

## HUMAN CAPITAL FORMATION AND ECONOMIC DEVELOPMENT : A CAUSALITY ANALYSIS

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Human Capital;  
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*The issue of causality is the foundation of any study that examines an economic relationship. There is a need to understand how a change in one variable affects another in comprehending economic behaviour and in the formulation of economic policies. This paper attempts to establish causality between HDI as a proxy for Human Capital Formation and Per Capita Income PPP as proxy for economic development by using Granger Causality Test. The study found that the causality between the two is bidirectional, however, if the variable is taken with a lag the causality becomes unidirectional.*

### INTRODUCTION

The country's potential to grow is not only dependent on its physical resources but also on its human resources. Thus, the human capital formation has a pivotal role in the process of development. Human capital formation is both qualitative and quantitative in the sense that it involves attainment of skills, education and experience as well as enhancing the number of individuals who possess these and is essential for economic development. Economic development in turn also influences individuals, their education, health and living conditions. Thus, there is a bidirectional relationship between economic development and human development which can be explained in many ways. Firstly, emphasis of investment on education, health, skills of people can enable them to participate in the process of development and share its benefits through productive and gainful employment. Better health and education results in productive and efficient labour force. Thus investment in education and health promotes economic growth. Secondly, investment in human capital in the form of job training benefits the firms directly in the form of increased production. Since industrial production as a whole also tends to increase, the nation also benefits. Thirdly, improvement in the health of masses increases their productive capacity and leads to qualitative improvement in human capital. Therefore, expenditure on health and education is important in building and maintaining a

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productive labour force as well as in improving the lives of people and the quality of society (UNDP, 1995). Thus, the human capital formation and economic development are closely related, so it is imperative to know the direction of causality between them. This paper undertakes the analysis for finding out the type and the direction of relationship between the two.

In this paper we have attempted to establish causality between the two by using Human Development Index (HDI) as a proxy for human capital formation and per capita income PPP as proxy for economic development.

## **REVIEW OF LITERATURE**

The studies which have analyzed the relationship between economic development and human capital formation used either growth accounting framework (Baumol, 1986; Barrow, 1991; Barro and Lee, 1993) or endogenous growth models (Lucas, 1988; Grossman and Helpman, 1991). The growth accounting framework suggests that with education the productivity of the human stock increases which ultimately contributes to growth and development. The endogenous growth models of Romer et al. (1990) assume that the creation of new ideas is a direct function of human capital which is manifest in the form of scientific knowledge. De Meulomeaster and Rochat (1995) test the Granger Causality between higher education enrollments and economic growth in six countries and found unidirectional short run Granger Causality running from higher education enrollments to economic growth in Sweden, United Kingdom, Japan and France and neutrality between higher education enrollments and economic growth in Australia and Italy. In and Doucouliagos (1997) examined the causal relationship between economic growth and human capital formation using US annual data from 1949 to 1984 and found strong evidence of bidirectional causality. Odusola (1998) examined the relationship between human capital investment and economic growth in Nigeria. The findings from the study indicate that the relationship between human capital and economic growth is weak in Nigeria although positively related. Dholakia (2003) examined the trends in regional disparity in India's economic and human development and found a two way causality between the two and suggested that emphasis on economic growth is likely to address the issue of disparities in income and human development speedily. Ghosh (2006) evaluates the relative performance of 15 major Indian states on human development and found the two way nexus between economic growth and human development. The estimates of cross sectional growth regression provide strong evidence of regional convergence in human development despite considerable divergence in real per capita income, indicating that the poor states that have failed to catch up with the rich ones in terms of per capita income have managed to catch up in terms of human development. Salisu and Ayinla (2007) examined empirically the causal impact of education on growth in Nigeria between 1970 and 2004 by breaking down education into primary, secondary and tertiary levels. The results suggest that only primary education has a causal linkage with growth in Nigeria.

## **DATABASE AND METHODOLOGY**

To examine the causal relationship between human capital formation and economic development the data for per capita income PPP and HDI were taken for the period 1980-2005 for 100 countries. The data were taken from UNDP Human Development Reports, World Development Reports, World Tables and World Development Indicators. The pooling of the data was done to perform the Granger Causality Test. To check the stationarity of the data panel, unit root test given by Breitung (2002) was applied.

Consider the null hypothesis that the time series  $Y_t$ ,  $t = 1, \dots, n$ , is a unit root process:

$$H_0: Y_t = Y_{t-1} + U_t$$

Alternatively  $Y_t$  is a Zero-mean stationary process

$$H_1: Y_t = U_t$$

Where in both cases  $U_t$  is a zero mean time series process

Breitung non-parametric unit root test is based on the idea of computation of the partial sums.

$$S_t = \sum_{j=1}^t Y_j \text{ and then the ratio}$$

$$(1/n^2) S_t$$

$$B_n = (1/2) \sum_{t=1}^n Y_t$$

Breitung shows that under the unit root hypothesis

$$B_n / n^2$$

whereas under the alternative hypothesis

$$1$$

$$B_n(2/2) W(x)^2 dx$$

$$0$$

The causal relationship between HDI denoted by  $X$  and per capita income (PCI) denoted by  $Y$  in the equations that have been tested by applying Sims test (Sims, 1972) based on Granger's (Granger's 1969) definition of causality. This test states that if past values of a variable  $Y$  significantly contribute to forecast the value of another variable  $X_{t+1}$  then  $Y$  is said to Granger cause  $X$  and vice-versa. The test is based on the following two sets of hypothesis:

(i)  $H_0$ : HDI ( $X$ ) does not granger cause PCI ( $Y$ )

(ii)  $H_1$ : HDI ( $X$ ) Granger cause PCI ( $Y$ ) ( $X \rightarrow Y$ )

In Sims approach, Granger causality relationship is expressed in two pairs of regression equations by simply trusting independent and dependent variable as follows.

$$X_t = \beta_{1,1} X_{t-1} + \beta_{1,2} X_{t-2} + \dots + \beta_{1,n} X_{t-n} + \beta_{2,1} Y_{t-1} + \beta_{2,2} Y_{t-2} + \dots + \beta_{2,n} Y_{t-n} + u_{1,t} \quad (1)$$

$$Y_t = \beta_{2,1} Y_{t-1} + \beta_{2,2} Y_{t-2} + \dots + \beta_{2,n} Y_{t-n} + \beta_{1,1} X_{t-1} + \beta_{1,2} X_{t-2} + \dots + \beta_{1,n} X_{t-n} + u_{2,t} \quad (2)$$

$$X_t = \beta_{1,1} X_{t-1} + \beta_{1,2} X_{t-2} + \dots + \beta_{1,n} X_{t-n} + \mu_{1,t} \quad (3)$$

$$Y_t = \beta_{2,1} Y_{t-1} + \beta_{2,2} Y_{t-2} + \dots + \beta_{2,n} Y_{t-n} + \mu_{2,t} \quad (4)$$

Equations (1) and (2) are called unrestricted

Whereas (3) and (4) are restricted.

According to Granger's definition of causal relationship

$$Y \text{ does not cause } X, \text{ if } \beta_{2,1} = \beta_{2,2} = \dots = \beta_{2,n} = 0 \quad (5)$$

$$X \text{ does not cause } Y, \text{ if } \beta_{1,1} = \beta_{1,2} = \dots = \beta_{1,n} = 0 \quad (6)$$

In order to judge whether these conditions hold, Sims employed the following F-statistic to equations (1) and (2) relative to equations (3) and (4):

$$F = [(R_{UR}^2 - R_R^2)/m] / [(1 - R_{UR}^2) / (n-2m-1)] \quad (7)$$

Where

$R^2_{UR}$  = the coefficient of determination of unrestricted equation [Eqs. 1 & 2]

$R^2_R$  = the coefficient of determination of restricted equation [Eqs 3&4]

n = number of observations

m = number of lagged periods.

With Sims test, the direction of causality based on equations 5 and 6 which can be either unidirectional or bidirectional or independent is judged as follows:

The result of F-Test	Direction of Causality
1) (5) holds, (6) does not hold:	X causes Y ( $X \rightarrow Y$ )
2) (5) does not hold, (6) holds:	Y causes X ( $Y \rightarrow X$ )
3) Both (5) and (6) hold:	Bidirectional between X and Y ( $X \leftrightarrow Y$ )
4) Neither (5) nor (6) hold:	X and Y are independent

The test is performed at lag length of 2. The significance of calculated F value has been checked by considering p-value of F statistic.

## RESULTS AND DISCUSSION

The result of the unit root test as suggested by Breitung is presented in table 1 for the variables per capita income and human development index.

**Table-1, Results for the Breitung Unit Root Test**

Variable	t-statistic	Probability	Cross Section
PCI	-21.7101	0	100
HDI	-8.36692	0	100

The results presented in the table show that the value of t statistic is significant 1% level of significance. Thus the null hypothesis for existence of unit root is rejected for both the variables. Hence both the variables are of Zero-mean stationarity and are integrated of order zero.

After determining the stationarity, analysis was further extended to determine the causal relationship between HDI (X) and PCI (Y) by applying Granger test. As both the series are of zero-mean stationarity and thus of same wavelength, so both the series have been considered to test the causality. The lag length 2 has been selected on the basis of Akaike Information Criteria. The results of the Granger causality are presented in table-2.

**Table-2, Results of Granger Causality Test HDI (X) Versus PCI (Y)**

Null Hypothesis	F values	P-values
I HDI(X) does not Granger cause PCI (Y) lag 2	83.1679	2.4E-35
II PCI(Y) does not Granger cause HDI (X) lag 2	4.56314	.01054

The table shows that first set of null hypothesis that HDI does not Granger cause PCI is rejected at 1% level of significance and the null hypothesis that PCI does not Granger cause HDI is rejected at 10% level of significance. Thus bidirectional causality holds between HDI and PCI.

Effort has also been made to test the causality between the two variables by taking PCI PPP at a lag of one, two, three, four and five years. This was done to see whether today's human development is a result of previous year's growth. The results of the Granger Causality test are presented in Table-3.

**Table-3, Results of the Granger Causality Test**

	<b>Null Hypothesis:</b>	<b>F-Values</b>	<b>P-Values</b>
	• <b>At PCI (t-5)</b>		
<b>I</b>	HDI(X) does not Granger cause PCI (Y)	0.78132	0.45795
<b>II</b>	PCI (Y) does not Granger cause HDI (X)	3.05974	0.04713
	• <b>At PCI (t-4)</b>		
<b>I</b>	HDI(X) does not Granger cause PCI (Y)	0.64610	0.52420
<b>II</b>	PCI (Y) does not Granger cause HDI (X)	2.81787	0.05998
	• <b>At PCI (t-3)</b>		
<b>I</b>	HDI(X) does not Granger cause PCI (Y)	0.65997	0.51698
<b>II</b>	PCI (Y) does not Granger cause HDI (X)	2.77788	0.06242
	• <b>At PCI (t-2)</b>		
<b>I</b>	HDI(X) does not Granger cause PCI (Y)	0.63388	0.53064
<b>II</b>	PCI (Y) does not Granger cause HDI (X)	2.86670	0.05713
	• <b>At PCI (t-1)</b>		
<b>I</b>	HDI(X) does not Granger cause PCI (Y)	0.72722	0.48338
<b>II</b>	PCI (Y) does not Granger cause HDI (X)	3.08238	0.04608

The table shows that first set of null hypothesis that HDI does not Granger cause PCI is not rejected in all the cases when PCI is taken at a lag of one, two, three, four and five years. The null hypothesis that PCI does not Granger cause HDI is rejected at 10 percent level of significance. Thus there is a unidirectional causality between per capita income and human development index (Y'!X) for these years of study. It means that presents day human development is influenced by the income earned in the past years. In other words present growth will lead to human development in the future.

The analysis was further extended to find out whether improved human capital leads to growth or not. This has been tested by taking human development index of period t with PCI t+i years. In the present exercise i takes the value 3, 5, 7 & 9. The results of causality analysis are presented in table-4.

**Table-4, Results of Causality Analysis**

Null Hypothesis		F-Values	P-Values
• <b>At PCI (t+3)</b>			
<b>I</b>	HDI(X) does not Granger cause PCI (Y)	19.9390	2.8E-09
<b>II</b>	PCI (Y) does not Granger cause HDI (X)	8.01042	.00035
• <b>At PCI (t+5)</b>			
<b>I</b>	HDI(X) does not Granger cause PCI (Y)	20.5417	1.60E-09
<b>II</b>	PCI (Y) does not Granger cause HDI (X)	7.73821	.00045
• <b>At PCI (t+7)</b>			
<b>I</b>	HDI(X) does not Granger cause PCI (Y)	21.0807	9.90E-10
<b>II</b>	PCI (Y) does not Granger cause HDI (X)	5.59607	0.00381
• <b>At PCI (t+9)</b>			
<b>I</b>	HDI(X) does not Granger cause PCI (Y)	19.9323	3.20E-09
<b>II</b>	PCI (Y) does not Granger cause HDI (X)	4.67215	.00954

The table shows that the first set of null hypothesis that HDI does not Granger cause PCI is rejected at 1% level of significance and the null hypothesis PCI does not Granger cause HDI is also rejected and hence bidirectional causality is established. Thus, it was found that human capital formation leads to growth which in turn further leads to improvement in the human capital formation.

## CONCLUSION

It was found that there is bidirectional causality between the human capital formation and economic development. However, when per capita income is taken with a lag then causality became unidirectional. This indicates the fact that growth is important for human capital formation and once there is a desired level of human capital formation it contributes to economic growth. Thus, human capital formation and economic development are very much closely related. Without quality human resources economic development is not thinkable because better human capital can exploit the infrastructure and other physical resources to the optimum level resulting in higher income and employment thereby leading to further increase in income. Thus, economic development results in improving the standard of living of the people.

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