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The Role of Human Capital in Industrial Development: The Nigerian Case (1980-2010)

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ABSTRACT

Human capital development is seen as a focal point for pivoting industrial development, for reducing the level of unemployment and increasing the supply of entrepreneurs in any economy. However, the effect of human capital on sustainable industrial development in Nigeria has not been adequately explored. In view of various policies adopted by successive governments to advance industrialization in Nigeria, the study examined the effect human capital development has had on industrial growth in the light of various factors that could have shaped industrial performance. In addition, the different educational enrollment rates were examined to find out if any significant positive impact will be felt in the industrial sector. Time series data covering the period between 1980 and 2010 were used with an appropriate econometric technique. It was discovered that human capital has to a large extent impacted on industry value-added, but in terms of output generated industrially, the effect of human capital remains low in Nigeria.

Keywords: Education; Industrial; Capital; Labour

1. Introduction

The centrality of industrial advancement in pivoting economic growth and development remains core in developing countries such as Nigeria with large population and labour force. It is therefore anticipated that the excess labour resources in the country could only be absorbed by the desired positive developments in the process of industrialization (Lewis, 1954: Todaro and Smith) [1]. In developing countries, a well-endowed human capital base could enhance the Industrial advancement desired for sustainable development. Not surprisingly, it is expected that the higher the level of training, the higher will be the skill possessed by the labour force of any country, which in turn has implications for the overall development of the economy. With particular reference to industrial development, most of the industries in developing countries have performed poorly relative to what appear to be their counterparts in developed countries [Mottaleb (2011) [2], Benhabib and Spigel (1994) [3], Guisan (2005) [4]]. This may not be a result of the absence of technical know-how in relevant industries alone, but the absence of relevant skills to drive technology production and usage.

As regards the ability of skill and technology driving output growth, some theoretical contributions on the growth literature were revealed in the works of the neo-classical growth models. For instance, according to the traditional neoclassical growth theory, output growth results from one or more of three factors, which includes increases in labour (through population growth and education), increases in capital (through saving and investment), and improvements in technology. According to the Solow growth model, human capital was seen to be part of the stock of human capital but, it was emphasized that long-run growth could only occur due to an exogenous component—*technological progress*—which could be alternatively referred to as labour productivity, (Solow, 1956) [5]. This could be contrasted with the endogenous growth model which belonged to the new growth theory; basically, it was postulated that output growth was determined by the system which included human capital, physical capital, technological efficiency, labour-governing the production process rather than by some forces outside the system, (Romer, 1986 [6]; Lucas, 1988 [7], Barro, 1991 [8]). Therefore, according to the new growth theorist, for any economy to experience meaningful growth, the forces within it such as human capital must be effective and augmented in terms of its quality in order to achieve efficiency in production.

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Meanwhile, to a certain extent, the role of human capital in the process of economic growth has been emphasized in Nigeria [Dauda (2012) [9], Ajetomobi and Ayanwale (2005) [10], Narasaiah, (2007) [11], Olomola (2007) [12]], but its role in various sectoral output growth is yet to be adequately addressed in Nigeria. Besides, the empirical literature on the link between human capital and industrial growth seemed to have changed course several times over the last decade (Maristella, 2007) [13]. On balance, the evidence now seems to indicate that educational expansion does contribute to output growth. At the other extreme, there could be grounds for thinking that human capital has a substantial impact on technological catch-up, possibly through improving a country's capacity to adopt new technologies [Arora and Badge (2008) [14], Karim, *et al.* (2012) [15]]. However, the literature is subject to many methodological and conceptual weaknesses, such as the inadequacy of empirical human capital proxies and the direction of causality. Therefore, deductions from previous studies may be preliminary and fragile. In view of this inconclusive nature of the role of human capital in advancing industrial development, a country-specific analysis situated for Nigeria is important.

Given the large population and large labour force in Nigeria, successive governments have embarked on industrialization as a means for transforming the Nigerian economy. For instance in1960s, the process from the agriculture was anticipated to be used to boost the industrial transformation process, as well as the windfall gains from crude oil price explosions in 1970s (Ayodele and Falokun, 2003 [16]). To further strengthen the industrial base of Nigeria, the structural adjustment programme was introduced in the mid-1980s to reduce government interference in price distortions and allow for free interactions between in market operations. But the overall contribution of the industrial sector to GDP has not really been encouraged as in 1975, the contribution was 21.2%, in 1985, it was 26%, in 1995, it was about 35%, while in 2005 (CBN, 2009 [17]). The question that may therefore be asked is that given the performance of the industrial sector, what are some of the factors that could have determined industrial development in Nigeria? In addition, the National economic Empowerment and Development Strategy (NEEDS) of 2001 aimed at forging stronger links between educational institutions and industry to stimulate rapid industrial growth and efficient exploitation of resources (National Planning Commission, 2005 [18]).

It is against this background that this paper will examine the various factors that had shaped industrial performance in Nigeria. In addition, the various effects of different educational enrollment levels have had on industrial development; finally, the relationship between human capital and industrial growth will be ascertained.

The study will be further divided as follows: Section two examined theoretical and empirical literatures on the nexus between human capital and output growth that could affect the industrial sector; Section three discussed the analytical framework of the study; while Section four presented the result of empirical analysis as well as the analysis of the results; finally, conclusion and policy recommendation were in Section five.

2. Theoretical Perspectives on Human Capital on Growth

According to the Harrod-Domar growth model, it is postulated that the more an economy is able to save and invest out of its national income, the faster will be the growth of such an economy; in addition for any level of savings and investment, growth rate can be accelerated by an inverse relationship between the proportions of capital to output. In addition to the investment, two other key components of economic of economic growth are labour force growth and technological progress. Although the Harrod-Domar model did not explicitly describe the labor force growth, but implicitly, labour is assumed to be abundant especially in developing economies and can be hired at any required point given the level of capital investments; while to boost growth rate, the issue of technological progressed can be inferred from a decrease in capital to output ratio , because it is evident that in the long-run, the capital to output ratio is not expected to be fixed and can change overtime in response to functionings that could drive its performance such as macroeconomic policies, and financial markets. The implication of the Harrod-Domar model is that, if any positive returns on growth is expected from investments, the use of labor and efficiency with which technology are employed must be adequately addressed, (Ayodele and Falokun, 2003 [16]).

A variant of the Harrod-Domar model was the Solow growth model. It particularly differed from the Harrod-Domar formulation by adding to the determinants of growth labour and an independent variable technology. Unlike the underlying assumption of the Harrod-Domar growth model of constant returns to scale, the Solow's neo-classical growth model exhibited diminishing returns to labour and capital separately and constant returns to both factors jointly. Technological progress became a residual factor for explaining long-term growth, and this level of technological progress was assumed by most neo-classical growth theorist including Solow to be exogenously determined; that is it is treated as an independent variable determining growth compared to other variables such as labour and capital. The implication of this advancement in growth theoretical formulation for this study is that there is the increasing recognition of the fact

that to experience output growth in all sectors of an economy, there must be increase in the quantity and quality of labour force through a healthy population growth and education; increases in capital through savings and investment and as well as improvements in technology.

Whenever there is an increase in the national output of an economy which cannot be attributed to short-term adjustments in labour and capital, it is usually attributed to a third category commonly referred to as the *Solow's residual*. It has been recorded from history that the growth experienced by most advanced countries is as a result of this residual concept-technological progress. But with the Solow's growth model, it is impossible to analyze the determinants of technological advancement; this is because it is independent of the decisions of economic agents. Besides, the Solow's model does not explain the reasons for experiencing large differences in residuals across countries with similar technology. This has led to the development of new growth theories such as the endogenous growth theories. The new growth theory provides a theoretical framework for analyzing endogenous growth where persistent output growth is explained by the system governing the production process rather than forces outside the system. With particular emphasis on the efficiency with which technology is used, the capital component is decomposed into physical and human capital. The endogenous growth model permits an increasing return to scale in aggregate production and assumes that public and private investment in human capital generate external economies and productivity improvements that offset the natural tendencies for diminishing returns. The new growth theory reaffirms the importance of savings which leads to investment as well as human capital investment for achieving rapid growth. The implication of the endogenous growth model to this study is that the potentially high rates of returns on investments in different sectors offered by developing economies with low capital-labour ratios are removed and this return is complemented by returns on investment in human capital, infrastructures or research and development.

Basically, there are direct means of advancing a nation's productive capacity; for instance, this could include increases in capital accumulation and capital stock. Likewise, there could be some indirect means of advancing a nation's productive capacity; for instance, these may include investments in social and economic infrastructures. Beyond these direct and indirect means of investment, there could be the inclusion of investment in human capital which can assist in augmenting labour productivity thereby, impacting on the overall productivity growth of any economy. Formal schooling, on-the-job training, vocational and technical trainings, and other forms of informal training can help to augment human skills given some direct investments in buildings, equipment and materials. Hence, to achieve meaningful output growth, the concept of investment in human resources and the creation of human capital are therefore analogous to that of improving the quality and thus the productivity of existing resources given planned investments (Todaro and Smith, 2011 [19]).

The concept of human capital refers to the knowledge, skills, attitudes, physical and managerial effort required to manipulate capital, technology, and land among other things, to produce goods and services for human consumption (UNECA, 1990 [20]). Investing in human capital entails when a person or society at large makes a current expenditure on education or training, it is anticipated that one's knowledge and skills and therefore future earnings will be enhanced; thus, having a continuing influence in all relevant sectors of an economy, (Connell and Brue, 1986 [21]).

3. Empirical Evidence on Human Capital Development and Its Implication for Industrial Development

A number of studies have examined the direct or indirect relationship between human capital and industrial development. Industrialization is generally accepted by policy makers, economic planners, researchers and professionals as one of the most desirable means for achieving objectives such as improvement in welfare, securing of viable employment, increasing of consumer and capital goods as well as expanding people's choices generally. During the process of Industrialization, the use of extensive technology to boost productive patterns cannot be overemphasized. As a result, the development of the industrial sector, which is central to industrialization, will involve the use of skilled personnel, extensive technology innovative management techniques, and other resources will be used to move an economy from inefficient means of production to the use of more sophisticated system. Therefore, as part of the human capital development process, there is the need for acquiring and increasing the number of persons who have the skills, education and experience in different fields of endeavour, as this is critical for the sustainable growth and development of a country.

Benhabib and Spigel (1994) [3] examined the role of human capital in economic development as well as the reason for cross-country differences in the level of human capital and technology. Using the growth accounting framework across different countries, the result suggested that the role of human capital in economic growth is that of facilitating the adoption of technology from abroad and the creation of appropriate domestic technology.

Mayer (2001) [22], in a study "technology diffusion, human capital and economic growth in developing countries" examined imports from both developed and devel-

oping countries, by using research and development expenditure to assess technology transfer to developing countries. The growth accounting frame work was also used to analyze the impact of machinery imports, in association with human capital on economic growth. They found out that machinery imports by developing countries have been higher between 1970s and 1980s;The growth accounting results suggest that machinery imports combined with human capital stocks have a positive and statistically strong significance on cross country growth differences. This goes to support the theoretical role of human capital and technology in advancing the use overall economic growth. Similarly, Schutt (2003) [23], in a study examined "the role of human capital in the process of economic growth". In line with theoretical expectations, it was concluded that human capital should matter for growth; but the channel through which it may affect growth could be direct or indirect. This implies that human capital could have a direct impact on growth or could through other sectoral channels influence economic growth.

Arora and Badge (2008) [14], in a study "private investment in human capital and industrial development: the case of the Indian software industry" examined the importance of skilled labour in the growth of Indian software industry between 1990 and 2003. Using the fixed effect estimate regression analysis, they found that engineering baccalaureate capacity had a significant effect on the growth of software exports even after controlling for some other factors. They also found out that the significant effect of this skilled capacity was due to private rather than publicly supported colleges.

Guisan (2005) [4] examined the state of human capital, population growth and industrial development in mexico and turkey in relation to other OECD countries between 1964 and 2004. In a regression analysis, it was discovered that Mexico and Turkey have some features in common, as both have experienced a high increase of population during the last half of the 20th century and a high growth of Gross Domestic Product (GDP) but they do not yet achieved an enough increase of the level of real GDP per inhabitant. In addition, it was shown that the comparison with other OECD countries regarding human capital, population growth, industry and trade, both countries could have experienced a higher increase in real GDP per inhabitant if they would have higher levels of average education per inhabitant. It is important to remark that improvements in education will have positive effects to increase industrial and non-industrial real-valued added per inhabitant.

Karim and Shabbir (2012) [15] in a paper examined the components of human capital and discussing their roles in achieving sustainable industrial development. For analysis purpose, a single-equation regression model of Malaysia's development of manufacturing sector was formed, which covers the period from 1981 to 2010. The findings highlighted the significance of human capital in which the variable of employment has the highest elasticity in contributing to the share of gross domestic product (GDP) of manufacturing sector. This was followed by labour productivity and human capital investment in education and health. Increasing in the number of job creations is expected to increase production of output to meet the market demand of local people and for exports. Moreover, increasing in labour productivity reduce cost of production and investment in education and health programmes assist in strengthening the skills, knowledge and capabilities of individual workers in the sector.

Galor and Moav (2004) [19] in a study, "human capital accumulation: inequality and the process of development" developed a growth theory that captured the replacement of physical capital accumulation, as a prime engine of growth along the process of development. It argued that the positive impact of inequality on the growth process was reversed in the process of development. They added that in the early stages of industrial revolution, when physical capital was the prime source of growth, inequality stimulated development by chanelling resources towards individuals with higher propensity to save. As human capital emerged as a growth engine, equality alleviated the adverse effects of credit constraints on human capital accumulation, thereby facilitating growth process.

Raul and Puvanasvaran (2009) [24], carried out a study to identify aspects of the employability skills and its relationship with the requirement of the employer in the manufacturing industries. Samples employed for the research consisted of 107 employers from manufacturing industry. In addition, the study had been done to companies in the manufacturing industry and grouped into three which are type of industry, company size and ownership status.

Analysis of the survey managed to determine important aspects of the employability skills needed by employers in the manufacturing industries. The skills were ranked and results showed that seven of the employability was considered important by Malaysian manufacturing industry which includes: basic skill, thinking skill, sources skill, resources skill, system and technology skill and personal qualities kills whereas Informational skill was considered moderately important.

In conclusion, the development of the industrial sector clearly needs the development of human capital, which is a vital input for the growth of output in a Nigeria. Besides, cooperation between private sector and relevant institutions needs to be encouraged to improve and upgrade human skills and talents in industrial activities. By so doing, human capital will be enhanced to increase

value-added to industrial production and development.

4. An Overview of the Trend and Growth Pattern in the Industrial Sector in Nigeria, 1980-2010

Before the discovery of oil in commercial quantity in Nigeria, the country was one of the major agrarian countries in Africa, and as such depended largely on proceeds of agricultural products. After Nigeria gained her independence, the drive towards industrialization led the government to adopt the import substitution strategy, in order to reduce heavy independence on the foreign manufactured products and equipments. Sequel to this, the government created incentives such as tax holidays to new firms, export license waiver, granting of pioneer status, etc to encourage foreign investors to invest in the industrial sector of Nigeria. Subsequently, the import substitution strategy gave rise to export promotion industrialization, particularly after the 1972/1973 windfall gains from crude oil price explosion at the global crude oil market; which led to heavy reliance oil revenue. The windfall gains improved the foreign exchange earned to purchase equipments and machines, thereby, enhancing the performance of the industrial sector and the manufacturing sub-sector. In 1981, the price of crude oil fell sharply, which had implications for the Nigerian economy, since oil revenue was the mainstay of the country; for instance, in the manufacturing sub-sector, the manufacturing value-added in 1985 was 8.7%, while it was 8.2% and 6.7% in 1990 and 1995 respectively, and by year 2000, the manufacturing value added stood at an average of 6% (CBN, 2000) [25].

It is equally to note that due to the oil-dependent nature of the Nigerian economy, the country had transformed into an inefficient and import-dependent economy. As a result there was the need to evolve a structure that will support a diversified, dynamic and export oriented economy. This led to the adoption of the proposed World Bank/ IMF Structural Adjustment Programme in July, 1986. Policies targeted at improving industrialization included technical devaluation of the Nigerian currency to favour manufactured exports, tax holidays for entrepreneurs wishing to invest in economically disadvantaged areas, promulgation of the Export Incentive Decree of 1986, as well as adoption of privatization and commercialization policy the enhancement of industrial productivity and efficiency. Relevant laws were made to energise the processes of effective industrialization, most of which are documented in the1988 industrial policy of Nigeria (FRN. 1988: Ayodele and Falokun [16]). The adoption of the SAP had some implications for the industrial performance in Nigeria, for instance, in **Figure 1** presented the proportion of industrial output to GDP revealed that the contribution of the industrial sector to

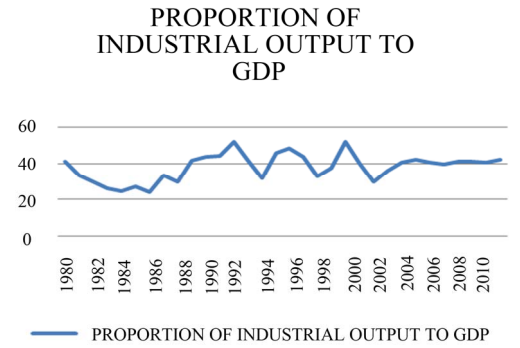

Figure 1. The proportion of industrial output to GDP. Source: central bank of Nigeria, 2011.

GDP was 40% in 1980, while in the mid-1980s, it fell to 23%. This could be as a result of the oil glut experienced in the late 1970s. But by mid-1980s, the global oil price started picking up again and by 1990s the contribution of the industrial sector to GDP began to rise from 41% in 1990 to 45% 1995 and in year 2000, it was about 50%. It is pertinent to note that the increasing contribution of the industrial sector to the GDP was largely as a result of the performance of oil sub-sector. For instance, in 1980, the share of oil revenue in total revenue was 81.6% in 1980, while in 1985, it was 72.2%; in 1990 and year 2000, the share of oil revenue in total revenue was 73.3% and 83.5% and by 2005, it was about 82% (CBN, 2010) [26].

In recent times, one of the policies designed to enhance industrial advancement is the National Economic Empowerment and Development Strategy (NEEDS) which started in the year 2001. As part of its plan, it was expected that an annual growth rate of 7% will be achieved in the industrial sector while special support be given to industries, oil and gas as well as small and medium scale enterprises. A major policy thrust of NEEDS was the idea that Nigeria should stop squandering its natural resources by selling them as crude products, instead, these products in crude form should be processed within Nigeria, thereby, creating opportunities for more jobs. In essence, the policy of the NEEDS proposed developing the industrial sector by relying more on local resources and less on imports. This was expected to be guided by a local research and development strategy that seeks to promote science and technology-based small and medium-size enterprises.

Statistics revealed that the despite the implementation of some of these policies, the growth rate of the real industrial sector growth has not been encouraging. As at 2005, real industrial growth was 1.71, in 2006, it fell to −2.51; in 2007 and 2008, it increased to −2.23 and −2.18 respectively. But in 2009, industrial output grew by 0.6%, in contrast to the fall recorded in the previous years. This development was attributable mainly to the implementation of the Federal Government amnesty programme,

which paved way for an increase in crude oil production. Other recent government programmes and policies in support of the real sector, especially the small and medium scale enterprise, impacted positively on growth; for instance, solid minerals real output grew from 9.53% in 2005 to 12.08% in 2009, while the manufacturing sector output grew at an average of 8% between 2005 and 2009, (CBN, 2010) [25].

The industrial sector in Nigeria is gradually picking up, but some of the principal challenges include poor infrastructure, while the most serious of all is the problem of inadequate power supply. In addition, the failure of past government at infusing greater transparency and accountability in the oil and gas industry affected the expected growth in the industrial sector. But in recent times, the government has introduced the Petroleum industry bill in order to establish the legal and regulatory framework, as well as the institutions and regulatory institutions for the petroleum industry.

5. Analytical Framework

An endogenous model of economic growth appears to be the most suitable for the study. The model suggests that endogenous factors such as capital formation, technology, government policies, political stability, market distortions, human capital etc., can significantly affect overall economic performance in terms of growth. In fact Industries experience cycles of economic growth and contraction based on many factors. These include the overall health of the markets, consumer preferences and even seemingly unrelated world news and events. Although some companies perform better than others in their industry, the global factors that affect the industry as a whole must be contemplated when planning to start or grow a business include interest rates, currency rates, economic health, government intervention through infrastructures as well as human capital .

It is a widely used growth model to provide a systemic investigation of the human capital-economic growth nexus. For example, Dauda (2010) [9], and Adamu (2003) [27] used it to assess the role of human capital in the Nigerian economy and as such could be used to assess the role of human capital in industrial development. This study is different from previous studies in terms of the fact that previous studies have concentrated on the role of human capital on the economy of Nigeria in general, but this study will be a little more specific by examining the industrial sector. The framework for this study is adapted from Dauda (2010) [9]. It assumes a standard neoclassical production function which begins from a premise that changes in quantities of factors of production account for growth. The neo-classical model is based on the Cobb-Douglas function and is given as:

$$Y = F\left(A, K, L\right) \tag{3.1}$$

where Y, K, L are aggregate real output, capital and labour respectively, and A denotes technical progress or total factor productivity.

When we differentiate Equation (3.1) with respect to time, divide by Y and rearrange the terms, it gives equation (3.2) as:

$$\left\{\frac{\Delta Y}{Y}\right\} = \left\{\frac{\Delta A}{A}\right\} + \left\{F_K \frac{\Delta K}{Y}\right\}\left\{\frac{K}{K}\right\} + \left\{F_L \frac{\Delta L}{Y}\right\}\left\{\frac{L}{L}\right\} \tag{3.2}$$

where;

Y/K = Rate of growth of output;

K/K = Rate of growth of capital;

L/L = Rate of growth of labour force;

F_K = Social marginal product of capital;

F_L = Social marginal product of labour;

$\Delta A/A$ = Hicks neutral rate of change of technological progress.

Modern economic growth depends on the accumulation of physical capital and an increase in labour force with improved technological embodiment without which labour cannot be effective. Human capital is a factor influencing labour productivity because it facilitates the absorption of new technology, increases the rate of innovativeness and promotes efficient management (Adamu, 2000) [27]. Consequently, for high labour productivity, an integral part of technological progress is investment in human capital and thus is termed endogenous factor because accumulation of physical capital is enhanced by the knowledge, skills, attitudes and health status of the people who partake in such exercise. Thus, there is a strong and positive relationship between investment in human capital and output growth.

In this regard, several studies have attempted to integrate exogenous forces with endogenous factors in explaining economic growth across countries by using augmented Solow neoclassical production function. These studies include but not limited to the following; Romer (1990) [6], Romer and Weil (1992) [28], Gemmell (1996) [29], Grammy and Assane (1996) [29] and Chete and Adeoye (2001) [30]. Generally, the impact of human capital on economic growth is incorporated according to the Romer and Weil (1992) [28] framework and is given below as:

$$Y_{(t)} = K_{(t)}\alpha H_{(t)}\beta\left(A_{(t)}L_{(t)}\right)^{1-\alpha-\beta} \tag{3.3}$$

where;

Y is output; K = Physical capital and H = the Human Capital Stock; L = Labour force; A is level of technology and α, $\beta < 1$, implying decreasing returns to capital. By implication, there is a strong and positive relationship between investment in human capital and output growth.

Based on the literature reviewed earlier, the following model is specified to evaluate the effect of human capital formation on industrial growth in Nigeria.

$$IV = (GCF, LBF, PRI, SEC, TER) \quad (3.4)$$

$$IO = (GCF, LBF, PRI, SEC, TER) \quad (3.5)$$

where

IV/IO = Industry value-added as a proxies for industrial growth;

GCF = Real gross capital formation;

LBF = Labour force;

PRI = Primary education enrollment;

SEC = Secondary education enrollment;

TER = Tertiary institution enrollment;

U = White noise.

For estimation purposes, we can re-specify Equations (3.4) and (3.5) in a log-linear functional form: This will give:

$$InIV = \alpha_0 + \alpha_1 InGCF + \alpha_2 InLBF + \alpha_3 InPRI + \alpha_4 InSEC + \alpha_5 InTER + U \quad (3.6)$$

$$InIO = \alpha_0 + \alpha_1 InGCF + \alpha_2 InLBF + \alpha_3 InPRI + \alpha_4 InSEC + \alpha_5 InTER + U \quad (3.7)$$

The apriori expectations are as follows:

$\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5, > 0$

In a similar fashion, in order to determine certain selected factors that could affect industrial development, the Equations (3.4) and (3.5) could be further modified to look this:

$$IV = (RINT, REER, INF, GDP, HUM) \quad (3.8)$$

$$IO = (RINT, REER, INF, GDP, HUM) \quad (3.9)$$

where

IV/IO = Industry value-added as a proxies for industrial growth.

RINT = Real interest rate;

REER = Real effective exchange rate;

INF = Infrastructures;

GDP = Gross domestic product;

HUM = Human capital;

U = White noise.

For estimation purposes, we can re-specify Equations (4) and (5) in a log-linear functional form: This will give:

$$InIV = \alpha_0 + \alpha_1 InRINT + \alpha_2 InREER + \alpha_3 InINF + \alpha_4 InGDP + \alpha_5 InHUM + U \quad (3.10)$$

$$InIO = \alpha_0 + \alpha_1 InRINT + \alpha_2 InREER + \alpha_3 InINF + \alpha_4 InGDP + \alpha_5 InHUM + U \quad (3.11)$$

The a priori expectations are as follows:

$\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5, > 0$

The equation was estimated using a variety of analytical tools, including unit root tests to examine is the variables employed are stationary at level or first difference. In addition co-integration tests were employed to know if any long-run relationship exists between human capital and the proxy measurement for industrial development. Likewise, ordinary least squares regression technique for know the short-run relationship that exist between human capital and the proxy measurement for industrial development. The results are discussed below.

The data used for the study covers the period 1980 and 2010, and the specific relationship is expected to in **Table 1**.

The study employed secondary data which are derived from various of Central Bank of Nigeria (CBN) Annual Report and Statement of Accounts, CBN Statistical Bulletin, 2011; International Financial Statistics (IFS), 2011 and World Bank African Development Indicators (WDI), 2011.

6. Estimation Results

6.1. Unit Root Test

It is not unusual to discover that most time-series variables are non-stationary in their levels and that several of these variables are therefore, represented in their first difference. These time-series are therefore said to be integrated of order one and are denoted by I(1). The level of some variables can be so large or small that they not revert to their mean as expected, hence the need for stationarity test which is also known as unit root test.

In view of the fact that the stationarity of a time series affects the consistency of the estimates of the error correction model, it becomes necessary to examine the order of integration of data employed in the study. In testing for the stationarity of variables, both the Augmented Dickey-Fuller as well as the Phillip-Perron unit root tests was adopted. The Augmented Dickey-Fuller test adopted lag 1, while the Phillip-Peron test specified 3 lags. The null hypothesis formulated using both test statistics is that the variable in question has a unit root. **Table 2** also showed that the null hypothesis which is specified that a variable under investigation has a unit root, against the alternative, can be rejected for all the data series in their levels at 1%, 5% and 10% significance level. Having taken the difference of all the series, the ADF and PP test was further employed in testing for the stationarity of the differenced series. By carrying out unit root tests for individual variables in their first difference, the comparison of respective critical values with their reported statistics (as indicated in **Table 2**) leads to the rejection of the null hypothesis for all variables at either the 1%, 5% or 10% level, (Gujarati and Porter, 2009 [31]).

The inference of the Augmented Dickey-Fuller and Phillip-Perron tests, therefore, is that all the data series for this study are I(1) series. This implies that these selected series become stationary when they are differenced once.

Table 1. Variable measurement. Dependent variable: industrial performance (using industry value added as a percentage of gdp and industrial output as a percentage of GDP).

Variables	Sources of Variable	Proxy Measurement	Apriori Expectation
Physical capital	IFS, (2011)	Gross fixed capital formation	Positive
Labour	IFS, (2011)	Labour force	Positive
Human capital	WDI (2011)	Primary enrollment	Positive
Human capital	WDI (2011)	Secondary enrollment	Positive
Human capital	WDI (2011)	Tertiary enrollment	Positive
Interest rate	WDI (2011)	Real interest rate	Negative
Currency strength	WDI (2011)	Real effective exchange rate	Negative
Human capital	WDI (2011)	Secondary school enrollment	Positive
Economic health	CBN (2011)	Gross domestic Product	Positive
Infrastructure	WDI (2011)	Electricity (kwh)	Positive

Table 2. Unit root test.

Variables	ADF* (1 Lag)		PP* (3 Lags)		*d*
GCF	1.5222	−0.8179	−1.3743	−1.3295	I(0)
ΔGCF	−4.2426	−3.6547	−4.2626	−4.2740	I(1)
LBF	−1.0472	−3.0445	−3.1550	−3.1395	I(0)
ΔLBF	−7.4111	−7.4698	−8.7977	−9.2134	I(1)
PRI	−2.7894	−2.8242	−1.8000	−1.9094	I(0)
ΔPRI	−3.6597	−3.5528	−3.6386	−4.3098	I(1)
SEC	−0.6303	−2.2149	−0.7842	−1.7194	I(0)
ΔSEC	−2.7244	−2.6459	−2.7244	−2.6131	I(1)
TER	−1.9393	−3.4799	−1.3257	−3.4348	I(0)
ΔTER	−6.1410	−6.1946	−6.7335	−6.7765	I(1)
GDP	−1.5297	−3.0093	−1.5297	−2.9107	I(0)
ΔGDP	−4.1789	−3.8128	−3.8694	−3.4575	I(1)
INF	−2.0107	−3.1187	−1.8640	−3.2437	I(0)
ΔINF	−8.1222	−8.0024	−8.3160	−8.3165	I(1)
RINT	−3.7132	−4.2093	−3.7132	−4.2178	I(0)
ΔRINT	−7.6245	−7.5182	−13.9115	−16.3970	I(1)
Mackinnon criticalvalues:					
Level: 1%	−3.610453	−4.211868	−3.610453	−4.211868	
5%	−2.938987	−3.529758	−2.938987	−3.529758	
10%	−2.609066	−3.198312	−2.607933	−3.196411	
1st Difference					
1%	−3.615588	−4.219126	−3.615588	−4.219126	
5%	−2.941145	−3.533083	−2.941145	−3.533083	
10%	−2.609066	−3.198312	−2.609066	−3.198312	

Notes: *ADF, PP and Δ denote augmented dickey fuller, Phillip-Perron and decision about the first order of integration respectively.

6.2. Emprical Results between Human Capital and Industial Development

Using stationary time series variables, the regression analysis carried out on the relationship between Industry Value added, industrial output and human capital variables revealed the results specified below:

From **Table 3**, the R-squared and adjusted R-squared showed that the independent variables explain the dependent variables by a magnitude of 76.9% and 76.3% respectively. The overall variables posed to be significant as the F-statistic had a high value. The Durbin Watson statistic showed no auto-serial correlation.

The primary enrollment ($t = 5.63$, $p < 0.05$), and secondary enrollment ($t = 2.91$, $p < 0.05$) had a significant positive effect on industrial performance. While the tertiary enrollment ($t = -0.7$, $p < 0.05$) had an insignificant negative effect on industrial performance. The primary and secondary enrollment meets our apriori expectation, but the tertiary enrollment negates the apriori expectation.

The implication of this result shows that in terms of value added at various levels, the skill acquired at the primary and secondary levels in relation to industrial requirement may just be adequate; while the quality of skill possessed at tertiary level and its relation to Industrial requirements may just not be adequate. Besides, post-secondary training may not be meet the needs in relation to the actual type of skill required by most Nigerian industries.

In a different manner, the R-squared and adjusted R-squared in **Table 4** showed that the independent variables explain the dependent variables by a magnitude of 57.6% and 49.2% respectively. The overall variables posed to be significant as the F-statistic had a high value. The Durbin Watson statistic showed no auto-serial correlation.

The primary enrollment ($t = 2.35$, $p < 0.05$), and secondary enrollment ($t = -3.37$, $p < 0.05$) had a significant negative effect on industrial output. While the tertiary enrollment ($t = -0.71$, $p < 0.05$) had an insignificant negative effect on industrial output. The primary and secondary enrollment does not meet apriori expectation, but the tertiary enrollment is in line with the apriori expectation.

The implication of this result shows that in terms of output generated industrially, primary and secondary skill may not be sufficient to drive growth within the industrial sector. The tertiary education may be driving industrial output, but this drive is not significant enough to boost the expected growth within the industrial sector.

In **Table 5**, the R-squared and adjusted R-squared showed that the independent variables explain the dependent variables by a magnitude of 72.4% and 70.8% respectively. The overall variables posed to be significant as the F-statistic had a high value. The Durbin Watson statistic showed no auto-serial correlation.

Table 3. The relationship between human capital and industry value added. Dependent variable: LNIV.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.604749	1.037435	4.438589	0.0002
LNGCF	−0.073978	0.013261	−5.578636	0.0000
LNLBF	−0.850439	0.257976	−3.296579	0.0029
LNPRI	0.606802	0.107716	5.633374	0.0000
LNSEC	0.218953	0.075110	2.915078	0.0074
LNTER	−0.089696	0.126383	−0.709717	0.4844
R-squared	0.769943	Mean dependent var		4.013068
Adjusted R-squared	0.763932	S.D. dependent var		0.282035
S.E. of regression	0.053563	Akaike info criterion		−2.843933
Sum squared resid	0.071725	Schwarz criterion		−2.566387
Log likelihood	50.08097	Hannan-Quinn criter.		−2.753460
F-statistic	16.3517	Durbin-Watson stat		1.753103
Prob (F-statistic)	0.000000			

Table 4. The relationship between human capital and industry output dependent variable: LNIO.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.592861	2.912515	2.606978	0.0152
LNGCF	0.032390	0.037229	0.870025	0.3926
LNLBF	0.220448	0.724247	0.304383	0.7634
LNPRI	−0.711164	0.302403	−2.351710	0.0269
LNSEC	−0.712404	0.210866	−3.378464	0.0024
LNTER	0.252465	0.354810	0.711549	0.4833
R-squared	0.576511	Mean dependent var		3.605068
Adjusted R-squared	0.491814	S.D. dependent var		0.210941
S.E. of regression	0.150374	Akaike info criterion		−0.779403
Sum squared resid	0.565305	Schwarz criterion		−0.501857
Log likelihood	18.08074	Hannan-Quinn criter.		−0.688929
F-statistic	6.806692	Durbin-Watson stat		1.853511
Prob (F-statistic)	0.000394			

Table 5. Factors influencing industrial performance in Nigeria. Dependent variable: LNIV.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.874858	0.364086	16.13591	0.0000
RINT	−0.001603	0.001214	−1.320840	0.1990
REER	0.000152	0.000155	0.979762	0.3370
LNINF	−0.267852	0.123736	−2.164706	0.0406
LNGDP	−0.096014	0.012820	−7.489474	0.0000
LNHUM	0.202857	0.129648	1.564672	0.1308
R-squared	0.724558	Mean depenent var		4.033044
Adjusted R-squared	0.708841	S.D. dependent var		0.263609
S.E. of regression	0.079590	Akaike info criterion		−2.046993
Sum squared resid	0.152031	Schwarz criterion		−1.766754
Log likelihood	36.70490	Hannan-Quinn criter.		−1.957342
F-statistic	58.82513	Durbin-Watson stat		1.703539
Prob (F-statistic)	0.000000			

With the human capital result above ($t = 1.56$, $p < 0.05$), the human capital component is in line with the apriori expectation; that is human capital has had significant effect on industry value-added.

The implication of this result shows that in terms of industry value-added, human capital had a significant effect on industrial performance. The economic health (GDP) and Infrastructures (Electricity consumed) of the Nigerian economy has not had significant effect on industry value-added. While the exchange rate showed that as real effective exchange rate increases, industry value added increases; interest rate reveals an inverse relationship between real interest rate and industry value added.

In the **Table 6**, the R-squared and adjusted R-squared showed that the independent variables explain the dependent variables by a magnitude of 62.6% and 54.8% respectively. The overall variables posed to be significant as the F-statistic had a high value. The Durbin Watson statistic showed no auto-serial correlation.

With the human capital result above ($t = -1.96$, $p < 0.05$), the human capital component is in not line with the apriori expectation; that is human capital has had no-

Table 6. Factors influencing industrial performance in Nigeria. Dependent variable: LNIO.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.472182	0.657478	6.802021	0.0000
RINT	−0.002981	0.002192	−1.359716	0.1866
REER	−0.000544	0.000279	−1.947352	0.0633
LNINF	−0.028689	0.223446	−0.128393	0.8989
LNGDP	0.061409	0.023151	2.652596	0.0139
LNHUM	−0.459736	0.234123	−1.963652	0.0613
R-squared	0.626417	Mean dependent var		3.602174
Adjusted R-squared	0.548588	S.D. dependent var		0.213920
S.E. of regression	0.143727	Akaike info criterion		−0.864949
Sum squared resid	0.495777	Schwarz criterion		−0.584710
Log likelihood	18.97424	Hannan-Quinn criter.		−0.775298
F-statistic Prob (F-statistic)	8.048563 0.000000	Durbin-Watson stat		1.615068

significant effect on industrial output.

The implication of this result shows that in terms of industrial output, human capital has had a significant effect on industrial performance. While infrastructures still maintained an inverse relationship with industrial output, the economic health (GDP) of the Nigerian economy has had significant effect on industrial output in Nigeria. It is revealed from the result in **Table 6** that in line with apriori expectation, real effective exchange rate and real interest rate had negative effects on industrial output.

6.3. Long-Run Analysis on Factors Influencing Industrial Performance in Nigeria

Due to the case of multivariate time series, and the fact that the data are of unit roots, this section investigates whether any long run relation exist between the selected human capital and industrialization process in Nigeria. Since most of the variables are found to be integrated of the same order I(1), it implies that an equilibrium relationship exist among the variables. In testing for cointegration among the selected variables, the Johansen cointegration test was conducted.

Table 7 presents the test results for the number of cointegrating vectors. The result showed that the Trace test suggests the presence of four cointegrating equation among the six variables in the Nigerian economy at 5 percent level in line with MHM critical values. This depicts the presence of a long-run equilibrium relationship among Industry Value Added, physical capital and human capital.

Table 8 presents the test results for the number of cointegrating vectors. The result showed that the Trace test suggests the presence of four cointegrating equation among the six variables in the Nigerian economy at 5 percent level in line with MHM critical values. This de-

Table 7. Johansen Cointegration Test for factors influencing industrial performance in Nigeria. Trace statistic.

Hypothesized No. of CE(s)	Trace Statistic	Critical Values	Prob.
None*	128.1756	95.75366	0.0001
At most 1*	85.36545	69.81889	0.0018
At most 2*	52.17178	47.85613	0.0186
At most 3	29.60147	29.79707	0.0527
At most 4	11.65717	15.49471	0.1741
At most 5	0.326399	3.841466	0.5678

Note: *(**) denotes rejection at 1% (5%). All variables are as defined earlier. Series: IV GCF, LBF, PRI, SEC, TER. Lags interval (in first differences): 1 to 1.

Table 8. Johansen Cointegration Test-for factors influencing industrial performance in Nigeria. Trace statistic.

Hypothesized No. of CE(s)	Trace Statistic	Critical Values	Prob.
None*	155.5209	95.75366	0.0000
At most 1*	95.40644	69.81889	0.0001
At most 2*	55.07321	47.85613	0.0091
At most 3	28.84368	29.79707	0.0641
At most 4	9.566063	15.49471	0.3156
At most 5	0.014874	3.841466	0.9028

Note: *(**) denotes rejection at 1% (5%). All variables are as defined earlier. Series: IO GCF, LBF, PRI, SEC, TER. Lags interval (in first differences): 1 to 1.

picts the presence of a long-run equilibrium relationship among Industrial output, physical capital and human capital.

7. Summary and Conclusions

It is evident from the analysis carried out in the preceding section that the available human capital has had some impacts on the value added to the industries in Nigeria, but in terms of the overall output generated within the industrial sector, the human capital component has not really boosted industrial performance. According to the Lewis's two-sector model which is a theory of development, he postulated a scenario where a traditional, overpopulated, rural subsistence sector with no marginal productivity transfers its excess labour to a high-productivity modern urban industrial sector; thereby it promotes industrialization and sustained development, (Chete and Adeoye, 2001 [32]. The primary focus of the model is on the process of labour transfer which basically depends on the growth of output and employment in the modern industrial sector (Todaro, 2010 [19]). This postulate is evident in the Nigerian mining industry (such as the crude oil and manufacturing industry) which requires peculiar manpower. In comparison with other sectors such as the agricultural sector, the crude oil and the manufacturing sectors employ specialized, semi-skilled, skilled, and dedicated people in all technical areas of operation. Despite the quality of personnel within the industrial sector, the **Figure 1** revealed that the industrial contribution to overall output remains below average.

In essence, given the continuous advancement in technology, the need is to meet up with other industrialized nations, as well as to further ensure sustainable industrial development. There is the need for high skilled personnels that are flexible and relevant at various operational stages of production. Besides, intensive training programmes in both technical and non-technical areas will provide a concrete base for personnel to cope with the dynamics of the industry as dictated by prevailing socio-economic and political factors.

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