HUMAN CAPITAL AND MANUFACTURING PRODUCTIVITY IN NIGERIA

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Abstract

This study examined the impact of human capital on manufacturing productivity in Nigeria. It employed time series data, covering the period 1981-2012. The time series properties of the variables were examined using the Phillips-Perron (PP) tests for unit roots and co-integration analysis. Thereafter, error correction estimation technique was applied to achieve the objective of the study. The findings were mixed. Health expenditure had positive and significant impact on manufacturing productivity while education expenditure affected manufacturing productivity negatively and significantly. A percentage rise in health and education expenditures led to approximately 0.02%increase and 0.01% decline in manufacturing productivity respectively. The coefficient of error correction variable was rightly signed and statistically significant. The speed of convergence to equilibrium was 46%. The adjusted R-Squared stood at 88%, an indication of a strong explanatory power of the model. The policy implication of the study is that government should increase expenditure on health facilities while expenditure on education should be strictly monitored.

Keywords: *Human capital, manufacturing productivity, Nigeria.*

JEL Classification: J24, 014

INTRODUCTION

Throughout the twentieth century and beyond, human capital has been observed to play very critical role in economic growth and development processes. This is based on the premise that people and their skills matter for economic wellbeing; and moreover, the wealth of any society is embodied in its people. The works of Schultz (1961), Becker (1962), and Mincer (1974) further bring to the fore important contribution of human capital in any economy. Besides, empirical findings by Lucas (1988); Romer (1990); and De la Fuente (2011) have also confirmed positive and significant contribution of human capital to economic growth and development of nations.

Human capital development policy has been one of the fundamental measures put in place by most African countries to engender growth and development of their economies. However, development indicators appear to suggest that not many of the efforts are yielding the desired outcomes. For instance, the Human Development Index (HDI) of Nigeria as released by United Nations Development Programme (2013) shows Nigeria ranking 153 (0.471) out of 186 countries, an indication of a very low human development. Furthermore, the nation's inequality-adjusted life expectancy index (ILEI) and inequality-adjusted education index (IEI) stood at 0.286 and 0.250 respectively. These seem low compared to 0.629 ILEI and 0.558 IEI as well as 0.508 ILEI and 0.352 IEI recorded by South Africa and Ghana respectively. In addition, the level of inequality in its different forms-income, gender, social, etc appears unnecessarily high in Nigeria, which could worsen human capital development problem.

Another critical issue debilitating human capital development activities in Nigeria is disease prevalence. Some of the top disease responsible for high mortality and morbidity rates in the country include: Malaria, HIV/AIDS, and Tuberculoses. United States Embassy in Nigeria (2011) reports that malaria constitutes a major public health problem in the country, accounting for more morbidity and deaths than in any other country in the world. The Embassy revealed that about 97% of the nation's population is at risk of malaria. Approximately, 100 million malaria cases and over 300,000 deaths due to the disease are recorded annually. World Health Organization (2012) attributes 20% of deaths among children age 5 in the country to malaria. In the same vein, Nigeria accounts for the second largest burden of HIV/AIDS globally, with about 3.5 million persons living with the virus (National Agency for the Control of AIDS, 2012).

Empirical literature on human capital and manufacturing productivity is scarce in Nigeria except Olayemi (2012), who focuses on human capital investment and industrial productivity. The present study therefore fills this gap by investigating the impact of human capital, captured by public expenditures on health and education sectors on manufacturing productivity, over the period 1980-2012. The rest of the paper is structured thus: section two provides stylized information on human capital situation in Nigeria and the contribution of manufacturing sector to gross domestic product (GDP) of the nation. Section three focuses on review of related literature while section four presents empirical results and discussion. Section five gives concluding remarks and policy implication of the study.

STYLIZED FACTS

Education in Nigeria

Western education in Nigeria was the brain child of Christian Missionaries (see Oluniyi & Akinyeye, 2013). As the nation began to prepare for political independence, a commission (Ashby Commission) was set up in 1959 to determine the manpower requirement of the country as it relates to post-school certificate education (see Ojo, 1997, and Dauda, 2011). Governments at various levels have continued to invest in education and health sectors while

private individuals have also been instrumental to the development of both sectors. However, these efforts appear to have yielded minima results.

Financial System Strategy (FSS) 2020 International Conference maintained that out of the 42 million children in Nigeria, who are supposed to be enrolled in primary school, less than 24 million are in school while only 6.4 million out of the 33.9 million children of secondary school age are enrolled in school.

United States Embassy in Nigeria (2012) maintained that Nigeria has a very large number of out-of-school children and young adults who possess limited literacy and numeracy skills, which may impair them from joining the formal workforce. The embassy gave some striking statistics, which are pointer to poor education indicators in the whole country. For instance, while enrolment in primary schools across the country appears encouraging, less than one-third of children in basic school are likely to proceed to senior secondary school. This is glaring from figure 1, showing enrolments in junior and senior secondary schools being below 5 million over the years.

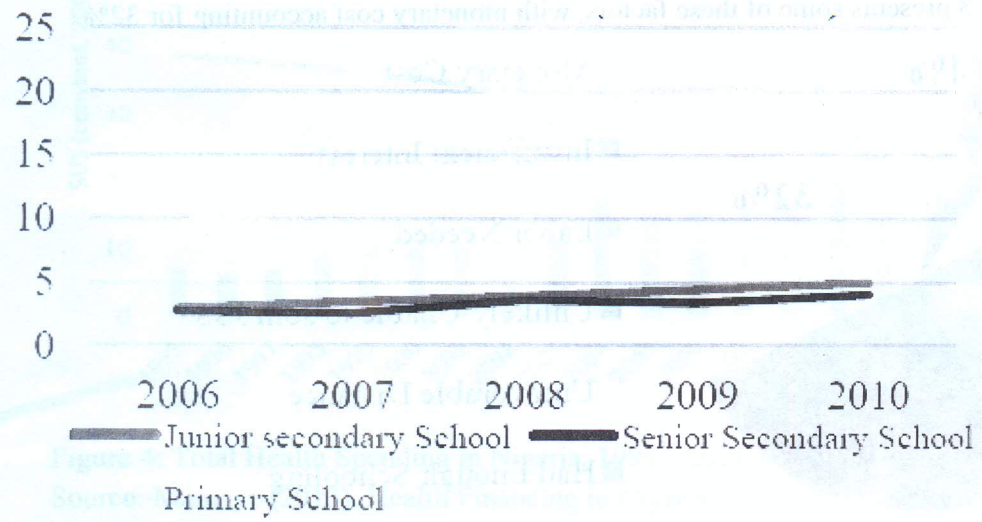

Figure 1: School Enrollment (in millions)

Source: United States Embassy in Nigeria (2012). Nigeria: education fact sheet

Furthermore, the average university enrollment in the country for the period 2008-2010 stood at 37.6% for women, compared to 62.4% for men. It is evident from figure 2 that not up to 20% of those seeking for admission into the universities actually secured one. These figures are far cry from what is supposed to hold considering the large number of students seeking admission to tertiary institutions in the country.

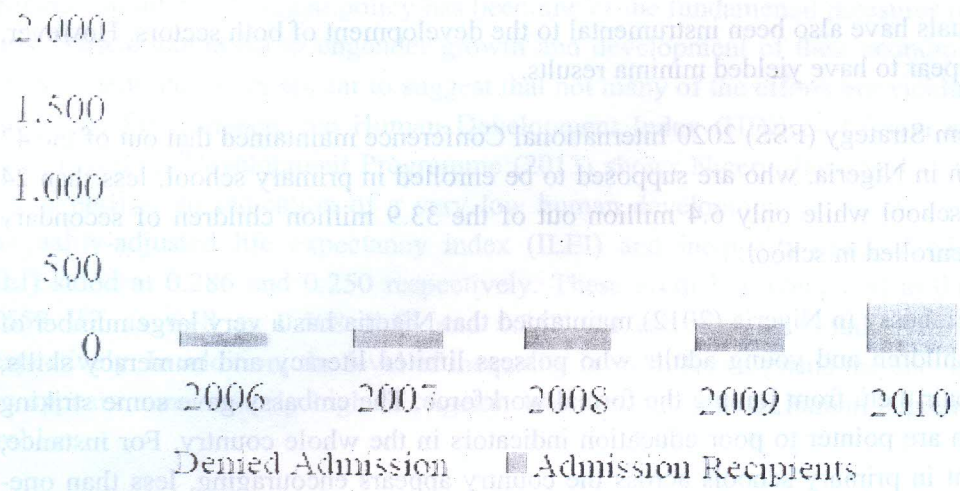

Figure 2: Application and Admission into Nigerian Universities (in thousands)
Source: United States Embassy in Nigeria (2012). Nigeria: education fact sheet.

Additionally, school dropout rate has been quit alarming; and several factors are responsible for this. Figure 3 presents some of these factors, with monetary cost accounting for 32%.

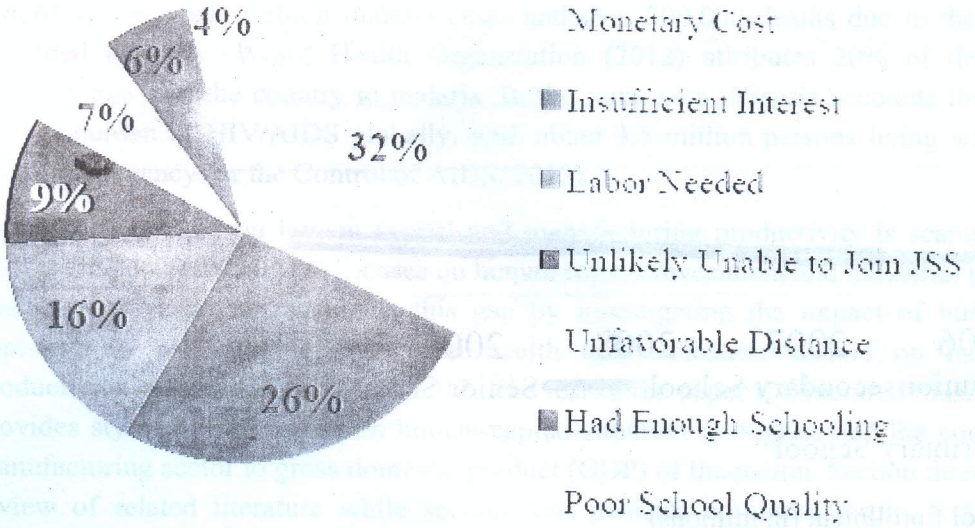

Figure 3: Factors Influencing Primary School Drop-Out
Source: United States Embassy in Nigeria (2012). Nigeria: education fact sheet.

With respect to funding, only 8.42% of the 2012 national budget was allocated to education sector (United States Embassy in Nigeria, 2012).

Health in Nigeria

The three tiers of government-Federal, State and Local, are key players in the health sector in Nigeria, in addition to private sector operators. However, private spending on health is the highest (see figure 4), with about 60% of all health spending financed by households (Mamaye, 2013). Out-of-pocket (OOP) spending remained very high because a large number

of Nigerian population lacks access to health insurance. According to Uzochukwu (2013), 70% of healthcare payments is made OOP. Of the total health expenditure in Nigeria, the author revealed that 3% comes from firms, 4% from development partners, 12% from the federal government, 8% from state government, and 4% from the local government while 69% comes from households. He maintained that out of private expenditure on health, OOPs alone increased from 92.7% to 95.9% in 2007. Moreover, 20% to 30% of total health expenditures come from the governments; however, 70% to 80% "of total health expenditure" are private expenditures (Riman & Akpan, 2012, p. 297). These facts are obvious in figure 4, showing private health spending outweighing public spending. Furthermore, public health expenditure as percentage of GDP and total expenditure remain very low, as contained in table 1.

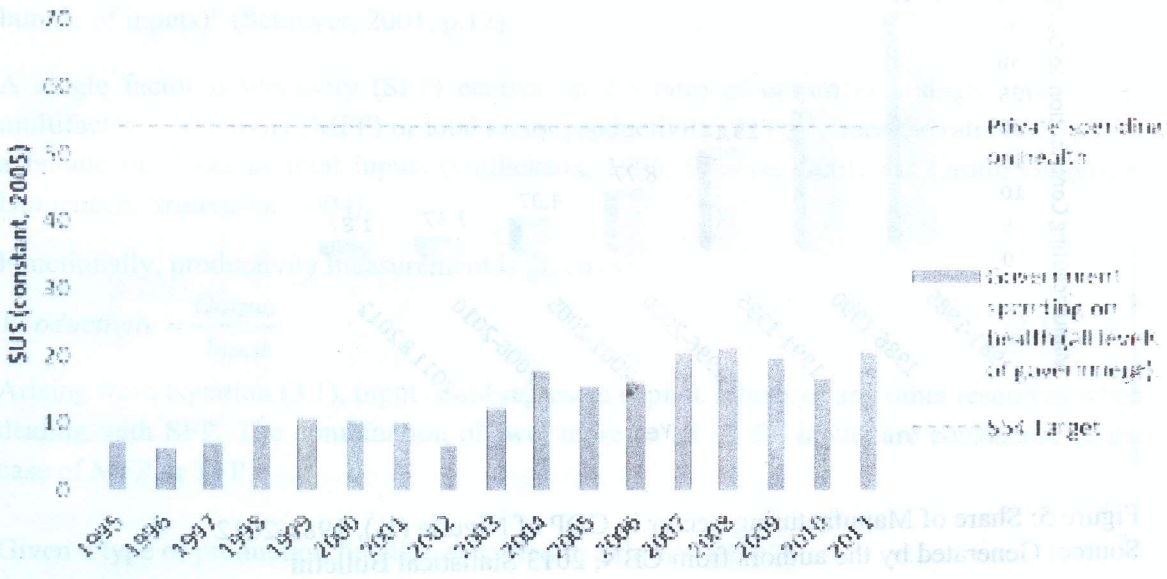

Figure 4: Total Health Spending in Nigeria, 1995 – 2011
Source: Mamaye (2013). Health Financing in Nigeria

Table 1: Health Expenditure as Percentage of Total Budget and Gross Domestic Product, 2009-2011

Year	2009	2010	2011
Total allocation (Nigerian Naira in Billion)	3,557.7	4,427.2	4,971.9
Allocation to health (Nigerian Naira in Billion)	154.6	164.9	266.7
As % of total budget	4.3	3.7	5.4
Gross Domestic Product (GDP, Nigerian Naira in Billion)	25,102.44	0,980.84	36,123.11
As % of GDP	0.6	0.5	0.7

Uzochukwu (2013).

Manufacturing Sector

The Nigerian economy experienced significant transformation after her political independence in 1960. However, the discovery of oil led to the neglect of other sectors such as agriculture and manufacturing. Citing Central Bank of Nigeria (2008), Loto (2012); and Atoyebi, Okafor & Falana (2014) indicated that the share of the nation's manufacturing sector in the GDP has been relatively low. In 1970 the sector contributed 9% to the nation's GDP while in 1980 it contributed 10%. Conversely, this share declined to 8% in 1990, 6% in 1998 and further to 5.9% in 2008. This declining trend has also continued in recent times. A peep into figure 5 showed the mean contribution of the sector to GDP for the period 2006-2010 as 2.37%. This however, fell to 1.87% during 2011-2012 period.

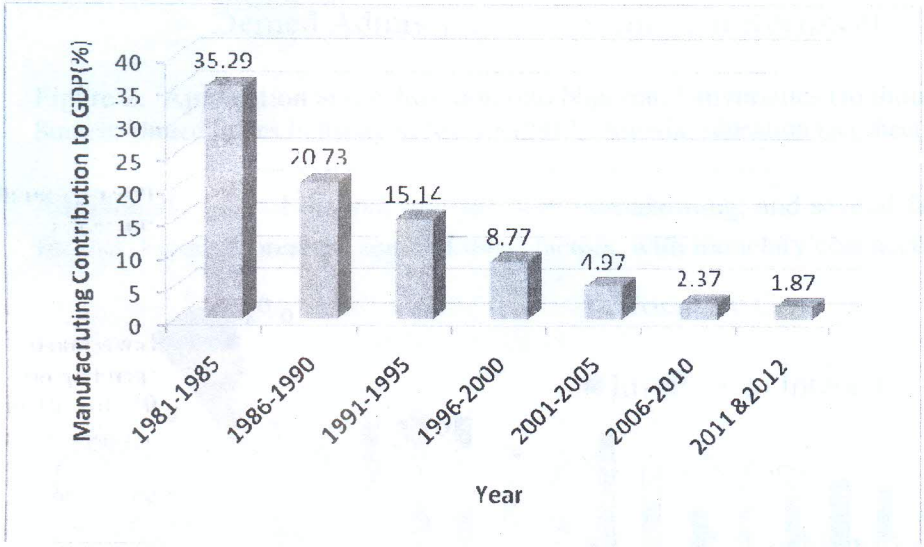

Figure 5: Share of Manufacturing Sector in GDP of Nigeria (%), 1981-2012
Source: Generated by the authors from CBN, 2013 Statistical Bulletin

LITERATURE REVIEW

Theoretical Issues

Human capital, a product of investment in education, health, training, and migration is very critical for productivity enlargement. De la Fuente (2011, P. 2) has observed that "theoretical models of human capital and growth are built around the hypothesis that the knowledge and skills embodied in humans directly raise productivity and increase an economy's ability to develop and to adopt new technologies." Productivity enhancement of human capital manifests in three specific areas. Human capital helps to improve individual, organizational and societal productive capacities thereby contributing to increase in income at the three levels (Kwon, 2009).

Human Capital and Productivity

Productivity is the key to long term economic growth. Increases in productivity allow firms to produce more output with the same quantity of inputs. Different potential drivers of productivity manifest in "technological change, increases in human capital, microeconomic reforms, trade related reforms, and competition" (Commonwealth of Australia, 2013, p.6). However, the focus of this review is on human capital and manufacturing productivity.

Measurement of Productivity

Different measures of productivity are discussed in the literature, depending on the purpose and data availability. Generally, productivity relates output to input; be it at individual, firm, national, regional or global level. Two distinct categories of productivity measures stand out. These include: "single factor productivity measures (relating a measure of output to a single measure of input) or multifactor productivity measures (relating a measure of output to a bundle of inputs)" (Schreyer, 2001, p.12).

A single factor productivity (SFP) centres on the ratio of output to a single input while multifactor productivity (MFP) or total factor productivity (TFP) defines the ratio of output to a bundle of inputs or total inputs (Gullickson, 1995, Schreyer, 2001; and Groth, Gutierrez-Domenech, Srinivasan, 2004).

Functionally, productivity measurement is given as:

$$\text{Pr}\,oductivity = \frac{Output}{Input} \tag{3.1}$$

Arising from equation (3.1), input could represent capital, labour or any other resources when dealing with SFP. The combination of two, more or all of the inputs are considered in the case of MFP or TFP.

Given a type of production function specified in Schreyer (2001),

$$Q = H(A, X, M) = A(t).F(X, M) \tag{3.2}$$

Where:

Q stands for maximum quantity of output produced through the combination of the right-hand-side variables, X denotes all primary inputs, such as labour and capital (physical or human), and M signifies intermediate inputs. $A(t)$ on the other hands is a parameter that captures disembodied technological shifts.

From equation (3.2), Labour, capital and intermediate productivity ratios can be given as

$$\frac{Q}{L}, \frac{Q}{K}, \frac{Q}{M} \text{ respectively.} \tag{3.3}$$

Where: L, K and M are correspondingly labour, capital and intermediate stocks.

In terms of MFP or TFP, the ratio becomes

$$MFP/TFP = \frac{Q}{F(X, M)} \text{ or } MFP/TFP = \frac{Q}{F(A, X, M)} \tag{3.4}$$

The level of technological change $A(t)$ becomes:

$$A(t) = \frac{Q}{F(X, M)} \tag{3.5}$$

To determine the change in output as a result of a change in any of the inputs or all of the inputs, the function can be differentiated with respect to the input of reference. This could also be done with respect to time.

For instance equation (3.5) can be derived with respect to time as

$$A(t) = \frac{\partial \ln H}{\partial t} \tag{3.6}$$

To determine the contribution of any of the inputs to output, a partial derivate of equation (3.2) can be derived with respect to the particular input in question.

When Q is assumed as manufacturing productivity, then the impact of any of the inputs on Q can be determined. When human capital is included as one of the inputs, its effects on manufacturing productivity can be derived.

Literature provides theories and models through which human capital and productivity relate. For instance the works of Solow (1956 & 1957); Lucas (1988); and Mankiw, Romer, & Weil (1992) are based on neoclassical (exogenous growth) theory while that of Aghion & Howitt (1988); and Romer (1990) centred on new endogenous) growth theory. The theories, stress the role of human capital accumulation in economic growth process (Chakraborty, 2005). They incorporate human capital in their models to determine how it affects the level of productivity in the economy. One important difference between exogenous and endogenous theories is that while the former views technological advancement as determined outside the model, the latter considers technology as inherently determined from within the model.

Robert Solow in his 1956 and 1967 articles identify three important determinants of income growth to include increases in physical capital, size of the labour force, and a residual (otherwise known as the Solow residual or technical progress, which invariable captures other factors. One important factor that contributes to the growth of this factor is education, a form of human capital); whose contribution to per capita income growth appears larger than other growth determinants. Dickens, Sawhill & Tebbs (2006) revealed that education contributes between 13% and 30% to labour productivity growth while according to the author, who cited Jorgenson & Stiroh (2000) the contribution of education to economic growth stood at 8.7% of total growth, and 13% of growth in output per worker over the period 1959 to 1988.

Empirical Evidence

One of the earliest studies was conducted by Cörvers (1996) to determine effects of human capital on level and growth of labour productivity in the manufacturing sectors in seven Member States of the European Union. The author uses the shares of intermediate and highly-skilled workers in the work force of the manufacturing sector to capture human

capital, dividing the sector into low-skill, medium-skill and high-skill. The findings revealed that intermediate and highly-skilled labour have positive effect on sectoral labour productivity. However, the effect was only significant for highly-skilled labour. Intermediate skilled labour also has a significantly positive effect on the growth in sectoral labour productivity.

Similarly, Ciccone & Papaioannou (2007) explored how human capital imparts growth among 37 manufacturing industries in 40 countries. Their findings showed that output growth in schooling-intensive industries was significantly faster in economies with higher education levels and greater education improvements than in countries with low education levels.

To determine the connection between total government spending and economic growth in Nigeria over the period 1977-2006, Maku (2009) incorporated human capital variable among the regressors. The result shows that human capital investment as a share of real output, has positive but insignificant effect on the growth rate of real GDP. A superior estimation technique could have produced better outcome than the ordinary least squares (OLS) employed for several of the analyses.

Lawal & Wahab (2011) also employed an OLS estimation technique to analyze the impact of education on economic growth in Nigeria between 1980 and 2008. The authors found a direct and significant effect of education on economic growth in the country. One reservation about the study is that the authors carried out static regression without testing the time series properties of the variables used for analysis. It has been discovered that most time series variables are non-stationary, and failure to examine their properties before regression may produce spurious results, and as such the findings may not be reliable.

The emphasis of the research conducted by Dauda (2011) was on health as a determinant of economic growth. The author used error correction modelling approach; however, the focus was on health capital and economic growth rather than manufacturing productivity. The findings revealed negative and significant relationship between government expenditure on education and economic growth while health expenditure showed positive and significant impact on growth.

Olayemi (2012) also employs co-integration and error correction modelling approach to study how human capital investment and industrial productivity in Nigeria relate over the period 1978-2008. His findings showed a direct relationship between government expenditure on education and index of industrial production while health expenditure and gross capital formation were found to have exhibited long run negative relationship with the index of industrial production.

A more recent study by Kathuria, Rajesh Raj & Sen (2013) on human capital and manufacturing productivity growth in India employed literacy rate as human capital measure. The authors use firm level data covering both formal and informal manufacturing sector across 90 industries for 15 major states in India over the period 1994-2005. The results showed education as a fundamental determinant of total factor productivity (TFP) growth of

Indian industries. This stems from the positive relationship between literacy and TFP growth that emerged from the analysis.

Apparently, the empirical studies reviewed above, particularly on Nigeria suffer from methodological weaknesses. Most of them employed OLS estimator without checking the time series properties of the variables used. Some carried out such check after the main analysis, implying that the test results did not reflect on the overall outcome of the study. Few others, which used error correction modeling approach, have the error correction variable appearing insignificant, which is counterintuitive. Another observation was that only one study focused on human capital impact on industrial sector. The remaining concentrate more on how human capital imparts economic growth.

METHODOLOGY

Following Aderemi (2014), which derives from the Lucas human capital theory, the framework used in the present study relates human capital to economic performance, with the function

$$Y = AK^{\beta}(thL)^{1-\beta} \tag{4.1}$$

Where:

Y represents manufacturing productivity; K signifies physical capital; L implies labour; t shows the proportion of time devoted to work; h indicates human capital; A equals available technology while β denotes elasticity of inputs.

Assuming the function exhibits constant returns to scale, it can be shown that

$$\lambda Y = Y(\lambda K, \lambda thL) = \lambda Y[K,(thL)] \tag{4.2}$$

Letting $\lambda = \frac{1}{L}$ (4.3)

The per capita term of equation (4.1) expressed in intensive form gives

$$y = Ak^{\beta}(th)^{1-\beta} \tag{4.4}$$

From equation (4.4), it is evident the function displays constant returns to scale in both k and th.

The fundamental equation, which states the capital accumulation (physical and human capital) process, can then be derived through differential equation as

$$\dot{k} = y - c - (\varepsilon + \delta)k \tag{4.5}$$

The process of human capital accumulation can be specified in relation to time spent not working. It is assumed such period is used to accumulate human capital. Thus,

$$\dot{h} = \psi h(1-t) \tag{4.6}$$

$$\frac{\dot{h}}{h} = \psi(1-t) \tag{4.7}$$

Equations (4.5) to (4.7) are similar to equations (3) and (4) in Aderemi (2014, p. 62). The implication of equations (4.6) and (4.7) is that the process of acquiring human capital depends largely on time not spent in working, and there is also a constant returns to scale when human capital is accumulated.

Differentiating equation (4.4) with respect to time yields

$$\frac{\dot{y}}{y} = \frac{\dot{A}}{A} + \beta\frac{\dot{k}}{k} + (1-\beta)\frac{\dot{th}}{th} \tag{4.8}$$

Equation (4.8) relates manufacturing productivity growth (y) to the growths of physical capital (k), human capital (th) and technology (A).

For the purpose of this study, human capital is further disaggregated to education capital and health capital.

Empirical Model Specification

The empirical model estimated in the present article is given as

$$PDM = \alpha_0 + \alpha_1 EDU + \alpha_2 HET + \alpha_3 PHY + \alpha_4 LAB + \alpha_5 OPE + \mu_t \tag{4.9}$$

Where:
PDM = Manufacturing productivity
EDU = Education capital (capital expenditure plus recurrent expenditure on education)
HET= Health capital (capital expenditure plus recurrent expenditure on health)
FHY = Fixed capital (gross fixed capital formation)
LAB = Labour force (labour force)
OPE = Trade openness
μ= Stochastic error term
α_0 = Intercept of the model
α_1- α_5, = Parameters estimated in the model

Estimation Technique

The study employed error correction modeling technique of estimation. This was however occasioned by the results of unit root test, which showed the variables as integrated of order one. In addition, co-integration analysis was also carried out.

A priori Expectation

All the explanatory variables are expected to impact the explained variable positively. In other words, $\alpha_1 ... \alpha_5 > 0$.

Data Requirements and Sources

The data used in the study were sourced as follows:
Expenditures on education and health were obtained from the Central Bank of Nigeria, 2013 Statistical Bulletins, likewise manufacturing productivity, physical capital and trade openness. Data on labour force were derived from World Bank (2013) World Development Indicators (WDI).

Table 2: Descriptive Statistics

	EDU	PHY	HET	LAB	PDM	OPE
Mean	60870.62	786278.2	34544.41	36178782	1638.30	9.34
Median	12542.82	217854.7	3881.35	35586424	1955.06	5.54
Maximum	348400.0	4012919.	231803.5	52323314	3527.00	39.69
Minimum	162.15	8799.48	41.31	23555676	224.92	0.06
Std. Dev.	91298.00	1210643.00	57112.53	8520584.	1028.38	11.16
Skewness	1.94	1.65	2.15	0.26	0.10	1.23
Kurtosis	6.29	4.39	7.19	1.94	1.75	3.61
Observations	32	32	32	32	32	32

Source: Computed by the Authors.

From table 2, productivity of manufacturing sector (PDM) averaged 1,638.30 million naira during the observed period. This varied between a minimum of 224.92 million and a maximum of 3,527 million naira. Expenditure on education (EDU) from 1981 to 2012 stood at an average of 60,870.62 million naira, ranging between the lowest value of 162.15 and the highest of 348,400 million naira. The same pattern could be observed in the mean value of health capital, which stood at an average of 34,544.41 million naira, and ranged from 41.31 to 231,803.5. Fixed capital averaged 786,278.2 million naira and had a range from 8,799.48 to 4,012,919 million naira. The mean labour value was 36,178,782 with a minimum of 23,555,676 and maximum of 52,323,314 people. Trade openness during the period averaged 9.34 and had a range from 0.06 to 39.69.

EMPIRICAL RESULTS AND DISCUSSION

Test of Unit Root

When dealing with time series variables, it is essential to examine their properties to ensure robustness of the analysis and estimation. In other words, the stationarity of the variables should be determined. This is because most time series variables are not stationary; if they are, their mean values and variances would not vary systematically over time. Hence, it is important to test for unit root and determine the order of integration of the variables. Phillips-Perron (PP) tests for unit roots were conducted in this paper. The results are shown in table 3.

3: Phillips-Perron (PP) Unit Root Test Results

Variables	PP Statistic Level	Critical Value (1%)	Critical Value (5%)	PP Statistic 1st Difference	Critical Value (1%)	Critical Value (5%)	Order of Integration
lnPDM	-2.231607	-3.661661	-2.960411	-3.5805	-3.67017	-2.963932	I(1)
lnEDU	-0.624318	-3.661661	-2.960411	-11.7943	-3.67017	-2.963972	I(1)
lnHET	-0.32486	-3.661661	-2.960411	-18.4651	-3.67017	-2.963972	I(1)
lnPHY	0.240768	-3.661661	-2.96041	-3.732516	-3.67017	-2.96397	I(1)
lnLAB	-0.475127	-3.661661	-2.96041	-5.809959	-3.67932	-2.967767	I(2)
lnOPE	-0.781874	-3.661661	-2.96041	-6.38221	-3.67017	-2.967767	1(1)

Source: Computed by the Authors.

From the results, all variables were stationary at their first difference excepting labour force, which was stationary at second difference. These imply that the series were integrated of order one, I(1) except labour force, which was of order I(2). This result therefore, necessitated co-integration test. To do this, the stationarity status of the residual of the long run regression analysis is necessary. The unit root test on the residual was conducted, which became stationary at first difference as presented in table 4.

Table 4: Result of the Phillips – Perron Unit Root Test for Residual

Variables	PP Statistic Level	Critical Value (1%)	Critical Value (5%)	PP Statistic 1st Difference	Critical Value (1%)	Critical Value (5%)	Order of Integration
Residual	-2.261543	-2.641672	-1.952066	-5.317430	-3.670170	-2.963972	1(1)

Source: Computed by the Authors.

Johnson Co-integration Test Results

The co-integration results are presented in tables 5 and 6.

Table 5: Unrestricted Cointegration Rank Test (trace)

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob.**
None*	0.799701	138.3144	95.75366	0.0000
At most 1*	0.672133	90.07610	69.81889	0.0005
At most 2*	0.582880	56.62171	47.85613	0.0061
At most 3*	0.50502	30.39025	29.79707	0.0427
At most 4	0.160210	9.291198	15.49471	0.3391
At most 5*	0.126375	4.053111	3.841466	0.0441

Source: Computed by the Authors.
Trace test indicates 4 cointegratingeqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 6: Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. Of CE(s)	Eigen value	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None*	0.799701	48.23830	40.03757	0.0049
At most 1	0.672133	33.45439	33.87687	0.0561
At most 2	0.582880	26.23146	27.58434	0.0737
At most 3	0.50502	21.09905	21.13162	0.0505
At most 4	0.160210	5.238087	14.26460	0.7115
At most 5*	0.126375	4.053111	3.841466	0.0441

Source: Computed by the Authors.
Max-eigenvalue test indicates 1 cointegratingeqn(s) at the 0.05 level
** denotes rejection of the hypothesis at the 0.05 level*
***Mac-Kinnon-Haug_Michelis (1999) p-values*

The results of the Johansen cointegration test showed some evidences of long run relationship between manufacturing productivity and the other explanatory variables. The Max-eigenvalues test indicates the presence of a cointegration relationship at 5% and the Trace test indicates the presence of 4 cointergrating equations at 5%. Hence, the explanatory variables can predict the behavior of the dependent variable (PDM) in the specific model.

Table 7: Static Regression Test Results

Dependent Variable: lnPDM

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnEDU	-0.100861	0.154338	-0.653509	0.5192
lnPHY	-0.623424	0.139413	-4.471790	0.0001
lnHET	0.186435	0.152561	1.222041	0.2327
lnLAB	0.018434	1.180835	0.015611	0.9877
lnOPE	0.791338	0.103565	7.640975	0.0000
Constant	5.662413	8.414709	0.672918	0.5069

R-squared	0.938136	Mean dependent var	3.092272
Adjusted R-squared	0.926239	S.D. dependent var	0.369004
S.E. of regression	0.100218	Akaike info criterion	-1.595576
Sum squared resid	0.261135	Schwarz criterion	-1.320751
Log likelihood	31.52922	Hannan-Quinn criter.	-1.504479
F-statistic	78.85490	Durbin-Watson stat	1.279772
Prob(F-statistic)	0.000000		

Source: Authors' Computation.

The presence of co-integrating equations further is an indication of the need for a more dynamic estimation to determine how the independent variables impart the dependent variable and to establish the short run behaviour of the model. Hence, the error correction modeling approach was adopted.

Error Correction Model

Both the over-parameterized and parsimonious analyses were conducted, with the results presented in tables 8 and 9 respectively.

Table 8: The over – Parameterized Dynamic Error Correction

Dependent Variable: ΔPDM

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Δ(lnEDU)	-0.012424	0.012007	-1.034724	0.3352
Δ(lnEDU(-1))	-0.003541	0.010562	-0.335268	0.7472
Δ(lnEDU(-2))	0.000134	0.016894	0.007920	0.9939
Δ(lnEDU(-3))	0.003878	0.040196	0.096486	0.9258
Δ (lnPHY)	-0.001812	0.001248	-1.451279	0.1900
Δ(lnPHY(-1))	-0.000426	0.001779	-0.239401	0.8177
Δ(lnPHY(-2))	-0.000555	0.001857	-0.299034	0.7736
Δ(lnPHY(-3))	0.000997	0.002248	0.443447	0.6708
Δ(lnHET)	0.009350	0.026152	0.357528	0.7312
Δ(lnHET(-1))	-0.005230	0.018315	-0.285569	0.7835
Δ(lnHET(-2))	0.014397	0.038843	0.370641	0.7219
Δ(lnHET(-3))	0.011377	0.098817	0.115134	0.9116
Δ(lnLAB)	0.000603	0.002090	0.288589	0.7813
Δ(lnLAB(-1))	0.001653	0.001737	0.951976	0.3728
Δ(lnLAB(-2))	-0.000478	0.002771	-0.172651	0.8678
Δ(lnLAB(-3))	-0.001696	0.001968	-0.861941	0.4173
Δ (lnOPE)	54.76994	39.35737	1.391606	0.2067
Δ(lnOPE(-1))	63.80705	32.58441	1.958208	0.0911
Δ(lnOPE(-2))	-45.36260	96.91970	-0.468043	0.6540
Δ(lnOPE(-3))	73.32005	52.79678	1.388722	0.2075
ECM(-1)	0.972052	0.368608	2.637093	0.0336

R-squared	0.962265	Mean dependent var	58.77357
Adjusted R-squared	0.854452	S.D. dependent var	275.5426
S.E. of regression	105.1217	Akaike info criterion	12.26182
Sum squared resid	77353.99	Schwarz criterion	13.26097
Log likelihood	-150.6655	Hannan-Quinn criter.	12.56727
Durbin-Watson stat	1.608917		

Source: Computed by the Authors.

Table 8 shows the results of the over-parameterized model used to handle all misspecification problems associated with the model. Having done this, variables which were insignificant

considering the high level of their probabilities were eliminated. This action was repeated until parsimony was achieved.

Table 9: The Parsimonious Error Correction Model

Dependent Variable: ΔPDM

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Δ(lnEDU)	-0.013***	0.002	-8.066	0.0000
Δ(lnEDU(-1))	-0.003*	0.001	-1.931	0.0715
Δ(lnPHY)	-0.001***	0.0002	-7.227	0.0000
Δ(lnPHY(-2))	-0.001**	0.0003	-2.518	0.0228
Δ(lnPHY(-3))	0.001***	0.0002	3.288	0.0046
Δ(lnHET)	0.015***	0.003	5.356	0.0001
Δ(lnLAB)	0.001***	0.0002	6.115	0.0000
Δ(lnLAB(-3))	-0.001***	0.0002	-4.883	0.0002
Δ(lnOPE(-1))	58.462***	14.021	4.170	0.0007
Δ(lnOPE(-2))	-48.858***	16.038	-3.047	0.0077
Δ(lnOPE(-3))	63.622**	21.312	2.985	0.0087
ECM(-1)	-0.460***	0.095	11.146	0.0000

R-squared	0.929043	Mean dependent var	58.77357
Adjusted R-squared	0.880260	S.D. dependent var	275.5426
S.E. of regression	95.34746	Akaike info criterion	12.25046
Sum squared resid	145458.2	Schwarz criterion	12.82140
Log likelihood	-159.5064	Hannan-Quinn criter.	12.42500
Durbin-Watson stat	1.735489		

0

Note: ***, **,* denote significance at 1%, 5% and 10% levels respectively while Δ symbolizes difference operator.

Source: Computed by the Authors.

Table 9 shows the results of the parsimonious model. This gives the final outcome of the analyses carried out to determine whether or not human capital has a fundamental impact on manufacturing productivity in Nigeria. From the results, expenditure on education at first difference was negative and statistically significant. This does not agree with theoretical a priori expectation of positive relationship. However, it appears to be consistent with the findings of Olayemi (2012). The negative relationship could be due to the possible fact that greater percentage of expenditure on education goes for gratification. Nigeria is still bedeviled with a high rate of corruption. The possibility of greater proportion of money earmarked as education expenditure could be diverted for personal enrichment. Health capital showed positive and statistically significant impact on manufacturing productivity in the country. This is also consistent with a priori expectation as well as the study of Dauda (2011), which reported positive and significant impact of health on economic growth in Nigeria. The control variables returned mixed signs. While the third lag of fixed capital showed positive

impact on manufacturing productivity, the first difference and the second lags however, returned negative sign. Labour force has positive relationship with manufacturing productivity. The error correction variable was negative, less than one in absolute term and statistically significant as expected. The coefficient was given as 0.460. This means that the speed of adjustment or convergence to equilibrium was 46%. The model demonstrated a good fit. This was evident from the coefficient of determination (Adjusted R-Squared), which stood at 88%.

CONCLUSION AND POLICY IMPLICATIONS

The study examined how human capital relates with manufacturing productivity in Nigeria over the period 1980-2012. Time series properties of the variables employed in the study were tested, using the Phillips-Perron (PP) unit root test. We proceeded by carrying out co-integration analysis, and then employed the error correction modeling (ECM) technique to estimate the model. The results showed that a positive and significant relationship exists between manufacturing productivity and health capital while education produced negative impact on manufacturing productivity.

Conclusion

The conclusion that emerged from the study was that human capital, in form of health, has positive and significant impact on manufacturing productivity in Nigeria. However, education produced counter-intuitive result.

Policy Implications of the Study

The policy implication of the study is that government should make adequate and sufficient investments in the health sector of the country. We recommend increase in health expenditure to at least 15% proposed at the 2001 Abuja declaration. Furthermore, due to the counter-intuitive result produced by education capital, the Nigerian government should put in place appropriate mechanism to monitor how effective fund allocated to education are expended.

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