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Empirical Analysis of HIV/AIDS, Government Health Investment and Economic Growth in Nigeria: Evidence from SVAR

Sede Igbaudumhe, Peter & Adediyan, Raphael Aderopo
University of Benin, Benin City, Edo State, Nigeria

Abstract

This paper concerns the dynamics of the connection of HIV/AIDS, government health investment and economic growth in Nigeria. The Structural Vector Autoregressive mechanism, (SVAR), was adopted as the major tool of estimation and analysis. Data on HIV/AIDS, government health investment, real GDP per capita, poverty rate and Literacy rate, used in the study were sourced from CBN Statistical Bulletin and World Bank Development indicator. Among the findings of the paper are that; government health investment has an unidirectional causality with HIV/AIDS. The key source of variations in HIV/AIDS emanated largely from own shock and government health investment. The dominant source of variation in government health investment was from itself and innovation from economic growth. Since HIV/AIDS responds significantly to government health investment shock, among other things, the paper recommends that government should increase its investment in the health sector to mitigate HIV/AIDS scourge and accomplish economic growth in the long run.

Key Words: Economic Growth, Government Health Investment, HIV/AIDS, Poverty, SVAR

JEL Classification: H51, H53, I15

Paper Classification: Research Paper

Introduction

An adequate health investment policy, in the form of growing government spending in the sector is pertinent as it helps to reduce spreading of diseases in the country, thereby increasing the health sector output, and at the same time serves as a stimulant and promoter of rapid economic growth among other things. Among the top concerns, the issue of government investment in health sector, lies in its power to mitigate endemic diseases; particularly the menace of HIV/AIDS through procurement of adequate modern health facilities, HIV/AIDS anti-retroviral drugs and hiring of health professionals.

To start with, the Human Immunodeficiency Virus or HIV is a type of virus that spreads through certain body fluids and progressively attacks the body's immune system that naturally defends the body against illness. On the contrary, Acquired Immunodeficiency syndrome, (AIDS),

referred as a series of symptoms diagnosed is caused by HIV. HIV/AIDS disease spreads easily via commercial sex workers and unscreened blood transfusion amongst others. It has a very serious debilitating effect on the victim and eventually culminates in mortality. It accentuates morbidity and mortality which is a threat to productivity. Following the emergence of HIV/AIDS in the 1980s and its subsequent effects on economic growth, many public sector economists argued in favour of the need for a rising government spending particularly in health sector since it is a sector upon which the life and health of workforce of the nation depends.

Provision of physical health facilities such as hospital buildings, beds, as well as infant immunization, provisions of life-saving HIV/AIDS, anti-retroviral drugs and employment of health experts are some of the ways through which the government invests in health sector. Adequate investment in the health sector is seen as a support for rapid expansion of the health sector output. This is derived through optimal use of infrastructural facilities that improve health workers' productivities. This also enhances rapid expansion of aggregate output which spells economic growth. Health infrastructural development from government health expenditure contributes to the economic growth directly via increased average health output per health worker. Indirectly, it contributes to the economic growth through beneficial externalities that improve productivities of other sectors of the economy. Also, with adequate health investment spending, the effect of HIV/AIDS can be dampened in the economy.

Background to the Study

Previous studies on government health expenditure shows, HIV/AIDS and economic growth were only done on a direct link basis, considering each topic against another like, the impact of government health spending on HIV, the impact of HIV/AIDS on economic growth or the like. The agitation is that there could be a simultaneous relationship among the three. HIV/AIDS affects the total amount to be spent in the health sector; it also determines economic growth through its effect on labour input among other mediums. For this reason, both the effect of government health investment and HIV/AIDS and their connection with economic growth ought to be jointly studied. This makes the current paper distinct from the previous works.

The menace of HIV/AIDS appears as the most critical disease to threaten the health sector, hence, retarding economic growth as well as altering the composition of government health investment spending. It may also be well said that the spread of HIV/AIDS epidemic may likely be one of those factors responsible for increasing government spending in the health sector without corresponding outcome over the years.

The burden of HIV/AIDS weighs on both victims and the neighbourhood in form of both direct and indirect costs. The prevalence rate of HIV/AIDS is still disturbing across the geo-political zones in Nigeria, in particular, among adults in the age bracket of 15 to 49 who are the sources of wealth and progress of the economy. HIV/AIDS victims are subjected to isolation and hardship, loss in the level of their productivity. Their resources as well as those of their relation who spend time and money to attend to them, are reduced. These coupled with increased death rate due to HIV/AIDS prevalence rate, slows down economic growth rate. (Duada, 2011; Dominic et al, 2014). In other words, the existence of HIV/AIDS creates a vicious cycle of economic retardation by reducing aggregate labour productivity, which in turn reduces aggregate output, income, savings and investment that culminates in a fall in economic growth rate.

To curtail the aforementioned effects of the disease, government embarks on health investment spending through several channels such as direct funds transfer to the health sector

of the economy. Since government health investment spending has been unstable and poor, the perturbation effects on Nigerian economic growth is of grave agitation. This is so because the economic growth can be affected by the quantity and quality of public health investment via the quality and quantity of health sector output. Thus for government, achieving her desire eradication targets of HIV/AIDS disease, will increase health sector output and expand economic growth rate in Nigeria.

Many hospitals and primary health care centres in Nigeria have little or no access to modern health facilities, and most of the professional personnel have no incentive to maximise efficiency, by discharging their duties in the most productive manner, owing to lack of adequate and impressive government investment in the sector. Where workers summon courage, the poor pay coupled with poor infrastructural facilities work place, increases the hazard rate of the workers in their work place. This is a serious disincentive towards contributing meaningfully towards health sector output growth and hence that of the economy at large.

It is against the aforementioned that this research effort is directed to examining, within the framework of Structural Vector Autoregressive (SVAR) model, the dynamic interrelationship and the mutual impacts of government investment in the health sector and the menace of HIV/AIDS on economic growth in Nigeria. Some of the research questions this paper is expected to answer are: does HIV/AIDS determine economic growth? Does government health investment control economic growth? What is the mutual interrelatedness among government health investment spending, HIV/AIDS and economic growth in Nigeria?

Literature Review

The relationship among HIV/AIDS, government health investment and economic growth is a complex one. While it may be argued that increased government health investment is required to reduce the menace of HIV/AIDS, raise health output and promote economic growth, increased economic growth may also explain the growth of output of health sector. Hence, there is an argument as to whether it is health service improvement that causes economic growth or economic growth that causes health improvement. There is however, no presence of HIV/AIDS in this transmission mechanism as a third variable, the innovation this study is introducing.

In line with this controversy, Nurudeen and Usman (2010) opined that intensifying government investment in health improvement, amounts to increasing economic growth. To Nurudeen and Usman (2010), government should elevate its investment in health sector improvement, since this, among other things, will push up productivity and economic growth rate. Government investment intervention in human capital development such as health service development is desirable at any particular point in time.

There are some economic rationale explaining why expanding the government investment or expenditure purposely for health sector improvement is desirable. Anyanwu et al (2007) opined that the justification for improved government expenditure on human capital development is often hinged on its impact on individuals' lifetime incomes, economic growth and fostering of economic development as well as poverty reduction. The positive and statistically significant link between investment in health and economic growth is identified in Gyimah-Brempong, (2004).

Therefore the level of government investment in health, determines to a large extent level of economic growth in the economy. A pertinent initiative here is the introduction of a disease pandemic (HIV/AIDS) specific question, into this cause-effect link.

The Keynsian Transmission Link

John Maynard Keynes, (1939) traced the transmission nexus between variables of fiscal instrument and productivity. Productivity on its part is normally proxied by gross domestic product of the affected economy. In the Keynesian postulation, instrument of fiscal policy include taxes and government expenditure. This is normally derived from the real sector equation of the Keynsian equilibrium. Quantitatively this is sited as:

$$Y = C(Y,r) + I(Y,r) + G \quad - \quad - \quad - \quad - \quad - \quad - \quad -1$$

Equation 1 is the real or goods sector model stating that aggregate output is the sum of aggregate consumption, investment and government expenditure. Consumption and investment are dependent on income (Y) and rate of interest (r) while government expenditure is taken as exogenously given. According to the Keynesian postulation, as government expenditure increases, interest rate decreases. This creates decrease in the cost of capital which spurs up aggregate demand and hence increased investment. Increase in investment culminates in the increase in aggregate output or income. This theory forms the basis for easy fiscal policy meant to bail out a typical economy out of recession. Thus the transmission mechanism between easy fiscal policy and health can be traced to the nexus between increased government health expenditure, increased aggregate income, which is normally proxied by the gross domestic product of the economy in view. At the core of the definition of economic growth of any nation is the GDP. Meanwhile one critical indice for development of any nation is the health of the populace. In this study, health is measured by HIV/AIDS. Below is the schematic connection running from increase in government health expenditure (GHEX), through decrease in HIV/AIDS to improved economic growth. GHEX HIV/AIDS–Economic Growth GHEX HIV/AIDS–Economic Growth.

To be specific, the transmition mechanism is such that, increased government health expenditure would mitigate HIV/AIDS prevalence, increase human capita productivity and hence increase economic growth. Eneji et al (2013) however, stressed that the size of government's non-productive spending and corruption has always swollen budget funds. It is against this backdrop, the paper calls on the policy makers to check the growth of government wage bills.

Included in the reason for government investment in health sector is the mitigation of epidemic of HIV/AIDS in the country of which its impact on economic growth potential has been a major concern ever since the onset of the disease. According to United Nations publication on the impact of AIDS, some researchers argued that the disease, HIV/AIDS scourge, is responsible for slowing the growth rate of gross national product of several economies that have shown serious effects from the disease to the point that in some cases, GNP growth could decrease by more than 1 percentage point for every 10 per cent HIV prevalence. Others take the view that HIV/AIDS has had little impact on the macroeconomy; yet to others, the impact of HIV/AIDS on the economic growth is a positive one.

Dixon et al (2002) are of the view that HIV/AIDS negatively impacts economic growth by reducing labour supply and productivity – through increased mortality and morbidity that creates loss of skills in key sectors of the labour market, decreases exports owing to low productivity and investment, and expanded imports – importation in terms of drugs among others necessary to ameliorate the disease.

Ainsworth and Over (1994) opined that AIDS affect the structure and composition of the active labour force in the country. The epidemic is known for increasing morbidity and mortality, and causes reduction in growth potential of aggregate output and productivity. It attacks the

productive segment, the labour force, of the population (Odetola, 2007). The economic impacts of AIDS progressively move from individual victims to business firms and to the economy as a whole. Contrary to the negative impact of AIDS is it positive impacts viewed by Bloom and Mahal (1995) who argued on that the epidemic positively affects growth rate per capita. The HIV/AIDS prevalence and its aggregative impact on economic growth rate in Nigeria in the light of these presented views is what this study is to examine.

Grossman Health Investment Models

The model asserts that, an individual is assumed to derive utility from consuming a commodity (Z) and disutility from 'sick time' (ts), which is a function of his stock of health capital Ht, according to the inter-temporal utility function see equation (1):

$$\int_0^T e^{-\rho t} U\left[t^s\left(H_t\right) Z_t\right], \qquad \text{.....(1)}$$

The mathematical derivative in equation 1 implies that:

$\frac{\partial U_t}{\partial t^s} < 0, \frac{\partial U_t}{\partial Z_t} > 0, \frac{\partial t^s}{\partial H_t} < 0, \textit{and } \rho \textit{ time discount factor}$ .This is saying that marginal utility decreases as time spent sick increases, it increases as more of other health improving commodities (Z) are consumed by the individual while marginal time spent sick decreases as total health stock increases.

The dynamics of H are given by equation (2):

$$H_t = I_t\left(M_t, t^i\right) - \delta_t H_t, \qquad \text{.....(2)}$$

With $\frac{\partial I_t}{\partial M_t} > 0, \frac{\partial I_t}{\partial t^i} > 0,$ This means that investment in health capital I is produced by medical care M and own time spent producing health, for instance, on sporting activities (*ti*) and that all these have direct relation with investment on health. On the other hand, health capital depreciates at a rate (δ). In Grossman's formulation, δ depends only on the individual's age (*ti*) and it is taken as exogenous, but other studies have opined that δ can be made endogenous by adding lifestyle variables like tobacco and alcohol consumption (Gerdtham et al. 1999), pollution (Erbsland et al. 1995) and unemployment (Gerdtham and Johannesson 1999).

Asset accumulation is given by equation (3)

$$\dot{A} = rA_t + Y\left[t^s\left(H_t\right)\right] - \pi_t^H I_t - \pi_t^Z Z_t \qquad \text{.....(3)}$$

Where A is the stock of financial assets, r is the rate of interest, Y is earned income as a function of 'sick time' which also depends on total health stock, and π^H and π^Z are the marginal cost of investment in health and consumption, respectively. The boundary conditions are H(0) = H0, A(0) = A_0, H_t H' and $A_t \leq 0$, where H' is the 'death stock' of health capital.

The individual has to solve the control problem to choose the time paths for Ht and Zt that maximize the inter-temporal utility function (1) subject to the dynamic constraints (2) and (3) and the boundary conditions. The solution for this problem is given by equation (4):

$$\left\{\frac{\partial U_t/\partial t_s}{\lambda(0)}e^{-(\rho-r)t}+\frac{\partial Y^t}{\partial t^s}\right\}\frac{\partial t_s}{\partial H_t}=\left\{r+\partial t-\frac{\dot{\pi}_t^H}{\pi_t^H}\right\}\pi_t^H \quad \text{.....(4)}$$

Where λ(0) is the shadow price of initial assets.

Equation (4) states that the marginal benefit of additional health capital on the left-hand side must be equal to the marginal cost of holding it on the right-hand side. Additional health capital reduces 'sick time', which provides direct utility (the first summand on the left hand side representing the 'pure consumption' effect) in addition to increasing labour income (the second summand representing the 'pure investment' effect). A rise in the depreciation rate δ raises the marginal cost of investing in health capital. So does a rise in the interest rate because opportunity cost increases. On the other hand, if health capital rises in value in the future, >0 this lowers the relative cost of investing today.

Due to the complex relationship between pure consumption (PC) and pure investment (PI

benefits in the model, either of the (PC) sub-model in which the term $\frac{\partial Y_t}{\partial t_s}\frac{\partial t_s}{\partial H_t}$

or (PI) sub-model in which the term $\frac{\partial U_t/\partial t^s}{\lambda(0)}e^{-(\rho-r)t}\frac{\partial t^s}{\partial H_t}$, in the left hand side, is usually set

equal to zero for effective empirical work. Grossman (2000) argues that this is necessary because it 'is difficult to obtain sharp predictions concerning the effects of changes in exogenous variables in a mixed model in which the stock of health yields both investment and consumption benefits'. Also, he thinks that the monetary returns are largely relative to the 'psychic' returns and therefore focusses on the PI model. The latter is derived from equation (4) by dropping the first term on the left-hand side and taking logs:

$$\mathrm{h}\left[-\partial t_s/\partial H^t\right]+\mathrm{h}\ w_t=\mathrm{h}\ \delta_t+\mathrm{h}\ \pi_t^H-\mathrm{h}\ \psi_t \quad \text{.....(5)}$$

Where the nominal wage rate wt equals $-\frac{\partial Y_t}{\partial t^s}$, and $\psi_t=\partial t\Big/\left[r+\partial t-\frac{\dot{\pi}_t^H}{\pi_t^H}\right]$

The PC model is derived from equation (4) by dropping the second term on the left-hand side and taking logs:

$$\mathrm{h}\left[\frac{\partial U^t}{\partial t^s}\frac{\partial t^s}{\partial H_t}\right]-\lambda(0)-(\rho-r)t=\mathrm{h}\ \delta_t+\mathrm{h}\ \pi_t^H-\mathrm{h}\ \psi_t \quad \text{.....(6)}$$

In order to estimate equations (5) and (6), assumptions must be made about the functional forms of

$t^s(\cdot), \delta(\cdot), \pi^H(\cdot)$ *and* $U(\cdot)$ Following Grossman (1972a) it is assumed that:

$$t_i^s = \beta_1 H_i^{-\beta_2}, \quad \text{.....(7)}$$

Where and are positive constants and

$$\ln \delta_{it} = \ln \delta_0 + \beta_3 t_i, \quad \text{.....(8)}$$

With $\beta_3 > 0$, subscript i denotes the i th time.

Investment in health capital is assumed to be affected by combining time (ti) and medical care (M) according to Cobb-Douglas production function with constant returns to scale. Furthermore, Grossman assumes that education (E) raises the efficiency of the production process in the household sector. This gives rise to the investment function (9):

$$I_{it} = M_i^{\beta_4} t^{i^{1-\beta_4}} E_i^{\beta_5}, \quad \text{.....(9)}$$

with $0 < \beta_4 < 1$ and $\beta_5 > 0$.

The demand for medical care follows from equations (2), (9) and the cost-minimizing condition for health investment, $\frac{P_{it}^M}{w_i} = \frac{\beta_4}{1-\beta_4}\frac{t_i^i}{M_i}$

$$\ln M_{it} = \beta_{10} + \ln H_{it} + (1-\beta_4)\ln w_{it} - (1-\beta_4)\ln P_{it}^M + \beta_3 t_i - \beta_5 E_{it} + u_{2it} \text{.....(10)}$$

With $\beta_0 = -(1-\beta_4)\ln[(1-\beta_4)/\beta_4]$ and $u_{2it} = \ln \delta_0 + \ln\left[1 + \frac{H_i}{H_i \delta_i}\right]$, Wagstaff (1986) treats u2it as an error term.

The stock of health capital H enters the demand for medical care equation with a coefficient equal to +1. This reflects the basic idea of the model that medical care is demanded in order to build up health capital. Thus there is a positive relationship between the stock of health capital of an individual and his or her demand for medical care. For a recount, the key variables that could affect the health stock of any individual or economy at any time, are consumption of health producing goods such as medicine (M), health producing habits such as exercise (Ht), time spent sick (ts) and education (E). It is important to note that attaining these core health determinants and optimal health investment attainment, depend on the income levels, ability and readiness to spend on health, on the part of the individual and the economy at large and the level of educational attainment in the economy. Implied in the above discussion, on the whole and for the purpose of macro study, the health stock of an individual or an economy for that matter, at any point in time, is seriously dependent on some key macroeconomic variables such as, the economic status (income level), government spending on health and educational level. In this study, the variables adopted as proxy in the afore-specified Grossman health investment model are: government health spending for health investment, HIV/AIDS prevalence rate, real GDP for economic growth, poverty rate, as instrument for health production variable and literacy rate for education.

The main critique of Zweifel et al. (2009) and Zweifel (2012) directed against the Grossman model is that most empirical studies found a negative relation between health status and the demand for medical care, not a positive one. In other words: the sick demand medical care, not the healthy. The focus of this study is however, is to estimate the joint relationship of the proxied variables of health care investment, HIV/AIDS and economic growth and not to test the structural demand function.

Empirical Literature Review

In the previous studies, the emphasis of researchers were either on the relationship between the menace of HIV/AIDS and economic growth and the impact of government expenditure/ investment on the economic growth rate of the Nigeria.

Essig et al (2015) empirically investigated the nature of the relationship between the menace of HIV prevalence in African countries and the growth of GDP per capita. The major argument of the study as reflected in their hypothesis is that as HIV infections spread within a country, the GDP per capita sinks owing to the harmful effect of the disease on human capital. A simple regression model is was used to capture the effect of HIV/AIDS on per capita GDP using GDP per capita as the dependent variable and number of children and adults living with HIV as the independent variable. Findings from this simple model revealed that HIV has a negative but weak correlation with per capita GDP. This model was later expanded to incorporate arable land per capita, labour force, foreign direct investment, life expectancy, imports and exports, as well as death resulting from HIV, and the number of people living with HIV. The results indicate that both deaths due to HIV and the number of people living with HIV have an inverse relationship with GDP per capita.

Maijama'a et al (2015) studied the impact of the HIV and AIDS epidemic on economic growth in 42 Sub-Saharan African countries from 1990-2013. The dynamic system GMM estimation technique was employed to obtain the numerical value of the relationship. The study concluded that the current HIV prevalence rate had a negative impact on GDP per capita growth; on the contrary, AIDS – associated with higher mortality in addition to morbidity, increased per capita GDP growth.

In Cameroonian country, Kambou et al (1992) using time series data spanning from 1986 – 1991 examined the effect of AIDS. The key finding of the study centred on the fact that over the period the research covers, the impact of a loss of workers in an urban area on production is more severe compared to that of a loss of workers in the rural area, and that both negatively impact on GDP growth rate.

Nicholls et al. (2001) assessed the macroeconomic impact of HIV in Tobago and Trinidad and in Jamaica. The study assumed a three-sector economy namely: industry, agriculture and services within a Cobb–Douglas production framework with further assumption of an existence of male and female labour markets for all the three sectors identified. Local-based savings are assumed and set proportional to the level of income and finance every investment, but then, this is affected negatively by spending on AIDS drugs, HIV tests among others. Finding of the study suggests HIV prevalence rises by 20 per cent from 1997 to 2005. They thus concluded through their simulation model that the GDP in the study region – Jamaica, and Trinidad and Tobago economies would decline, on the average, by 6.4 per cent and 4.2 per cent respectively.

Daudu et al. (2006) considered the impact of HIV/AIDS on families in Makurdi Benue State. The study employed primary data. The study adopted non-parametric method such as the chi-square and descriptive statistics such as frequency distribution, percentages in its analysis. The

study concluded that HIV/AIDS has negative effect on the productivity, farm income and standard of living of HIV/AIDS victims' families.

Focusing on the regional variation in a multi-country study, Amico et al (2010) examined HIV spending as a share of the total health expenditure. A descriptive analysis of HIV and health expenditures in 2007 from 65 countries was examined. The share of HIV spending across the 65 countries was found to be quite moderate considering that the estimated share of deaths attributable to HIV stood at 3.8 per cent. The study further shows that many high spending economies are using a large share of their total health spending for HIV health, although these countries are exceptional, and by no way an average representative of Sub-Saharan African country. Also, it is reported that there is wide disparity among regions as per the burden of disease.

Considering government health investment, its implication for health outcome and economic growth, many empirical studies have been geared towards establishing the relationship. While similar variables were used to achieve virtually the same outcome, controversy of findings is clearly noticeable. For instance, Day and Tousignant (2005) examined the relationship between health outcomes and health investment in Canada with the conclusion that positive or causal relationships between a measure of the health status of the population and real per capita health expenditures exists, although the established relationships were not very strong according to their findings.

The study of Harttgen and Misselhorn (2006) found that access to health infrastructure is important for child mortality reduction. They further argued that socio-economic considerations shape health outcomes in the country.

Tibandebage et al (1998) examined the implication of expenditures on HIV/AIDS in Tanzania. The data used were gathered from research studies, government documents which were combined with the secondary qualitative information obtained in the field. The qualitative information used among other things were sourced from proceedings of a workshop as well as from interviews with officials in the Government and with representatives of non- governmental organizations that are concerned with the treatment and prevention of AIDS. The research suggests that about 59.5 per cent of total health care expenditures is channelled to HIV treatment in Tanzanian health, while prevention claims 39.6 per cent of total health expenditures.

Similar to the work of Tibandebage et al (1998) is the research conducted by Gyimah-Brempong et al (2004). The outcome of the research shows that health capital investment measured by some selected health capital indicators, positively influence aggregate output. The result further revealed that roughly 22 to 30 per cent of economic growth rate is attributed to health capital, and that improvement in health conditions which is equivalent to one more year of life expectancy are found to be associated with higher GDP growth of up to 4 per cent points per year.

The influence of government health investment or expenditure on health outcome, noting that variation in health outcome is a rising function of change in economic growth rate, is also well documented in the research conducted by Filmer and Pritchett (1999). Through the research they conducted, Filmer and Pritchett found that government health investment explains less than one-seventh of one per cent change in under-five mortality across regions in the countries studied. The study concluded that 95 per cent of the total changes in under-five mortality rate might be explained by factors like country's per capita income, female educational attainment, and choice of region. The outcome of research conducted by Burnside and Dollar (1998) negated this as it found no significant evidence of the relationship between health investment and change in infant

mortality. Thus, one cannot conclude that increase in health investment will stimulate expansion of economic growth via reduction in the mortality rate leading to increase in health outcome.

From the literature reviewed above, controversy trails the nature of the relationship among government health investment, HIV/AIDS and economic growth. The significant impact of both government health investment and prevalence of HIV/AIDS on economic growth is also an issue of concern as it appears to be lack of consensus in the literature. Therefore this study aims at filling this gap.

Theoretical Framework

The theoretical framework of this study is based on Grossman model of health demand and investment as discussed earlier. The model relates health to a durable commodity that economic agents demand and invest in. The model argues that individual economic agent has initial endowment of health subject to depreciation over time but can be revived through health investment like medical care, exercise, diet etc. That is, health investment comes in from of medical care and like, that economic agent purchases. Health capital according to the model can be a consumption of good that gives economic agents pleasure and an investment good which creates more healthy time for both non-market and market activities.

The model further argued that the production of health depends on education and the resources spent on producing health such as time spent on gym and cost of setting up health producing centres that in turn depend on income level. Although according to the model, better health outcome may not always be associated with higher income. The model in general focuses on the connection between the health stock, health investment and other types of human capital such as knowledge acquired through education. The model has implication for health, education, poverty, income, health investment etc. Consequently, the interaction among HIV/AIDS, health investment and economic growth is determined through the application of this model.

Data Description

Specifically, the study makes use of time series data. Data on economic growth and the amount of government investment on health sector are sourced from CBN annual Statistical Bulletin of various issues. On the other hand, data on HIV/AIDS used in the study are obtained directly from the World Bank development indicator. All in all, variables used include real Gross Domestic Product per capita, HIV/AIDS, education (secondary school enrolment as a proxy), and poverty rate and government health investment.

Method of Modelling

The study employs the Structural Vector Autoregression (SVAR) Technique. According to Sim (1980), this method is designed for co-integrated series as well as for those whose co-integration status are unknown, however the cointegration status of the series used in this study is clear from the Johansen cointegration test results. This methodology was employed because the responses of the variables to structural shocks can be retrieved. To this end, Enders (2014) contends that the objective of SVAR is to get back the structural innovations from the reduced form residuals using economic theory. It is worthy to note that under the SVAR methodology, emphasis is highly placed on the structural errors rather than coefficient estimates. This study adopts the two basic tools of analysis under the SVAR model: the Impulse Response Function and Forecast Error Variance Decomposition.

Impulse Response Function: This is a tool which allows researchers to trace out the time path of the various shocks or innovations on the variables in the SVAR system. It shows the time path response of variable to own shock and shock to other variables influencing the response variable in the model (Abubakar, 2016)

Forecast Error Variance Decomposition: This measures the proportion of variation in each of the variables emanating from its own shocks and shocks to other variables in the model. That is, the variance decomposition depicts the percentage of forecast error variance for each variable in the model that is attributable to its own innovation and to innovations in other variables. The proportion of variation or movement is taking sequentially over specified period horizon.

Model Specification

The structure of the model takes the format:

$$Rgdppt = \rho_0 + \rho_1 Rgdppt\text{-}i + \rho_2 GIVHt\text{-}i + \rho_3 HIV/AIDSt\text{-}i + \rho_4 PORt\text{-}i + \rho_5 EDUC\ t\text{-}i + u1 \text{..... .i}$$

$$GIVHt = \gamma_0 + \gamma_1 Rgdppt\text{-}i + \gamma_2 GIVHt\text{-}i + \gamma_3 HIV/AIDSt\text{-}i + \gamma_4 PORt\text{-}i + \gamma_5 EDUC\ t\text{-}i + u2 \text{..... .ii}$$

$$HIV/AIDSt = \delta_0 + \delta_1 Rgdppt\text{-}i + \delta_2 GIVHt\text{-}i + \delta_3 HIV/AIDSt\text{-}i + \delta_4 PORt\text{-}i + \delta_5 EDUC\ t\text{-}i + u3 \text{... iii}$$

$$PORt = \Psi_0 + \Psi_1 Rgdppt\text{-}i + \Psi_2 GIVHt\text{-}i + \Psi_3 HIV/AIDSt\text{-}i + \Psi_4 PORt\text{-}i + \Psi_5 EDUC\ t\text{-}i + u4 \text{... iv}$$

$$EDUCt = \beta_0 + \beta_1 Rgdppt\text{-}i + \beta_2 GIVHt\text{-}i + \beta_3 HIV/AIDSt\text{-}i + \beta_4 PORt\text{-}i + \beta_5 EDUC\ t\text{-}i + u5 \text{..... v}$$

In compact form, equation i through v may be restated as:

$$Z_t = \Omega + \sum_{i=1}^{k} A_i Z_{t-1} + \mu_t \text{..... vi}$$

Z_t = (RGDPP, GIVH, HIV/AIDS, POR, EDUC), it defines a vector of real GDP per capita, government health investment, the epidemic of HIV/AIDS, poverty rate (used to capture the extent to which resource is spent on producing health) and education (used as a proxy for human capital).

A_i specifies the matrix of coefficients of all variables included in the stated model

Z_t-1 = vector of the lagged variables in the model

Ω = all the intercepts of autonomous variables found in the model.

And lastly, μt is the vector of the stochastic error terms. The μ's are called impulses or innovations or shocks in the language of VAR. The above model shows the structure of the Vector Autoregression (VAR) model used in the study to capture the linear interdependencies among the variables used. All the variables are treated symmetrically with each variable having an equation.

Empirical Results and Analysis

Unit Root Test

Table 1 shows the test for the presence or otherwise of unit root within each of the series employed in the regression analysis of the study. In doing this, the test was conducted with the Augmented Dickey Fuller test statistic at both intercept with no trend and intercept and trend. Result shows that all the series are not stationary at level but with first difference, they become stationary at 5 percent level of significance. Thus they are integrated of order one

Table 1: Summary of Unit Root Test

	ADF: Intercept, No Trend			ADF: Trend and Intercept		
Variable	ADF Value	Critical Value	Order of Integration	ADF Value	Critical Value	Order of Integration
RGDPP	-4.209	-2.981	I(1)	-4.251	-3.595	I(1)
POR	-5367	-2.986	I(1)	-5.342	-3.603	I(1)
LNGIVH	-3.655	-3.012	I(1)	-3.674	-3.105	I(1)
HIV_AIDS	-4.906	-2.998	I(1)	-5.022	-3.622	I(1)
EDUC	-5.875	-2.986	I(1)	-5.892	-3.603	I(1)

Source: Authors' computation using Eview

Table 2: VAR Optimal Lag Length Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-280.4841	NA	5707.635	22.83873	23.08251	22.90634
1	-171.2722	166.0022	7.100264	16.10178	17.56443	16.50745
2	-117.1304	60.63880*	0.907880*	13.77043*	16.45196*	14.51418*

* indicates lag order selected by the criterion (each test at 5% level of significance)

Table 3: Toda-Yamamoto Augmented Granger Causality Test Summary

Direction of Influence	Chi-Sq	DF	P-Value	Conclusion
POR → RGDPP	7.132740	2	0.0283	Unidirectional
EDUC → GIVH	8.720556	2	0.0128	Bidirectional
EDUC → GIVH	7.789380	2	0.0203	
GIVH → HIV_AIDS	23.61850	2	0.0000	Unidirectional
HIV_AIDS → POR	7.799689	2	0.0202	Bidirectional
HIV_AIDS → POR	14.17070	2	0.0008	
EDUC → HIV_AIDS	16.16906	2	0.0003	Bidirectional
EDUC → HIV_AIDS	10.49283	2	0.0053	

Note: The significance level selected is 5%.
Source: Extracted from Eview result

Causality is normally tested at optimum lag length to forestall against econometric imperfections of the model. Such includes autocorrelation of the residual of the observations. This when occurred can render the coefficient estimates inefficient and affect the predictive power of the estimates. This therefore necessitates the choice of a lag length under a guided econometrics criterium. Thus in order to arrive at the appropriate optimum lag length for this study the Akaike Information Criteria (AIC) at lag 2, is adopted. This is shown in Table 2.

The result of the granger causality is shown in Table 3. From it, poverty rate granger causes economic growth for the period of study unidirectionally. This implies that the future value of the economic growth rate may be predicted by the present value of the poverty rate and not vice-

versa. Similarly, unidirectional causality is reported between government health investment and HIV/AIDS with the impulse running from the government health investment to HIV/AIDS. Contrarily, there is a complete feedback (bidirectional relationship) between education and government health investment, poverty rate and HIV/AIDS, and between education and HIV/AIDS. Government health investment was found to granger cause economic growth beyond 5 per cent level.

Forecast Error Variance Decomposition Results Analyses

To examine the dynamics of interrelatedness of HIV/AIDS, government health investment and economic growth, the paper considers the forecast error variance decomposition which is reported in Table 3.

Table 4: Forecast Error Variance Decomposition

Variance Decomposition of RGDPP:

Period	S.E.	RGDPP	LNGIVH	HIV_AIDS	DPOR	DEDUC
1	3.698711	100.0000	0.000000	0.000000	0.000000	0.000000
2	5.963846	39.78286	40.38340	1.545213	17.00990	1.278627
3	6.974144	32.86311	33.36887	6.086341	26.26274	1.418938
4	7.039992	32.34125	33.33250	6.497656	26.05577	1.772824
5	7.124132	31.68569	33.14363	7.981862	25.45761	1.731201
6	7.168114	31.34873	32.80833	8.970142	25.14740	1.725400
7	7.246338	30.73795	32.67236	9.642959	25.12895	1.817790
8	7.274024	30.51660	32.62694	9.982746	25.02300	1.850716
9	7.321998	30.21302	32.77482	10.22226	24.92432	1.865577
10	7.367256	29.98641	32.92467	10.37651	24.84109	1.871317

Variance Decomposition of LNGIVH:

Period	S.E.	RGDPP	LNGIVH	HIV_AIDS	DPOR	DEDUC
1	0.401691	18.59508	81.40492	0.000000	0.000000	0.000000
2	0.528009	19.78092	67.98367	4.054623	4.930354	3.250434
3	0.576022	20.01253	67.00029	5.549161	4.689518	2.748497
4	0.636373	17.81492	67.15647	5.965396	4.969632	4.093576
5	0.659871	17.84154	65.85126	7.454619	4.970844	3.881738
6	0.701921	16.93509	65.33713	7.931091	6.007461	3.789227
7	0.722877	17.00338	64.96048	8.117007	6.186163	3.732967
8	0.748587	16.82646	65.02295	7.873222	6.668669	3.608696
9	0.762997	16.79253	65.21541	7.645406	6.775416	3.571233
10	0.773667	16.80838	65.40684	7.450088	6.821993	3.512696

Variance Decomposition of HIV_AIDS:

Period	S.E.	RGDPP	LNGIVH	HIV_AIDS	DPOR	DEDUC
1	0.036499	5.244794	3.333685	84.60570	6.815818	0.000000
2	0.067090	3.322148	2.636044	85.51078	2.573693	5.957333
3	0.103368	2.525364	4.982386	83.80237	3.026917	5.662962
4	0.142998	2.121337	9.003310	78.32304	4.830708	5.721607
5	0.183205	2.780529	12.86188	72.55917	6.570436	5.227983
6	0.226951	3.952065	18.54563	63.82064	8.884088	4.797579
7	0.268015	5.144766	23.80631	56.17789	10.31683	4.554209
8	0.306491	6.208671	28.60252	49.62592	11.20193	4.360958
9	0.340744	7.074817	32.46472	44.59022	11.65251	4.217730
10	0.370812	7.788606	35.50942	40.76249	11.83907	4.100411

Variance Decomposition of DPOR:

Period	S.E.	RGDPP	LNGIVH	HIV_AIDS	DPOR	DEDUC
1	2.813105	12.81930	36.77230	0.000000	50.40840	0.000000
2	3.152685	11.57084	35.15164	11.03990	41.99437	0.243251
3	3.433181	10.34484	32.07448	21.76351	35.60872	0.208458
4	3.562729	9.618650	30.08269	25.71476	34.07833	0.505570
5	3.691007	9.472609	29.93573	26.12696	33.86746	0.597248
6	3.812718	9.455251	31.63414	24.75897	33.50181	0.649826
7	3.885847	9.665114	32.96546	23.84363	32.85361	0.672189
8	3.938447	9.859668	33.89289	23.30842	32.27639	0.662625
9	3.963459	9.943373	34.29616	23.19011	31.91095	0.659408
10	3.973351	9.977587	34.40098	23.21233	31.75255	0.656550

Variance Decomposition of DEDUC:

Period	S.E.	RGDPP	LNGIVH	HIV_AIDS	DPOR	DEDUC
1	3.401472	0.090468	33.03332	16.78128	3.046285	47.04865
2	3.702344	4.359959	32.14698	14.43636	2.654994	46.40171
3	3.761779	7.028116	31.16564	13.98725	2.783314	45.03567
4	3.883770	7.849996	32.40804	14.23259	2.743432	42.76594
5	4.072420	7.823673	33.68692	13.20641	6.329223	38.95377
6	4.090181	7.776445	33.40303	13.38603	6.654223	38.78027
7	4.094084	7.768020	33.51086	13.36080	6.650600	38.70973
8	4.094919	7.777019	33.49769	13.38131	6.647898	38.69608
9	4.096591	7.783884	33.47219	13.43278	6.645973	38.66518
10	4.101979	7.783381	33.47143	13.48366	6.684779	38.57674

Cholesky Ordering: RGDPP LNGIVH DPOR HIV_AIDS DEDUC

From Table 4, it can be seen that the variance decomposition of real GDP per capita (RGDPP) reveals that the leading source of variation in RGDPP in the first period is due, mainly, to its own shock; the contribution of own shock is 100 per cent. Hence, neither shock in HIV/AIDS, poverty rate, government health investment, nor the perturbation in education (human capital) contributed to the movement in RGDPP. Turning to the fifth period-horizon, the variation in RGDPP due to shock in POR increased to about 25.45 per cent over-taking both the shock in HIV/AIDS and education which are approximately 7.98 per cent and 1.73 per cent respectively. The shock in government health investment (about 33 per cent) claims the largest share, followed by own shock in the fifth year. As at the tenth period horizon, HIV/AIDS shock was found to cause about 10.38 per cent in the movement in RGDPP, while about 1.87 per cent, 24.84 per cent and 32.92 per cent variation in RGDPP are attributed to the perturbation in education, poverty rate and government investment in health. Own shock reduces from about 31.68 per cent in the fifth year to about 29.99 per cent in the tenth year.

In the case of the variation in government health investment (GIVH), own shock maintained the largest contribution throughout the period. Own shock accounts for about 81.40 per cent of the total variation in GIVH in the first period with roughly 18.60 per cent from shock in RGDPP. Aside from own contribution, shocks in government health investment is driven mostly by RGDPP and HIV/AIDS during the third period through the tenth period. Although, the contribution of the RGDPP decreases up to the tenth period, it remains the largest source of movement in GIVH. Perturbations in the poverty level and education influence government health investment marginally in the 10th period.

Lastly, the case of HIV/AIDS is not significantly different. The lion's share of variation in HIV/AIDS is associated to its own shock throughout the period. That is, own shock constitutes the predominant source of variation in the entire period. While shock in education does not influence the variation in HIV/AIDS in the first year, RGDPP contributed roughly 5.24 per cent and government health investment contributes as low as 3.33 per cent. The shock in poverty rate accounts for about 6.82 per cent and roughly 84.61 per cent comes from own share in the period.

In the fifth year, government health investment shock is observed to be about 12.86 per cent, rising to approximately 35. 50 per cent in the tenth year. In terms of shock in RGDPP, its influence on HIV increases from roughly 2.78 per cent in the fifth period to about 7.79 per cent at the end of the 10th period horizon. Variation in HIV/AIDS attributed to shock in poverty rate increases from 6.57 per cent in the 5th period to approximately 11.84 per cent while that of education reduces from 5.22 to 4.10 per cent in the tenth period.

Impulse Response Functions

Figure 1 depicts the outcome of the impulse response function obtained. It is noted that in the first period, there was a non-response of real GDP per capita to a unit innovation in government health investment. The response of RGDPP to one unit innovation in government health investment was negative in the second period but positive from third up to the sixth period. It turned to negative at the end of the sixth year through the tenth year. The greater level of its impact was felt in the second and the third periods; it reduces slightly in the early fourth period and maintains this trend up to the tenth period.

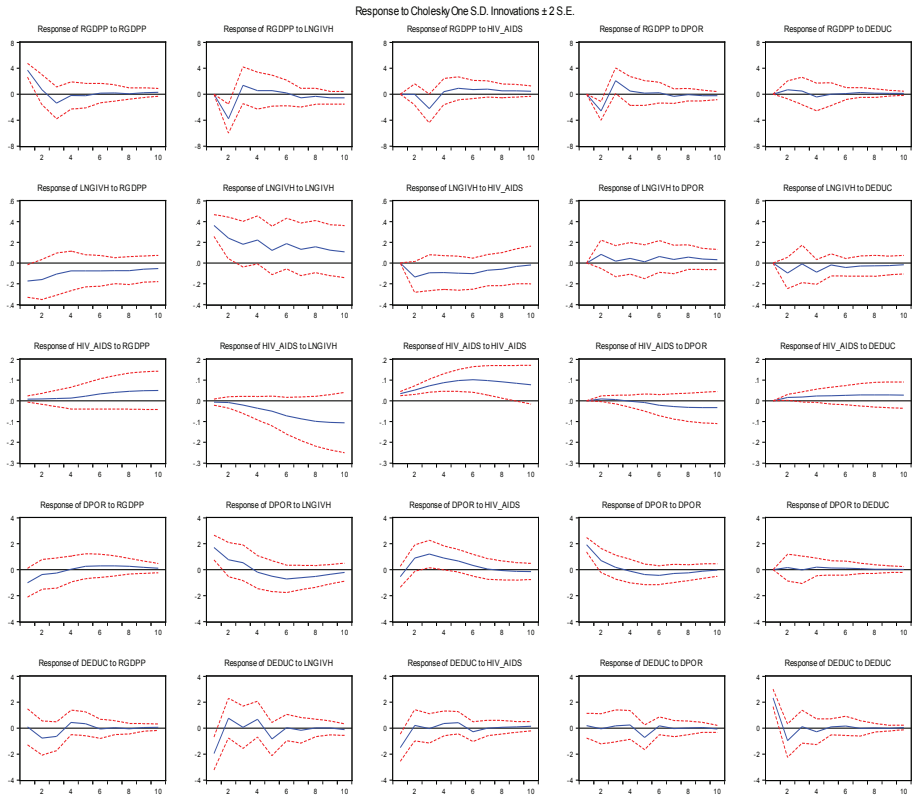
The response of RGDPP to HIV/AIDS was negative from the second period but becomes positive in the eight through the tenth period. Thus, the impact of HIV/AIDS on RGDP is mixed; its negative impact is short-lived compared to its positive impact; the maximum level of its impact was observed during the third (negative) and the fourth period extending to seventh period (positive). Further, poverty rate exerts negative impact (second period only) on the RGDPP; it became positive in the third year, and its effect was neutral in the fifth year through the tenth year. Similarly, the response of RGDPP to one unit innovation in education is positive and brief (from the second up to the fourth period and thereafter becomes zero). This implies that education can be used to enhance economic growth at least for a short term.

In the case of HIV/AIDS, the response of HIV to government health investment was negative, expanding and significant from the second year to the tenth year with no response in the first year. Real GDP per capita positively impacts HIV/AIDS throughout the periods. Although highly negligible over the second through the fourth year, the size of the impact of RGDPP continues to expand positively from the fifth through the tenth period. The response of HIV to a unit innovation in the poverty rate is negative and last through the tenth period from the sixth period but was neutral between the second and the fifth period. It can be concluded from this that increase in poverty rate may not raise HIV prevalence. Contrary to expectation, education (human capital) shows a long term positive response to a shock in HIV/AIDS.

The response of government health investment to one unit innovation in real GDP per capita was equally noted. The IRF graph shows the absence of response of government health investment in the early phase of first period. At the end of the first period, the response of government health investment to RGDPP is negative and large up to the fourth year. It reduces sharply towards the fifth period but is highly stable from the sixth period up to the eighth period and becomes closer to zero from the later part of the eighth period onward. Also, the response of government health to innovation in HIV/AIDS is noticeably positive from the second period through the tenth period with its peak in the second period.

Furthermore, the poverty rate exerts positive impact on government health investment throughout the period with the highest impact in the second and the seventh periods. Subsequent increase in poverty rate is likely to induce more government investment in health services. Finally, the response of government health investment to education is positive but quite trivial from the 5th period through the 10th period. This implies that growth in the education (human capital) reduces the amount spent on health services indicating the improvement in health habit formation from acquisition of education.

Figure 1: Impulse Response Functions



Summary, Conclusion and Policy Recommendations

This paper looks at the dynamics of interrelationship among HIV/AIDS, government health investment and economic growth in Nigeria. Economic literature suggests that the menace of HIV/AIDS has the power to raise government health investment and reduce economic growth through its negative effect on labour force. Nigerian economy is labour intensive; thus HIV/AIDS increase can easily disrupt production, lower investment undertakings, decrease economic growth and raise poverty rate. In this regards, increasing government health investment spending is argued to lower HIV/AIDS and improve economic growth, however, problem arises when uneconomic use of resources coupled with increasing poverty rate are not put on effective check.

This study reveals that HIV/AIDS responds more to government health investment and that economic growth is the major source of variation in health investment apart from its own variation. Similarly, poverty rate, HIV/AIDS and government health investment determine economic growth with greater response from the perturbations in poverty rate and itself. Against this, this paper recommends that, government should pay policy attention to HIV/AIDS reduction by increasing resources to health investment. This will reduce the HIV/AIDS prevalence rate, curb poverty and boost economic growth. HIV/AIDS and poverty rate are found to influence the movement in economic growth, subsequently, the paper calls for HIV/AIDS and poverty rate reduction especially in the short-run for a desired economic growth rate to be achieved.

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Authors' Profile

Sede Igbaudumhe Peter PhD, holds a combined honours in Economics and Education for his first degree, Masters of Science in Banking and Finance and another Masters of Science degree in Economics in the University of Benin, Benin City Edo State, Nigeria. He also has his doctoral degree in Economics through the scholarship scheme of the African Economic Research Consortium under the auspices of the University of Benin. Apart from basic economic theory, he specializes in Health Economics and Econometrics which he teaches at both under graduate and post graduate classes. He is currently, a Senior Lecturer in the Department of Economics, Faculty of Social Sciences, in the same University where he researches on Health Economics related courses and teaches Econometrics, Health Economics, Microeconomics and Macroeconomics. He has published number of research papers in other journals like Asian-Africa journal of Economics and Econometrics, Health Economics Review, Amity Journal of Economics, Journal of Business Research and not less than thirty other journal articles in academic institutions in Nigeria. He has held several positions of responsibility in the department such as, pioneering the teaching of Health Economics and coordinating all post graduate programmes in Health Economics. Currently, also, he is the Project Coordinator of a World Bank supported Centre of Excellence in Reproductive Health Innovation (CERHI) Project in the University.

Aderopo Raphael Adediyan, is a young researcher and, holds a Bachelor of Science degree in Economics from Kogi State University, Anyigba, Nigeria. He also holds a Master of Science degree in Economics from the University of Benin, Benin City, Nigeria. His research interests are in Applied Econometrics, Development Economics, Macroeconomics, Monetary Economics, and Natural Resources and Conflict Management Economics.