"Human Capital Formation And Economic Development in Karnataka: An Econometric Analysis"

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Abstract: The paper overviews the economic development and human capital formation in karnataka. The present study is based on secondary data sources, The study period is 1991 to 2016.The study area is karnataka state. The database is taken from RBI handbook of statistics, Ministry of Human Resource Department (MHRD) Government of India, Registrar General of India, Primary Census Abstract 2011, Indiastat. In order to study the performance of human development in Karnataka, the education and health sectors have considered. Tools like Johansen co-integration and Error Correction Model (ECM) for determining long run and short run relation between factors determining human capital formation in Karnataka. Granger causality test used to examine the causality relation among human capital formation determinants in Karnataka. The present study deals with analytical part of human capital formation on economic development in the state during last three decades. The present study attempts to investigate how expenditure on education, health and development expenditure help to economic growth that is NSDP (Net State Domestic Product) in Karnataka during reform period. The empirical analysis is conducted through a correlation analysis and time series econometrics based on Johansen cointegration and vector error correction model to detect long run and short run causality between variables of the model respectively. The correlation results showed that economic growth has strong positive association with development expenditure, education and health expenditure while education expenditure has positive association with health expenditure, it implies that expenditure on human capital formation definitely helps to economic growth in the long run at least not immediately. Regarding the long run estimation, the empirical results found that evidence of expenditure on development activities and education helped for economic growth in Karnataka while health variables are not significant but it has indirect implication on growth prospect.

Keywords: Human Capital, Economic Development, physical capital ,Net State Domestic Product, development expenditure, , education and health expenditure.
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I. INTRODUCTION

The present study deals with analytical part of human capital formation on economic development in the state during last three decades. There are many factors effect on human capital formation meanwhile conversion and transformation of human population as educated, trained and skilled labour force and in return it helps to generation income and employment through more productivity, output and finally overall economic development.

II. DETERMINANTS OF ECONOMIC DEVELOPMENT

The classical growth and development theories in economics assumed technology is given while Solow first time attempted to explain the growth theory with influence of technology in the model but it came clear only after origin of endogenous growth theories which successfully incorporated technology variable in the model as endogenous variable which earlier assumed as exogenous variable. The endogenous theories used technology in the model by incorporating education, training, research and development concepts and in turn help to innovation and improvement of technology. Technological advancement has led to innovation consequence high economic-growth experienced in developed economies after Second World War. Education and research have created most suitable innovation for easing human activities and improved standard of living and its trend has led to creation of knowledge based economies in the world.

The twenty first centaury is technology era and economic development factors mainly determined by technology-intensive resources while technology depends on capacity to generate, adapt and utilize knowledge as the foundation of productivity and growth. The same thing applies to service sector as applied in

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manufacturing sectors (Trajtenberg, 1990; Romer, 1990; Lichtenberg, 1992; Grossman and Helpman, 1994; Navarro et al., 2010). Many literatures examined the association and relation between economic growth and human capital formation through improvement in technology. Jones and Williams (1998, 2000) Hall and Jones (1999) Rouvinen (2002), Crespi and Zuniga (2012), Boskin and Lau (2000) studies found that technology driven economies accounted more than half of economic growth (i.e. gross domestic product, GDP) in all member countries of the Organisation for Economic Co-operation and Development (OECD). Measuring the impact of research is difficult for many reasons. One problem is that not all impacts are direct and some can be negative or result from the identification of problems that require a non-research response. A second problem is that the time between the performance of research and when its benefits become apparent can be significant, unpredictable and vary for different kinds of research. Thirdly, research does not exist in isolation but draws on the work of other researchers or on complementary progress in other areas of research or technology. Fourthly, the impact that research has will often depend on the imagination, creativity and identified needs or problems of people outside the research system. Furthermore, measurement of the output in research and development (R&D) based on good physical and human resource with quality education and health.

III. OBJECTIVES OF THE STUDY
* To examine the factors determining human capital formation in Karnataka.
* To analyse the role of human capital formation in the Economic development of Karnataka.
* To offer findings and suggestions for human capital formation in Karnataka.

IV. HYPOTHESIS OF THE STUDY
➢ There is relation between human capital formation and economic development in Karnataka .
➢ There is no association between economic growth and human capital expenditures.

V. RESEARH METHODOLOGY
5.1. Source of Data and Study Area:
The study is based on secondary data sources. The study period is 1991 to 2016.The study area is karnataka state. The database is taken from RBI handbook of statistics, Ministry of Human Resource Department (MHRD) Government of India, Registrar General of India, Primary Census Abstract 2011, Indiastat, Saikshanic Anki Anshagala Pakshinota, and Karnataka. Human Development Reports at national and state level for health and education status. Report on Higher Education Vision 2020 submitted by Mission Group on Higher education policy Karnataka Jnana Aayoga (Karnataka Knowledge Commission) Government of Karnataka-December 2012.

5.2 Variables:
In order to study the performance of human development in Karnataka, the education and health sectors have considered. For co-integration and error correction models time series data of Net State Domestic Product (NSDP), Development Expenditure that is total revenue and capital account of plan and non-plan development expenditure, expenditure on education that is total expenditure on education in the state, and total health expenditure data series are used for econometric modelling which are taken from RBI handbook on states 2010 and Economic Survey-2017, Government of Karnataka.

5.3 Methods:
In order to determine the output and employment which are proxy for economic development in Karnataka state. In this study NSDP as economic growth that is dependent variable followed by physical and human capital as independent variables. The development expenditure is used as proxy for physical capital and expenditure on education and health is used as proxy for human capital. Tools like Johansen co-integration and Error Correction Model (ECM) for determining long run and short run relation between factors determining human capital formation in Karnataka. Granger causality test used to examine the causality relation among human capital formation determinants in Karnataka.

VI. REVIEW OF LITERATURE
Schultz(1999) overviewed the basic in order and analytical methodologies which are most essential required tools to evaluate the productive returns to investments in public health were only opening to be assembled. There were strong indications that health limitations were a pricey burden on the productive potential of adults in Africa and it was explained in earlier experiential study of Schultz and Tansel in 1993. A third or more of the gains in labour productivity achieved in the last two hundred years in Western Europe were correlated to improvements in health, nutrition, and resulting gains in adult height. Scattered surveys indicated that advancements in sustenance were reflected in gains in adult height in Africa as they were in the previous

period in Europe, and certainly life expectancy has risen more rapidly in Africa than it has in developed countries. But these recent health gains in low income countries were strongly related to increases in female education, per capita income, and in Africa with urbanization. As these indicators of growth in education and development have ceased to rise in many African countries consequence health improvements were slow or stagnate.

Waldow (2002) considered educational expenditure was an important and widely used indicator for the quantitative growth of educational systems and for human capital formation. However, educational expenditure was often difficult to measure correctly, especially in historical studies. The study focussed on the trouble of measurement, using the case of Sweden in the second half of the 19th and the early 20th century as an example. Official statistics used as main empirical basis for data on educational expenses. Their aim is to register the social, financial etc. conditions in a certain area as a qualification for modern, rational, bureaucratic modes of governing. The collection of data and the application of statistical categories to social reality possess a structuring force in itself. The main problems discussed in the paper were: imperfect monetarisation of the educational system in the 19th and early 20th centuries, mainly affecting the collection of data on primary schooling, the subsistence of a private sector of education, data on which were scarce, and the fact that some public educational institutions overcome sources of income other than the state and municipalities' budgets. The study concludes with some remarks on the particular problems these measurement difficulties create in comparative studies. The author strongly objected data gathering pattern and originality in Sweden country and argued only collecting the data according to standardised "labels" (e.g. "only public expenditure" etc.) was more a sign of a methodological fetish than of methodological rigidity. Instead, standardising the definitions will usually have to mean identifying functional equivalents and comparing them, for this, an friendly knowledge of the qualitative structural properties and system of financing of the studied educational systems is necessary.

Chani et. al (2012) empirically tested the casual relationship between human capital formation all the way through education and economic development in Pakistan. Keeping in view the endogenous growth theory, the study also tests direction of causality, also human capital formation causes economic development or economic development causes human capital or both of them are causing and following each other. The study investigated the informal relationship between economic development and formation of human capital in Pakistan. Based on endogenous growth theory, empirically tested the standard growth model consisting of Gross household Product (GDP) per capita as a dependent relative variable and human capital formation, asset in physical capital and labour force as independent variables. Auto Regressive Distributive Lag (ARDL) bound testing approach to cointegration was used to ensure the long run equilibrium relationship between the variables included in the model. For checking the causal relationship between economic development and human capital formation, Pair-wise Granger Causality test was utilized using the time series data ranging from 1972 to 2009. The results of the co-integration explain that the variables are co-integrated. They have long run stable equilibrium relationship. The marks of the causality test show that there was bidirectional causal relationship between economic development and human capital formation.

Shahzad (2015) observed the role of human capital formation on economic growth in Pakistan. The author time series data from the period of 1990 to 2013. The study included education enrolment index (Proxy of human capital), health (IMR) and physical capital (GFCF, IGR) as independent variables which were the major giver for the economic growth of Pakistan. Data manipulated from side to side least square multiple regression models by using E-view. The main variable human capital (Education Enrolment Index) has a positive significant collision on dependent variable GDP so it established that enrolment in education favoured for growth of the Pakistan economy and results were robust. Gross fixed capital formation (GFCF) has positive important impact on dependent variable furthermore investment growth rate (IGR) has highly significant and positive impact on GDP. There were negative but significant association between Infant Mortality Rate and consumer price index through gross domestic product of Pakistan respectively. These results recommended that both health and education sector should be given more notice to sustain the economic growth of Pakistan.

7. Long-run and Short-run Analysis of Human Capital Formation and Economic Development in Karnataka

The present study attempts to identify the implications of human capital formation on economic development in Karnataka state. In order to identify the association and regression results we need time series data of human capital formation specifically education and health at state level. Leeuwen (2006), Madsen et.al (2010), Chani et.al (2012), Mukherjee et.al (2014), Debgupta (2015), used endogenous growth theory for econometric modelling to identify implications of human capital formation on economic development in India and developing nations. Due to lack of time series data regarding education, health, research and development at Karnataka state level, the present study uses proxy variables based on previous literatures (Vishwanath et.al 2009; Shahzad 2015; and Awan et.al 2015). For example, development expenditure used as proxy for physical capital; education and health expenditure used as human capital formation. For economic growth in Karnataka,

NSDP (Net State Domestic Product) used as dependent variable. Therefore, expenditure on development activities, education and health taken as explanatory variables to identify impact on NSDP in the state. Time series data of annual data series from 1991 to 2015 are taken for econometric modelling in the study.

VII.   COINTEGRATION ANALYSIS

It is not possible for Yt to be a random walk and Xt and et to be covariance stationary. As Granger (1981) pointed out, because a random walk cannot be equal to a covariance-stationary process, the equation does not "balance". An equation balances when the processes on each side of the equal sign are of the same order of integration. Before attacking any applied problem within integrated variables, make sure that the equation balances before proceeding. An example from Engle and Granger (1987) provides more intuition. Redefine Y_t and x_t to be:

$$\mathbf{Y_t + \beta x_t = \varepsilon_t} \qquad\qquad \mathbf{\varepsilon_t = \varepsilon_{t-1} + \xi_t} \qquad\qquad \textbf{(3)}$$
$$\mathbf{Y_t + \alpha x_t = v_t} \qquad\qquad \mathbf{Y_t = \rho v_{t-1} + \zeta_t} \qquad \mathbf{|\rho| < 1} \qquad \textbf{(4)}$$

Where ξ_t and ζ_t are i.i.d. disturbances over time that are correlated with each other. Because ε_t is I(1), equations (3) and (4) imply that both x_t and Y_t are I(1). The condition that $|\rho| < 1$ implies that v_t and $y_t + \alpha x_t$ are I(0). Thus, y_t and x_t cointegrate, and $(1, \alpha)$ is the cointegrating vector. Rewrite the equations (3) and (4) as;

$$\mathbf{\Delta Y_t = \beta\, \delta\, z_{t-1} + \eta 1_t} \qquad\qquad \textbf{(5)}$$
$$\mathbf{\Delta X_t = -\, \delta\, z_{t-1} + \eta 2_t} \qquad\qquad \textbf{(6)}$$

where, $\delta = (1-\rho) / (\alpha - \beta)$, $z_t = y_t + \alpha x_t$, and $\eta 1_t$ and $\eta 2_t$ are distinct, stationary, linear combinations of ξ_t and ζ_t. This representation is known as the vector error-correction model (VECM). One can think of $z_t = 0$ as being the point at which y_t and x_t are in equilibrium. The coefficients on z_{t-1} describe how y_t and x_t adjust to z_{t-1} being nonzero, or out of equilibrium. z_t is the "error" in the system, and (5) and (6) describe how system adjusts or corrects back to the equilibrium. As $\mathbf{\rho}$ goes to 1, the system degenerates into a pair of correlated random walks. The VECM parameterization highlights this point, because $\mathbf{\delta \to 0}$ as $\mathbf{\rho \to 1}$.

The Multivariate VECM

In practice, most empirical applications analyse multivariate systems, so the rest of our discussion focuses on that case. Consider a VAR with p lags;

$$\mathbf{y_t = v + A_1 y_{t-1} + A_2 y_{t-2} + \ldots\ldots\ldots + A_p\, y_{t-p} + \varepsilon_t} \qquad\qquad \textbf{(7)}$$

Where y_t is a K x 1 vector of variables, v is a K x 1 vector of parameters, A_1–A_p are K x K matrices of parameters, and ε_t is a K x 1 vector of disturbances. ε_t has mean 0, has covariance matrix $\sum$, and is i.i.d. normal over time. Any VAR(p) can be rewritten as a VECM. Using some algebra, we can rewrite (7) in VECM form as

$$\mathbf{\Delta y_t = v + \textstyle\prod y_{t-1} + \sum_{i=1}^{p-1} \psi i\, \Delta\, y_{t-i} + \varepsilon_t} \qquad\qquad \textbf{(8)}$$
Where
$$\textstyle\prod = \sum_{j=1}^{j=p} A_j - I_k \qquad\qquad \psi_i = -\sum_{j=i+1}^{j=p} A_j\,.$$

The v and ε_t in equations (7) and (8) are identical. Engle and Granger (1987) show that if the variables Y_t are I (1) the matrix $\prod$ in (8) has rank $0 \le r < K$, where r is the number of linearly independent cointegrating vectors. If the variables cointegrate, $0 < r < K$ and equation (8) shows that a VAR in first differences is miss-specified because it omits the lagged level term $\prod y_{t-1}$.

Assume that $\prod$ has reduced rank $0 < r < K$ so that it can be expressed as $\prod = \alpha\beta$, where α and β are both r x K matrices of rank r. Without further restrictions, the cointegrating vectors are not identified: the parameters (α, β) are indistinguishable from the parameters $(\alpha Q, \beta Q^-)$ for any r x r non-singular matrix Q. Because only the rank of $\prod$ is identified, the VECM is said to identify the rank of the cointegrating space, or equivalently, the number of cointegrating vectors. In practice, the estimation of the parameters of a VECM requires at least r^2 identification restrictions. The conventional Johansen restrictions will be applied. The VECM in equation (8) also nests two important special cases. If the variables in y_t are I (1) but not cointegrated, $\prod$ is a matrix of zeros and thus has rank 0. If all the variables are I (0), $\prod$ has full rank K.

VIII.   RESULTS AND DISCUSSION

The present study attempts to investigate how expenditure on education, health and development expenditure help to economic growth that is NSDP (Net State Domestic Product) in Karnataka during reform period. The basic empirical study has two-way approach. The first one is to examine the long-run relationship between human capital formation and economic growth while the second is to examine the short-run dynamic causal relationship between education, health and NSDP. Before modelling, the basic testing procedure is

checking stationarity of each variables. The unit root test is done by using the Augmented Dickey–Fuller tests (ADF).Next step is for the existence of a long-run cointegrating relation between the variables through Johansen Cointegration method. Finally, the last step, if all variables are integrated of order one I(1) and cointegrated short-run elasticities can be computed using the vector error correction model (VECM) method suggested by Engle and Granger (1987).

Table 1: Unit Root Tests

Unit Root Test		
Augmented Dickey Fuller Unit Root Test (ADF)		
	At Level	**At 1st Difference**
NSDP	6.343400	-4.485364***
DE	4.465637	-4.680***
EE	3.091403	-4.155305***
HE	5.222543	-3.977676***

Note: NSDP denotes Net State Domestic Product, DE is Development Expenditure, EE is Education Expenditure, HE is Health Expenditure
*, ** and *** Denotes the rejection of the null hypothesis at 10%, 5%, 1% level of significance respectively.

Augmented Dickey–Fuller (ADF) unit root tests used to test the non-stationarity in a given data series. The unit root tests are displayed in Table 5.1. The test statistics for the log levels of NSDP, DE, EE and HE are statistically insignificant. The ADF unit root test to the first difference of all variables found to be stationary. Thus, the ADF test indicate that each variable is integrated of order one and stationary.

Correlation Analysis

The log differenced series of the NSDP, DE, EE and HE have positive association hence, there is positive correlation between each other. Table 5.2 shows correlation association among cointegration variables NSDP (i.e. economic growth), development expenditure (DE), expenditure on education (EE), health expenditure (HE).

Table 2

Pearson Correlation Coefficient Results			
	NSDP_LD	**DE_LD**	**EE_LD**
DE_LD	0.55	-	-
EE_LD	0.41	0.25	-
HE_LD	0.29	0.19	0.32
Correlation coefficients, using the observations 1992 - 2016 5% critical value (two-tailed) = 0.3961 for n = 25 *, ** and *** Denotes the rejection of the null hypothesis at 10%, 5%, 1% level of significance respectively. Note: NSDP_LD is log differenced Net State Domestic Product DE_LD is log differenced Development Expenditure EE_LD is log differenced Education Expenditure HE_LD is log differenced Health Expenditure			

All variables used in the correlation analysis are log differenced in order to avoid spurious results. Development expenditure has strong positive association with NSDP at 0.55 percentage followed by education expenditure and health expenditure have 0.41 percentage and 0.29 percentage positive association with NSDP respectively. In addition, development expenditure had 0.25 percentage positive association with education expenditure and 0.19 percentage association with health expenditure while health and education expenditure have 0.32 percentage positive associations. It shows that economic growth in Karnataka state has strong association with DE, EE and HE while education expenditure also has positive impact on health expenditure.

Cointegration: Long Run Analysis

The cointegration tests based on multivariate Johansen approach (1988) which uses two statistic tests namely: Trace test and Max-Eigen value. The likelihood Ratio (LR) test is based on the trace statistics (λ trace) which tests the H_0: $r \leq q$ against H_1: $q = r$ is calculated thus:

$$\lambda_{\text{trace}}(r) = -T\sum_{i+1}^{p} \ln(1 - \lambda i)$$

Where λr + i…. λn, are the least value of eigenvectors (p − r). The second test is the maximal eigenvalue test max (λ_{max}) which tests the (Null) H_0: there are r cointegrating vectors against the (Alternative) H_1: there are r +1cointegrating vectors and is calculated as follows:

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

Results of the Johansen cointegration tests are displayed in Table 2 below. The Trace test and Max-Eigen value suggest the existence of two cointegrating vectors at 5% of significance. Table 5.3 shows the cointegration tests of Trace and Max.

Table 3 Results for Trace and Max-Eigen Statistics

Hypothesized No of CE(s)	Trace Statistics	Max-Eigen Statistics
None	55.011*	36.033*
At most 1	18.978	13.642
At most 2	5.335	3.959
At most 3	1.375	1.375
Note: Trace and Max tests indicate 1 cointegrating equations at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values CE denotes Cointegrating Equations *, ** and *** Denotes the rejection of the null hypothesis at 10%, 5%, 1% level of significance respectively.		

Trace test and Max-Eigen statistics indicate there are one cointegrating equation at the 0.05 significance level and the existence of cointegration signifies that there is at least one long-run equilibrium relationship among the variables. Therefore, in this case, Granger causality exists among these variables in at least one way (Engle and Granger, 1987).

Table 4 Long-run elasticities

Dependent Variable: NSDP_L (Economic Growth)			
Explanatory	Coefficients	S. E	t-value
DE_L	1.72	0.20324	8.46***
EE_L	1.759	0.35234	4.99**
HE_L	1.27007	0.18239	6.96**

Note: *, ** and *** Denotes the rejection of the null hypothesis at 10%, 5%, 1% level of significance respectively and S.E denotes Standard Error.

To get a long-run relationship among the variables the coefficient of θ_i should be statistically significant. The results of the long-run equilibrium relationship are presented in Table 5.4. The result in table 5.4 shows that the coefficients of development expenditure (DE_L), education expenditure (EE_L) and health expenditure (HE_L) are1.72, 1.75 and 1.27 respectively which are positive and the development expenditure is significant at 1%, level of significance and remaining education and health expenditures are significant at 5% level of significance. It implies that a 1% increase in Karnataka state's growth (NSDP_L) will be explained by 1.72 percentage increase in development expenditure (DE_L) followed by 1.75 percentage increase in education expenditure (EE_L) and 1.27 percentage increase in health expenditure (HE_L) in the long-run. In this sense, Karnataka state economic growth and development dependent on both physical capital and human capital. Therefore, development expenditure along with human capital expenditure mainly education and health expenditures have long run cointegration association hence in the long run perspective of development health and education expenditure in Karnataka state have crucial role. Therefore, these results make us to accept the hypothesis that is **There is relation between human capital formation and economic development in Karnataka.**

Vector Error Correction: Short-run Analysis
The Vector Error Correction Model (VECM) is used to correct the short run disequilibrium in the cointegration relationship, as well as to test for long and short-run causality among cointegrated variables. The correction of the disequilibrium is done by the mean of the Error correction term (ECT). The present study uses multivariate VECM model which is specified as follows:

First Equation:$\Delta NSDP\_L_t = \alpha_1 + \sum_{i-1}^{P} \beta_{1i} \Delta NSDP\_L_{t-1} + \sum_{i-1}^{P} \beta_{2i} \Delta DE\_L_{t-1} + \sum_{i-1}^{P} \beta_{3i} \Delta EE\_L_{t-1} + \sum_{i-1}^{P} \beta_{4i} \Delta HE\_L_{t-1} + \theta_1 ECT_{t-1} + \varepsilon_{1t}$

Second Equation:$\Delta DE\_L_t = \alpha_1 + \sum_{i-1}^{P} \beta_{2i} \Delta DE\_L_{t-1} + \sum_{i-1}^{P} \beta_{1i} \Delta NSDP\_L_{t-1} + \sum_{i-1}^{P} \beta_{3i} \Delta EE\_L_{t-1} + \sum_{i-1}^{P} \beta_{4i} \Delta HE\_L_{t-1} + \theta_2 ECT_{t-1} + \varepsilon_{1t}$

Third Equation:$\Delta EE\_L_t = \alpha_1 + \sum_{i-1}^{P} \beta_{3i} \Delta EE\_L_{t-1} + \sum_{i-1}^{P} \beta_{1i} \Delta NSDP\_L_{t-1} + \sum_{i-1}^{P} \beta_{2i} \Delta DE\_L_{t-1} + \sum_{i-1}^{P} \beta_{4i} \Delta HE\_L_{t-1} + \theta_3 ECT_{t-1} + \varepsilon_{1t}$

Fourth Equation:$\Delta LHE\_L_t = \alpha_1 + \sum_{i-1}^{P} \beta_{4i} \Delta HE\_L_{t-1} + \sum_{i-1}^{P} \beta_{1i} \Delta NSDP\_L_{t-1} + \sum_{i-1}^{P} \beta_{2i} \Delta DE\_L_{t-1} + \sum_{i-1}^{P} \beta_{3i} \Delta EE\_L_{t-1} + \theta_4 ECT_{t-1} + \varepsilon_{1t}$

Where, $\Delta NSDP\_L$, ΔDE_L, ΔEE_L, ΔHE_L are endogenous variables that is Karnataka state economic development (i.e NSDP as proxy variable), development expenditure (DE_L), education expenditure (EE_L) It implies that in short-run, two of these variables have not contributed significant short run divergence in NSDP but positive values of DE imply that short run adjustment of errors is immediately rather lag effect and negative values of HE implies that short run adjustment of errors is slow and had lag effect. However, the education expenditure does have significant impact on NSDP of Karnataka in the short run. and health expenditure (HE_L) respectively.$\alpha_1$are constant and ε_t are the serially uncorrelated random error terms. The $ECT_{t-1}$is the cointegrating vectors and θ_i is the adjustment coefficient indicating the weight of adjusted disequilibrium in the past.

Vector error Correction Model (VECM) Results

The multivariate error correction mechanism that is VECM used for understanding any divergence in short run and it explains short term adjustment time period needed for long run convergence level and cointegration. The VECM results are presented in table 5.5. The long run analysis showed that there is one cointegrating equation and further short-run relation explained by vector error correction model and it shows the short term adjusting factors. Table 5.5 illustrates the short run results of VECM model where NSDP (i.e. Karnataka state Net State Domestic Product) is the dependent variable. Based on lag length selection criteria of AIC (Akaike Information Criteria) and SBC (Scharj Bayesian Information Criterion), two lag lengths have chosen for analysis. Since the optimal lag length is two which is based on information criteria, the short-run results are also presented for two lags of each variable. The error correction term in our VECM model is negative at -0.423 with statistically significant at 5 percentage which is illustrated in table 5.4. Therefore, short term deviation from development expenditure, education and health expenditures can be adjusted -0.423 percentage that is around five to six months for long run convergence.

Table 5 VECM results based on Johansen cointegration

Equation 1: NSDP is dependent variable		
	Coefficient	**t-ratio**
Constant	0.100033	2.569**
NSDP	−0.318470	−1.640
DE	0.0167076	0.07721
EE	1.0634	3.147***
HE	−0.189336	−0.8464
Error Correction	−0.423932	−2.862**

Note: *** denotes the rejection of null-hypothesis at 1% significance levels.
** denotes the rejection of null-hypothesis at 5% significance levels.

The coefficient of the lagged error correction terms of EE is positive an statistically insignificant at the 1 percent level while NSDP and HE are negative and insignificant while DE is positive and statistically insignificant. Therefore, short term deviation of education expenditure takes -0.189 percent that is almost one year at least for short run equilibrium to maintain long run convergence level. This relationship shows the crucial role education and education expenditure in the context of growth and development in Karnataka state. Therefore, economic development in Karnataka state is primarily dependent on physical capital that is development expenditure as well as human capital that is education and health.

The positive coefficient of education expenditure (EE) indicates that deviations from the short run to the long run are corrected by within a year which is huge error due to lagged influence of fund allocation and expenditure on education and human capital formation. The negative coefficient of NSDP itself and health expenditure (HE)and positive sign of development expenditure (DE)is an indication of short run relationship among economic growth (NSDP) while their respective coefficients are statistically insignificant, hence only education expenditure to be corrected in the short run while other variables adjust itself very soon. The results of

the short-run analysis seem interesting in the sense that, the development expenditure and health expenditure are statistically in significant but positive and negative respectively. It implies that in short-run, two of these variables have not contributed significant short run divergence in NSDP but positive values of DE imply that short run adjustment of errors is immediately rather lag effect and negative values of HE implies that short run adjustment of errors is slow and had lag effect. However, the education expenditure does have significant impact on NSDP of Karnataka in the short run.

Diagnostics and Model Adequacy

The stability of the VECM model was checked by various diagnostic tests. The results are reported in the table 5.6 which confirms that the model has the aspiration econometric properties: it has a correct functional form and the model's residuals are serially uncorrelated, normally distributed and homoscedastic. Moreover, R^2 shows that the model is a relatively good fit. Hence, the results reported are valid for reliable interpretation.

Table 6: Model Adequacy Test

Diagnostic Tests	p-value
White test	0.8041
Normality Test	0.5108
ARCH-LM test	0.2846
R-Square	0.54

Source: Estimated from Eviews and Gretl softwares

Granger Causality Test

In order to know causality among variables the study further inspect the direction of causality between the different variables of the model. The basic methodology requires conducting four Granger causality tests: pair wise Granger causality. The first test reveals the significance of the sum of three lagged terms of each explanatory variable by the mean of Chi-square test (χ- test). Table 5.7 illustrates the results of VECM Granger causality tests or block erogeneity Wald test. The empirical results of Granger causality analysis show that, one of the most important conclusions is the existence of unidirectional causality between education expenditure and NSDP, DE, HE in the short run while bidirectional causality between NSDP and EE.

Table 7 Results of the Granger causality tests

VECM-Granger Causality/Block Exogeneity Wald Test				
Dependent variable	**Excluded**			
NSDP	**DE**	**EE**	**HE**	**All**
	0.59	6.203**	2.61	9.83
DE	**NSDP**	**EE**	**HE**	**All**
	2.28	2.93	4.03	7.95
EE	**NSDP**	DE	**HE**	**All**
	6.48**	0.16	0.86	13.43**
HE	**NSDP**	DE	**EE**	**All**
	0.24	1.24	0.23	4.95
Note: coefficient values are Chi-square test statistic.				
*** denotes significance at 1%, ** at 5% and * at 10% significance level.				

The Chi-square statistics for NSDP on DE, EE and HE are jointly insignificant but education expenditure (EE) Granger cause on NSDP at 5 percentage significance level. Similarly, NSDP Granger cause on education expenditure (EE) while DE and HE are insignificant and does not Granger cause on NSDP but jointly NSDP, DE and HE Granger cause on education expenditure. Therefore, education expenditure and NSDP have bidirectional causality that is both have causality each other in the short run. This means that there exists a dynamic connection between the two variables education expenditure and Karnataka state economic growth (i.e. NSDP). It proves that expenditure on education will help to produce more goods and services and in turn help for economic growth through increasing income, employment and output over the period. Consequence, dynamic of investment on education encourages human capital formation in India and also positively impacts on Karnataka economic growth. Therefore, these results make us to reject the hypothesis that is **There is no association between economic growth and human capital expenditures.**

9. Findings and Suggestions:

- The correlation results show that economic growth in Karnataka state has strong positive correlation with development expenditure, education and health expenditures during reform period while education expenditure also has positive impact on health expenditure.
- Johansen Co integration showed there is long run relation between economic growth with development expenditure, education and health expenditures.
- The long run elasticities showed that one percent increase in economic growth in Karnataka state is explained by increases in expenditure on development activities 1.72%, education 1.755 and health 1.27%.
- The short run analysis of VECM results showed that the speed of error correction in the short run due long run divergence can be corrected within five to six months (i.e. error correction -0.42 percent) and only expenditure on education has short run divergence which would be adjusted after one year. Therefore, the short run divergence of long run cointegration is much affected by education expenditure hence, education expenditure does have significant impact on economic growth of Karnataka in the long run. The health expenditure coefficient is not significant but it is negative value of -0.18 which is implied as at least three months would be taken for correction short run divergence.
- The VECM-Granger Causality test showed that there is bidirectional causality and dynamic connection between the two variables education expenditure and Karnataka state economic growth in the short run. Therefore, dynamic of investment on education encourages human capital formation in India and also positively impacts on Karnataka economic growth.

IX. CONCLUSION

The purpose of present study is to investigate whether the improvement in education and health conditions help to human capital formation and in turn promoted economic growth in Karnataka state during last three decades. The empirical analysis is conducted through a correlation analysis and time series econometrics based on Johansen cointegration and vector error correction model to detect long run and short run causality between variables of the model respectively. The correlation results showed that economic growth has strong positive association with development expenditure, education and health expenditure while education expenditure has positive association with health expenditure, it implies that expenditure on human capital formation definitely helps to economic growth in the long run at least not immediately. Regarding the long run estimation, the empirical results found evidence of expenditure on development activities and education helped for economic growth in Karnataka while health variables are not significant but it has indirect implication on growth prospect. The positive and statistically significant effect of development expenditure and education expenditure are complementing economic growth and development in our state while Karnataka is the knowledge hub in India especially Bengaluru. The long-run estimation shows that development expenditure and expenditure on education are the main engine of economic growth and income generation in Karnataka. It implies that promoting more education by quality and skill will definitely help to Karnataka economic development further.

The short run analysis of VECM showed that around five to six months have taken for short term adjustment to smooth out long run equilibrium. The short run divergence is only from education expenditure in our model and error correction of education expenditure takes almost one year for long run convergence from short run divergence. The empirical results of Granger causality analysis show that, one of the most important conclusions is the existence of unidirectional causality between education expenditure and NSDP, DE, HE in the short run while bidirectional causality between NSDP and EE. This relationship shows the crucial role education and education expenditure in the context of growth and development in Karnataka state. Therefore, economic development in Karnataka state is primarily dependent on physical capital that is development expenditure as well as human capital that is education and health.

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