Journal of Economics and Sustainable Development
ISSN 2222-1700 (Paper) ISSN 2222-2855 (Online)
Vol.14, No.6, 2023

Tax Revenue and Infrastructure on Composite Health and Education Development in Nigeria: A Simulation Approach

Onyinye, O. Mgbemena[1] Chris U. Kalu[2] Obinna Osuji[1]
1. Department of Economics, Michael Okpara University, Umudike Umuahia
2. Department of Economics, Nnamdi Azikiwe University, Awka

Abstract
Insufficient allocation of resources and infrastructure remains two daunting challenges of human capital development in Nigeria despite government policy measures to efficiency of resources and infrastructure development. This paper examined the effect of tax revenue proxy by value added tax and infrastructure on composite health and education in Nigeria from the period 1980- 2021. This paper utilized the simulation approach in forecasting performance of the macroeconometric model. From the results, the following were observed: First, value added tax has positive and statiscally significan effect on government expenditure on education and health. This implies that an increase in tax revenue causes increase in government's spending on education and health in Nigeria. Second, health is not a good channel through which tax revenue can be used to influence economic growth, relative to education. Education impacts more on human capital in Nigeria than health. Three, higher investment in infrastructure or higher infrastructure will increase economic growth and human capital development. Four, positive and significant relationship exist between value added tax revenue and government expenditure on education and health. This implies that increase in tax revenue causes increase in government spending on social and community services including health and education. Five, to increase human capital development in Nigeria, temporary tax revenue shock is sufficient. This implies that the growth reducing effect of government tax via permanent increase in value added tax revenue. Six, to increase human capital development in Nigeria, permanent infrastructure development and investment is required. From the results, the following were observed: First, value added tax has positive and statiscally significan effect on government expenditure on education and health. This implies that an increase in tax revenue causes increase in government's spending on education and health in Nigeria. Second, health is not a good channel through which tax revenue can be used to influence economic growth, relative to education. Education impacts more on human capital in Nigeria than health. Three, higher investment in infrastructure or higher infrastructure will increase economic growth and human capital development. Four, positive and significant relationship exist between value added tax revenue and government expenditureon education and health. This implies that increase in tax revenue causes increase in government spending on social and community services including health and education. Five, to increase human capital development in Nigeria, temporary tax revenue shock is sufficient. This implies the growth reducing effect of government tax via permanent increase in value added tax revenue. Six, to increase human capital development in Nigeria, permanent infrastructure development and investment is required. The study recommended that: (i) The government should increase its investment on critical infrastructure to further bolster human capital development and by extension accelerate the rate of economic growth, (ii) The government should diversify its revenue base and expend more on health and education in addition to building a strong institutional framework to ensure the efficacy of government spending on both health and education.
Keywords: Tax revenue, infrastructure, composite health, education, simulation , Nigeria
JEL Codes: H24, I10, E27
DOI: 10.7176/JESD/14-6-04
Publication date: March 31st 2023

1. Introduction

Human capital development is a process of enlarging people's choices and strengthening human capacities in a way that enables them to lead longer, healthier and fuller lives (UNDR, 2015). It also meas the abilities and skills of human resources of a country, while human capital development refers to the process that are critical for economic growth and development(Eigbiremolen & Anaduaka, 2014). Human capital allows an economy to grow. When human capital increases in such areas as science, education, health and management among others, it leads to increase in innovation, social well-being, equality, increased productivity, improved rates of participation, all of which contribute to economic growth.

The Human Development Index (HDI) that measures human capital development , is a composite index of three core indicators: health index; education index and per capita income index. However, in this paper, we put forward that the bigger picture of human capital development and welfare requires analysis of other indicators and information on infrastructure. Measures of infrastructure cuts across a broad spectrum of social and economic indicators of basic facilities, systems and structures needed by the populace and the society such as transportation, communication, water, electricity, energy, and others. Access to the aforementioned is considered fundamental

and drivers for human capital development. Without infrastructures, there will be poor outcomes in education and health. Some studies emphasize inadequate investment in education and health as major causes of low human capital perdformance in Africa(Appleton & Teal, 1998; Dae-Bon, 2009; Omojimite, 2011; Asaju et al., 2013; World Bank, 2010; Ndul, 2010; Odia & Omofonmwa, 2010 ; Kern, 2009). These studies opine

When human capital development is deficient, infrastructural development and volume of tax revenue would be adversely affected. Therefore, aside from the fact that to the best of our knowledge, there has not been any known study that explored this trivariate relationship, this paper employed the structural equation method of analysis so as to account for both the direct, indirect and simulation effects of tax revenue and infrastructure on human capital development in Nigeria. The objectives of this paper is to:

- analyzed the effects of tax revenue and infrastructure on the composite of health and eduction developments in Nigeria;
- characterize the simulation effect of tax revenue and infrastructure on health and education composite in Nigeria.

Following the introductory section is the methodology presented in the next section.

2 Methodology

2.1 Theoretical Framework/Model

Human capital captures the abilities, skills, and knowledge. Like other economic goods, human capital can be rivalry and excludable. Thus, the endogenous growth model explored in this paper is that of the Solow model, the Ramsey and Diamond models which assumed constant returns to scale. The model differs from other models in suggesting that moderate adjustment in the resources directed to physical and human capital accumulation may result in large changes in output per worker. Thus, huge investment in physical capital (e.g. infrastructure) and human capital is essential for the development of the economy. A simple theoretical model follows Mankiw, Romer and Weil (1992). Given a Cobb-Douglas production function as presented below:

$$Y(t) = K(t)^{\alpha} H(t)^{\beta} \left[A(t) L(t) \right]^{1-\alpha-\beta} \tag{2.1}$$

Given that $\alpha \succ 0$, $\beta \succ 0$, $\alpha + \beta \prec 1$. Where Y is the output or productivity, K is the physical capital (in our case infrastructure), H is the stock of human capital, L captures the number of labour and A is the technological progress, therefore a skilled labour supplies both 1 unit of L and some amount of H and the production function exhibits constant returns to K, H, and L together. It is also important to know that huge allocation of resources and efficient utilization of such resources in financing infrastructures that are beneficial to human capital will lead to a tremendous increase in productivity. According to Funke and Strulik (2000), physical capital enhances growth significantly at the early stage of development and human capital accumulation through an accumulation of knowledge (education and training) move the economy to a higher stage of development. Many studies such Bundell *et al.* (1999), De la Fuente and Cicoone (2002), Raheem *et al.* (2018), and Oyinlola *et al.* (2020), have emphasized the importance of huge investment in the human capital development. Thus, productivity can only expand significantly if the huge resources are directed towards infrastructural and human capital development. This clearly shows the linkages among financial resources, infrastructure, human capital and growth.

2.2 Empirical Model Specification

The model is built on the IS-LM framework as explored by Olubusoye *et al.* (2016) and Olofin *et al.* (2014).Thus, the structure of our model consists of six important equations which have 13 variables (6 endogenous and 7 predetermined variables). The macro-model designed allows us to incorporate both stochastic and definitional equations.

2.2.1 The IS equation

The aggregate demand equation shows the real output as a function of the real interest rate and the real exchange rate for Nigeria (a small open economy):

$$y_t^g = \beta_1 y_{t-1}^g + \beta_2 (i_{t-1} - \pi_t^e) + \beta_3 s_{t-1} + \beta_4 r_{t-1} + \beta_5 h_t + \eta_t^y \tag{2.2}$$

Where y_t^g measures the real output gap which is the percentage difference between the actual and potential real GDP (y_t^g is computed as $100 \log\left(\frac{Y_t}{Y_t^*}\right)$ where Y_t represents the level of real GDP and Y_t^* represents potential output which is captured the trend level of GDP (Berg et al., 2006), i_t is the nominal interest rate, π_t^e is

the expected inflation rate, $(i_{t-1} - \pi_t^e)$ is the real interest rate, s_t is the real exchange rate, r_t is the government revenue and h_t is the human capital development. According to the economic theory, the relationship between output and lagged output is expected to be positive. The restriction $1 \prec \beta_1 \geq 0$ is analyzed to ascertain if output depends on its lagged value, y_{t-1}^g. The real interest rate influences the level of real economic activity negatively as it discourages the investment and productive activities in the economy then $\beta_2 \prec 0$. The long-run coefficient of the real interest rate can be recovered using the formula $\beta_2 / (1-\beta_1)$. In addition, a decline in s_t (suggesting an appreciation of the real exchange rate) will lead to a reduction in the level of real output and thus $\beta_3 \succ 0$. In essence, an appreciation of real exchange rate does not attract foreigners to export while import becomes cheaper to domestic consumers. The long-run effect can be computed as $\beta_3 / (1-\beta_1)$. An increase in r_t is expected to increase the level of real output and thus, $\beta_4 \succ 0$. The long-run effect of government revenue can be obtained from this computation: $\beta_4 / (1-\beta_1)$. The positive relationship is expected since the economy is largely funded by government. Hence, a high level of government revenue will enhance output expansion whereas a low level of government revenue will inhibit output expansion. h_t captures the role of human capital in the growth process. According to Mankiw et al. (1992), human capital accumulation amplifies growth through education and training. Accumulation of knowledge and new skills enable a worker to contribute meaningfully to the production process. Thus, as human capital accumulation continues to increase, real output also increase as there will be an increase in productivity through new skills acquired by the worker and hence $\beta_5 \succ 0$. High level of human capital accumulation is expected to lead to an increase in output while a low level of human capital accumulation is expected to reduce it. The long-run effect of human capital development is computed by $\beta_5 / (1-\beta_1)$. The inclusion of human capital development in the IS equation differentiates our model from Olofin et al. (2014) and Olubusoye et al. (2016).

2.2.2 Human Capital Equation

This equation is the key equation introduced into the structural equations by Olubusoye et al. (2016) and it is specified as follows:

$$h_t = \alpha_1 h_{t-1} + \alpha_2 r_t + \alpha_3 f_t + \alpha_4 \pi_t + \eta_t^h \tag{2.3}$$

Where h_t represents human capital development, r_t is the government revenue, f_t is the infrastructure and π_t is the inflation rate. The predetermined level of human capital (h_{t-1}) plays a significant role in determining the increase in the current level of human capital. Government revenue is positively related to human capital development. As more resources are channelled towards knowledge, training and health of workers, the level of human capital accumulation increases. Thus, we expect $\alpha_2 \succ 0$. The long-run effect of government on human capital development is computed as $\alpha_2 / (1-\alpha_1)$. The level of infrastructure also enhances human capital development. Availability of huge infrastructure determines to a large extent the efficiency of human capital. This also allows workers to contribute to meaningfully to the overall economy since there is a conducive environment for workers to efficiently utilize their skills and training in the production process. Thus, an increase in the level of infrastructure will lead to an increase in human capital development which implies that $\alpha_3 \succ 0$. The long-run effect of infrastructure is computed by $\alpha_3 / (1-\alpha_1)$. In addition, a high level of inflation is expected to dampen human capital development. This can be pass through the cost of new skills and training which in turn will

discourage human capital development. Since knowledge is also economic good which has features of rivalry and excludability. High cost of training and knowledge accumulation will prevent many workers from pursuing beneficial knowledge thus human capital declines. Human capital will respond negatively to a high price level, thus, $\alpha_4 \prec 0$. The long-run effect of inflation is also computed as $\alpha_4 / (1-\alpha_1)$.

2.2.3 Government Revenue Equation

This equation was introduced by Olubusoye et al. (2016) and it is specified as follows:

$$r_t = \delta_1 op_t + \delta_2 v_t + \eta_t^r \tag{2.4}$$

Where r_t is the government revenue, op_t is the crude oil price in the current year t and v_t is the value-added tax revenue at year t. The coefficients of the op_t and v_t are expected to be positive since an increase in the crude oil price and value-added tax revenue are expected to increase the level of government revenue. Any negative shocks to crude oil price and value-added tax will lead to a decline in government revenue.

2.2.4 The LM Equation

The LM equation can also be called real money balance. Conventionally, the real money balance is assumed to be affected by the level of income, interest rate and nominal exchange rate. The level of income and interest rate captures the transactionary, precautionary and speculative motives of money demand. The exchange rate was included to capture the peculiarity of the small open economy such as Nigeria (Salisu et al. 2013).

$$m_t - p_t = \varphi_1 y_t^g + \varphi_2 i_t + \varphi_3 e_t + \eta_t^m \tag{2.5}$$

Where m_t represents the nominal money, p_t is the price level in the economy, y_t^g captures real output gap, i_t is the nominal interest rate and e_t is the nominal exchange rate. The real income captures the transactionary motive of demand for money which influenced real money balance positively. As real income increases, people tend to increase the level of their spending while a decline in real income suggests a decline in the spending level of people. Also, the nominal interest rate and exchange rate captures the opportunity cost of holding money and they affect real money balance negatively. As interest rate and exchange rate (depreciation) increase, the motivation to hold money reduces which will lead to a reduction in the real money balance in the economy. Hence, $\varphi_2, \varphi_3 \prec 0$.

2.2.5. The Aggregate Supply Equation

The reduced-form Philip curve used in this study is derived from a combination of wage-contracting and consumption price index equations. This combination gives an aggregate supply curve or price-setting equation which captures the effect of output gap on the inflation. The specification represents a small open-economy aggregate supply equation which expresses inflation as a function of its next period expected value and lagged values, output gap (the mark-up of firms prices over marginal costs), and expected real exchange rate. The equation is presented as follows:

$$\pi_t = \gamma_1 \pi_{t+1}^e + (1-\gamma_1)\pi_{t-1} + \gamma_2 y_t^g + \gamma_3 S_{t+1}^e + \eta_t^\pi \tag{2.6}$$

Where π_t is the inflation rate, π_{t+1}^e is the inflation expectation at period $t+1$ relying on information at a time t, π_{t-1} is the inflation rate at the previous period, y_t^g is the current value of output gap and S_{t+1}^e is the real exchange rate expectation at period $t+1$ based on the information at period t. Theoretically, the summation of coefficients of the expected inflation and lagged inflation must fall between 0 and 1. The value of the coefficient will now determine if the inflation rate is forward-looking or backwards-looking. Inflation rate is expected to respond negatively to output gap which suggests a low level of real GDP in the economy. In addition, the expected exchange rate will be positively related to inflation since depreciation of exchange rate in countries (e.g. Nigeria) with low elasticity of import demand will likely increase inflation rate (Olubusoye et al., 2016).

2.2.6. The Interest Rate Equation

In this case, there is an assumption that monetary policy instrument is determined by the short-term nominal interest rate (that is MPR for Nigeria). Also, the monetary authority (Central Bank) sets this policy instrument to pursue the objective of inflation-targeting. The nominal interest rate can also respond to deviation output from steady-state. Thus, interest rate equation is expressed as a function of inflation rate, monetary policy rate, real output gap, and nominal exchange rate expectation. This equation is simply Taylor's monetary policy rule. The

model is expressed as flows:

$$i_t = \theta_1 e^e_{t+1} + \theta_2 \pi_t + \theta_3 y^g_t + \theta_4 mpr + \eta^i_t \quad (2.7)$$

Where ^{t} is the nominal interest rate, e^e_{t+1} is the expected nominal interest rate at period $t+1$, π_t is the inflation rate, y^g_t is the output gap, and mpr is the monetary policy rate. Expectedly, the monetary policy variable is should be positively related to nominal interest rate in the economy. In addition, nominal exchange rate expectation and inflation rate are expected to influence nominal interest rate positively since loanable funds may become expensive when anticipated nominal exchange rate depreciates coupled with high inflation rate in the economy. Since exchange volatility is carefully observed by the policymaker and exchange rate expectation is linked with adaptive expectation, then, monetary policy may respond directly to the exchange rate. In line with Woodford (2003), the CBN is expected to smoothen interest rates by adjusting them slowly to the required level given the deviations of inflation and output from steady-state. Table 2.1 presents the summary of the variables included in the equations.

Table 2.1: Summary of Variable Descriptions

S/N	Variable Name	Acronym	Unit of measurement	Role in the model	Source
1.	Broad Money	M2	Billion Naira	Endo	CBN
2.	Consumer Price Index	CPI	Index (Basis points)	Exo	CBN
3.	Human capital development	HCD1a	Education Index (EI)	Endo	UNDP
		HCD1b	Sec. Sch. Enrolment (SSE)		WDI
		HCD2a	Life expectancy Index (LEI)		UNDP
		HCD2b	Life expectancy at birth (LEB)		WDI
		HCD3a	Composite (EI & LEI)		Computed
		HCD3b	Composite (SSE & LEB)		Computed
4.	Inflation	INF	Percentage (%)	Endo	CBN
5.	Infrastructure	INFRAST	Index(Basis points)	Exo	Computed
6.	Interest rate	MLR	Percentage (%)	Endo	CBN
7.	Monetary Policy Rate	MPR	Percentage (%)	Exo	CBN
8.	Nominal exchange rate	NER	Naira/US$	Exo	CBN
9.	Nominal exchange rate expectation	NERE	Naira/US$	Exo	CBN
10.	Bonny Light Crude oil price	OILP	US$/Barrel	Exo	CBN
11.	Real GDP growth	RGDP_GR	Percentage (%)	Endo	CBN
12.	Recurrent and Capital Social and Community Services Expenditure	SCST	Billion Naira	Endo	CBN
13.	Net Value Added Tax Receipt	VAT	Billion Naira	Exo	CBN

Source: Researcher's Compilation(2020)

3. Estimation Techniques and Procedure

This section focuses on the estimation technique explored to address the objectives of the paper.

Given the common challenges of endogeneity in the structural models, the paper also explores Two-Stage Least Squares (2SLS). This method is employed to address the endogeneity issues and for robustness purpose. The approach allows for the inclusion of instrumental variables. Instead of having exogenous and endogenous variables like OLS, the 2SLS accounts for the instrumental variables. In the process of estimating 2SLS, each endogenous variable was introduced as dependent variable in the first stage regression equation. Then, each endogenous

variable is regressed on all the exogenous and instrumental variables. The estimated values from the regressions substitute for the original estimates of the endogenous variables in the second stage regression equation.

4 Empirical results and Analysis

4.1 Descriptive Statistics

Figure 4.1 and Table 4.1 presents the trends of the variables included in the model

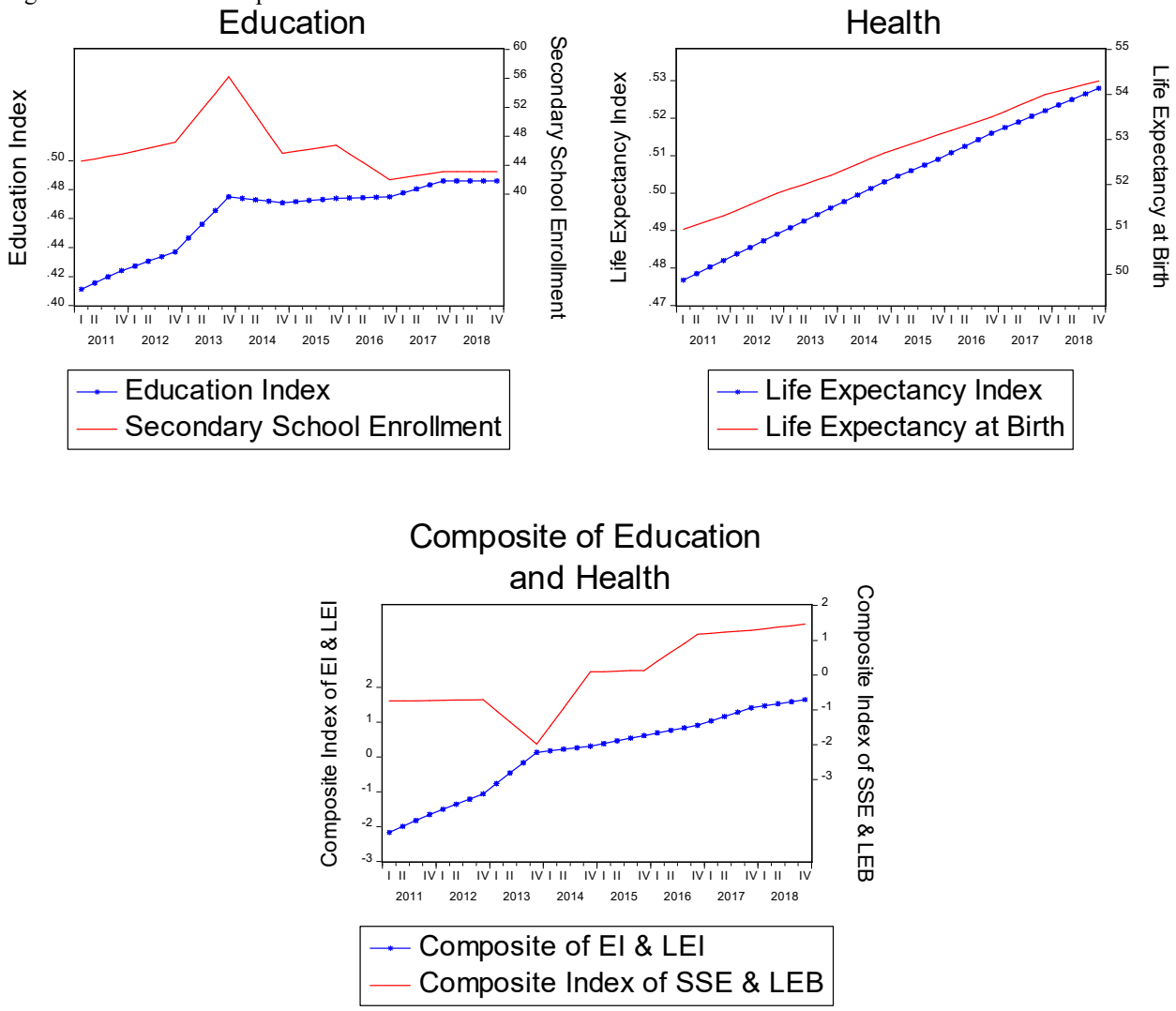

Figure 4.1: Trends in Human Capital Development

Table 4.1: Summary Statistics

	Mean	Std. Dev.	Min.	Max.	Skew.	Kurt.	J.-Bera
Human Capital Development (HCD) Indicators							
Education Index - (1)	0.46	0.03	0.41	0.49	-0.88	2.27	5.00*
Sec. Sch. Enrolment - (2)	46.19	3.59	42.00	56.21	1.22	3.82	9.16**
Life exp. Index - (3)	0.50	0.02	0.48	0.53	-0.07	1.79	2.03
Life exp. at birth - (4)	52.65	1.05	50.90	54.30	-0.05	1.78	2.07
Composite HCD (1 & 3) - (5)	0.03	1.22	-2.33	1.65	-0.52	2.02	2.80
Composite HCD (2 & 4) - (6)	-0.03	1.04	-1.98	1.47	0.05	1.76	2.12
Infrastructure and Tax revenue indicators							
Infrastructure (Compos. Index)	54.111	22.492	18.935	91.815	-0.002	1.776	1.998
VAT Receipt (Billion)	65.964	10.968	47.172	89.501	0.706	2.715	2.766
Control variables and Macroeconomic indicators							
Soc. & Comm. Exp. (Billion)	944.10	125.19	746.577	1287.15	1.30	4.11	10.59***
RGDP growth (%)	3.15	2.681	-2.341	6.892	-0.416	2.206	1.763
CPI (Index)	177.57	52.68	103.58	278.40	0.42	1.92	3.10
Inflation (%)	11.81	2.76	8.00	17.60	0.45	2.44	1.81
Broad Money (₦' Billion)	3,748.00	2,859.00	8,378.80	10,311.00	0.99	2.57	6.67**
Max. Lending rate (%)	26.63	3.25	21.85	31.45	0.17	1.67	3.04
Monet. Pol. Rate (MPR) (%)	12.320	1.744	6.833	14.000	-1.534	5.499	20.88***
Nom. Exch. Rate (₦/US$)	212.468	65.488	153.513	306.713	0.661	1.595	4.960*
Bonny Oil price (US$/Barrel)	82.511	29.605	33.373	121.227	-0.083	1.330	3.756

Source: Reserachers' Computation Using Stata 11.0

Furthermore, Table 4.1 corroborates the observation from Figure 4.1 that the two indicators of health as measure of human capital development follow a similar pattern. This is evident from the skewness, kurtosis and the Jarque-Bera statistics, which are very similar. The standard deviation for life expectancy at birth is however higher than that of the life expectancy index, indicating that life expectancy at birth is more volatile than life expectancy index as a measure of human capital development. Our composite index combines the education and health indicators based on their level of volatility. Thus, the composite health and education based on life expectancy at birth and secondary school enrolment is more volatile as a measure of human capital development compared to the composite health and education based on life expectancy index and education index. This is explained by their standard deviation (see Table 4.1).

Figure 4.2 shows the graphical presentation of the main explanatory variables; infrastructure and tax revenue, and other control and macroeconomic variables. More importantly, the composite infrastructure index in upward trending all through the period of analysis, implying that infrastructure is increasing between 2010 and 2018. As regards the (Value Added) tax revenue, it only experienced a falling trend between 2013Q4 and 2015Q4, as it fell from about ₦71 billion to ₦57 billion within the period. As may be observed from Table 3.2, the average value of infrastructure is 54.11 index points, while the average VAT revenue is ₦65.96 Billion. The Jarque-Bera statistic, which combines the values of skewness and kurtosis revealed that both variables are not normally distributed.

Figure 4.2: Trends in control and macroeconomic indicators (2010Q1 – 2019Q4)

Nigeria economic is largely dependent on oil; hence, we account for the role of oil in our macroeconometric modeling of the Nigerian economy. As may be observed from Figure 4.2, Nigeria's crude oil price increased from about US$78/barrel in 2010Q1 to about US$120/barrel in 2011Q2. It fell slightly to about US$112/barrel in 2014Q2 and then, drastically to about US$33/barrel in 2016Q1. There was a gradual recovery in crude oil price, as the price of oil increased gradually to about US$76/barrel in 2018Q3. According to Table 4.2, the average value of Nigeria's crude oil price between 2010 and 2018 is US$82.5/barrel, with the maximum values being US$121.23/barrel and the minimum value being US$33.37/barrel.

More so, Figure 4.2 reveals that consumer price index (CPI), maximum lending rate (MLR) and Broad money supply (M2) is on the rising trend. The rising trend in the monetary policy rate (MPR), however, revealed that the monetary policy implemented by the Central Bank of Nigeria (CBN) during this period is, predominantly, a contractionary type. An expansionary policy was introduced in 2015Q4 through 2016Q1, when MPR was reduced from 13.00 percent to 11.67 percent in 2015Q4 and 11.33 percent in 2016Q1. The policy was again changed to a contractionary type, as the increase and maintained MPR at 14.00 percent from 2016Q3 to 2018Q4. Nigeria's inflation rate follows a falling trend between 2010Q1 and 2015Q1. This may not be unassociated with the use of a contractionary monetary policy by the monetary authority. It, however, increased rapidly from about 8.0 percent in 2014Q2 to as high as 17.6 percent in 2017Q2. This may not be unattributed to the drastic fall in crude oil price and exchange rate depreciation. As evident from Table 4.2, the average lending rate during the period is 26.52 percent. Its maximum value is 31.45 percent and its minimum value is 22 percent. The average broad money supply (M2) is₦3,748billion. Its minimum values over the period is ₦1,190billion and its maximum value is ₦8631 billion. More so, the average nominal exchange rate is ₦212.47/US$, its minimum value is ₦153.5/US$ and

its maximum value is ₦306.7/US$. Lastly, the average real GDP growth rate is 3.15 percent, with economic recession experienced between 2016Q1 and 2017Q1, where real GDP growth recorded consecutive negative values.

This paper employed macroeconometric modeling approach to examine the effect of infrastructure and government tax revenue on human capital development in Nigeria. The country's macroeconomic indicators are expected to be affected through the effect of changes in human capital development in economic growth, as postulated by the endogenous growth model. Basically, the empirical analyses contain (i) examination of the effect of tax revenue through human capital development on the Nigerian economy; (ii) examination of the effect of infrastructure through human capital development on the Nigerian economy; (iii) forecasting of the effect of temporary and permanent changes in tax revenue on the Nigerian economy though their effect on human capital development; (iv) forecasting of the effect of temporary and permanent changes in infrastructureon the Nigerian economy though their effect on human capital development.

The proposed small scale macroeconometric model of the Nigerian economy consists of fourteen variables divisible into six (6) endogenous and seven (7) exogenous variables. The description of the variables is presented in Table 4.2. Based on the various indicators of human capital development, six models emerged; two on education as indicator of HCD, two on health as indicator of HCD, and two on the composite of education and health as indicator of HCD. Most especially, using education and health separately allow us to compare the effect of HCD on the Nigerian economy through different channels. Appropriate model evaluation statistics was deployed to select a better model.

4.2 In-Sample Forecast Performance

The graphical presentation of the in-sample forecast performance of all the dependent variables is presented in Figures 4.3 a&b, 4.4a&b and 4.5a & b. Basically, Figures 4.3 a&b present the forecast performance of the endogenous variables using education (education index (in Figure 4.3a) and secondary school enrolment (in Figure 4.3b)) as indicator for human capital development. Figures 4.4a&b present the forecast performance of the endogenous variables using health (life expectancy index (in Figure 4.4a) and life expectancy at birth (in Figure 4.4b)) as indicator for human capital development. Lastly, Figures 4.5a&b present the forecast performance of the endogenous variables using composite of education and health (indexes (in Figure 4.5a) & values (in Figure 4.5b)) as indicator for human capital development.

The performance of the six models is examined based minimum variance assumption (see Table 4.3). According to the table, education appears to be best modelled with education index when considering education as the indicator of human capital development. This is apparent as modelling with education index appears to have lower residual covariance than modelling with secondary school enrolment. Similarly, health appears to be best modelled with life expectancy index when considering health as the indicator of human capital development. This is apparent as modelling with life expectancy index appears to have lower residual covariance compared to modelling with secondary school enrolment. More so, composite of health and education indexes appears as better proxy for human capital development in the model, compared to composite of secondary school enrolment and life expectancy at birth, which has relatively higher variance.

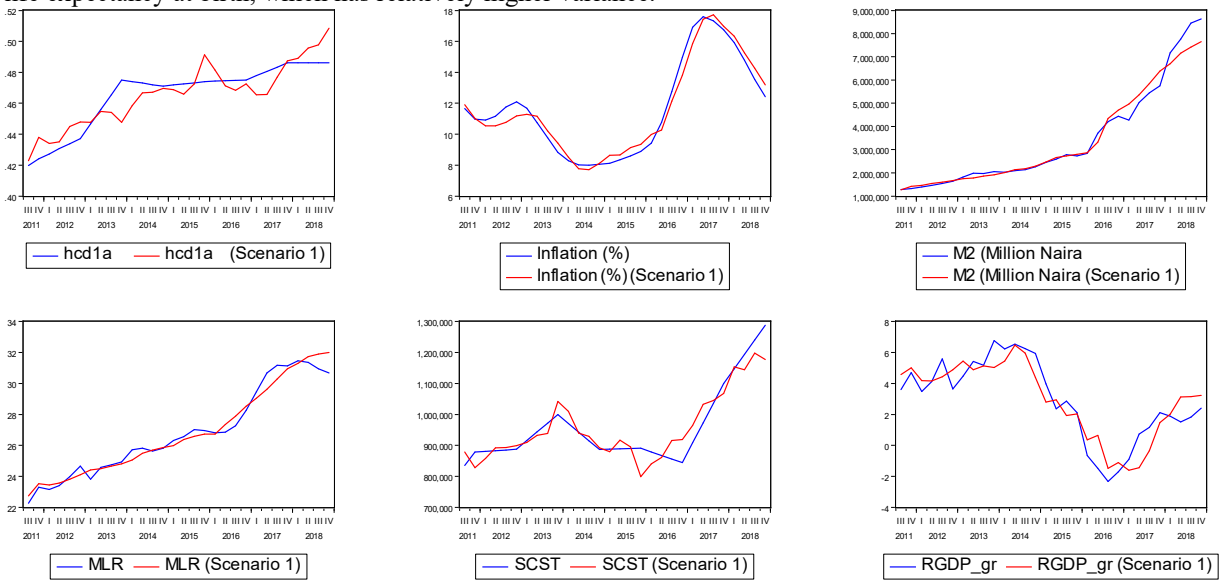

Figure 4.3a: In-sample forecast performance (using Education Index (EI) for HCD)

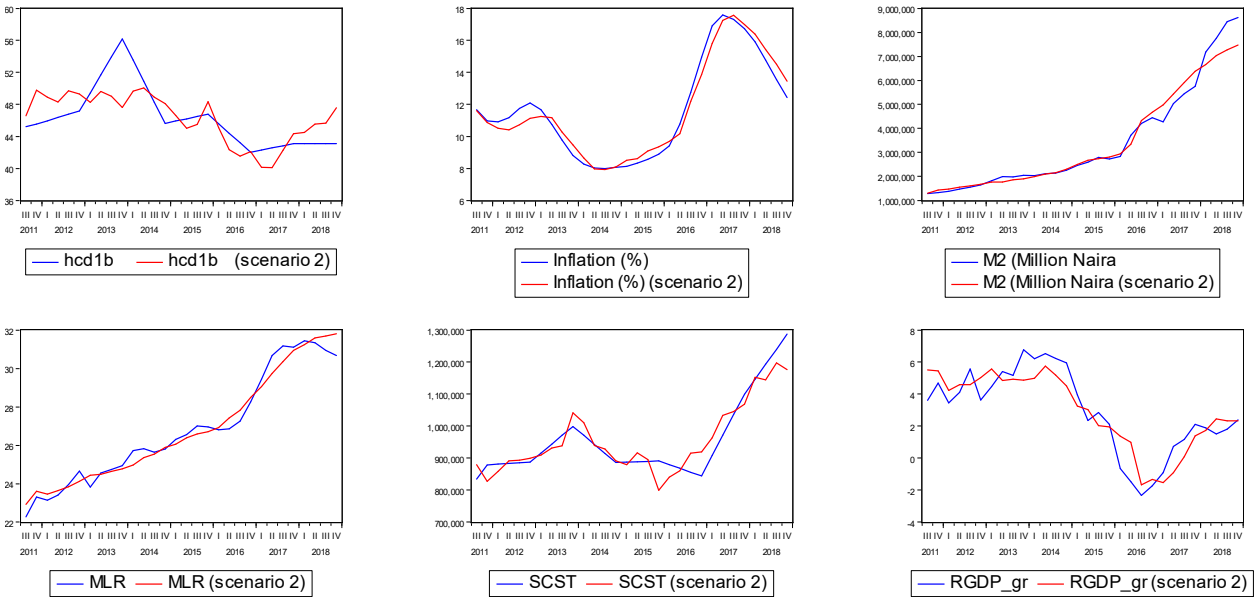

Figure 4.3b: In-sample forecast performance (using Secondary School Enrollment (SSE) for HCD)

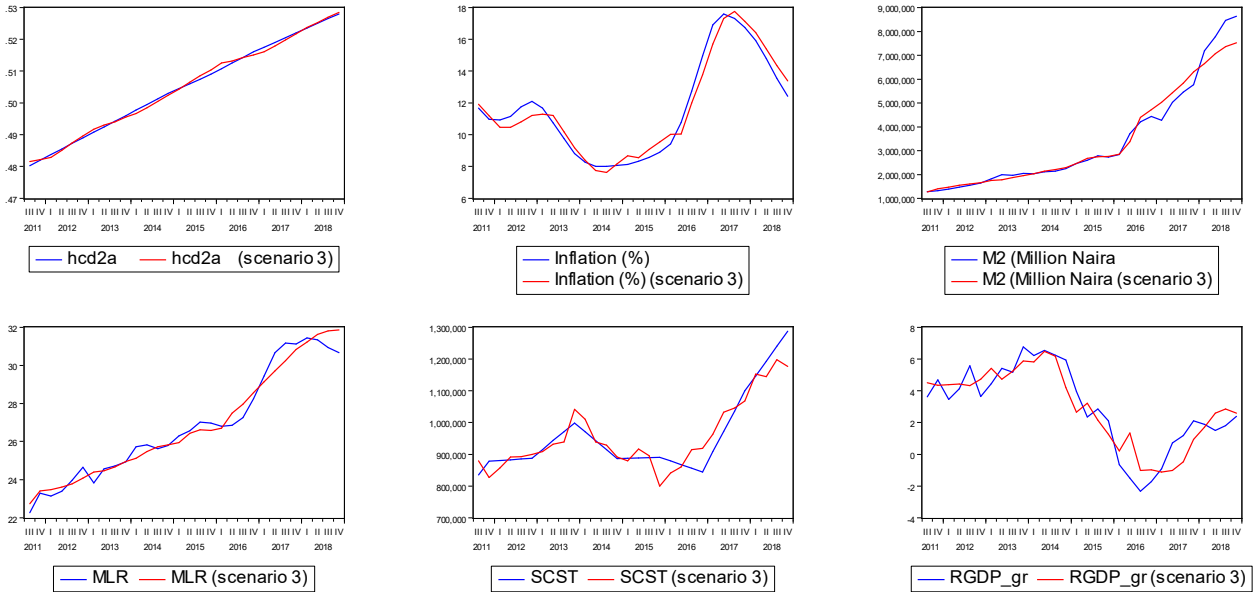

Figure 4.4a: In-sample forecast performance (using Education Index (EI) for HCD)

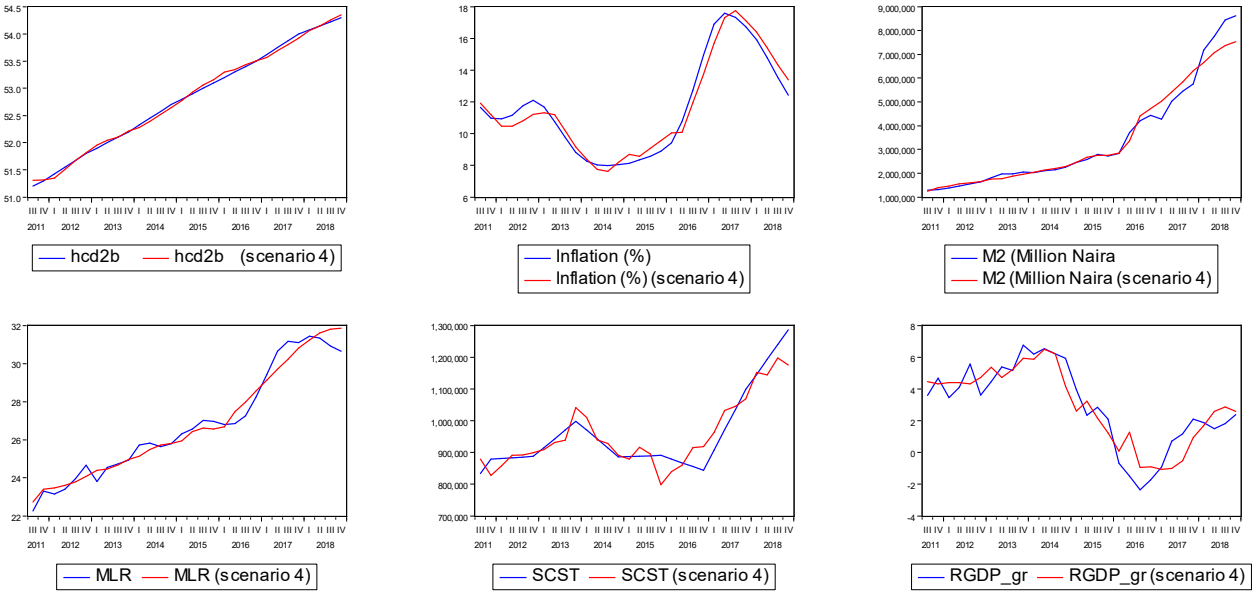

Figure 4.4b: In-sample forecast performance (using Secondary School Enrollment (SSE) for HCD)

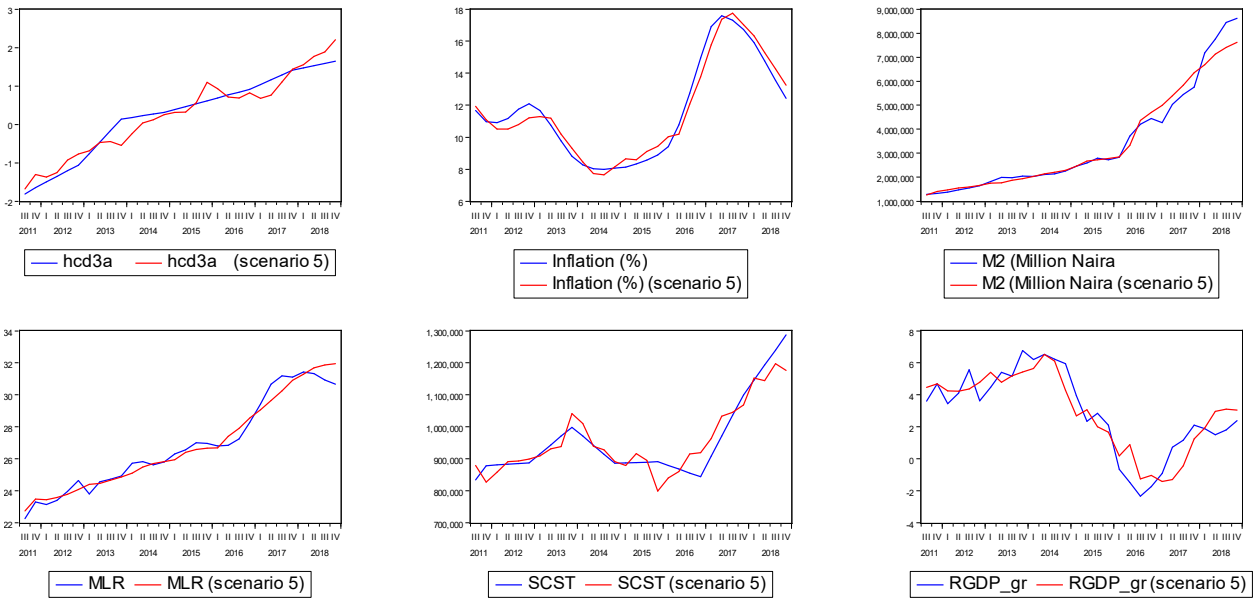

Figure 4.5a: In-sample forecast performance (using Composite of EI and LEI for HCD)

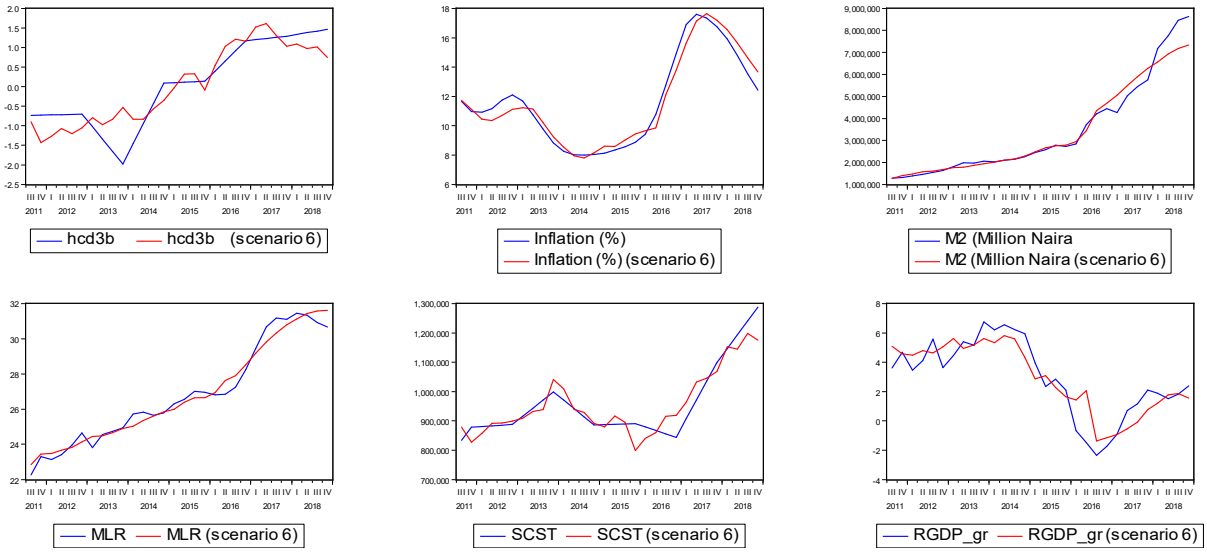

Figure 4.5b: In-sample forecast performance (using Composite of SSE and LEB for HCD)

4.3 Validation of the Estimated Model

The equation-based forecast evaluation criteria are presented in Table 4.3. This consists of the Root Mean Square Error (RMSE), Mean Absolute Error (MAE), Mean Absolute Prediction Error (MAPE) and Theil inequality. For all these criteria, the lower their values, the better. Summarily, the results are consistent with the model-based forecast evaluation criteria. Specifically, human capital development (using education index)was found to outperform human capital development (using secondary school enrolment) in modeling the effect of tax revenue and infrastructure, through human capital development (with education as indicator), on the Nigeria economy. The forecast performance of human capital development (using life expectancy index) is not significantly different from that of human capital development (using life expectancy at birth) in modeling the effect of tax revenue and infrastructure, through human capital development (with health as indicator), on the Nigeria economy.Meanwhile, human capital development (using composite of education and life expectancy indexes) was found to outperform human capital development (using secondary school enrolment and life expectancyat birth) in modeling the effect of tax revenue and infrastructure, through human capital development (with education as indicator), on the Nigerian economy.

Table 4.3: Equation-based Model Evaluation Criteria

Forecast	RMSE	MAE	MAPE	Theil U1	RMSE	MAE	MAPE	Theil U1
	Education Index (EI)				**Secondary School Enrollment (SSE)**			
RGDP_GR	**0.9729**	**0.7423**	39.8690	**0.1248**	1.0112	0.7849	**39.7162**	0.1304
HCD	**0.0100**	**0.0075**	**1.6142**	**0.0109**	2.6419	2.0022	4.2287	0.0285
LSCST	0.0440	0.0340	0.2468	0.0016	0.0440	0.0340	0.2468	0.0016
LM2	**0.0682**	**0.0554**	**0.3672**	**0.0023**	0.0734	0.0591	0.3914	0.0025
INF	**0.4874**	**0.3694**	3.2385	**0.0201**	0.5152	0.3764	**3.2159**	0.0212
LMLR	0.0179	0.0144	**0.4353**	0.0027	**0.0173**	0.0144	0.4380	**0.0026**
	Life Expectancy Index (LEI)				***Life Expectancy at Birth (LEB)***			
RGDP_GR	0.9747	0.7337	38.0870	0.1253	0.9747	**0.7304**	**37.6455**	0.1253
HCD	**0.0008**	**0.0006**	0.1235	0.0008	0.0485	0.0391	**0.0740**	**0.0005**
LSCST	0.0440	0.0340	0.2468	0.0016	0.0440	0.0340	0.2468	0.0016
LM2	**0.0697**	**0.0551**	**0.3642**	0.0023	0.0699	0.0552	0.3648	0.0023
INF	**0.5318**	**0.4079**	3.5153	**0.0219**	0.5361	0.4108	**3.5400**	0.0221
LMLR	0.0175	0.0143	**0.4318**	0.0027	0.0175	0.0143	0.4329	0.0027
	Model with Composite Index of EI and LEI				***Composite of SSE and LEB***			
RGDP_GR	**0.9614**	**0.7249**	**38.7605**	**0.1234**	1.0623	0.7808	39.6618	0.1372
HCD	**0.2615**	**0.1986**	**46.5588**	**0.1091**	0.4438	0.3382	63.0195	0.2247
LSCST	0.0440	0.0340	0.2468	0.0016	0.0440	0.0340	0.2468	0.0016
LM2	**0.0682**	**0.0548**	**0.3631**	**0.0023**	0.0753	0.0589	0.3889	0.0025
INF	**0.5026**	**0.3852**	3.3588	**0.0207**	0.5752	0.4219	**3.5501**	0.0237
LMLR	0.0178	0.0144	0.4351	0.0027	**0.0168**	**0.0138**	**0.4196**	**0.0026**

Source: Resaerchers' Computation using Stata

Table 4.4: Model Evaluation based on Human Capital Development (HCD) proxy

SN	HCD Proxy	Determinant Residual Covariance
1.	Education Index	6.48E-15
2.	Secondary School Enrollment	1.25E-09
3.	Life Expectancy Index	6.07E-17
4.	Life Expectancy at Birth	2.37E-13
5.	Composite of 1 and 3	4.55E-12
6.	Composite of 2 and 4	4.05E-11

Source: Computed by the Researcher

4.4 Policy Simulation

Relying on the model with composite index for human capital development, we conduct simulation analyses to forecast the effect of temporary and permanent increase in tax revenue,through human capital development, on the Nigerian economy and the effect of temporary and permanent increase in infrastructure, through human capital development, on the Nigerian economy.The analysis was conducted over the out-of-sample period (2019Q1 – 2020Q4) and results are presented in the subsequent sub-sections.

In Figure 4.6, we present the simulation results of the effect of a 10 percent temporary and permanent increase in tax revenue, through human capital development, on the Nigerian economy using the deviations of the variables from the baseline scenario, which is based the assumption that the variables in the model follows their natural path. In the figure, blue line represents the baseline scenario;red line indicates the effect of a 10 percent temporary increase in tax revenue, while the green line denotes the effect of a 10 percent permanent increase in tax revenue.Temporary 10 percent increase in value added tax revenue has higher effect on human capital development, real GDP growth, broad money supply and the maximum lending rate than the permanent 10 percent increase in value added tax revenue. Contrarily, permanent increase in value added tax revenue has higher effect on government spending on social and community services (including health and education) and inflation rate than the temporary 10 percent increase in value added tax revenue. Thus, to increase human capital development in Nigeria, temporary tax revenue shock is sufficient. This result appears to acknowledge the growth reducing effect of government tax by penalizing permanent increase in value added tax revenue with lower human capital development and real GDP growth enhancing capacity. The larger effect of permanent 10 percent increase value added tax revenue on government expenditure on social and community services (including health and education) indicates a direct relationship between government revenue and government expenditure.

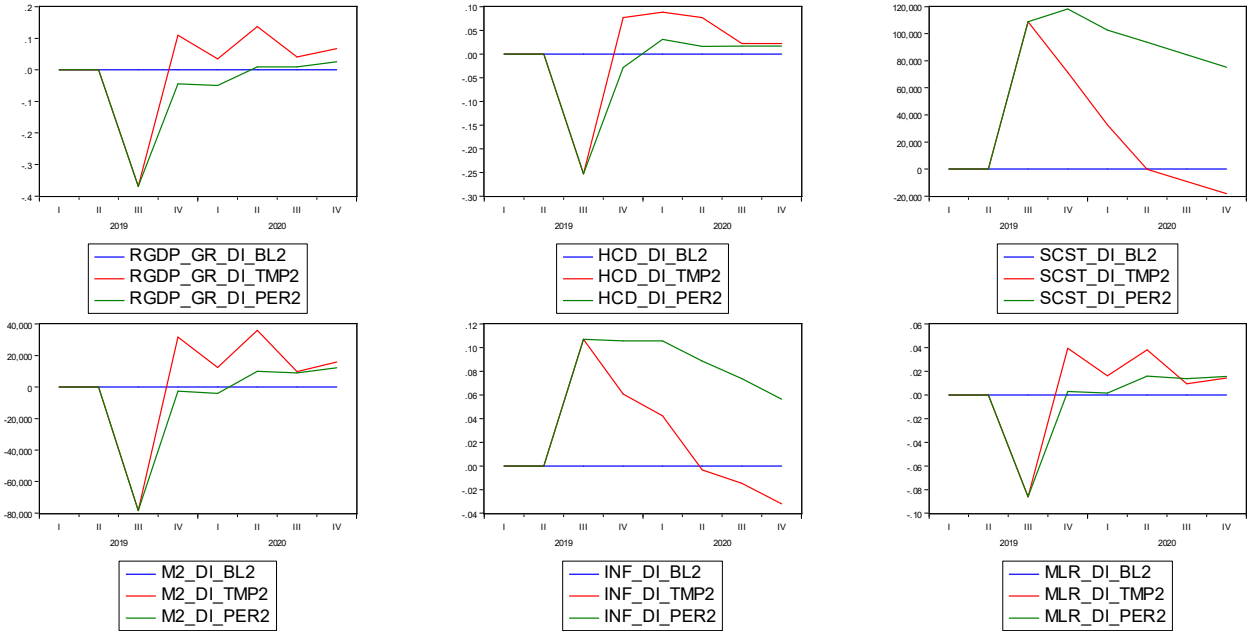

Figure 4.6: Effects of a 10 percent temporary and permanent change invalue added tax revenue on the Nigerian economy

In Figure 4.7, we present the simulation results of the effect of a 10 percent temporary and permanent increase in infrastructure, through human capital development, on the Nigerian economy using the deviations of the variables from the baseline scenario. The baseline scenariowas based the assumption that the variables in the model follows their natural path. Like under the effect of value added tax revenue (in sub-section 4.5.1),the blue line

represents the baseline scenario; red line indicates the effect of a 10 percent temporary increase in the level of infrastructural development, while the green line denotes the effect of a 10 percent permanent increase in the level of infrastructural development.

A temporary 10 percent increase in the level of infrastructural development has higher effect only on inflation rate compared to the permanent 10 percent increase. Both temporary and permanent 10 percent increase in the level of infrastructural development has no significant effect on government spending on education and health. Whereas, a permanent 10 percent increase in the level of infrastructural development has higher effect human capital development, real GDP growth, real money balances and nominal interest rate. Thus, to increase human capital development in Nigeria, permanent infrastructural development in required. Summarily, the simulation results suggest that real growth (occasioned by increase in the level of infrastructural development) has stronger effect on human capital development than nominal growth (occasioned by increase in government tax revenue). The weak effect of tax revenue in boosting human capital development may not unconnected with corruption and growth constraining effect of taxes.

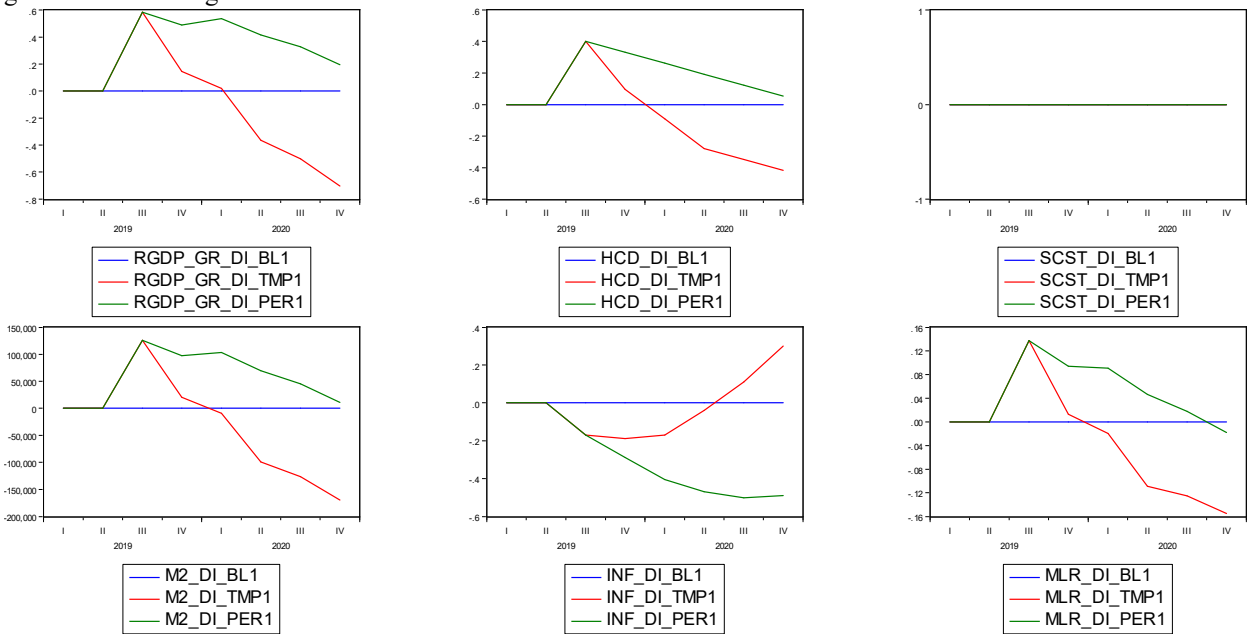

Figure 4.7: Effects of a 10 percent temporary and permanent change in infrastructure on the Nigerian economy.

4.5 Discussion of Findings

We combine education and health variables to form a more informative indicator of human capital development. The first composite HCD index for education and health was based on less volatile series, that is, education index and life expectancy index, while the second composite HCD index was based on relatively more volatile series, that is, secondary school enrolment and life expectancy at birth. Models with these two indicators of human capital development are presented in Tables 4.6a and 4.6b. The result from the small scale macroeconometric model of Nigeria using composite HCD index for education and health indexes (in Table 4.6a) reveals that human capital development has positive and statistically significant effect on economic growth in Nigeria. This is consistent with the earlier results and the postulation of the endogenous growth model. The result is however sensitive to the choice of human capital development proxy, as the alternative model (consisting of composite HCD index with secondary school enrolment and life expectancy at birth) shows contrary result. Meanwhile, the two models (in Table 4.6a & 4.6b) show evidence of positive and significant relationship between (Value Added) tax revenue and government expenditure on education and health. This implies that increase in tax revenue causes increase in government spending on social and community services including education and health.

Meanwhile, the models (in Table 4.6a & 4.6b) show negative relationship between government expenditure on education and health and human capital development. This is suggesting that increase in government expenditure on education and health will cause reduction in human capital development. This contradicts the theoretical expectation and the relationship between government spending on socialand community services and human capital development. The problem may be associated with the recent increase in the private sector expenditure on education and health, while government spending, particularly on capital social expenditure, has remained fairly constant. Thus, subsequent studies in this area may need to consider the effect of private sector spending on human capital development.

More so, this result indicates that human capital development channel does not constitute a good transmission link between tax revenue and the Nigerian economy. The problem may also be as a result of corruption in the government-led health sector, which is not making government spending on the health to translate into increase in human capital development with health as indicator (see Table 4.5a). While education index exhibits significant positive impact on human capital development (see Tables 4.4a), the negative impact exhibited by the composite HCD index (for education index and life expectancy index) may be influenced by the performance of health indicator. Thus, we may conclude thataggregation of education and health as indicator of HCD may yield inconsistent results. This conclusion isconsistent with evidence from the alternative model with composite HCD index based on secondary school enrolment for education and life expectancy at birth for health (see Table 4.6b). This is apparent as secondary school enrolment for education has positive and significant impact on human capital development (see Table 4.4b), while life expectancy at birth for health has negative insignificant effect (see Table 4.5b). Specifically, human capital development (using education index)was found to outperform human capital development (using secondary school enrolment) in modeling the effect of tax revenue and infrastructure, through human capital development (with education as indicator), on the Nigeria economy. The forecast performance of human capital development (using life expectancy index) is not significantly different from that of human capital development (using life expectancy at birth) in modeling the effect of tax revenue and infrastructure, through human capital development (with health as indicator), on the Nigeria economy. Meanwhile, human capital development (using composite of education and life expectancy indexes) was found to outperform human capital development (using secondary school enrolment and life expectancyat birth) in modeling the effect of tax revenue and infrastructure, through human capital development (with education as indicator), on the Nigerian economy. Temporary 10 percent increase in value added tax revenue has higher effect on human capital development, real GDP growth, broad money supply and the maximum lending rate than the permanent 10 percent increase in value added tax revenue. Contrarily, permanent increase in value added tax revenue has higher effect on government spending on social and community services (including health and education) and inflation rate than the temporary 10 percent increase in value added tax revenue. Thus, to increase human capital development in Nigeria, temporary tax revenue shock is sufficient. This result appears to acknowledge the growth reducing effect of government tax by penalizing permanent increase in value added tax revenue with lower human capital development and real GDP growth enhancing capacity. The larger effect of permanent 10 percent increase value added tax revenue on government expenditure on social and community services (including health and education) indicates a direct relationship between government revenue and government expenditure. Moreover, a temporary 10 percent increase in the level of infrastructural development has higher effect only on inflation rate compared to the permanent 10 percent increase. Both temporary and permanent 10 percent increase in the level of infrastructural development has no significant effect on government spending on education and health. Whereas, a permanent 10 percent increase in the level of infrastructural development has higher effect human capital development, real GDP growth, real money balances and nominal interest rate. Thus, to increase human capital development in Nigeria, permanent infrastructural development in required. Summarily, the simulation results suggest that real growth (occasioned by increase in the level of infrastructural development) has stronger effect on human capital development than nominal growth (occasioned by increase in government tax revenue). The weak effect of tax revenue in boosting human capital development may not unconnected with corruption and growth constraining effect of taxes.

4.6 Policy Implication of Findings

The foregoing analysis has thus revealed the effect oftax revenue and infrastructure on human capital development in Nigeria. From the results, the following were observed: First, value added tax has positive and statiscally significan effect on government expenditure on education and health. This implies that an increase in tax revenue causes increase in government's spending on education and health in Nigeria. Second, health is not a good channel through which tax revenue can be used to influence economic growth, relative to education. Education impacts more on human capital in Nigeria than health. Three, higher investment in infrastructure or higher infrastructure will increase economic growth and human capital development. Four, positive and significant relationship exist between value added tax revenue and government expenditureon education and health. This implies that increase in tax revenue causes increase in government spending on social and community services including health and education. Five, to increase human capital development in Nigeria, temporary tax revenue shock is sufficient. This implies the growth reducing effect of government tax via permanent increase in value added tax revenue. Six, to increase human capital development in Nigeria, permanent infrastructure development and investment is required.

5 Conclusion and policy recommendations

Specidically, it can be deduced fom this paper that: i)Education is a good channel through which tax revenue and infrastructure can be used to influence the Nigerian economy,ii) Education is a better link than health as indicator of human capital development, when modeling the effect of tax revenue on economic growth though human capital

development, and iii) Aggregation of education and health as indicator of human capital development may yield inconsistent results; iv) Tax revenue (value added tax receipt) does not serve a good link through human capital development to economic growth, but infrastructure does; iv) Real effect (infrastructural development) has much impact than nominal effect (increase in tax revenue and government spending on health and education) in promoting human capital development, vi) To increase human capital development in Nigeria, temporary increase in tax revenue is sufficient; vii) To increase human capital development in Nigeria, permanent infrastructural development is required.

5.1 Policy Recommendations

In line with the findings of this paper enumerated in the preceding section, the study recommends that: (i) The government should increase its investment on critical infrastructure to further bolster human capital development and by extension accelerate the rate of economic growth, (ii) The government should diversify its revenue base and expend more on health and education in addition to building a strong institutional framework to ensure the efficacy of government spending on both health and education.

5.2 Contributions to Knowledge

The contributions of the study to existing knowledge are as follows:

i)Among the first empirical studies that examined the effect of tax revenue and infrastructure through human capital development using education index. An approach that supports the endogenous growth model.

ii) Among the first empirical studies that examined the effect of tax revenue and infrastructure through human capital development using life expectancy index and life expectancy at birth as proxy for health.

iii) Quite novel, as the study examined the effect of tax revenue and infrastructure through human capital development using composite of education and health as indicators of human capital development, first of its approach in the literature.

iv) Most importantly, its forcasting power using the root mean square error, mean absolute error, mean absolute prediction error and Theil inequality is contributory to the literature. As such, the effect of temporary and permanent increase in tax revenue through human capital development were examined as well as the effect of temporay and permanent increase in infrastructure through human capital development were investigated using deviations of the variables from the baseline scenario.A value addition to the literature.

5.3 Suggestion for Future Research

The paper focused on the effect of a component of government revenue, namely, tax revenue and infrastructure on economic growth through their impact on human capital development neglecting the role of the private sector on this nexus. With the expanding contribution of the private sector to the education and health sectors in Nigeria, accounting for its role in macroeconometric analysis of the effect of human capital development on economic growth in Nigeria may give a better and more holistic result. This is an area that can be explored in future research. Also, as pointed out earlier in our analysis, the unexpected negative effect of increased tax revenue on economic growth through its impact on life expectancy and life expectancy index as indicators of human capital development suggests a weak institutional support to guarantee the effectiveness of government health spending on improving health performance and human capital development to accelerate economic growth. This hypothesis has not been tested in our analysis and investigating it in future research will be worthwhile.

References

Eigbiremolen, G.O., & Anaduaka, U.S.(2014) Human capital development and economic growth. The Nigerian experience. International Journal of Academic Research in Business and Social Sciences, 4(4), 25-35.

Faria, H.J., Montesinos-Yufa H. M., Morales, D.R., & Navarro, C.E. (2016) Unbundling the roles of human capital and institutions in economic development. *European Journal of Political Economy (2016),doi: 10.1016/j.ejpoleco.2016.08.001*

Johnson, A.O. (2011). Human capital development and economic growth in Nigeria. *European Journal of Business and Management,*Vol. 3, Issue 9, pp29-38.

Mohammed, J.I., Karimu, A., Fiador, V.O. & Abor, J.Y. (2020).Oil revenues and economic growth in oil-producing countries: The role of domestic financial markets. *Resources Policy, (69)101832.*

Usman, F.K. & Adeyinka, O. (2019). Effect of human capital development on economic growth of ECOWAS member states. *Advances in Sciences and Humanities,*Vol. 5, Isue 1, pp 27-42.

Wang, C. & Lee, P.T. (2020). Railway and road infrastructure in the belt and road initiative countries: Estimating the impact of transportation infrastructure on economic growth. *Transportation Research Part A: Policy and Practice*, Vol. 134, pp 288-3-7

Ajakaiye, D. O. (1995). Short run macroeconomic effects of bank lending rates in Nigeria, 1987-91: A Computable General Equilibrium Analysis. AERC Research paper 34, Nairobi, Kenya.

Akanbi, O. A. & Du Toit, C.B (2009). Macro-econometric modeling for the Nigerian economy: Growth Poverty Gap Analysis. Available at http://www.africametrics.org/documents/conference09/papers/Olusegun_DuToit.pdf

Berg, A., Karam, P. & Laxton, D. (2006). Practical model-based monetary policy analysis- A How-To Guide. IMF Working Paper, WP/06/81.

Bundell R., Dearden Lorraine, Meghir C., Barbara Sianesi (1999). Human capital investment: The returns from education and training to the Individual, the firm and the economy, *Fiscal Studies*, vol. 20, no. 1, pp. 1-23.

De la Fuente Á, & Cicoone A, (2002). Human capital in a global and knowledge-based economy, Final Report, European Commission.

Ekeoku N.I. (1984). Simulation and fiscal policy analysis with a macroeconometric model of the Nigerian economy. Unpublished PhD. Thesis, University of Ibadan.

Funke M., & Strulik, H. (2000). On endogenous growth with physical capital, human capital and product variety, *European Economic Review*, 44, pp. 491-515.

Ghosh, D. & Kazi, U. (1978). A macroeconomic model for Nigeria". 1958-19. Physica-Verlag, Vienna *Empirical Economics*, Vol. 3, Issue 3, pp135-154.

Iyoha, M. A. (2003). An overview of leading issues in the structure and development of the Nigerian economy since 1960 in Nigerian economy: Structure, growth and development. Edited by Milton Iyoha and Chris Itsede.

Kwiatkowski, D., Phillips, P., Schmidt, & Shin, Y. (1992). Testing the null hypothesis of stationarity against the alternative of a unit root. *Journal of Econometrics*, 54, 159-178.

Mankiw NG, Romer D, & Weil D. (1992) A contribution to the empirics of economic growth. *Q J Econ.* 107(2):407–438.

Mordi, C. N. O. (1988). A macroeconometric models of the Nigerian economy, Ph.D. Proposal Submitted to the Department of Economics, UNILAG, Lagos.

NISER (1983). The NISER econometric model of the Nigerian economy, Nigerian Institute of Social and Economic Research, Ibadan.

Ojo, G.O. (1972). "An econometric-simulation model of the Nigerian economy", Unpublished PhD Thesis, State University of Science and Technology, Ames, Iowa.

Olofin, S. (1977). A tentative specification of an econometric model of the Nigerian economy", mimeo, University of Ibadan.

Olofin, S. (1985). Modelling Nigeria's economic development, Ibadan University Press, Ibadan.

Olofin, S.O., Olubusoye, O.E., Mordi, C.N.O., Salisu, A.A., Adeleke, A.I., Orekoya, S.O., Olowookere, A.E., & Adebiyi, M.A. (2014). A small macro-econometric model of the Nigerian economy. *Economic Modeling*, 39C, 305-313.

Olofin, S.O., Salisu, A.A., & Tule, M.K. (2017). Revised small macro-econometric model of the Nigerian Economy. *Applied Econometrics and International Development* 20-1.

Olubusoye, O.E., Olofin, S. O., Sarah O. Alade, S. O., Oloko, T.F., Ogbonna, A. E. and Isah, K.O. (2016). Forecasting the impact of global oil price movement on the Nigerian economy. In: Adenikinju A., Jerome A., and Ogunkola O. (Eds.). Chapter 14: The Quest for Development: Essays in Honour of Professor Akin Iwayemi at 70.

Oshikoya, T.W. (1990) The Nigerian Economy: A macroeconometric and input-output model, Praeger Publishers, New York.

Oyinlola, M. A., Adedeji, A. A., Bolarinwa, M. O., & Olabisi, N. (2020). Governance, domestic resource mobilization, and inclusive growth in sub-Saharan Africa. *Economic Analysis and Policy*, 65, 68-88.

Phillips, P.C. B. & Perron, P. (1988). Testing for a unit root in time series regression, *Biometrika*, 75, 335-346.

Raheem, I.D., Kazeem, O.I. & Adedeji, A.A. (2018), "Inclusive growth, human capital development and natural resource rent in SSA", *Economic Change and Restructuring*, 51, 29-48.

Salisu, A.A., Ademuyiwa, I., & Basiru, F. (2013). Modelling the demand for money in Sub-Saharan Africa (SSA). *Econ. Bull*. 33 (1), 635–647.

Soludo, C. C. (1998). Macroeconomic policy modelling of the African Economies. ACENA Publishers.

Soludo, C.C. (2002). Macroeconomic modelling and economic policymaking: A survey of experience in Africa, AERC.

UNCTAD (1973). Model of the Nigerian Economy, Ball (ed.) The international linkage of the National model. Amsterdam: North-Holland Pub. Coy.

Uwujaren, G.P. (1977). "Specification and Estimation of an Economy-wide Macroeconometric Model of Nigeria", *The Nigerian Journal of Economic and Social Studies*, 14(3), 12-16.

Woodford, M., 2003. Optimal monetary policy inertia. Rev. *Econ. Stud.* 70, 861–886.

World Bank. (1974). World Bank long-term projection model of the Economy, in Nigeria, Options for long-term development. Baltimore: Johns Hopkins Press.