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Human Capital Development in Nigeria: A Granger Causality Dynamic Approach

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ABSTRACT

The paper explores the causal relationships between economic growth and some human capital variables such as total school enrollment, real capital expenditure on education, real recurrent expenditure on education, real capital stock and total labour force in Nigeria. The basic idea of Granger causality analysis is to find-out whether past values of human capital development variable help to explain current values of economic growth. Multivariate causality tests were performed in a vector autoregression (VAR) model. The analysis also make use of the techniques variance decompositions (VDCs) and impulse response functions (IRFs) to unveil Granger causality in human capital development activity in a dynamic context. In the short-run, variables total school enrollment and real recurrent expenditure on education stand out econometrically exogenous. In the empirical period, these variables were relatively the leading variables. They were initial receptors of exogenous shocks to the long run equilibrium. The causal relationships detected among the variables indicate that economic growth is neutral in the short run.

Keywords: Economic growth, granger causality, human capital development, Nigeria. Real gross domestic product, real capital expenditure, real recurrent expenditure, labour force, real capital stock, total school enrollment

INTRODUCTION

One of the key tasks in empirical development economics is to investigate the significance of human capital development[1] shocks to economic growth. In this study, the main objective is to examine the causal relationship between economic growth and human capital variables such as real capital stock, total school enrollment, real capital expenditure on education, real recurrent expenditure on education and total labour force. Different economists have postulated various types of relationships between human capital development and economic growth. Base on Fagerlind and Saha (1997), human capital theory give a rational explanation for large government expenditure on education in developing and developed nations. The theory is in tune with the philosophy of democracy and liberal progression preeminent in most Western societies. Its report is based on the supposed economic return of investment in education both at the macro and micro levels. Measures and efforts to encourage investment in human capital yields rapid economic growth for society; this investment is seen to provide returns in the form of individual economic status and achievement.

The economic success and performance of a nation depend on its accumulation of physical and human capital stock. Where physical capital has traditionally been the focus of economic research, factors affecting the development of human skills and talent are increasingly featured in the research of behavioral and social sciences. In broad terms, human capital stand for the investment people makes in themselves that enhance their economic productivity.

The theoretical framework mainly responsible for the wholesome acceptance of development and education policies is now known as human capital theory. Based on the study by Harrod (1939), Domar (1946), Solow and Swan (1956), Lewis (1956), Schultz (1971), Harbinson (1973), Mincer (1973) and Romer (1989), human capital theory rests on the hypothesis that formal education is greatly helpful and even necessary to improve the productive ability of a population. As a matter of fact, human capital theorists argue that an educated population is a productive population.

[1] In this case of human capital development we concentrated on the education and public expenditure aspect of development.

Human capital theory highlights how education increases the efficiency and productivity of workers by increasing the level of accumulating stock of economic productive human capability, which is a product of investment in human beings and their inborn abilities. The proviso of formal education is taken as a productive investment in human capital in which the theory proponents have considered as equally or even more valuable than that of physical capital. Babalola (2003), states that the justification for investing in human capital is based on three premises:

i. The new generation should be granted the right part of the knowledge which has already been accrued by older generations;
ii. New generation must be educated on how existing knowledge should be used to develop new technologies, to come up with new processes, production methods and social services;
iii. Individual should be inspired to develop entirely new technologies, ideas, processes, products and methods through innovative approaches.

Generally, economists concur that it is the human resources of a country and not its material or capital resources that eventually determine the character and pace of its social and economic development. Psacharopoulos and Woodhall (1997) assert that:

> *"Human resources constitute the ultimate basis of wealth of nations. Capital and natural resources are passive factors of production. Human beings are the active agencies that accumulate capital, exploit natural resources, build a social, economic and political organization, and carry forward national development".*

The causal chain (between economic growth and human capital development) implied by the existing macroeconomic paradigms seems relatively ambiguous. The subject, therefore, as to the dynamic causal relationships (even in the Granger temporal sense rather than in the structural sense) remains uncertain and is a practical one.

The general idea of Granger causality analysis is to check if the past values of economic aggregate can explain current values of output (Granger, 1969). There are three different ways to carry out this sort of test, there are: Basic Granger causality tests, Granger causality tests in a vector autoregression (VAR) and multivariate causality tests.

The basic Granger causality[2] test works in an equation with two variables as well as their lags (autoregressive distributed lag models). It tests whether the lags of the lagged human capital development variables are equal to zero. If we can reject this hypothesis, it is therefore, said that human capital development granger causes economic growth. In order to empirically determine the problem of the direction of causation in a bivariate context, various causality[3] tests were applied (the standard Granger, 1969 test, or Sims, 1972 and Geweke et al, 1983).

Various studies applying these tests suffered from the following methodological deficiencies:

i. These standard tests did not take into account the basic properties of the variables. If there is cointegration[4] among the variables, then all the tests that included differenced variables will be wrongly estimated, unless the lagged error correction term is incorporated (Granger, 1988).
ii. The tests utilize the series stationary mechanically by first differencing the variables and consequently, get rid of the long-run information embodied in the original level form of the variables. The vector error correction (VEC) model takes the difference of the data so as to achieve stationary and use an error correction term to substitute the long-run information lost during differencing. The error-correction term highlights the short-run adjustment to long-run equilibrium trends. Besides that it opens up the additional channel for Granger-causality so far ignored by the standard causality tests.

The idea is still the same for the case of simple Granger causality tests, except that now the impact of other variables can influence the test results. Finally, in vector autoregression (VAR) there are Granger-causality tests taking place. In this case, the multivariate model is extended to give room for the simultaneity of all included variables.

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[2] Granger causality is defined as the existence of feedback from one variable to another. Granger non-causality is defined as nonexistence of such feedback.

[3] Causality is a subject of great debate among economists: for example, refer to Zellner (1988). Without intruding the debate, we like to state clearly that the concept of causality is in the stochastic or 'probabilistic' sense rather than in the philosophical or 'deterministic' sense. As well as the concept is in the Granger 'temporal' sense rather than in the 'structural' sense.

[4] Two or more variables are said to be cointegrated, if there exist long-run equilibrium relationship(s) among them, i.e. they share common trend(s).

The aim of this study is to examine the dynamic causal relationships between economic growth and human capital variables such as total school enrollment, real capital expenditure on education, real recurrent expenditure on education, real capital stock and total labour force for a developing economy such as Nigeria during the period 1970-2008.

This study will be examined in a multivariate framework and within the environment of a vector error-correction model (VECM). Variance decomposition and impulse response functions will also be use to show Granger causality in human capital development activity in a dynamic context. The error correction terms obtained from the cointegrating vectors are from the Johansen's multivariate cointegration test procedure (Johansen (1988) and Johansen and Juselius (1990)). There are used as an additional means to identify Granger causality. Since this process recognizes multiple cointegrating relationships, hence error correction terms, this is a central issue in Granger causality testing in a dynamic multivariate context.

EMPIRICAL EVIDENCE OF HUMAN CAPITAL MODEL

The significance of education and human capital has been emphasized in various studies of economic growth and development. Robert (1991) developed a human capital model that revealed that education and the creation of human capital was accountable for both the differences in labour productivity and the differences in overall levels of technology that we observe in the world. Given the contribution of education around the world, it is the impressive growth in East Asia that has raised the current popularity of education and human capital in the field of economic growth and development. Hong Kong, Malaysia, Singapore, South Korea and Taiwan among other countries have achieved extraordinary rates of economic growth by making huge investments in education. From his study, the World Bank found that expansion in education is an important explanatory variable for East Asian economic growth.

There are numerous ways of modeling how the huge expansion of education accelerates economic growth and development. The first step is to take education as an investment in human capital. A further reason why education is important for the success of an economy is that it has positive externalities. "Give education to a part of the society and the whole will benefits," The initiative that education generates positive externalities is not new. Many of the classical economists argued strongly for government's role in education on the premises that countries would profit more from the positive externalities of an educated labour force and society at large (Van-Den-Berg 2001). The externalities from education are of central necessity to the proper running of an economy and an independent state as well (Smith 1976).

A different technique of modeling the role of education in the growth and development process is to take human capital as a vital input for innovations, research and development activities. From this point of view, education is seen as an intended effort to augment the resources needed for creating new ideas. Thus, any increase in education will directly speed up technological progress. This modeling approach typically follows the Schumpeter (1973) assumptions of imperfect competitive product markets and competitive innovation that allow for the process of generating technological progress. Education is taken to be a factor input in planned and entrepreneurial efforts to establish new technology and come up with new products. Proponents of this view of education highlight the strong correlation between new product development and levels of education. Van-Den-Berg (2001) the countries with the most educated population are the leaders of technologies.

Since there is convincing facts about the positive relationship between initial human capital levels and economic growth; and (weaker) empirical support for the relationship between changes in human capital and economic growth, it is not at all clear that this implies a causal relationship running from human capital to economic growth. Driven by the fact that within 30 years schooling has increased greatly, while the rate of productivity slowdown became patent in most of the high income economies; Bils and Klenow (2000) suggest that the causal direction may run from growth to schooling. Of which the relationship would be determined by a Mincerian model in which high expected growth leads to lower discount rates among the population as well as higher level of demand for schooling. It is true that both variables could be motivated by other factors. Given the results of different empirical tests, Bils and Klenow concluded that the connection from schooling to growth is extremely weak at explaining the strong positive relationship found by Barro (1991), and Barro and Lee (1993), as described above. However, they argue that the "growth to schooling" connection has the ability of generating a coefficient of the magnitude.

ECONOMETRIC METHODOLOGY

Step 1: Unit root test

The general procedure when dealing with time series in economics is to test for the existence of a unit root to detect non-stationary behavior. We employ two of conventional unit root tests as the Augmented Dickey-Fuller test (ADF) (Dickey and Fuller 1979 and 1981), and the Phillips-Perron (1988) test (PP). Unit root tests are usually conducted first to establish the stationary properties of the time series' data.

Stationary entails long-run mean reversion and determining a series stationary property prevents spurious regression, which will occur when we regress time series data set having unit roots into one another. The existence of non-stationary variables leads to spurious regressions, which will produce high R^2 and significant *t*-distribution results even though the two variables are independent. This could lead to untrue inferences and wrong policy implications. The Augmented Dickey Duller (ADF) test is used for this purpose with the critical values computed by MacKinnon, which allows for calculation of ADF critical value for any number of regressors and sample size.

In order to ascertain the stationary status of each variable for each time series of the sample, the Augmented Dickey–Fuller (ADF) test is employed as well as Phillip-Perron. The ADF model used is given as follows:

$$\Delta Y_t = \alpha_1 + \gamma Y_{t-1} + \alpha_2 t + \sum_{i=1}^{p} \beta_1 \Delta Y_{t-1} + \varepsilon_t \quad (1)$$

Where $\gamma = (1 - \sum_{i=0}^{n} \alpha_1)$, $\beta_1 = \sum_{i=0}^{n} \alpha_j$, and Y_t represent the natural logarithm of RGDP, α_0 is the intercept term, γ is the coefficient of interest in the unit root test, β_1 is the parameter of the lagged first difference of Y_t, to better represent the ρth-order autoregressive process, and ε_t is the white noise error term.

Step 2: Cointegration and granger causality

The cointegration technique initiated by Engle and Granger (1987), Hendry (1986) and Granger (1986) made a major contribution towards testing Granger causality. According to this method, when two variables are cointegrated, without any causality in either direction, one of the possibilities with the standard Granger and Sims tests is excluded. So long as two variables share a common trend, causality (not in the structural sense but in the Granger sense), must exist in at least one direction, (Granger, 1988, Miller and Russek, 1990). This Granger (or temporal) causality can be detected using the vector error correction model (VECM) derived from the long-run cointegrating vectors[5].

Step 3: Vector error correction modelling (VECM) and exogeneity

Engle and Granger (1987) showed that once a given number of variables (say X_t and Y_t) are found to be cointegrated, there always exists a corresponding error correction representation which entails that variations in the endogenous variable are a function of disequilibrium in the cointegrating relationship (captured by the error correction term) as well as changes in other explanatory variables(s). A consequence of ECM is that either DX_t or DY_t or both must be caused by e_{t-1} (the equilibrium error) that is itself a function of xt^t-1 and yt^t-1. Intuitively, if X_t and Y_t have a common trend, then the current change in Y_t (say dependent variable) is partly the result of Y moving into alignment with trend^t value of X (say independent variable). Through the error-correction term, the ECM opens an additional channel for Granger causality (ignored by standard Granger and Sims tests) to emerge. The statistical significance of the F-tests applied to the joint significance of the sum of the lags of each explanatory variable and/or the t-test of the lagged error-correction term(s) will indicate the Granger causality (or

[5] Given a system of unrestricted reduced form equations, the VAR model has been criticized by Cooley and Le Roy (1985). Runkle (1987) is a good illustration of the disagreement surrounding this methodology. It is controversial if the technique of identification used by the simultaneous structural model which usually relies on many abridged assumptions and subjective exclusion restrictions together with the related exogenous-endogenous variables' classification (which are usually untested), is advance compare to the identification procedure used in the VAR model. The critics of VAR, however, agreed that there are important uses of the VAR models. For example, McMillan (1988) points out that VAR models are exceptionally helpful in the case of 'forecasting, analysing the cyclical behaviour of the economy, the generation of facts about the behaviour of the elements of the system which can be compared with existing theories or can be used in formulating new theories, and testing of theories that generate Granger causality implications.'

endogeneity of the dependent variable). The non-significance of the t-test(s) and F-tests in the VECM will imply econometric exogeneity of the dependent variable.

The t-tests of the 'differenced' independent variables indicate the presence of the 'short-term' causal effects, strict exogeneity of the variables. However, the significance of the lagged error-correction term(s)[6] will show the 'long-term' causal relationship. The lagged error-correction term coefficient is a short-term adjustment coefficient and stand for the proportion by which the long-term disequilibrium (or imbalance) in the dependent variable is being corrected in each short period. The exclusion or insignificance of any of the lagged error-correction terms affect the implied long-term relationship and may be a violation of theory. The insignificance of any of the 'differenced' variables, that reflect only the short-term relationship, does not entail such a violation because the theory in general does not say anything about short-term relationships, (Thomas, 1993).

Step4: Variance decompositions (VDCs) and relative exogeneity

The f-test[7] and t-tests in VECM are interpreted as within sample causality tests. They can show only the Granger causality of the endogenous variable within the sample period. They present little evidence on the dynamic properties of the system, the degree of exogeneity or the relative strength of the Granger causal chain or among the variables.

By separating the variance of the forecast error of a given variable into the proportions attributable to shocks or innovations in the entire variable in the system, as well as its own, the variance decompositions (VDCs), can provide an indication of these relativities. Bessler and Kling (1985), VDCs[8] can be seen as out-of-sample causality tests. The variable that is mostly forecasted from its own lagged values will have all its forecast error variance explained by its own shock or disturbances (Sims, 1982)[9].

Step 5: Impulse response functions (IRFs)

The VDCs contains information that can be equivalently epitomized by IRFs. VDCs and IRFs are obtained from the same MA[10] representation of the original VAR model. The IRFs are the dynamic response of each dependent variable to a period standard deviation shock to the system.

EMPIRICAL RESULTS

Data and model

The data set collected for this study is the annual time series data of six variables: real gross domestic product (RGDP), real capital stock (RCS), real capital expenditure on education (RCE), real recurrent expenditure on education (RRE), total school enrollments (TSE) and total labour force (TLF). RGDP is used to proxy economic growth while the rest of the variables are the proxy for human capital development.

The data covers a period of 39 years, spanning from 1970-2008. Data on RGDP, RCE, and RRE, are collected from the Central bank of Nigeria *statistical bulletin 2009*, data on TSE is sourced from the Nigerian national bureau of statistics *annual abstract of statistics 2009*, data on labour force is source from world data bank, *world bank development indicators (WDI) and global development finance (GDF)* is computed from gross fixed capital formation[11] using three main steps: obtaining investment series, obtaining a price deflator to transform investment into constant-quality units valued at base-year prices (1999), and calculating the capital stock. Since the capital data for the initial year (1970) is not available, we calculate the benchmark stock from investment series. The benchmark stock (K_{t-1}) is expressed as follows assuming a constant growth rate in investment:

[6] The long-run information is contained in the lagged error-correction term since it is derived from the long-run cointegrating relationship(s). Weak exogeneity of the variable refers to ECM-dependence (dependence upon stochastic trend).
[7] F-test can be derived by multiplying the value of the t-test by two (2)
[8] VDCs tell us how the behavior of a variable is affected by its "own" shocks versus shocks to other variables.
[9] By formation, errors found in any equation in a VAR are usually not correlated. However, contemporaneous correlations across errors of different equations could occur. The errors are orthogonal via Choleski factorization. The factorization is sensitive to the ordering of the variables. Variables with fewer expectations of having any predictive value for other variables should be put first.
[10] MA representation of a model is simply the complete set of IRFs.
[11] Gross capital formation is sourced from central bank of Nigeria *statistical bulletin 2009.*

$$K_{t-1} = \frac{I_t}{g+\delta} \quad (2)$$

I_t is investment at period t, g is the growth rate of investment, and is the depreciation rate. We used a mean depreciation rate of 34%.Starting with the benchmark stock; we construct capital stock series using the perpetual inventory method[12]. Following Loening (2002) we considered an expanded Cobb–Douglass Model with constant return to scale where the contribution of each explanatory variable in explaining the *RGDP* is captured by its exponent.

$$RGDP = A.RCE^{\alpha}.\ RRE^{\beta}.\ RCS^{\lambda}.TLF^{\delta}.\ TSE^{(1-\alpha-\beta-\lambda-\delta)} \quad (3)$$

Here, *A* refers to the productivity coefficient. By taking natural logarithm of both sides of equation 2, the linearized form of the model is as follows.

$$LnRGDP = C + \alpha LnRCE + \beta LnRRE + \lambda LnRCS + \delta LnTLF + (1-\alpha-\beta-\lambda-\delta)LnTSE \quad (4)$$

Here $C = LnA$ which is the constant term and each coefficient shows the elasticity of economic growth with respect to the changes in the associated variable. All the empirical works are carried-out with E-view 7.0.

Integration and cointegration properties (Unit Root Test*)*

The necessary but not sufficient condition for cointegration is that each of the variables should be integrated of the same order[13] (more than zero) or that all series should contain a deterministic trend, (Granger, 1986). Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) unit root tests were applied to test the order of integration of the variables, and the results are presented in Table 1.0.

This process examined the characteristics of the variables selected to avoid the problems of spurious correlation often associated with non-stationary time series and generate long-run equilibrium relationships concurrently. The variables were examined in logarithmic forms to help in achieving linearity. The data series was tested for stationarity using the Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) test as the starting point to assess the order of integration[14]. The result of the tests indicated that the null hypothesis (the series has a unit root) at 5 % significance level cannot be rejected at levels. At first difference all the variables are stationary or I(1). Therefore, the null hypothesis is rejected and the alternative accepted for each of the variables.

The results of the unit root test at first difference analysis affirmed the need to test for cointegration among these variables. We move on to test for cointegration using the Johansen–Juselius cointegrating technique that allows for the existence of multiple cointegrating relationships.

Cointegration

The Max-Eigen statistic indicated 1 cointegrating vectors at both 1% and 5% level of significances and Trace statistic indicated 2 cointegrating vectors at 5% and 1 cointegrating vector at 1%. The study utilizes Max-Eigen statistic, which indicated just one cointegrating vector at 1%. λ_{max} test statistic results indicated that there is exactly one cointegrating vector at 1% level of significance in the model with a lag period of 1. This means that a single vector uniquely defines the cointegration space (Harris and Sollis, 2003: 152). Table 1.1 depicts the test result from the cointegration test.

The cointegrating equation can be seen on Table 1.2 where the dependent variable is LRGDP while LRCE, LRRE, LRCS, LTLF and LTSE are the independent variables. The estimated long-run parameters which are derived from the Johansen-Juselius (JJ) procedure suggested that real capital expenditure on education, real recurrent expenditure on education and labour force has negative relationships with economic growth, while real capital stock and school enrollments are positively associated with

[12] Refer to ICT and spill over by Sang-Yong Tom Lee and Xiao Jia Guo page 23

[13] If a variable must be differenced *d* times before it becomes stationary, than it contains *d* unit roots and is said to be integrated of order *d*, denoted *I(d)*

[14] Augmented Dickey Fuller 1979 (ADF) and Phillips and Perron, 1988 (PP) tests were performed. PP test was performed to confirm the results of the ADF. PP tests are non-parametric unit root tests that are modified so that serial correlation does not affect their asymptotic distribution. PP tests confirm the above conclusion i.e. that all variables are integrated of order one with and without trends, and with or without intercept terms.

economic growth. This implies that real capital stock and school enrollments plays significant roles in economic growth.

As a precondition for estimating VECM, the cointegration test was carried-out under the assumption that there are linear trends in the data, so the model allows the non-stationary relationships in the model to drift. From Table 1.1 we conclude that there exists one significant cointegrating vector, i.e. these six variables are bound together by long-run equilibrium relationship. The number of cointegrating vectors found corresponds with the number of residual series, and hence error-correction terms (ECTs), which can be embodied as exogenous variables appearing in their lagged-levels as part of the vector error-correction model (VECM), Table 1.3.

Vector error correction model

The vector error correction model (VECM) result is given in Table 1.3. A set of necessary standard diagnostic tests was conducted during the process of estimation to rule out any discrepancies. Table 1.3 reports the results from estimation of the VECM with the choice of lag intervals as 1 as determined by Schwarz info criterion (SIC). Based on the VECM estimation the speed of the adjustment coefficient showed that the short run regression is adjusting to the long run equilibrium by 45 percent in each period. Although cointegration indicates existence or nonexistence of Granger-causality, it does not indicate the direction of causality between variables.

The significance of the t-statistics for the lag values of the independent variables presented in Table 3 indicates that there is a unidirectional short-run causal effect running from LRCE to LRGDP, LRCE to LRCS, LRCS to LRCS (autoregressive variable), TLF to LRGDP, LTSE to LRCE, and LTSE to LTLF. The significance of the error correction term shows that the burden of short-run endogenous adjustment (to the long term trend) to bring the system back to its long-run equilibrium has to be initiated by LGDP, LRCE and LTLF variables. The VECM indicates that in the short-run variables like real recurrent expenditure on education and total school enrollment stand out econometrically exogenous, as evidenced in the statistical significance of the t-test of the lagged error correction term. In the empirical period, these variables were rigid, so they were relatively the leading variables. Real recurrent expenditure on education and total school enrollment were initial receptors of exogenous shocks to the long run equilibrium.

Having the cointegrating vector normalized LRGDP, the causal relationships detected among the variables indicate that real recurrent expenditure on education, real capital stock and total school enrollment are neutral in the short run base on one lag period. The t-test on VECM may be interpreted as within-sample causality tests, since it only indicates the Granger-exogeneity or endogeneity of the dependent variable within the sample period. They do not provide us with the dynamic properties of the system or relative potentials of the variables beyond the sample period. In order to analyze the properties of the system, the forecast error variance decompositions (VDCs) and impulse response functions (IRFs) were carried-out. Thus, the results of the relative contribution of the exogenous variables in explaining the changes in the dependent variable in the post-sample period are presented through Table 1.4 and Figure 1.

Variance decomposition

The VDCs results from Table 1.4 relatively confirm the conclusion obtained by within sample VECM analysis. In the case of real recurrent expenditure on education is completely exogenous after 15-year horizons, 89% of the forecast error variance is explained by its own shocks, total school enrollment is 42%, which is relative exogenous given the slow rate of reduction within 15 years, also real capital stock explains most of its own forecast error variance by 70%. Furthermore, real gross domestic product, real capital expenditure on education and total labour force are completely endogenous. Their forecast error variances are 23%, 30% and 35% respectively.

Furthermore, the results from different orderings indicate no significant difference. So the innovations were orthogonalized in the following Cholesky order[15]: {LRGDP, LRCE, LRRE, LRCS, LTLF and LTSE}. Real capital expenditure on education, real recurrent expenditure on education, real capital stock, total labour force and total school enrollments accounts for 0.71%, 11%, 0.84%, 17% and 47% of the variation in the forecast error of real gross domestic products respectively. After one year LRGDP accounts for 25% of the variation in the forecast error of LRCE, 0.85% of LRRE, 2% of

[15] As pointed out earlier the results of VDCs may be sensitive to the ordering of the variables. But, in our study the residuals were close to being uncorrelated, so the results were not sensitive to alternative ordering of the variables. Moreover, the results from different orderings show no significant difference. So the innovations were orthogonalized in the following order: {LGRDP, LRCE, LRRE, LRCS, LTLF and LTSE}.

LRCS, 31% of LTLF and 12% of LTSE. This further supports the hypothesis that there is a causal effect from economic growth to human capital development and vice versa.

Impulse response function

Figure 1 suggests that one standard deviation shock to real gross domestic products relatively has no significant effect on real capital expenditure on education, real capital stock, total school enrollments, total labour force; and little effect within the first six years and zero effect onward. A shock to real capital expenditure on education affects real gross domestic products positively within the first two years, negatively afterward to the eighth year and zero effect onward. It has no significant effect on real capital stock and total labour force; also it affects real recurrent expenditure on education significantly and relatively no effect on total school enrollments.

The innovations arising from real recurrent expenditure on education exhibit a significant effect on economic growth (RGDP), real capital expenditure on education, real capital stock, total labour force and total school enrollments. A shock to real capital stock has a significant on real recurrent expenditure on education and total school enrollments after four years; it affects total labour force and real capital expenditure on education significantly, while it exhibits no effect on economic growth (RGDP).

The innovations from total labour force have a significant effect on total school enrollments and relatively no effect on real capital stock. Its effect on real gross domestic product and real capital expenditure on education can be seen after the first three years and four years for real capital stock. Shocks to total school enrollments affect economic growth (RGDP) and total labour force significantly while it has zero effects on real recurrent expenditure on education and real capital stock. It impacted significantly on real capital expenditure on education after seven years.

CONCLUSION

The main task in this empirical macroeconomic work is to investigate the causal relationship between economic growth and some human capital variables such as government expenditure on education (capital expenditure and recurrent expenditure on education), capital stock, total labour force and total school enrollments in Nigeria. Different schools of economic thought have postulated various relationships between economic growth and other human capital variables. However, the causal chain implied by the existing macroeconomic paradigms still remains ambiguous and the issue remains unresolved and is an empirical one.

The basic idea behind Granger-causality analysis is to test whether past values of human capital development aggregate help to explain the current state of economic growth. The multivariate Granger-causality tests were performed in a vector autoregression (VAR) model. So, we included additional variables, besides real gross domestic products and government expenditure on education in the model, allowing for the simultaneity of all included variables. The methodology employed here uses variance decomposition and impulse response functions to capture out-of sample Granger causality in macroeconomic activity in a dynamic context.

The empirical results of this study show that economic growth (LRDGP) cannot be the independent stimulus to human capital development in Nigeria in the short run i.e. economic growth is neutral in the short run and cannot contribute towards human capital in Nigeria. Granger causality from real capital expenditure on education to real gross domestic product indicates that the Nigerian government expenditure on education in the form of capital expenditure as well as the national youth service corp (NYSC)[16] scheme (direct employment scheme after graduation for the duration of one year) and other labour schemes contribute to the economic growth of the economy.

The direction of the Granger causality was detected using the vector error correction model (VECM). The VECM indicates that in the short-run real recurrent expenditure on education and total school enrollments stand out econometrically exogenous. In order to evaluate the dynamic properties of the system, the forecast error variance decompositions (VDCs) and impulse response functions (IRFs) were computed. The results of the relative contribution of the exogenous variables in explaining the changes in the endogenous variable in the post-sample period tend to confirm relatively the conclusion obtained by within sample VECM analysis.

[16] National youth service corp is a scheme employed by the Nigeria government as a compulsory service to the nation for a period of one year.

Government expenditure on education in the form of recurrent expenditure on education, capital stock and school enrollment, do not lead to economic growth during a year lag, so education alone is insufficient to achieve sustainable economic growth. Other sectors like the health sector should be developed extensively to achieve the full benefit of human capital development.

Finally, Bils and Klenow (2000) stated that a causal direction may run from growth to schooling and concluded that the channel from schooling to growth is too weak. Barro (1991) and Barro and Lee (1993) argued that "growth to schooling" is capable of generating a coefficient of magnitude. Base on our VECM analyses, there appear to be no "growth to schooling" connection rather growth was neutral. However, the result supports the argument by Bils and Klenow (2000) that the link from schooling to growth is extremely weak in Nigeria and this could account for the low rate of growth and development in Nigeria as compared to East Asian economies.

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TABLE 1.0 Unit Root Test

Variables	Variables at level		Variables at first difference	
	ADF	**PP**	**ADF**	**PP**
LRGDP	-2.277744 (0.1841)	-2.056650 (0.2002)	-5681391*** (0.0000)	-5.700358*** (0.0000)
LRCE	-0.947944 (0.7616)	-0.922683 (0.7701)	-6.961393*** (0.0000)	-6.921326*** (0.0000)
LRRE	-0.771842 (0.8153)	-0.461926 (0.8877)	-5.177116*** (0.0001)	-17.66944*** (0.0001)
LRCS	-0.101191 (0.9616)	0.386003 (0.9797)	-3.562100** (0.0116)	-3.528089*** (0.0126)
LLF	-3.530640 (1.0000)	-2.673453 (0.0880)	-7.934541*** (0.0000)	-8.274499*** (0.0000)
LSCHE	-1.432140 (0.5558)	-1.831623 (0.3601)	-3.796723*** (0.0065)	-5.324900*** (0.0001)

Notes: All variables are in log forms, we use Scharwz Information Criteria with a maximum lag length of 10. (***) denotes significance for 1%, 5% and 10% level while (**) implies that it is not significant at 1% but significant at 5% and 10% level. For Phillips-Perron unit root test, we used Bartlett Kernel

Spectral estimation method and select Newey-West automatic bandwidth. The p-values are given in brackets

TABLE 1.1 Johansen Cointegration

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	1 Percent Critical Value
r = 0*	0.785924	57.03265	45.10
r = 1	0.564694	30.77311	38.77
r = 2	0.528950	27.85327	32.24
r = 3	0.215560	8.983063	25.52
r = 4	0.183027	7.479541	18.63
r = 5	0.012505	0.465605	6.65

Notes: Trace test indicates 1 cointegrating equation(s) at the 1% level of significance. *(**) denotes rejection of the null hypothesis at 1% level of significance.

TABLE 1.2 Johansen Cointegrating Equation

LRGDP	LRCE	LRRE	LRCS	LTLF	LTSE
1.000000	0.290224	0.195573	-3.621083	1.903887	-2.877732
	(0.08140)	(0.10756)	(0.90554)	(1.58050)	(0.47335)

Notes: 1 cointegrating equation(s) Log Likelihood 71.62589 Normalized cointegrating coefficients (standard error in parentheses)

TABLE 1.3 Temporal Causality Results Based on Vector Error Correction Model (VECM)

Error Correction:	D(LRGDP)	D(LRCE)	D(LRRE)	D(LRCS)	D(LTLF)	D(LTSE)
CointEq1	-0.486323	-0.322050	0.002433	-0.014631	-0.024838	-0.020623
	(0.11882)	(0.22318)	(0.32046)	(0.01156)	(0.00794)	(0.04644)
	[-4.09283]***	[-1.44299]	[0.00759]	[-1.26577]	[-3.12869]***	[-0.44410]
D(LRGDP(-1))	0.072910	0.179360	0.489911	-0.014370	0.010133	0.009300
	(0.14103)	(0.26488)	(0.38034)	(0.01372)	(0.00942)	(0.05511)
	[0.51700]	[0.67713]	[1.28809]	[-1.04749]	[1.07543]	[0.16875]
D(LRCE(-1))	0.176630	-0.253390	0.187346	-0.017000	-0.001611	0.026132
	(0.09576)	(0.17987)	(0.25827)	(0.00932)	(0.00640)	(0.03743)
	[1.84443]*	[-1.40873]	[0.72539]	[-1.82487]*	[-0.25186]	[0.69824]
D(LRRE(-1))	-0.064669	0.048879	-0.217715	0.005603	6.32E-05	0.003502
	(0.06961)	(0.13075)	(0.18773)	(0.00677)	(0.00465)	(0.02720)
	[-0.92903]	[0.37385]	[-1.15971]	[0.82750]	[0.01359]	[0.12874]
D(LRCS(-1))	-1.846642	3.398353	-0.410838	0.577388	0.106421	-0.177157
	(1.50409)	(2.82510)	(4.05645)	(0.14632)	(0.10049)	(0.58781)
	[-1.22775]	[1.20292]	[-0.10128]	[3.94613]***	[1.05900]	[-0.30138]
D(LTLF(-1))	-6.728900	1.517385	6.597327	0.053834	0.236522	1.114245
	(2.56872)	(4.82477)	(6.92770)	(0.24988)	(0.17162)	(1.00388)
	[-2.61955]***	[0.31450]	[0.95231]	[0.21544]	[1.37815]	[1.10994]
D(LTSE(-1))	-0.619196	-1.788710	-1.583280	-0.098450	-0.075869	-0.067355
	(0.57929)	(1.08807)	(1.56232)	(0.05635)	(0.03870)	(0.22639)
	[-1.06889]	[-1.64393]*	[-1.01342]	[-1.74702]*	[-1.96026]*	[-0.29752]

Notes: Included observations: 37 after adjustments Standard errors in ( ) & t-statistics in [ ] ***, ** and * indicates significant at 1%, 5% and 10% levels. Lag length criteria was based on Schwarz, Akaike and Hannan-Quinn info criterion.

TABLE 1.4 Variance Decomposition

Percentage of forecast variance explained by innovations in:						
Relative variance in:	LRGDP	LRCE	LRRE	LRCS	LTLF	LTSE
Year	Variance Decomposition of LRGDP					
1	100.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4	74.1645	1.5398	0.2301	1.4562	3.5672	19.0423
8	48.3214	0.9543	3.5949	1.7192	8.2568	37.1535
12	31.1496	0.6952	8.0767	1.1169	14.4061	44.6556
15	23.4816	0.7137	10.7129	0.8358	17.5461	46.7099
Variance Decomposition of LRCE						
1	5.2517	94.7483	0.0000	0.0000	0.0000	0.0000
4	10.6137	71.6464	9.8918	6.3380	0.4725	1.0376
8	18.8472	48.1579	18.8284	11.6718	2.0193	0.4755
12	23.1522	35.5579	23.2606	14.0213	3.6403	0.3678
15	25.0019	30.0705	25.1092	14.9281	4.5238	0.3666
Variance Decomposition of LRRE						
1	1.7069	13.5535	84.7395	0.0000	0.0000	0.0000
4	2.2205	13.0746	82.7929	0.0538	0.2024	1.6558
8	1.1030	10.3281	86.8686	0.1351	0.7238	0.8414
12	0.8487	8.3558	88.4867	0.3176	1.4612	0.5301
15	0.8478	7.3609	89.0021	0.4490	1.9232	0.4170
Variance Decomposition of LRCS						
1	0.3661	1.5721	10.0223	88.0394	0.0000	0.0000
4	0.7002	2.0174	20.3265	75.3960	0.1359	1.4240
8	1.1841	3.0417	21.8822	72.0999	0.0481	1.7439
12	1.4290	3.4225	22.4576	70.8826	0.0376	1.7708
15	1.5449	3.5739	22.7048	70.3771	0.0386	1.7607
Variance Decomposition of LTLF						
1	28.0891	2.3533	2.1125	1.4579	65.9871	0.0000
4	31.7663	7.2055	14.6232	1.3442	44.0416	1.0193
8	31.7214	7.6310	17.9804	2.7763	37.8047	2.0863
12	31.4464	7.7779	19.1862	3.5662	35.4998	2.5235
15	31.3039	7.8358	19.6543	3.9152	34.5979	2.6931
Variance Decomposition of LTSE						
1	0.2224	1.0220	0.6733	0.0048	29.5901	68.4874
4	4.0411	1.1404	0.5977	0.0597	38.1717	55.9894
8	8.3112	0.4434	2.2807	0.2135	40.5041	48.2471
12	10.7648	0.3261	3.7143	0.5018	40.9800	43.7130
15	11.8940	0.3319	4.4653	0.6858	41.0392	41.5838

Notes: Figures in the first column refer to the time horizons (number of years). Several alternative ordering of these variables were also analysed, i.e. Human capital development variables appearing prior to output variable but such alteration did not change the results to any substantial degree. This is possibly due to the variance-covariance matrix of the residuals being near diagonal, obtained through choleski decomposition in order to orthogonalise the innovations across equations.

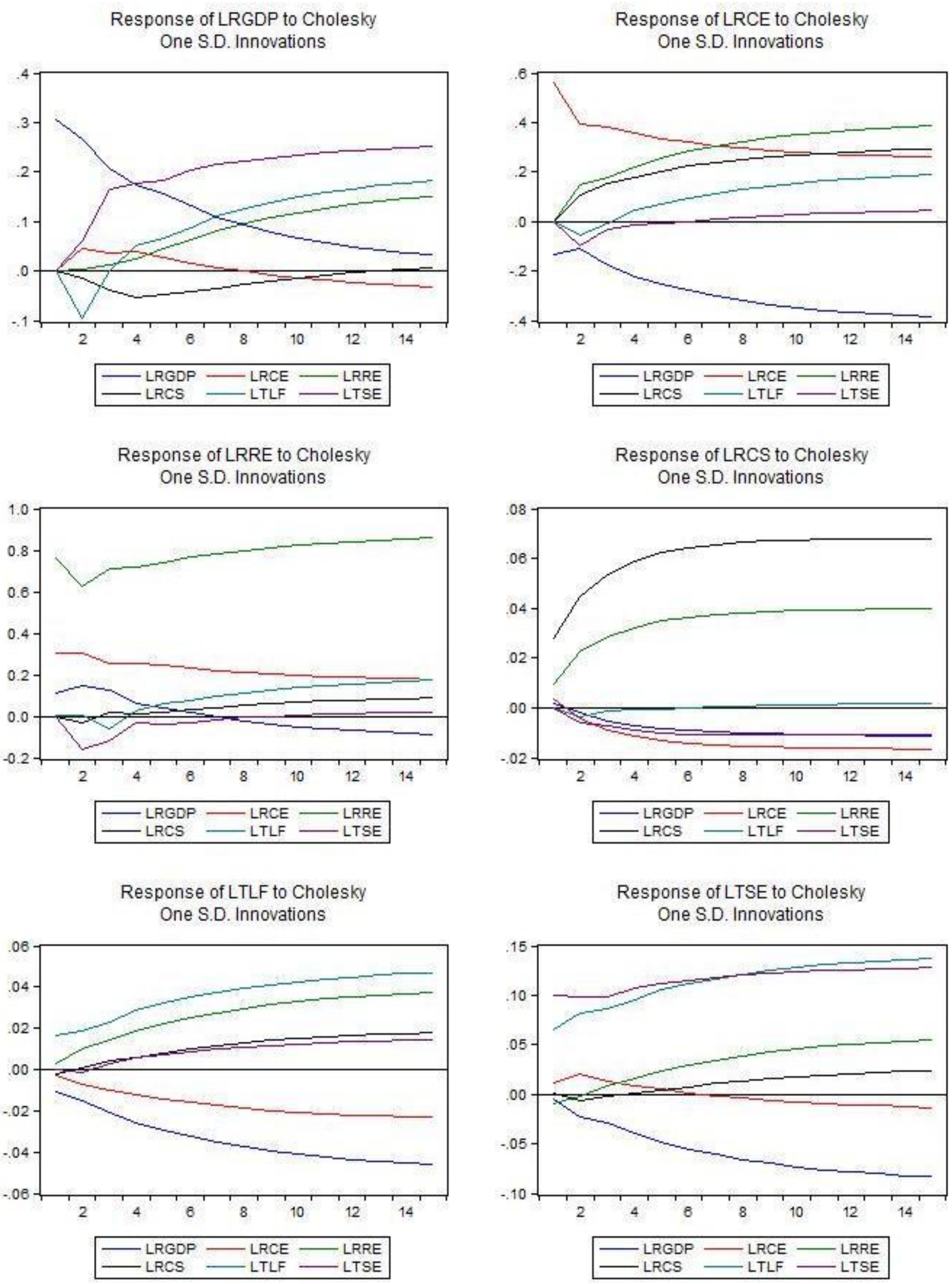

FIGURE 1: Impulse Response Function of all variables to a one Standard Deviation Shock to LRGDP, LRCE, LRRE, LRCS, LTLF and LTSE.