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Government expenditure on health and economic growth in Botswana: Testing for cointegration and specification of deterministic components using the pantula principle



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ABSTRACT

This study examines the relationship between government expenditure on health and economic growth in Botswana. It seeks to test the existence of cointegration and specification of the deterministic components with special reference to the Pantula Principle. This helps to overcome the shortfall of the method by Johansen, which may lead to spurious results by omitting the presence of deterministic components in the analysis. The cointegration approach is used and tested using three methods by Engle and Granger (1987) or EG, a procedure suggested by Johansen (1988) and error correction model (ECM) approach proposed by Granger(1988) and short-run analysis is made using the pairwise granger causality tests. Findings show that the correct model specification for testing long-run relationships consists of one cointegrating vector with a constant which is the most restrictive hypothesis according to the Pantula principle. Using the Johansen approach, total health expenditure and recurring health expenditure have a cointegration relationship with growth while development health expenditure and growth are not cointegrated. The ECM and the approach by EG confirm a weak and/or no cointegration between the variables. Growth has no effect on government expenditure on health in the short run, but a cointegration relationship suggests that it may marginally contribute to an increase in health expenditure over the long term. The study clarifies the correct model to test for cointegration and specification for the deterministic component. It confirms the existence of a healthcare expenditure-led growth hypothesis. This requires Botswana to design a policy that targets specific parts of recurrent and development health expenditure to support human capital development and influence future growth.

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Introduction

This study examines the relationship between government expenditure on health (GEH) and economic growth, as proxied by gross domestic product (GDP), within the context of Botswana. At a global level, the need to understand this relationship is underpinned by sustainable development goals number three and eight which seek to ensure healthy lives and promote wellbeing for all at all ages and ensure sustainable and inclusive growth, full and productive employment and decent work for everyone. Health lives forester productivity and hence future growth of the economy. It is argued that high expenditures on health lower mortality and morbidity rates and result in a high working age of the population and later improves per capita incomes. As the health of the nation improves, so does the intellectual and physical development of the population. This justifies the need to improve government expenditure on health and invest in the human capital which drives production (Chakrabarti et al, 2019, Faruk et al, 2022, Nazar et al, 2022). More so, the level of GEH is a good indicator to gauge the success and failure of a country's development plans (Ndaguba & Hlotywa, 2021).

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There are divergent views on the nature of the relationship between the two variables. For example, evidence show that the proportion of GEH is on the rise due to rapid economic development. Its increase results in an improvement in human capital which later drives economic growth. The changes in GEH and economic growth can be captured in absolute terms and using the rate of growth. The commitment by government on human capital development is seen by rising proportion of GEH as a percentage of GDP (Zhang et al, 2020).

Evidence confirms that a relationship between these two variables exists in both short and long run (Dikmen, 2017, Azam et al, 2019). However, there is considerable disagreement on the nature of the relationship between the two variables. Findings from past studies are both mixed and inconclusive. The multitude of economic and social pathways through which health affects growth and the reversal causal channel by which economic growth promotes health brings complications in understanding this relationship. This further cause challenges to trusted theoretical modeling and empirical identification. In dealing with health expenditure functions, availability of international data has fostered the development of a significant amount of empirical work. However, heterogeneously regulated, financed and managed health systems are pooled together, which arguably might limit the comparability across countries. Indeed, among the European countries there are sizeable differences in the health care systems. Accordingly, it is doubtful that data from different developing countries are better in terms of health care packages.

Studies have applied different methods to test the bidirectional linkages between these variables. For example, positive association and relationships have been tested using constraint method, autoregression lag approach, and other methods employing panel data to help understand the dynamics involved (Murthy & Okunade, 2016, Atilgan et al, 2017, Sinha, 2021). Moreover the conclusions from panel data are unreliable due to omitted variables bias and the presence of unobserved country and year specific determinants of per capita health expenditures. Several studies employ panel data unit roots (see, e.g Sen, 2005, Piabuo & Tieguhong, 2017, Raghupathi & Raghupathi, 2020, Abdulqadir et al, 2022) and raise concerns that panel data estimations of the GDP and GEH relationship may be spurious. Whilst, using panel data has advantages over cross-sectional data; it has its own problems ranging from the presence of trending variables in the regressors, such as GDP and GEH to the problem of exchange rates (Zulfikar & STp, 2019).

The importance of GEH on economic growth is generally accepted but country specific dynamics also matter due to differences in quality of institutions and other macroeconomic factors. Poor institutions adversely affect the health of the population which is detrimental to growth in the long term (Sarpong et al, 2020, Seth et al, 2020). Improved health care stabilizes life and contributes to high worker productivity. In pursuant to this, the Botswana government seeks to improve both recurrent and development health expenditures and subsequently improve supporting infrastructure and the productivity of human capital. However, there is no clarity on the extent to which each component of GEH should be designed and how it will subsequently affect growth. In addition, there is dearth of evidence on studies that examine the linkages between GEH and GDP within the Botswana and African context. This limits the scope for initiation of policy and its application to help Botswana and similar countries in driving their human capital development and growth agenda. Past studies based on different jurisdictions leave policy makers, in context of emerging markets, with no direction on how to develop human capital and promote growth in, both, the short and long run. More so, conventional methods for analyzing the long-term relationships between the major variables produce spurious results which may lead to false conclusions and hence misdirected policy prescriptions.

Consequently, by examining the relationship between growth and the composition of GEH, the study makes the following important contributions: applies pairwise granger causality tests within the Johansen multivariate cointegration and error correction framework; and employs the principle by Pantula (1989) to jointly determine the cointegration rank and deterministic components specification. By omitting the presence of deterministic components in the analysis, the Johansen procedure leads to spurious cointegration. Specifically, this study contributes to literature and policy making by answering the following research questions: How does government expenditure on health contributes to economic growth and vice versa? Does this relationship depend on the type of government expenditure on health (GEH)? What is the correct model specification of deterministic components, in view of the pantula principle, and does it matter in enhancing our understanding of the long and shortrun relationship between the two variables?

The rest of this study is organized as follows: section two puts the study into context by discussing health care and growth in Botswana; section three reviews literature that links the major variables; section four outlines the methodology; section five presents and discusses the main findings and section six concludes the study with policy implications.

Literature Review

Conceptual and Theoretical Background

Botswana, at independence in 1966, ranks as one of the most poorest countries in sub Saharan Africa (SSA). After transformation the country is, now, classified within the middle income band being underpinned by a political leadership that pursues growth promoting policies. The country has strong political, economic and legal institutions. As much as the country depends on diamonds the adverse consequences of resource wealth are overcome by keeping government expenditure at economical levels. The country has an impressive sustainable development and political stability record (Fidzani, 1998, Samatar, 2005, Jerven, 2009, Makoni, 2015). The economy experiences three phases of development: the period 1960 to 1975 has much uncertainty as the country passes through a base setting and transitional phase. This sees the transformation of institutions and offering of developmental policy directions. The country experiences mainly state led development policies. The period from 1975 to 1989 witnesses rapid economic transformation

coupled with fast growth and limited structural diversification. The period from 1989 onwards witnesses a change in policy emphasis from a state to private sector led development strategy. The rate of growth slows down considering the dynamics in the political environment (Maipose and Somolekae, 1999, Leith, 2001). According to Siphambe (2004) national development plans have always emphasized that the government should facilitate and not be an active participant in economic activities. However, despite being credited with good resource wealth management, as seen in high levels in health, education and infrastructure, the low quality of health outcomes is still a concern. This makes it more difficult to meet objectives on growth, diversification and alleviation of poverty.

Botswana has one of the highest HIV/AIDS prevalence rate in the world standing at 18.5% and 15.6% in urban centres and rural areas respectively. This lowers life expectancy from 68 years (1995) to 36 years (2006) according to World Health Organisation (WHO) 2006 report. The Botswana Statistics office indicates a life expectancy of 57 years as per 2001 census. Prior to the HIV/AIDS pandemic life expectancy stands at around 48 years (1966) and 65.3 years (1995). Thus, the population looks healthier than an average SSA state due to having a higher life expectancy and lower infant mortality rate (Mogae, 2005). The high HIV/AIDS prevalence poses high morbidity and mortality rates and comes with other social costs as families lose loved ones. Additional expenses come in form of reduced productivity, high absenteeism from work, high staff turnover and additional hiring costs for firms which reduces growth. The country has made major strides in health care as close to 88% of the population stays within 8 kilometers of a health facility and trained personnel attend to 99% of births. The fight against HIV/AIDS is supported by non governmental, religious and community based organisations (Clover, 2003).

The country is considered as the first, in Africa, to distribute antiretroviral therapy (ART) to all citizens. Treatment is free of charge in public health institutions and private medical aid facilities also help in many respects. At least 90% of those who are eligible receive ART. Huge investment has been made in building new medical facilities, recruiting qualified personnel and availing drugs. The overall adult HIV/AIDS prevalence rate falls among young adults and women. The prevalence rate among pregnant women has fallen over the years being 37.4% (2003), 33.7%(2007), 30.4% (2011) and now stands at 20.8% (2022). However, industry is still experiencing challenges as man hours are lost due to the high prevalence of HIV/AIDS pandemic. The government still faces high expenditure to assist victims through loss of breadwinners (Jefferis & Kenewendo, 2013, Clover, 2003). Much of the challenges in the response to HIV/AIDS occur in the health sector and most antiretroviral treatment in Botswana are delivered through the public sector.

More so, by focusing more on HIV/AIDS the healthcare system is still under pressure which contributes to poor outcomes in maternal and child health, non-communicable diseases and limiting women who are, mainly, heading families from participating in productive employment. In addition, developing a new model of growth would be dependent on improvements in human capital by working through investment in education and healthcare. The average expenditure on health has averaged 5.5% of GDP between 2007 and 2010 showing the government's commitment to improving outcomes (Diop, Alam & Farole, 2015). More so, the 2020/21 budget speech shows that the Ministry of Health and Wellness receives the third largest share of recurrent budget allocations and the second in 2022/23 financial year covering provision of drugs, dressings, vaccines and provision of antiretroviral therapy (Matsheka, 2020). An analysis of growth in health spending in relation to economic growth provides useful guidelines because domestically financed public health dominates health spending in Botswana, and it accounts fully for the increase in this category of expenditure since 2001. Before 2001, public health spending accounted for just over half of total health expenditures (THE) which hovers just above 4 percent of GDP (Lule and Haacker, 2012). Sinha (2021) shows that THE is on a steep rise since 2001 being underpinned by a similar trend in RHE. DHE makes a gradual increase until 2009 before receding to 2002 levels until the end of 2013. GDP has been on the rise since 1983 with a slowed down witnessed in 2002 and 2008 due to global financial shocks

Empirical Review

The nexus between health care expenditure and growth has been examined in recent years. Findings are inconclusive and differ due to context, variable measurement, period and method of analysis. Literature shows that these variables have no relationship, positive relationship and negative relationship. For example, the hypothesis by Mushkin (1962) suggests a health led growth relationship. Investment in health is a type of capital as it improves incomes and overall economic growth. It contributes to human and physical capital accumulation. Rising expenditure on health improves productivity, quality of life and general welfare. More so, the endogenous growth theory postulates that improvement in health boosts output. The positive effect of expenditure on health works through improved worker productivity since a health population adapts quickly, works longer and more efficiently (Aghion & Howitt, 1996, Gaies, 2022). This is supported by past studies (Liang, 2012, Lee et al, 2019, Erçelik, 2018, Raghupathi & Raghupathi, 2020, Sinha, 2021, Abdulqadir et al, 2022, Gaies, 2022) which show that an increase in health care expenditure accompanies economic growth. This is realised as better health care stabilizes life and contributes to improved worker productivity. Ozturk and Topcu (2014) argue that health care expenditure leads to growth in the short run while feedback effects are experienced in the longrun. This is consistent with Bedir (2016) who shows that increases in income level stimulate healthcare expenditures in emerging markets.

Furthermore, past studies (Erdil & Yetkiner, 2009, Bedir, 2016, Ogungbenle et al, 2013) suggest a two way causality between expenditure on health and growth. They state that increases in income stimulate expenditure on health. In addition, Mayer (2001) finds strong causality moving from growth to expenditure on health More so, Elmi and Sagedhi (2012) confirm a strong short run relationship moving from growth to expenditure on health and bidirectional causality in the long run. These findings are consistent with those by Aurangzeb (2003) who finds a positive relationship in both the short and long run. Studies (Mehrara & Musai, 2011,

Clemente et al, 2004, Arisoy et al, 2010, Samadi & Rad, 2013) confirm the existence of a strong and positive longrun relationship between the two variables. On the contrary, Esen & Celik Kecili (2022) find a unidirectional causal link moving from expenditure on health to growth. Others (Hassan & Kalim, 2012, Boussalem et al, 2014) find no relationship in the short run but a strong positive link in the long term. On the contrary, Bhargava et al (2001) find a positive but weak link between expenditure on health and growth. This is supported by studies (Cetin & Ecevit, 2010, Canbay & Kirca, 2022) that did not find any statistically significant relationship between the two variables. On the other hand, Kar and Taban (2003) find a negative and significant relationship between the two variables in the longrun. In addition, Wang (2011) suggests that an increase in growth leads to a reduction in expenditure on health .

The stability of the relationship in the context of expenditure on health is a recent innovation. Freeman (2003) provides new evidence on the income elasticity of health care using a panel data set of expenditure on health and disposable personal income for the United States for the years 1966-1998. By combining stationarity and cointegration tests, it is revealed that expenditure on health and incomes at the state level are non-stationary and cointegrated. Dynamic ordinary least squares (DOLS) cointegrating regressions of the pooled state time series estimate the income elasticity of expenditure on health as ranging from 0.817 to 0.844, well below unity, confirming that health care expenditure, even at the aggregate level, is a necessity good. Clemente, Montanes, and Pueyo (2004) considering a sample of Organisation for Economic Co-operation and Development (OECD) countries examine the stability of the function using cointegration approach. However, the existence of cointegration only shows the presence of some changes in the elasticity and there is a long-term relationship between THE and GDP (Boussalem, Boussalem & Taiba, 2014, Ghorbel & Kalal, 2016, Faruk et al, 2022).

Research and Methodology

Pantula Principle

The Pantula principle specifies the correct order in which different versions of Dickey-Fuller test should be set up. Depending on restrictions on the parameters, the deterministic components, equation (7), can be modeled in five different ways starting from the most restrictive (Model 1) to the least restrictive (Model 5) specification. In this manner, Model 1 does not allow for any deterministic components. This is rather unusual and should only be used with great caution. Model 2 does not include any linear trends, but allows for constants in the co-integration space. This is the minimum deterministic component recommended by Johansen (1995) since the constants account for differences in measurement units. In addition to allowing for constants in the co-integration space, Model 3 allows for linear trends. It is assumed, however, that there are no trends in the co-integration space. Thus, the linear trends enter the Vector Error Correction Model (VECM) as drift (constant) terms. In Model 4, both constants and linear trends are allowed in the co-integration space, in addition to the drift terms. The linear trends in the co-integration space allow for r trend-stationary stochastic variables, that is, the variables are stationary after detrending, and p_r variables that are integrated of order one, that is, $I(1)$ processes that also have a linear trend. This is the model to use if some of the stochastic variables are trend-stationary. Finally, Model 5 places no restrictions on the deterministic components. This case allows for linear trends in the differenced series, Dz_t , and hence quadratic trends in Z_t . This case is also considered to be unusual by Hansen and Juselius (1995) as it may be a case of model mis-specification. They recommend that more variables be added to the model to increase the information content and account for the quadratic trends.

There are several works that treat the problem of deterministic components specification in Johansen procedure. Toda (1995), analyzes through simulation the properties of the Likelihood Ratio (LR) test using Model 2 and Model 3, as well as the capacity of the “Pantula Principle” to jointly determine cointegration rank and deterministic components specification. The study argues that the procedure usually requires specifying Model 2 even when the true process is Model 3. Doornik et al (1998) employ a data generating process (DGP) with a restricted trend within the cointegration space (Model 4). They show that a mis-specification of deterministic terms leads to a wrong cointegration rank. The non-inclusion of a restricted trend when it is present in the DGP causes distortions in the test size, while the inclusion of an unrestricted trend is problematic as it leads to a loss of test power. A restricted trend in the cointegration space and unrestricted constant produce good power and reasonable size, even when the true DGP has no trend and a constant. Gonzalo and Lee (1998) demonstrate that in cases where the presence of deterministic components is omitted, the Johansen procedure leads to spurious cointegration with probability approaching one asymptotically. Nielsen and Rahbek (2007), find that for Model 2 and Model 4, the Johansen LR test is asymptotically similar with respect to the deterministic parameters. Thus, the hypothesis on co-integration rank can be analysed separately from deterministic parameters. Franses (2001) suggests Model 2 is useful when none of the series shows trend and Model 4 is used when some or all the series shows a trend in the data. Lastly, Ahking (2002) and Narayan (2005) suggests the Johansen models are meaningful if they are related to the co-integration space or excluded from it. This is rarely observed, and hence the consequences of mis-specifying the deterministic components in empirical studies remain a mystery. This may be due to lack of clarity on knowing which of the deterministic components to assimilate and whether or not they should be included the cointegration space.

Method

This study considers THE which has been decomposed in two components namely RHE & DHE and their impact on economic growth. THE is defined as sum of public health expenditure which covers, 1) all payments other than for capital assets, including on goods and services, interest payments, subsidies and transfers on health care (RHE) and 2) payments for acquisition of fixed assets, stock, land or intangible assets for the health care sector (DHE). For the dependent variable, the study uses GDP representing the

value of total national output in local current units as defined by the World Bank. All variables have been transformed by taking the natural logarithm (Banerjee et al, 1993, Banerjee et al, 2011).

The study employs annual data from Bank of Botswana reports for the period 1983 to 2019. The reasons for the choice of period are two-fold: data availability and also the first case of HIV was diagnosed in Botswana in 1984. Subsequently, Botswana became the first country in Africa to administer ARV treatment sponsored by the Government since 2002 under “Masa”, a Setswana word meaning “new dawn”, programme.

Econometric evaluation has been performed under following steps: First, the stochastic properties of each variable are undertaken. Second step consists of estimation of cointegrating regressions. Third step considers testing cointegrating relationships. Finally, appropriate specification of the cointegration relationship is examined following the Pantula principle within Johansen approach. Income elasticity of GEH has been estimated, separately, using its decomposed forms. The specific model is as follows:

$$\ln GEH_t = \alpha_0 + \alpha_1 \ln GDP_t + \alpha_2 T + \varepsilon_t \quad (1a)$$

$$\ln GDP_t = \beta_0 + \beta_1 \ln GEH_t + \beta_2 T + \varepsilon_t \quad (1b)$$

where GDP captures the economic growth variable, and ε_t is the error term

The most commonly used cointegration tests include method developed Engle and Granger (1987) or EG, Johansen (1988) procedure and error correction model (ECM) suggested by Granger (1988). The principal difference is that while an EG test is a single equation method, the Johansen cointegration test is a system where the number of cointegration vectors is not fixed apriori but determined during estimation.

EG argues that two variables are cointegrated if an error correction term (ECT) exists. This equilibrium correction model has both short run and long run effects that explains how dependent variables evolve over time. The model has lagged values and first differences of variables are tested as follows:

$$\Delta GEH_t = \beta_1 \Delta GDP_t + \beta_2 (GEH_{(t-1)} - \gamma GDP_{(t-1)}) + u_t \quad (2)$$

Where: $\Delta GDP_t = GDP_t - GDP_{(t-1)}$ and the ECT is $GEH_{(t-1)} - \gamma GDP_{(t-1)}$ which is stationary if GEH and GDP have a cointegrating coefficient γ . The ECT is zero where the system of two variables is in its long run equilibrium. The coefficient of the ECT shows how fast GEH adjust back to the longrun equilibrium.

EG approach also proposes a, two stage, residual based univariate process for estimating cointegrating parameters. A time series should not contain a unit root since it must be integrated becoming cointegrated. Firstly, a cointegrating regression is run using OLS to get parameter values. A simple static model can be employed as follows:

$$\Delta GEH_t = C + \beta GDP_t + u_t \quad (3)$$

Residuals are saved and tested for stationarity. This is done by applying Augmented Dickey Fuller (ADF) test on the autoregression model:

$$\hat{u}_t = \phi \hat{u}_{(t-1)} + v_t, \quad (4)$$

where the error term v_t is IID

If $\hat{u}_t$ is stationary then the time series is cointegrated. If the error term is not stationary then the model is estimated using variables in first differences and not levels. Secondly, the approach estimates the cointegration parameters by including the error term as an additional explanatory variable in the ECM. The cointegrating vector can be specified as follows:

$$\Delta GEH_t = \beta_1 GDP_t + \beta_2 \hat{u}_{(t-1)} + v_t \quad (5)$$

Where: $\hat{u}_{(t-1)} = GEH_{(t-1)} - \hat{\gamma} GDP_{(t-1)}$ and the cointegrating vector is $1 - \hat{\gamma}$

Nevertheless, the Johansen (1988) procedure is arguably the most popular method in estimating long-run economic relationships and performs better compared to other approaches using a Monte Carlo framework, under certain assumptions. First, Gonzalo (1994) shows that it performs even when the errors are not normally distributed, or the dynamics of the VECM are unknown, and additional lags are included. Similarly, Hargreaves (1994) concludes that it is the best if the sample size is fairly large (about 100 observations or more), the model is well specified, and the residuals are not highly auto-correlated. However, Stock and Watson (1993) observe that the approach sensitive to the lag length used in the VECM and to the sample-ending point.

Since Johansen's co-integration model is mainly applied in literature, this study models the deterministic components by writing the p-dimensional vector autoregressive model in its VECM form which can be expressed as:

$$\Delta Z_t = \sum_{i=1}^{k-1} \Gamma_i \Delta Z_{t-i} + \alpha \beta' Z_{t-1} + \mu_2 + \Psi D_t + u_t \quad (6)$$

where Δ is the first difference operator, Z_t is a $p \times 1$ vector of stochastic variables, α gives the speed of adjustment to longrun equilibrium and β is matrix containing long run coefficients, μ_2 is a vector of constants, D_t is a vector of deterministic variables, which may include linear time trends, seasonal dummies, and constants, and u_t is a vector of normally, independently, and identically distributed (IID) errors with zero means and constant variances.

Without loss of generality, we let $k = 2$, and $D_t = t$, and rewrite (6) as

$$\Delta Z_t = \Gamma_1 \Delta Z_{t-1} + \alpha \beta' Z_{t-1} + \mu_2 + \delta t + u_t \quad (7)$$

Results and Discussion

The study provides descriptive statistics, Table 1, and shows averages based on absolute values and after taking natural logarithms (LN). The values are provided for all health care variables and the measure of economic growth (GDP). Growth is most volatile in absolute terms, all variables are positively skewed in absolute and logarithmic terms, and they are not normally distributed as the value of kurtosis is less than 3.

Table 1: Summary Statistics, Using The Observations

Variable	Mean	Median	Minimum	Maximum
RHE	917.901	350.230	16.3700	4489.10
DHE	362.196	96.770-0	4.97000	1350.80
THE	1282.22	468.360	22.6000	4819.20
GDP	35458.1	21523.7	1390.90	124223.
LN RHE	5.76491	5.85859	2.79545	8.40941
LN DHE	4.78823	4.57234	1.60342	7.20845
LN THE	6.13530	6.14924	3.11795	8.48036
LN GDP	9.85956	9.97691	7.23771	11.7298

Variable	Std. Dev.	C.V.	Skewness	Ex. kurtosis
RHE	1231.73	1.34190	1.69381	1.92362
DHE	452.025	1.24801	0.957011	-0.775353
THE	1516.00	1.18233	1.04336	-0.272451
GDP	35719.4	1.00737	1.10309	0.0466078
LN RHE	1.67898	0.291241	-0.174271	-1.08675
LN DHE	1.69302	0.353580	-0.0269094	-1.12928
LN THE	1.67527	0.273055	-0.186612	-1.18993
LN GDP	1.26162	0.127959	-0.366765	-0.766094

Source: Authors' compilation

The study tests for stationarity for all variables in LN and absolute terms both at levels and after first differencing. Three methods are applied: ADF, Phillips - Perron (PP) test and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test for comparison. Table 2 provides a summary showing that all variables, in their non-logarithmic form, are I(1) using KPSS except DHE. Only THE is I(1) with constant and trend. Using PP all variables are I(1) with neither constant nor trend. GDP and DHE are I(0) using KPSS after transforming variables into logarithms. Findings based on ADF shows that GDP, THE and DHE are all I(1) when the model is applied with constant and trend. Given that using the natural logarithmic form THE is stationary after first differencing and GDP is stationary at levels, this study proceeds to search for a long-run relationship among the variables by employing three cointegration approaches namely the EG, Johansen and ECM.

Table 2: Summary on Stationarity

Variables (1)	ADF		PP		KPSS	
	(2)	(3)	(4)	(5)	(6)	(7)
THE	I(1)	c+t	I(1)	None	I(1)	c+t
RHE	I(1)	C	I(1)	None	I(1)	C
DHE	I(1)	c+t	I(1)	None	I(0)	C
GDP	I(1)	c+t	I(1)	None	I(1)	C
LN THE	I(1)	None	I(1)	None	I(1)	c
LN RHE	I(1)	C	I(1)	None	I(1)	c
LN DHE	I(1)	None	I(1)	None	I(0)	none
LN GDP	I(0)	C	I(0)	C	I(0)	c+t

Source: Authors' compilation

Models are first estimated with constant(c) and trend (t). If null is not rejected estimations are done with constant (c) only and if null is not rejected, again, estimations are done with neither constant nor trend (none)

The study estimates the long-run effect of economic growth on GEH using DOLS. This requires that we first find a long-run relationship among the variables, and then proceed to estimate the long-run and short-run effects of growth on all three GEH variables.

Based on the findings using EG, there is no cointegrating relationship among variables. Based on ECM, results withheld, the study reveals that only RHE and GDP are weakly co-integrated at 10% level of significance, see equation below, while DHE and THE are not co-integrated with GDP (results withheld).

$$\Delta RHE = -0.562326 - 0.3273 \Delta RHE_{-1} + 0.0950015 \Delta GDP_{-1} - 0.0956000(ECT)$$

p-values (0.45540) (0.08463)* (0.43036) (0.29247)

Unadjusted $R^2 = 0.224392$ DW statistic = 1.98545

From the above equation, it is evident that the coefficient of the ECT has *a priori* sign, though significant at 10% level. Hence the most logical conclusion is that the long run relationship between RHE and GDP does not exist.

Table 3 presents findings based on elasticities in the short run and shows that the ECT for models [2] to [6] is negative and significant as expected. This suggests that the previous years' deviations from long run equilibrium are corrected at speeds ranging from 5.5% to 52.9% on average. This study further shows that growth has no effect on all health variables, in the longrun. However, a one percent change in RHE is associated with a 0.60% decrease in growth and a one percent change in DHE is associated with a 0.135% increase in growth on average, *ceteris paribus*, in the short run. The variable THE has no effect on growth.

Table 3: Vector Error Correction Model estimates

Explanatory Variables	Dependent Variable			Dependent Variable		
	D(LNRHE) [1]	D(LNDHE) [2]	D(LNTHE) [3]	D(LNGDP) [4]	D(LNGDP) [5] [5]	D(LNGDP) [6]
ECT	-0.034145 (0.10484) [-0.32569]	-0.212576 (0.10334) [-2.05705]	-0.436264 (0.14222) [-3.06759]	-0.512704 (0.13151) [3.89849]	-0.055163 (0.03165) [-1.74287]	-0.528635 (0.17005) [-3.10867]
D(LNGDP(-1))	0.123749 (0.13895) [0.89061]	-0.928448 (0.63113) [-1.47110]	-0.076751 (0.15950) [-0.48119]	0.008392 (0.17431) [0.04815]	-0.559702 (0.19330) [-2.89552]	-0.355708 (0.19072) [-1.86507]
D(LNGDP(-2))	-0.055968 (0.12663) [-0.44197]	-0.944366 (0.64443) [-1.46542]	-0.146766 (0.15464) [-0.94907]	0.075858 (0.15886) [0.47752]	-0.218385 (0.19737) [-1.10645]	-0.092492 (0.18491) [-0.50020]
D(LNRHE(-1))	-0.365295 (0.21771) [-1.67792]			-0.386704 (0.27310) [-1.41596]		
D(LNRHE(-2))	-0.109988 (0.20632) [-0.53310]			-0.599681 (0.25882) [-2.31699]		
D(LNDHE(-1))		-0.110691 (0.20813) [-0.53184]			0.063663 (0.06374) [0.99871]	
D(LNDHE(-2))		-0.944366 (0.64443) [-1.46542]			0.134974 (0.07621) [1.77117]	
D(LNTHE(-1))			-0.104048 (0.22675) [-0.45886]			0.107491 (0.27113) [0.39645]
D(LNTHE(-2))			-0.342806 (0.20304) [-1.68833]			-0.122344 (0.24278) [-0.50392]
C	0.270226 (0.07108) [3.80191]	0.389947 (0.18234) [2.13852]	0.296682 (0.05672) [5.23057]	0.315915 (0.08916) [3.54315]	0.223832 (0.05585) [4.00790]	0.210275 (0.06782) [3.10038]

Source: Authors' compilation;

Standard errors in () & t-statistics in []

The study finally employs the Johansen's (1988) multivariate maximum likelihood approach. The estimates of trace test statistics, λ trace, which test the hypothesis of less than or equal to r co-integrating vectors are reported in Tables 4 to 6. The number of co-integrating vectors is determined by starting at the top of the table and moving down until H_0 cannot be rejected.

Case 1 (Table 4) shows that the trace-test statistics for the null hypothesis of no co-integration (λ trace) exceeds its 95%-critical value for all Models 2 to 4. The null hypothesis of $r = 1$ cannot be rejected for model 2 since λ trace is less than critical value for the first time. There appears to be evidence for one co-integrating relationship between the THE and GDP under model 2.

Table 4: Case 1- LNTHE and LNGDP

	n-r	M2		M3		M4	
H₀	H ₁	λ_{trace}	0.05 %	λ_{trace}	0.05	λ_{trace}	0.05
r = 0	r>0	36.96	20.26	20.65	15.49	25.89	25.87
r = 1	r>1	6.71*	9.16	3.76	3.84	4.11	12.52

Source: Authors' compilation

Case 2 (Table 5) show that the trace-test statistics for the null hypothesis of no-co-integration (λ trace) exceeds its 95% critical value for models 2 to 4. The null hypothesis of $r = 1$ cannot be rejected for model 4 since λ trace is less than critical value for the first time. There is one co-integrating relationship between the RHE and GDP.

Table 5: Case 2- LNRHE and LNGDP

R	n-r	M2		M3		M4	
H₀	H ₁	λ_{trace}	0.05 %	λ_{trace}	0.05	λ_{trace}	0.05
r = 0	r>0	45.66	20.26	21.87	15.49	25.91	25.87
r = 1	r>1	14.91	9.16	6.89	3.84	9.70*	12.52

Source: Authors' compilation

Case 3 (Table 6) show that the trace-test statistics for the null hypothesis of no-co-integration (λ trace) exceeds its 95%-critical value for Model 2, but cannot be rejected for the first time for model 3 since λ trace is less than critical value. There is no co-integrating relationship between DHE and GDP, under model 3.

Table 6: Case 3- LNDHE and LNGDP

	n-r	M2		M3		M4	
H₀	H ₁	λ_{trace}	0.05 %	λ_{trace}	0.05	λ_{trace}	0.05
r = 0	r>0	30.98	20.26	11.64*	15.49	19.94	25.87
r=1	r>1	2.83	9.16	2.41	3.84	2.99	12.52

Source: Authors' compilation

The deterministic components of the VECM are defined according to the rank test based on the so-called the Pantula principle (Johansen and Juselius, 1992). The critical values for Model 2, Model 3 and Model 4 correspond to those in Osterwald-Lenum (1992). The test procedure is to move through Table 7 from the most restrictive model while comparing the trace test statistics to its critical value and only stop when the null hypothesis is not rejected the first time. In our case, this is for $r = 1$ and Model 2. The rank test thus suggests the inclusion of a constant in the co-integration space.

Table 7: Rank Test

The Trace Test				
R	p-r	Model 2	Model 3	Model 4
0	3	45.838	34.086	49.340
1	2	13.575*	5.849	19.181
2	1	4.023	0.246	5.584

*Rank test is for the first time not rejected at the 95% critical level of 19.96, indicating a one cointegration vector and a constant in the cointegration space. (**Source:** Authors' compilation)

Findings based on pairwise Granger Causality Tests, (Table 8), show existence of shortrun relationship among the variables. For example, the growth in THE granger causes the economic growth at 1% level of significance; the growth in RHE granger cause economic growth at 10% level while DHE and growth have no relationship in the short run.

Table 8: Pairwise Granger Causality Tests

Null Hypothesis:	Obs	F-Statistic	Prob.
LNGDP does not Granger Cause LNDHE	29	0.45576	0.6393
LNDHE does not Granger Cause LNGDP		1.55339	0.2321
LNRHE does not Granger Cause LNDHE	29	0.50787	0.6081
LNDHE does not Granger Cause LNRHE		0.13878	0.8711
LNTHE does not Granger Cause INDHE	29	0.60627	0.5535
LNDHE does not Granger Cause LNTHE		2.36291	0.1157
LNRHE does not Granger Cause LNGDP	29	2.84056	0.0781
LNGDP does not Granger Cause LNRHE		1.98602	0.1592
LNTHE does not Granger Cause LNGDP	29	6.65588	0.0050
LNGDP does not Granger Cause LNTHE		1.97294	0.1610
LNTHE does not Granger Cause LNRHE	29	0.05105	0.9503
LNRHE does not Granger Cause LNTHE		1.80300	0.1864

Source: Authors' compilation

The study estimates the impact of growth on GEH using variables in logarithms, using OLS. Findings (Table 9) shows that growth has a positive effect on all measures of health care expenditure in the long term. This is consistent with past studies (Faruk et al, 2022, Ozturk and Topcu, 2014, Bedir 2016) which suggest a change in the direction of causality and impact between short and long run periods.

Table 9: Elasticities

Dependent Variable	LNRHE	LNDHE	LNTHE
C	0.0264	-5.7348***	-6.0472***
LNGDP	0.3350***	1.0566***	1.2384***
Time	0.1349***	-	-
R ²	0.99	0.80	0.98
Durbin Watson	0.94	0.54	0.50
F-test	3865.96***	-	-
First order Autocorrelation	-	0.7331	0.6619
Observations	36	36	36

*** significant at 1%; ** significant at 5%; *significant at 10%

Source: Authors' compilation

The major findings are consolidated and discussed with reference to the relationships in the short and long term and model specification. The correct model specification for testing a longrun relationship consists of one cointegrating vector and a constant. It is the most restrictive hypothesis according to the Pantula principle which is consistent with results by Mahajan and Verma (2015). This shows that specifying a different model would produce results that are spurious and lead to wrong policy prescriptions for Botswana. It is considered as the most powerful version of the cointegrating rank test compared to where the model has linear trends only, with linear trend and constant and a model with no restrictions. By specifying a model with a constant, the study can capture and account for differences in units' measurement. Using this model, it makes it possible to analyse relationships among variables.

The results based on ECM and EG approach confirm that there is weak and/or no cointegration between the variables when using data in levels. Growth has no effect on government expenditure on health (GEH) in the short run. This existence of a weak cointegration relationship suggests that growth may marginally contribute to an increase in health expenditure over the longterm and vice versa. Results are consistent with those by Bhargava et al (2001) who show that there is no longrun relationship among the variables. Using elasticities, the study then applies the Johansen approach, which shows that both total health expenditure (THE) and recurring health expenditure (RHE) have a cointegration relationship with growth while development health expenditure (DHE) and growth are not cointegrated. In addition, results using ECM, based on elasticities, show that cointegration exists between growth and health variables (RHE & DHE). Overall, findings are showing that any deviations from short run relationships among variables are corrected in the long term. Our results suggest that the country's growth prospects are better understood after decomposing the expenditure in health variable. This is so since THE appears to have dampened effects on growth. Specifically, growth can only be improved over the long term by working through DHE and they are reduced as more is spent on RHE. This is confirmed by examining shortrun relationships, using Granger causality, which show that RHE and THE granger causes growth while DHE does not. There is unidirectional relationship moving from both health care variables to growth. This shows that increasing RHE may bring about improvements in the health of the population and hence growth in the short run. But this is not sufficient to improve the economic prosperity of the country as growth can only be improved by spending more on DHE.

Thus, findings are consistent with some past studies (Akingba et al, 2018, Lee et al, 2019, Raghupathi & Raghupathi, 2020) which show that growth is enhanced as the health status of the population improves. This is mainly supported by increased GEH in the short term. Its increase suggests that the labour force becomes more productive. In the context of Botswana, the government is continuously giving priority to RHE which will improve livelihoods in the short term with potential of marginally impacting on growth over the longterm. Thus, by increasing RHE, the country is building potential for future growth. Any short term shocks in the system will be corrected in the long term as the government prioritizes more of DHE. The assertion is supported by the existence of significant coefficient of the ECT in the system of equations which confirm this dynamic adjustment. DHE has been on a decline in Botswana over the review period. This may explain the decline in growth rate of the economy in recent years from a human capital development point of view.

Conclusion

This study examined the relationship between government expenditure on health (GEH) and economic growth in the context of Botswana. Specifically, the study analysed the cointegration and specification of deterministic components with special reference to the Pantula Principle. This was done to overcome the shortfall of Johansen's cointegration approach which may lead to spurious results by omitting the presence of deterministic components. Furthermore, the study tested relationships among these variables by employing the methods by EG, ECM and pairwise Granger causality tests.

It was revealed that the best model specification is one with the most restrictive hypothesis according to the Pantula principle. This helps to improve the credibility of results though other specifications can still be possible depending on the pretest conditions set at the beginning. Findings confirmed the health led growth hypothesis by Mushkin. They are similar to those found for a group of developed countries using similar variables in a study by Artekin and Konya (2020). More so, Odhiambo (2021) showed that the relationship between economic growth and expenditure on health care is sensitive to a country's level of income, the manner in which variables are defined and length of period of analysis. This is better understood by decomposing the expenditure on health care variable. The important role of public expenditure on health on growth has been supported by this study. In particular, spending more on RHE can improve the quality of human capital though it is not sufficient to increase future growth. By spending more on wages and salaries, recurrent grants and transfers, debt payments and recurrent goods and services, the country will be building a foundation for future growth. This is possible considering that Botswana has a young population and so the country can still afford to spend less in the short term and build resources for the future when the labourforce will be ageing. Results are clear that economic growth is not important in explaining levels of GEH. This may be a function of other policy variables like age of population, level of technological progress and access to health insurance. In the context of Botswana 17% of the working population and 42% of the entire population have access to health insurance and the remainder rely on the government for their health upkeep (Mbogo & McGill, 2016).

In view of findings from this study, the government should make short term interventions to improve recurrent expenditure on health (RHE) while taking firm decisions to improve development expenditure on health (DHE) to boost future growth. A policy that targets specific components of these two forms of expenditure may be more plausible as an engine for economic growth. More so, knowledge on how to allocate funds to meet current health care needs while building reserves for future health care exposures is critical as it defines the rate at which the country attains growth in the coming years. This is so since having a health workforce may not produce effective results in the absence of the necessary equipment and machinery to work with. Future work may look at the development of human capital and its contribution to growth via different channels. This is critical considering that expenditure on both health and education will be key priorities for skills advancement and driving future developmental initiatives that support the country's Vision 2036 agenda. More so, there are limitations posed by data and method of analysis. Future studies can be improved by employing data with different time frequencies like daily, weekly and monthly and period extensions may be useful. It is critical that additional variables be incorporated into the analysis to reveal more longterm relationships. The method by Johansen usually fail to detect such relationships between variables that are cointegrated through a common variable. It may also fail to detect non-linear longterm relationships between variables. Thus, use of other methods which are linear or non-linear in nature may improve results.

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References

- Abdulqadir, I. A., Sa'idu, B. M., Adam, I. M., Haruna, F. B., Zubairu, M. A., & Aboki, M. (2022). Dynamic inference of healthcare expenditure on economic growth in Sub-Saharan Africa: a dynamic heterogenous panel data analysis. *Journal of Economic and Administrative Sciences*. <https://doi.org/10.1108/JEAS-03-2021-0049>
- Aghion, P., & Howitt, P. (1996). Research and development in the growth process. *Journal of Economic Growth*, 1(1), 49-73.
- Ahking, F. W. (2002). Model mis-specification and Johansen's co-integration analysis: an application to the US money demand. *Journal of Microeconomics*, 24, 51-66.
- Akingba, I. O. I., Kaliappan, S. R., & Hamzah, H. Z. (2018). Impact of health capital on economic growth in Singapore: an ARDL approach to cointegration. *International Journal of Social Economics*, 45(2), 340-356
- Aurangzeb, A. Z. (2003). Relationship between Health Expenditure and GDP in an Augmented Solow Growth Model for Pakistan: An Application of Co-integration and Error-Correction Modeling. *Lahore Journal of Economics*, 8(2), 1-16. <http://dx.doi.org/10.35536/lje.2003.v8.i2.a1>
- Arisoy, İ., Ünlükaplan, İ., & Ergen, Z. (2010). The relationship between social expenditures and economic growth: a dynamic analysis intended for 1960–2005 period of the Turkish economy. *MaliyeDergisi*, 158, 398-421.
- Artekin, A. O., & Konya, S. (2020). Health expenditure and economic growth: Is the health led growth hypothesis supported for selected countries? *Poslovna Izvrsnost*, 14(1), 77-89
- Atilgan, E., Kilic, D., & Ertugrul, H. M. (2017). The dynamic relationship between health expenditure and economic growth: is the health-led growth hypothesis valid for Turkey?. *The European Journal of Health Economics*, 18(5), 567-574. <http://dx.doi.org/10.1007/s10198-016-0810-5>
- Azam, M., Khan, A. Q., & Ozturk, I. (2019). The effects of energy on investment, human health, environment and economic growth: empirical evidence from China. *Environmental Science and Pollution Research*, 26(11), 10816-10825. <http://dx.doi.org/10.1007/s11356-019-04497-4>
- Banerjee, A., Dolado, J. J., Galbraith, J. W., & Hendry, D. (1993). *Co-integration, error correction, and the econometric analysis of non-stationary data*. Oxford: Oxford University Press. <http://dx.doi.org/10.1093/0198288107.001.0001>
- Banerjee, A., Banerjee, A. V., & Duflo, E. (2011). *Poor economics: A radical rethinking of the way to fight global poverty*. Perseus Books: Philadelphia, PA
- Bedir, S. (2016). Healthcare expenditure and economic growth in developing countries. *Advances in Economics and Business*, 4(2), 76-86. <http://dx.doi.org/10.13189/aeb.2016.040202>
- Bhargava, A., Jamison, D. T., Lau, L. J., & Murray, C. J. (2001). Modeling the effects of health on economic growth. *Journal of Health Economics*, 20(3), 423-440. [http://dx.doi.org/10.1016/S0167-6296\(01\)00073-X](http://dx.doi.org/10.1016/S0167-6296(01)00073-X)
- Boussalem, F., Boussalem, Z., & Taiba, A. (2014). The relationship between public spending on health and economic growth in Algeria: Testing for co-integration and causality. *International Journal of Business and Management*, 2(3), 25.
- Canbay, Ş., & Kirca, M. (2022). Health expenditures (total, public and private) and per capita income in the BRICS: panel bootstrap causality analysis. *Journal of Economics, Finance and Administrative Science*. Emerald Publishing. <http://dx.doi.org/10.1108/JEFAS-06-2021-0105>
- Cetin, M., & Ecevit, E. (2010). The impact of health expenditures on Economic growth: A Panel regression analysis on OECD Countries. *Dogus University Journal* 1(2), 166-182.
- Chakrabarti, S., Khan, M. T., Kishore, A., Roy, D., & Scott, S. P. (2019). Risk of acute respiratory infection from crop burning in India: estimating disease burden and economic welfare from satellite and national health survey data for 250 000 persons. *International Journal of Epidemiology*, 48(4), 1113-1124. <http://dx.doi.org/10.1093/ije/dy022>
- Clemente, J., Marcuello, C., Montanes, A., & Pueyo, F. (2004). On the international stability of health care expenditure functions: are government and private functions similar? *Journal of Health Economics*, 23, 589-613. <http://dx.doi.org/10.1016/j.jhealeco.2003.08.007>
- Clover, J. (2003). Botswana: Future prospects and the need for broad-based development. African Security Analysis Programme Situation Report. Retrieved from: <https://media.africaportal.org/>
- Dikmen, N. (2017). The relationship between government expenditure on health and GDP in Turkey. In *Advances in Applied Economic Research* (pp. 73-89). Springer, Cham. DOI: 10.1007/978-3-319-48454-9_6
- Diop, M., Alam, A. and Farole, T. (2015). Botswana: Systematic Country Diagnostic. World Bank
- Doornik, J. A., Hendry, D. F., & Nielsen, B. (1998). Inference in cointegrating models: UK M1 revisited. *Journal of Economic Surveys*, 12(5), 533-572. <http://dx.doi.org/10.1111/1467-6419.00067>
- Elmi, Z. M., & Sadeghi, S. (2012). Health care expenditures and economic growth in developing countries: panel co-integration and causality. *Middle-East Journal of Scientific Research*, 12(1), 88-91.
- Engle, R. F., & Granger, C. W. (1987). Co-integration and error correction: representation, estimation, and testing. *Econometrica: Journal of the Econometric Society*, 251-276. <http://dx.doi.org/10.2307/1913236>
- Ercelik, G. (2018). The relationship between health expenditure and economic growth in Turkey from 1980 to 2015. *Journal of Politics*, 1(1), 1-8.
- Erdil, E., & Yetkiner, I. H. (2004). A panel data approach for income-health causality. Retrieved from: <https://academic.edu>.

- Esen, E., & Celik Kecili, M. (2022). Economic growth and health expenditure analysis for Turkey: evidence from time series. *Journal of the Knowledge Economy*, 13(3), 1786-1800. <http://dx.doi.org/10.1007/s13132-021-00789-8>
- Faruk, B. U., Haque, M. I., Tausif, M. R., & Khan, M. R. (2022). The association between health expenditure, institutions, and economic growth in MENA countries. *Health Promotion Perspectives*, 12(1), 92. <http://dx.doi.org/10.34172/hpp.2022.12>
- Fidzani, N. H. (1998). Land reform and primitive accumulation: A closer look at the Botswana Tribal Grazing Land Policy. *Botswana: Politics and Society*, 237.
- Franses, P. H. (2001). How to deal with intercept and trend in practical cointegration analysis?. *Applied Economics*, 33(5), 577-579. <http://dx.doi.org/10.1080/00036840121713>
- Freeman, D. G. (2003). Is Health Care A Necessity or A Luxury? Pooled Estimates of Income Elasticity from US State-Level Data. *Applied Economics*, 35(5), 495-502. <http://dx.doi.org/10.1080/00036840210138374>
- Gaies, B. (2022). Reassessing the impact of health expenditure on income growth in the face of the global sanitary crisis: the case of developing countries. *The European Journal of Health Economics*, 1-22. <http://dx.doi.org/10.1007/s10198-022-01433-1>
- Ghorbel, A., & Kalal, M. (2016). Health expenditure, human capital and economic growth in Tunisia: An ARDL bounds testing approach. *Journal of Business Management and Economics*, 4(8), 36-45.
- Gonzalo, J. (1994). Five alternative methods of estimating long-run equilibrium relationships. *Journal of Econometrics*, 60(1-2), 203-233. [http://dx.doi.org/10.1016/0304-4076\(94\)90044-2](http://dx.doi.org/10.1016/0304-4076(94)90044-2)
- Gonzalo, J., & Lee, T. H. (1998). Pitfalls in testing for long run relationships. *Journal of Econometrics*, 86(1), 129-154. [http://dx.doi.org/10.1016/S0304-4076\(97\)00111-5](http://dx.doi.org/10.1016/S0304-4076(97)00111-5)
- Granger, C. W. (1988). Some recent development in a concept of causality. *Journal of Econometrics*, 39(1-2), 199-211. [http://dx.doi.org/10.1016/0304-4076\(88\)90045-0](http://dx.doi.org/10.1016/0304-4076(88)90045-0)
- Hansen, H., & Juselius, K. (1995). *CATS in RATS: Cointegration analysis of time series*. Estima Inc., Evanston, IL.
- Hassan, M. S., & Kalim, R. (2012). The triangular causality among education, health and economic growth: A time series analysis of Pakistan. *World Applied Sciences Journal*, 18(2), 196-207.
- Hargreaves, C. (1994). A review of methods of estimating cointegrating relationships. *Nonstationary time series analysis and cointegration*, 87-131.
- Jefferis, K and Kenewendo, B (2013). Botswana Country Overview 2012/13. Retrieved from: <http://econsult.co.bw/tempex/>
- Jerven, M. (2009). Accounting for the African Growth Miracle: The Official Evidence: Botswana 1965-1995. Retrieved from: <http://www.lse.ac.uk/collections/economicHistory/seminars/Morten%20Jerven.pdf>.
- Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control*, 12(2-3), 231-254. [http://dx.doi.org/10.1016/0165-1889\(88\)90041-3](http://dx.doi.org/10.1016/0165-1889(88)90041-3)
- Johansen, S., & Juselius, K. (1992). Testing structural hypotheses in a multivariate cointegration analysis of the PPP and the UIP for UK. *Journal of Econometrics*, 53(1-3), 211-244. [http://dx.doi.org/10.1016/0304-4076\(92\)90086-7](http://dx.doi.org/10.1016/0304-4076(92)90086-7)
- Johansen, S. (1995). *Likelihood-based Inference in Cointegrated Vector Autoregressive Models*. Oxford University Press. <http://dx.doi.org/10.1093/0198774508.001.0001>
- Kar, M., & Taban, S. (2003). The impacts of the disaggregated public expenditure on economic growth. *Ankara University Faculty of Political Science*, 53(3), 145-169.
- Lee, J. C., Won, Y. J., & Jei, S. Y. (2019). Study of the Relationship between Government Expenditures and Economic Growth for China and Korea. *Sustainability* 11(22), 1-11. <http://dx.doi.org/10.3390/su11226344>
- Leith, J. C. (2001). Why Botswana prospered. Presentation at CSAE Seminar, 14 November.
- Lule, E., & Haacker, M. (2012). *Fiscal Dimension of HIV/AIDS in Botswana, South Africa, Swaziland, and Uganda*. Washington D.C.: World Bank.
- Mahajan, N., & Verma, S. (2015). International Financial Integration and Economic growth in India: An empirical investigation. *Eurasian Journal of Business and Economics* 2015, 8(16), 121-137s. <http://dx.doi.org/10.17015/ejbe.2015.016.07>
- Maipose, G.S and Somolekae G.M. (1999) "Managing a Transition from Aid Dependence in Africa: The Case of Botswana" (Nairobi, African Economic Research Consortium, AERC Policy Working Paper.
- Makoni, P. L. (2015). Exploring Economic Structure and Drivers of Economic Growth in Botswana. *Journal of Governance and Regulation*, 4(4), 673-677. http://dx.doi.org/10.22495/jgr_v4_i4_c6_p1
- Matsheka, T. (2020). 2020 Budget Speech. Republic of Botswana. Retrieved from: <https://www.finance.gov.bw> [Accessed 15 Dec 2020]
- Mayer, D. (2001). The long-term impact of health on economic growth in Latin America. *World Development*, 29(6), 1025-1033.
- Mbogo, B. A., & McGill, D. (2016). Perspectives on financing population-based health care towards Universal Health Coverage among employed individuals in Ghanzi district, Botswana: A qualitative study. *BMC Health Services Research*, 16(1), 1-14. <http://dx.doi.org/10.1186/s12913-016-1657-2>
- Mehrara, M., & Musai, M. (2011). Granger causality between health and economic growth in oil exporting countries. *Interdisciplinary Journal of Research in Business*, 1(8), 103-108.
- Mogae, F. (2005). Botswana: How We Created an African Success Story. *New African*, April, pp. 32-36.
- Murthy, V. N., & Okunade, A. A. (2016). Determinants of US health expenditure: Evidence from autoregressive distributed lag (ARDL) approach to cointegration. *Economic Modelling*, 59, 67-73.

- Mushkin, S. J. (1962). Health as an Investment. *Journal of political economy*, 70(5, Part 2), 129-157. Narayan, P. K. (2005). The saving and investment nexus for China: evidence from cointegration tests. *Applied Economics*, 37(17), 1979-1990. <http://dx.doi.org/10.1080/00036840500278103>
- Nazar, R., Meo, M. S., & Ali, S. (2022). Role of public health and trade for achieving sustainable development goals. *Journal of Public Affairs*, 22(3), e2585. <http://dx.doi.org/10.1002/pa.2585>
- Ndaguba, E. A., & Hlotywa, A. (2021). Public health expenditure and economic development: The case of South Africa between 1996 and 2016. *Cogent Economics & Finance*, 9(1), 1905932. <http://dx.doi.org/10.1080/23322039.2021.1905932>
- Nielsen, H. B., & Rahbek, A. (2007). The likelihood ratio test for cointegration ranks in the I (2) model. *Econometric Theory*, 23(4), 615-637. <http://dx.doi.org/10.1017/S0266466607070272>
- Odhambo, N. M. (2021). Health expenditure and economic growth in sub-Saharan Africa: an empirical investigation. *Development Studies Research*, 8(1), 73-81. <http://dx.doi.org/10.1080/21665095.2021.1892500>
- Ogungbenle, S., Olawumi, O. R., & Obasuyi, F. O. T. (2013). Life expectancy, public health spending and economic growth in Nigeria: A vector autoregressive (VAR) model. *European Scientific Journal*, 9(19), 210-235.
- Osterwald-Lenum, M. (1992). A note with quantiles of the asymptotic distribution of the maximum likelihood cointegration rank test statistics. *Oxford Bulletin of Economics and Statistics*, 54(3), 461-472.
- Ozturk, S., & Topçu, E. (2014). Health expenditures and economic growth: Evidence from G8 countries. *International Journal of Economics and Empirical Research*, 2(6), 256-261.
- Pantula, G. (1989). Testing for Unit Roots in the Time Series Data. *Econometric Theory*, 5(2), 256-271. <http://dx.doi.org/10.1017/S0266466600012421>
- Piabuo, S. M., & Tieguhong, J. C. (2017). Health expenditure and economic growth-a review of the literature and an analysis between the economic community for central African states (CEMAC) and selected African countries. *Health Economics Review*, 7(1), 23. <http://dx.doi.org/10.1186/s13561-017-0159-1>
- Raghupathi, V., & Raghupathi, W. (2020). Healthcare Expenditure and Economic Performance: Insights From the United States Data. *Frontiers in Public Health*, 8(156). <http://dx.doi.org/10.3389/fpubh.2020.00156>
- Samadi, A., & Rad, E. H. (2013). Determinants of healthcare expenditure in Economic Cooperation Organization (ECO) countries: Evidence from panel cointegration tests. *International Journal of Health Policy and Management*, 1(1), 63-68. <http://dx.doi.org/10.15171/ijhpm.2013.10>
- Samatar, A. (2005). *An African Miracle: State and Class Leadership and Colonial Legacy in Botswana Development*, Heinemann, Portsmouth, New Hampshire.
- Sarpong, B., Nketiah-Amponsah, E., & Owoo, N. S. (2020). Health and economic growth nexus: Evidence from selected sub-Saharan African (SSA) countries. *Global Business Review*, 21(2), 328-347. <http://dx.doi.org/10.1177/0972150918778966>
- Sen, A. (2005). Is Health Care a Luxury? New Evidence from OECD Data. *International Journal of Health Care Finance and Economics*, 5(2), 147-164. <http://dx.doi.org/10.1007/s10754-005-1866-4>
- Sethi, N., Mohanty, S., Das, A., & Sahoo, M. (2020). Health expenditure and economic growth nexus: empirical evidence from South Asian countries. *Global Business Review*, <https://doi.org/10.1177/0972150920963069>
- Sinha, N. (2021). Health Expenditure and GDP Growth in Botswana. *SDMIMD Journal of Management*, 1-17. <http://dx.doi.org/10.18311/sdmimd/2021/26140>
- Siphambe H. K. (2004). Botswana's economy and labour market: are there any lessons for SADC regional integration? *Development Southern Africa*, 21(2), 353-364. <http://dx.doi.org/10.1080/0376835042000219578>
- Stock, J. H., & Watson, M. W. (1993). A simple estimator of cointegrating vectors in higher order integrated systems. *Econometrica: Journal of the Econometric Society*, 783-820. <http://dx.doi.org/10.2307/2951763>
- Toda, H. Y. (1995). Finite sample performance of likelihood ratio tests for cointegrating ranks in vector autoregressions. *Econometric Theory*, 11(5), 1015-1032. <http://dx.doi.org/10.1017/S0266466600009956>
- Wang, K. M. (2011). Health care expenditure and economic growth: Quantile panel-type analysis. *Economic Modelling*, 28(4), 1536-1549. <http://dx.doi.org/10.1016/j.econmod.2011.02.008>
- World Health Organization. (2006). *Country Health System Fact Sheet 2006: Botswana*. Retrieved from: http://www.afro.who.int/home/countries/fact_sheets/botswana.pdf.
- Zhang, X., Zong, G. A. N. G., & Xiao, D. O. N. G. (2020). Effects of government healthcare expenditure on economic growth based on spatial Durbin model: evidence from China. *Iranian Journal of Public Health*, 49(2), 283-293. <http://dx.doi.org/10.18502/ijph.v49i2.3091>
- Zulfikar, R., & STp, M. M. (2019). Estimation model and selection method of panel data regression: an overview of common effect, fixed effect, and random effect model. *INA-Rxiv 9qe2b, Center for Open Science*.

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