Public Health Expenditure and HIV/AIDS Epidemic in Nigeria: An Evidence from Vector Autoregressive Methodology

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Abstract: The paper was an attempt to investigate the impact of public health expenditure on diseases/epidemics in Nigeria particularly as development assistance for HIV/AIDS decreases. Data were sourced from World Development Indicator (WDI) from the period of 1982 to 2016 and analysis was done using a vector autoregressive (VAR) methodology. The findings from the VAR analysis indicate a negative significant relationship between hiv prevalence and government expenditure on health. Per capita income suggests weak relationship with hiv prevalence. Shocks from government expenditure on health and per capita income caused a persistent downward spiral in hiv prevalence and most of the variations in hiv prevalence explained by government health expenditure. The paper recommends that government expenditure on health would be a viable alternative for the management and control of epidemics/diseases in Nigeria cum to achieve the HIV/AIDS goal by 2030 compare to per capita income of households.

Keywords: HIV/AIDS epidemic; Health; Per capita income; VAR

JEL Classification: H5; I1; Y1

1. Introduction

The recent improvement of Nigeria's HIV epidemic to 1.4% in 2019 as against previous estimates of 2.8% (UNAIDS, 2019), is not only desirable but also calls for more renewed interest and efficient investments in response to the deadly epidemic given the decline in development assistance for HIV/AIDS between 2012 and 2016 (Haakenstad, Moses, Tao, et al, 2019). This remarkable improvement led to the launched of the Revised National HIV and AIDS Strategic Framework 2019-2021 by the President of Nigeria, Muhammadu Buhari. According to the President, the framework among other things, is to guide the country towards future response to the epidemic. UNAIDS and the National Agency for the Control of AIDS, (2019) reported that Nigeria has about 1.9 million people living with HIV. HIV prevalence

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among adults in Nigeria is about 2.9%. This is less compared to other countries (South Africa (18.9%) and Zambia (12.4%)) in sub-Saharan Africa region. South Africa, Uganda and Nigeria account for almost half of all new HIV infections in SSA region every year. Though Nigeria achieved a 15% reduction in new infections between 2005 and 2016, unsafe sex and other high risk behavior accounted for over 80% of the new HIV infections (NACA, 2017).

The drop in HIV epidemic in recent times (Figure 1) and particularly to 1.4% in 2019 would have been possible because of the renewed investment in health sector as development assistance for HIV/AIDS falls, and other commitment (policy efforts) aimed at targeting the reduction of the epidemic in Nigeria. Nevertheless, it is still on record that Nigeria is the second undesirable country in the world with the epidemic of HIV/AIDS and also has one of the highest rate of new infection in the region of sub-Saharan Africa (SSA).

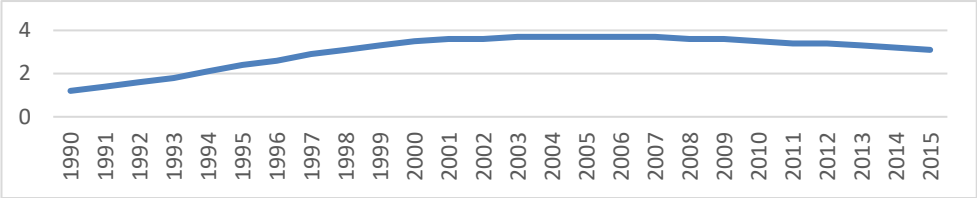

Figure 1. Trends of HIV Prevalence (Percentage of Total Population Age15-49) in Nigeria

Source: Authors' Plot Using WDI Data 2016

Improved public spending in health sector, treatment, care services for those living with HIV and serious advocacy on prevention delivery are the possible interventions needed to end or reduce to barest minimum HIV epidemic in Nigeria. This position has been advocated by stakeholders, policy makers and researchers alike. Positive interaction and relationship has been found in economic theories and studies (Grossman, 1972 and Onisanwa, 2014) between good health and productivity of workers. It is evidence that only healthy individual (physically and mentally) can contribute positively to the development and growth of the society through increase productivity compared to sick ones. This explains why government all over devote significant amount of their societal resources to achieving good health for all through public spending on healthcare. In addition, International organization such as United Nation (UN) also saw the need to expand investment in quality healthcare by recommending to leaders of less developed countries to allocate a benchmark of about 10% of their total budget annually on health care spending. With this, they would be able to grow effective capacity and adequate interventions in healthcare delivery. To this effect, Nigeria government has continued to struggle to increase the allocation of resources on average to health sector amid lean resources over the years (See Figure 2). This effort has

yielded some positive outcomes in recent times. Notably, is the drop in HIV prevalence in 2019 despite the decline in development assistance for HIV/AIDS between 2012 and 2016, improvement in maternal and child mortality rate and other health outcomes (See WDI, 2019).

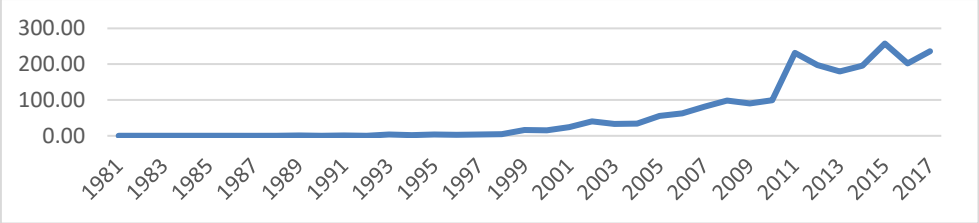

Figure 2. Trends of Government Expenditure on Health from 1981 to 2017
Source: Authors' plot using data from Nigeria Statistical Bulletin 2017

As observed in most researches, increasing public health spending has been the major policy direction in improving quality healthcare outcomes anywhere. But it can be argued that there are no direct relationship between public health spending and health outcome due to the complexity inherit in the structure of administration and governance in most developing countries, particularly sub-Saharan Africa countries. Thus, the direct role of increased public health spending in improving health outcome can be argued in developing economies compared to developed economies that have explicit or good health indicators. Thus, more researches are needed in developing countries to clear the doubts on the role of public spending on health sector development.

Then, the pertinent question the study seeks to answer is that could the slight improvement in HIV prevalence in Nigeria in recent times be attributed to increased spending (on the average) on health sector in Nigeria as revealed by Figure 1 and 2 despite the decline in development assistance for HIV/AIDS between 2012 and 2016? The focus of the study is to provide answer to the question raised above using empirical evidence. The study also tends to add to the frontier of knowledge on the on-going debate on the contribution of public health spending on diseases prevalence in Nigeria by using recent data from World Development Indicator (WDI) and the Nigerian Statistical Bulletin. This will help to clear the role of improved public health spending on health outcome, and also contribute to both theoretical and methodological gaps.

The study adopts vector autoregressive (VAR) techniques within the framework of impulse response functions (IRFs) and error variance decompositions (EVDs) for effective policy direction. The rest of the study is organized thus: literature review is featured in section two. Section three discuses methodology and model specification while section four analyzes empirical findings and section five provides conclusion and recommendations.

2. Literature Review

Several studies on the relationship between HIV/AIDS and public spending have observed a positive association between HIV prevalence and increased government finances. For instance, Avila, Loncar, Amico and Lay (2013) found a positive relationship between HIV prevalence and HIV-spending from public sources. The authors used a panel data from 2000 to 2010 for 125 countries. In their random effect results, they found that GDP per capital and HIV prevalence are positively associated with increasing levels of HIV-spending. The paper concluded that emphasis should be on increasing importance of government finance on HIV prevalence so as to reduce the epidemic.

In a more recent study, Haakenstad, Moses, Tao, Tsakalos, Zlavog, Kates, Wexler, Murray and Dieleman (2019) found a positive relationship between government spending on HIV and AIDS prevalence. The study employed a spatiotemporal gaussian process regression to estimate a time series of spending by domestic sources from 2000 to 2016 for 137 low and middle-income countries. The paper concluded that more funding should be mobilized to finance the response to HIV/AIDS prevalence.

In a study on HIV spending as a share of total health expenditure carried out by Amico, Aran and Avila (2010), they employed a descriptive analysis of HIV and health expenditure in 2007 for 65 countries. They observed in their findings that the total public and international expenditure in LMICs for HIV was put at 1.6% of the total spending on health while the share in SSA was put at 19.4%. This indicates a positive relationship between HIV spending and total health expenditure. The study concluded that the percentage of HIV spending as a share of total health expenditure is useful to understand healthcare resources and their allocation pattern.

Dixon, McDonald and Roberts (2002) investigated the impact of HIV and AIDS on Africa's economic development. The authors considered how economic theory can contribute to the response to HIV/AIDS. They observed that HIV/AIDS do not only affects labour supply and productivity but also reduce exports and increase imports. The greater impact was on economic growth. According to the study, there was a significant reduction in nation's economic growth due to the diversion of investment and resources to healthcare instead of other productive uses in the economy that would have stimulated growth.

In a similar study, Yonde (2010) investigated the relationships between foreign aid, HIV and government health spending on the 15 countries identified by PEPFAR between 2004 and 2008 period. The study applied correlation analysis and found out that a statistical significant relationship exists between adult HIV prevalence rates and the amount of foreign funding for HIV/AIDS programs. The study also

found out that additive relationships exist between foreign and domestic health spending.

More so, Theodore (2001) identified the losses of resources to other productive investment or uses due to increase in healthcare spending as one of the channels of the impact of HIV/AIDS on the economy. The study investigated the economic effects of HIV in three Caribbean Countries (Trinidad and Tobago, Jamaica and Saintlacia). Haacker (2004) in his study opined that the impact of HIV/AIDS on government operations is on healthcare services and expenditure. According to the study, expenditure on healthcare services is the most visible impact of HIV on the economy.

3. Methodology

3.1. The Model

A popular model used in the theoretical description of *health outcome* is the Grossman Model of 1972. Apparently, the model emphasizes the importance of socioeconomic variables (such as education, income, healthcare spending, etc.) as key determinants of good health or health outcomes. These variables do not only affect good health but also affect the amount of investment (health expenditure) and time in good health. This implies that investment in good health by way of healthcare spending, income, time and education depends on other socioeconomic factors beside the demand for healthcare services. Changes in this variables have the capacity of changing the optimal amount of good health and the amount of investment in good health.

Therefore, following Grossman model, the current study adopts a more systematic methodology to establish a dynamic relationships between public health expenditure and health outcome (HIV/AIDS) in the context of vector autoregressive (VAR) technique. The VAR technique considers all variables as endogenous. The VAR model for this study is drawn from the studies of Izilien and Osemwengie (2016) and Shaibu, Osemwengie, Kanwanye (2017). Applying matrix algebra notation as in Shaibu, etal (2017), a three (3) variable structural dynamic economic model for this study is specified as:

$$By_t = \alpha + \theta y_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

Where the matrix of variable coefficients is B, y_t is the 3 x 1 vector of observations of the variables of the study. Also, α is the vector of constants, θ is a matrix of coefficients and ε_t is a diagonal matrix of structural innovations with zero means, constant variances and which are independently and identically distributed (that is, $\varepsilon_t \sim NIID$ [0,1]). So, specifically, the VAR model estimated for this study is stated as:

$$\Delta RHIV_t = \alpha_i + \sum_{i=1}^{x} \beta_i \Delta RHIV_{t-i} + \sum_{i=1}^{y} \gamma_i \Delta PEXH_{t-1} + \sum_{i=1}^{z} \delta_i \, \Delta IPC_{t-1} + \mu_{1t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots 2$$

$$\Delta PEXH_t = \alpha_i + \sum_{i=1}^{x} \beta_i \Delta PEXH_{t-i} + \sum_{i=1}^{y} \gamma_i \Delta RHIV_{t-1} + \sum_{i=1}^{z} \delta_i \, \Delta IPC_{t-1} + \mu_{2t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3$$

$$\Delta IPC_t = \alpha_i + \sum_{i=1}^{x} \beta_i \Delta IPC_{t-i} + \sum_{i=1}^{y} \gamma_i \Delta PEXH_{t-1} + \sum_{i=1}^{z} \delta_i \, \Delta RHIV_{t-1} + \mu_{3t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4$$

Where $\alpha_i, \beta_i, \gamma_i, \delta_i$ are parameter estimates, x, y and z are the optimum lag length and μ_i for $i = 1, 2, 3$ are the stochastic error terms.

RHIV is the variable for HIV/AIDS, proxy for health outcome.

PEXH is the variable of public expenditure on health proxy by government expenditure on health.

IPC is the variable for per capita income.

The apriori expectation from the study is that we expect RHIV to fall as PEXH rise, *ceteris paribus*. In the same way, inverse relationship is also expected between RHIV and PCI.

3.2. Techniques of Estimation

The study adopts the following estimation techniques− unit root test, co-integration test, vector autoregressive (VAR) technique, this will include impulse response function (IRFs) and forecast error variance decompositions (FEVDs).

The rationale for the VAR model adopted in this study is analyzed thus: the VAR model has robust procedure for evaluating relationships, which makes it suitable for analyzing impact in a multivariate system, as exhibited by Sims (1989). As a system estimator, the VAR technique treats all variables in the model as endogenous. As a dynamic multi-equation system, each of the equation in the model is of the autoregressive distributed lag (ARDL) form, applied where there is a sufficient evidence of no co-integration among the variables. In order to analyze the impact of unanticipated shocks on the variables in a more convenient and comprehensive way, Sims (1980) proposed the use of impulse response functions (IRFs) and forecast error variance decompositions (FEVDs).

A preliminary test will be conducted prior to the VAR estimation to ascertain evidently the stationary properties of the variables in the model. In this light, the study adopts both the Augmented Dickey Fuller (ADF) unit root tests and the Phillips-Perron (PP) unit root tests for the purpose of robustness. This will be followed by a long-run cointegration check using Johansen co-integration tests. In addition, the optimum lag length will be ascertained using some selection criteria as suggested in econometric literature which include Akaike Information Criterion (AIC), Hannan-Quinn information criterion (HIC), Schwarz Bayesian Criterion (SBC) and others.

3.3. Data Source

The key variables for the study are health outcome proxy by HIV/AIDS, and public expenditure on health. Other variable in the model is income per capita. The time series data employed in the study covered the period of 1982 to 2016. This period was chosen due to the availability of comprehensive data on HIV/AID for Nigeria. The data were sourced from World Bank Development Indicators (WDI) 2016 and the Central Bank of Nigeria (CBN) 2016 Statistical Bulletin.

4. Results and the Analysis

4.1. Results

Estimated results conducted in the study are reported in the Tables below:

Table 1. Unit Root Tests Results for Variables of the VAR model

Augmented Dickey Fuller (ADF) Unit root test statistic							
Variables	**Levels**			**First Difference**			**Order of Integration**
	ADF test stat.	**ADF critical value (5%)**	**Inference**	**ADF test stat.**	**ADF critical value (5%)**	**Inference**	
RHIV	-9.206	-3.587	Stationary				I(0)
PEXH	-1.935	-3.548	Non-stationary	-5.641	-3.552	Stationary	I(1)
PCI	-0.857	-3.548	Non-stationary	-6.014	-3.552	Stationary	I(1)
Phillips-Perron (PP) Unit root Test Statistic							
	Levels			**First Difference**			

Variables	ADF test stat.	ADF critical value (5%)	Inference	ADF test stat.	ADF critical value (5%)	Inference	Order of Integration
RHIV	-0.144	-3.548	Non-stationary	-4.739	-3.552	Stationary	I(1)
PEXH	-2.216	-3.548	Non-stationary	-5.641	-3.552	Stationary	I(1)
PCI	-0.857	-3.548	Non-stationary	-6.016	-3.552	Stationary	I(1)

Source: Authors' estimation using EVIEWS9.

Table 2. Johansen Cointegration Test

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CES(s)	**Eigenvalue**	**Trace Statistic**	**0.05 Critical Value**	**Prob.****
None	0.378257	24.66684	29.79707	0.1737
At most 1	0.174254	8.984294	15.49471	0.3668
At most 2	0.077607	2.665866	3.841466	0.1025
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CES(s)	**Eigenvalue**	**Max-Eigen**	**0.05 Critical Value**	**Prob.****
None	0.378257	15.68255	21.13162	0.2439
At most 1	0.174254	6.318428	14.26460	0.5727
At most 2	0.077607	2.665866	3.841466	0.1025
Both Trace and Max-eigenvalue tests indicate no cointegration at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level. ** MacKinnon-Haug-Michelis (1999) p-values				

Source: Authors' Estimation Using EVIEWS 9.

Table 3. VAR Order Selection Criteria

Endogenous variables: RHIV PCI PEXH		Sample: 1982-2016			Included observations: 32	
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-510.7514	NA	1.77e+10	32.10946	32.24688	32.15501
1	-438.7428	126.0151*	3.46e+08	28.17143	28.72108*	28.35362*
2	-428.4987	16.00635	3.26e+08*	28.09367*	29.05556	28.41251
3	-423.6199	6.708395	4.40e+08	28.35124	29.72537	28.80673

LR: sequential modified LR test statistic (each test at 5% level), FPE: Final prediction error, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion. *indicates lag order selection

Table 4. Vector Autoregression Estimates

Sample (adjusted): 1983 2016. Included observations: 34 after adjustments. t-statistic in [ ]			
Variable	RHIV	PCI	PEXH
RHIV(-1)	0.946634 [18.4885]	1047.578 [1.49204]	2.080654 [0.47729]
PCI(-1)	1.43E-05 [0.81455]	0.800668 [3.31487]	0.001631 [1.08772]
PEXH(-1)	-0.003412 [-1.41030]	-31.70321 [-0.95555]	0.497393 [2.41457]
C	0.207543 [2.32153]	357.4444 [0.29158]	-2.291387 [-0.30105]
R-squared	0.970191	0.734657	0.677210
Adj. R-squared	0.967210	0.708123	0.644931
F-statistic	325.4644	27.68712	20.97987
Sum sq. resids	2.160175	4.06E+08	15658.56
S.E. equation	0.268339	3679.664	22.84627
Akaike AIC	0.317000	19.36916	9.205583
Schwarz SC	0.496572	19.54873	9.385155
Mean dependent	2.573529	9205.189	35.61713
S.D. dependent	1.481872	6810.959	38.34058

Source: Author's estimation using EVIEWS9

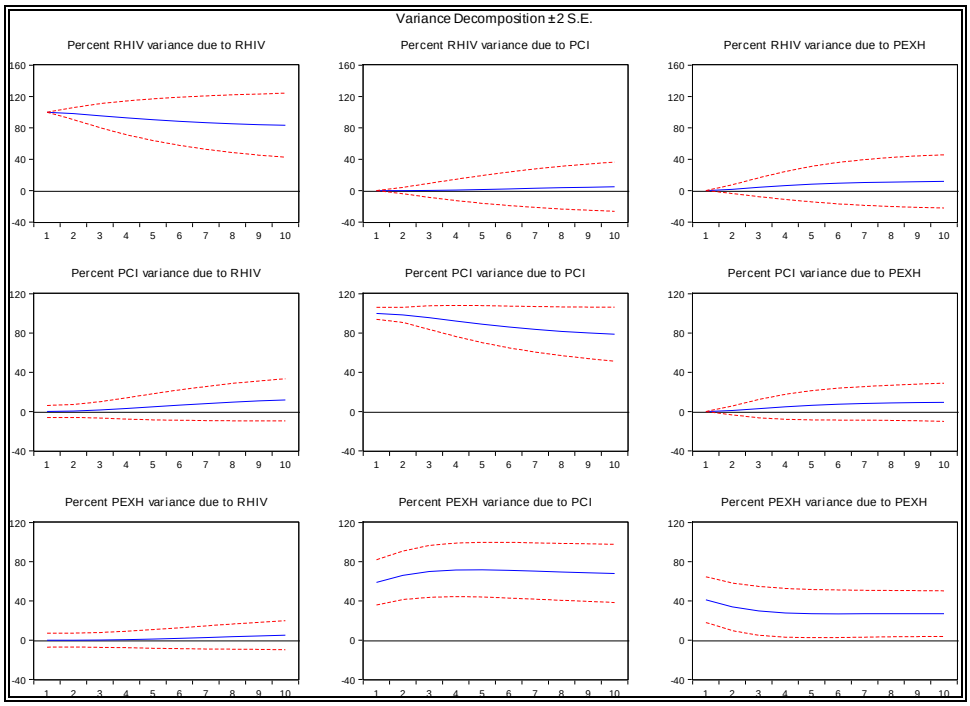

Figure 3. Variance Decompostion Results based on Monte Carlso Estimation

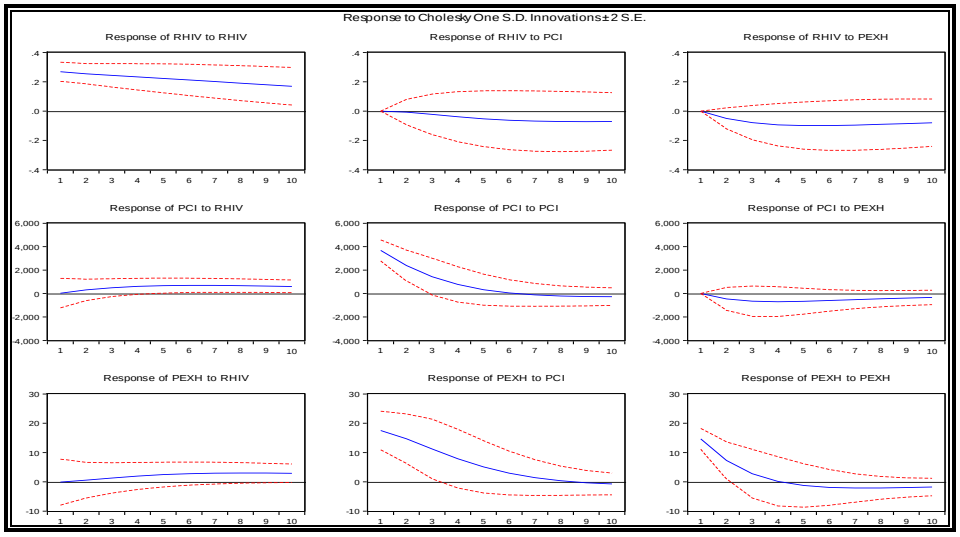

Figure 4. Impulse Response Functions (IRFs)

Source: Authors' Estimation Using EVIEW9

4.2. Analysis of Results.

The unit root tests requires all the variables in the VAR model to be stationary in levels or first differences. The ADF and PP unit root tests statistics are presented in Table 1. In the ADF unit root tests results, only RHIV was stationary in levels while PCI and GEXPH attained stationary after first differencing at 5% level of significance. However, the PP unit root tests statistics showed that all the variables in the VAR model were first difference stationary. Their observed values -5.641, -4.739 and -6.016 for GEXPH, RHIV and PCI respectively are greater than the critical value of -3.552 in absolute terms at 5% level of significance (Table 1). Thus, integrated of order one (1).

Table 2 reports Johansen Cointegration tests results for the VAR model. The unrestricted cointegration rank tests (Trace and Maximum Eigenvalue) are presented. The Trace test shows no evidence of a co-integrating relationship among the variables – RHIV, PEXH and PCI in the model. Similarly, the maximum eigenvalue test also indicates no cointegrating equation(s) among the variables at 5% level of significance. With this, it can be concluded that a long run equilibrium relationship do not exist among the variables in the model. It therefore follows that the variables have the tendency not to converge in the long run. This development justifies the use of VAR methodology adopted by the study.

Having justified the use of VAR methodology as a result of the fact that the variables may not move in perfect harmony in the long run as indicated by both the trace and maximum eigenvalue tests in Table 2, it was therefore imperative to determine the optimum lag length of the VAR model before proceeding for estimation. The result of the lag length is presented in Table 3. The optimum lag length structure suitable for the VAR analysis is one, as suggested by sequential modified LR test statistics, Schwarz information criterion and Hannan-Quinn information criterion in Table 3.

The estimated VAR results in Table 4 indicates a positive relationship exist between one-period lag in RHIV and current level of PCI and PEXH. This implies that a rise in HIV/AIDS infection in previous year by 1 unit, can cause per capita income (PCI) and public expenditure on health (PEXH) to increase in the current year by 1047.57 and 2.08 units respectively. While this positive impact is significant for PCI at 10% level, it was however weak for PEXH. In the same vein, one-period lag in PCI has a weak positive impact on the current level of RHIV and PEXH. It means that per capita income of household could not explain the rise in HIV/AIDS and public expenditure on health as aggregate income increases. Finally, one-period lag of PEXH has a negative significant impact on current level of HID/AIDS at 10% level of significance (Table 4). According to the result, a unit rise in PEXH in the previous year will cause HIV/AIDS to drop by 0.003 units in the current year. PEXH is therefore a strong determinant of HIV/AIDS. PEXH has

a negative insignificant relationship with PCI. Meaning as expenditure on healthcare increase, income of households are likely to fall.

The FEVD results are reported in Figure 3. In the first chart, the error decomposition of HIV/AIDS (RHIV) shows that through the 10-quarter periods of analysis, RHIV variations were mostly explained by itself and, after some time, the PEXH followed. Changes in RHIV resulting from the contributions of RHIV improved all through the period, and the highest contributions witnessed in the 10th period (first chart). PCI however, had the lowest contributions to RHIV throughout the periods. This submits that PEXH impacts more on RHIV reduction in Nigeria. On the contribution to PCI, PEXH contributed more to variations in PCI up to the 7th period compared to RHIV. However, from the 8th to the 10th periods, RHIV exceeded PEXH as indicated in the fourth chart. The eight chart shows an interesting results as most of the variations in PEXH was not explained by itself but by PCI all through the periods. This means that PEXH is less self-determined than those of RHIV and PCI. The contributions of RHIV to PEXH slightly improved through the periods with the highest in the 10th period.

The results of the impulse response functions in Figure 4 are quite revealing. The second and third charts shows that HIV/AIDS respond negatively to both PCI and PEXH. This is however expected. As income and public expenditure on health increase, the prevention advocacy, treatment and care for HIV/AIDS patients are likely to rise and thereby lowering the level of the epidemic. HIV/AIDS responded negatively, showing a downward responses to Cholesky one standard deviation innovations or shocks arising from both PCI and PEXH throughout the horizons (Figure 4). Main while, a gradual upward pattern of responses to Cholesky one standard deviation were observed by both PCI and PEXH as a result of shocks or innovations arising from HIV/AIDS (RHIV). This is clearly depicted in Figure 4 by the fourth and seventh charts respectively. This suggests that as the HIV/AIDS epidemic increases, per capita income and public health expenditure are most likely to rise in order to contain the spread and deaths arising from the disease.

In all, the policy implication of the results is quite extensive. Public expenditure on health has a negative significant impact on health outcome (HIV/AIDS) in Nigeria. This implies that high HIV/AIDS prevalence is associated with low public health expenditure, vice-versa. Thus, the question raised in section one is adequately addressed empirically that the slight improvement in HIV/AIDS achieved in Nigeria recently could be attributed to the marginal growth in government expenditure on healthcare over time.

5. Conclusion

So far the paper has attempted to investigate the role of public health expenditure in Nigeria as it affects diseases infection (HIV/AIDS). Nigeria is one of the nations in sub-Saharan Africa with a high burden of HIV/AIDS disease. Over two hundred thousand deaths have been recorded and the level of infection stood above three million. Recently, the country recorded a slight improvement in HIV/AIDS by sliding down the curve. The contribution of public expenditure on health to diseases or epidemics reduction in emerging economies has become essential. This has led to quite a lot of researches with regard to improving and developing a good healthcare system amid epidemic. Using annual time series data from 1982 to 2016 periods, the VAR methodology was used to investigate empirically the nexus between public expenditure on health and HIV/AIDS epidemic.

Results obtained in the study have far-reaching implications and suggest certain policy direction. First, the result reveals that public expenditure on health has a significant negative impact on HIV/AIDS in Nigeria. This implies that, increasing public expenditure on health in Nigeria is a veritable measure of stimulating reductions in HIV/AIDS as well as other epidemics or diseases, such as Ebola, Lassa fever etc. Second, per capita income suggest a weak relationship with diseases infections (HIV/AIDS). This implies that per capita income is not effective in dealing/managing epidemics. Finally, the paper recommends the intervention of government through increase public health expenditure in the effective management of diseases or epidemics (HIV/AIDS, Ebola, Lassa fever, Malaria etc) as per capita income of the individual cannot effectively manage these diseases. Therefore, the improvement in HIV/AIDS infection recently in Nigeria could be attributed to the marginal increase in public health expenditure in the area of treatments of HIV/AIDS patients, prevention, awareness campaign as well as other interventions. Specifically, increase in domestic spending on healthcare in addition to international development efforts are required to achieve HIV/AIDS goal by 2030.

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