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Impact of Social Sector Expenditure on the Economic Growth of North-Eastern States of India

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Abstract: The study examines the causal relationship between economic growth and government expenditures on education and healthcare in the North-Eastern states during 1990-91 to 2022-23, applying the Vector Error Correction Model. The results of the Augmented Dickey-Fuller test revealed that all variables are stationary at their first order difference. The results of the co-integration test and Vector Error Correction Model showed that there is a long-run relationship among variables in all the states. The Granger causality test indicated that there is a bidirectional causality between the variables used in all the selected states. The Variance Decomposition results indicate that fluctuations in Gross State Domestic Product (GSDP) are primarily explained by educational expenditure, with a relatively lesser contribution from total health expenditure, in the states of Arunachal Pradesh, Manipur, and Meghalaya. The study's findings may be helpful for the policy-makers to amend the existing policies and budgetary allocation for the healthcare and education sectors in the selected states of India.

Keywords: Economic growth, Human Capital Expenditure, Granger Causality Test, VECM.

JEL Codes: C32, C35, H51, H52, J24.

I. INTRODUCTION

Education and health are the primary components of the social sectors that significantly contribute to human resource development and economic growth. Social expenditures in the education sector encompass education, training,

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sports, arts, and culture. Similarly, social expenditures in the health sector cover healthcare, family welfare, water supply, sanitation, housing conditions, and nutrition. These expenditures collectively contribute to the enhancement of human capital. The modern concept of "human capital" was first introduced in economic literature by Theodore Schultz (1961) and Burton Weisbrod (1961). Schultz and Weisbrod pioneered the development of a conceptual framework for estimating the economic value of human capital, recognising the importance of investments in education, health, and skills. Noted economists stress the crucial role of education and healthcare in driving economic growth. Economists (Schultz, 1961; Becker, 1964; Rosen, 1976) have long emphasised the crucial role of human capital, comprising education and healthcare, in driving economic growth. Grossman (1972) has equally demonstrated that education and health expenditures are forms of human capital. Endogenous growth theory, as posited by Lucas (1988) and Romer (1990), underscores the importance of education and health expenditures in fostering economic growth. By investing in human capital, governments can stimulate innovation, productivity, and sustainable economic development. Both education and healthcare constitute fundamental human capital, forming the backbone of human resource development and economic progress (Bloom & Canning, 2003).

Investments in education have far-reaching benefits, including enhanced workforce efficiency, reduced inequality, and improved health outcomes, as well as fostering good governance, knowledge, and innovation (Aghion *et al*., 1999; Hanushek & Woessmann, 2008). Conversely, investments in healthcare stimulate economic growth by boosting labour productivity, enhancing mental and physical well-being, and minimising time lost to illness, ultimately resulting in more effective work performance and higher productivity (Jack, 1999; Strauss & Thomas, 1998).

India, as one of the world's fastest-growing, largest democracies, and most populous economies, has embarked on an ambitious journey. India has set a lofty goal to achieve developed country status by 2047, marking the 100th anniversary of its independence. However, the country's progress is hindered by significant disparities in economic, social, human development, and environmental parameters across its states. The north-eastern states, in particular, face formidable challenges due to their unique demographics, with predominantly scheduled tribal populations. Annual Report of Ministry of Health and Family Welfare, Government of India (2014-2015) also highlighted that the north-eastern region struggles with inadequate educational and healthcare infrastructure, limited access to quality education and healthcare, poor transportation, poor communication networks and economic backwardness. These obstacles collectively hinder economic development and perpetuate regional disparities. Addressing these challenges requires increased investments in education and healthcare in the North-eastern region, which are essential for bridging the development gap and fostering inclusive growth.

The underlying idea is that a highly educated and healthier workforce is likely to be more productive and contribute significantly to economic growth. Government expenditures on social sectors are often categorised into productive (development) and unproductive expenditures. Numerous empirical studies across both developed and developing countries have explored the interrelationship between human capital and economic growth. The rest of the paper is organised as follows. Section II presents the review of the literature. The sources of data and methodology are described in Section III. The estimated empirical results have been explored in Section IV, and the final Section V gives the summary and conclusions.

II. REVIEW OF LITERATURE

A comprehensive review of international and national empirical literature is essential to gain a deeper understanding of the rationale and dynamics underlying public expenditure. This section synthesises relevant national and international empirical studies, examining the causal relationships between government expenditure and economic growth.

International Studies

Many studies examined the relationship between education expenditure and economic growth in developing and developed countries. The following available studies (Musila & Belassi, 2004; Hussin *et al.*, 2012; Mercan & Sezer, 2014; Mekdad *et al.*, 2014) investigated the relationship between education expenditure and economic growth using time series econometric models. The key findings of these studies showed that education expenditure has a significant positive impact on economic growth both in the short run and long run periods.

Zoran (2015) has examined a comparative analysis of investment funds in the education systems of the European Union and BRICS. The results of the study showed that there is a positive association between public expenditure on education and GDP in these countries. Mallick *et al.* (2016) investigated dynamic expenditures on education and economic growth in the 14 major Asian countries (Bangladesh, China, Hong Kong, India, Japan, Malaysia, Nepal, Pakistan, Philippines, Saudi Arabia, Singapore, Sri Lanka, Thailand, and Turkey) using balanced panel data from 1973 to 2012 with Panel Vector Error Correction (PVECM). The results indicated the existence of long-run equilibrium relationships between variables. There is a unidirectional causality running from economic growth to expenditure on education, both in the short run and long run, in the 14 Asian countries. Keller (2006) investigated the interaction between education expenditure and economic growth in Asia. The study found that there is a negative and insignificant connection between the education expenditure and economic growth.

Danda (2010) examined the relationship between health expenditure and economic growth of Nigeria, covering the period from 1970 to 2009 by using the Johansen Co-integration test and Error Correction Model (ECM). The results showed that health expenditure has a positive effect on economic growth. The error correction term has an expected negative sign, and its coefficient implies that the speed of adjustment is 40 per cent. Babatunde (2014) examined the impact of health expenditure on economic growth in Nigeria using OLS for the period covered from 1970 to 2010. The results showed that the health expenditure has a significant positive impact on GDP and a direct relationship between health expenditure and GDP in Nigeria. The results suggested that a 1 per cent increase in the health expenditure led to about a 71 per cent increase in the real GDP. Tang & Lai (2011) examined the causal relationship between health and education expenditures in Malaysia using the Granger causality test with annual data from 1970 to 2007. The results showed that education causes health expenditure in both the short run and long run. Rahman (2011) analysed the causal relationship among health expenditure, education expenditure and GDP for Bangladesh covering the period 1990 to 2009, applying the ECM, VAR and Granger Causality test. The study found that the existence of bidirectional causality from education expenditure to GDP, and also from education expenditure to health expenditure and only unidirectional causality is obtained from health expenditure to GDP.

Maitra & Mukhopadhyay (2012) examined the effect of public spending on education and health care on GDP in the selected ASIA and PACIFIC countries over the last three decades (1981-2011), applying the ADF test, Co-integration test and ECM, VAR and variance decomposition. The results showed that spending on education is found to have raised GDP in Bangladesh, Fiji, Kiribati, Maldives, Nepal, Singapore, Sri Lanka, Tonga and Vanuatu. But, the health-care spending contributed to GDP growth in Bangladesh, Nepal, the Philippines, Singapore and Sri Lanka. In the Philippines, spending on education had a negative impact on GDP, while the impact of health-care spending on GDP is found to be negative in Kiribati, the Maldives and Vanuatu. In the case of Malaysia and the Republic of Korea, neither education spending nor health-care spending exhibited an appreciable impact on GDP.

Adekola (2014) examined the relationship between public investment in human capital and economic growth in Nigeria during the period 1961-2012 using the ADF test, Co-integration and Parsimonious Error Correction procedure. The study of empirical findings indicated that the federal and state governments' spending on human capital (education and health) had a positive impact on economic growth in Nigeria, individually and collectively. Torruam & Abur (2014) investigated the impact of human capital and the causal relationship between human capital development and economic growth in Nigeria for the period 1977-2012 using unit root and Granger-causality tests. The results of Granger-causality showed that there is bidirectional causality running from economic growth to human capital development and from total expenditure on education to total expenditure on health in Nigeria. The study concluded that human capital development has a positive impact on Nigerian economic growth. Ayuba (2014) examined the causal relationship between public social expenditure for education & health and economic growth in Nigeria for the period 1990 to 2009, applying the VECM. The result of the study revealed that there is a long-run relationship between these variables (public social expenditure and real GDP), and there is a positive relationship between aggregate social expenditure, education expenditure, as well as health expenditure and real GDP.

Yun & Yusoff (2015) investigated the relationship between the education expenditure, health care expenditure and economic growth in Malaysia using the Granger Causality approach over the period 1980 to 2012. The estimated results of the Granger causality test indicated that there was a unidirectional causality relationship that ran from GDP to the education expenditure and also found a one-way causal relationship from the GDP to the health care expenditure. Hakooma *et al.* (2017) examined the impact of human capital on economic growth both in the short and long run in Zambia using the co-integration test and ECM, using annual data from 1970-2013. The results of the co-integration test indicated the presence of a long-run relationship between economic growth (GDP per capita) and government expenditures on health and education, and secondary school enrolment. The estimated ECM model revealed that human capital in the form of public health expenditure on health is the main contributor to the real GDP per capita rise, followed by secondary school enrolment.

Indian Studies

Few available Indian studies investigated the causal relationship between education investment and economic growth. Ansari & Singh (1997) examined the association between public spending on education and growth from 1951 to 1987 using time series econometric models. The study found that there is no long-run relationship between public spending on education and growth. Ranjan & Sharma (2008) showed that government expenditure exerted a significant positive impact on economic growth in India during the period 1950-2007 and that the two sets of variables co-integrated. Pradhan (2009) investigated the causality between public education spending and economic growth in India during 1951 to 2001 using Error Correction Modelling. The study confirmed that there is a unidirectional causality between education and economic growth in India. Sharma & Sahni (2015) examined the causality relationship between the human capital investment (education & health investment) and Indian economic growth during the period 1991-92 to 2012-13 using co-integration and the Granger causality test. The co-integration test showed that education investment, health investment and GDP are co-integrated. It implied that there was an existence of a long-run equilibrium relationship among the three variables, and it implies that investment in education and health has a definite long-run impact on GDP. Mariappan (2019) examined the effect of the public social expenditure on economic growth and direction of causality among the variables in the high-income states of India using VAR and VECM models covering the period from 1990-1991 to 2016-2017. The results showed that the coefficients of the error correction terms had an appropriate negative sign and were statistically significant, which confirmed that there was a long-run equilibrium relationship between the human capital expenditures and economic growth in the states of Goa, Himachal Pradesh, and Haryana.

Available international and national comparative studies have consistently shown that public expenditures on education and healthcare have a significantly positive impact on the economic growth of countries worldwide. Few empirical studies showed that the influence of human capital expenditure on economic growth is a mixed result.

Research Gap and Objective of the Study

A review of the existing literature reveals that no Indian study has investigated the causal relationship between government expenditures on education and healthcare and economic growth (GSDP) in the north-eastern states of India using econometric techniques with recent data. The present study seeks to fill a notable research gap in the Indian context by examining the causal link between public expenditures on education and healthcare and Gross State Domestic Product (GSDP) in select Indian states, using advanced econometric techniques.

Contribution of the Present Study

This study builds upon existing research in the Indian context by addressing a critical knowledge gap that has been overlooked in previous empirical studies. This analysis aims to provide policymakers in India with empirical evidence and valuable insights to inform strategic decision-making, ultimately contributing to the development of effective policies that promote sustainable economic growth and human development.

III. ECONOMETRIC METHODOLOGY

Source of Data

This section describes the data sources and econometric techniques employed in this study to investigate the empirical relationship between government expenditure on human capital and economic growth, as measured by Gross State Domestic Product (GSDP), in the Indian North-Eastern states of

Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Sikkim, and Tripura. The analysis utilises annual time series data on GSDP, revenue and capital expenditures on education (encompassing education, sports, art, and culture), and revenue and capital expenditures on healthcare (including medical, public health, family welfare, water supply, and sanitation). The data were obtained from the Reserve Bank of India's (RBI) publication, State Finances: A Study of Budgets, and the Handbook of Statistics on the Indian Economy. Due to data availability constraints, the study period spans from 1990-91 to 2022-23, yielding a sample size of 33 annual observations.

Measurement of Variables

Dependent Variable

The economic growth of the North-Eastern states of India is measured in Gross States Domestic Product (GSDP), which is used as a dependent variable in many empirical studies. The target variable GSDP has been used to capture the economic growth of the above-selected states.

Independent Variables

The data collected relating to educational capital expenditure and revenue expenditure are pooled, and it is taken as total expenditure on education (EE). Likewise, the healthcare capital expenditure and revenue expenditure are pooled, and it is taken as total expenditure on health (EH). Pooled government capital and revenue expenditures on education and health (in rupees) are taken as independent variables. All variables are converted to natural logarithms in this analysis.

Time Series Econometric Models

The time series Econometric models, like Augmented Dickey Fuller (ADF) unit root test, Johansen co-integration test, Vector Error Correction Mechanism (VECM), Granger causality test and variance decomposition method were used in this study.

Stationarity Test

Unit root tests are a crucial component of time series analysis, enabling researchers to determine whether a variable is stationary or non-stationary (i.e., contains a unit root). In this study, the Augmented Dickey-Fuller (ADF) test was employed to examine the stationarity of the time series data, comprising GSDP, expenditure on education, and healthcare. Time series economic data often exhibit non-stationarity, characterised by changes in mean, variance, or autocorrelation over time. Estimating a regression model using Ordinary Least Squares (OLS) with non-stationary variables can lead to spurious regression, as noted by Muftaudeen and Bello (2014). Therefore, it is essential to verify the stationarity of the variables before proceeding with further analysis. The stationarity properties of the data and the order of integration of the time series data were empirically investigated by the unit root test in the first stage. Therefore, the study applied the popular method of Augmented Dickey Fuller (ADF) unit root test to check the stationarity of each time series before analysing the VECM. The ADF test is specified as follows:

$$\Delta Yt = \beta 1 + \alpha Yt - 1 + \gamma i \Sigma_{i=1}^{n} \Delta Yt - 1 + \in t \text{ (Model-I: With constant)} \quad (1)$$

$$\Delta Yt = \beta 1 + \beta 2t + \alpha Yt - 1 + \gamma i \Sigma_{i=1}^{n} \Delta Yt - 1 + \in t \text{ (Model-II: With constant \& Trend)} \quad (2)$$

$$\Delta Yt = \alpha Yt - 1 + \gamma i \Sigma_{i=1}^{n} \Delta Yt - 1 + \in t \text{ (Model-III: Without constant \& Trend)} \quad (3)$$

Where, Δ denotes first difference operator (Y_t-Y_{t-1}), t denotes captures time trend, n denotes the maximum lag length, α, β and γ denote the parameters to be estimated, εt denotes the error term, and it is assumed to be normally distributed. The testing of Null Hypothesis (H_0): α = 0, Time series data are not stationary. Alternative Null Hypothesis (H_1): α ≠ 0 Time series data are stationary. If the ADF test statistic is greater than the Mackinnon critical value, the null hypothesis can be rejected. Hence, the alternative hypothesis was accepted.

Optimal Lag Length Criterion

To decide the optimal lag-length of variables used, the following criterions like Akaike's Information Criterion (AIC), Schwarz's Bayesian Information Criterion (SBIC) and Hannan-Quinn Criterion (HQIC) were widely employed in empirical analysis. The lag length criteria are specified as

$$AIC = -2T(\ln(\hat{R}^2 \rho)) + 2p \quad (4)$$

$$SBIC = \ln(\hat{R}^2 \rho) + (\rho \ln(T)) / T \quad (5)$$

$$HQIC = \ln(\hat{R}^2 \rho) + 2T^{-1} \rho \ln(\ln(T)) \tag{6}$$

Where p denotes the lag length to define the time series model, $\hat{R}$ denotes the estimation of the residuals from the model, and T represents the number of observations.

Co-integration Test

After the verification of the stationarity test, the Johansen (1991) co-integration test was applied to confirm whether the variables are co-integrated. If the variables are co-integrated, it means that a long-run equilibrium relationship exists among the variables. The Trace statistic (λ_{trace}) and Maximum Eigenvalue statistic (λ_{max}) test statistics were applied to estimate the co-integration ranks, which are specified as:

$$\lambda_{Trace(r)} = -T \, \Sigma_{i=r+1}^{k} \ln(1 - \lambda) \tag{7}$$

$$\lambda_{\max}(r, r+1) = -T \, \ln(1 - \lambda) \tag{8}$$

Where λ denotes Eigenvalues, T denotes the number of observations, and K denotes the number of endogenous variables. The null hypothesis meant no co-integrating relation against the alternative hypothesis between the time series variables. The null hypothesis was rejected since the values were more significant than the test statistic.

Multivariate VECM framework

Once the co-integration is confirmed between variables, the VECM was applied to study the presence of an equilibrium relationship between the short-run and long-run equilibrium. The study applied the VECM to investigate the causality between expenditure on education (EE), expenditure on health (EH) and economic growth (GSDP). The VECM is specified as follows:

$$\Delta GSDP_t = \alpha_0 + \alpha_{1i(ECT)t-1} + a_{2i} + \Sigma_{i=1}^{n} . \Delta GSDP_{t-1} + \alpha_{3i} \Sigma_{i=1}^{n} . \Delta EE_{t-1} + \alpha_{4i} \Sigma_{i=1}^{n} . \Delta EH_{t-1} + e_t \tag{9}$$

$$\Delta EE_t = \delta_0 + \delta_{1i(ECT)t-1} + \delta_{2i} + \Sigma_{i=1}^{n} . \Delta EE_{t-1} + \delta_{3i} \Sigma_{i=1}^{n} . \Delta GSDP_{t-1} + \delta_{4i} \Sigma_{i=1}^{n} . \Delta EH_{t-1} + e_t \tag{10}$$

$$\Delta EH_t = \gamma_0 + \gamma_{1i(ECT)t-1} + \gamma_{2i} + \Sigma_{i=1}^{n} . \Delta EH_{t-1} + \gamma_{3i} \Sigma_{i=1}^{n} . \Delta GSDP_{t-1} + \gamma_{4i} \Sigma_{i=1}^{n} . \Delta EE_{t-1} + e_t \tag{11}$$

Where expenditure on healthcare is denoted by *EE*, total educational expenditure is denoted by *EE*, gross state domestic product is denoted by GSDP. The first difference of GSDP, EE and EH denotes ΔEEt, ΔEHt and $\Delta GSDPt$ respectively. $(EC)_{t-1}$ denotes the error correction term (speed of adjustment).

Granger Causality Test & Variance Decomposition Test

The popular Granger causality test is widely applied in empirical studies to determine the direction of causality among the variables. X_t is said to be Granger-cause Y_t, if Y_t is better predicted using the lagged values of both X_t and Y_t than if only lagged values of Y_t are used (Engel & Granger, 1987). A general specification of the Granger causality test in a bivariate (X and Y) system can be tested as:

$$\Delta X_t \, \alpha'_X + \Sigma_{i=1}^{n} . \alpha_i \, \Delta X_{t-i} + \Sigma_{i=1}^{n} . \beta j \Delta Y_{t-j} + u_{1t} \quad (12)$$

$$\Delta Y_t \, \alpha'_Y + \Sigma_{i=1}^{n} . \lambda_i \, \Delta Y_{t-i} + \Sigma_{i=1}^{n} . \gamma j \Delta Y_{t-j} + u_{2t} \quad (13)$$

In the first equation examined, the null hypothesis X does not Granger-cause Y. In the second equation examined, the null hypothesis Y does not Granger-cause X. Unidirectional causality occurs between two variables if either null hypothesis of equations (12) or (13) was rejected. Bidirectional causality existed if both null hypotheses were rejected, and no causality existed if neither the null hypothesis of equation (12) nor (13) was rejected. The rejection or non-rejection of the null hypothesis is based on the probability values of the F-statistic. Finally, the variance decomposition derived from VECM measures the strength of variance among the variables.

IV. ESTIMATED EMPIRICAL RESULTS & DISCUSSION

Result of Unit Root Test

The estimated results of the ADF test are presented in Table 1. The results show that GSDP, EE and EH are non-stationary at the level, but all are stationary at their first order difference at a 5 per cent level of significance. The estimated test statistic of each variable is greater than the corresponding critical values, and the probability value is less than 5 per cent. Hence, the null hypothesis (Ho) is rejected and we conclude that the non-stationarity of GSDP, EE and EH are transformed into stationary by taking the first difference integrated of the same order I (1) at the state level.

Result of Co-integration Test

The results of co-integration were reported in Table 3. The estimated results show that the trace and Max-Eigen statistics are less than their respective critical values at a 5 per cent level of significance. It implied that the dependent and independent variables are co-integrated (a long-run relationship between GSDP, EE and EH) in Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Sikkim and Tripura. Thus, the effect of human capital expenditure (EE and EH) on economic growth is explored by the estimation of VECM.

Result of *VECM*

The estimated results of the VECM were reported in Tables 4 to 6. The results of VECM show that the coefficients of the error correction terms (EC_{t-1}) or speed of adjustment coefficients have an appropriate negative sign and are statistically significant at the 5 per cent level, which confirms that there is a long-run equilibrium relation between the dependent variable and independent variables in all the selected states. The error correction term (-0.147) indicates that 14.7 per cent of the deviation of GSDP disequilibrium errors of previous periods has been corrected for the present period in Arunachal Pradesh. It implied that the absolute value of the speed of adjustment coefficient for GSDP is -0.147 in Arunachal Pradesh. Similarly, the estimated results of remaining states showed that the absolute value of speed of adjustment coefficient for SGDP are -0.646, -0.040, -0.095, -0.155, -0.327 and -0.103 statistically significant and implies that 64.6, 4, 9, 15 and 10 per cent of the deviation of SGDP from their long-run equilibrium level are corrected every year respectively in Manipur, Meghalaya, Mizoram, Sikkim and Tripura.

The estimated lagged coefficients of education and health are found to be positive and statistically significant, and these coefficients have led to a rise in GSDP in the selected states. The results of the VECM showed that the coefficients of D (EE (-1)) and D (EH (-1)) have positive and statistically significant impacts on GSDP in Arunachal Pradesh, Manipur and Mizoram. The results of VECM suggested that a one per cent increase in D (EE (-1)) lagged by one period increases GSDP by 0.82, 0.214 and 0.667 per cent in Arunachal Pradesh, Manipur and Mizoram, respectively. The results are in consonance with findings of Maitra and Mukhopadhyay (2012) and Mariappan (2019), who found that educational and Health expenditure significantly and positively impacted GSDP in the Indian states from 1990-1991 to 2016-2017. The results of VECM suggest that a 1 per cent increase in D (EE (-1)) lagged by one period increases GSDP by 0.016, 0.147 and 0.162 per cent in Meghalaya, Tripura and Sikkim, respectively.

Hakooma *et al.* (2017) discovered a positive and significant relationship between health expenditure to the GSDP, which agrees with the findings of the present study. The results of the present study are not similar to the study of Keller (2006), who found that there is a negative connection between the education expenditure and economic growth of Asia. A negative effect on GSDP may be due to some practical constraints of the education sector like geographical location (scattered population), lack of human resource constraints, vulnerable climate change and so on (Maitra *et al.* 2012). This result confirms the poor allocation and utilisation of public educational expenditure in these states. Similarly, a one per cent increase in D(EH (-1)) lagged by one period increased GSDP by 0.657, 0.348, 0.431, 0.564 and 0.155 per cent in Arunachal Pradesh, Manipur, Mizoram, Nagaland and Sikkim, respectively.

The result indicated that public spending on human capital expenditure significantly affects the GSDP. However, the results of VECM showed that there is a negative impact of human capital expenditure on economic growth. The estimated second-year lagged coefficients of education and health are found to be insignificant on the GSDP in the selected states. The adjusted R^2 value revealed that approximately 81, 43, 38, 34, 59,51 and 24 per cent of the variation in GSDP is jointly explained by independent variables (education and Health), respectively, in Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Sikkim and Tripura states.

Result of Granger causality

The Granger-causality test exhibited the relationship between the variables, which may be a unidirectional (one-way) or bidirectional (two-way) relationship, or no relationship. The estimated results of the causality analysis are reported in Table 7. The results show that there is a unidirectional causality running from EE to GSDP in Arunachal Pradesh, Meghalaya, Nagaland and Tripura. Similarly, the results show that there is a unidirectional causality running from EH to GSDP in Arunachal Pradesh, Manipur, Nagaland and Tripura. The results also show that there is no unidirectional causality running from EE and EH to GSDP in Sikkim. However, there is a bi-directional causality between all variables (EE and EH) and GSDP in all the selected states.

Results of Variance Decomposition

The estimated results of the variance decomposition of VECM were presented in Table 8. The results indicate that in the fifth-year lag period of 47.32 per cent of the variance in GSDP is explained by 21.48 per cent of the variance in educational expenditure and 31.19 per cent of the variance in health expenditure. In the tenth lag period, 37.73 per cent of the variance in GSDP is explained by 35.85 per cent of the variance in educational expenditure and 26.40 per cent of the variance in health expenditure in the state of Arunachal Pradesh. The results reveal that variance in GSDP is mostly explained by educational expenditure and less by total health expenditure in the states of Arunachal Pradesh, Manipur, Meghalaya and Tripura.

The health expenditure plays a significant role than educational expenditure in the composition of GSDP in the states of Mizoram, Nagaland and Sikkim. This could be due to several reasons: (i). Human capital formation: Education expenditure can lead to the formation of human capital, which is a critical factor in economic growth. As education improves, the workforce becomes more skilled, leading to increased productivity and economic growth. (ii). Multiplier effect: Education expenditure can have a multiplier effect on the economy, as educated individuals earn higher incomes, spend more, and create demand for goods and services, stimulating economic growth. (iii). State-specific factors: The relative importance of education versus health expenditure may vary across states due to factors like differences in industrial structure, economic development, regional disparities, better governance and institutions and demographic characteristics. In contrast, health expenditure, while crucial for well-being, may have more immediate benefits but less direct long-term impact on economic growth and (iv). Economic Growth Mechanisms including: Increased labour productivity, improved innovation and entrepreneurship, enhanced competitiveness and better governance and institutions. By considering these factors, it becomes clear that education expenditure can have a more significant impact on GSDP than health expenditure in some states, due to its long-term effects.

Table 1: Estimated Results of ADF Unit Root Test

ADF Unit Root Test			*At their level*				*At their first difference*			
State	*Variable*	*Specifications*	*T- Statistic*	*Test Critical value @ 5 %*	*P-Value*	*Decision Non-Stationary*	*T- Statistic*	*Test Critical value @ 5 %*	*P-Value*	*Decision Stationary*
Arunachal .Pradesh	GSDP	Constant	-0.521	-2.960	0.873	I (0)	-9.071	-2.960	0.000	I (1)
		Trends & constant	-8.913	-3.562	0.000	I (0)	-5.572	-3.557	0.000	I (1)
		None	2.889	-1.952	0.998	I (0)	-7.628	-1.952	0.000	I (1)
	EE	Constant	-0.716	-2.957	0.828	I (0)	-7.343	-2.960	0.000	I (1)
		Trends & constant	-2.438	-3.557	0.354	I (0)	-7.353	-3.562	0.000	I (1)
		None	1.247	-1.951	0.942	I (0)	-6.939	-1.952	0.000	I (1)
	EH	Constant	-0.621	-2.957	0.852	I (0)	-6.115	-2.960	0.000	I (1)
		Trends & constant	-2.148	-3.557	0.5008	I (0)	-6.122	-3.562	0.000	I (1)
		None	1.218	-1.951	0.939	I (0)	-5.852	-1.952	0.000	I (1)
Manipur	GSDP	Constant	-1.879	-2.986	0.336	I (0)	-3.186	-2.986	0.0329	I (1)
		Trends & constant	-3.509	-3.587	0.058	I (0)	-3.414	-3.603	0.0720	I (1)
		None	2.959	-1.955	0.998	I (0)	-8.338	-1.953	0.000	I (I1)
	EE	Constant	-1.364	-2.957	0.587	I (0)	-3.649	-2.991	0.0122	I (1)
		Trends & constant	-4.306	-3.595	0.011	I (0)	-5.247	-3.562	0.000	I (1)
		None	0.909	-1.951	0.899	I (0)	-5.233	-1.952	0.000	I (1)
	EH	Constant	-0.110	-2.957	0.939	I (0)	-4.743	-2.960	0.006	I (1)
		Trends & constant	-4.241	-3.595	0.129	I (0)	-4.768	-3.562	0.0031	I (1)
		None	1.777	-1.951	0.979	I (0)	-4.427	-1.952	0.000	I (1)
Meghalaya	GSDP	Constant	-2.94	-2.957	0.051	I (0)	-5.47	-2.96	0.001	I (1)
		Trends & constant	-0.37	-3.557	0.984	I (0)	-7.16	-3.56	0.000	I (1)
		None	10.57	-1.951	1.000	I (0)	-7.23	-1.95	0.000	I (I1)
	EE	Constant	-2.19	-2.991	0.213	I (0)	-4.36	-2.99	0.002	I (1)
		Trends & constant	-1.28	-3.612	0.868	I (0)	-4.88	-3.61	0.003	I (1)
		None	1.75	-1.955	0.977	I (0)	-7.51	-1.95	0.000	I (1)
	EH	Constant	0.130	-2.986	0.961	I (0)	-3.35	-2.98	0.022	I (1)
		Trends & constant	-5.03	-3.595	0.002	I (0)	-3.26	-3.60	0.095	I (1)
		None	2.406	-1.955	0.994	I (0)	-4.60	-1.95	0.000	I (1)

ADF Unit Root Test			At their level				At their first difference			
State	*Variable*	*Specifications*	*T- Statistic*	*Test Critical value @ 5 %*	*P-Value*	*Decision Non-Stationary*	*T- Statistic*	*Test Critical value @ 5 %*	*P-Value*	*Decision Stationary*
Mizoram	GSDP	Constant	-1.22	-2.981	0.646	I (0)	-4.30	-2.98	0.002	I (1)
		Trends & constant	-4.81	-3.562	0.002	I (0)	-4.36	-3.59	0.009	I (1)
		None	2.542	-1.952	0.996	I (0)	-5.20	-1.95	0.000	I (1)
	EE	Constant	-1.15	-2.957	0.682	I (0)	-3.31	-2.98	0.025	I (1)
		Trends & constant	-2.10	-3.603	0.518	I (0)	-3.17	-3.60	0.111	I (1)
		None	1.02	-1.951	0.915	I (0)	-5.38	-1.95	0.000	I (1)
	EH	Constant	-0.65	-2.957	0.843	I (0)	-4.26	-2.96	0.002	I (1)
		Trends & constant	-3.50	-3.587	0.058	I (0)	-4.58	-3.56	0.005	I (1)
		None	1.175	-1.951	0.934	I (0)	-4.15	-1.95	0.002	I (1)
Nagaland	GSDP	Constant	-2.60	-2.981	0.104	I (0)	-2.96	-6.02	0.000	I (1)
		Trends & constant	-3.56	-4.065	0.016	I (0)	-3.59	-4.48	0.007	I (1)
		None	2.53	-1.952	0.996	I (0)	-4.89	-1.95	0.000	I (1)
	EE	Constant	-1.05	-2.957	0.721	I (0)	-6.73	-2.96	0.000	I (1)
		Trends & constant	-2.22	-3.557	0.458	I (0)	-6.65	-3.56	0.000	I (1)
		None	1.159	-1.951	0.933	I (0)	-6.42	-1.95	0.000	I (1)
	EH	Constant	-0.11	-2.957	0.939	I (0)	-5.37	-2.98	0.002	I (1)
		Trends & constant	-1.97	-3.603	0.585	I (0)	-5.23	-3.60	0.001	I (1)
		None	1.551	-1.951	0.967	I (0)	-4.73	-1.95	0.000	I (1)
Sikkim	GSDP	Constant	1.697	-2.986	0.999	I (0)	-4.77	-2.98	0.008	I (1)
		Trends & constant	-5.19	-3.557	0.001	I (0)	-5.26	-3.60	0.001	I (1)
		None	5.388	-1.955	1.000	I (0)	-4.06	-1.95	0.000	I (I1)
	EE	Constant	-0.69	-2.957	0.833	I (0)	-5.22	-2.96	0.000	I (1)
		Trends & constant	-1.73	-3.557	0.710	I (0)	-5.15	-3.56	0.001	I (1)
		None	1.64	-1.951	0.972	I (0)	-4.88	-1.95	0.000	I (1)
	EH	Constant	0.121	-2.957	0.962	I (0)	-4.19	-2.96	0.002	I (1)
		Trends & constant	-2.08	-3.562	0.532	I (0)	-4.22	-3.56	0.011	I (1)
		None	2.494	-1.951	0.996	I (0)	-3.76	-1.95	0.005	I (1)

ADF Unit Root Test			*At their level*				*At their first difference*			
State	*Variable*	*Specifications*	*T- Statistic*	*Test Critical value @ 5 %*	*P-Value*	*Decision Non-Stationary*	*T- Statistic*	*Test Critical value @ 5 %*	*P-Value*	*Decision Stationary*
Tripura	GSDP	Constant	-3.16	-2.986	0.034	I (0)	-6.40	-2.96	0.000	I (1)
		Trends & constant	-4.10	-3.562	0.015	I (0)	-4.28	-3.60	0.012	I (1)
		None	2.81	-1.952	0.998	I (0)	-5.04	-1.95	0.000	I (1)
	EE	Constant	-1.22	-2.986	0.646	I (0)	-3.64	-2.98	0.012	I (1)
		Trends & constant	-1.77	-3.603	0.686	I (0)	-3.53	-3.60	0.056	I (1)
		None	1.791	-1.955	0.979	I (0)	-6.54	-1.95	0.000	I (1)
	EH	Constant	-0.25	-2.991	0.917	I (0)	-7.05	-2.99	0.000	I (1)
		Trends & constant	-1.35	-3.612	0.848	I (0)	-6.81	-3.61	0.000	I (1)
		None	5.85	-1.955	1.000	I (0)	-5.07	-1.95	0.000	I (I1)

Source: Authors' estimation

Note: Level & First Difference (No Trend & Intercept), OI = Order of Integration, (1) First Order Difference Variables

Table 2: Estimated Results of Lag length Criteria

Lag Length: GSDP, EE & EH

	Lag	*LogL*	*LR*	*FPE*	*AIC*	*SC*	*HQ*
Arunachal Pradesh	0	-97.10538	NA	0.128073	6.458411	6.597184	6.503648
	1	-46.71717	87.77300	0.008905	3.788205	4.343296	3.969151
	2	-29.84463	26.12523*	0.005464*	3.280298*	4.251709*	3.596954*
Manipur	0	-96.58098	NA	0.123813	6.424579	6.563352	6.469816
	1	-47.67259	85.19525	0.009472	3.849845	4.404936	4.030791
	2	-28.47589	29.72393*	0.005002*	3.191993*	4.163403*	3.508648*
Meghalaya	0	-104.5131	NA	0.206546	6.936330	7.075103	6.981567
	1	19.38422	10.37154	0.000228	0.104244	1.075655	0.420900
	2	12.68593	204.1532*	0.000193*	-0.044254*	0.510838*	0.136693*
Mizoram	0	-91.66568	NA	0.090166	6.107463	6.246236	6.152700
	1	-30.13144	107.1887	0.003055	2.718157	3.273249*	2.899103
	2	-16.61512	20.92849*	0.002327*	2.426782*	3.398193	2.743438*
Nagaland	0	-84.86520	NA	0.058143	5.668723	5.807496	5.713959
	1	-1.992387	9.633803	0.000906	1.483380	2.454791	1.800035
	2	-8.214218	133.5211*	0.000743*	1.304143*	1.859235*	1.485089*
Sikkim	0	-100.7484	NA	0.162006	6.693444	6.832217	6.738680
	1	-26.48098	129.3690*	0.002414	2.482644	3.037736*	2.663590*
	2	-16.75639	15.05744	0.002349*	2.435896*	3.407307	2.752552

	Lag	*LogL*	*LR*	*FPE*	*AIC*	*SC*	*HQ*
Tripura	0	-81.33015	NA	0.046286	5.440655	5.579428	5.485891
	1	-25.73079	96.85049	0.002300	2.434245	2.989336*	2.615191
	2	-12.96318	19.76920*	0.001839*	2.191173*	3.162584	2.507829*

Source: Authors' estimation

Table 3: Estimated Results of Johansen Co-integration Test

State	*Variables : GSDP, EE and EH*									
	Trace Test					*Max-Eigen Test*				*Inference of Trace Test & Max-Eigen Test*
	Eigen Value	*Trace Statistic*	*C.V @ 5%*	*P-Value*	*Hypoth-esized*	*Eigen Value*	*Max-Eigen Statistic*	*C.V @ 5%*	*P-Value*	
Arunachal Pradesh	0.357	15.918	29.797	0.718	None	0.357	12.825	21.131	0.468	Co-integrated
	0.097	3.092	15.494	0.962	At most 1	0.097	2.979	14.264	0.948	Co-integrated
	0.003	0.113	3.841	0.736	At most 2	0.003	0.113	3.841	0.736	Co-integrated
Manipur	0.631	37.83	29.797	0.004	None	0.631	29.961	21.131	0.002	Co-integrated
	0.204	7.878	15.494	0.478	At most 1	0.204	6.865	14.264	0.505	Co-integrated
	0.033	1.013	3.841	0.314	At most 2	0.033	1.0134	3.841	0.314	Co-integrated
Meghalaya	0.345	23.23	29.797	0.234	None	0.345	13.161	21.131	0.437	Co-integrated
	0.194	10.074	15.494	0.275	At most 1	0.194	6.7160	14.264	0.523	Co-integrated
	0.102	3.358	3.841	0.066	At most 2	0.102	3.358	3.841	0.066	Co-integrated
Mizoram	0.304	15.923	29.797	0.717	None	0.304	10.88	21.131	0.658	Co-integrated
	0.154	5.033	15.494	0.805	At most 1	0.154	5.033	14.264	0.737	Co-integrated
	1.070	0.0003	3.841	0.987	At most 2	1.070	0.001	3.8414	0.987	Co-integrated
Nagaland	0.243	15.245	29.797	0.764	None	0.243	8.649	21.131	0.859	Co-integrated
	0.190	6.595	15.494	0.625	At most 1	0.190	6.561	14.264	0.542	Co-integrated
	0.001	0.033	3.841	0.853	At most 2	0.001	0.033	3.841	0.853	Co-integrated
Sikkim	0.149	9.554	29.797	0.986	None	0.149	5.031	21.131	0.995	Co-integrated
	0.134	4.523	15.494	0.857	At most 1	0.134	4.473	14.264	0.806	Co-integrated
	0.001	0.050	3.841	0.822	At most 2	0.001	0.050	3.8414	0.822	Co-integrated
Tripura	0.361	18.91	29.797	0.499	None	0.361	13.45	21.131	0.410	Co-integrated
	0.154	5.451	15.494	0.759	At most 1	0.154	5.023	14.264	0.738	Co-integrated
	0.014	0.427	3.841	0.513	At most 2	0.014	0.427	3.841	0.513	Co-integrated

Source: Authors' estimation

Note: Max-eigenvalue test indicates no co-integration at the 0.05 level
*denotes rejection of the hypothesis at the 0.05 level, **MacKinnon-Haug-Michelis (1999) p-values

Table 4: Estimated Results of Vector Error Correction Estimation by States

	Arunachal Pradesh			*Manipur*		
Variables	*Dependent variable*			*Dependent variable*		
	D(GSDP)	*D(EE)*	*D(EH)*	*D(GSDP)*	*D(EE)*	*D(EH)*
CointEq1	-0.147068*	0.130885	0.007590	-0.646517*	0.239951	0.158588
	(-4.54948)	(1.64460)	(0.05825)	(-3.82851	1.34744	0.95230
D(GSDP (-1))	-0.635030*	0.456300	-0.003162	0.622021**	1.377007*	0.987287**
	(-5.69923)	(1.66342)	(-0.00704)	(1.93894)	(4.07035)	(3.12072)
D(GSDP(-2))	-0.267635*	-0.435032	-1.075236**	-0.068186	-0.045972	-0.071677
	(-2.02674)	(-1.33815)	(-2.02004)	(-0.21035)	(-0.13449)	(-0.22422)
D(EE(-1))	0.872026*	0.208127	0.473922	0.214550*	-0.013606	0.402353
	(5.72837)	(0.55534)	(0.77234)	(0.78707)	(-0.04733)	(1.49673)
D(EE(-2))	-0.762460*	-0.039669	-0.113541	0.406260	0.569243	0.485233
	(-7.53474)	(-0.15923)	(-0.27836)	(1.23936)	(1.64675)	(1.50105)
D(EH(-1))	0.651242*	-0.245116	-0.259343	0.348175*	-0.061223	-0.442606
	(6.13053)	(-0.93725)	(-0.60566)	(0.95923)	(-0.15995)	(-1.23650)
D(EH(-2))	0.722586*	0.007869	-0.196159	-1.000296*	-0.337021	-0.424631
	(8.53034)	(0.03774)	(-0.57449)	(-2.76735)	(-0.88416)	(-1.19124)
Constant	0.233045*	0.148138	0.341814**	0.312667*	-0.053412	0.086157
	(5.63004)	(1.45368)	(2.04862)	(3.43151)	(-0.55587)	(0.95884)
Diagnostic Statistic						
R	0.855476	0.591854	0.314783	0.569078	0.614337	0.475520
$\bar{R}^2$	0.809491	0.461990	0.096760	0.431966	0.491626	0.308640
Observation		33			33	

Source: Authors' estimation.

Note: Figures given in parentheses indicate 't' values.
*and ** indicate statistically significant at 1 per cent and 5per cent level respectively

Table 5: Estimated Results of Vector Error Correction Estimation by States

	Meghalaya			*Mizoram*		
Variables	*Dependent variable*			*Dependent variable*		
	D(GSDP)	*D(EE)*	*D(EH)*	*D(GSDP)*	*D(EE)*	*D(EH)*
CointEq1	-0.040791*	-0.004405	0.150871	-0.09526**	-0.071898	0.017937
	(-3.32603)	(-0.02359)	(1.11244)	(-1.35178)	(-1.10839)	(0.19555)
D(GSDP (-1))	-0.194116	-3.056515	-1.823433	0.032200	0.506856**	0.58601*
	(-1.22611)	(-1.26772)	(-1.04152)	(0.17242)	(2.94855)	(2.41086)
D(GSDP(-2))	0.138614	0.368515	-0.027257	-0.669273**	-0.057873*	--0.9243**
	(0.85613)	(0.14946)	(-0.01522)	[-3.08636]	[-0.28995]	-1.834646]
D(EE (-1))	-0.016328	-0.966951**	-0.023047	0.6673***	-1.223490*	-0.924325
	(-0.80212)	(-3.11922)	(-0.10238)	[1.72392]	[-3.43388]	(-1.83465)
D(EE(-2))	-0.022797	-0.345570	0.081628	0.053607	0.105252	1.17159 **
	(-1.15019)	(-1.14487)	(0.37243)	(0.11675)	(0.24904)	(3.150981)

Variables	Meghalaya			Mizoram		
	Dependent variable			*Dependent variable*		
	D(GSDP)	*D(EE)*	*D(EH)*	*D(GSDP)*	*D(EE)*	*D(EH)*
D(EH (-1))	0.002684**	1.194068**	0.124957	0.431036*	1.192470*	1.17159**
	(0.09695)	(2.83214)	(0.40815)	(1.50883)	(4.53495)	(3.15098)
D(EH(-2))	-0.035902	0.063208	-0.216552	-0.198537	-0.247734	-0.548438**
	(-1.19297)	(0.13792)	(-0.65071)	(-0.46410)	(-0.62915)	(-1.943170)
Constant	0.137193*	0.413009	0.384191	0.237410*	0.040371	0.103499
	(4.22789)	(0.83576)	(1.07065)	(2.97429)	(0.54949)	(0.99623)
Diagnostic Statistic						
R	0.531049	0.449988	0.178363	0.401961	0.745807	0.616549
$\bar{R}^2$	0.381838	0.274985	0.083067	0.341676	0.664927	0.494542
Observation		33			33	

Source: Authors' estimation.

Note: Figures given in parentheses indicate 't' values.
*and ** indicate statistically significant at 1 per cent and 5per cent level respectively

Table 6: Estimated Results of Vector Error Correction Estimation by States

	Nagaland			*Tripura*			*Sikkim*		
	Dependent variable			*Dependent variable*			*Dependent variable*		
	D(GSDP)	*D(EE)*	*D(EH)*	*D(GSDP)*	*D(EE)*	*D(EH)*	*D(GSDP)*	*D(EE)*	*D(EH)*
CointEq1	-0.15586*	0.08715**	0.259539	-0.3277**	0.25767	0.3131***	-0.1039*	0.0330	0.0853
	(-1.72674)	(0.54212)	(1.65464)	(-2.8876)	(1.2953)	(1.61210)	(-0.810)	(0.259)	(0.769)
D(GSDP (-1))	0.547095	0.55730**	0.481727	0.274**	0.58576	0.930873*	-0.4728**	0.2018	0.0008
	(3.53612)	(2.02255)	(1.79183)	(1.7756)	(2.1636)	(3.52090)	(-2.237)	(0.962)	(0.004)
D(GSDP (-2))	-0.846402	0.103429	-0.424012	-0.978*	0.32872	-0.198291			
	(-5.62439)	(0.38591)	(-1.62147)	(-4.9279)	(0.9450)	(-0.58373)			
D(EE (-1))	0.487772	-1.22137**	-0.502178	-0.14708	-0.22379	0.306087	-0.1625	-0.1631	-0.0922
	(1.65492)	(-2.32676)	(-0.98050)	(-0.5599)	(-0.4861)	(0.68087)	(-0.546)	(-0.552)	(-0.358)
D(EE (-2))	-0.993799	-0.384496*	0.050058	-0.841**	0.21615	-0.057321			
	(-3.30595)	(-0.71818)	(0.09583)	(-3.1672)	(0.4642)	(-0.12607)			
D(EH (-1))	0.56436**	1.041385*	0.691387	0.23844	0.113**	-0.250783	0.1555**	0.2844	0.3547
	(2.16062)	(2.23857)	(1.52324)	(0.9639)	(0.2626)	(-0.59239)	(0.4053)	(0.746)	(1.068)
D(EH (-2))	1.058390	0.42959**	0.121609	0.7836**	-0.10044	0.207972			
	(3.61063)	(0.82288)	(0.23875)	(3.1560)	(-0.2308)	(0.48940)			
Constant	0.148201	0.010584*	0.080914	0.1813**	-0.01922	0.035859	0.2380*	0.0717	0.1106
	(3.17771)	(0.12743)	(0.99844)	(3.2549)	(-0.1968)	(0.37613)	(2.7632)	(0.839)	(1.483)
Diagnostic Statistic									
R	0.692592	0.609722	0.611188	0.63410	0.43887	0.524300	0.343	0.121	0.093
$\bar{R}^2$	0.594780	0.485542	0.487475	0.51768	0.26032	0.372941	0.247	0.013	0.045

Observation 33 33 33

Source: Authors' estimation.

Note: Figures given in parentheses indicate 't' values.
*and ** indicate statistically significant at 1 per cent and 5per cent level respectively

Table 7: Estimated Results of Granger causality analysis based on VECM

State	*Dependent Variables*	*Independent variable*	*Test Statistic*		*Causality*	*State*	*Dependent Variable*	*Independent Variable*	*Test Statistic*		*Causality*
		Excluded	Chi-sq	Prob.				Excluded	Chi-sq	Prob.	
Arunachal Pradesh	D (GSDP)	D(EE)	59.50840	0.0000	YES	Manipur	D (GSDP)	D(EE)	3.875533	0.1440	NO
		D(EH)	73.54343	0.0000	YES			D(EH)	8.298648	0.0158	YES
		All	74.86107	0.0000	YES			All	13.34104	0.0097	YES
Meghalaya	D(GSDP)	D(EE)	1.326307	0.0152	YES	Mizoram	D(GSDP)	D(EE)	4.056287	0.0316	YES
		D(EH)	1.670633	0.4337	NO			D(EH)	2.301648	0.3164	NO
		All	13.07165	0.0109	YES			All	4.844402	0.0036	YES
Nagaland	D(GSDP)	D(EE)	18.78057	0.0001	YES		D(GSDP)	D(EE)	0.299081	0.5845	NO
		D(EH)	16.81582	0.0002	YES	Sikkim		D(EH)	0.164340	0.6852	NO
		All	21.92179	0.0002	YES			All	0.299131	0.011	YES
Tripura	D(GSDP)	D(EE)	12.08452	0.0024	YES						
		D(EH)	10.78867	0.0045	YES						
		All	13.08037	0.0109	YES						

Source: Author's calculation

Table 8: Estimated Results of Variance Decomposition of VECM

Arunachal Pradesh Variance Decomposition of GSDP:					*Manipur Variance Decomposition of GSDP*			
Period	*S.E.*	*GSDP*	*EE*	*EH*	*S.E.*	*GSDP*	*EE*	*EH*
1	0.170973	100.0000	0.000000	0.000000	0.419846	100.0000	0.000000	0.000000
2	0.188229	94.80451	4.165975	1.029511	0.633824	98.20785	0.000815	1.791334
3	0.276851	76.26915	20.16000	3.570844	0.693395	93.07196	5.035108	1.892936
4	0.353942	46.97966	23.07574	29.94460	0.793942	84.28582	13.10631	2.607872
5	0.367964	47.32258	21.48270	31.19472	1.077749	77.66250	17.87043	4.467066
6	0.425739	46.32249	29.46654	24.21097	1.457392	78.58435	18.03954	3.376114
7	0.468232	44.02318	32.61621	23.36062	1.759586	77.27631	20.20238	2.521311
8	0.496335	40.53453	34.05595	25.40952	2.001890	73.47291	24.44827	2.078818
9	0.530470	39.54888	34.95457	25.49655	2.291358	69.83055	28.04585	2.123595
10	0.563100	37.73473	35.85742	26.40785	2.683914	68.56341	29.20774	2.228848
Meghalaya Variance Decomposition of GSDP					*Mizoram Variance Decomposition of GSDP*			
Period	*S.E.*	*GSDP*	*EE*	*EH*	*S.E.*	*GSDP*	*EE*	*EH*
1	0.046502	100.0000	0.000000	0.000000	0.375870	100.0000	0.000000	0.000000
2	0.058127	98.91799	0.581310	0.500698	0.530168	97.45156	2.223757	0.324684
3	0.074831	96.53118	2.696895	0.771927	0.555951	93.88115	3.206281	2.912567
4	0.084217	96.13588	3.019453	0.844668	0.581674	91.19443	3.612623	5.192952
5	0.091614	92.94787	5.187516	1.864609	0.641585	86.86119	5.589263	7.549544
6	0.098774	87.06324	10.56302	2.373743	0.718687	81.55253	8.211736	10.23574
7	0.107687	76.36238	19.75454	3.883079	0.775136	76.72231	10.49058	12.78710
8	0.117814	65.45067	28.34877	6.200561	0.818433	72.65197	11.99070	15.35733
9	0.129399	54.94955	37.27210	7.778349	0.863103	70.06908	13.01319	16.91773
10	0.142211	45.74950	44.63854	9.611961	0.910979	68.32890	13.90795	17.76315
Nagaland Variance Decomposition of GSDP					*Sikkim Variance Decomposition of GSDP*			
Period	*S.E.*	*GSDP*	*EE*	*EH*	*S.E.*	*GSDP*	*EE*	*EH*
1	0.343262	100.0000	0.000000	0.000000	0.432245	100.0000	0.000000	0.000000
2	0.557515	96.12228	0.459610	3.418115	0.490723	98.82714	0.031711	1.141153
3	0.626863	96.58343	0.693086	2.723482	0.593898	98.26052	0.241461	1.498019
4	0.691399	96.76222	0.722067	2.515712	0.666968	97.26799	0.402557	2.329452
5	0.754239	96.32791	0.630375	3.041717	0.743098	96.33908	0.695344	2.965577
6	0.816487	95.31769	0.543952	4.138353	0.811934	95.38910	0.981956	3.628942
7	0.878265	93.90242	0.546116	5.551466	0.878390	94.51244	1.280979	4.206579
8	0.939226	92.27536	0.664159	7.060479	0.941256	93.70074	1.563550	4.735706
9	0.998828	90.59822	0.886743	8.515040	1.001486	92.96761	1.828944	5.203444
10	0.142211	45.74950	44.63854	9.611961	1.059107	92.30726	2.072355	5.620384

Tripura Variance Decomposition of GSDP										
Period	*1*	*2*	*3*	*5*	*5*	*6*	*7*	*8*	*9*	*10*
SE	0.2616	0.411	0.504	0.56	0.63	0.70	0.77	0.82	0.88	0.93
GSDP	100.00	82.99	57.07	50.08	50.04	48.74	45.28	42.87	42.11	41.54
EE	0.000	12.87	19.30	25.31	28.36	29.97	32.05	33.83	34.96	35.71
EH	0.000	4.131	23.62	24.60	21.58	21.28	22.66	23.28	22.92	22.73

Source: Authors' estimation

V. SUMMARY & CONCLUSIONS

The study examined the casual association between expenditure on health and education and economic growth in the North-eastern states of India during 1990-91 to 2022-23 using appropriate time series econometric techniques. The results of ADF tests show that all the variables are stationary at their first difference. The results of Johansen co-integration tests show that all the variables are co-integrating in all the selected states. The estimated coefficients of error correction terms are statistically significant and have a negative sign, which confirms that there is a long-run equilibrium relationship between these variables. The estimated results of Granger causality test indicate that that there is a unidirectional causality running from EE to GSDP in Arunachal Pradesh, Meghalaya, Nagaland and Tripura. Similarly, the results show that there is a unidirectional causality running from EH to GSDP in Arunachal Pradesh, Manipur, Nagaland and Tripura. The results of variance decomposition reveal that variance in GSDP are mostly explained by educational expenditure and less by health expenditure in the states of Arunachal Pradesh, Manipur and Meghalaya. This could be due to several reasons like human capital formation, multiplier effect, state-specific factors, better governance, institutions, demographic characteristics and economic growth mechanisms.

Policy Recommendations: Based on the present study's findings, the following potential policy recommendations are suggested: (i) Allocating a higher proportion of the budget to education and healthcare in the North-Eastern states, with a focus on improving infrastructure and access to quality services. (ii) Implementing region-specific initiatives, such as vocational training programs or healthcare schemes tailored to the needs of local communities. (iii) - Encouraging public-private partnerships to leverage additional resources and expertise for education and healthcare development in the region. Therefore, the present study of analysis will be useful for policymakers, and to contribute to the development of more effective strategies for promoting economic growth in the Indian North-Eastern states

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