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Public Health Expenditure and Economic Growth in India & China.

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ABSTRACT

Human capital constitutes a significant ingredient of economic growth. As more and more countries are moving on the path of growth and development one needs to explore the contribution of human capital in economic growth. This paper empirically investigates the relationship between the two important variables: public health expenditure and economic growth for India and China based on the data available for the period of 1970-2016. The two variables are tested by using a model which includes Gross Domestic Product (GDP), Public Health Expenditure (PHE), employment, investment, energy use. On applying the Augmented Dickey Fuller and Granger Causality test, it is concluded that in both the countries the variables become stationary at one lag time period and there exists uni-directional causality between economic growth and PHE or annual growth rate of GDP granger causes PHE in both India and China. In case of China PHE granger causes employment.

Key words: Co-integration, Economic growth, Granger causality, Human Capital.

INTRODUCTION

Health, the state of being physically, mentally and socially sound in addition to the absence of illness is one of the key features of human resource. Health is a crucial determinant of economic growth for numerous reasons. First, a healthier workforce is more productive as it largely implies less frequent leaves, better school attendance records and better cognitive functions. Second, a healthier population tends to save more by avoiding expenditure on medicines and treatment. These savings further find their way to productive investment and contribute to economic growth. Better health therefore builds the strong foundation of economic growth. Public Health Expenditure (PHE) is an indicator of good health since it reflects the effort made by a government towards building human capital. Investments in health through programmatic and financial commitments by the public sector can help stimulate development. Thus, PHE finds space in our study as a proxy of health welfare.

On the other hand, a higher Gross Domestic product (GDP) reflects economic growth and therefore larger focus and capacity of government to finance expenditure on good health in the economy. A higher GDP and hence a higher income implies that more resources are available to the government to be spent on public health, thus implying a direct relationship

between them. Hence, income has acquired an integral role as a determinant in the level of PHE across countries. At the same time, it is probable that a higher income can result in people opting for better quality services offered usually by private sector, decreasing the PHE. Hence, a unidirectional relationship from economic growth to PHE or vice-versa or both between the two variables is expected.

In the context of examining the bi-directional or uni-directional relationship between PHE and economic growth, it is crucial to explore this relationship specifically for developing nations which have scarcity of capital, but with growth it is crucial for these economies to strengthen the status of human capital; and therefore it becomes inevitable for the government to spend on health of its people. Having understood the need and significance of PHE, this Paper attempts to explore the relationship between PHE and economic growth in India and China.

We aim to examine the long and short-term relationship between economic growth (measured as growth rates) and PHE (measured as a percentage of GDP) for India and China for the period 1970-2016.

Using the Granger Causality Test, the long-term relationship between PHE and economic growth is tested by creating the model which includes variables such as GDP, PHE, employment, investment, energy use by using the method of co-integration.

An interesting study by (Habibullah Khan, Fall 2015) concluded that there exists a bi-directional relationship between social expenditure and economic growth in case of Australia and New Zealand and derived lessons for fast developing ASEAN economies. This result further suggests that the developing nations should not neglect social welfare since it is evident that there is a positive linkage between social welfare expenditure and economic growth.

(Tiemin Zhai, 2017) studied health expenditure in two decades (1993-2012) in China and observed it to grow at a rate of 11.6% per year much faster than the growth of the country's economy (9.9% per year). He concluded that to reduce the growth in expenditure per case of disease and to ensure that excess health price inflation does not grow out of control, measures should be taken to strengthen the capacity of health personnel in grass-roots facilities and to establish an effective referral system.

(Mohapatra, 2017) investigated the bi-directional causal linkages between economic growth and public expenditure on health; public expenditure on health and infant mortality rate; and economic growth and infant mortality in the Indian context. The study highlights the linkage between economic growth and PHE to achieve better results, suggesting that GDP granger causes PHE both in the short and long-run but PHE granger causes GDP only in the long run.

(Haldar, 2008) states that a wide range of variation of income, health expenditure and health status across 15 states in India, from 1980-81 to 2005-06. In the study, interconnections and causality is examined between socio-economic status of health, income and health expenditure using Granger Causality and concludes that the results vary across states.

(Ritwik Sasmal, 2016) demonstrated how public policy and public finance can be used as instruments for removal of poverty for the case of India. The study showed that in states where ratio of public expenditure on the development of infrastructure such as road, irrigation, power, transport and communication is high, there, per capita income is also higher and poverty is lower, thus indicating that economic growth is important for poverty

alleviation and development of infrastructure is necessary for growth.

(Li, May 2016) constructed a simple model to examine decisions on public and private health spending under majority voting, a quantitative exercise concluded the importance of the relative effectiveness of public and private health expenditure and their substitutability in determining the public-private mix of health expenditure.

(Weil, 2014) examined the relationship between health and economic growth across both the countries. We see income per capita is highly correlated with health, as measured by life expectancy or a number of other indicators. Within countries, there is also a correlation between people's health and income. They concluded that causality runs in both directions.

(Bloom, 2001) concluded that healthy individuals tend to live longer and get motivated to invest in their abilities therefore increase their human capital value which in turn will positively affect income. This study further connected the findings of Smith Life Cycle model (1999) establishing the relationship between health status, future income, welfare and consumption.

(Suzanne K. McCoskeya, June 1998) presents a unit root test results for time series on per capita national health care expenditures and GDP in the Organization for Economic Cooperation and Development (OECD). Unlike the country-by-country test used by (P Hansen, 1996) the test employed here exploits the panel nature of the OECD data. Using this approach, results are able to reject the null hypothesis that these series contain unit roots. No single test is likely to be definitive in this rapidly-evolving area of econometric research.

(SantiagoLago-Peñas, May 2013) analyzed the relationship between income and health expenditure in 31 OECD countries. They focused on the differences between short and long-term elasticity; and checked the adjustment process of health care expenditure to changes in per capita Gross Domestic Product (GDP) and its cyclical and trend components. Econometric results show that the long-run income elasticity is close to unity; and that the adjustment to income changes in countries with a higher share of private health expenditure over total expenditure is faster.

METHODOLOGY

The aim of the paper is to examine the relationship between PHE and economic growth in developing countries like India and China while also assessing the role or effect of other factors in determining the relationship of PHE and economic growth. The data related to the variables considered for the analysis are obtained for the time period 1970 - 2016 from the World Bank databank.

Various sophisticated econometric techniques have been used to test the relationship. Augmented Dickey Fuller test is used to identify the unit root. If there are unit roots existing then it generally expected that the variables might have a long-term relationship.

Unit Root

When the time series data is used to test any hypothesis, it is usually expected that the data is non-stationary. This implies that the data has a unit root. In such cases, Dickey Fuller test is used to test the presence of unit root. David Dickey and Wayne Fuller originated the

methodology for testing unit root in 1979. The null hypothesis for such a test is that the variable under consideration has a unit test. The null hypothesis includes a drift term in order to test whether the regression obtains a test statistics that includes a constant and a time trend.

1. Test for unit root :$\Delta Y_t = \delta y_{t-1} + \mu_t$
2. Test for a unit root with drift: $\Delta Y_t = \alpha_0 + \delta y_{t-1} + \mu_t$

Test for a unit root with drift and deterministic time trend:

$$\Delta Y_t = \alpha_0 + \alpha_1 t + \delta y_{t-1} + \mu_t$$

In each case, null hypothesis is that there is a unit root $\delta = 0$.

Consider the following equation

$$\Delta Y_t = \alpha_0 + \mu_t$$

The above equation can be written as

$y_t = y_O + \sum \mu_t + \alpha_0 t$ with deterministic trend coming from $\alpha_0 t$ and a stochastic intercept term from $y_O + \sum \mu_t$ referred to as stochastic trend.

Granger Causality Test

This test is crucial for testing whether one time series could be used to determine or to forecast the other time series. This test was developed by Granger in 1969 and came to be known as Granger – Causality. The test involves the estimation of the Vector Auto regressions, which are also commonly known as VAR.

$$X_t = \sum \alpha_i Y_{t-i} + \sum \beta_j X_{t-j} + \mu_{1t}$$
$$Y_t = \sum \lambda_i Y_{t-i} + \sum \delta_j X\ t\text{-}j + \mu_{2t}$$

μ_{1t} and μ_{2t} are the error terms that are uncorrelated. Here the Granger Causality implies that the lagged values of Y can influence X variable while the lagged values of X can also influence Y variable.

The aim of this paper is to examine the relationship between PHE and economic growth while also identifying the factors affecting this relationship. This relationship is tested for India and China for the time period 1970-2016.

The variables GDP, PHE, employment, investment, energy use are the key macroeconomic variables which play a critical role in growth and development of economy. PHE as percentage of GDP serves as a good indicator of health expenditure while GDP annual growth rate indicates economic growth adequately. Investment is depicted by gross capital formation as percentage of GDP while employment status of a country is revealed by employment to population ratio 15+ as percentage of total. Energy consumption per capita indicates the energy intensity of a country basically reflecting the requirement of energy which is indirectly a part of demand for the infrastructure.

Since both India and China are rapidly developing economies of South Asia, they need to concentrate on the development of their human capital. In this study, human capital is captured by PHE. There are other variables too that are significant in growing economies like employment, infrastructure, investment which are equally critical for economic growth and in turn get affected by economic growth. The objective of the paper is to specifically examine the relationship or causality between economic growth and PHE and in turn identify the impact or relationship with other chosen variables. Figure I. effectively depicts the

relationship between the concerned variables.

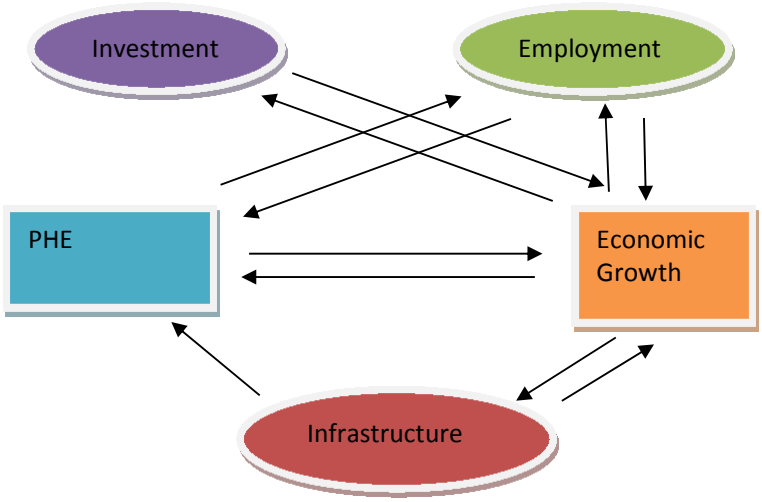


Figure I: Linkages between PHE and economic growth and effect of other variables.

It is evident and also plausible that the variables under consideration, mainly economic growth, employment, PHE, infrastructure − all have two-way causality and at the same time they effect each other either directly or indirectly. The linkages hypothesized in Figure I. would also be equally tested for both the developing nations for the time period 1970-2016 while categorically evaluating the relationship between economic growth and PHE.

RESULTS AND DATA

Data

The data for selected variables have been obtained from World Bank data set for the time period 1970-2016 for the countries, India and China. The various variables considered are as prescribed in Table-I.

Table-I: Variable Description

S No.	Variables	Indicators	Symbols	Units	Data Source
1.	Health Expenditure	Health expenditure, public (% of GDP)	HE	%	http://data.worldbank.org/
2	Economic Growth	GDP growth (annual %)	GDP	%	http://data.worldbank.org/
3	Investment	Gross capital formation (% of GDP)	GCF	%	http://data.worldbank.org/
4	Employment	Employment to population ratio, 15+, total (%) (modeled ILO estimate)	N	%	http://data.worldbank.org/
5	Infrastructure Requirement	Energy use (kg of oil equivalent per capita)	ENGY	per capita	http://data.worldbank.org/

Some basic statistical analysis for the selected variables is given in Table II.

Table-II: Descriptive statistics for variables in case of India

	GDP	HE	N	Engy	GCF
Mean	5.62109	1.141414	56.46138	394.312	27.46768
Standard Error	0.435757	0.012714	0.284444	16.68121	1.061047
Median	5.947343	1.134555	57.19261	365.8344	26.42433
Mode	#N/A	1.407238	#N/A	637.4286	#N/A
Standard deviation	2.987403	0.087165	1.95005	114.3606	7.274169
Sample Variance	8.924575	0.007598	3.802695	13078.35	52.91353
Kurtosis	2.592458	4.059545	1.244755	-0.35361	-0.7415
Skewness	-1.16523	1.661226	-1.60159	0.846176	0.549401
Range	15.49815	0.422307	6.747002	369.3468	26.12214
Minimum	-5.23818	0.984931	51.774	268.0818	16.35411
Maximum	10.25996	1.407238	58.521	637.4286	42.47625
Sum	264.1912	53.64647	2653.685	18532.67	1290.981
Count	47	47	47	47	47

Author's Calculations

Table-III: Descriptive Statistics for variables in case of China

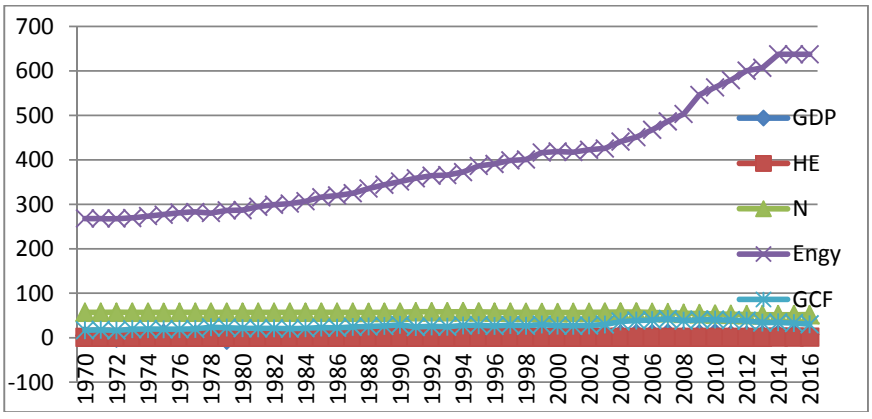
	GDP	HE	N	Engy	GCF
Mean	9.186203	2.281146	71.19754	1028.681	38.67421
Standard Error	0.520977	0.08455	0.420866	84.01905	0.710907
Median	9.130646	2.292123	70.94696	788.1287	38.15074
Mode	#N/A	3.095174	#N/A	2236.73	45.40088
Standard deviation	3.571641	0.579648	2.885309	576.0056	4.873733
Sample Variance	12.75662	0.335991	8.325006	331782.5	23.75328
Kurtosis	1.754592	-0.57395	-1.11076	-0.15	-0.90505
Skewness	-0.14121	0.305646	0.175085	1.125277	0.467034
Range	20.87	2.7131	10.81066	1771.797	16.6915
Minimum	-1.57	0.997	65.61674	464.9332	30.99436
Maximum	19.3	3.7101	76.4274	2236.73	47.68586
Sum	431.7515	107.2139	3346.284	48348.03	1817.688
Count	47	47	47	47	47

Table-I. and II. depict that − variance which is the deviation from the average is higher for all variables in case of China with an exception of gross capital formation or investment for which the variations in India are much larger than China.

India and China both have been investing in a very large scale not only on infrastructure but also in the social goods like health facilities. Therefore, it is worthwhile and imperative to examine the impact of such investments on economic growth, as well as to, evaluating the trends followed by these variables overtime will be of crucial significance when it comes to a comparison between India and China.

Overview of trends in GDP, PHE, Employment, Investment, Energy use: Case of India

Figure II. overviews the trends in health expenditure, public expenditure (% of GDP), GDP growth (annual %), Gross capital formation (% of GDP), employment to population ratio, 15+, total (%) (modeled ILO estimate), energy use (kg. of oil equivalent per capita).

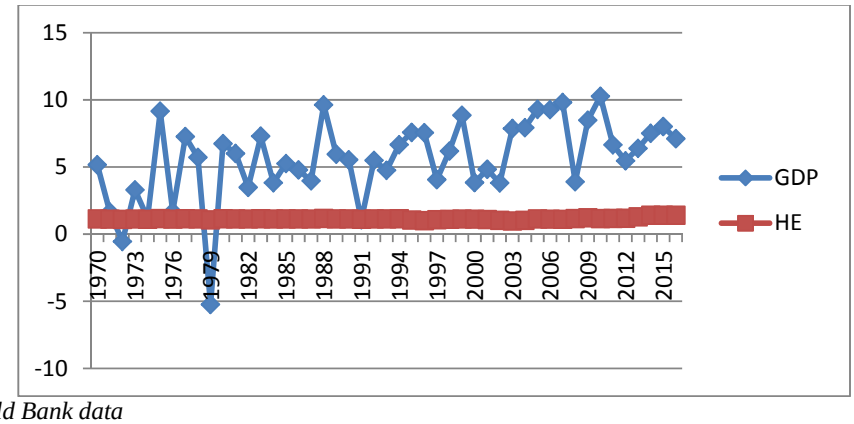


Source: World Bank data

Figure II: Trends in health expenditure, employment, economic growth and investment for the time period

1970-2017 in India.

Figure II. reveals that though the variables, health expenditure (HE), employment (N), economic growth (GDP) and investment (GCF) have maintained a steady growth, energy consumption per person has been steeply rising.

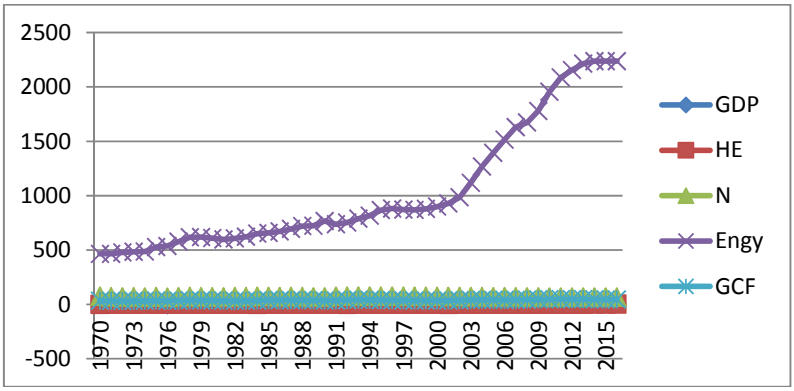


Source: World Bank data

Figure III: Trends in economic growth and PHE for period 1970-2016 in India.

Annual GDP growth rate appears to be immensely fluctuating but growing gradually while PHE as proportion of GDP is stable and slowly showing a little upward trend.

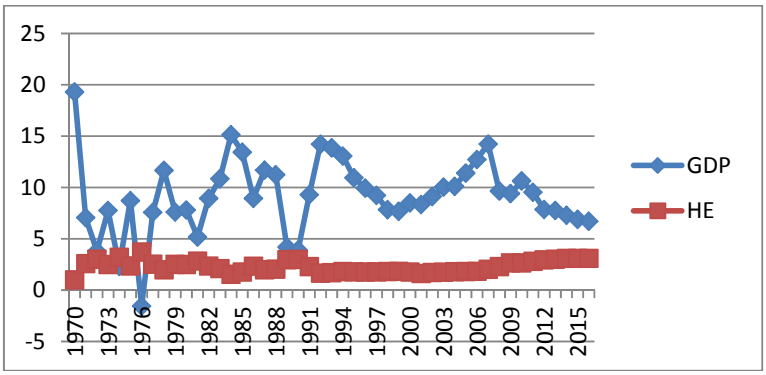
Trends in GDP, PHE, employment, investment: Case of China



Source: World Bank data

Figure IV: Trends in health expenditure, employment, economic growth and investment for the time period 1970-2017 in India.

In case of China also the above graph reveals that though the variables in health expenditure, employment, economic growth and investment have maintained a steady growth, energy consumption per person has been steeply rising.



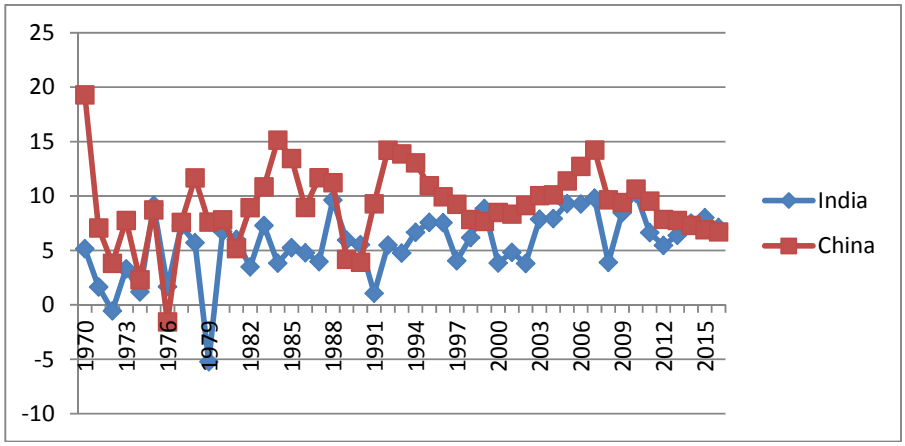
Source: World Bank data

Figure V: Trends in economic growth and PHE for period 1970-2016 in India.

In case of China also, it is observed that annual GDP growth rate is immensely fluctuating but growing gradually; while PHE as proportion of GDP is stable and slowly shows an upward trend.

Comparative trends in economic growth and PHE in India and China

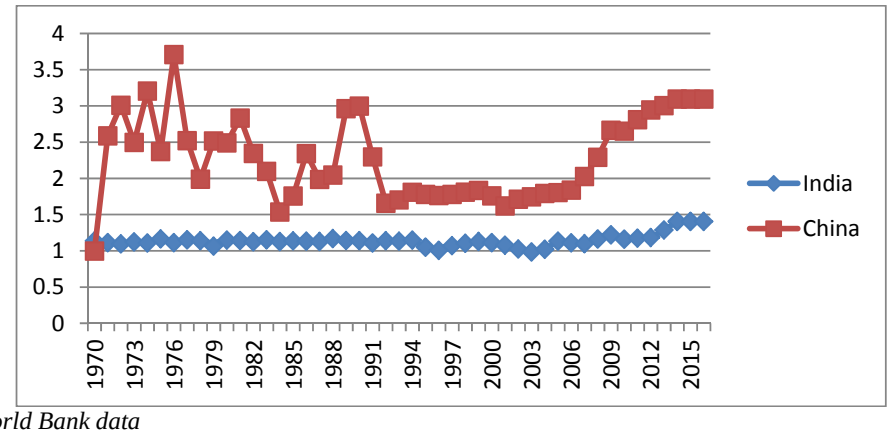
Both India and China are excessively growing economies. A comparative account of trends in economic growth and PHE of both the nations would be highly relevant.



Source: World Bank data

Figure VI: A comparison of annual growth rate of GDP in India and China for the period 1970-2016

China exhibits higher economic growth in comparison to India in the period 1970-2016. But the annual GDP growth rate has been fluctuating in both the nations. It is also observed that Chinese growth rates have declined in the time periods 2015 and 2016, while Indian growth rates have picked up.



Source: World Bank data

Figure VII: A comparison of PHE as proportion of GDP in India and China for the period 1970-2016.

Figure VII. signifies that the PHE made by China is much larger than India and that the PHE in India has grown very slowly in comparison to China which has shown a phenomenal rise.

In order to evaluate the relationship between the variables considered for examining the relationship between economic growth and PHE Unit root and Granger Causality tests are performed using the time series data between 1970-2016 for the variables under consideration for each country, with the help of Eviews, a statistical package for econometrics.

To test the stationarity of variables, Augmented Dickey-Fuller unit root tests are carried out for each variable. The Augmented Dickey-Fuller test statistics are tabulated in Table IV.

Table-IV: Tabulated Augmented Dickey-Fuller test statistics for India
Lag Length: 1 (Automatic - based on SIC, maxlag=1)

	t-statistics	**Prob.**
GDP_INDIA	-11.94585	0.0000
N_INDIA	-10.77191	0.0000
ENGY_INDIA	-7.108091	0.0000
GCF_INDIA	-8.002457	0.0000
HE_INDIA	-7.798819	0.0000

The null hypothesis for the Augmented Dickey-Fuller test is that there exists a unit root or in other words the series are non-stationary. In Table-IV. all variables in case India become stationary at lag of one time period. Because the null hypothesis that they are non-stationary is rejected.

Granger Causality: Results

Now, to evaluate the relationship or causality between the variables GDP, PHE, employment, investment, energy use Granger Causality test is carried out. Table-IV is the compilation of output generated using Eviews for Granger Causality test in case of India. The results are discussed below.

Energy use per capita Granger causes health expenditure, employment GDP in India while Investment Granger causes GDP, health expenditure, employment. Further GDP Granger causes health expenditure and employment Granger also? causes health expenditure.

It is evident from the results of Granger causality that in case of India there is a one way uni-directional relationship between economic growth and PHE. It is GDP annual growth or

economic growth which Granger causes PHE while the opposite causality is rejected that PHE causes economic growth. This result basically reflects the argument that in developing countries which are progressively heading on path of development, in the initial growth periods the increased expenditure on social infrastructure like PHE will not lead to economic growth because it is an expenditure on human capital and the benefits would be realized only after a time lag.

The unit root tests are carried out for each variable in case of China. The Augmented Dickey-Fuller test statistics are tabulated in Table V.

Table V: Tabulated Augmented Dickey-Fuller test statistic for India
Lag Length: 1 (Automatic - based on SIC, maxlag=1)

	t-statistics	**Prob.**
GDP_CHINA	-9.019831	0.0000
N_CHINA	-9.279687	0.0000
ENGY_CHINA	-6.957655	0.0000
GCF_CHINA	-7.418386	0.0000
HE_CHINA	-9.132482	0.0000

Again, in case of China all the variable are stationary with one lag time period, rejecting the null hypothesis that there is a unit root.

Granger Causality Test: Results

Now, to evaluate the relationship or causality between the variables GDP, PHE, employment, investment Granger Causality test is carried out. The table 5 is the compilation of output generated using Eviews for Granger Causality test in case of China. The results are discussed below.

Energy use Granger causes Investment. Further investment Granger causes health expenditure. GDP Granger causes investment. GDP Granger causes health expenditure and further GDP Granger causes employment. A very significant result that is reflected in China data is that health expenditure Granger causes employment.

In case of China the Granger Causality test reveals that gross capital formation that is investment Granger causes PHE in China and in case of China also economic growth has uni-directional causality with PHE but the case of China indicates a crucial finding that there is unidirectional causality of health expenditure with employment reflecting that spending more on health would constitute a better human capital and that increases the individuals productivity and enhances employment. Increase in employment is bound to lead to a higher economic growth.

CONCLUSION

The study concludes that the data for the variables GDP, PHE, employment, investment and energy use for the period 1970-2016 for India and China is stationary with one lag time period in both the countries. In terms of variance of investment, it is China which exhibits higher values in comparison with India but for all other variables India shows higher variance. Both the countries show similar trends in all the considered variables. The time series trend depicted that apart from energy use, rest of the data for both the countries has been showing a very gradual rise but energy use has shown a substantial increase. Further, in case of rapidly growing economies like India and China, a unidirectional causality exists between economic growth and PHE. This implies that economic growth would cause a rise in PHE but it is not the other way around, that is, the rise in PHE would not result in economic growth. It is imperative that any additional investment made by growing economies on human capital would find its contribution to economic growth only after a substantial time lag. In case of China it is evident that the rise in PHE contributes to increase in employment which in turn indirectly leads to economic growth. This holds significant policy implications for the governments of growing economies which are capital deficient. Continued investment in human capital in the form of health and education would contribute to the economic growth of a nation; the benefits of which would be realized and reflected in the increase in economic growth at a later stage.

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APPENDIX

Unit Root Tests: India

Null Hypothesis: D(HE_INDIA,2) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.798819	0.0000
Test critical values:	1% level	-3.592462	
	5% level	-2.931404	
	10% level	-2.603944	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(ENGY_INDIA,2) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.108091	0.0000
Test critical values:	1% level	-3.592462	
	5% level	-2.931404	
	10% level	-2.603944	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GDP_INDIA,2) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-11.94585	0.0000
Test critical values:	1% level	-3.592462	
	5% level	-2.931404	
	10% level	-2.603944	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(N_INDIA,2) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.77191	0.0000
Test critical values:	1% level	-3.588509	
	5% level	-2.929734	
	10% level	-2.603064	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GCF_INDIA,2) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.002457	0.0000
Test critical values:	1% level	-3.592462	
	5% level	-2.931404	
	10% level	-2.603944	

*MacKinnon (1996) one-sided p-values.

Unit Root Tests: China

Null Hypothesis: D(HE_CHINA,2) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.132482	0.0000
Test critical values:	1% level	-3.592462	
	5% level	-2.931404	
	10% level	-2.603944	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(N_CHINA,2) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.279687	0.0000
Test critical values:	1% level	-3.592462	
	5% level	-2.931404	
	10% level	-2.603944	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GDP_CHINA,2) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.019831	0.0000
Test critical values:	1% level	-3.592462	
	5% level	-2.931404	
	10% level	-2.603944	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(GCF_CHINA,2) has a unit root

Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.418386	0.0000
Test critical values:	1% level	-3.592462	
	5% level	-2.931404	
	10% level	-2.603944	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(ENGY_CHINA,2) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.957655	0.0000
Test critical values:	1% level	-3.588509	
	5% level	-2.929734	
	10% level	-2.603064	

*MacKinnon (1996) one-sided p-values.

Results for Granger Causality: India

Pairwise Granger Causality Tests
Date: 10/07/17 Time: 15:52
Sample: 1 47
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
GCF_INDIA does not Granger Cause ENGY_INDIA	45	15.2399	1.E-05
ENGY_INDIA does not Granger Cause GCF_INDIA		1.11740	0.3371
GDP_INDIA does not Granger Cause ENGY_INDIA	45	0.56435	0.5732
ENGY_INDIA does not Granger Cause GDP_INDIA		5.60567	0.0071
HE_INDIA does not Granger Cause ENGY_INDIA	45	3.52458	0.0389
ENGY_INDIA does not Granger Cause HE_INDIA		2.71568	0.0784
N_INDIA does not Granger Cause ENGY_INDIA	45	3.47960	0.0404
ENGY_INDIA does not Granger Cause N_INDIA		3.44552	0.0416
GDP_INDIA does not Granger Cause GCF_INDIA	45	0.42662	0.6556
GCF_INDIA does not Granger Cause GDP_INDIA		5.39631	0.0084
HE_INDIA does not Granger Cause GCF_INDIA	45	4.54332	0.0167
GCF_INDIA does not Granger Cause HE_INDIA		3.85509	0.0294
N_INDIA does not Granger Cause GCF_INDIA	45	3.84170	0.0298
GCF_INDIA does not Granger Cause N_INDIA		5.34131	0.0088
HE_INDIA does not Granger Cause GDP_INDIA	45	0.57282	0.5685
GDP_INDIA does not Granger Cause HE_INDIA		4.21385	0.0218
N_INDIA does not Granger Cause GDP_INDIA	45	0.44715	0.6426
GDP_INDIA does not Granger Cause N_INDIA		1.16143	0.3234
N_INDIA does not Granger Cause HE_INDIA	45	7.80195	0.0014
HE_INDIA does not Granger Cause N_INDIA		0.28070	0.7567

Results for Granger Causality: China

Pairwise Granger Causality Tests
Date: 10/07/17 Time: 17:46
Sample: 1 47
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
GCF_CHINA does not Granger Cause ENGY_CHINA	45	0.77445	0.4677
ENGY_CHINA does not Granger Cause GCF_CHINA		6.28277	0.0042
GDP_CHINA does not Granger Cause ENGY_CHINA	45	0.66976	0.5175
ENGY_CHINA does not Granger Cause GDP_CHINA		0.25732	0.7744
HE_CHINA does not Granger Cause ENGY_CHINA	45	1.71298	0.1933
ENGY_CHINA does not Granger Cause HE_CHINA		1.02843	0.3668

N_CHINA does not Granger Cause ENGY_CHINA	45	0.69849	0.5033
ENGY_CHINA does not Granger Cause N_CHINA		1.38420	0.2623
GDP_CHINA does not Granger Cause GCF_CHINA	45	3.66831	0.0345
GCF_CHINA does not Granger Cause GDP_CHINA		0.47663	0.6244
HE_CHINA does not Granger Cause GCF_CHINA	45	3.04653	0.0587
GCF_CHINA does not Granger Cause HE_CHINA		4.33525	0.0198
N_CHINA does not Granger Cause GCF_CHINA	45	3.93294	0.0276
GCF_CHINA does not Granger Cause N_CHINA		5.54241	0.0075
HE_CHINA does not Granger Cause GDP_CHINA	45	0.49917	0.6108
GDP_CHINA does not Granger Cause HE_CHINA		3.89965	0.0284
N_CHINA does not Granger Cause GDP_CHINA	45	0.15383	0.8579
GDP_CHINA does not Granger Cause N_CHINA		4.82422	0.0133
N_CHINA does not Granger Cause HE_CHINA	45	1.83184	0.1733
HE_CHINA does not Granger Cause N_CHINA		3.70329	0.0335