Public Expenditure and Human Capital in Nigeria: An Autoregressive Model

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Abstract.

In this study, we set out to empirically investigate the direction of causality between human capital (i.e. education and health) expenditures and defence spending including debt service obligations in Nigeria, using annual time series data from 1970 to 2000. Some statistical tools are employed to explore the relationship among these variables. The study examines stochastic characteristics of each time series by testing their stationarity using Augmented Dickey Fuller (ADF) and Phillip Perron (PP) tests. Then, the effects of stochastic shocks of each of the endogenous variables are explored, using vector autoregressive (VAR) model.

The evidence from the Granger causality tests shows that, in Nigeria, debt service obligations determine human capital expenditure such as education. Also, from impulse response analysis, the result shows that unanticipated effect of debt service obligations or defence spending on human capital expenditure is ambiguous in Nigeria.

Key Words: Human Capital, Public Expenditure and Vector Autoregressive Model

1 Introduction

Economic development theorists generally agree that the quality of human resources has a significant impact on economic development and growth. This body of thinking is of the opinion that the quality and quantity of labour determine production by virtue of it being a factor of production. Moreover, improving the quality of the labour force yields implicit, non-economic outputs related to the generation of ideas and decisions which have a significantly positive impact on investment, innovation and other growth opportunities (Roux, 1994).

Although various factors determine the quality of human capital and, according to Hartshorne (1985: 255) "... there is a problematic relationship between education and economics which the conflicting theories of the economists have done little to illuminate", there is sufficient evidence to suggest that formal education makes a positive contribution towards economic growth. Consequently, the definition of a nation's wealth has widened to accommodate not only physical capital but also human capital as an independent factor of production required to achieve high and sustainable economic growth rates. In recognition of this relationship, however, developing nations have, in varying degrees, attempted to stimulate the accumulation of human capital through public education expenditure as well as government spending on health and related social services. The success of government initiatives in this regard can be gauged from the fact that in the late eighties, all developing countries allocated an average of 4.0 per cent of their gross domestic product to public education and health expenditure. However, although this represents an improved performance on previous years, comparable data show that during the same period, the average defence burden (defence spending as a share of GDP) in developing countries amounted to 6.5 per cent (World Bank, 1992: 141-143).

This is indicative of the apparent conflict within government budgets between, on the one hand, education and health expenditure and, on the other, defence spending and debt service obligations. However, the crowding-out effect[1] of defence spending on public education and health is not that simplistic (Roux, 1994). In practice, there are numerous channels by which defence spending or debt service obligations may have an impact on the stock and quality of human capital. Some of these channels may ultimately be of a positive nature. The aim of this study is to examine the interactions between public expenditure (defence spending and debt service obligations) and human capital in Nigeria, with a view to quantifying the effects for the country. The rest of the paper is structured as follows. Section two discusses the theoretical underpinnings and empirical evidence, while section three explains the data and the methodology of the paper. Empirical results are presented in Section four, while the summary and conclusions are contained in the last section.

[1] The proposition is that government spending on defence reduces the volume of resources available for spending in other areas of the economy.

11 Theoretical Considerations and Empirical Evidence

In any country, there can be no meaningful economic growth without adequate human and natural resources. Human capital is so important that in the Khartoum Declaration of 1988, it was asserted that:

> …the human dimension is the *sine qua non* of economic recovery …no SAP or economic recovery programme should be formulated or can be implemented without having at its heart detailed social and human priorities. There can be no real structural adjustment or economic recovery in the absence of the human imperative (Adedeji et.al. 1990: 390)

The concept of human capital refers to the abilities and skills of human resources of a country, while human capital formation refers to the process of acquiring and increasing the number of persons who have the skills, education and experience that are critical for economic growth and development of a country (Okojie 1995:44). Human resources are all embracing, that is, it is inclusive of persons who works now, or are likely to be productively employed sooner or later. It is a continuum, a continuing process from childhood to old age, and a must for any society or enterprise that wishes to survive under the complex challenges of a dynamic world.

Yesufu (2000: 321), in agreement with this view, opines that "the essence of human resources development becomes one of ensuring that the workforce is continuously adapted for, and upgraded to meet, the new challenges of its total environment". This implies that those already on the job require retraining, reorientation or adaptation to meet the new challenges. This special human capacity can be acquired and developed through education, training, health promotion, as well as investment in all social services that influence man's productive capacities (Adamu, 2003)

In human capital development, education and health are essential. Education is concerned with the cultivation of "the whole person" including intellectual, character and psychomotor development. It is the human resources of any nation, rather than its physical capital and material resources, which ultimately determine the character and pace of its economic and social development. According to Harbison:

> *"Human resources constitute the ultimate basis for the wealth of nations. Capital and natural resources are passive factors of production; human beings are the active agents who accumulate capital, exploit natural resources, build social, economic and political organization, and carry forward national development. Clearly, a country which is unable to develop the skills and knowledge of its people and utilize them effectively in the national economy will be unable to develop anything else"* (Harbison, 1973, p.3).

Education occupies an important place in most plans for economic and social development. Whichever way one looks at it, the education sector is important in human development as a supplier of the trained manpower and it is a prerequisite for the accomplishment of other development goals. Also, it is the main sector through whose national identity goals and aspirations are given meaning and reality among the people.

Despite the importance of educational institutions, Nigeria spends an almost insignificant proportion of her financial resources on education. In Nigeria, education expenditure as a proportion of gross domestic product (GDP) averaged 1 per cent between 1986 and 1990, compared to 0.72 per cent between 1995 and 1990. This performance fell below those of

other developing countries, which in 1960 and 1977, were spending an average of 11.7 and 16.3 per cent of their total expenditure on education respectively. The United Nations recommends that 26 per cent of the government budget be devoted to education. Seychelles had committed 10.2 per cent of its gross national product (GNP) to total education in 1985-87 and 8 per cent in 1995-97. Ghana allocates an average of 20 per cent of its total expenditure to education yearly. Between 1986 and 1992, Botswana spent 21 per cent of her expenditure on education; Malaysia, 19 per cent; Kenya, 20 per cent; Uganda, 15 per cent; and Nigeria, 3 per cent (Olaniyi and Adam, 2003).

Not only that education expenditure, as a percent of total expenditure, falls in many developing countries, including Nigeria, the budgetary allocations for the formal education system also have the shape of an inverted pyramid in which secondary and tertiary education receive more than four times as much public resources as primary education[2] In many cases primary schools are starved of financing while universities receive heavy subsidies. The majority of the population, particularly the poor, may lack adequate educational facilities, or may find that the opportunity cost of attending school exceeds short run private benefits, while the children from middle and upper class backgrounds benefit from comparatively generously financed university education[3].

Not only is this inversion of the financial pyramid not equitable, it is also not efficient. Particularly in the poorest developing countries, where primary education has been most neglected, the social rate of return on investing in basic education is high[4]. In addition to high returns, investing in primary education has the advantage of bringing government closer to the people it serves while simultaneously giving people greater control over their own lives and a basic institution of the communities in which they live. Primary schools are easier for local communities (villages, small towns, urban neighbourhoods) to control than secondary schools, colleges and universities. There is more opportunity for participatory development, for the active involvement of people in education and hence there is a greater likelihood that educational programmes will enjoy sustained support from the community.

This poor performance was also glaring in the health sector. Between 1986 and 1990, health expenditure as a percentage of GDP, in Nigeria, averaged 0.32 per cent and hardly changed between 1995 and 1999 (when it averaged 0.33 per cent). When Nigeria's performance is compared with other African countries, it is observed than in 1990, government expenditure on health as a fraction of GDP was 2.7 per cent against 3.5 per

[2] The inverted pyramid applies not only to public expenditure on formal education but also to health, pensions, public food distribution, transportation (compare air travel with farm-to-market roads), irrigation (compare expenditures on large scale water management projects with small scale irrigation facilities), industrial support, etc. In each case, expenditure per beneficiary increases as one climbs the pyramid while net social returns tend to fall. Thus the point made in the study about the composition of educational expenditure has wide applicability to other sectors.

[3] For example in Indonesia in 1978 it is estimated that 83 per cent of state subsidies to higher education accrued to the upper income group, 10 per cent to the middle income group and only 7 per cent to the lower income group. Indonesia is perhaps an extreme case, but a similar pattern is evident in Chile, Colombia and Malaysia.

[4] In Africa, for example, the rates of return on investments in education are estimated to be 26 per cent for primary education, 17 per cent for secondary education, and 13 per cent for higher education. These rates of return include public subsidies in total costs but do not attempt to include positive externalities in the benefits. Thus they understate the true social rates of return

cent in Ghana, 4.3 per cent in Kenya and between 1995 and 1997, 4 per cent in Seychelles (Olaniyi and Adam, 2003).
Poor expenditure on health sector in most developing countries is worsened by an inverted nature of health expenditure pyramid. About three-quarters of all public expenditure on health are for expensive medical care that benefits a small minority of the population living in the urban areas. A high proportion of the budget for health, 80 to 90 per cent in some countries, is spent on hospitals, almost all of which are located in the cities. At the same time, only about 60 per cent of the people have access to primary health care. A high proportion of the poor, and of those living in rural areas, is not reached by the health care system and is forced to rely on home remedies and traditional medicine (Griffin and McKinley, 1992).

One may ask: why this poor funding in social services in Nigeria? The explanation to this can be attributed, among others, to excessive defence spending and rising debt service obligations. There has not been a clear link between human capital expenditure and defence spending. While, Benoit (1973) postulates that technical training is a vital element of military service which augments the skill content of the existing labour force, Ball (1983) questions the value of military-induced training and education in a country where unemployment is so high that the soldier will not be able to find gainful employment at the termination of his military service. Whynes (1979 has suggested that the military has an important role to play in dismantling social rigidities by virtue of the fact that it is a progressive institution. Moreover, military regimes are sometimes perceived to promote the modernisation of society which, in turn, dispenses with its feudal and social obligatory system (Pye, 1972) and moves towards a market-oriented, capitalist system which places a much greater premium on enhancing the quantity and quality of human capital in society (Roux, 1994).
Diamond (1990) also argues that defence expenditure, by ensuring the maintenance of security and public order, may be an essential precondition for healthy investment environment. However, Arora and Bayoumi (1994) argue that reduction in world military spending would offer significant long-term benefits for private investment and private consumption, especially for developing countries. Depending on the structure of country's economy and the composition of her military expenditure, a reduction in military spending may have positive welfare effects on the populace through the primary impact of the reductions on national security (Olaniyi and Adam, 2003). In general, therefore, the defence sector may enhance the supply of skilled labour, thereby alleviating an important growth constraint. Conversely, however, it may compete for scarce human resources with the more productive civilian economy, thereby compromising the overall productivity and efficiency of the economy (Roux, 1994).

The bulk of research on the trade-off[5] between defence and social programmes has emanated from, and been applied to, industrialized nations. From the observation that there has generally been a trade-off of almost equivalent amounts between military expenditure and investment in developed countries, Smith (1980: 31-32) concludes that defence spending does not significantly affect the social wage (including education and health), the burden of higher defence outlays primarily falling on investment. However, in African countries, most of the researchers come to the general conclusion that military spending substitute for spending on other sectors of the economy. Gyimah-Brempong (1998, 1992), using simultaneous equation models and panel data, finds that there is a trade off between military spending on the one hand and spending on social services, investment in physical, and human capital, but not on social security on the other. Dunne and Mohammed (1995) also find that military spending in African countries substitute for investment in human and physical capital.

Griffin and McKinley (1992) are of the opinion that human capital development is a growth and development strategy intended to improve the well being of people in as short a time as possible. They believe that implementation of the strategy will require a change in the composition of government spending and that the percentage of the budget earmarked for activities, which do not contribute to development, should be reduced to a minimum. This includes spending on the military and internal security (which often have little to do with defending the state from external enemies), subsidies for some public enterprises (such as airlines, luxury hotels and breweries which cater primarily to upper income groups), excessively large bureaucracies in the public administration (which sometimes have been used to reduce unemployment among the urban educated youth) and external debt service (Griffin and McKinley, 1992).

The normative and traditional assumption is that governments of developing nations have displayed a greater willingness to reduce the social wage for human capital to accommodate an increase in defence expenditure. This willingness can be attributed to the virtual absence of institutional resistance (e.g. influential trade unions or consumer groups) to decreasing the social wage, together with a reluctance to reduce investment expenditure (Deger, 1986: 115). The implication is that increased defence spending in developing countries may have negative consequences for socio-economic development programmes such as education and health. This has been supported by economic theory (Fosu, 2001; 1999; 1996; Adebiyi, 2003 and Tomori and Adebiyi, 2002) as demonstrated in Appendix 1.

[5] The concept of trade-off is used to describe the way in which one policy area may gain at the expense of others in the allocation of scarce resources. There is a continuum of possible trade-off patterns. At one extreme, increases in defence expenditure may be entirely paid for by decreases in health or education expenditure, producing a negative trade-off effect. A positive trade-off would occur if defence spending increases are matched by increases in education or health spending.

111 Data and Methodology

This section presents the data set and the econometric framework, including vector autoregressive (VAR) Models.

The Data Set and Description

The data set for this paper consists of annual time series spanning 1970 through 2000. The variables under consideration are education expenditure, health expenditure, human capital expenditure, debt service obligations and defence spending, all expressed as percentage of total expenditure. The variables are obtained from Central Bank of Nigeria's *Statistical Bulletin* and *Economic and Financial Review*, various years.

Table 1 gives the description of variables used in the estimation. Education expenditure share averages 5.49 percent and varies from 0.50 percent to 11.4 percent. The debt-expenditure ratio averages 15.74 percent. It ranges from 1.41 percent to 53.06 percent and with a standard deviation of 14.93. Defence expenditure ranges from 2.59 percent to 14.68 percent, with a mean of 6.94 percent. Health expenditure, with a mean of 1.61 percent, also varies from a minimum of 0.29 percent to a maximum of 3.07 percent.

Table 1: Descriptive Statistics, 1970- 2000

	HEAEXP	DEBTEXP	DEFEXP	EDUEXP
Mean	1.612581	15.73903	6.941290	5.487097
Median	1.680000	10.29000	6.660000	5.200000
Maximum	3.070000	53.06000	14.68000	11.40000
Minimum	0.290000	1.410000	2.590000	0.500000
Std. Dev.	0.590288	14.92592	2.748329	2.865978
Observations	31	31	31	31

Notes: EDUEXP measures government education expenditure, expressed as the share of education expenditure in the government's total expenditure; DEFEXP is the ratio of defence expenditure to total expenditure; DEBTEXP is the external debt service obligations as a ratio of total expenditure; HEEXP indicates health expenditure, which is the ratio of health expenditure in the total government expenditure.
Sources: Central Bank of Nigeria, Statistical Bulletin, various issues.

Econometric Framework

This paper uses the forecast error variance decomposition and the impulse responses from estimated vector autoregressive models (VAR) to examine the effects of shocks to human capital expenditure. VAR models are the best method for investigating shock transmission among variables because they provide information on impulse responses (Adrangi and Allender (1998). Zellner and Palm (1974), Zellner (1979), and Palm (1983) show that any linear structural model can be written as a VAR model. Therefore, a VAR model serves as a flexible approximation to the reduced form of any wide variety of simultaneous structural models.

Let consider a bivariate AR (1) model. Let y_t be a measure of human capital expenditure on health or education and zt is the public expenditure like defence spending or debt service obligations. A VAR system can be written as follows

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = A_0 + A[L]\begin{bmatrix} y_{t-1} \\ z_{t-1} \end{bmatrix} + \begin{bmatrix} u_{yt} \\ u_{zt} \end{bmatrix}$$

A_0 is s vector of constants, A (L) a 2X2 matrix polynomial in the lag operator L, and u_{it} serially independent errors for i. Suppose the structural equations can be represented as follows

$$y_t = b_{10} - b_{12}z_t + b_{11}y_{t-1} + b_{13}z_{t-1} + u_{yt} \quad \text{.....(1)}$$

$$z_t = b_{20} - b_{21}y_t + b_{22}y_{t-1} + b_{23}z_{t-1} + u_{zt} \quad \text{.....(2)}$$

which can be rewritten as

$$y_t + b_{12}z_t = b_{10} + b_{11}y_{t-1} + b_{13}z_{t-1} + u_{yt} \quad \text{.....(3)}$$

$$z_t + b_{21}y_t = b_{20} + b_{22}y_{t-1} + b_{23}z_{t-1} + u_{zt} \quad \text{.....(4)}$$

and in matrix form

$$\begin{bmatrix} 1 & b_{12} \\ b_{21} & 1 \end{bmatrix}\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} b_{10} \\ b_{20} \end{bmatrix} + \begin{bmatrix} b_{11} & b_{13} \\ b_{22} & b_{23} \end{bmatrix}\begin{bmatrix} y_{t-1} \\ z_{t-1} \end{bmatrix} + \begin{bmatrix} u_{yt} \\ u_{zt} \end{bmatrix}$$

let

$$B = \begin{bmatrix} 1 & b_{12} \\ b_{21} & 1 \end{bmatrix}$$

$$Z = \begin{bmatrix} y_t \\ z_t \end{bmatrix}$$

$$V_0 = \begin{bmatrix} b_{10} \\ b_{20} \end{bmatrix}$$

$$V_1 = \begin{bmatrix} b_{11} & b_{13} \\ b_{22} & b_{23} \end{bmatrix}$$

which allows us to write a more compact form of the structural equation as

$BZ_t = V_0 + V_1 Z_{t-1} + u_{it}$

Assuming that B is invertible, we pre-multiply the equation by B^{-1} to obtain

$$Z_t = A_0 + A_1 Z_{t-1} + \varepsilon_{it} \quad \text{.....} \quad (5)$$

Where

$A_0 = B^{-1}V_0$

$A_1 = B^{-1}V_1$

and $\varepsilon_t = B^{-1}u_{it}$

Given the a_{ij} is the element of the i^{th} row and j^{th} column, we can now write our VAR in standard form.

$$y_t = a_{10} + a_{11}y_{t-1} + a_{12}z_{t-1} + \varepsilon_{yt} \quad \text{.....(6)}$$

$$z_t = a_{20} + a_{21}y_{t-1} + a_{22}z_{t-1} + \varepsilon_{zt} \quad \text{.....(7)}$$

and the matrix form,

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} a_{10} \\ a_{20} \end{bmatrix} + \begin{bmatrix} a_{11}\, a_{12} \\ a_{21}\, a_{22} \end{bmatrix} + \begin{bmatrix} \varepsilon_{yt} \\ \varepsilon_{zt} \end{bmatrix} \quad \text{.....(8)}$$

Note that the errors are a composite of two errors u_{yt} and u_{zt} since $\varepsilon_t = B^{-1}u_{it}$ i.e.

$$\begin{bmatrix} \varepsilon_{yt} \\ \varepsilon_{zt} \end{bmatrix} = \begin{bmatrix} 1 & b_{12} \\ b_{21} & 1 \end{bmatrix}^{-1} \begin{bmatrix} u_{yt} \\ u_{zt} \end{bmatrix}$$

so that

$$\varepsilon_{yt} = \frac{u_{yt} - b_{12}u_{zt}}{1 - b_{12}b_{21}} \quad \text{.....(9)}$$

$$\varepsilon_{zt} = \frac{u_{zt} - b_{21}u_{YT}}{1 - b_{12}b_{21}} \quad \text{.....(10)}$$

Since the u_{it}s are white noise, so are the ε_ts.

From Equations 9 and 10, we can see that policy errors can be caused by exogenous y and policy disturbances. Let $\sum_u$ be the 2X2 variance-covariance matrix of u_{it} and $\sum_\varepsilon$ that of ε_{it}. Then $\sum_\varepsilon = B \sum_u B^{1.}$ To determine the impact of policy on output, we need to look at the effect of u_{zt} but unless $b_{21} = 0$, ε_{zt} is not equal to u_{zt} and therefore does not provide a measure of the policy shock. If we estimate our VAR in Equations 6 and 7 as it is, B and $\sum_u$ will not be identified without further restrictions since estimation of the reduced form in Equations 6 and 7 will yield less parameters than the structural form in Equations 1and 2. One of the most common restrictions is to assume that the structural shocks are uncorrelated so that the off diagonal elements in the covariance matrix are zero (Simatele, 2003; Bernanke and Blinder, 1992).

Two results obtained from VARs that are useful for analyzing transmission mechanisms are impulse response functions and forecast error variance decompositions. The impulse responses tell us how macro variables respond to shocks in the policy variables, while the variance decompositions show the magnitude of the variations in the macro variables due to the policy variables.

If we assume a stable system (like Simatele, 2003), we can iterate Equation 5 backwards and let n approach infinity and solve to obtain

$$Z_t = \lambda + \sum_{i=0}^{\infty} A_1^i \varepsilon_{t-i}$$

Where the λs are the means of y_t and z_t and use Equation 8 to get

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} \mu_y \\ \mu_z \end{bmatrix} + \frac{1}{1-b_{12}b_{21}} \sum_{i=0}^{\infty} \begin{bmatrix} a_{11}\, a_{12} \\ a_{21}\, a_{22} \end{bmatrix} \begin{bmatrix} 1 & -b_{12} \\ -b_{21} & 1 \end{bmatrix} \begin{bmatrix} u_{yt} \\ u_{zt} \end{bmatrix} \text{.....(11)}$$

We define the 2X2 matrix as F (i) with elements F_{jk} (i) such that

$$\text{F(i)} = \frac{A_1^i}{1-b_{12}b_{21}} \begin{bmatrix} 1 & b_{12} \\ b_{21} & 1 \end{bmatrix}$$

and we write in moving average form as

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} u_y \\ u_z \end{bmatrix} + \sum_{i=0}^{\infty} \begin{bmatrix} F_{11}(i) F_{12}(i) \\ F_{21}(i) F_{22}(i) \end{bmatrix} \begin{bmatrix} u_{yt-1} \\ u_{zt-1} \end{bmatrix}$$

or in a more compact form

$$Z_t = \mu + \sum_{i=0}^{\infty} F(i) u_{t-i} \text{ ……(12)}$$

F_{jk}(i) are the impulse response functions. As we vary (i), we get a function describing the response of variable j to an impulse in variable k (Simatele, 2003).

To derive the forecast error variance decompositions, let us use Equation 12 to make a forecast of z_{t+1}. The one step ahead forecast error is $Fu_{t+1}$and in general the n-period forecast error $Z_{t+n} - E_t Z_{t+n}$ is

$$Z_{t+n} - E_t Z_{t+n} = \sum_{i=0}^{\infty} F(i) u_{t+n-i} \text{.....(13)}$$

and the mean square error (MSE)

$$(Z_{t+n} - E_t Z_{t+n})^2 = \sigma_z^2 \sum_{1=0}^{\infty} F(i) \text{ ……..(14)}$$

where σ_z^2 is the variance of z_{t+n}.

To show that the decomposition more explicitly, let us narrow down on y_t

$$y_{t+n} - Ey_{t+n})^2 = \sigma_y^2 \sum F(i)^2 \text{.....(15)}$$

The share of σ_z^2 due to u_{yt} and u_{zt} are

$$\frac{\sigma_y^2 [F_{11}(0)^2 + F_{11}(1)^2 + ... + F_{11}(N-1)^2]}{\sigma_Y^2 (n)^2} \text{.....(16)}$$

$$\frac{\sigma_z^2 [F_{11}(0)^2 + F_{11}(1)^2 + ... + F_{11}(N-1)^2]}{\sigma_Y^2 (n)^2} \text{.....(17)}$$

Since the variance decomposition tells us the share of the total variance attributed to a given structural shocks, for an exogenous sequence y, u_{zt} will not explain any of the forecast error variance of y_t.

In using VAR model, the selection of lag order is very essential. Without a formal method, the selection of lag order in a VAR model will be arbitrary and could lead to specification error (see Fair and Schiller, 1990; Funke, 1990). Several criteria, similar to those used in the distributed lag models, are suggested to determine the model dimension (see Judge, et al., 1985; Lutkepohl, 1985).

1V Policy and Sensitivity Analyses

Unit Root Tests

In the literature, most time series variables are non-stationary and using non-stationary variables in the model might lead to spurious regressions (Granger 1969). The first or second differenced terms of most variables will usually be stationary (Ramanathan 1992). All the variables are tested at levels for stationarity using the Augmented Dickey-Fuller (ADF) and Phillip-Perron tests. The test reveals that all the variables are not stationary at levels except education expenditure (using both tests) and health expenditure (using Phillip-Perron test). However, they are stationary at first-order difference (see Table 2).

Table 2:Unit Root Test Using Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) Tests: 1970-2000.

Variables	At Level	95% Critical Level	Order of integration		At level	95% Critical Level	Order of integration	
DEBTEXP	-1.61	-3.57	I (2)		-1.92	-3.56	I (1)	
EDUEXP	-3.83*	-3.57	I (1)		-3.95*	-3.56	I (1)	
HEAEXP	-3.36	-3.57	I (1)		-5.51*	-3.56	I (1)	
DEFEXP	-2.82	-3.57	I (1)		-3.38	-3.56	I (1)	

Notes: Variables are as defined in Figure 1
*Significant at 5 per cent level
Source: Own Computations

Co-integration Test and Results

Co-integration tests are conducted by using the reduced rank procedure developed by Johansen (1988) and Johansen and Juselius (1990). This method should produce asymptotically optimal estimates since it incorporates a parametric correction for serial correlation. The nature of the estimator means that the estimates are robust to simultaneity bias, and it is robust to departure from normality (Johansen, 1995). Johansen method detects a number of cointegrating vectors in non-stationary time series. It allows for hypothesis testing regarding the elements of co-integrating vectors and loading matrix.

Johansen procedure is used to determine the rank *r* and to identify a long-run relationship. The number of lags used in the VAR is based on the evidence provided by the Akaike Information Criteria. However, in the case of serial correlation, sufficient numbers of lags are introduced to eliminate the serial correlation of the residuals. The co-integration tests include education expenditure (EDUEXP), health expenditure

(HEAEXP), defence expenditure (DEFEXP) and debt service obligations (DEBTEXP), which includes seven lags in the VAR.
Table 3 reports the estimates of Johansen procedure and standard statistics.

Table 3: Johansen Co-Integration Test

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	Hypothesized No. of CE(s)
0.54	49.83	47.21	None*
0.46	27.61	29.68	At most 1
0.25	9.94	15.41	At most 2
0.05	1.43	3.76	At most 3

NOTES: VAR includes seven lags on each variable and a constant term. The estimation period is 1986:1-2002:4. None of the deterministic variable is restricted to the co-integration space; Likelihood ratio is trace test statistics, adjusted for degrees of freedom. The critical values are taken from Osterwald-Lenum (1992). The * indicates rejection of likelihood ratio tests at 5%significance level. L.R. test indicates 1 co-integrating equation at 5% significance level.

In determining the number of co-integrating vectors, we used the degrees of freedom, adjusted version of trace statistics, given the existence of small samples with too many variables or lags. Johansen procedure tends to over estimates the number of co-integrating vectors. The test statistics strongly reject the null hypothesis of no co-integration in favour of one co-integration relationship.

Correlation Matrix

Table 4 provides the correlation matrix. According to the Table, negative correlation exists between health expenditure and defence expenditure (-0.43). Also, public expenditure, which is the summation of defence and debt service obligations, has a negative correlation with health expenditure (0.07). Also, a positive correlation exists between education expenditure and health expenditure (0.10). This may be due to the possibility of spin-off effect of education on health. The strong complementarities between expenditures on health and education are a case here. Students who enjoy good health, for example, also benefit from an increased ability to learn. At the same time, people who enjoy a good education also are likely to know how best to maintain good health. Hence a reallocation of public expenditure to both primary health care and primary education can have a beneficial impact on each area of activity, which is mutually reinforcing.
Moreover, human capital expenditure and public expenditure have a positive correlation (0.148).
However, correlation should not be seen as causality. The correlation between two totally unrelated series could be strong while causality between the same variables may be non-existent. Therefore, in another part of paper, we perform formal tests of causality in addition to reporting simple correlation coefficients between two variables.

Table 4: Correlation Matrix, 1970- 2000

	HEAEXP	DEBTEXP	DEFEXP	EDUEXP	HCE	PUBEXP
HEAEXP	1.000000	0.013328	-0.432822	0.101730	0.295487	-0.071372
DEBTEXP	0.013328	1.000000	-0.492365	0.130605	0.128060	0.985002
DEFEXP	-0.432822	-0.492365	1.000000	0.138361	0.047262	-0.334800
EDUEXP	0.101730	0.130605	0.138361	1.000000	0.980450	0.168822
HCE	0.295487	0.128060	0.047262	0.980450	1.000000	0.148008
PUBEXP	-0.071372	0.985002	-0.334800	0.168822	0.148008	1.000000

Note: Public expenditure (PUBXEP) is the summation of defence spending and debt service obligations while human capital expenditure (HCE) is the addition of education and health expenditure. Other variables are as defined in Table 1

Pairwise Granger Causality Test

Pairwise Granger Causality test between human capital expenditure and defence spending, including debt service obligations are examined in Table 5. The Pairwise Granger causality tests were inconclusive at 5 per cent level of significance. The results alternated between bi-directional, no causality and uni-directional, depending on the lag length allowed. The outcome in respect of one-lag length is presented in Table 5. The Table reveals that debt-service obligations Granger cause human capital and education expenditure. That is debt service obligations determine human capital such as education expenditure. Moreover, defence spending is Granger-caused by health expenditure. It is also noted that public expenditure (both defence spending and debt service obligations) Granger-causes human capital expenditure, such as education expenditure.

Table 5: Pairwise Granger Causality Test.

Sample: 1970 2000
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
DEBTSER does not Granger Cause HCE	30	0.00331	0.95453
HCE does not Granger Cause DEBTSER		3.72794	0.06407
DEF does not Granger Cause HCE	30	0.02063	0.88686
HCE does not Granger Cause DEF		0.19325	0.66372
EDU does not Granger Cause HCE	30	1.27976	0.26789
HCE does not Granger Cause EDU		1.18546	0.28587
HEALTH does not Granger Cause HCE	30	1.27976	0.26789
HCE does not Granger Cause HEALTH		1.85798	0.18412
PUBEXP does not Granger Cause HCE	30	0.00834	0.92791
HCE does not Granger Cause PUBEXP		4.93804	0.03484
DEF does not Granger Cause DEBTSER	30	0.13600	0.71517
DEBTSER does not Granger Cause DEF		1.05261	0.31401
EDU does not Granger Cause DEBTSER	30	3.45873	0.07385
DEBTSER does not Granger Cause EDU		0.00420	0.94880
HEALTH does not Granger Cause DEBTSER	30	0.35676	0.55529
DEBTSER does not Granger Cause HEALTH		0.09827	0.75633
PUBEXP does not Granger Cause DEBTSER	30	0.13600	0.71517

DEBTSER does not Granger Cause PUBEXP		0.01222	0.91278
EDU does not Granger Cause DEF	30	0.29131	0.59381
DEF does not Granger Cause EDU		0.22192	0.64136
HEALTH does not Granger Cause DEF	30	0.22578	0.63849
DEF does not Granger Cause HEALTH		5.58620	0.02556
PUBEXP does not Granger Cause DEF	30	1.05261	0.31401
DEF does not Granger Cause PUBEXP		0.01222	0.91278
HEALTH does not Granger Cause EDU	30	1.18546	0.28587
EDU does not Granger Cause HEALTH		1.85798	0.18412
PUBEXP does not Granger Cause EDU	30	0.02693	0.87087
EDU does not Granger Cause PUBEXP		4.66407	0.03985
PUBEXP does not Granger Cause HEALTH	30	0.53825	0.46948
HEALTH does not Granger Cause PUBEXP		0.37338	0.54628

Source: Own Computations

Forecast Error Variance Decomposition

An examination of the short-run dynamic properties of human capital expenditure is further supplemented by forecast error variance decomposition and generalized impulse response analysis. Forecast error variance decomposition (FEVD), provides complementary information on the dynamic behavior of the variables in the system. It is possible to decompose the forecast variance into the contributions by each of the different shocks. When calculated by the structural shocks, as in the present case, the FEVD provides information on the importance of various structural shocks explaining the forecast error variability of human capital expenditure and its determinants.

Table 6 presents the FEVD of the four endogenous variables. By definition, the variance decomposition shows the proportion of forecast error variance for each variable that is attributable to its own innovation and to innovation in the other endogenous variables. "Own shocks" constitute the predominant source of variation in human capital expenditure forecast errors (see Table 6.1). The variation ranged from 96.8 per cent to 100 percent over the ten-year horizon. The innovations of defence expenditure and debt service obligations account for the forecast error variance of human capital expenditure ranged from 0 to 2.7 percent and 0 to 0.5 percent respectively. The persistence of human capital expenditure shocks after ten quarter of the shocks explains 97% of the variance of human capital, while debt service obligations and defence spending account for just 3%.

Table 6: Variance Decomposition

Table 6.1: Variance Decomposition of Human Capital Expenditure (HCE)

Period	S.E.	HCE	DEBTEXP	DEFEXP
1	2.648108	100.0000	0.000000	0.000000
2	2.707461	98.07747	0.261385	1.661143
3	2.718064	97.46711	0.304419	2.228476
4	2.724951	97.04831	0.447691	2.504003
5	2.729138	96.92893	0.463381	2.607694
6	2.730361	96.88100	0.463232	2.655764
7	2.730610	96.86920	0.466333	2.664465
8	2.730775	96.85796	0.476084	2.665952

9	2.730922	96.84764	0.486449	2.665911
10	2.731047	96.83914	0.495181	2.665675

Note: Variables are as defined in Table 1
Source: Own Computations

When human capital expenditure is decomposed into health and education, the variance error decomposition of health and education varies. The persistence of health expenditure shocks after ten quarter of the shocks explains 53% of the variance of health expenditure, while debt service obligations and defence spending account for 13% and 28% respectively (see Table 6.2).

Table 6.2:Variance Decomposition of Health Expenditure (HEAEXP)

Period	S.E.	DEBTSER	DEF	EDU	HEALTH
1	0.451230	4.651274	8.360160	5.227753	81.76081
2	0.491086	8.301667	13.51805	5.746688	72.43359
3	0.541082	7.306247	27.41602	5.223701	60.05403
4	0.551053	7.045094	28.75838	6.294311	57.90222
5	0.560673	7.993697	29.18555	6.809618	56.01113
6	0.564683	8.892780	29.08714	6.713411	55.30667
7	0.569448	10.21743	28.62859	6.642923	54.51105
8	0.573811	11.33208	28.19758	6.636573	53.83377
9	0.577420	12.16416	27.84653	6.630672	53.35864
10	0.579906	12.71146	27.61303	6.617492	53.05802

Note: Variables are as defined in Table 1
Source: Own Computations

"Own shocks" constitute the predominant source of variation in education expenditure forecast errors (see Table 6.3). The variation ranged from 85 per cent to 99 percent over the ten-year horizon. The salient feature of the variance decomposition results is that the predominant sources of human capital expenditure fluctuations, particularly health expenditure, are due largely to own shocks, and, to a lesser extent, to defence expenditure and debt service obligations. In sum, the forecast error variance decomposition shows that the innovations of debt service obligations and defence spending can be better predictors of health expenditure in Nigeria

Table 6.3: Variance Decomposition of Education Expenditure (EDUEXP)

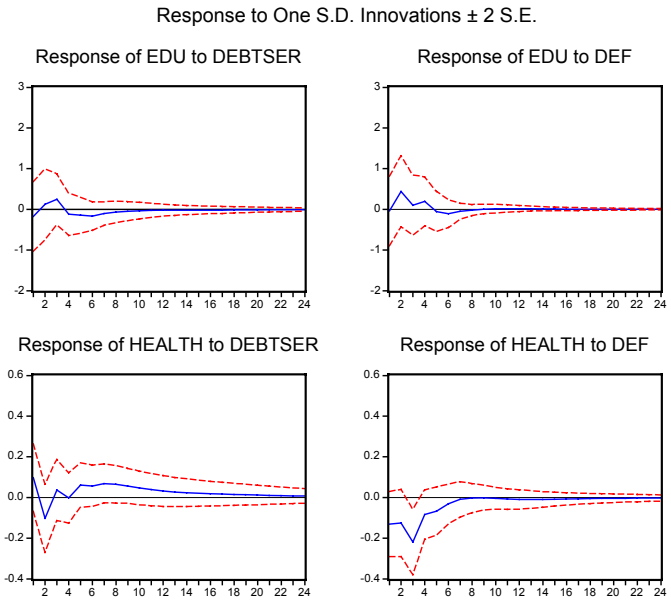
Period	S.E.	DEBTSER	DEF	EDU	HEALTH
1	2.310061	0.566281	0.029746	99.40397	0.000000
2	2.518107	0.704436	3.064527	88.84986	7.381172
3	2.537316	1.625786	3.175965	87.51708	7.681171
4	2.564500	1.809296	3.675766	86.24023	8.274707
5	2.571187	2.120584	3.698635	85.94311	8.237666
6	2.579779	2.529678	3.845213	85.37677	8.248335
7	2.583653	2.688039	3.870885	85.13735	8.303722
8	2.585400	2.748052	3.871200	85.05788	8.322864
9	2.586111	2.779399	3.869759	85.02477	8.326072
10	2.586509	2.796553	3.872500	84.99998	8.330969

Note: Variables are as defined in Table 1
Source: Own Computations

Impulse Response Functions

The impulse response functions are reported in Figure 1. Impulse response analysis is a device to display the dynamics of the variables tracing out the reaction of each variable to a particular shock at time t. Figure 1 shows the results of the impulse response analyses derived from the estimated VAR models.

Figure 1: Impulse Response to One S.D. Innovations



Source: Own Computations.

Figure 1: Generalized Impulse Response Human Capital Expenditure to one S.E shock in its explanatory Variables. The Size is 5%

According to Figure 1, a positive debt service obligations shocks affect health expenditure only in the short run as health expenditure reduces significantly within the first two periods. These results of the impulse responses of health expenditure shocks are consistent with economic theory, where a negative relationship is expected. The impulse responses show that increase in debt service obligations will reduce expenditure available for health in the short run. However, defence spending shocks increase education expenditure in the short-run. Roux (1994) shows that education and defence programmes may increase in tandem with one another because both are supported by relatively strong interest groups. Hence, demands by well-organised education groups for increased education spending are matched by similar demands by powerful military groupings. As a result, both education and defence budgets benefit at the expense of socio-economic activities that are free from organizational pressure (Verner, 1983: 87-88). Also, the military can be an effective instrument in mobilizing human resources by promoting a disciplined work ethic and fostering basic work skills. Benoit (1973) has also postulated that technical training is a vital element of military service and thus augments the skill content of the existing labour force.

Also, defence spending shocks apparently reduces health expenditure in the short-run significantly. This relationship was succinctly expressed by Roux (1994): "as far as research and development is concerned… defence spending has a negative impact on non-defence research and development, thereby draining the economy of key resources, inhibiting its innovative abilities and militating against productivity, growth and international competitiveness"

It is also observed that there is no long-run impact of either debt service obligations or defence spending shocks on human capital expenditure. It implies that, in the long run, government can determines defence spending or debt service obligations independent of human capital expenditure. However, it appears that, in the short run, debt service obligations and defence spending shocks are crucial factors in explaining human capital expenditure in Nigeria, particularly in the health sector.

V Summary and Conclusions

In this study, we set out to empirically investigate the direction of causality between human capital (i.e. Education and health) expenditure and defence spending including debt service obligations in Nigeria, using annual time series data from 1970 to 2000. Some statistical tools are employed to explore the relationship between these variables. The study examines stochastic characteristics of each time series by testing their stationarity using Augmented Dickey Fuller (ADF) and Phillip Perron (PP) tests. Then, the effects of stochastic shocks of each of the endogenous variables are explored, using Vector Autoregressive (VAR) model.

The evidence from the Granger causality tests shows that, in Nigeria, debt service obligations Granger-cause human capital such as education expenditure. That is debt service obligations determine human capital expenditure including education.

The salient feature of the variance decomposition results is that the predominant sources of human capital expenditure fluctuations are due largely to own shocks, and, to a lesser extent, to defence expenditure and debt service obligations. The forecast error variance

decomposition shows that the innovations of debt service obligations and defence spending can be better predictors of health expenditure in Nigeria.

From impulse response analysis, also, the results are mixed in Nigeria. While, public expenditure such as defence spending and debt service obligations shocks apparently reduce health expenditure in the short-run significantly, they increase education expenditure in the same period.

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Appendix 1

Following the works of Fosu (2001) and Adebiyi (2003), we can classify public expenditure into two- human capital and non-human expenditure. The government is assumed to choose levels of human capital expenditure, H, and non-human capital expenditure, B, in order to maximize a social-welfare (utility) function. The objective function to be maximized is

$$U(H, B) \quad \text{----------(1)}$$

subject to the budget constraint

$$H + B = C \quad \text{----------(2)}$$

where C denotes government revenue, which may be represented as

$$C = X + Y + Z - D \quad \text{----------(3)}$$

where X is tax revenue, Y domestic non-tax revenue, Z external aid, and D debt service or defence expenditure.
The first-order conditions are

$$Uh = Ub, \text{ and} \quad \text{----------(4)}$$

$$H + B = C = X + Y + Z - D \quad \text{----------(5)}$$

where Uh and Ub are the marginal utilities of expenditures of human capital and non-human capital commodities respectively. If the social welfare function has the usual properties of strict quasi-concavity, then the second-order conditions are satisfied, that is:

$$Uhh < 0, \quad Ubb < 0, \text{ and } UhhUbb > Uhb \quad \text{----------(6)}$$

where Uhh, Ubb and Uhb are the second-order partial utilities.
Hence, by use of the Implicit Function Theorem, we can write the demand function

$$H = H(C) \quad \text{----------(7)}$$

Where C is assumed to be exogenous.
We explore the response of human capital (H) to revenue (C), in particular, the change in H following a change in debt service or defence spending (D), ceteris paribus. Assuming that H is a normal good, then from equation (7), $dH/dC > 0$.
Further, $dC/dD < 0$, according to equation (5). Thus, $dH/dD < 0$. That is, we expect the (partial) effect of debt service or defence spending on human capital expenditure (H) to be negative.