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An Econometric Exploration of Health Expenditure and Economic Growth in India

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ABSTRACT

Increase in health expenditure has a massive impact on the socio-economic conditions in any country. Though, there is no consensus as to whether the rising health expenditure is beneficial or detrimental to economic growth. The present study chose India as a case study to empirically examine a complex relationship between health expenditure and economic growth and used time-series data from 1980-81 to 2014-15 for gross domestic product (GDP) and health expenditure. The findings from the Johansen Cointegration test indicated that there existed a long-run relationship between India's health expenditure and GDP. Furthermore, the Granger causality test detected bi-directional causality from GDP to health expenditure. Findings from the impulse response function further confirmed these results. This means that India represents an example of a developing economy where the size of health expenditure expands in the process of economic transformation.

Keywords: *Health Expenditure; GDP, Econometric Exploration*
JEL Code: *I15, H51, C01*

Health expenditure is one of the basic components of human capital. Increase in health expenditure improves health quality of human capital. There are a large number of theoretical and empirical studies indicating that increase in human capital affects economic growth positively.

Health is an essential factor for the human resource development and is very critical ingredient to economic growth. The worldwide emphasis on human resource development has necessitated particularly the developing countries to pay greater attention to health infrastructure as health and human resource development are closely related. Health infrastructure is universally recognized as an important part of social infrastructure. Moreover, the status of health depends upon the health spending in the economy.

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In the early 1990s economists began to place greater emphasis on the role of human capital as a determinant of productivity and growth. Since then, the importance of health and education in economic growth has received much attention (both theoretical and empirical), and a strong consensus has emerged in the last decade that human capital accumulation is an important determinant of economic growth.

Better health care is a primary human need. According to the World Health Organization (WHO, 2005), fifty percent of economic growth differentials between developed and developing nation is attributable to ill-health and low life expectancy. Developed countries spend a high proportion of their Gross Domestic Product (GDP) on Health Care because they believe that their resident health can serve as a major driver for economic activities and development.

There are a number of possible reasons for a positive relationship between GDP, and the amount spent on health care. First, increased income means that there is more money to spend on health both in the public and private sectors. Second, more health spending may lead to better health status, which may in turn cause higher income. Healthier workers are more productive and hence the economy as well as individuals has more income. This implies that the causal relationship between health expenditure and GDP may run in either or both directions (Syed Adnan Haider, 2007: 126).

Present research intends to study the causation between health expenditure and economic growth in India. Increase in health expenditure has a huge impact on the socioeconomic conditions in any country. Though, there is no consensus as to whether the rising health expenditure is beneficial or detrimental to economic growth. The present study chooses India as a case study to empirically examine a complex relationship between health expenditure and economic growth. The paper has been structured after this introduction, literature review section data and methodology, empirical results and conclusions are followed.

LITERATURE REVIEW

Elmi, Z. M. and Sadeghi, S. (2012) investigated the causality and co-integration relationships between economic growth and health care expenditures in developing countries during 1990 to 2009. Their findings revealed that there was a bilateral causality and long-run relationship between economic growth and health spending. In the long run, income is an important factor across developing countries in the level and growth of health care expenditure. Furthermore, the health-led growth hypothesis in developing countries was confirmed.

Rengin, A.K. (2012) analyzed a long-term causality relationship between health expenditures, economic growth and life expectancy at birth for the Turkish economy. The paper concluded that there has been a long run relationship between health expenditures and economic growth while there was no relationship in the short run. Bousslem F., Bousslem Z. and Taiba A., (2014) examined the causality and co-integration relationships between public health expenditure and economic growth in Algeria during 1974-2014. In which concentrated on time series co-integration and causality in VECM framework. The results revealed that there is a long-run causality from public health expenditure to economic growth but, it is not observed any short-run causality in Algeria.

Goel, M.M. and Garg, I. (2011) examined the causal relationship between public expenditure on health and economic growth in Haryana for the period 1991-92 to 2007-08 by using granger causality test. Their findings that the existence of uni-directional causal relation between public expenditure on

health and economic growth. The direction of causality was to be found from economic growth to public expenditure on health but absent of the reverse causality.

Rajeshkumar N. and Nalraj P. (2014) have inquired about the casual relationship between health care expenditure and economic growth on the four states of India during 1991 to 2010. It is confirmed that the health expenditure and economic growth are co-integrated in the four states. Hence, these results revealed that there exists a unidirectional causality from health expenditure to economic growth in all four states.

DATA AND METHODOLOGY

This research endeavors intend to study the causal relationship between National income measured in Gross Domestic product (GDP) at market price and health expenditure at market price for India. The yearly time series data from 1980-81 to 2014-15 a data set of 35 years has been considered for this analysis and are taken from various Government of India reports, Reserve Bank of India's website and many other secondary sources. The public health expenditure includes all sort of health-related expenditure incurred by the Central Government.

The below Graph-1 indicates the Log of GDP (LNY) and Log of Health Expenditure (LNHEX). Both of the line graphs depict exponential increase. It is evident from the theoretical ground that there has always been an increasing relationship between both of these variables in a developing country like India. There has been a case of causal relationship. Thus, to check the direction of causality between the concerned variables, it is imperative to check stationarity of the series and cointegration test.

The proposed model with Y = *f* (Health Expenditure) has been tested where Y is taken as the log value of GDP and Health expenditure with log value as HEX. The formal linear model can be developed as below.

$$LNY = \beta_1 + \beta_2 LNHEX + \varepsilon_t \quad (1)$$

In the present study, the Model one is a relationship between *GDP* in current value and *HEX* in current value. There are reasons for this selection. Firstly, due to flaws that may exist in the statistical data, *GDP* or *HEX* in current values could ensure a more precise measurement compared to *GDP* or *HEX* in real values. Besides, the Indian government does not provide an official version of the GDP price deflator (Keidel 2001:355). Secondly, the previous analyses of health spending-development relationship used the ratio variables, such as the growth of *GDP* or the *HEX*'s share in *GDP*. This can pose methodological problems because these two variables have same denominator.

In order to check causality, the definition given by Granger has been used. x_i causes y_i if the prediction of y_i based on knowledge of the past values of x_i and y_i. The choice of the estimation's method is dictated by the nature of the variables. If they are stationary, then the VAR has been employed. In considering the two variables x_i and y_i, the VAR process takes the following form:

$$x_t = c_1 + \sum_{i=1}^{p} \delta_i x_{t-i} + \sum_{i=1}^{p} \varphi_i y_{t-i} + e_{1t} \quad (2)$$

$$y_t = c_2 + \sum_{i=1}^{p} \alpha_i y_{t-i} + \sum_{i=1}^{p} \beta_i x_{t-i} + e_{2t} \quad (3)$$

where e_{1t} and e_{2t} are white noise and p refers to the lag length. The null hypothesis of the Granger test is that the variable y_t does not affect x_t:

$$\boldsymbol{H}_0 : \varphi_1 = \varphi_2 = \ldots\ldots = \varphi_p = 0 \quad (4)$$

It is also possible to test the absence of causality of x_t on y_t:

$$\boldsymbol{H}_0 : \beta_1 = \beta_2 = \ldots\ldots = \beta_p = 0 \quad (5)$$

Through the hypothesis (3) and (4), four possible outcomes are considered:

- If the hypothesis (4) is rejected and if the hypothesis (5) is accepted, then y_t causes x_t, it is a unidirectional causality.
- If (4) is accepted and if (5) rejected, then x_t causes y_t, causality is again unidirectional.
- If (4) and (5) are accepted, then there is no causality between x_t and y_t.
- If (4) and (5) are rejected, then the causality is bidirectional, also called feedback.

This method requires stationarity of series. Moreover, numerous macroeconomic variables have a unit root and so are not stationary at level. To implement the Granger causality test with non-stationary series, the co-integration framework needs to be used. There is a co-integration relationship between two non-stationary variables x_t and y_t if a linear combination of x_t and y_t is stationary. The existence of a co-integration relationship does not yet detect the direction of causality.

EMPIRICAL RESULTS

As explained in earlier section, the first step is to check the properties of each series. Two widely employed test, Augmented Dickey Fuller (ADF) and the Phillips-Perron (PP) test with the null hypothesis of presence of unit root has been tested.

The ADF test requires choosing the optimal lags of the variable, to avoid autocorrelation problems. This is done with the help of AIC (Akaike Information Criteria) and with the partial autocorrelation. For the PP test, the bandwidth given by the Newey-West method has been used. The results of ADF and PP test are given in the below Table-3.

Table 1: Description of variables

Variables	Measurement Indicator of variable
Health Expenditure (HEX)	Total government expenditure on health (Rs. in crores)
Economic growth (GDP)	Gross domestic product at market price (Rs. in crores)
LNHEX	Logarithm of Health Expenditure
LNY	Logarithm of GDP

If there is a conflict between the ADF and PP test, the latter is chosen since it had a better correction of autocorrelation. From Table-3, LNY and LNHEX are stationary, so a VAR could be implemented to check causality. LNY is the log of GDP in current value; LNHEX is log of health expenditure in current value.

Table- 2 Descriptive Statistics

	LNHEX	LY
Mean	9.286451	11.84181
Median	9.302206	11.94226
Maximum	11.47765	14.02419
Minimum	7.382815	9.590147
Std. Dev.	1.146779	1.326832
Skewness	0.167598	-0.049425
Kurtosis	1.969125	1.843703
Jarque-Bera	1.713629	1.964074
Probability	0.424512	0.374547
Sum	325.0258	414.4634
Sum Sq. Dev.	44.71349	59.85640
Observations	35	35

To compute the VAR, first it is necessary to determine the optimum lag length. This is done by checking information criteria: Akaike criteria (AIC), Hannan Quinn criteria (HQ) and Schwarz criteria (SC). As per Table -4, for all the criteria, the appropriate choice of four lags has been made. VAR has been checked with four lags and stability condition checked by examining the roots of characteristics polynomial. They are less than 1, so the VAR satisfies the stability condition. The Granger causality test could then be checked and presented in Table 5.

Graph-1-Time series plot of Log GDP and Log Health Expenditure

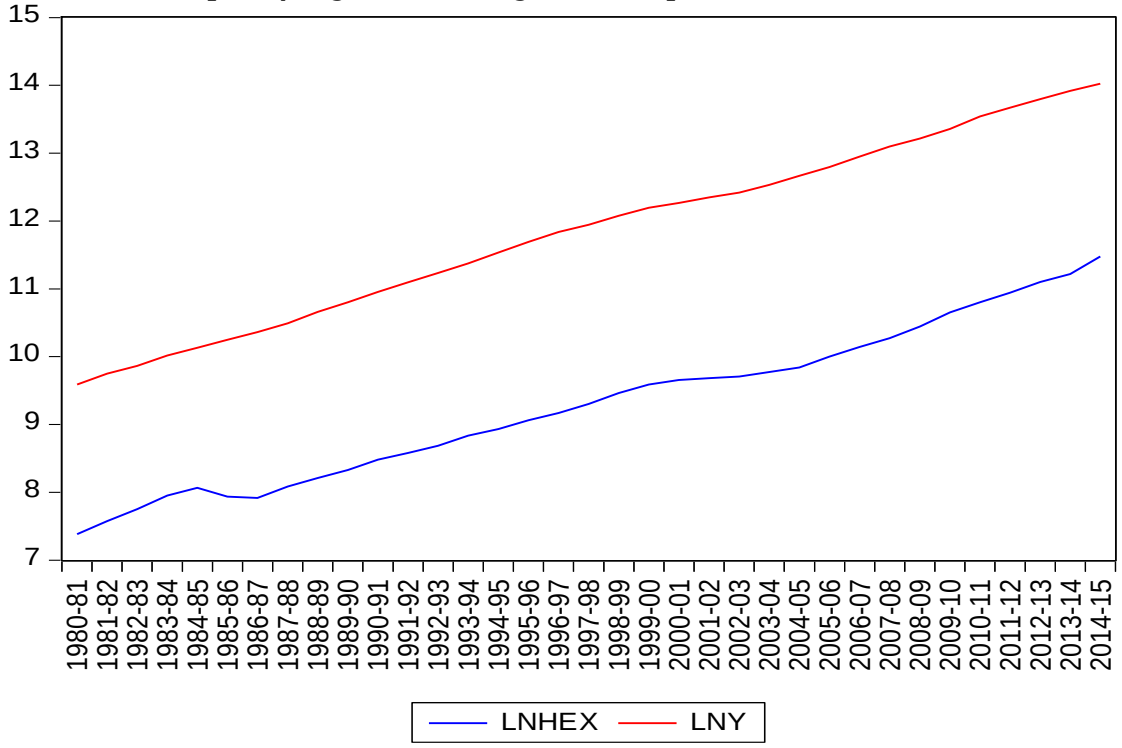


Table 3: Unit Root Tests

	ADF		Phillp-Perron	
Variable	Intercept	Intercept & Trend	Intercept	Intercept & Trend
At Level				
LNY	-0.358127	-1.912313	-0.665161	-1.830213
LNHEX	1.277721	-1.758073	0.913439	-1.139137
1st Difference				
LNY	-3.512607 (0.0139) **	-3.469565 (0.0595) **	-3.554128 (0.0125) **	-3.514832 (0.0542) **
LNHEX	-3.193745 (0.0294) **	-3.412180 (0.0670) ***	-3.026519 (0.0427) **	-2.914555 (0.1711)

(*Denotes significant at 1 %, ** Denotes significant at 5 %, **** Denotes significant at 10 %)

Table 4: Number of lags in VAR

Lag	AIC	SC	HQ
0	1.498689	1.591204	1.528847
1	-7.145808	-6.868262	-7.055335
2	-7.467590	-6.968787	-7.316802
3	-7.461006	-6.628369	-7.189587
4	-7.616394*	-7.005014*	-7.405290*

* indicates lag order selected by the criterion

AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion

Table 5: Causality test

Null Hypothesis	F-Statistic	Probability	Direction
LNY does not Granger Cause LNHEX	3.23015	0.0315**	GDP → Health
LNHEX does not Granger Cause LNY	2.44725	0.0765***	Health → GDP

(*Denotes significant at 1 %, ** Denotes significant at 5 %, *** Denotes significant at 10 %)

From Table 5, causality is confirmed between economic growth and health expenditure and that it is bi-directional. This meant that health could not be considered as being exogenous from economic factors. This result not only confirmed the previous literature, but also pointed out a positive effect of health expenditure to growth. As a consequence of this test, single-equation regressions are biased, due to the endogeneity of health expenditure.

In order to examine the impact of one shock, Impulse Response Functions (IRF) is used. It represents the impact of an innovation's shock to the variables of the system, in the present and in the future. A shock to one variable might affect itself but also other variables through the dynamic of the VAR. More specifically, IRF maps out the dynamic response path of a variable, due to a one-period standard deviation shock to another variable. The steady state value is 0, and this approach led to an examination of how one variable converges (or not) to this value, following a shock from another variable.

To compute IRF and so orthogonalize shocks in the VAR, the Cholesky decomposition has been widely used in empirical literature. It only requires knowing the order of the variables; they have to

be listed from the most exogenous to the most endogenous. This might have been problematical since two different ordering choices lead to two different IRFs. To avoid this weakness, the method of generalized impulse is employed as provided by Pesaran and Shin. In this method, IRF are invariant to the ordering of the variables.

Figure 1 provides the plots of IRF of LNY in response of a shock of LNHEX and Figure 2 the IRF of LNHEX is response of a shock of LNY. The solid blue line refers to the value of IRF and the dotted red line is the confidence interval.

Figure 1: Response of LNY to LNHEX

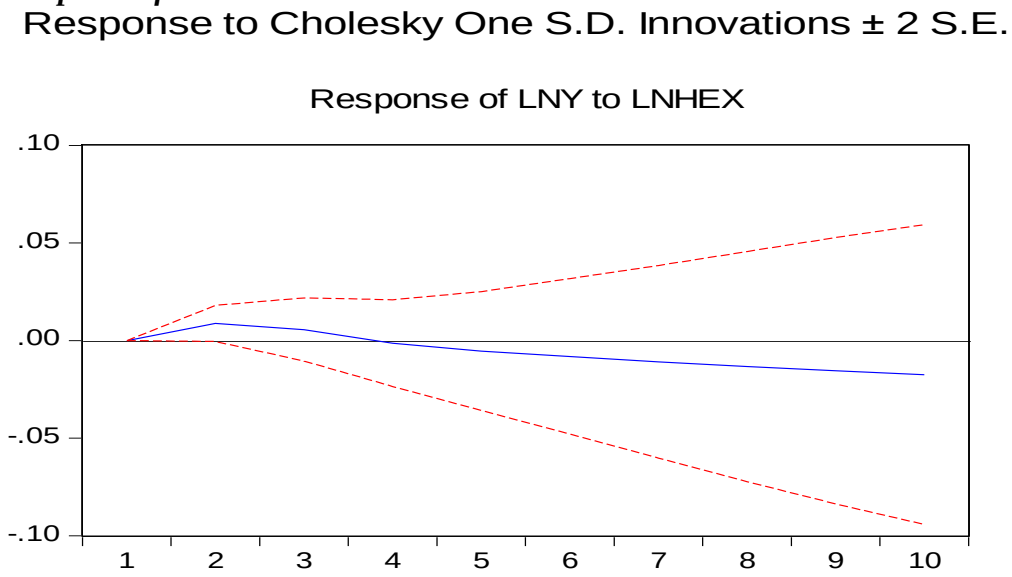
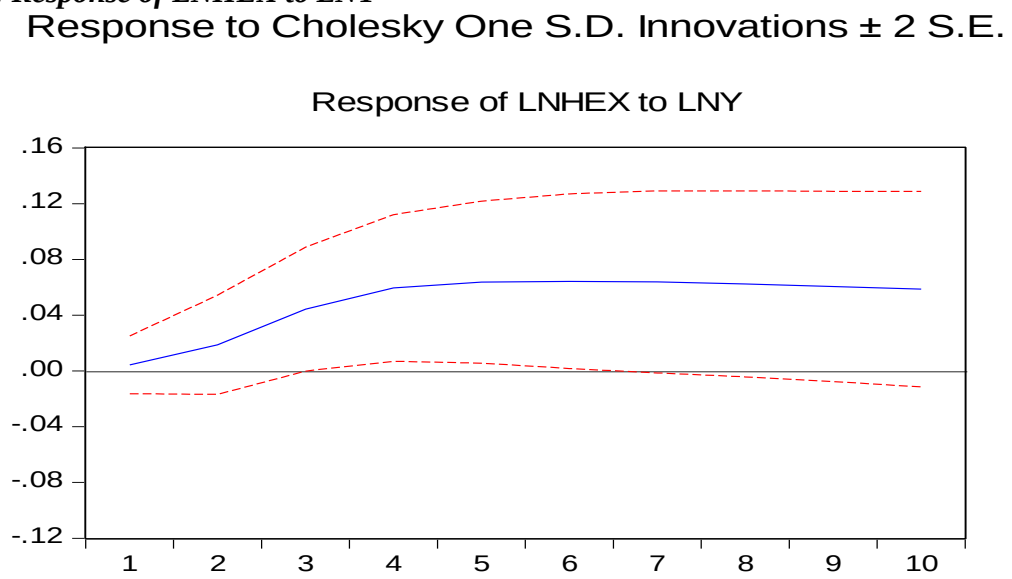


Figure 2: Response of LNHEX to LNY



Looking to the Figure 1, GDP has positive and immediate impact on health expenditure. The positive impact increases with the passage of time as can be seen from the graph. It remains positive up to

four years. Afterwards it shows declining and negative impact of LNY on LNHEX. So, with this analysis, it can be inferred that GDP can foster health expenditure and growth and its effect seems to be short. Consequently, GDP displays short run impact on the health expenditure in the in India.

While studying to the Figure 2, health expenditure has positive impact on GDP. The effect is gradually increasing. It reaches maximum in four years. Onwards, the impact tends to increase and remains positive for a long period. While it has been observed in the case of GDP, the effect remains short lasting and having short run association of health expenditure, the effects of health expenditure on GDP remained positively with a long run impact. While comparing these two figures, the effect of health expenditure to GDP is larger than the effect of GDP to health expenditure. Nevertheless, both effects seem to be persistent over time, since they occur over 20 years. Both IRFs reach steady state nearly after 25 years.

Table 6: Variance Decomposition from VAR

	Variance decomposition of LNY			**Variance decomposition of LNHEX**		
Period	S.E.	% due to LNY	% due to LNHEX	S.E.	% due to LNY	% due to LNHEX
1	0.021299	100.0000	0.000000	0.058802	0.540682	99.45932
2	0.037903	94.69047	5.309526	0.101111	3.615547	96.38445
3	0.054163	96.32795	3.672054	0.127903	14.25530	85.74470
4	0.070089	97.77133	2.228666	0.150290	25.98909	74.01091
5	0.084130	98.03771	1.962289	0.169616	34.50695	65.49305
6	0.096043	97.77272	2.227282	0.185870	40.71027	59.28973
7	0.106378	97.13888	2.861117	0.199573	45.54230	54.45770
8	0.115524	96.23474	3.765257	0.211230	49.38400	50.61600
9	0.123715	95.14270	4.857301	0.221232	52.51007	47.48993
10	0.131155	93.90061	6.099389	0.229899	55.13597	44.86403

At last, the Variance Decomposition (VD) has been utilized to complete the results obtained with Granger causality test and IRF. Here, the goal is to compute each variable's contribution to the variance of the forecast error for a given horizon. Table 6 is divided into two parts, the first part of the table provides the percentage of variance of growth due to GDP and health expenditure and the second part indicates the percentage of variance of health expenditure due to GDP.

The Table 6 provides information that nearly 97.77 % variance of forecast error for GDP for four years mainly due to its own innovations. Onwards the variance of forecast error for GDP declines marginally up to the 25 years and nearly 5 % variance is due to health expenditure in second year. This implies that the relative weight of health expenditure is strong. Furthermore, health expenditure has no direct impact on the first period as the attributed percentage for this variable is 0. For the variance of forecast error for health expenditure, GDP accounts a minimal of 0.54 % for the first horizon and grows quickly to stand for more than one third variance of forecast error within five years.

Thereby health expenditure is endogenous vis-à-vis economic growth and so is the case with economic growth. VD also provides an interesting inference; the effect of a shock on health expenditure due to GDP is equally important as GDP to health expenditure. Therefore, results obtained with IRFs can be further confirmed. Both analyses are providing a reason for new

explanation in Indian case and are in line with the previous literature, which confirms that health expenditure is influenced by economic factors and so the economic growth, whereas there is more pronounced impact of health expenditure into growth.

CONCLUSION

This article deals with the new information about the relationship between GDP and health expenditure for Indian economy. The results are in line with the previous literature. There is bi-directional causality between GDP and health expenditure, even if health expenditure has a little favorable impact to GDP, the former cannot be considered as exogenous from the later. Furthermore, with IRFs and VD, the effect of health expenditure into GDP is larger than the reverse.

By concluding, some indications in terms of policy recommendations are offered. Health expenditure has been used as an instrument of counter-cyclical policy, because it is determined by economic factors (here GDP). Such a tool of economic policy is very useful because its effects are strong with persistence. Efforts can be made on the effectiveness of health expenditure at a disaggregated level. This may provide a good reason for future study.

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Conflict of Interest

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