively influenced development outcomes, though interstate disparities remained persistent. Similarly, Mittal (2016) argued that higher per capita social sector expenditure significantly improved HDI across Indian states, particularly in states such as Kerala and Tamil Nadu which consistently invested more in health and education.

Reddy and Reddy (2019) employed Tobit regression analysis to study the impact of social sector expenditure on human development in India. The findings revealed that expenditure on education, healthcare, sanitation, housing, nutrition, and welfare programmes positively contributed toward improving human development indicators. Likewise, Dutt, Das, and De (2023) observed that increased social sector expenditure improved education, healthcare, and living standards, thereby contributing to both human development and economic growth.

Several studies have specifically focused on the role of education and health expenditure in poverty reduction and welfare improvement. Ruzima and Veerachamy (2023) analysed the long-run relationship between public expenditure on health, education, and human development in India during 1990–2018. The study found that health expenditure had a positive and significant impact on human development, whereas the effect of education expenditure was mixed due to issues such as poor educational quality and high dropout rates. Sinha (2025) also highlighted that expenditure on education and health contributes significantly toward human capital formation, productivity growth, and inclusive economic development.

In the context of poverty and deprivation, Alkire and Foster (2011) developed the multidimensional poverty measurement framework, which has been widely adopted by the United Nations Development Programme (UNDP) for estimating the Multidimensional Poverty Index (MPI). Their approach emphasised that poverty extends beyond income deprivation and includes deficiencies in health, education, and living standards. The MPI approach has increasingly gained policy relevance in developing countries including India.

Several Indian studies have examined multidimensional poverty and regional disparities. Seth and Alkire (2014) analysed multidimensional poverty across Indian states and observed substantial interstate disparities in deprivation levels. The study highlighted that states with better social infrastructure and higher welfare expenditure performed relatively better in reducing multidimensional poverty. Mohanty and Vasishtha (2018) also found that multidimensional poverty in India is closely associated with inadequate access to healthcare, education, sanitation, and housing facilities.

Ranjan and Panda (2021) studied development expenditure and its relationship with HDI and GSDP in low-income states of India. The study observed that although development expenditure contributed positively toward economic growth, its long-run impact on human development remained limited due to unequal distribution of resources. Das, Mandal, and Patra (2021) employed panel data analysis to examine the relationship between social sector expenditure and human development across Indian states and found the existence of long-run associations between government expenditure and development indicators.

A number of studies have also investigated regional disparities and efficiency of social sector expenditure across Indian states. Chattopadhyay (2017) argued that despite policy emphasis on inclusive growth, social sector expenditure remained inadequate in several Indian states during the post-reform period. Soni (2019) identified considerable interstate variations in health and education outcomes, with states such as Kerala and Himachal Pradesh performing better due to higher social sector investment. Purohit (2014) assessed the efficiency of social sector expenditure using Free Disposable Hull (FDH) and Stochastic Frontier Analysis (SFA) techniques and found significant disparities in the utilization efficiency of health and education expenditure across states.

Roula and Kumaran (2025) analysed public expenditure efficiency across Indian states using Data Envelopment Analysis (DEA). The study reported that economically advanced states with better governance and infrastructure demonstrated higher efficiency in public expenditure utilization compared to poorer states. Similarly, Bose and Banerjee (2025) examined the relationship between social spending, fiscal policy, and human development in India and argued that fiscal consolidation policies under the FRBM framework constrained public expenditure on education and health despite rising economic growth.

Further, Roula (2025) investigated the role of social sector expenditure in rural empowerment and found that expenditure on health, education, nutrition, and welfare programmes significantly reduced rural unemployment and improved wage levels. Roula, Sethi, and Sahu (2026) also emphasised the importance of fiscal discipline and efficient public expenditure management for achieving sustainable development outcomes across states.

Although extensive literature exists on social sector expenditure, human development, and economic growth, relatively few studies have specifically examined the impact of education expenditure, health expenditure, and economic growth on Multidimensional Poverty Index (MPI) across Indian states using robust panel data techniques. Moreover, earlier studies have often ignored econometric issues such as heteroskedasticity, serial correlation, and cross-sectional dependence in macro panel datasets. Therefore, the present study attempts to fill this research gap by employing robust panel data estimation methods such as the Driscoll–Kraay Fixed Effect estimator to analyse the impact of education expenditure, health expenditure, and GSDP on multidimensional poverty across selected Indian states.

The existing literature largely focuses on the relationship between social sector expenditure, human development, economic growth, and poverty reduction in India. Several studies have examined the impact of education and health expenditure on Human Development Index (HDI), welfare indicators, and economic growth across Indian states. Other studies have analysed regional disparities, efficiency of public expenditure, and the role of fiscal policy in promoting inclusive development. However, relatively limited empirical research has specifically investigated the impact of education expenditure, health expenditure, and Gross State Domestic Product (GSDP) on Multidimensional Poverty Index (MPI) across Indian states.

Further, most earlier studies have concentrated either on income poverty, human development outcomes, or overall development expenditure without adequately addressing multidimensional poverty from a panel data perspective. Moreover, many previous studies have not employed robust econometric techniques capable of addressing important panel data issues such as heteroskedasticity, autocorrelation, and cross-sectional dependence, which may affect the reliability of empirical estimates.

In this context, the present study attempts to bridge this research gap by examining the impact of education expenditure, health expenditure, and economic growth on multidimensional poverty across selected Indian states during 2000–01 to 2022–23. The study employs robust panel data estimation techniques including Fixed Effect, Random Effect, Hausman specification test, and Driscoll–Kraay Fixed Effect estimator to obtain reliable and consistent empirical results. Therefore, the study contributes to the existing literature by providing a comprehensive panel data analysis of the determinants of multidimensional poverty in India.

### 3. Data Source

The present study is based entirely on secondary data collected from various official government publications and databases. The analysis covers 14 major Indian states for the period from 2000–01 to 2022–23, forming an unbalanced panel dataset consisting of 322 observations.

Data relating to the Multidimensional Poverty Index (MPI) have been obtained from reports published by NITI Aayog, the United Nations Development Programme (UNDP),

and various State Human Development Reports. Information on education expenditure and health expenditure has been collected from the Reserve Bank of India (RBI) publication *State Finances: A Study of Budgets* along with respective state budget documents. Data on Gross State Domestic Product (GSDP) have been sourced from the Ministry of Statistics and Programme Implementation (MOSPI), Government of India.

**Table 1:** Variables, Measurement, and Data Sources

| Variables     | Description                               | Measurement/Proxy                                                            | Source                                                                    |
|---------------|-------------------------------------------|------------------------------------------------------------------------------|---------------------------------------------------------------------------|
| <b>MPI</b>    | Multidimensional Poverty Index            | Index value measuring deprivation in health, education, and living standards | NITI Aayog, UNDP, State Human Development Reports                         |
| <b>EE</b>     | Education Expenditure                     | Total government expenditure on education                                    | RBI, <i>State Finances: A Study of Budgets</i> and State Budget Documents |
| <b>HE</b>     | Health Expenditure                        | Total government expenditure on health sector                                | RBI, <i>State Finances: A Study of Budgets</i> and State Budget Documents |
| <b>GSDP</b>   | Gross State Domestic Product              | Gross State Domestic Product at current prices                               | Ministry of Statistics and Programme Implementation (MOSPI)               |
| <b>LNEE</b>   | Logarithm of Education Expenditure        | ln(EE)                                                                       | Computed by Author                                                        |
| <b>LNHE</b>   | Logarithm of Health Expenditure           | ln(HE)                                                                       | Computed by Author                                                        |
| <b>LNGSDP</b> | Logarithm of Gross State Domestic Product | ln(GSDP)                                                                     | Computed by Author                                                        |

**Source:** Compiled by the author based on various official publications.

The study uses education expenditure, health expenditure, and GSDP as the major explanatory variables influencing multidimensional poverty across states. To reduce scale differences, improve normality, minimize heteroskedasticity, and facilitate elasticity interpretation of coefficients, these variables have been transformed into logarithmic form before empirical estimation.

The study further employs panel econometric techniques, including Fixed Effect and Random Effect models, to analyse the relationship between social sector expenditure and multidimensional poverty across Indian states. In addition, several diagnostic and robustness tests have been conducted to ensure the reliability and consistency of the estimated results.

#### 4. Model Specification

The present study examines the impact of social sector expenditure on multidimensional poverty across Indian states using panel data regression analysis. Panel data methodology is considered appropriate because it combines both cross-sectional and time-series dimensions, thereby enabling the study to capture state-specific heterogeneity and temporal variations more effectively than pure cross-sectional or time-series techniques. The study constructs an unbalanced panel dataset comprising 14 major Indian states covering the period from 2000–01 to 2022–23, with a total of 322 observations.

The functional relationship between Multidimensional Poverty Index (MPI) and the explanatory variables is expressed as:

$$MPI = f(LNEE, LNHE, LNGSDP)$$

The econometric model of the study is specified as:

$$MPI_{it} = \beta_0 + \beta_1 LNEE_{it} + \beta_2 LNHE_{it} + \beta_3 LNGSDP_{it} + \mu_i + \varepsilon_{it}$$

where  $MPI_{it}$  denotes the Multidimensional Poverty Index of state  $i$  at time  $t$ . The variable  $LNEE_{it}$  represents the logarithm of education expenditure, while  $LNHE_{it}$  denotes the logarithm of health expenditure. Further,  $LNGSDP_{it}$  indicates the logarithm of Gross State Domestic Product. In the model,  $\beta_0$  represents the intercept term, whereas  $\beta_1$ ,  $\beta_2$ , and  $\beta_3$  are the slope coefficients of the explanatory variables. The term  $\mu_i$  captures unobserved state-specific effects, and  $\varepsilon_{it}$  represents the random error term.

The explanatory variables are transformed into logarithmic form to reduce scale variations, improve normality, minimize heteroskedasticity, and facilitate elasticity interpretation of coefficients. The logarithmic transformation equations are expressed as:

$$LNEE = \ln(EE)$$

$$LNHE = \ln(HE)$$

$$LNGSDP = \ln(GSDP)$$

where  $EE$  denotes education expenditure,  $HE$  represents health expenditure, and  $GSDP$  refers to Gross State Domestic Product.

Initially, both Fixed Effect (FE) and Random Effect (RE) panel regression models are estimated. The Fixed Effect model assumes that state-specific effects are correlated with the explanatory variables and controls for unobserved time-invariant heterogeneity across states. The Fixed Effect model is represented as:

$$MPI_{it} = \alpha_i + \beta_1 LNEE_{it} + \beta_2 LNHE_{it} + \beta_3 LNGSDP_{it} + \varepsilon_{it}$$

where  $\alpha_i$  represents state-specific intercepts.

In contrast, the Random Effect model assumes that individual state-specific effects are random and uncorrelated with the explanatory variables. The Random Effect specification is expressed as:

$$MPI_{it} = \beta_0 + \beta_1 LNEE_{it} + \beta_2 LNHE_{it} + \beta_3 LNGSDP_{it} + u_i + \varepsilon_{it}$$

To determine the appropriate estimation technique between the Fixed Effect and Random Effect models, the Hausman Specification Test is employed. The null hypothesis of the Hausman test states that the Random Effect model is appropriate, while the alternative hypothesis supports the Fixed Effect model. The Hausman test statistic is given as:

$$H = (\hat{\beta}_{FE} - \hat{\beta}_{RE})' [Var(\hat{\beta}_{FE}) - Var(\hat{\beta}_{RE})]^{-1} (\hat{\beta}_{FE} - \hat{\beta}_{RE})$$

Further, the Levin–Lin–Chu (LLC) panel unit root test is applied to examine the stationarity properties of the variables. The general LLC test equation is expressed as:

$$\Delta Y_{it} = \alpha Y_{it-1} + \sum_{j=1}^p \beta_j \Delta Y_{it-j} + \mu_i + \varepsilon_{it}$$

The study also employs the Kao panel cointegration test to investigate the existence of long-run equilibrium relationships among the variables.

In addition, diagnostic tests are conducted to examine the presence of heteroskedasticity, autocorrelation, and cross-sectional dependence. The Modified Wald test is used to detect heteroskedasticity, the Wooldridge test is employed for autocorrelation, and the Pesaran Cross-Sectional Dependence (CD) test is applied to identify cross-sectional dependence across states.

Since the empirical results indicate the presence of heteroskedasticity, autocorrelation, and cross-sectional dependence, the study finally adopts the Driscoll–Kraay Fixed Effect estimator for robust estimation. The Driscoll–Kraay estimator provides standard errors that are robust to heteroskedasticity, serial correlation, and cross-sectional dependence simultaneously, making it particularly suitable for macro panel datasets involving Indian states.

## 5. Results and Discussion

**Table 2:** *Descriptive Statistics of Variables*

| Variables | Observations | Mean    | Standard Deviation | Minimum | Maximum |
|-----------|--------------|---------|--------------------|---------|---------|
| MPI       | 322          | 0.1875  | 0.1400             | 0.0020  | 0.5590  |
| LNEE      | 322          | 14.0043 | 0.6787             | 12.5708 | 15.7604 |
| LNHE      | 322          | 12.9311 | 0.8728             | 10.9194 | 15.0280 |
| LNGSDP    | 322          | 17.4954 | 0.7233             | 15.8813 | 19.2277 |

**Sources:** Author's own estimation using Stata.

The descriptive statistics indicate moderate variation among the variables across selected Indian states during the study period. The average value of Multidimensional Poverty Index (MPI) is 0.1875, with values ranging from 0.0020 to 0.5590, indicating substantial interstate differences in multidimensional poverty. The mean values of logarithm of education expenditure (LNEE), logarithm of health expenditure (LNHE), and logarithm of Gross State Domestic Product (LNGSDP) are 14.0043, 12.9311, and 17.4954 respectively. The standard deviations suggest reasonable dispersion in public expenditure and economic growth across states.

**Table 3:** *Correlation Matrix of Variables*

| Variables | MPI        | LNEE      | LNHE      | LNGSDP |
|-----------|------------|-----------|-----------|--------|
| MPI       | 1.0000     |           |           |        |
| LNEE      | -0.4689*** | 1.0000    |           |        |
| LNHE      | -0.6192*** | 0.9356*** | 1.0000    |        |
| LNGSDP    | -0.5381*** | 0.9658*** | 0.9909*** | 1.0000 |

**Note:** \*\*\* indicates significance at 1 percent level.

**Sources:** Author's own estimation using Stata.

The correlation matrix indicates that Multidimensional Poverty Index (MPI) is negatively associated with education expenditure (LNEE), health expenditure (LNHE), and Gross State Domestic Product (LNGSDP). The negative coefficients imply that higher social sector expenditure and economic growth are associated with lower multidimensional poverty across Indian states. Among the explanatory variables, health expenditure exhibits the strongest negative association with MPI. Further, the explanatory variables are highly positively correlated with one another, indicating close association among fiscal and economic indicators.

**Table 4:** *Levin–Lin–Chu (LLC) Panel Unit Root Test*

| Variables | Adjusted t-statistic | P-value | Order of Integration |
|-----------|----------------------|---------|----------------------|
| MPI       | -2.1168              | 0.0171  | Stationary at Level  |
| LNEE      | -5.4126              | 0.0000  | Stationary at Level  |
| LNHE      | -3.6146              | 0.0002  | Stationary at Level  |
| LNGSDP    | -3.6827              | 0.0001  | Stationary at Level  |

**Sources:** Author's own estimation using Stata.

The Levin–Lin–Chu (LLC) panel unit root test was employed to examine the stationarity properties of the variables used in the study. The null hypothesis of the LLC test states that the panels contain unit roots, while the alternative hypothesis suggests stationarity.

The results reveal that the adjusted t-statistics of MPI, LNEE, LNHE, and LNGSDP are statistically significant with p-values less than 0.05. Therefore, the null hypothesis of unit root is rejected for all variables. This indicates that all variables are stationary at level and integrated of order zero,  $I(0)$ . Hence, the variables do not suffer from non-stationarity problems, validating the application of panel regression techniques such as Fixed Effect and Random Effect models.

**Table 5:** *Kao Panel Cointegration Test*

| Test Statistics                     | Statistic Value | P-value |
|-------------------------------------|-----------------|---------|
| Modified Dickey–Fuller t            | 1.5837          | 0.0566  |
| Dickey–Fuller t                     | 1.6358          | 0.0509  |
| Augmented Dickey–Fuller t           | 1.1947          | 0.1161  |
| Unadjusted Modified Dickey–Fuller t | 1.5408          | 0.0617  |
| Unadjusted Dickey–Fuller t          | 1.5866          | 0.0563  |

**Sources:** Author’s own estimation using Stata.

The Kao panel cointegration test was employed to examine the long-run equilibrium relationship among Multidimensional Poverty Index (MPI), education expenditure (LNEE), health expenditure (LNHE), and Gross State Domestic Product (LNGSDP). The null hypothesis of the Kao test states that there is no cointegration among the variables, while the alternative hypothesis suggests that all panels are cointegrated.

The empirical findings indicate that the Dickey–Fuller t-statistic is marginally significant at the 10 percent level with a p-value of 0.0509. Similarly, the Modified Dickey–Fuller and Unadjusted Dickey–Fuller statistics also show near-significant values. Although the Augmented Dickey–Fuller statistic is statistically insignificant, the majority of the test statistics provide evidence supporting the existence of a long-run equilibrium relationship among the variables.

Therefore, the study suggests that education expenditure, health expenditure, and economic growth maintain a long-run association with multidimensional poverty across selected Indian states. This validates the use of panel regression estimation techniques for further empirical analysis.

**Table 6:** *Fixed Effect and Random Effect Model Results (MPI Model)*

| Variables              | Fixed Effect (FE)      | Random Effect (RE)     |
|------------------------|------------------------|------------------------|
| LNEE                   | 0.0222<br>(0.0311)     | 0.0007<br>(0.0306)     |
| LNHE                   | -0.5248***<br>(0.0742) | -0.6001***<br>(0.0642) |
| LNGSDP                 | 0.4881***<br>(0.1133)  | 0.6063***<br>(0.1003)  |
| _cons                  | -1.8773**<br>(0.7937)  | -2.6685***<br>(0.6726) |
| Observations           | 322                    | 322                    |
| Number of Groups       | 14                     | 14                     |
| Within R <sup>2</sup>  | 0.8572                 | 0.8567                 |
| Between R <sup>2</sup> | 0.3544                 | 0.4978                 |

| Variables              | Fixed Effect (FE)          | Random Effect (RE) |
|------------------------|----------------------------|--------------------|
| Overall R <sup>2</sup> | 0.6479                     | 0.6809             |
| F/Wald Statistic       | 610.27                     | 1799.65            |
| Prob > Test            | 0.0000                     | 0.0000             |
| Hausman Test (p-value) | \multicolumn{2}{c}{0.0016} |                    |

Note: \*\*\* p<0.01, \*\* p<0.05, \* p<0.10.

Sources: Author's own estimation using Stata.

The table presents the Fixed Effect (FE) and Random Effect (RE) estimation results for the MPI model across selected Indian states. The Hausman specification test reports a p-value of 0.0016, which is statistically significant at the 1 percent level. Therefore, the null hypothesis of the Random Effect model is rejected, and the Fixed Effect model is considered appropriate for empirical analysis.

The FE estimation results reveal that health expenditure (LNHE) has a negative and statistically significant effect on Multidimensional Poverty Index (MPI). The coefficient value of -0.5248 implies that an increase in health expenditure significantly reduces multidimensional poverty across states. This finding suggests that greater public investment in healthcare improves living conditions, health accessibility, and overall welfare, thereby reducing deprivation among households.

On the other hand, Gross State Domestic Product (LNGSDP) exhibits a positive and statistically significant relationship with MPI. The coefficient value of 0.4881 indicates that economic growth alone may not necessarily reduce multidimensional poverty unless accompanied by inclusive development policies and equitable distribution of income. The result suggests that higher economic growth in some states may coexist with persistent poverty and inequality.

Further, education expenditure (LNEE) shows a positive but statistically insignificant relationship with MPI. This indicates that education expenditure alone may not have an immediate measurable impact on multidimensional poverty reduction during the study period.

The model exhibits strong explanatory power with a within R<sup>2</sup> value of 0.8572, implying that approximately 85.72 percent of the variation in MPI within states is explained by the explanatory variables included in the model.

**Table 7: Diagnostic Test Results for MPI Model**

| Diagnostic Test                           | Null Hypothesis                    | Test Statistic        | P-value | Decision                                                   |
|-------------------------------------------|------------------------------------|-----------------------|---------|------------------------------------------------------------|
| Hausman Test                              | Random Effect model is appropriate | $\chi^2 = 15.31$      | 0.0016  | Reject H <sub>0</sub> ; Fixed Effect model preferred       |
| Modified Wald Test for Heteroskedasticity | Homoskedasticity exists            | $\chi^2(14) = 253.16$ | 0.0000  | Reject H <sub>0</sub> ; Heteroskedasticity present         |
| Wooldridge Test for Autocorrelation       | No first-order autocorrelation     | $F(1,13) = 516.870$   | 0.0000  | Reject H <sub>0</sub> ; Autocorrelation present            |
| Pesaran Cross-Sectional Dependence Test   | No cross-sectional dependence      | CD = 13.083           | 0.0000  | Reject H <sub>0</sub> ; Cross-sectional dependence present |

Sources: Author's own estimation using Stata.

The diagnostic test results reveal the presence of several econometric issues in the panel dataset. The Hausman specification test confirms that the Fixed Effect model is more appropriate than the Random Effect model. Further, the Modified Wald test indicates the

existence of heteroskedasticity across panels. The Wooldridge test confirms the presence of first-order serial correlation, while Pesaran's test reveals significant cross-sectional dependence among states.

Since the panel dataset suffers from heteroskedasticity, autocorrelation, and cross-sectional dependence simultaneously, the conventional Fixed Effect estimator may produce biased and inefficient standard errors. Therefore, the study employs the Driscoll–Kraay Fixed Effect estimator to obtain robust and reliable empirical estimates.

**Table 8:** *Driscoll–Kraay Fixed Effect Regression Results (MPI Model)*

| Variables | Coefficient | Driscoll–Kraay Std. Error | t-value | P-value |
|-----------|-------------|---------------------------|---------|---------|
| LNEE      | 0.0222      | 0.0570                    | 0.39    | 0.700   |
| LNHE      | -0.5248***  | 0.0654                    | -8.03   | 0.000   |
| LNGSDP    | 0.4881***   | 0.1131                    | 4.32    | 0.000   |
| _cons     | -1.8773**   | 0.7767                    | -2.42   | 0.024   |

#### Model Statistics

| Statistics             | Value  |
|------------------------|--------|
| Number of Observations | 322    |
| Number of Groups       | 14     |
| F-statistic            | 206.73 |
| Prob > F               | 0.0000 |
| Within R <sup>2</sup>  | 0.8572 |
| Maximum Lag            | 2      |

**Note:** \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

**Sources:** Author's own estimation using Stata.

To obtain robust and reliable estimates in the presence of heteroskedasticity, autocorrelation, and cross-sectional dependence, the study employed the Driscoll–Kraay Fixed Effect estimator. The estimator provides robust standard errors that are consistent in the presence of these econometric issues.

The empirical findings reveal that health expenditure (LNHE) has a negative and statistically significant impact on the Multidimensional Poverty Index (MPI). The coefficient value of  $-0.5248$  indicates that a one percent increase in health expenditure significantly reduces multidimensional poverty across Indian states. The result suggests that increased public investment in healthcare improves health accessibility, living standards, and overall welfare conditions, thereby reducing deprivation among households.

On the other hand, Gross State Domestic Product (LNGSDP) exhibits a positive and statistically significant relationship with MPI. The coefficient value of  $0.4881$  implies that economic growth alone does not automatically reduce multidimensional poverty unless supported by inclusive development policies and equitable distribution of income. In some states, higher economic growth may coexist with persistent inequality and deprivation.

Further, education expenditure (LNEE) shows a positive but statistically insignificant relationship with MPI. This suggests that education expenditure alone may not have an immediate measurable effect on multidimensional poverty reduction during the study period.

The model is statistically significant overall, as indicated by the F-statistic value of 206.73 with a probability value of 0.0000. Additionally, the within  $R^2$  value of 0.8572 implies that

approximately 85.72 percent of the variation in MPI within states is explained by the explanatory variables included in the model. Therefore, the Driscoll–Kraay estimator provides robust and reliable estimates for examining the determinants of multidimensional poverty across Indian states.

## 6. Summary of Findings

The present study examined the impact of education expenditure, health expenditure, and Gross State Domestic Product (GSDP) on the Multidimensional Poverty Index (MPI) across selected Indian states during the period 2000–01 to 2022–23 using panel data analysis. The study employed descriptive statistics, correlation analysis, panel unit root tests, cointegration analysis, Fixed Effect and Random Effect models, diagnostic tests, and the Driscoll–Kraay Fixed Effect estimator.

The descriptive statistics revealed considerable interstate variations in multidimensional poverty, education expenditure, health expenditure, and economic growth. The correlation analysis showed that MPI is negatively associated with education expenditure, health expenditure, and GSDP, indicating that higher public expenditure and economic growth are generally linked with lower multidimensional poverty.

The Levin–Lin–Chu (LLC) panel unit root test confirmed that all variables are stationary at level and integrated of order zero,  $I(0)$ . Further, the Kao panel cointegration test suggested the existence of a long-run equilibrium relationship among MPI, education expenditure, health expenditure, and GSDP.

The empirical analysis estimated both Fixed Effect and Random Effect models. The Hausman specification test confirmed that the Fixed Effect model is more appropriate for the study because state-specific effects are correlated with explanatory variables. Diagnostic tests further identified the presence of heteroskedasticity, first-order autocorrelation, and cross-sectional dependence in the panel dataset. Therefore, the Driscoll–Kraay Fixed Effect estimator was employed to obtain robust and reliable estimates.

The robust regression results revealed that health expenditure has a negative and statistically significant impact on MPI, implying that higher public investment in healthcare significantly reduces multidimensional poverty across Indian states. The findings indicate that improved healthcare expenditure enhances living standards, welfare conditions, and accessibility to health services, thereby reducing deprivation among households.

In contrast, Gross State Domestic Product exhibited a positive and statistically significant relationship with MPI. The result suggests that economic growth alone may not automatically reduce multidimensional poverty unless accompanied by inclusive development strategies, equitable income distribution, and effective social welfare policies.

Further, education expenditure showed a statistically insignificant relationship with MPI, implying that education expenditure alone may not produce an immediate measurable effect on multidimensional poverty reduction during the study period.

Overall, the study concludes that social sector expenditure, particularly health expenditure, plays a crucial role in reducing multidimensional poverty across Indian states. Sustainable poverty reduction therefore requires not only economic growth but also inclusive and welfare-oriented public expenditure policies.

## 7. Conclusion and Policy Implications

The study examined the impact of education expenditure, health expenditure, and Gross State Domestic Product (GSDP) on Multidimensional Poverty Index (MPI) across selected Indian states during 2000–01 to 2022–23 using panel data techniques. The empirical analysis employed Fixed Effect, Random Effect, and Driscoll–Kraay Fixed Effect estimation methods.

The findings reveal that health expenditure has a negative and statistically significant impact on MPI, indicating that higher public expenditure on healthcare helps reduce multidimensional poverty across states. Improved healthcare services enhance welfare conditions, reduce deprivation, and improve living standards. On the other hand, GSDP shows a positive and significant relationship with MPI, suggesting that economic growth alone may not reduce poverty unless supported by inclusive development policies and equitable distribution of income. Further, education expenditure was found to be statistically insignificant in influencing multidimensional poverty during the study period.

The diagnostic tests confirmed the presence of heteroskedasticity, autocorrelation, and cross-sectional dependence in the panel dataset. Therefore, the Driscoll–Kraay estimator was used to obtain robust and reliable estimates.

The study suggests that policymakers should increase public expenditure on healthcare and strengthen social welfare programmes to reduce multidimensional poverty effectively. Inclusive growth policies, equitable resource distribution, improvement in educational quality, and efficient utilization of social sector expenditure are essential for achieving sustainable and balanced development across Indian states.

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