Does fiscal deficit, public debt, economic growth and energy consumption affect health expenditure in India: an empirical evidence based ARDL bound testing approach

Tariq Ahmad Lone*

Department of Economics,
Aligarh Muslim University,
Aligarh, Utter Pradesh,
R/O: Kaladrang Kulgam
P/O: Yaripora Kulgam, 192232, J & K, India
Email: tariqlonest@gmail.com
*Corresponding author

Parveez Ahmad Lone

Department of Education Studies,
Central University of Haryana,
Mahindragarh, India
Email: loneparveez786@gmail.com

Abstract: This paper examines the impact of fiscal deficit, public debt, economic growth and of energy consumption on health expenditure in the country. Annual data for the time period 1980–2019 has been taken for analytical purposes. The bound testing approach ARDL model has been used for testing the long run cointegration among variables. Besides vector error correction model (VECM) has been utilised for determining the direction of causality. The results specify the presence of long run causal relationship between fiscal deficit, public debt, economic growth, energy consumption and health expenditure. However in the short run a single relationship between GDP and health expenditure was observed. These results reveal that all these variables are important but GDP is more important for maintenance of health expenditure. Thus we recommend that prudent public debt management, fiscal discipline, efficient energy consumption and economic growth should go a long way in maintaining the health expenditure and therefore better health outcomes.

Keywords: health expenditure; ARDL bound; VECM; vector error correction model; cointegration; causality.

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Biographical notes: Tariq Ahmad Lone is presently pursuing PhD from Aligarh Muslim University. He has done MA Economics from University of Kashmir and MPhil from Central University of Jammu. He has qualified NET & SET in the subject and has articulated various research papers published in

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the reputed national and international journals. His subject of interest is health and development economics.

Parveez Ahmad Lone has done MPhil from Central University of Haryana and is currently pursuing PhD from the same University. He has done M.Ed from Central University of Jammu. Besides he has done MSc in the subject of Botany from B.R. Ambedkar University Agra. He has qualified NET & SET in the subject and has published many research papers in his area of interest. His area of interest is educational psychology and school leadership.

1 Introduction

Low per capita income and low economic growth have been one of the major problems of developing countries. Most of these countries falling in the low or middle-income brackets are amidst with widespread poverty which leads to a number of problems like unemployment, hunger, malnutrition, high infant and maternal mortality rates, low life expectancy rates etc. It is because of this low level of per capita income and widespread poverty that health outcomes in bulk of these countries are unfavourable. Further, it is widely accepted that human capital is one of the indispensable essences for the development of the economy. Therefore, healthy population has a considerable role to play as it is considered a valuable asset for the economy. Thus implication of health especially of human capital has been widely well recognised. The World Health Organization (WHO, 2015) attributed 50% discrepancy in economic growth between developed and developing regions to healthcare and this is an indicator to the fact that healthcare has a positive impact on economic growth. In view of this fact a greater part of the population is still impoverished in developing countries there is an escalating need to create a quality public health infrastructure in order to improve the existing health facilities, therefore public health. However, this can only be achieved, if respective governments allocate a major proportion of their budgets towards public health which further can only be possible if the economy is in a better condition.

Various studies have been undertaken to verify the factors that are affecting the health expenditure. Most of the studies related to the relation between economic growth and health expenditure. One such study was conducted by Wang (2015) reveals that real level of health spending in OECD countries is 5.48% of GDP with 1.87% economic growth rate. It indicates that when the ratio of health spending to GDP is less than optimal level of 7.55% an increase in health spending leads to better economic performance. Newhouse (1977) depicted that GDP and health expenditure are significantly related to each other supported by Kleiman (1974). Such type of relationship was also observed by Baltagi and Moscone (2010). Lone et al. (2021) by using the co-integration analysis depicted that health expenditure has a significant impact on health outcomes. Raghupathi and Raghupathi (2020) studied the relationship between health expenditure and economic performance in the United States. The overall results suggested strong relation between healthcare expenditure and economic indicators of income, GDP and labour productivity. Fedeli (2015) studied the impact of GDP on healthcare expenditure in Italy depict that both variables are cointegrated. The results show a strong short run as well as long run relation depicting as income rises people devote more towards healthcare. Erdil and Yetkiner (2009) employed the Granger-causality test to find the relationship between real per capita GDP and real per capita healthcare expenditure by making use of a panel data with a VAR illustration. The results reveal a dominant type of bidirectional Granger-causality. Narayan et al. (2010) investigated the relationship between health expenditure and economic growth by using the panel co-integration analyses with structural breaks using investment, research and development, imports and exports as variables. They found that all these variables share a strong long-run relationship. They observed that all variables except imports have contributed positively to the economic growth. The imports have a significant negative effect on health expenditure while education has insignificant effect on it. Anantha and Gajithri (2016) investigated the relationship between fiscal deficit composition and economic growth in India suggested that fiscal deficit is adversely affecting economic growth. Yun and Yosuff (2017) while analysing the relationship between education expenditure, healthcare finance and economic growth in Malaysia found a significant and positive relationship among the said variables supported by Wahab et al. (2018). In this connection we take an opportunity to see the combined influence of these various components on the health expenditure as many of the previous studies have checked the relationship between one and the other variables with respect to health expenditure.

2 Review of literature

It is very decisive for policy makers to know the long-term relationship between health expenditure and GDP, fiscal deficit, public debt and other relevant variables influencing the health expenditure. These kinds of relationships guide the policy makers in making the judgements about how much aggregate health expenditure will change in the coming years, based on the prediction of trend of these variables. It assists them to plan health sector reforms and to allocate the resources efficiently. Although many studies have been done on the relation between health expenditure and other related variables in different countries but not much is known in case of India. In this connection, we mention few studies highlighting the relation between health expenditure and other related variables. One such study was conducted by Rahman (2011) depicting a significant positive relation between health expenditure, education expenditure and GDP growth in Bangladesh. Gyimah and Wilson (2004) found that investment in health expenditure; stock of health and human capital has a positive and significant relationship with growth of per capita income. MacDonald and Hopkins (2002) also illustrated the unit root properties of healthcare expenditure and GDP for OECD countries. The findings of the study indicate that there is a cointegrating relationship between healthcare expenditure and GDP. Ozturk and Topcu (2014) studying the relation between healthcare expenditure and economic growth finds a strong evidence of long run relationship based on the results of Kao's cointegration. Boukthir and Maha (2014) examined the impact of health expenditure on Tunisian GDP for a period 1961–2010 using ARDL approach. The results reveal that there is a stable long-run relationship between GDP, health expenditure, labour and capital. Further the causality test results depict bidirectional causal relation from health expenditure to income, both in short as well as in long run. Devlin and Hansen (2001) applied the Granger-causality method to test the relation between health expenditure and GDP. They found bi-directional Granger- causality between health expenditure and GDP. Rivera and Currais (2005) while looking for reverse causation reveals a significant relationship between income growth and healthcare spending. Murthya and Okunade (2000) by applying the cointegration tests empirically confirms the existence of a long-run economic relationship between healthcare expenditure and real gross domestic product, demographics, number of physicians, school enrolments and government budget deficits in US. Similar study was conducted by Moscone and Tosetti in (2010). Toor and Butt (2005) while analysing the data in Pakistan reveals that socio-economic factors and political scenario in the country plays a vital role in health resource determination. Khandelwal (2015) has used the autoregressive distributed lag (ARDL) method for presence of cointegration among the variables while vector error correction model (VECM) has been employed to determine the direction of causality. The results disclose the presence of long run causal relationship between energy consumption, fiscal deficit and GDP and public health expenditure. In the short run, only causal relationship was found between GDP and health expenditure. Many empirical studies examined the relationship between the health expenditure and income and uphold the view that health is a capital, therefore investment on health is an important factor behind the income growth (Hansen and King, 1996; Clemente et al., 2004). Mehrara and Musai (2011) investigated the relationship between health expenditure and economic growth in Iran for the period 1970–2007 based on the ARDL approach. The study found a significant cointegrating relation among real GDP, health expenditure, capital stock, oil revenues and education. It is on this background present study is designed to examine if any convincing relationship exists between health expenditure and fiscal deficit, public debt, GDP and energy consumption in case of India.

3 Methodology

3.1 Data and variables

The study is based on the annual data taken for a period 1980–2019. The variables of our interest are health expenditure, fiscal deficit, public debt, GDP (economic growth) and energy consumption. Health Expenditure as a percent of GDP has been taken as a variable to look at the total government expenditure including both private and public. The data on GDP, Health Expenditure, Energy Consumption, Fiscal deficit and Public Debt has been taken from World Development Indicators, RBI News Bulletin, National Health Accounts and Economic Surveys respectively.

3.2 Empirical model

The empirical model illustrating the relationship between health expenditure, fiscal deficit, public debt, economic growth and energy consumption is presented as

$$LHE_t = \alpha_0 + \alpha_1 LFD_t + \alpha_2 LPD_t + \alpha_3 LGDP_t + \alpha_4 LEC_t + \varepsilon_t \quad (1)$$

where LHE_t is natural log of health expenditure as a ratio of GDP, LFD_t is natural log of fiscal deficit, LPD_t is the natural log of public debt, $LGDP_t$ is the natural log of GDP growth, LEC_t is natural log of energy consumption, and ε_t is the white noise error term. The parameters α_1, α_2, α_3 and α_4 represent the long-run elasticity estimates.

Since the objective of our study is to find the interrelationship among health expenditure, fiscal deficit, public debt, economic growth and energy consumption, the

ARDL bound testing procedure has been employed. To employ this method, we have to first go for the stationary tests to look for the unit root problem.

3.3 Unit root and stationarity test

In order to test the unit root problem, we use the Augmented Dickey and Fuller test (ADF; Dickey and Fuller, 1979). The Augmented Dickey and Fuller test makes use of a regression of the first differences of the series against the series lagged once, Y_{t-1}, and lagged difference terms. It may include a constant term Ψ_1 and trend term $\mu_2 t$ as follows

$$\Delta LY_t = \Psi_1 + \mu_2 t + \lambda LY_{t-1} + \sum_{i=1}^{m} \gamma i \Delta LY_{t-i} + \varepsilon_t \tag{2}$$

where Δ is the first difference operator, $\Delta LY_t = (LY_t - LY_{t-1})$, $\Delta LY_{t-1} = (LY_{t-1} - LY_{t-2})$ and ε_t is a stationary random error. The lag length (m) is determined automatically by SIC information criteria. The test for a unit root has the null hypothesis that $\lambda = 0$. If the coefficient is statistically different from 0, the hypothesis that Y_t contains a unit root stands rejected.

In order to determine the causal relationship between LHE, LFD, LPD, LGDP and LEC we employed the ARDL bounds testing procedure of Pesaran et al. (1999, 2001). The main benefit of employing this testing procedure is that it can be employed even in situations when the variables have different orders of integration which cannot be handled with the traditional cointegrating tests like Johansen cointegration test (1988) and Engle and Granger (1987). Further ARDL approach is applicable to small samples which is the reason of ours while Johansen test is unhandy in these situations which needs a large sample size for correct estimation. The application of ARDL model requires two step procedure. The first step involves determination of whether a long term relationship exists between the variables under study or not. To accomplish that purpose, we used the ARDL bound testing approach. The second step is to estimate the short run as well as long run causality. In order to determine this relationship, we used the VECM model of cointegration.

To test for cointegration among health expenditure, fiscal deficit, public debt, economic growth and energy consumption, the ARDL models for our study are as follows:

$$\begin{aligned}\Delta LHE_t = {} & \alpha_0 + \sum_{i=1}^{p} \phi_i \Delta LHE_{t-1} + \sum_{i=0}^{p} \Psi_i \Delta LFD_{t-1} + \sum_{i=0}^{p} \lambda_i \Delta LPD_{t-1} + \sum_{i=0}^{p} \eta_i \Delta LGDP_{t-1} \\ & + \sum_{i=0}^{p} \gamma_i \Delta LEC_{t-1} + \Omega_1 LHE_{t-1} + \Omega_2 LFD_{t-1} \\ & + \Omega_3 LPD_{t-1} + \Omega_4 LGDP_{t-1} + \Omega_5 LEC_{t-1} + \varepsilon_t\end{aligned} \tag{3}$$

where ϕ_i, Ψ_i, λ_i, η_i and γ_i refer to short run and Ω 1 to 5 represent the long run parameters. The null hypothesis of no cointegration is H0: $\Omega_1 = \Omega_2 = \Omega_3 = \Omega_4 = \Omega_5 = 0$ against the alternative hypothesis H1: $\Omega_1 \neq \Omega_2 \neq \Omega_3 \neq \Omega_4 \neq \Omega_5 \neq 0$. The rejection of the null based on the F-statistic suggests cointegrating relationship. The null hypothesis of no cointegration was tested by using the critical bound F statistics developed by Pesaran et al. (2001). The upper critical bound is based on the presumption that all series are of I(1) and the lower bounds indicate that the series are of $I(0)$. If the calculated F-statistics is greater than the upper critical bound then the null hypothesis of cointegration is sustained. If it is less than the lower critical bound, then there is no cointegration. However, if the F-statistic is in between upper and lower bound values then the decision about the cointegration will depend upon the order of integration of the variables. If a long run relationship exists, the ARDL representation of equation (1) is formulated as follows:

$$LHE_t = \alpha_1 + \sum_{i=1}^{p+1}\phi_{1t}LHE_{t-1} + \sum_{i=1}^{p+1}\Psi_{1t}LFD_{t-1} + \sum_{i=1}^{p+1}\eta_{1t}LPD_{t-1} + \sum_{i=1}^{p+1}\theta_{1t}LGDP_{t-1} + \sum_{i=1}^{p+1}\gamma_{1t}LEC_{t-1} + \varepsilon_t \quad (4)$$

In this model $(p + 1)^k$ shows the number of regressions in order to obtain the optimal lags for each variable, whereas $p + 1$ shows the maximum number of lags and k is the number of variables used in the equation (Shrestha and Chowdary, 2005). The model is selected based on the minimum value of Schwartz-Bayesian Criterion (SBC) and is therefore described as the thrifty model.

The ARDL specification of short run relationship is explored through ECM version of ARDL model. To identify the short run causality among the variables, the error correction model would be written as:

$$\Delta LHE_t = \alpha_2 + \sum_{i=1}^{p}\phi_{2t}\Delta LHE_{t-1} + \sum_{i=1}^{p}\Psi_{2t}\Delta LFD_{t-1} + \sum_{i=1}^{p}\eta_{2t}\Delta LPD_{t-1} + \sum_{i=1}^{p}\theta_{2t}\Delta LGDP_{t-1} + \sum_{i=1}^{p}\gamma_{2t}LEC_{t-1} + \Psi ECM_{t-1} + \varepsilon_t \quad (5)$$

where ECM is the error correction mechanism with lag showing the speed of adjustment towards the long run equilibrium.

3.4 Variance decomposition analysis

Finally, we used the variance decomposition analysis (VDA) to weigh up to what extent shocks to some macroeconomic variables are explained by other variables in the system. VDA assesses the magnitude of forecast error variance in a variable due to its self-innovation and by the other variables under consideration.

3.5 Residual and stability diagnostic tests

In order to check the validity of the model, various diagnostic tests were applied for checking the goodness of fit, serial correlation and heteroskedasticity. To check this stability CUSUM test was employed. If the CUSUM plot was found to be within the 5% critical bound, then the null hypothesis of the stability of the parameters cannot be rejected. On the other hand if the CUSUM plot was found to be outside the critical bound the null hypothesis of stability stands rejected.

4 Data analysis and discussion

Before going through the ARDL model, it is imperative to check the order of integration of the variables. ARDL can be used when the variables are integrated of the order $I(0)$ or order $I(1)$ but it cannot be applied if the variables are of the order $I(2)$. Therefore, it is essential to check the order of integration of the variables. To test for the order of integration we employed the Augmented Dickey and Fuller (ADF) unit root test both at levels and at first difference. The results of the ADF test are presented in Table 1.

Table 1 Results of augmented dickey-fuller unit root test

Variables	*At level*		*At first difference*	
	With intercept	*With intercept and trend*	*With intercept*	*With intercept and trend*
LHE	–1.9444170(0)	2.819126(0)	7.181381(0)***	7.128968(0)***
LFD	–0.898281(1)	–5.325927(0)***	–7.166227(1)***	7.073951(1)***
LPD	–0.902916(0)	–1.736425(0)	–5.789088(0)***	5.806199(0)***
LGDP	–5.310453(0)***	–6.001101(0)***	–9.669893(0)***	–9.532502(0)***
LEC	–2.450639(0)	–2.1742273(0)	–4.773298(0)***	–4.832155(0)***

*, **, *** indicates the significance at ten, five, and 1% level respectively and the values in parenthesis shows the lag length.

Source: Author's authentication

Table 1 depicts that some variables were non-stationary at levels while taking the first difference all variables turn out to be stationary. No doubt, fiscal deficit and GDP are stationary at both levels while all other variables became stationary at first difference. Thus the null hypothesis of unit root gets rejected for all the variables and become stationary at $I(1)$. Therefore the order of integration is same for all variables, we can apply the ARDL approach of cointegration test as the application of ARDL requires that all the variables be either of order $I(0)$ or of $I(1)$ or both.

After looking for the stationarity, the next step is to use ARDL Bound Testing procedure of Pesaran et al. (2001) in order to investigate the presence of long-run relationships among the variables. To use the Bound Testing procedure we are first required to determine the optimum lags for each of the variables used in the model. The maximum number of lags selected for the model on the basis of various lag selection criteria's are illustrated in Table 2.

Table 2 Lag order selection criteria

Lag	*Log likelihood*	*LR*	*FPR*	*AIC*	*SC*	*HQ*
0	–91.80364	NA	0.000204	5.694332	5.918797	5.770881
1	5.697288	160.5898*	2.93e–06*	1.429571*	2.776360*	1.888865*

*indicates the lag order selected by each criterion.

Source: Authors Authentication

Lag 1 is therefore the optimal lags chosen for the model through various lag selection criterias. After obtaining the optimal lag length of order1, we can now look for the cointegration among variables. This necessitates us to compute the value of the F-statistics and compare it with the critical values. This calculation of F statistics along with the lower and upper bound critical values are presented in Table 3.

Table 3 ARDL bound test

F Statistics	*8.048731****	
Significance level	*Critical Bound F Values*	
	Lower bound values	*Upper bound values*
1%	3.29	4.37
5%	2.56	3.49
10%	2.2	3.09

***shows significance at 1% level significance.

Source: Authors authentication

The calculated F statistics is 8.049, which is higher than the upper bound critical value at 1% level of significance. Thus, the null hypothesis of no cointegration among health expenditure, fiscal deficit, public debt, GDP, and energy consumption stands rejected which gives clear indication for the presence of long run relationship among variables.

The next step after identifying the cointegration would be to estimate the coefficients of both the short run as well as long-run relationships. To accomplish that purpose, we employed the Granger causality test. This action will help us in identifying the direction of causality among variables as illustrated in Table 4.

Table 4 Results of granger causality based on VECM

Variable	*Short run causality*					*Long run causality*
	$D(LHE_{t-1})$	$D(LFD_{t-1})$	$D(LPD_{t-1})$	$D(LGDP_{t-1})$	$D(LEC_{t-1})$	ECT_{t-1}
$D(LHE_t)$	–	1.888634	0.502994	0.055938**	1.456288	–0.442552***
		(0.3880)	(0.776)	(0.0484)	(0.4828)	(0.0291)

The asterisks ** and *** show the rejection of null hypothesis at 5% and 1% level of significance, respectively

The values in parenthesis () contain the p-values.

Source: Authors Calculation

The condition for long run causality/relationship is that the value of error correction term (ECT) should be negative and significant. Both these conditions are satisfied which clearly indicates the long run causal relationship running from fiscal deficit to health expenditure, from public debt to health expenditure, from gross domestic product to health expenditure and from energy consumption to health expenditure. However in short run a single causal relationship between GDP and health expenditure was found to be significant and no other variables reveal such type of relationship. These results are in conformity with the results of Mehrara and Musai (2011) and Khandelwal (2015). They also found the long run relation between health expenditure and other related variables and in short run only GDP was found to be causally related to health expenditure. These results show that all these variables do influence the health expenditure showing prudent fiscal and public debt management and efficient energy consumption go a long way in sustaining public health expenditure. However the results reveal that economic growth (GDP) is strongest among the all concerned variables i.e., showing how the maintenance of economic growth is essential for all economic parameters including the health expenditure as well. No doubt only GDP is important in both the periods but other variables indirectly affect the health expenditure because for maintenance of economic growth reduction in unnecessary subsidies and interest obligations is essential. Similarly efficient use of energy resources is equally important for economic growth as India is highly dependent on other countries for such resources. If alternative sources like renewable energy are to be developed to its best potential, it will reduce the import dependency to a large extent. Therefore, research and development in energy sector and thrifty savings and abolition of various types of subsidies should go a long way in sustaining economic growth and therefore better health expenditure.

The various diagnostic tests like Breusch-Godfrey LM Test for serial correlation, ARCH effects, Jarque-Bera Test of Normality, Whites heteroskedasticity and Ramsy RESET test for functional form are reported in Table 5.

Table 5 Diagnostic and stability results

Serial correlation	*Normality test*	*ARCH*	*Whites test*	*Ramsey Rest*	*CUSUM*
26.04363	0.21296	10.46647	13.88059	0.012137	Stable
(0.4053)	(0.2327)	(0.1612)	(0.1785)	(0.9130)	

The values in parenthesis () shows the p- values.

Source: Author's calculation

All the values of diagnostic tests provide no evidence of serial correlation, autoregressive conditional heteroskedasticity (ARCH) and Whites heteroskedasticity. Further, the residual terms are normally distributed and the functional form of the model is well specified. Thus, our model is statistically fit for the estimation and the conclusions we have drawn must be valid.

Besides these diagnostic tests, the results of CUSUM test are presented in Figure 1. The test divulges that the CUSUM plot is inside the 5% critical bound which indicates that parameters are stable and do not suffer from any structural instability over a period of time.

In addition to these results, variance decomposition analysis (VDA) based on VECM for these macroeconomic variables have been calculated for a period of 10 years as shown in Tables 6–10. The VDA result of health expenditure exposes that innovative shocks to LFD, LFD, LGDP and LEC from initial period do not contribute anything to the variance of forecast error of LHE. However, in the 10thforecast period an impulse to LFD, LPD, LGDP and LEC contribute 9.8%, 1.5%, 26.3%, and 3.9% respectively to the variance of forecast error of health expenditure (LHE). However, the remaining 58.6% effect is the result of its own shocks as depicted by Table 6. The VDA of fiscal deficit shows that 71% variance of its estimate error is contributed by its own shock and other major remaining portion 19 % by health expenditure (Table 7). The VDA of public debt depicts that for 10thforecast period more than 59% of the forecast variance is explained by an innovative shock in health expenditure, hence indicating a well-built long-run relationship between the two variables as shown in Table 8. The VDA of GDP explains 40% of its variation by shocks in health expenditure and 39% by its own shocks (Table 9). Similarly, the VDA of energy consumption shows 74% of its variation by its own shocks (Table 10). Moreover, VDA results verify that the two variables, namely LFD and LEC are fairly exogenous as they are explained by their own shocks in the long-run.

Figure 1 CUSUM test (see online version for colours)

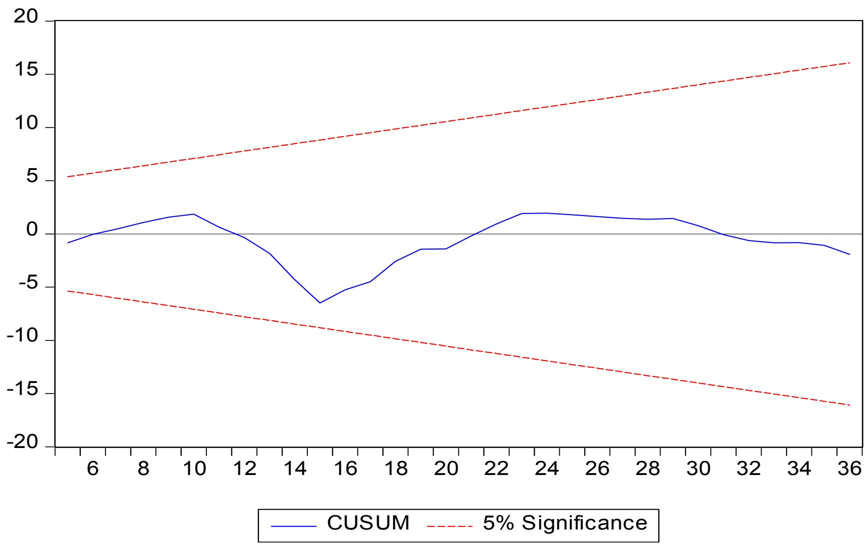

Table 6 Variance decomposition of health expenditure

Period	*S.E*	*LHE*	*LFD*	*LPD*	*LGDP*	*LEC*
1	0.108456	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.108456	96.942883	2.652003	0.000869	0.071368	0.332935
3	0.168945	84.03993	6.683818	0.639517	8.345979	0.290759
4	0.197560	77.53358	6.863322	0.534530	13.90951	1.159051
5	0.218247	69.48299	9.688703	1.325780	16.23399	3.268527
6	0.228277	67.73605	9.763624	1.390150	18.00519	3.104983
7	0.242457	64.69546	9.108589	1.316875	21.99031	2.888758
8	0.257170	62.00509	9.239187	1.397481	23.69537	3.662875
9	0.268753	59.89629	9.693162	1.510423	24.78098	4.119151
10	0.280063	58.63130	9.746346	1.480348	26.25413	3.887875

Table 7 Variance decomposition of fiscal deficit

Period	*S.E*	*LHE*	*LFD*	*LPD*	*LGDP*	*LEC*
1	0.476871	9.5235880	90.47641	0.000000	0.000000	0.000000
2	0.537723	16.323885	81.07104	0.174641	2.047707	0.382725
3	0.564324	15.202975	79.20309	1.557559	1.945826	2.090529
4	0.627018	13.930580	77.61998	1.307809	4.683192	2.458434
5	0.682730	16.930580	74.90320	1.173963	3.975355	3.149535
6	0.724236	18.457748	72.97196	1.312572	3.762814	3.494908
7	0.767611	17.056186	7342207	1.338799	4.907717	3.275228
8	0.813422	17.476225	72.26186	1.256655	4.774966	4.230289
9	0.847164	19.255609	71.18734	1.173787	4.448498	3.934771
10	0.883441	18.735212	70.93176	1.303491	4.701993	4.327540

Table 8 Variance decomposition of public debt

Period	*S.E*	*LHE*	*LFD*	*LPD*	*LGDP*	*LEC*
1	0.081860	42.95876	0.311580	55.72966	0.000000	0.000000
2	0.131504	55.77409	2.098839	39.16902	2.478572	0.479475
3	0.185869	57.34174	12.37393	23.85821	6.184985	0.241131
4	0.226697	55.19729	8.533297	20.66136	14.60696	1.001094
5	0.259165	56.12394	6.637589	21.24124	14.62462	1.372605
6	0.300506	57.50729	6.163125	20.54331	14.32991	1.456366
7	0.334458	58.86260	6.279933	19.39700	14.20177	1.258691
8	0.363106	59.36669	5.909552	18.74896	14.78095	1.193852
9	0.389734	59.34627	5.607011	18.58914	15.08885	1.368737
10	0.416214	59.85268	5.385009	18.41744	14.93152	1.413351

Table 9 Variance decomposition of economic growth

Period	*S.E*	*LHE*	*LFD*	*LPD*	*LGDP*	*LEC*
1	0.490780	28.88958	6.048383	2.923102	62.13894	0.000000
2	0.543210	33.60099	7.507226	2.495937	53.66938	0.726471
3	0.603976	29.77679	13.15052	3.949336	50.18867	2.934677
4	0.623779	29.96249	15.12051	3.751079	47.35300	3.812915
5	0.667788	29.48915	13.95216	3.565250	48.01176	4.981648
6	0.728906	35.46996	13.91837	3.132119	42.74014	4.739407
7	0.752545	36.64794	13.34203	3.113050	42.26137	4.635614
8	0.771520	37.51816	13.20761	2.976261	41.40139	4.896579
9	0.812235	38.58411	12.41573	2.885894	39.60111	6.513154
10	0.846253	40.45962	11.71861	2.659017	39.15724	6.005513

Table 10 Variance decomposition of education expenditure

Period	*S.E*	*LHE*	*LFD*	*LPD*	*LGDP*	*LEC*
1	0.976722	0.232800	1.117579	4.506542	0.299854	93.84322
2	1.231787	3.134909	0.819612	3.284172	8.242148	84.51916
3	1.290001	3.834630	7.190543	3.888644	7.599015	77.48717
4	1.385831	8.440690	6.511193	3.625517	6.598149	74.82445
5	1.736774	6.354482	4.166781	3.603254	5.618304	79.25718
6	1.796560	6.546917	5.503509	4.354494	7.700812	75.89427
7	1.832340	8.769390	6.220837	4.520431	7.505422	72.98392
8	2.011009	7.727892	5.198091	4.848991	6.241720	75.98331
9	2.193131	7.738440	4.775721	4.646055	7.516246	75.32354
10	2.211646	7.662740	5.629394	4.902132	7.711592	74.09414

Source: Authors Authentication

5 Conclusion

The main objective of this paper was to investigate the short run and long run dynamics of fiscal deficit, public debt, GDP, energy consumption and health expenditure. To accomplish that purpose ARDL bound testing approach was used. In order to make use of this approach, the first task to be done was to make the data stationary if it turns out to be non-stationary. The Augmented Dickey Fuller (ADF) test was used for that purpose and the optimal lag length was selected through various lag selection criteria's. Further Error Correction technique has been used to check the short run and long run causality among variables. Finally for checking the strength of causality, VDA has been used. The results reveal that fiscal deficit, public debt, GDP and energy consumption has a significant influence on the health expenditure in the long run, and in the short run only GDP has shown such relationship.

The long run causal relationship running from fiscal deficit, public debt, gross domestic product and energy consumption to government health expenditure clearly supports the idea that these variables do affect the health expenditure but among all these variables GDP is a strong variable as it influences the health expenditure in both the periods. Therefore, we suggest that maintenance of economic growth, fiscal discipline, prudent public debt management, and judicious energy consumption should go a long way in ensuring better health expenditure therefore better public health outcomes. Thus if the government will reduce the unwanted subsidies and interest obligations and develop alternative energy sources, it will bring a sigh of relief to the government which will prove very beneficial to the economic growth that will surely make the health sector better and efficient.

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