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Abstract: In this paper, we examined whether there is a long run relationship between government spending on healthcare and mortality rate, life expectancy as using data for the period 1980 and 2015. The analysis reveals long run relationship between government spending on healthcare and fertility rate and infant mortality rate. However, no co-integration is observed between government spending on healthcare and life expectancy and adult mortality rate. This implies that an investment in health via an expansionary government expenditure on health may be adopted in order to realize faster economic growth and better health outcome in Namibia.

Introduction

Literature has revealed that human capital is one of the most important elements of economic development and growth (Romer, 1988; Lucas, 1988; Robelo, 1991; Mankiw et al., 1992; Creedy and Gemmell, 2005; Riley, 2012). Although accumulation of human capital is a clear determinant of economic growth, it was only 1990s, when the investments in healthcare became a focus of serious academic inquiry (Fogel (1994; Lilliard and Yoram, 1997; Aurangzeb, 2001). These studies have shown that investment in health is not only a necessity, but also an essential priority for most societies to fast-track development. Studies have shown that government spending on healthcare may have a multiplier effect in increasing economic growth, reducing income inequality and poverty (Tanzi and Chu, 1998). Thus, slowing the investments in health could be reflected as an obstacle for economic progress. With data of 191 WHO member countries, Musgrove et al. (2002) backed up the notion that an inadequate investment and low health expenditure is causing loss of potential economic growth.

Health is an important determinant of economic development; a healthy population means higher productivity, thus higher income per head (World Health Organisation, 2005). Mushkin (1962) proposed that contribution of health expenditure to economic development arises from the health led growth hypothesis. According to Lilliard and Yoram (1997), health is one of the most important assets a human being has. It permits societies to fully develop their capacities. If this asset erodes or it is not developed completely, it can cause physical and emotional weakening, causing obstacles in the lives of people and subsequently poor development. David, et al, (2004) maintained that, healthier workers are physically and mentally more energetic and robust. They are more productive and earn higher wages, they

are also less likely to be absent from work because of illness and therefore have means to participate in the economic activities.

Grossman (1972) developed a model in which illness prevents work so that the cost of ill health is lost labour time, and therefore, low productivity. Low productivity is seen as having a negative impact on economic growth and development. Consequently, health has been recognised as another fundamental element of human capital (Bloom et al., 2001; and Barro, 2013). Preston (1975) demonstrated a positive correlation between national income levels and life expectancy. While Strauss and Thomas (1998) stated that health and income mutually affect each other. Thus, problems affecting health cause negative shocks in growth. Bloom and Canning (2000) suggest that healthy communities or populations tend to have enhanced physical abilities and mental clarity, which in turn increases productivity. Health can also affect growth indirectly when health status affects education performance. Good health can be associated with increased levels of schooling and high education performance.

Health is not only important to countries as health can be a causal factor for the aggregate economic growth of a country, but also it is instrumental to an individual's education, income and overall development. David (2005) used the direct linkage and impact of health and suggested that healthier people are better workers; they can work harder and longer, and also think more clearly. He also recommended that beyond this proximate effect of health, there are a number of indirect channels through which health affects output. Good health also raises the incentive to acquire schooling, since investments in schooling can be amortized over a longer working life. Thus, health influences labour productivity, the capacity to learn at school and to grow intellectually and physically (Jack and Lewis, 2009). David et al. (2004) used a sample of 104 countries over the period 1960-1990 to examine the relationship between health and economic growth by applying non-linear two-stage least squares estimates, and they revealed that good health had significant positive effect on economic growth.

Empirical evidences on the relationship between health expenditure and economic development have delivered mixed results by way of positive to negative relationships. Aurangzeb (2001) used an augmented Solow growth model for Pakistan during the period 1973–2000. He employed a Johansen co-integration technique and error correction model (ECM) to show a positive and significant relationship between economic growth and health expenditure in both the short and long-run. Gyimah-Brempong (2004) finds that investment in healthcare and stock of human capital has a positive relationship with economic growth. Bloom and Canning (2000) considers health to be capital; therefore investments on health can lead to an increase in labour productivity, thus increase income and subsequently increase the wellbeing of population.

Dreiger and Reimers (2005) employed a panel data co-integration technique, using a data of 21 OECD countries between 1975-2001, to investigate the relationship between healthcare expenditure and economic growth and found the existence of a long-run relationship between health expenditures, GDP per capita and proxies for medical progress. Bakare and Sanmi (2011) also investigated the relationship between healthcare expenditures and economic

growth in Nigeria using ordinary least square multiple regressions as their method of analysis and showed a significant and positive relationship between healthcare expenditure and economic growth.

Amadu, Eseokwea and Ngamb (2017) examined the contribution of public health investments to the economic growth of Cameroon. They employed Vector Error Correction (VECM) as the econometric model in their estimations. Annual time series data from 1988 to 2013 was used for the purpose. The results of the estimation showed that public health investments contribute to the economic growth of Cameroon only in the long-run. Fogel (1994) discovered that approximately one third of income growth in Britain during 1790-1980 would be attributed to the improvement in health facilities and better nutrition. Therefore, a consistent finding is a strong and positive correlation between national income and national expenditure on healthcare (Abel-Smith, 1967; Leu, 1986; Wilson, 1999).

While some studies discovered a positive relationship between government expenditure on healthcare and economic growth, some shows a unidirectional relationship, some find no effect of healthcare expenditure on the economic growth at all (Hansen and King, 1996; Day and Tousignant, 2005). However, in several cases healthcare performance is found to be significantly dependent on the economic growth as well as on the health systems themselves. Thus, this reverse linkage cannot be ignored at all. Eggoh et al. (2015) however conclude that increasing healthcare expenditures may have negative influence on growth, even when the level of health expenditures for the countries is at low level, provided that the education expenditures remain below a certain threshold level. Ogundipe and Lawal (2011) also examined the impact of health expenditure on economic growth in Nigeria using OLS and find a negative effect of total health expenditure on growth. Less investment of government on health comes at a cost of individuals deepening in their pocket to fund their personal wellness. However, introduction of hospital service fees others opinions highlight its' negative effects, particularly the inequity for the poor people (Lagarde and Palmer, 2008).

Objective and Methodology

Namibia gained its independence in 1990. However, the country inherited an economy of highly skewed income distribution with resourceful minority white settlers; while the majority of the country's population was in absolute poverty. The healthcare system was highly fragmented and biased towards curative care, while being inefficient and inadequate, thus putting the previously-disadvantaged at the bitter end of the stick. Thus, after Namibia gained independence, its healthcare delivery system reflected a traditional medical model, focused mainly on hospital-based and curative services and the health outcomes were generally poor.

Soon after independence, a switch in policy with emphasis to primary healthcare was adopted. In order to provide effective and equitable primary healthcare services, the healthcare reform included the decentralization of responsibilities and local communities

were involved in the decision-making processes (Low, Ithindi and Low 2003). In 1994, thirteen regional health management teams were created to plan and manage all local Primary Healthcare services and facilities equitably. These teams were responsible for managing district healthcare system as they sought to operationalize a primary care approach. Hence, the new government gave more stress on primary healthcare among others.

Therefore, in the present study we analyse if there is a relationship between government expenditure on health and economic growth as well as other human development measures, and after examining the nature of relationship, analysis is stressed on establishing the direction of relationship using the data from Namibia over the period of 1980-2015.

Model

To test for the causal relationship between two variables the standard Granger test, as stipulated by Granger (1969), has been employed [see (Keho 2010), Kónya (2004) among others]. Granger (1969) states that, if past values of a variable Y significantly contribute to forecast value of another variable, X_{t+1}, then Y is said to Granger cause X, the opposite is also true. According to Sims (1980), if there is simultaneity among variables, Vector Autoregressive (VAR) model should be employed. A VAR model suggests that if there is no much knowledge about the forces influencing a variable, then treat those variables symmetrically. This is shown by the following system of equations:

$$Y_t = \beta_{10} + \beta_{11}Y_{t-1} + \beta_{12}X_{t-1} + U_{yt} \quad (1)$$

$$X_t = \beta_{20} + \beta_{21}Y_{t-1} + \beta_{22}X_{t-1} + U_{xt} \quad (2)$$

Where U_{yt} and U_{xt} are correlated white noise and β_{ij} are coefficients. The equations shown above are in reduced form. The VAR model can be estimated with the usual ordinary least square (OLS). Y_t and X_t are the variables to be tested (GDP, heath indicators and government expenditure on healthcare respectively), while Y_{t-1} and X_{t-1} are lagged values for the Y_t and X_t variables, and t = 1, 2, 3…, T (1980-2015). The βs are parameters to be estimated.

According to Granger (1969), the test of causality is invalid if the variables order of integration is unknown. Thus, a non-stationarity (Unit root) test of the original variables should be done using Augmented Dickey Fuller (ADF) test (Dickey and Fuller, 1979; Said and Dickey, 1984), to check stationarity of variables and then further test for co-integration between the variables.

According to Asteriou (2007), the concept of cointegration was first introduced by Granger (1981) and elaborated further by Engle and Granger (1987), Engle and Yoo (1987), Phillips and Ouliaris (1990), Stock and Watson (1988), Phillips (1986 and 1987), and Johansen (1988, and 1991). It is known that trended time series can potentially create major problems in empirical econometrics due to spurious regressions. One way of resolving this is to difference the series successively until stationarity is achieved and then use the stationary series for regression analysis.

Results and discussion

As mentioned above, stationarity of all the variables is tested by Augmented Dickey Fuller test. Here, the results failed to reject the null hypothesis of non-stationarity at level form including the intercept, for all the variables. Public expenditure on healthcare, infant mortality and GDP are found to be integrated of order 1, while life expectancy and adult mortality rate (male and female) are found to be integrated of order 2 (Table 1). Therefore, variables that are integrated of different order can be safely assumed to be non-co-integrated. However, there may be a co-integrating relation among the life expectancy at birth and both male-female mortality rate.

Table 1: Test of Stationarity and Coefficient of Change in Health Expenditure and Health Output

	Akaike Info Criterion						
	Level Form		***First Difference***		***Second Difference***		
	Coeff.	***τ***	***Coeff.***	***τ***	***Coeff.***	***τ***	***Remark***
P/C GDP	0.061	1.7274	-0.560	-3.530			I(1)
P/C Health Expenditure	-0.016	-1.213	-1.137	-3.249			I(1)
Life Expectancy at Birth	**-0.056**	**-1.416**	**-0.011**	**-0.462**	**-0.162**	**-4.042**	**I(2)**
Female Mortality Rate	**-0.0502**	**-2.4934**	**-0.1521**	**-1.634**	**-0.995**	**-5.499**	**I(2)**
Male Mortality Rate	**-0.0455**	**-2.5266**	**-0.135**	**-1.5237**	**-0.991**	**-5.518**	**I(2)**
Infant Mortality Rate	0.006	0.585	-0.805	-6.863			I(1)
Fertility Rate	0.044	2.946	-2.516	-3.393			I(1)
Critical Value at	1% = -3.689, 5% = -2.971		1% = -3.639, 5% = -2.951		1% = -3.646, 5% = -2.954		

Note: * indicates that the coefficient is significant at 1% level of significance, while ** indicates that the coefficient is significant at 5% level of significant.

Tests for Co-integration

As mentioned earlier, the Johansen Co-integration test is used to examine the existence of long run relationship between the variables. Before performing the Johansen co-integration tests, we have chosen the optimum lag length. There are different criteria for the optimal lag selection. One of the criteria is by using Akaike information criterion (AIC). According to the AIC standard we have to choose the model with the lowest AIC value. The lower the value of AIC, the better is the model. The other way of choosing optimal lag is by using the system equation lag length criteria. In this study, we used both AIC and the system equation lag optimal length criteria. The series optimum lags length ranged from 1 to 6 for healthcare expenditure and health output variables (Table 2).

Table 2: Optimal lag Selection for Co-integration between Health Expenditure, GDP and Healthcare Output Variables

Series Name	Lowest AIC lag	System equations
LNHealth_Exp & LNFert_Rate	4	4
LNHealth_Exp & LNInf_Mort_Rate	6	6
LN_PC_GDP LN_PC_HEALTH_EXP	1	1

The trace statistic and Max-Eigen value test both indicate at least 1 co-integrating equation between health expenditure and fertility rate at the 0.05 level of significance (Table 3). Also, the results reveal that as per both the trace statistic and Max-Eigen value test, there is 1 co-integrating equation at the 0.05 level of significance between health expenditure and infant mortality. Both the trace statistic and Max-Eigen value test indicate presence of 1 co-integrating equation between per capita GDP and per capita healthcare expenditure at the 0.05 level of significance.

Table 3: Results of Co-integration Test Results		
Co-integration Test between Health Expenditure and Fertility Rate		
Null hypothesis	$^{J}trace$	^{J}max
$r = 0$	17.612	17.227
	(-0.023)	(-0.017)
$r = 1$	0.384	0.384
	(-0.535)	(-0.535)
Co-integration Test between Health Expenditure and Infant Mortality Rate		
Null hypothesis	$^{J}trace$	^{J}max
$r = 0$	26.278	24.207
	(-0.001)	(-0.001)
$r = 1$	2.071	2.071
	(-0.15)	(-0.152)
Co-integration Test between Per Capita GDP and Per Capita Health Expenditure		
Null hypothesis	$^{J}trace$	^{J}max
$r = 0$	28.107	17.002
	(-0.003)	(-0.033)
$r = 1$	8.284	8.284
	(-0.015)	(-0.015)
Note: p-value is in the parentheses.		

Vector Error Correction Model

Since there is co-integration between the major health output variables and expenditure on healthcare, vector error correction model is estimated in order to examine the short run adjustment of the dependent (target) variable/s and the impacts of various explanatory variables on it. The normalized long-run co-integrating equation between government expenditure on healthcare and fertility rate, mortality rate, as well as per capita GDP and per capita healthcare expenditure is formally presented in Box 1 below. To safeguard the reliability of the results, we limit the number of variable in a single VAR to at most 4 most relevant variables only. Here, lag literacy rate is also included as explanatory variable as it would have significant influence on fertility (Bloom and Canning, 2000). Similarly, education expenditure has also been incorporated in the error correction model after careful examination of stationarity; in order to check its effect on health status and GDP.

From the results in Box 1, coefficients for government expenditure on healthcare and per capita GDP are negative and statistically significant in equations 3 and 4. Hence, the long run impact of government spending on healthcare and per capita GDP on fertility rate, as well as with infant mortality rates is found to be significantly negative in the co-integrating vector.

However, the coefficients of literacy rate in both equations are found to be not significant. This implies that rate of literacy has no long run significant impact on fertility rate and infant mortality rate.

Box 1:

Health Expenditure

Fertility rate

$$LnFR(-1) = -0.156LnHExp(-1) - 1.066\,Ln\_Pc\_GDP(-1) - 0.426067\,LnLR(-1) + 4.693 \quad \ldots \quad 3$$
$$[-11.965] \qquad [-5.1699] \qquad [-0.8436]$$

Infant Mortality rate

$$LnIMR(-1) = -0.970LnHExp(-1) - 0.4268Ln\_Pc\_GDP(-1) - 0.01937\,LnLR + 3.533 \quad \ldots \quad 4$$
$$[9.9812] \qquad [-2.8181] \qquad [-0.0733]$$

Note: t-statistics are in [ ].

LnFR = log of fertility rate, LnHExp = log of government healthcare expenditure, LnIMR = log of mortality rate, Ln_Pc_GDP = per capita GDP.

The estimated coefficient of the VECM regression residual EC_{t-1}, is negative as it should be for most of the variables (Table 4). Nonetheless, the EC_{t-1} is found to be significant and less than one in absolute sense, implying that there is short run relationship between government expenditure on healthcare and infant mortality rate as well as government expenditure on education and primary net enrolment rate. Thus, there is sufficient evidence to show that in the short-run, government expenditure on healthcare has much influence on infant mortality and GDP though education expenditure is found to influence insignificantly in this reconstruction phase of Namibia. It may also be due to the fact that the educational level on an average has not reached that critical level after which it will only show its relevance.

Table 4: Vector Error Correction Models

Vector Error Correction Model: Healthcare Expenditure		
ECT_1	-0.3587	-0.53366
Healthcare Expend.	[-3.2460]	[-4.3981]
Variable	Fertility Rate Per Birth	Infant Mortality rate
ECT_1	-2.45229	5.141797
	[-2.1999]	[1.56118]
Vector Error Correction Model: Per Capita GDP		
ECT_1	-0.053170	-0.05306
Per Capita GDP	[-3.52063]	[-3.53603]
Variable	Healthcare Expenditure	Education Expenditure
ECT_1	-0.01953	0.15589

Note: t-statistics are in the parentheses.

Granger Causality Test

The long run relationship between health expenditure and health outcome is established that helps in developing human resources. Now the development of human

resource may lead to the growth of GDP and on the other hand GDP growth may be the source of growing healthcare expenditure along with education and other development expenditure. Hence the causality between such expenditures and GDP in per capita form has been examined through Granger Causality test. The test reveals that there is unidirectional causality running from per capita government expenditure on healthcare to per capita GDP. Furthermore, the test also reveals that there is a unidirectional causal relation between fertility rate and per capita GDP, running from fertility to GDP. The result further reveals that there is causal relationship between healthcare expenditure and fertility rate at birth as well as health expenditure and infant mortality rate. However, there is a bidirectional relationship between infant mortality rate and fertility rate, between infant mortality rate and per capita GDP as well as between fertility rate and per capita GDP.

Table 5: Granger Causality test Statistics

Null Hypothesis:	F-Statistic	Prob.
LN_PC_HelExp does not Granger Cause LN_PC_GDP	5.93647	0.0069
LN_PC_GDP does not Granger Cause LN_PC_HelExp	0.00139	0.9986
LNFR does not Granger Cause LN_PC_GDP	7.47302	0.0025
LN_PC_GDP does not Granger Cause LNFR	9.89539	0.0006
LNIMR does not Granger Cause LN_PC_GDP	3.09558	0.0605
LN_PC_GDP does not Granger Cause LNIMR	3.71944	0.0365
LNFR does not Granger Cause LN_PC_HelExp	0.11509	0.8917
LN_PC_HelExp does not Granger Cause LNFR	124.049	0.0000
LNIMR does not Granger Cause LN_PC_HelExp	1.63014	0.2133
LN_PC_HelExp does not Granger Cause LNMRI	3.59839	0.0402
LNIMR does not Granger Cause LNFR	61.3918	0.0000
LNFR does not Granger Cause LNIMR	5.46020	0.0099

The coefficients results indicated that the is a positive relationship between government expenditure on healthcare and GDP as well as a positive relationship between GDP and fertility rate at birth and a negative relationship between GDP and infant mortality rate. The relationship between health expenditure and both fertility rate at birth and infant mortality rate is also negative.

The indication is that the impact of health status on per capita GDP is more pronounced for direct and indirect effect through birth and mortality control, enhancement of life expectancy and overall productive capacity of individuals; than the effect of per capita GDP on various health aspects. Obviously, rising GDP has some impact on the healthcare expenditure and some variables reflecting health status.

Conclusion and Recommendation

In this paper we tried to examine if there is a long run relationship between government spending on healthcare and per capita GDP, mortality rate, life expectancy in Namibia using a dataset for the period 1980 and 2015. The resultant outcome is in a mix. Here, analysis reveals positive long run relationship between government spending on healthcare and

fertility rate (positive) and infant mortality rate (negative). However, no co-integration is observed between government spending on healthcare and life expectancy and adult mortality rate. This implies that there is no clear cut relationship government spending on healthcare and life expectancy at birth and adult mortality rate so far. The results further, reveals that there is a positive long run relationship between government expenditure on health and GDP as well as positive a relationship between GDP and fertility rate at birth and a negative relationship between GDP and infant mortality rate.

This implies that an investment policy in healthcare through the expansion of government spending on healthcare may be adopted in order to realise faster economic growth. This finding has a clear implication for the debate on sustainability of public finances. It is often claimed that rising government spending would be a key to ensure the sustainable economic development over the long-run, as it is proposed by John Maynard Keynes. Even though the evidences from the estimations support the Keynes' theory in some aspects, the findings suggest that there is no long run relation between government spending on healthcare and some health indicators (like, adult mortality rate and life expectancy) in Namibia. This is due to the fact that still the economy is in reconstruction phase after the independence and some results on health outcome started showing results only after 2000. There is an apparent inefficiency in the use of growing expenditure due to sudden shortage of required manpower immediately after the independence.

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