

Human Capital Investment and Industrial Performance in Nigeria: A GMM Approach

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Abstract

This study analyses the likely impact (static and contemporaneous impacts) of human capital investment on industrial performance in Nigeria. Methodologically, the Generalized Method of Moments (GMM) model was modelled to analyse the nature of the framework, where industrial performance proxied by value added to industrial production is presumed to depend upon changes in various indicators of industrial performance with a list of instrumental variables (IV) estimators which were estimated over the period 1981-2011. We find results consistent with other researchers on static and contemporaneous impacts and all the explanatory variables appear to have impacted on industrial productivity and consistent with the overall industrial productivity model both in the short and long run. Specifically, we found out that the public investment on education apart from other control variables in the model is very important in explaining variation in industrial productivity both in the short and long run while, public investment on health plays a less important or insignificant role in variation of industrial productivity in Nigeria. This study recommends and concludes that the Nigerian policy makers (government) should do all it could, to increase its budgetary allocation to human capital development factors in order to boost industrial productivity through the increase in skilled workforce and more policy attention should be given to positive regulation of health policy expenditure and a steady boost in that sector.

Keywords: Human Capital Investment, Industrial Performance, A GMM Approach

1.0 INTRODUCTION

Industrialization has been central to the economic growth and development debate for several decades. Generally, industrialization is widely believed to propel economic growth and quicken the achievement of structural transformation and diversification of economies. Industrialization empowers a country to fully utilize its factor endowments and thereby reduce dependence on the external sector for its growth and sustenance. With industrialization, an economy gains the versatility and resilience that enable it raise the standard of living of its people and cope well with internal stress and strains (Eqwaikhide et al., 2001). Economic theory underscores the fact that, one of the contributory factors to economic growth and enhanced industrial productivity

is human capital. Consequently, investment in human capital particularly, on education, training, and health is fundamental to economic progress, industrial growth and productivity.

The importance of human capital investments in improving long run economic growth and productivity is well articulated in literature. The Organization of Economic Co-operation and Development (1998, 2001) stresses that knowledge, skills and competences constitute a vital asset in supporting economic growth and reducing social inequality. Thus, human capital constitutes an intangible asset with the capacity to enhance or support productivity, innovation, and employability. It is a key factor in combating high and persistent unemployment and the problems of low pay and poverty. As we move into “knowledge-based” economies the importance of human capital investment becomes even more significant than ever.

It has been stressed that, human resources input play a significant role in enhancing firm's competitiveness. The constantly changing business environment requires firms to strive for superior competitive advantages via dynamic business plan which incorporate creativity and innovativeness. This is essentially important for their long term sustainability (Barney, 1995; Simon-Oke, 2012).

There is no doubt that only investment in human capital can contribute significantly to global competitiveness. The emergence of the newly industrializing countries in East Asia has pointed out that knowledge, skills and competence are essential for long term expansion in the production of goods and services. Many industrial based economies are moving to knowledge based economies with human capital as the new source of wealth of nations. Human capital contributes to output just like other factors of production and also through technological change by driving both innovation and imitation. Any nation that must survive in a changing global economy must develop its competence in research and development and also in the ability to innovate products and processes that would ensure sustainable growth and enhance industrial productivity. Therefore, investment in human capital should be the central focus of developing countries in order to enhance growth and sustainable development.

In response to the changing global environment, most developing nations have embraced the idea of human capital as a good competitive advantage that will enhance growth, productivity and economic integration. Thus, this has reignited the debate on the relevance of public

investment in economic and social services such as education, training, health, transport and telecommunication. Concerns about the role of government and effectiveness of public expenditure in enhancing economic efficiency and private sector productivity, according to Adewuyi (2002) has followed two lines of argument. First, the Keynesian economists who are of the opinion that government should perform major functions in the economy. Second, the neoclassical economists who queried the validity or authenticity of Keynesian position that public expenditure fosters economic performance gained momentum towards the middle of the twenty first century.

In Nigeria, like in most developing countries, arguments about the public goods nature of basic components of human capital such as education, training and health have stimulated the need for active government participation in the provision of basic infrastructure. It has been asserted that for effective development of human resources, the Nigerian government should play a leading role in financing health, education and training. As the acceleration of globalization creates a new economic environment, the successive Nigerian governments have reorganized its industrial support system in line with international standard. As such economic openness has been adopted with regard to industrial production, trade and finance. A variety of measures were taken in these directions. One of which is investment in social and economic infrastructure, particularly education and health.

Against the foregoing background, this paper will contribute to policy in Nigeria by providing a quantitative evaluation of the role and impact of public human capital investment in enhancing industrial performance in Nigeria during the period 1981 and 2011. Specifically, it analyses the likely impact (static and contemporaneous impacts) of public human investment on industrial performance in Nigeria.

The rest sections are as follows: Section two gives the review of relevant literature while section three provides the theoretical and analytical framework. Section four contains the estimation strategy and model specification. Section five discusses the empirical analysis and results while section six explains the policy implications of the findings. Section seven concludes the paper.

2.0 LITERATURE REVIEW

2.1 Human Capital Investment: The Key Role of Education and Health

One of the challenges facing developing countries is to achieve rapid economic growth rates and sustainable development. As aptly underscored by Todaro and Smith (2012), in the light of the changing global environment, there can be no meaningful development in developing economies without investment in human resources. In economic literature, there is growing recognition of the importance of investment in human capital through lifelong learning and improved health status. According to (Anyanwu, 1997), the accumulation of human capital is considered to be a function of the education level, work experience, training and healthiness of the workforce. Improvements in education and health are essential if an economy wants to promote economic prosperity, fuller employment, and social cohesion. Studies show that education as economic investment creates a more productive labour force and endows it with increased knowledge and skills, raises the quality of life, improves health, and living standards, increases individual's access to paid employment and emancipates them for social and political participation in the economy. On the other hand, the preponderance of the evidence is that health and nutrition do affect employment, productivity and wages and very substantially so among the poorest of the poor. At the aggregate level, Bloom and Canning (2000) identified four pathways by health outcome can affect productivity: firstly, a healthy labour may be productive because workers have more physical and mental energy and are absent from work less often.

Secondly, individuals with a longer life expectancy may choose to invest more in education and receive greater returns from their investments. Thirdly, with longer life expectancy, individuals may be motivated to save more for retirement, resulting in a greater accumulation of physical capital. Lastly, improvement in the survival and health of young children may provide incentives for reduced fertility and may result in an increase in labour force participation – which may, in turn, result in increased per capita income if these individuals are accommodated by the labour market. Explaining this further, Bukenya (2009) showed that productivity of labour depends on factors like physical and mental capabilities, investments in human capital and efficiency of labour organization and management. In conclusion, investment in health and education is a veritable variable for enhancing productivity growth and sustainable development.

2.2 Human Capital Investment and Industrial Growth: Empirical Review

There are quite a large number of studies on the impact of human capital investment on productivity and growth of the economy. Many of these studies have shown that 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 (Barro, 1991; and Mankiw, Romer and Weil, 1992). Some studies have produced positive results which support the fact that human capital particularly, education impact positively on output growth. While others studies have argued that the effects of schooling on aggregate productivity have not produced desirable results.

Black and Lynch (1996) examine the relationship between human capital and productivity. The results indicate that human capital in the form of education had a substantial impact on productivity. Formal training conducted outside the company had a significant impact on productivity for manufacturing firms whereas computer training had a significant impact for non-manufacturing firms.

Adenikinju (1996) showed that public expenditure on education and health has a significant and positive impact on productivity of the manufacturing sector. The story is entirely different in the case of results observed for investment on economic infrastructure. He finds that public expenditure on transport and communication has negative impact on manufacturing productivity. The study found that human capital has apposite and significant impact on total factor productivity. While explaining the variation in manufacturing productivity, the author opined that economic infrastructure exerts the greatest relative impact on manufacturing productivity, followed by social infrastructure and human capital. In the same vein, Nader and Ramirex (1997) found that public investment in education services, health care services, airports, streets and highways, electrical and gas facilities and mass transit improves both total factor productivity and labour productivity.

Adewuyi (2002) provide evidences which showed that the impacts of various public human capital investment categories on efficiency and total factor productivity growth (TFPG) in the Nigerian manufacturing sector are mixed. The study employed panel data for 10 manufacturing subsectors over some selected years covering the period before, during and after SAP. A non-parametric technique (data envelopment analysis) was used to obtain the efficiency and TFPG

indices which were employed in panel regression analysis. The study revealed that the impacts of various human capital expenditure categories on efficiency and TFPG are mixed. With or without SAP, the impacts of various capital expenditure categories on pure technical efficiency in the manufacturing sector remain unchanged. Capital expenditure on education, transport and communication except that on health promote pure technical efficiency in the manufacturing sector. In the case of scale efficiency, the results obtained for the two periods differ. In the entire period, apart from capital expenditure on health, which produces positive impact on scale efficiency, all other capital expenditure categories have negative effect. In the case of results obtained for the SAP and post-SAP periods, the results of the two periods revealed that impacts of the capital expenditure categories on TFPG are similar to that on scale efficiency.

Aggrey, Eliab and Joseph (2010) use firm level panel data to analyze the importance of relevant human capital variables in explaining labour productivity in East African manufacturing firms. The study employs generalized least squares to estimate the modified human capital model. Findings reveals that proportion of skilled workers and average education in Uganda, training, proportion of skilled workers and education of the manager in Tanzania and average education and training in Kenya were positively associated with labour productivity.

Similarly, Simon-Oke (2012) examines the nexus between human capital investment and industrial productivity in Nigeria using secondary data spanned through 1978 to 2008. Co-integration and Error Correction Mechanism (ECM) was employed to examine the relationship between human capital investment and industrial productivity. Granger causality test was also adopted as a supplementary estimation method to explore the nature of causality among the variables established in the model. Findings revealed that government expenditure on education maintained a positive long run relationship with index of industrial production while government expenditure on health and Gross Capital Formation exhibited long run negative relationship with the dependent variable.

2.3 KEY CHALLENGES FACING THE NIGERIAN INDUSTRIAL SECTOR

The aim of Nigeria's industrialization is to achieve global competitiveness in the production of specific processed and manufactured goods by effectively linking industrial activity with primary sector activity, domestic and foreign trade, and service activity (NPC, 2009). For this purpose, a variety of measures were taken. These include; privatization & commercialization,

devaluation & convertibility of Naira, reduction in custom tariffs, open door policy towards foreign direct investments, foreign technology, and institutional support measure etc. However, after more than three decades since the country embarked on the policies of liberalization and new industrial policy initiatives, the performance of the industrial sector leaves much to be desired. The average capacity utilization which is a major indicator of industrial performance has progressively worsened. In 1981, the average capacity utilization stood at 73.3 percent, it dropped sharply to 42.0 percent in 1991 and 36.1 percent in the year 2000. The figure, however, rose to 53.84 percent in 2008. As at 2010, the manufacturing sector accounts for only 4.16 percent of real GDP and has been providing very little employment, while in 2013 the Industrial productivity amounted to ₦14,180.9 billion with a Gross Domestic Product at 2010 Constant Basic Prices of ₦65,259.5 billion (CBN, 2013). A number of key challenges facing the Nigerian industrial sector in a rapidly changing global economic environment have been identified by the authors. They are briefly discussed below:

Fostering a sustainable long term industrial growth

It is becoming increasingly clear that reform packages designed to promote industrial development by successive Nigerian government are causing the demise of domestic industries belonging to the traditional sectors like consumable durables, textiles, etc. Industrial openness has resulted in large inflows of cheaper commodities, thus effectively reducing demand for domestically produced goods. Moreover, it is observed that the degree of responsiveness to reform measures has remained weak. This is ascribed largely to a number of factors acting on both the demand and supply sides. On the demand side there was a reduction in the purchasing power of the vast majority of the people owing to a slowdown in the overall growth of the economy, a reduction in public investment in real terms, a deceleration in private investment, owing to a slow growth of the economy. The supply side rigidities resulted from infrastructural bottlenecks and high cost of servicing loans among others. Therefore, to enhance industrial growth rate, urgent attention needs to be paid to proper management of the Nigerian economy and adoption of coherent strategies, aim explicitly at improving and diversifying industrial production.

Enhancing International Competitiveness of Local Commodities

The position of Nigerian industries in the face of international competition is still worse. The products produced by industry had little acceptance in the international arena. Industrial policy

has to be formulated in order to enhance the competitiveness of the industries through the production and export of competitive commodities. In this regard, appropriate incentives to increase the output and productivity of the sector, investment in modern technology and information skills, organizational improvement are prerequisites for strengthening the industrial sector to face the challenges of globalization.

It is a clear fact that every firm cannot market several products internationally. Identification of products with competitive advantage is an essential component of globalization.

Removing Infrastructural Bottlenecks

Infrastructure has strong-formed linkages with several economic activities. To a large extent, Nigeria's long-term growth and competitiveness is greatly hampered by its poor infrastructural capacity. The existing poor, under-developed, inadequate, and inefficiency transport and communication skills, undeveloped monetary & financial institutions constitute major barriers to industrial development. Business enterprises can only thrive in an environment where basic infrastructures function efficiently. A situation of poor infrastructural facilities can only increase the cost of business transactions, curtail production and thereby discourage investment. Relieving these constraints should be a priority for government development expenditure and all stakeholders in the nation's economy.

Matching International Quality Standards

Maintaining product quality is an important aspect in facing this challenge. In the global economic scene, only those who can produce and deliver goods and services of high quality making best use of the latest technology at competitive cost will survive.

Over the years, Nigerian firms have concentrated less on quality. Several locally manufactured goods do not meet the international standards, leave alone being leaders in the world. The main task ahead is to develop competitiveness of Nigerian products and reorient the production and marketing efforts as per overseas requirement. The first step in this regard relates to creation of brand image i.e. "Made in Nigeria". Excellence in international marketing requires heavy expenditure in product development, marketing and building up of our own brands. Once a brand backed by continuous product improvement is established, it will generate a kind of faith and credibility in the product, which will sell automatically. Nigerian industries aiming at

globalization must be prepared for a continuous up gradation of technology, huge investment in brands and product development to meet the international standards.

Improving efficiency

At present, the low productive efficiency profile of the industrial sector is not encouraging and constitutes a crucial obstacle in the drive towards globalization Nigerian companies are. At present, most Nigerian firms are less efficient in terms of cost, raw material use, production techniques, marketing and finance. The productive efficiency of Nigerian firms is abysmally low. This has largely been attributed to lack of efficiency in terms of cost, raw material use, production techniques market and finance traceable to weak technological base, and infrastructural bottlenecks.

Besides, we believe the poor productivity performance of firms lies in the low level of capacity utilization. It is noteworthy that during the study period 1986 – 2001, average capacity utilization in the manufacturing sub sector remains far below 50 per cent.

Facilitating market access

Availability of market information is one of the most crucial aspects in the world trade system. It has been clearly demonstrated from past experience that lack of awareness of the existence of goods and the conditions under which they are available by implication casts a shadow over the competitiveness of local produced goods in terms of both quality and price.

This scenario has hampered the smooth integration of the Nigerian firms into the global economy. Our challenge, therefore, is to ensure that all relevant trade information is collected and disseminated to prospective foreign buyers on a regular basis.

Investment in human capital and Harnessing science and technology

Investment in human capital in order to harness science and technology is *sine qua non* for promotion of improved productivity and competitiveness. Without doubt, one of the major reasons for slow progress of industrial development is the weak technology base. In the global economic environment, efficient production including meeting quality requirements and the attainment of expected standards are the main elements in defining competitiveness. Thus if Nigeria is to meet the challenge of globalization and sharpen the competitive edge of firms, the

process of investment in human capital in order to promote research and development (R & D) and applied technology has to be accelerated. Innovation, skill, knowledge, science and technology are essential to add value to locally produced commodities so as to attract better market price.

3.0 THEORETICAL AND ANALYTICAL FRAMEWORK

In our methodology we adopted and modified the Nelson and Phelps (1966) and Ciccone and Papaioannon (2006) theoretical framework, which shows that a country's capacity to adopt world technologies depend on their human capital, may affect production or their comparative advantage in human-capital-intensive industries. The two main building blocks of their framework are (i) a technology adoption function in the spirit of Nelson and Phelps (1966) linking each country's technology to its initial level of human capital and the world-frontier technology; and (ii) the simplest possible multicounty general equilibrium model of international specialization.

Their framework shows that, a country's production structure depends on its human capital for two very different reasons: (i) because of the factor supply effect emphasized in the Heckscher-Ohlin model and (ii) and most importantly, because each country's level of human capital determines its distance from the world-frontier technology in the steady state, and also how quickly countries converge to steady state, and also how quickly countries converge to steady state. Their main result is that an acceleration of skilled-labour augmenting efficiency growth at the world frontier leads countries with abundant human capital to specialize further in human-capital-intensive industries. Intuitively, they were trying to capture that faster technology adoption in countries with abundant human capital will lead to more rapid total factor productivity growth in human-capital-intensive industries at times when new technologies are skilled-labour augmenting. . With free trade, this will lead to shifts in international specialization patterns as countries with higher levels of human capital specialize further in human-capital - intensive industries.

Nelson and Phelps (1966) and Ciccone and Papaioannon (2006), theoretical framework links human capital and industry production both in steady state and during the transition to a new steady state triggered by an acceleration of skilled-labour augmenting technical change. This allows them to illustrate the positive effect of initial human capital on output growth in human-capital-intensive industries during such a transition.

In Nelson and Phelps (1966) and Ciccone and Papaioannon (2006) framework, the world consists of many open economies, indexed by c , that can produce in two industries, indexed by $s = 0, 1$. There are two types of labour, high and low human capital, and we denote their supply in country c , at time t by $M_{c,t}$ and $L_{c,t}$ respectively. The efficiency levels $A_{c,t}^L$ and $A_{c,t}^M$ of the two types of labour evolve over time and depend on each country's capacity to adopt world technologies.

In line with Nelson and Phelps (1966), we assume efficiency growth;

$$\hat{A}_{c,t}^f = \left(\frac{\partial A_{c,t}^f}{\partial t} \right) / A_{c,t}^f \quad (1)$$

of labour of type $f = L, M$ (hats indicate growth rates) to be increasing in the gap between country efficiency $A_{c,t}^f$ and world-frontier efficiency $A_t^{f,W}$ (W indicates the world frontier),

$$\hat{A}_{c,t}^f = \phi^f(H_{c,t}) \left(\frac{\partial A_t^{f,W} - A_{c,t}^f}{A_{c,t}^f} \right) \quad (2)$$

where $\phi^f(H)$ captures the country's capacity of technology adoption, which is increasing in its human capital $H \equiv M/L$. The only difference between this framework and that of Nelson and Phelps is that we distinguish between technologies augmenting the efficiency of high and low human capital workers, as in the literature on skill-biased and directed technical change (e.g. Acemoglu, 1998, 2003a; Acemoglu and Zilibotti, 2001; Caselli and Coleman, 2002, 2005)

Output $X_{s,c,t}$ in industry s and country c , at time t is produced according to

$$X_{s,c,t} = D_{c,t} E_{s,t} (A_{c,t}^L)^{1-s} (A_{c,t}^M)^s \quad (3)$$

where D captures country-level efficiency and E industry-specific technology. Hence, industry 1 uses only high human capital labour, while industry 0 uses only low human capital labour. This extreme assumption regarding factor intensities simplifies our analysis, but is not necessary for the implications that follow.

To examine how steady-state production levels depend on a country's capacity to adopt technologies we suppose constant efficiency growth at the world-frontier,

$$\hat{A}_t^{L,W} = g^L \text{ and } \hat{A}_t^{M,W} = g^M \quad (4)$$

Each country's human capital H_c , and hence its capacity to adopt technologies (ϕ_c^L and ϕ_c^M), are assumed to be constant in time. In steady state, efficiency in each country grows at the same

rate as at the world-frontier. Equation (2) therefore implies that the steady-state level of efficiency of labour of type $f = L, M$ in country c is

$$A_{c,t}^{f*} = \frac{\phi_c^f}{g^f + \phi_c^f} A_t^{f,W} \quad (5)$$

(asterisks denote steady-state values). Hence, the greater the capacity of countries to adopt technologies, the closer their steady-state efficiency levels to the world-frontier. It is now immediate to determine steady-state output in sector s in country c as

$$X_{s,c,t}^* = D_{c,t} E_{s,t} L_{c,t} \left(\frac{\phi_c^L}{g^L + \phi_c^L} A_t^{L,W} \right)^{1-s} \left(\frac{\phi_c^M}{g^M + \phi_c^M} A_t^{M,W} H_c \right)^s \quad (6)$$

where we have assumed that competitive labour markets ensure full employment. Steady state production in the high relative to the low human capital industry, $Z_{c,t}^* \equiv X_{1,c,t}^* / X_{0,c,t}^*$ in country c as compared to q is therefore

$$\frac{Z_c^*}{Z_q^*} = \left[\frac{H_c}{H_q} \right] \left[\frac{\left(\phi_c^M / \phi_c^L \right) \left(\frac{g^L + \phi_c^L}{g^M + \phi_c^M} \right)}{\left(\phi_q^M / \phi_q^L \right) \left(\frac{g^L + \phi_q^L}{g^M + \phi_q^M} \right)} \right] \quad (7)$$

This expression does not depend on country-level efficiency because we are comparing two industries within each country; it does not depend on industry-level technology because we are comparing the same industries in different countries.

Equation (7) implies that country c 's human capital H_c has a factor supply effect and a technology adoption effect on its steady-state production structure as compared to country q . The factor supply effect (captured by the bracket square bracket) is straightforward. An increase in human capital means an increase in the relative supply of the factor used by the human-capital-intensive industry and therefore relatively greater production in the human capital-intensive industry. The focus of our theoretical framework is on the technology adoption effect (captured by the second square bracket). This effect can reinforce the factor supply effect or work in the opposite direction, depending on whether it is skilled or unskilled labour-augmenting technology that is progressing faster at the world frontier. For example, consider the case where human capital has the same impact on the capacity to adopt skilled and unskilled-labour augmenting technologies, $\phi^M(H) = \phi^L(H)$ for all H . Suppose first that skilled-labour augmenting technical progress at the world frontier exceeds unskilled- labour augmenting technical progress, $g^M > g^L$. In this case, a higher level of

human capital H_c will translate into more human-capital-intensive production in the long run through the technology adoption effect. This is because human capital facilitates the adoption of all technologies equally and it is skill-augmenting technology that is advancing more rapidly at the frontier. Now suppose instead that $g^L > g^M$. In this scenario it is unskilled-labour augmenting technology that is progressing faster at the frontier. The technology adoption effect of higher human capital levels will therefore shift production towards the low human capital industry.

We now suppose that skilled-labour augmenting efficiency growth g^M at the world frontier increases at some time T . Equation (7) implies that this acceleration of skilled-labour augmenting technical change translates into an increase in Z_c^*/Z_q^* if and only if $H_c > H_q$. Countries with high levels of human capital will therefore experience an increase in steady-state production levels in the human-capital-intensive industry relative to countries with low human capital. As a result, they will see relatively faster growth in the human-capital-intensive industry during the transition to the new steady state; this is because they adopt new skill-augmenting technologies more rapidly. Formally, using lower-case variables to denote logs of upper-case variables,

$$\Delta z_c - \Delta z_q \equiv |z_{c,t} - z_{c,T}| - |z_{q,t} - z_{q,T}| = g\left(h_{c,+}^T\right) - g\left(h_{q,+}^T\right) \quad (8)$$

for $t > T$, where $g(h)$ is strictly increasing in h . Value added in each industry is $Y_{s,c,t} \equiv P_{s,t} X_{s,c,t}$ where $P_{s,t}$ denotes international prices. The production function implies that growth of value added between T and t equals

$$\Delta y_{s,c,t} \equiv y_{s,c,t} - y_{s,c,T} = \Delta d_c + \Delta l_c + \Delta p_s + \Delta e_c + s\Delta a_c^M + (1-s)\Delta a_c^M \quad (9)$$

Combined equation (8) to equation (9) this yields

$$\Delta y_{s,c,t} = \underbrace{[\Delta d_c + \Delta l_c]}_{\lambda_c} + \underbrace{[\Delta p_s + \Delta e_c]}_{\mu_s} + \eta + g\left(h_{c,+}^T\right) s \quad (10)$$

The country-specific effect λ_c captures country-level labour-force and total-factor-productivity growth, while the industry-specific growth effect μ_s is the sum of price changes and industry-specific technical progress. η captures unskilled-labour augmenting technical change. According to (10), the impact of initial human capital on growth during the transition is greater in the human-capital-intensive industry. During the transition, the TFP growth differential between the high and the low human capital industry is greater in a country with high than a

country with low human capital. Our framework does not make predictions about whether this TFP growth differential is positive or negative. This is what we refer to as the human capital level effect on output growth in human-capital-intensive industries.

So far we have assumed that human capital in each country is constant in time. As a result, human capital affects industry output growth only through technology adoption in (10). When human capital levels increase in time there is also a factor supply effect. Increases in human capital could also affect industry output growth through technology adoption. Such As industries are assumed to be at opposite extremes in terms of their human capital intensity, this effect takes a particularly simple form in our framework. A one percent increase in human capital leads to a one-point output growth differential between the high and the low human capital industry over the same time period. With non-extreme factor intensities, the implied output growth differential would be larger (e.g. Ventura, 1997). This is because an increase in human capital would lead to labour moving from the less to the more human capital intensive industry (assuming the economy is not fully specialized). We refer to the positive effect of factor supply on output growth in human-capital-intensive industries as the human capital accumulation effect.

The factor supply effect linking human capital and relative production levels in the human-capital-intensive industry in (7) does not carry through to single industry pairs in a neoclassical multi-industry model. It can be shown, however, that human capital abundant countries will still specialize in human-capital-intensive industries on average (e.g. Dear-dorff, 1982; Forstner, 1985). Furthermore, as shown by Romalis (2004), the positive effect of human capital abundance on relative production levels in human-capital-intensive industries reemerges for single industry pairs once monopolistic competition and transport costs are incorporated into an otherwise standard neoclassical multi-industry model.

Furthermore, we view the key assumption of neoclassical model where Solow residual or total factor productivity is often used as a measure of technological progress. Solow starting point is that the society saves a given constant proportion of its income. The population and supply of labour grows at a constant rate and capital intensity is determined by the prices of population factor. As a result of diminishing yields additional capital injection (increasing capital intensity) will make even a smaller contribution to production. This implies that in the long run, the economy will approach a condition of identical growth rate for capital labour and total production, presume on condition that there is technological progress.

The aggregate production function $Y = f(K,L)$ is assumed characterized by constant return to scale, for example, in the special case known as the Cobb-Douglass production function, at any time t , we have;

$$Y_{(t)} = K_{(t)}^{\alpha} A_{(t)} L_{(t)}^{1-\alpha} \quad (11)$$

Where; Y is Gross Domestic Product, K is the stock of capital which may include capital as well as physical capital, L is labour and $A_{(t)}$ represents the productivity of labour which grows over time at an exogenous rate.

The Solow equation gives the growth of the capital-labour ratio (known as capital deepening) and shows that the growth of K depends on savings of (K) , after allowing for the amount of capital required to service depreciation δK , and after capital widening, that is, providing the existing amount of capital per worker to net workers joining the labour force, ηK that is;

$$\Delta K = sf(K) - (\delta + \eta)K \quad (12)$$

For simplicity, we are assuming for now that, A remains constant. In this case, there will be a state in which output and capital per worker are no longer changing, known as the steady state (if A is increasing, the corresponding state will be one in which capital per effective worker rises as A rises, this is because when workers have higher productivity, it is as if there were extra workers on the job). To get this steady state, then we set $\Delta K = 0$

$$\delta f(K^*) = (\delta + \eta)K^* \quad (13)$$

The notation K^* means the level of capital per worker when the economy is in the steady rate. In a rather ad-hoc manner, neoclassical theory credits the bulk of economic growth to an exogenous of completely independent process of technological progress. Though intuitively plausible, this approach has at least two insurmountable drawbacks. First, using the neoclassical framework, it is impossible to analyze the determinants of technological advance because it is completely independent of the decision of economic agents. And second, the theory fails to explain large differences in residual across countries with similar technologies.

To illustrate the endogenous growth approach, we examine the Romer endogenous growth model because it addresses technological spillovers (in which one firm or industry's productivity gain leads to productivity gain in the other firm's or industries) that may be present in the process of industrialization. Romer proposes accumulation of knowledge as a driver and means of achieving economic growth. This was further developed by Lucas (1998) who added that it is investment in human capital that have spillover effect that increases the level of technology by external effect on human capital. Romer departs from Solow by assuming that the economy wide capital stock K , positively affect all outputs at the industry level, so that there may be increasing return to scale at the economy wide level

It is valuable to think of each firm's capital stock as including its knowledge. The knowledge part of the firm's capital stock is essentially a public good, like in the Solow model that is spilling over instantly to the other firm in the economy. As a result, this model treats learning by doing as learning by investing. You can think of Romer's model as spelt out by endogenising the reason why growth might depend on the rate of investment.

$$Y_i = AK_i^\alpha L_i^{1-\alpha-\beta} K \quad (14)$$

Assuming symmetry across industries for simplicity, each industry will use the same level of capital and labour. Then, we have the aggregate production function as;

$$Y = AK^{\alpha-\beta} L^{1-\alpha} \quad (15)$$

To make endogenous growth model stand out clearly we assume that A is constant rather than rising overtime, that is, we assume there is no technological progress. Romer identified three elements that define the differences between knowledge and physical capital;

- a. The development of new knowledge has positive external effect of the production possibilities of other firms that is knowledge though can be patented or kept secret but cannot be monopolized by any individual or firm.
- b. The creation of new knowledge exhibit diminishing returns
- c. New knowledge is more profitable when it leads to more efficient production

Early empirical studies such as ADB (1998) has offered a formal demonstration on how positive spillover effect (pecuniary externality) created by workers' educational training investment decision can give rise to macro-level increasing return in human capital. His model supposes

that workers and firm make their investment in human and physical capital, respectively, before being randomly matched with one another. The direct consequence of random match is that the expected rate of return on human capital is increasing in the expected amount of (complimentary) physical capital with which a worker will be provided. Hence, the increase in education for a group of workers induces the firm to invest more in tangible assets, thereby increasing the return to all workers in the economy

4.0 ESTIMATION STRATEGY AND MODEL SPECIFICATION

The purpose of this study is to develop a model to show the relationship between public human capital investment and industrial performance. As argued in the earlier discussions, the general human capital investment includes training, education, knowledge and skills that will enhance human capital effectiveness. Based on the literature reviews, it is therefore postulated that human capital leads to greater firm performance. According to Marimuthu et al (2009) firm performance can be viewed in two different perspectives; financial performance and non-financial performance. Financial performance includes productivity, market share and profitability, whereas, non-financial performance includes customer satisfaction, innovation, workflow improvement and skills development. The analysis frameworks above have shown that that a well-educated labour force possesses a positive and significant impact on economic growth through factor accumulation and on the evolution of total factor productivity.

The idea of health representing next to education an important component of human capital was introduced most prominently by Grossman (1972), but has recently been acknowledged more widely. In the original formulation of his theory, Becker (1964) pointed to health as one component of the stock of human capital, but then focused in his early empirical work exclusively on education. The major contribution to our understanding of health as an integral part of human capital was provided by Grossman (1972), who was the first to construct a model of the demand for health applying human capital theory.

Grossman distinguishes between health as consumption good and health as a capital good. As a consumption good, health enters directly into the utility function of the individual, as people enjoy being healthy. As a capital good, health reduces the number of days spent ill, and therefore increases the number of days available for both market and non-market activities. Thus, the production of health affects an individual's utility not only because of the pleasure

of feeling in good health, but also because it increases the number of healthy days available for work (and therefore income) and leisure.

Health is not only demanded, but also produced by the individual. Individuals inherit an initial stock of health that depreciates with time, but they can invest to maintain and increase this stock. Many inputs contribute to the production of health, as indicated in Figure 1. Healthcare is one among these factors. The demand for healthcare is therefore a derived demand for health. The production of health also requires the use of time by the individual away from market and non-market activities, while the Grossman model has encountered some criticism (3); it continues to stand with some extensions as the key model of the demand for health

According to Suhrcke et al (2005) healthier individuals could reasonably be expected to produce more per hour worked. On the one hand, productivity could increase directly due to enhanced physical and mental activity. On the other hand, more physically and mentally active individuals could also make a better and more efficient use of technology, machinery or equipment. A healthier labour force could also be expected to be more flexible and adaptable to changes (e.g. changes in job tasks, in the organisation of labour)

Our model links public human capital investment and industrial performance both in steady state and during the transition to a new steady state triggered by an acceleration of skilled-labour augmenting technical change. This allows us to illustrate the positive effect of public human capital investment on industrial performance.

The standard methodology of productivity studies begins with the neoclassical production function. The neoclassical growth theory posits that changes in quantities of factors of production account for growth.

Let re-considering the production function in equation (11)

$$Y = f(A K^{\alpha} L^{1-\alpha})$$

where: Y = Aggregate real output

K = Physical stock of capital

L = Quantity of Labour

A = Level of technology (efficiency parameter)

t = Time dimension

and following the empirical work of Mankiw *et al.*, (1992); and Odusola (1992), the augmented Solow model is presented thus;

$$Y_t = A_{(t)} K^{\beta_1} L^{\beta_2} H^{\beta_3} \quad (16)$$

where H is investment human capital, $\beta_1 + \beta_2 + \beta_3 = 1$ (assuming constant return to scale) other variables are as defined earlier.

What variables are considered as potential determinants of industrial performance? The included variables are as follows: public total expenditure on education, public total expenditure on health, stock of human capital, physical capital and other control variables such as compensation of employees and operating surplus with a set of instrumental variables

To obtain some rough estimates of the magnitude of the impacts of public human capital investment on industrial performance in Nigeria, we empirically modeled the relationship between the determinants of industrial performance and value added to industrial production using the Generalized Method of Moments (GMM), with a set of Instrumental variables (IV) estimators. The GMM is a robust estimator in that, unlike maximum likelihood estimation, it does not require information of the exact distribution of the disturbances. This is to avoid the short comings of exact distribution of the disturbances in the variables. The theoretical relations that the parameters should satisfy are usually *orthogonality conditions* between some (possibly nonlinear) function of the parameters $f(\theta)$ and the set of instrumental variables Z_i :

$$E\left(f(\theta)' Z\right) = 0, \quad (17)$$

where θ are the parameters to be estimated. The GMM estimator selects parameter estimates so that the sample correlations between the instruments and the function f are as close to zero as possible, as defined by the criterion function:

$$J(\theta) = \left(m(\theta)\right)' Am(\theta), \quad (18)$$

where $m(\theta) = f(\theta)'Z$ and is a weighting matrix. Any symmetric positive definite matrix will yield a consistent estimate of q . However, it can be shown that a necessary (but not sufficient) condition to obtain an (asymptotically) efficient estimate of q is to set A equal to the inverse of the covariance matrix of the sample moments m .

For the GMM estimator to be identified, there must be at least as many instrumental variables as there are parameters to estimate. The instrumental variables in the model included are as follows: foreign assets, domestic credit (net), gross domestic product, inflation, total loan and advance and nominal interest rate.

To estimate the hybrid model, we specified the model in the GMM form and list of instrumental variables as follow:

$$\text{Equation specification: } y \text{ c } x \tag{19}$$

We test for the effect of public investment in human capital on industrial performance using the following equations (3), (6) and (16) in our analytical framework. The empirical model adopted in this study after a minor modification of (3), (6) and (16) is presented thus;

$$\text{LogVAIP}_{1t} = \beta_1 + \beta_2 \text{LogPEE}_{2t} + \beta_3 \text{logPEH}_{3t} + \beta_4 \text{logSHC}_{4t} + \beta_5 \text{logGCF}_{5t} + \beta_6 \text{logCOE}_{6t} + U_t \tag{20}$$

$$\text{Instrument list: } c \text{ z } w; \text{ logOPS}_{7t}, \text{ logLAI}_{8t}, \text{ REE}_{9t}, \text{ CPI}_{10t}, \text{ EPT}_{11t}, \text{ TAX}_{12t} \tag{21}$$

The a-priori expectations for equation (20) are: $\beta_1 > 0$; $\beta_2 > 0$; $\beta_3 > 0$; $\beta_4 > 0$; $\beta_5 > 0$; $\beta_6 > 0$

where (variable list),

LogVAIP_{1t} represents log of value added to industrial production

LogPEE_{2t} represents log of public total expenditure on education

logPEH_{3t} represents log of public total expenditure on health

logSHC_{4t} represents log of stock of human capital (workforce)

logGCF₅ represents log of gross capital formation (as proxy for physical capital)

logCOE_{6t} represents log of compensation of employees

logOPS_{7t} represents log of operating surplus

logLAI_{8t} represents log of loan and advance to the industrial sector

REE_{9t}, represents real exchange rate

CPI_{10t} represents consumer price index

logEPT_{11t}, represents log of export

logTAX_{12t} represents log of taxes

The orthogonality conditions given by

$$\sum (y_t - c(1) - c(2)x_t) = 0 \quad (22)$$

$$\sum (y_t - c(1) - c(2)x_t) z_t = 0 \quad (23)$$

$$\sum (y_t - c(1) - c(2)x_t) w_t = 0 \quad (24)$$

In testing the relationship between industrial performance and the public human capital investemnt, the J-statistic is used to carry out hypothesis tests from GMM estimation; see Newey and West (1987a). A simple application of the J-statistic is to test the validity of overidentifying restrictions when you have more instruments than parameters to estimate. In this study, we have six instruments to estimate five parameters and so there are six overidentifying restrictions. Under the null hypothesis that the overidentifying restrictions are satisfied, the J-statistic times the number of regression observations is asymptotically with degrees of freedom equal to the number of overidentifying restrictions.

In estimating the model we used the Time Series (HAC) of Weighting Matrix and Coefficients with GMM estimates. These estimates are used to compute a coefficient covariance matrix that is robust to cross-section heteroskedasticity and autocorrelation of unknown form. For the HAC option, we specify the kernel type and bandwidth. The Kernel Options determine the functional form of the kernel used to weight the autocovariances in computing the weighting matrix. The overall relationship between the industrial performance and its explanatory variables are expected to be positive for almost all the variables except taxes. We use annually data from the CBN Statistical Bulletin (CBN, 2011) and National Bureau of Statistical (NBS, 2006, 2011) to establish our empirical investigation of our formulated model.

5.0 ESTIMATION OF EMPIRICAL RESULTS

Our estimation technique consists of three steps procedure. First we test for variables stationarity this is in order to ensure stationarity of the data and all the variables are in terms of first differences of logarithms (growth rates) and none at level. Second, a GMM estimate, with a list of instrumental variables is run over the sample period 1981-2011. This is done once the stationarity test was determined. The third part of the estimation provides the co-integrating relations among the variables under consideration, using the Engle-Granger single-equation cointegration test and last part is to explain the dynamic response of shocks with an impulse response function (IRF) (see Table 1-4).

Im, Pesaran and Shin Unit Root Test

In this study, to determine the order of integration, we test for the presence of unit root using Im, Pesaran and Shin W-stat and the summary of the results of the tests are presented in Table 1 below;

Table 1: Summary of Results of Unit Root Tests

Null Hypothesis: Unit root (individual unit root process)						
Method: Im, Pesaran and Shin W-stat					Statistic	-9.56335
** Probabilities are Computed Assuming Asymptotic Normality					Prob.**	0.0000
Intermediate ADF test results						
Series	t-Stat	Prob.	E(Var)	Order of integration	Max Lag	Obs
D(LOGVAIP)	-5.8288	0.0003	0.695	I(1)	1	29
D(LOGPEE)	-6.7871	0.0000	0.695	I(1)	1	29
D(LOGPEH)	-8.8575	0.0000	0.695	I(1)	1	29
D(LOGSHC)	-6.0165	0.0002	0.748	I(1)	1	28
D(LOGGCF)	-4.3625	0.0111	0.695	I(1)	1	29
D(LOGCOE)	-5.9539	0.0002	0.748	I(1)	1	28
D(LOGOPS)	-4.8621	0.0027	0.695	I(1)	1	29
D(LOGLAI,2)	-6.9498	0.0000	0.699	I(2)	1	28
D(REE)	-5.1395	0.0014	0.695	I(1)	1	29
D(CPI,2)	-7.9177	0.0000	0.699	I(2)	1	28
D(LOGEPT)	-6.1563	0.0001	0.695	I(1)	1	29
D(LOGTAX)	-4.3891	0.0169	0.748	I(1)	1	28
RESID	-4.5471	0.0002	0.789	I(0)	1	30
Average	-5.3782		0.708			
Test critical values:		1% level		-4.323979		
		5% level		-3.580623		
		10% level		-3.225334		

From the ADF test statistics, the results above show that all the series regarded as explanatory variables (logVAIP, logPEE, logPEH, logSHC, logGCF, logCOE and LOGOPS) and that some of the series listed as Instrument variables (REE LOGEPT and LOGTAX) were integrated at order one. The results also show that some listed instruments variables series (LOGLAI and CPI) were integrated at order two, that is I(2), or stationary at second difference. Comparing the variables levels with their first and second difference (Im, Pesaran and Shin W-stat) and various probabilities, the test statistics show that the variables are integrated at order of one and two. All the variables were statistically significant at 1%, 5% and 10% critical values in first and second difference. This implies that all the variables are in terms of first and second differences of logarithms (growth rates) and none at level.

From the results in the above tables' summary, there is an existence of unit root. This implies that all the series are non-stationary at levels. Therefore the null hypothesis ($\rho = 1$) is accepted at levels and the null hypothesis ($\rho = 1$) that the series are non-stationary after the first and second difference is rejected for all the series. For the random walk above, there are unit roots, so it is an I(1) and I(2) series. We therefore concluded that the series are of order one I(1). These are MacKinnon critical values for the rejection of hypothesis of a unit root.

The results for unit root test also show that the model residual is integrated of order of zero I(0). This is in conformity with the postulated theory, which stated that residuals of the estimated model must be significant at level. These are MacKinnon critical values for the rejection of hypothesis of a unit root. Next we look for the short-run impact relationship using the GMM-IV and possible existence of a long run relationship among the variables.

Short Run Impact Estimation

In Table 2 we GMM estimate (using Time series (HAC) of simultaneous weighting matrix for the five variables excluding the standard errors, with lists of six instrumental variables. Examination of these results indicates the conformity to our theoretical framework or the economics theory of the determination of productivity and active in performance issues given the coefficient of determinations of the explanatory variables; these include, coefficients of public total expenditure on education (PEE) (0.140%), public total expenditure on health (PEH) (0.042%), stock of human capital (SHC) (0.003%), gross capital formation (GCF) (0.601%), and compensation of employees (COE) (0.438%), all have positive effects on industrial production (VAIP). Though all explanatory variables have positive effects, but the public total expenditure on health (PEH) and stock of human capital (SHC) looking at their probability values (P-values) and their level of impacts (0.042%) and (0.003%), respectively, shows that both variables contribute less (insignificant) to industrial production in the Nigeria. Also looking at the level of impacts of PEE (0.140%), GCF (0.601%) and COE (0.438%), their coefficients showed that these are the most important variables in explaining industrial performance in the short run in Nigeria, it implies that their significance will be much felt

Furthermore, an examination of the results shows a good fit in terms of apriori expectation and statistical significance of the explanatory variables and in terms of the standard error of the parameters, ($\text{Std}\beta_1 > \text{Std}\beta_2\text{-}\beta_6$), which indicates a non-negative constant term for inflation (9.34%) no matter the changes in the public human capital investment and other control

variables (the independent variables). R^2 of (0.98) show that only 98% of variations in VAIP are accounted for by the changes in the PEE, PEH, SHC, GCF and COE and changes in the instrumental variables. The Durbin-Watson (DW) test statistic (d^*) shows the presence of negative serial correlation (2.52) between the error terms in the VAIP equation.

The J-statistic reported at the bottom of the table is the minimized value of the objective function. The J-statistic times the number of regression observations is asymptotically with degrees of freedom equal to the number of overidentifying restrictions. In our model we have six instruments to estimate five parameters and so there are five variables under the performance equation, not all are significant in explaining industrial performance, though all are positively related.

Table 2: Estimation

Method: Generalized Method of Moments					
Kernel: Bartlett, Bandwidth: Fixed (3), No prewhitening					
Simultaneous weighting matrix & coefficient iteration					
Lagged dependent variable & regressors added to instrument list					
Dependent Variable: LOGVAIP					
SERIES	Coefficient		Std. Error	t-Statistic	Prob.
C	β_1	9.344409	1.184065	7.891802	0.0000
LOGPEE	β_2	0.140498	0.012897	10.89392	0.0000
LOGPEH	β_3	0.042136	0.274893	0.153283	0.8795
LOGSHC	β_4	0.002779	1.002190	0.002773	0.9978
LOGGCF	β_5	0.601204	0.039793	15.10844	0.0000
LOGCOE	β_6	0.437847	0.152863	2.864305	0.0088
AR(1)		0.481141	0.030086	15.99198	0.0000
J-statistic			0.206514		
Equation: $LOGVAIP = \beta_1 + \beta_2 LOGPEE + \beta_3 LOGPEH + \beta_4 LOGSHC + \beta_5 LOGGCF + \beta_6 LOGCOE$					
Instrument list: LOGOPS, LOGLAI, REE, CPI, LOGEPT, LOGTAX					
Substituted Coefficients: $LOGVAIP = 9.344 + 0.140LOGPEE + 0.042LOGPEH + 0.003LOGSHC + 0.601LOGGCF + 0.438LOGCOE + [R(1)=0.481]$					
R-squared	0.983926		Mean dependent var	13.57156	
Adjusted R-squared	0.977157		S.D. dependent var	2.162438	
S.E. of regression	0.326826		Sum squared resid	2.029486	
Durbin-Watson stat	2.515023				
Inverted AR Roots	00				

Engle-Granger Single-Equation Cointegration Test

In the third step, the Engle-Granger single- equation cointegration test is used to confirm the existence of a cointegrating vector and the results are reported in Table 3. Looking at the test description, we first confirm that the test statistic is computed using constant and Trend as

deterministic regressors, and note that the choice to include a single lagged difference in the ADF regression was determined using automatic lag selection with a Schwarz criterion and a maximum lag of 1.

As to the tests themselves, the Engle-Granger tau-statistic (t-statistic) and normalized autocorrelation coefficient (which we term the z-statistic) both reject the null hypothesis of no cointegration (unit root in the residuals) at the 5% significance level. The probability values are derived from the MacKinnon response surface simulation results. Given the small sample size of the probabilities and critical values there is evidence of three cointegrating equation at the 5% level of significance using the tau-statistic (t-statistic) and evidence of four cointegrating equation at the 5% level of significance using the z-statistic.

This implies that the both rejected the null hypothesis of no co-integration among the variables at the 5 per cent level of significance. On balance, using the tau-statistic (t-statistic) the evidence clearly suggests that LOGVAIP, LOGPEH and LOGSHC are cointegrated, while LOGVAIP, LOGPEE, LOGPEH and LOGSHC are cointegrated using the z-statistic. This implies that there exists a long-run relationship or cointegration between industrial performance and some of its determinants.

Table 3: Engle-Granger Cointegration Test Results

Dependent	tau-statistic	Prob.*	z-statistic	Prob.*		
LOGVAIP	-5.850764	0.0450	-74.42757	0.0001		
LOGPEE	-3.875284	0.2478	-32.45937	0.0061		
LOGPEH	-5.104114	0.0331	-28.42869	0.0318		
LOGSHC	-5.185731	0.0284	-29.57610	0.0216		
LOGGCF	-3.870595	0.2470	-22.15524	0.1754		
LOGCOE	-3.098091	0.5696	-14.69755	0.6007		
*MacKinnon (1996) p-values.						
Intermediate Results						
	LOGVAIP	LOGPEE	LOGPEH	LOGSHC	LOGGCF	LOGCOE
Rho - 1	-0.790599	-0.777230	-0.947623	-0.985870	-0.738508	-0.489918
Rho S.E.	0.193886	0.181242	0.185659	0.190112	0.190800	0.158136
Residual variance	0.116750	0.076497	0.081731	2.127544	0.062764	0.184582
Long-run residual variance	0.116750	0.076497	0.081731	2.127544	0.062764	0.184582
Number of lags	0	0	0	0	0	0
Number of observations	30	30	30	30	30	30
Number of stochastic trends**	6	6	6	6	6	6
**Number of stochastic trends in asymptotic distribution						

In Table 3, the middle section of the output displays intermediate results used in constructing the test statistic that may be of interest. First, the “Rho S.E.” and “Residual variance” are the

(possibly) degree of freedom corrected coefficient standard error and the squared standard error of the regression. Next, the “Long-run residual variance” is the estimate of the long-run variance of the residual based on the estimated parametric model. The estimator is obtained by taking the residual variance and dividing it by the square of 1 minus the sum of the lag difference coefficients. These residual variance and long-run variances are used to obtain the denominator of the z-statistic. Lastly, the “number of stochastic trends” entry reports the value used to obtain the p-values.

Impulse Response Functions (IRF)

An IRF traces the effect of a one-time shock to one of the innovations on current and future values of the endogenous variable (variables). Thus, in Table 4, we present the results from the generalized impulse response for the level of industrial performance for a ten year period. The actual impulse response function is based on the initially estimated model of the vector autoregression (VAR) estimate using the actual data. The estimated coefficients of the VAR and contemporaneous model indicate the direct effects on the measure of industrial productivity. Yet, we are also interested in the effects (direct and indirect effects) that the explanatory variables will have on industrial performance.

Table 4: Response of LogVAIP to Generalized one S.D Innovations

Period	LOGPEE	LOGPEH	LOGSHC	LOGGCF	LOGCOE
1	0.053787	-0.050068	0.062897	0.165906	0.051317
2	0.135339	0.069404	0.180834	0.199189	0.078388
3	0.214000	0.112938	0.190035	0.190404	0.063930
4	0.196038	0.096912	0.213896	0.168366	0.071706
5	0.152376	0.054033	0.216410	0.173687	0.093006
6	0.142691	0.050986	0.176354	0.180372	0.117594
7	0.152179	0.070419	0.164008	0.176876	0.127128
8	0.156465	0.075806	0.180148	0.172962	0.136938
9	0.152792	0.069098	0.184738	0.172418	0.144834
10	0.147909	0.065581	0.177556	0.171911	0.168202
Generalized Impulse					

The IRF results in Table 4 describe how industrial productivity reacts over time to exogenous impulses' (shocks) of its determinant variables (public expenditure on education public expenditure on health, stock of human capital, gross capital formation and compensation of employees). The results show that current and future industrial productivity is affected contemporaneously by the shocks from these variables. The response is also portrayed

graphically, with horizon (period) on the horizontal axis and response on the vertical axis (see Appendix: Fig1).

The first column is the response of industrial productivity to increase in public expenditure on education, while the second column is the response of industrial productivity to increase in public expenditure on health. The third column is the response of industrial productivity to stock of human capital shock, the fourth column is the response of industrial productivity to gross capital formation and the fifth column is the response of industrial productivity to the increase in compensation of employees

The results shows that response of VAIP to the generalized impulse of the explanatory variables values are all positive to the ten period horizons except for PEH for the first period horizon. That is VAIP is affected contemporaneously by the shock to the explanatory variables, though the result in the five columns shows positive impact, they seem to have instability effects on their overtime trend both in their medium and long run growth rate

VAIP response to structural one innovation appears to be greater in SHC and GCF than other exogenous variables. SHC and GCF effects on VAIP appear to be more sensitive at medium run horizon for SHC, from third to fifth years (19.0%, 21.4% and 21.6% respectively) and short run horizon for GCF, for second and third years (19.9% and 19.0%). In overall, one innovation in SHC and GCF show large percentages of VAIP response. This shows that SHC and GCF innovations play an important role in variation of VAIP both in the short run and long run. It implies that labour and capital are very important factors in determining productivity in any economy.

An innovation in PEE appears to follow the same trend of SHC and GCF; aggregate PEE shocks explain a greater proportion of the variation in VAIP. This also shows that PEE is a very important factor in determining productivity in any economy. Innovations in COE, appears to have much impacts in long run than in the short run. Overall, it appears that an innovation in COE is another important factor affecting VAIP though it appears to be less sensitive in short run

Finally, VAIP response to structural one innovation appears to be less sensitive in PEH than other exogenous variables. PEH shock effect is stronger on the VAIP at initial horizon (the third and fourth years). One innovation in PEH shows small percentages of VAIP response

from the fifth to tenth horizons. This shows that government health policy innovations play a less important role in variation of VAIP in long run than they do in the medium run. Indeed, for the fifth to the ten period horizons (5.4%, 5.1%, 7.0%, 7.6%, 6.9% and 6.6% at 5th, 6th, 7th, 8th, 9th and 10th years' horizon, respectively) aggregate PEH shocks does not explain a greater proportion of the variation in VAIP. This shows that VAIP does not depend largely on PEH in Nigeria.

6.0 POLICY IMPLICATION

This research has highlighted a number of questions that possibly need more attention in an effort to establish a common understanding of how public investment in human capital influence industrial growth and performance and the result of our analysis is relevant to the Nigerian policy makers who desire to understand this.

The deductions that could be made from the empirical findings are predicted on the sizes and magnitude of the slope coefficients. Our analysis shows that though all explanatory variables have positive effects, but not all were significant in explaining the industrial performance. Holding the other control variables constant, the result shows that public expenditure on health contribute (less both short and long run) to industrial performance in the Nigeria, while, public investment on education contributes more to explaining industrial performance in the both short and long run in Nigeria, it implies that its significance is much felt. This shows that public investment on education is a very important factor in determining productivity in any economy.

One obvious policy implication is that governments which value the industrial growth and performance should ensure proper policy response to further investment in human capital. If the policy response is effective, industrial performance is likely to increase, provided that the productivity of government expenditure is not too low. The implication is that value-added to the industrial sector will be significantly faster in economies with higher initial levels of education. For example those government health policy innovations play a less important role in variation of industrial performance in the long run than they do in the medium run. It pointed out that targeting human capital is a key factor for the policy makers in Nigeria in order to achieve her industrial growth objectives.

An immediate, if general, policy implication that derives from the findings is that policy-makers that are interested in improving economic outcomes (e.g. on the labour market or for the entire economy) would have good reasons to consider investment in health as one of their options by which to meet their objectives. Like all investments, the return on expenditure on health and healthcare is at some point in the future. In this respect it is no different from a major infrastructure project. It is, however, an area where the potential for return on investments, and the uncertainty associated with a return, has been less well understood than in other sectors, and where fewer efforts have been undertaken to explicitly measure the returns to public health investment in monetary terms so that they can be more directly compared with alternative investment projects.

7.0 RECOMMENDATION AND CONCLUSION

This study focused, on the trade-offs faced by public investment in human capital - that is, government expenditure on education and health in enhancing industrial performance in Nigeria. This paper presents both the theoretical and analytical underpinnings productivity and describes the enhanced routines with a set of Instrumental variables (IV) estimators in the context of Generalized Method of Moments (GMM) estimation. Our purpose was to see if public investment in human capital has both static and contemporaneous impacts on industrial performance in Nigeria. We find results consistent with other researchers on static and contemporaneous impacts and all the explanatory variables appear to have impacted on industrial performance. We also used the impulse response of the effect of public investment in human on industrial performance. The results appear to be consistent with the overall industrial performance model.

The principal finding of this paper is that the public investment on education apart from other control variables in the model that are also significant (e.g gross capital formation) is more important in explaining variation in industrial productivity in the short run while, government health policy plays a less important role in variation of industrial productivity in Nigeria. Also, from our impulse response function, the study also revealed that, sudden changes or shocks or innovations in government human capital investment tend to have much impact on industrial productivity in Nigeria in case of education expenditure and less impact in case of health expenditure in Nigeria both in the short and long run.

Thus, the Nigerian policy makers (government) should do all it could, to increase its budgetary allocation to human capital development factors in order to boost industrial productivity through the increase in skilled workforce and more policy attention should be given to positive regulation of health policy expenditure and a steady boost in that sector. Given that many of today's health issues are driven by lifestyle factors, there is a need to establish more explicitly the economic case for governments to intervene in areas that *prima facie* might be seen as issues of individual choice. There is much to suggest that a case for doing so can be made using sound economic reasoning. If so, this could provide a similar rationale for investing in health as already exists for investment in road infrastructure or public schools.

As the key next step in developing further the economic argument, more research is needed to assess the costs and benefits in particular of broader public health interventions. This would represent the ultimate and necessary step in order to make a direct comparison of the returns to health investment with alternative uses of the money involved. In doing so, it would further facilitate the integration of health investment into overall national economic development plans.

References

- Adenikinju, A. F. (1996), "Structural adjustment programme and productive efficiency in the Nigerian manufacturing sector: Lessons beyond adjustment: *Beyond Adjustment: The Management of the Nigerian Economy*. Selected Papers for the 1996 Annual Nigerian Economic Society Conference, Ibadan, NES
- Adeyemi, A. O. (2002), "Public Human Capital Investment, Efficiency and Productivity Growth in the Manufacturing Sector: A Panel Data Analysis of Nigeria's Case. *Human Resource Development in Africa* Selected Papers for the 2002 Annual Nigerian Economic Society Conference, Ibadan, NES
- Aggrey, N., Eliab, L. and S. Joseph (2010), "Human Capital and Labour Productivity in East African Manufacturing Firms," *Current Research Journal of Economic Theory* 2(2): 48-54, 2010
- African Development Bank (1998), 'African Development Report, (Human Capital Development), ' Blackwell Publisher, Oxford
- Anyanwu, J.C., Oyewusi, A., Oaikhenan, H., and Dimowo, F.A. (1997), "The Structure of the Nigerian Economy (1960-1997)", Joanee Educational Publishers Ltd, Onitsha
- Barney, J.B. (1995); Looking Inside for Competitive Advantage: *Academy of Management Executive*, 9 (4), Malaysia.
- Mankiw, N.G., P. Romer and D. Weil, D. (1992), "A Contribution to the Emperics of Economic Growth", *Quarterly Journal of Economics* 107(2), 407-37
- Barro, R. (1991) Economic growth in a cross section of countries, *Quarterly Journal Economics* 106: May, pp. 407-43.

- Becker, G. S. (1964), 'Human capital: A Theoretical and Empirical Analysis with Special Reference to Education,' Third Edition, Chicago and London: The University of Chicago Press.
- Black, S. and L. Lynch (1996), "Human-Capital Investments and Productivity", *American Economic Review*, Nashville: American Economic Association, Vol. 86, No 2, p. 263-267.
- Bloom, D. E. and Canning, D. (2000), "The Health and Wealth of Nations" *Journal of Science*, 287: 1207-9
- Bukenya, J. (2009), Do fluctuations in Health Expenditure Affect Growth?" *The Open Economics Journal*, 2, 31-38
- Central Bank of Nigeria (2011), Statistical Bulletin, Vol. 22, December, Abuja, Nigeria
- Central Bank of Nigeria (2013), Statistical Bulletin, Vol. 24, December, Abuja, Nigeria
- Ciccone A. and E. Papaioannou (2006), "Human capital, The Structure of Production, and Growth" *The Review of Economic and Statistic*, 66-82
- Collis, D.J. and Montgomery C.A. (1996); Competing on Resources: Strategy in the 1990s. *Harvard Business Review*.
- de la Fuente, A. (2011) Human Capital and Productivity. Barcelona Economics, Working Paper No 530
- Deardorff, Alan (1982), "The General Validity of the Heckscher-Ohlin Theorem" *American Economic Review*, 72(4), pp. 683—694
- Egwaikhide, F.O., Ekpo, A.H., Oyeranti, O.A. and Ayodele, S.A. (2001) Four Decades of Industrialization in Nigeria: A critical Analysis. The Nigerian *Journal of Economic and Social Studies*, Vol. 43, No. 3, 365-400
- Forstner, Helmut (1985), "A Note on the General Validity of the Heckscher-Ohlin Theorem" *American Economic Review*, 75(4), Pp. 844-849.
- Grossman, M. (1972), 'On the Concept of Health Capital and the Demand for Health', *Journal of Political Economy*, 80(2): 223–255.
- Johansen, S. (1995a), "Likelihood-based Inference in Cointegrated Vector Autoregressive Models," Oxford University Press
- Lucas, Robert (1988), "On the Mechanisms of Economic Development" *Journal of Monetary Economics*, 22(1), pp.3-42
- Marimuthu M., L. Arokiasamy, M. Ismail (2009), 'Human Capital Development and Its Impact on Firm Performance: Evidence from Developmental Economics' *the Journal of International Social Research* Volume 2 / 8 Summer, page 265-271
- Nader, N and Ramirex, M.D. (1997) Public and Private Investment and Economic Growth In Mexico. Contemporary Economic Policy, XV: January.
- National Bureau Of Statistics (The Presidency) (2006), National Account Of Nigeria, Federal Republic Of Nigeria, Plot 762, Independence Avenue, Central Business District, Abuja.
- National Bureau Of Statistics (The Presidency) (2011), GDP Expenditure Report Federal Republic Of Nigeria, , Plot 762, Independence Avenue, Central Business District, Abuja, [Www.Nigerianstat.Gov.Ng](http://www.nigerianstat.gov.ng)
- Nelson, R.R. and E.S. Phelps (1966), "Investment in Humans, Technical Diffusion, and Economic Growth" *American Economic Review*, 56(1/2), pp. 69-75.
- Newey, W. and K. West (1987a), "Hypothesis Testing With Efficient Method of Moments Estimation," *International Economic Review*, 28, 777–787
- Organization for Economic Co-operation and Development (OECD), (1998) *Human Capital Investment: An International Comparison*. Paris, OECD.

Organization for Economic Co-operation and Development (OECD), (2001), The Well-Being of Nations: The Role of Human and Social Capital Paris, OECD.

Romalis, John (2004), "Factor Proportions and the Structure of Commodity Trade." *American Economic Review*, 94(1), pp. 67-97.

Romer, P. (1986); Endogenous Technological Change, *Journal of Political Economy* 98 (5)

Simon-Oke O. O. (2012), Human Capital Investment and Industrial Productivity in Nigeria *International Journal of Humanities and Social Science* Vol. 2 No. 16 [Special Issue

Solow, R.M. (1957); "Technical Change and the Aggregate Production Function", *Review of Economics and Statistics*

Suhrcke M.; M. McKee; R. S. Arce; S. Tsoleva and J. Mortensen (2005), The Contribution of Health to The Economy in The European Union, Health and Consumer Protection Directorate-General, European Commission

Todaro, M.P. and Smith, S.C (2012), "Economic Development" 11th ed. Addison-Wesley, Pearson Education Limited, England

Ventura, Jaume (1997), "Growth and Interdependence" *Quarterly Journal of Economics*, 112(1), pp. 57-84.

Fig 1. Response to Generalized One S.D. Innovations ± 2 S.E.

