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Contribution of Public Health Investments to the Economic Growth of Cameroon

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Abstract

The goal of this paper is to measure the contribution of public health investments to the economic growth of Cameroon. The Vector Error Correction Model (VECM) was the econometric model used in the estimations. The data used are annual and the period is from 1988 to 2013. The results of the estimations show that public health investments do contribute to the economic growth of Cameroon only in the long run. This implies that public health investments boost economic growth in the long run through efficient allocation of resources. Hence, it is recommended that: first, the government should increase its health investments to 10 or 15 percent of its GDP as recommended by the AU and WHO respectively; second, to enhance the provision of health care services by the private sector and third, to ameliorate the quality of health care services rendered by granting competitive awards to health units that render quality health care services.

Keywords: Public health investments; Economic growth; Cameroon

Introduction

The report of the WHO's Commission on Macroeconomics and Health (2001) states "Improving the health and longevity of the poor is an end in itself, a fundamental goal of economic development. But it is also a means to achieving the other development goals relating to poverty reduction. The linkages of health to poverty reduction and to long term economic growth are powerful, much stronger than is generally understood. The burden of disease in some low income regions, especially sub-Saharan Africa, stands as a stark barrier to economic growth and therefore must be addressed frontally and centrally in any comprehensive development strategy". Also, Bloom and Sachs [1], claim that poor health conditions in Africa explain a substantial part of the difference between African growth rates and the average growth rates of other countries.

According to the World Health Organization [2], the health status of a country's population is an important determinant or even a prerequisite for its economic growth and development since health contributes to people's happiness, wellbeing, economic progress, longevity, productivity and savings.

In Cameroon, access to health units is still limited due to bad roads and long distances to reach health units especially in rural areas. Also, Soja [3] argues that long distances and bad roads greatly decrease access to health units. Furthermore, Arthur [4] emphasizes that covering long distances in order to get to a health unit limits its access. Black [5] also affirm that distance reduces the accessibility to health units. It is in this light that the NIS [6] outlines that despite the efforts of the government to create and construct new health units, the access to the later still remains limited. This is due to long distances to health units and unequal spatial distribution of health units available, which itself (the unequal spatial distribution) is as a result of the absence of a national health map.

Moreover, the provision of medical drugs in the public health units is grossly inadequate. Despite the supply mechanism of essential drugs put in place, the shortage of almost all sorts of drugs is frequent in almost all health units [6]. Health units are more often in shortage of Coartem, Amodiaquine (tb) + Artesunate and Cotrimoxazole(tb). Concerning the duration of stock run out, it varies from 3 to 19 days. Coartem represents the product that experienced more shortages and for a long duration in health units (19 days on average), contrary to quinine for which the shortage lasts at most 3 days. Furthermore, in 2009, about 30% of health units have not had the required minimum stock of medical drugs [6]. This clearly shows that the shortage of medical drugs in health units in Cameroon is a big challenge which deteriorates the quality of health care services offered.

Twumasi [7] is emphatic that the unequal spatial distribution of health units makes it difficult for patients to get access to health care. Cameroon's public medical structures are mainly concentrated in urban areas and this reduces their access by people, especially those in rural areas. Furthermore, the NIS [6] outlines that 69 percent of patients resorted to health units in the urban areas in 2009. This illustrates the high concentration of health units in urban areas.

Also, the unequal spatial distribution of health units is not only between urban and rural areas but among regions as well. For example, in Adamawa region, there are on average 169,270 people for a hospital, whereas in the South region, there are 43,259 people for a hospital [6]. As such, the unequal coverage of health units among regions, between urban and rural areas leads to a limited access to health units.

Nowadays, most countries, including developed countries are multiplying reforms such as the OBAMA CARE in the United States of America (USA) to reduce health care cost, make it accessible for all social classes, so as to have a healthy and productive population. Cameroon, classified as a lower middle-income country with low economic growth is similar to many developing countries with high burden of diseases (both communicable and non-communicable)

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and concurrent development challenges. The diseases pledging the health of people reduce their productivity, life expectancy, savings, the education of children and eventually economic growth. Thus, can the problem of low economic growth of Cameroon be solved by public health investments? How effective can the public health investments be in ameliorating the population's health and the economic growth of Cameroon? Can the public health investments largely curb down the challenges faced by the public health sector? Do the various government (public) health investments contribute to the economic growth of Cameroon?. In order to resolve this paper would follow thus; literature review, Data and methodology, results and discussion and finally conclusion.

Literature Review

An increasingly influential view argues that many countries, especially those in Africa and South Asia, are poor largely because their populations are unhealthy, For example, [1] claim that poor health conditions in Africa explain a substantial part of the difference between African growth rates and the average growth rates of other countries. Poor health may directly reduce human capital investments. For example, children may be sick or have less energy to attend school. Miguel and Kremer [8] and Bleakley [9] find evidence consistent with this view in the case of children infected with hookworm. Alternatively, workers with poor health may fail to invest on the job and human capital accumulation. This shows a strong correlation between measures of the general health status of the population and economic performance [1].

In a prominent macro study, Gallup and Sachs [10] suggest that better health conditions could improve annual per capita growth rates in malaria prone countries, such as Sub-Saharan Africa, by approximately 1.3 percent. Sachs and Malaney [11] describe a number of channels through which malaria can compromise educational attainment, including hampering fetal development, reducing cognitive ability, and lowering school attendance. Also, the health status of adults affects human capital accumulation by their children. All of this reduces present and future productivity, thus, lowering economic growth. Lleras-Muney [12] examines the determinants of life expectancy in the USA using a synthetic cohort beginning in 1900. Her estimates indicate that each year of education increases life expectancy at age 35 by as much as 1.7 years, a very significant increase that suggests the central importance of education. Similar findings are reported in multiple studies in developing countries [13]. This implies that long life results to high productivity, increase savings and eventually economic growth. Empirically, high levels of population health go hand in hand with high levels of national income. This is not unexpected. Higher incomes promote better health through improved nutrition, better access to safe water and sanitation, and increased ability to purchase more and better quality health care. However, health may not only be a consequence but also a cause of high income [14]. In practice, the major force behind health improvements has been improvements in health technologies and public health measures that prevent the spread of infectious disease, and not higher incomes [15].

Furthermore, the microeconomic effects of a disease are both evident and to a substantial extent measurable. Individual households are severely affected when they must cope with the consequences of sick, debilitated and dying family members. The rising burden of health care costs and the declining productivity of adults, who are the breadwinners and family managers, combine to bring the household into acute financial difficulties [16]. The death of one or more adults results in a drastic loss of lifetime family income and perhaps the dissolution of the household itself. To the extent that other families help out financially or take in the children, the burden is spread, but not diminished. This shows that the ill health or death of an adult (working and having children) caused by a disease does not only reduces productivity but spreads the cost to the society. As such, economic growth falls because savings are reduced, productivity has fallen, etc. For example, Arndt [17] estimated that between 1997 and 2010, the Acquired Immune Deficiency Syndrome (AIDS) in South Africa has reduced the country's GDP by 17 percent and its per capita income by about 8 percent (or about 0.6 percent annually).

As Bloom and Canning [18] point out, "The key issue is not that spending on health would be good (although some authors question even this assumption), it is whether spending on health is better than other uses of the limited funds available in developing countries." Pritchett and Summers [19] use the relationship between income levels and health to argue for an emphasis on economic growth in poor countries as a method of increasing population health. However, the findings of Easterly [20] weaken this argument. Easterly finds that, although income levels and population health are closely related, the effect of changes in income on population health over reasonable time period appears to be quite weak. By contrast, relatively inexpensive public health interventions and policies can have remarkable impacts on population health, even in very poor countries.

Grossman [21] develops a model in which illness prevents work so that the cost of ill health is lost labor time. In addition, it is necessary to separate out the effect of investments in health from the effect of natural or genetic variation in health [22]. The eradication of diseases that affect children and the working population will lead to an increase in income and productivity [9]. This body of research on health and human capital generally supports the idea that health affects worker productivity. Shastry and Weil [23] calibrate a production function model of aggregate output using microeconomic estimates of the return to health. They assume a stable relationship between average height and adult survival rates so that when adult survival rates improve we can infer a rise in population heights. Using estimates of the effect of height on worker productivity and wages from microeconomic studies they calibrate what health improvements in the form of lower adult survival rates should mean for aggregate output. Bhargava [24] argue that the effect of health on economic growth is larger in developing countries than in developed countries.

According to Acemoglu [25], public health investments reduce mortality and increases life expectancy. This leads to a significant increase in population if birth rate increases. A small positive effect of life expectancy spilt on total GDP over the first 40 years, and this effect grows somewhat over the next 20 years, but not enough to compensate for the increase in population. Overall, the increases in life expectancy (and the associated increases in population) appear to have reduced income per capita. Hence, there is no evidence that the increase in life expectancy leads to faster growth of income per capita or output per worker. This evidence casts doubts on the view that health has a first order impact on economic growth. However, they considered that an increase in life expectancy leads to an increase in births, which is not always the case.

According to Israr [26] the shortages of essential drugs is caused by the resale of the drugs by health personnel and the inefficiency of drugs supply. Inefficiency of drugs supply is due to long procedures and duration that are required to deliver medical drugs to health units.

Countries in Sub Saharan Africa (including Cameroon) bear 24

percent of the global burden of diseases, meanwhile they only have 3% of the world health personnel [27]. It is in this light that Abena [28] and Ngufor [29] underline that Cameroon is facing serious shortages of health personnel especially medical doctors. The number of medical and paramedical personnel has not considerably increased to meet up with the health personnel shortages. From 2005 to 2009, the ratios medical doctor per inhabitants and nurse per inhabitants have depreciated respectively from 10,084 to 14,418 inhabitants for one medical doctor, and 2,249 to 2,545 inhabitants for one nurse [6]. Furthermore, Abena [28] outline that Cameroon will need 10, 447 physicians on average by 2015, whereas the physician supply is only projected to reach an average of 822 physicians by 2015. Bowen and Zwi [30] highlight that the number of health personnel has to be increased by 140% in order to overcome health personnel shortages in Cameroon. According to WHO [27], there should be 2.3 health personnel for every 1,000 inhabitant in order to render effective health care services. But in Cameroon there are only 1.07 health personnel for every 1,000 inhabitants. This shows that the shortage of health personnel is chronic.

The shortages of health personnel are caused by many factors. Bowen and Zwi [30] outline that health personnel shortages are due to brain draining (emigration of qualified health workers to different countries), to the lack of human resource development plan for health, to retirements without replacements and also due to the rapid growth rate of the population.

The emigration of health personnel was favored by the easing of visa and work permit obtention (due to international cooperation), job vacancies, relatively higher wages and better working conditions abroad [31]. The availability of such opportunities abroad, especially in developed countries fostered the emigration of health personnel from Cameroon. Vujicic [31] rank Cameroon as one of the top 30 countries most affected by high rates of medical personnel emigration with about 5000 health personnel world wide and 500 to 600 in the USA alone. This emigration has significantly reduced the number of health personnel in the country leading to their shortages.

Awases [32] outline that health personnel in Cameroon are generally less motivated because of dissatisfactions at work. These dissatisfactions are usually due to low salaries, limited promotional opportunities and poor working conditions. Job satisfaction is mostly influenced by the level of salary earned by the health personnel because it determines the purchasing power and wellbeing of the later. It is in this light that Hagopiana [33] emphasize that most health personnel in Africa (including Cameroon) are dissatisfied with their work situation generally because of low salaries and poor working conditions. Due to the dissatisfactions at work, health personnel become less motivated and spend less time at work.

Furthermore, Ndiwane [34] focuses on nurses' job satisfaction in the North West Region of Cameroon and found that the low salary negatively affected satisfaction at work in nurses and the time spent working. According to Israr [26], government health personnel earn low salaries and work in difficult conditions and this leads to dissatisfactions at work and eventually discourage health personnel to work more. When health personnel are not satisfied with their working conditions and their salaries, they tend to pay less attention to work. This might even result to workers not coming to work and as such the quality of health care services will deteriorate. Hence, weakening the health care system and risking the lives of patients. According to Dolvo, the level of salary is the main determinant of worker motivation. High salaries motivate workers to work more, whereas low salaries discourage workers to work.

Methodology

The theoretical model chosen is inscribed within the framework of endogenous growth theories. Endogenous growth theories emphasize on boosting long run economic growth from within. This is done by public spending (on health, infrastructure and education), innovation, human capital accumulation, etc. In this work, it is the model of Romer [35] of human capital that is going to be used. Hence, we'll justify and specify the model. Also, the Vector Error Correction Model (VECM) is the econometric model used.

The Romer [35] model is used here because it brings out the importance of human capital to economic growth. This model points out that human capital is a very important factor of production as it concerns man who is at the center of production activities. Also, Romer [35] outlines that an economy can achieve economic growth by increasing investment in health and education as they determine the quality of human capital needed to produce goods and services. From our literature review above, we noticed that the impact of government expenditure on health is a long run relationship. As such, the VECM was considered as the econometric model for estimation in this work because it brings out the long run relationship between variables. Hence, it is suitable for time series analyses as it is the case of our work.

Numerous models were developed to incorporate impact of human capital on economic growth. Romer [35], Barro have emphasized that human capital is a very important factor in boosting economic growth.

As the focus of our study is to analyze the contribution of public health investments to economic growth, so the human capital is separated into two parts; health human capital (H) and education human capital (E). Per capita income (Y) is assumed as a function of the stocks of physical capital (K), health human capital (H), education human capital (E) and a vector of other variables (Z) that include technology and other environmental variables.

$$Y = f(K, H, E, Z) \quad (1)$$

Y is per capita GDP, H is health human capital, E is Education human capital and Z is all other explanatory variables. H at time t is the sum of H in the previous period and in the current period, that is, $H_t = H_{t-1} + H_{present}$. It is assumed that the accumulation of H depends on the amount of resources devoted to health care and the efficiency by which this expenditure is converted into health stock. It is further assumed that the quantity of resources devoted to health investment is a product of the proportion of income devoted to health care (Yh) and the level of income. The stock of health human capital evolves in the following way

$$H_t = H_{t-1} + H_{present} \text{ and } \Delta H = \lambda Yh\, Y \quad (2)$$

where λ is the productivity parameter of health expenditure and all other variables. The ability to transform health expenditure into health stock is assumed to be dependent on H. The health technology equation can be written as:

$$\lambda = \lambda(H) \quad (3)$$

Substituting λ into equation (1) and that in turn into the production function, the income growth equation becomes.

$$Y = f(\Delta H + \Delta k + \Delta E + H_{t-1} + Z) \quad (4)$$

Estimation method

The VECM is the econometric model that will be used in the estimation. The EVIEWS7 software will be used to effectuate estimations. The vector autoregressive (VAR) model with k explicative

variables would be used to specify the nature of the VECM. Let us consider a VAR of the form;

$$y_t = \beta_0 + \beta_1 x_{1t} + \beta_2 x_{2t} + \ldots + \beta_k x_{kt} + \varepsilon_t \quad (5)$$

Where the variables y_t and x_{1k} are not stationary, integrated of order one I(1). There is thus a high possibility of cointegration. It should be noted that a linear combination of these variables is stationary, they are therefore co-integrated. Estimating by ordinary least square permits us to calculate the residuals as shown in equation (6) below.

$$e_t = y_t - \widehat{\beta_0} - \hat{\beta}_1 x_{1t} - \ldots - \hat{\beta}_k x_{1k} \quad (6)$$

If this residual is stationary, we accept the hypothesis of co-integration between the variables. The Dickey fuller test of stationarity of residual should be carried from the critical values tabulated by MacKinnon with respect to the total number of variables of the model. The vector of co-integration is given by (1- $\widehat{\beta_0} - \hat{\beta}_1 \ldots\ldots \hat{\beta}_k$).

In a general manner, with a dependent variable and k independent variables (that is, k+1 variable in total) there can exist k co-integration vectors in total. The number of co-integrated vectors linearly independent is called the rank of the co-integration.

Econometric estimation

The preliminary tests shall first be effectuated before the Granger causality test.

Preliminary tests: The preliminary tests are the unitary root and co-integration tests

Unitary root tests: Unit root tests are used to check if a series is stationary or not. A series is stationary if its probability distribution does not change as time proceeds. The Augmented Dickey fuller (ADF) test would be used in this analysis to test for stationarity. The test is written at level and at difference as follows.

At level

$$\Delta x_t = \alpha x_{t-1} + \sum_{i=1}^{k} \beta_i \Delta x_{t-1} + \partial + y_t + \varepsilon_t \quad (7)$$

First difference

$$\Delta \Delta x_t = \alpha \Delta x_{t-1} + \sum_{i=1}^{k} \beta_i \Delta \Delta x_{t-1} + \partial + y_t + \varepsilon_t \quad (8)$$

Test of co-integration: Engle and Granger observe that even though time series may wonder through time, that is, may have the characteristic of non stationarity in their level, there might exist some linear combinations of these variables that converge to a long run relationship over time. If the series individually are stationary only after differentiating and it is found that a linear combination of their levels is stationary, then the series are said to be co-integrated. In the present analysis, the existence of a common trend between the public health expenditure and economic growth variables means that, in the long run the behavior of the common trend will drive the behavior of the two variables and that there exists some convergence of policies. In other words, a finding of co-integration would simply mean that the transmission mechanism underlying public health expenditure led growth hypothesis is stable and more predictable over long periods.

To investigate the existence of a long run equilibrium relationship between public health expenditure and economic growth, we employ the maximum-likelihood test approach established by Johansen and Juselius. This approach is especially appealing since it provides a unified framework for estimating and testing co-integrating relations in VECM. Thus, by treating all the variables as endogenous, this approach avoids the arbitrary choice of the dependent variable in the co-integrating equations as in the Engle-Granger methodology. They have also been shown to have good large and finite sample properties.

Specifically, Y_t is a vector of *n* stochastic variables, then there exists a k-lag vector auto regression with Gaussian errors of the following form:

$$\Delta Y_t = a + B_1 \Delta Y_{t-1} + \ldots + B_{k-1} \Delta Y_{t-k-1} + \Pi Y_{t-1} + z_t \quad (9)$$

where B_1,....., B_{k-1} and ɑ are coefficient matrices, z_t is a vector of white noise process and ∀ contains all deterministic elements.

The focal point of conducting Johansen's co-integration test is to determine the rank (r) of the p x p A matrix. In the present application, there are five possible ranks. First, it can be of full rank, which would imply that the variables are given by a stationary process that would contradict the earlier finding that the two variables are non-stationary. Second, the rank of A can be zero, in which case it indicates that there is no long run relationship between public health expenditure and economic growth. In instances where A is of either full rank or zero rank, it will be appropriate to estimate the model in either levels or first differences, respectively. Finally, in the intermediate case when 0<r<p (reduced rank), there are r co-integration relations among the elements of Y_t and p-r common stochastic trends. The number of lags used in the VAR is chosen based on the evidence provided by Akaike's Information Criterion (AIC).

The co-integration procedure yields two likelihood ratio test statistics, referred to as the trace test and the maximum Eigen-value (8-max) test, which will help determine which of the five possibilities is supported by the data. The study employs both tests to examine the sensitivity of the results to different tests. In the trace test, the null hypothesis that there are at most r co-integrating vectors is tested against the general alternative, whereas in the maximum eigenvalue test the null hypothesis of r co-integrating vectors is tested against the alternative of at least (r+1) co-integrating vectors.

Granger causality test: This test is used to determine the direction of causality or causal relationship between the variables. The general model is as follows.

$$x_t = \sum_{j=1}^{k} \alpha_i x_{t-j} + \sum_{j=1}^{k} \beta_i y_{t-j} + \varepsilon_t \quad (10)$$

$$y_t = \sum_{j=1}^{k} \alpha_i y_{t-j} + \sum_{j=1}^{k} \beta_i x_{t-j} + \delta_t \quad (11)$$

ε_t and δ_t are white noise series and k is the maximum number of lags. The granger causality is very sensitive with number of lags used. The test has four possible outcomes: a) neither variable Granger causes the other, b) unidirectional causality from x to y, c) unidirectional causality from y to x, d) both variables Granger cause each other.

Data

The data used in this study are obtained from the database of the World Bank, that is, the World Development Indicators (WDI-2013). The data are annual and the period of analysis is from 1988 to 2013. The reliability of the data is supposed acquired once their source is always exploited to carryout economic studies that are concluding both at national and international levels.

In this study, the variables are GDP per capita (constant LCU), public expenditure on health (% of GDP), public expenditure on education (percentage GDP), general government final consumption expenditure (current LCU) and net FDI.

Variables used in the study

Endogenous or explained variable: The endogenous variable here is GDP per capita which refers to the sum of value added of all branches of the national economy at a given period of time usually one year divided by the total population.

Explaining or exogenous variables

Public health expenditure (% of GDP): Public health expenditure refers to the various government spendings geared towards ameliorating health care provision and population's health. These public health expenditures have a positive effect on economic growth. It is in this light that Fogel [36] highlighted that economic growth was boosted in Britain between 1780 to 1980, due to improved population's health by public health investments.

Public expenditure on education (% of GDP): Public expenditure on education reduces the cost of education and increases the level of scholarisation. As such, more knowledge is acquired by a greater proportion of the population. Hence, resulting to human capital accumulation and eventually boosting economic growth.

Net FDI: Net FDI refers to the difference between the inflow and out flow of FDI into and from a country. The presence of FDI in a country leads to more production of goods and services. This boosts economic growth. Thus, the level of FDI in a country plays an important role when it comes to GDP increases or decreases.

General government final consumption: It refers to the general rate of government consumption of the national budget. It is only when the national budget is spent that the government can function or invest. Thus, when the government consumption of the budget is high, economic growth will rise and vice versa.

Descriptive statistics

The descriptive statistics of the various variables and their evolution are shown in the following Table 1.

From Table 1 above, we see that there are 26 observations for all the variables. Also, the mean and standard deviation of each variable are shown. As it can be noticed, GDP (constant LCU) has the highest mean (435091.2) and standard deviation (41470.98). Furthermore, net FDI has the lowest mean (1.103496) and Public expenditure on health (% of GDP) has the lowest standard deviation (0.301868).

Results and Discussion

Here, we're going to present the results of our estimations and also recommend. But we have to carry out some preliminary tests to determine the nature of the VECM to use. The augmented Dickey Fuller test is to be used to determine the order of integration of the variables while the Johansen co-integration test will be used to determine the number of co-integrating relationships. We also go further to effectuate the granger causality test which reveals the direction of causality between variables.

Results of ADF test

Table 2 shows the results of ADF test. The results show that the variables are non-stationary at level but they become stationary at first difference. This means that they are integrated of order 1. Thus a linear combination of these series would lead to stationary variables. These results imply that there is a high possibility of co-integration of these variables. In order to verify this, we shall use the Johansen test of co-integration.

Results of co-integration test

We already found that variables are stationary at first difference, that is, series of the model are integrated of order one [I(1)]. Therefore, the co-integration can be determined between the variables. Second step involves choosing the optimal lag length. To determine the lag length we use the VAR model. According to AIC criterion, we determine the lag length of two for the model. The next step deals with determining the number of co-integrating vectors. In this study, both trace statistic and Eigen-value statistic are used. The results of the test are presented in Table 3. The table shows the trace statistics which indicates that there are two co-integrating relationship. This means that we can linearly combine our variables in two ways to have stationary variables. Also, the table indicates the maximum Eigen-value statistics is used and it confirms the results of the trace statistics that there are two co-integrating relationships. This means that we are now sure there is a long run relationship between public health expenditure and economic. We can now proceed to the estimation of our vector error correction model. But before doing that, we'll present the results of the Granger causality test to know the direction of causality between variables.

Results of granger causality test

This test shows the direction of causality between variables, the results of this test are shown in Table 4. We see from the table that government final consumption expenditure granger causes net FDI. Also, GDP per capita granger causes expenditure on education while government final consumption granger causes expenditure on education. The results also outline that GDP per capita granger cause's public health expenditure. Furthermore, government final consumption expenditure granger causes public health expenditure. Finally government final expenditure granger causes GDP per capita and GDP per capita granger causes government final consumption expenditure.

Presenting Results VECM and recommendations

Here, we will present the results of the VECM. The preliminary

Variable	Mean	Standard deviation	N	Minimum	Maximum
GDP (constant LCU)	435091.2	41470.98	26	373103.0	550541.5
Public expenditure on health (% of GDP)	1.120031	0.301868	26	0.784630	1.859084
Public expenditure on education (% of GDP)	4.705060	0.368262	26	3.861243	5.357820
Net FDI	1.103496	1.412225	26	-1.011797	5.530867
General government final consumption expenditure (current LCU) in log	27.26140	0.493034	26	26.65199	28.15610

Table 1: Summary statistics of variables.

Variables	Augmented Dickey Fuller test			
	Level		First Difference	
	inter	trend and inter	Inter	trend and inter
GDP(constant local currency)	0.294719	-1.418002	-9.995723	-10.22400
Expenditure on Health (% GDP)	-2.415892	-5.815922	-6.253461	-6.145270
Expenditure on education(% GDP)	1.220742	-4.319741	-2.747946	-5.196975
Foreign direct investment net	-3.362122	-4.575734	-8.266662	-8.075752
Government final consumption expenditure (constant LCU)	1.220742	-4.319741	-2.747946	-5.196975

Table 2: Results of the Augmented Dickey fuller test for unit Roots.

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.928258	133.6308	69.81889	0.0000
At most 1 *	0.854222	73.03330	47.85613	0.0000
At most 2	0.572403	28.74287	29.79707	0.0658
At most 3	0.245448	9.202685	15.49471	0.3470
At most 4	0.111736	2.725180	3.841466	0.0988
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.928258	60.59755	33.87687	0.0000
At most 1 *	0.854222	44.29043	27.58434	0.0002
At most 2	0.572403	19.54018	21.13162	0.0822
At most 3	0.245448	6.477505	14.26460	0.5527
At most 4	0.111736	2.725180	3.841466	0.0988

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level

Table 3: Results of the co-integration test.

tests indicate that our variables are integrated of order one [I(1)] and that there are two co-integrating relationships, thus a VECM is best adapted for our estimation. This model gives us information on the short run and long run relationships between public health investments and economic growth. We would first present the short run and long run impact of public health investments on economic growth before presenting the recommendations.

Presenting the VECM results

Here, we will first present the short run impact of the explaining variables on the explained variable before presenting the long run impact of public health investments on economic growth.

Short run impact of the explaining variables on the explained variable

We would individually examine the short-run impact through the Wald test of coefficients. The results of the wald test shows that there is no short run impact of public health investments on economic growth as the coefficients are negative. Thus, in the short run, public health investments have no impact on economic growth. This means that public health investments today would boost economic growth only in the long run. Meanwhile there is a no positive relationship linking short run effect of expenditure on education on economic growth. The short run impact of general government final expenditure on economic growth is very significant, at 5% level. The table below illustrates the results of the wald test Table 5.

Null Hypothesis:	Obs	F-Statistic	Prob.
EDUCATION does not Granger Cause FDINET	24	0.61802	0.5495
FDINET does not Granger Cause EDUCATION		0.65259	0.5320
HEALTH does not Granger Cause FDINET	24	2.21452	0.1366
FDINET does not Granger Cause HEALTH		0.20953	0.8128
LGDPC does not Granger Cause FDINET	24	1.85571	0.1836
FDINET does not Granger Cause LGDPC		0.49224	0.6188
LGFCEXP does not Granger Cause FDINET	24	3.45899	0.0524
FDINET does not Granger Cause LGFCEXP		0.01517	0.9850
HEALTH does not Granger Cause EDUCATION	24	1.52512	0.2431
EDUCATION does not Granger Cause HEALTH		0.89521	0.4251
LGDPC does not Granger Cause EDUCATION	24	4.07625	0.0336
EDUCATION does not Granger Cause LGDPC		1.67770	0.2133
LGFCEXP does not Granger Cause EDUCATION	24	10.2322	0.0010
EDUCATION does not Granger Cause LGFCEXP		0.43332	0.6546
LGDPC does not Granger Cause HEALTH	24	3.15444	0.0656
HEALTH does not Granger Cause LGDPC		0.64763	0.5345
LGFCEXP does not Granger Cause HEALTH	24	4.78138	0.0208
HEALTH does not Granger Cause LGFCEXP		0.78976	0.4683
LGFCEXP does not Granger Cause LGDPC	24	11.1703	0.0006
LGDPC does not Granger Cause LGFCEXP		17.9499	4.E-05

Table 4: Results of the Granger causality test.

Variable	F-statistics	Probability
health expenditure	2.390690	0.1417
expenditure on education	0.568315	0.5838
general government final consumption	4.146659	0.0488
net FDI	1.886868	0.2017

Source: authors Calculations

Table 5: Wald test results for Short run effects.

Long run impact of public health investments on economic growth

The results show equally that the coefficient of long run adjustment is negative and significant, thus we conclude that there is a long run effect of public health investments on economic growth. This is in the following Table 6.

From Table 6 above, it can be seen that the adjustment coefficient is -0.2 which indicates that 20% of the disequilibrium of the previous year is corrected in the present year. There exists a two-way relationship between improved health and economic growth. Also, the value of R-squared is 0.815837 which is positive and close to 1. This implies that the long run impact of public health expenditure on economic growth is not only positive but also significant.

Health and other forms of human and physical capital increase the per capita GDP by increasing productivity of existing resources coupled

	Coefficient	Std. Error	t-Statistic	Prob.
Long run causality	-0.205765	0.112727	-1.825331	0.0979
Exp education(-1)	0.009603	0.051214	0.187503	0.8550
dGDP(-1)	1.084839	0.263103	4.123244	0.0021
dGDP(-2)	-0.866914	0.397478	-2.181036	0.0542
dExp Education(-1)	0.000577	0.036722	0.015724	0.9878
dExp Education(-2)	0.015995	0.022724	0.703897	0.4976
dExp Health(-1)	-0.037092	0.060853	-0.609533	0.5558
dExp Health(-2)	-0.120059	0.054945	-2.185062	0.0538
dGross gov't exp(-1)	0.343736	0.147482	2.330704	0.0420
dGross gov't exp(-2)	-0.156273	0.087687	-1.782164	0.1051
dfdinet (-1)	-0.010656	0.005645	-1.887937	0.0884
dfdinet(-2)	-0.003641	0.003997	-0.911043	0.3837
Constant	0.014369	0.008791	1.634578	0.1332
R-squared	0.815837	Mean dependent var		0.026141
Adjusted R-squared	0.594841	S.D. dependent var		0.032968
S.E. of regression	0.020985	Akaike info criterion		-4.592490
Sum squared resid	0.004404	Schwarz criterion		-3.950689
Log likelihood	65.81364	Hannan-Quinn criter.		-4.431079
F-statistic	3.691640	Durbin-Watson stat		1.877595
Prob(F-statistic)	0.023434			

Table 6: The VECM results showing the long run impact of public health investments on economic growth.

with resource accumulation and technical change. Furthermore, some parts of this increased income are spent on human capital investment, which results in further growth. According to Fogel [36], approximately one third of GDP of Britain between 1790 and 1980 is the outcome of health improvements, especially improvements in nutrition, public health and medical care facilities. This process is not immediate, it takes time, and this explains why the positive effect is felt only in the long run.

Conclusion

Man plays a central role in every economy. This is because man himself is a resource (human resource) that is in highly needed in every activity, he takes decisions regarding production, he brings in financial resources, etc. that are required to produce goods and services to satisfy human needs. The satisfaction of these needs ameliorates the wellbeing of man. However, man cannot effectively play this central role in an economy if he is not in good health. It is in this light that many authors in recent years like Bloom and Canning [37-50] underlined that the health of a person is primordial for the attainment of high economic growth. This is because sick people cannot study well, cannot produce many and quality goods, their cognitive development might be low, etc. As such, governments across the world became more concerned in ameliorating their population's health, so as to reap the benefits of growth. It in this light that this research work had as principal objective to measure the contribution of public health investments to the economic growth of Cameroon. Hence, we first brought out the various challenges that hinder the public health sector from providing quality health care services and the various public health investments geared towards strengthening the public health sector, in order to ameliorate the population's health. Also, the contribution of these public health investments to the economic growth of Cameroon was analyzed conceptually and empirically [51-63].

In this paper, we had as objective to empirically verify the contribution of public health investments to economic growth. The VECM was the econometric model used in our estimations. The theoretical model used was that of Romer [35, 64-71] which laid emphases on human capital. Human capital accumulation on its part is determined by health and education. We started by specifying the human capital model, method of estimation and we went further to present the results of our estimations [72-83].

Thus, it was found that public health investments do not have a short run effect on economic growth. It is only in the long run that there is a positive and significant effect of public health investments on economic growth. Thus, public health investments do boost economic growth but only in the long run [84-93].

Recommendations

From the results of our estimations, we see that public health investments contribute to economic growth in the long run. As such, future economic growth can be ameliorated by increasing public health investments. Hence, one can recommend the following to the government of Cameroon regarding the amelioration of the population's health.

First, the government should increase significantly the level of health investments so as to ameliorate the health situation of its citizens. It is in this light that the AU and WHO recommended that the government should spend 10% and 15% respectively of its budget on health. By increasing these health investments, health care provision will be widened and ameliorated. As such, more people especially the poor will benefit of health care improvements and this will boost production. Furthermore, the population of Cameroon is growing thus, increasing public health investments will ameliorate population's health and this will ensure a healthy population in the future and this will lead to higher economic growth.

Second, the government should favor the provision of health care services by the private sector. Here, the government should enhance the creation of private health units and increase subsidies granted to the private health units so as to reduce the cost of medical treatment.

Last, competitive awards should be granted by the government to all health units (private and public) based on the quality of health care services offered. This will lead to the improvement of the quality of health care services in all health units, hence ameliorating population's health at all levels. This will result to higher economic growth in the future.

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