HUMAN CAPITAL, INDUSTRIAL OUTPUT AND ECONOMIC GROWTH IN NIGERIA

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Abstract

Despite Nigeria's vast size in human capital, physical capital, and natural resources, her economic growth still needs improvement. This is because of low productive skills and the dilapidated industrial tools which have constrained rapid human capital skills, industrial output growth thereby slowing economic growth. Using unit root tests, trend analysis and Ordinary Least Square (OLS) techniques, this study examined the impact of human capital skill and industrial output on economic growth in Nigeria. Findings disclosed that human capital skills and industrial output jointly influenced economic growth in Nigeria. Notably, the study systematically revealed that labour participation rate, proxy as human capital skills and industrial output, catalyzed economic growth in Nigeria. The overall outcomes via the F-statistics showed significant effects of industrial output and human capital skill on the Nigerian economic growth. Consequently, to improve economic growth in Nigeria, the study suggests that governments at all levels should draft policy to prioritize productive factor inputs such as improving school enrolment rate at the secondary schools to enhance human capital skills, vocational skills and infrastructure technology so as to reduce real cost and money cost of production for rapid industrial output.

Keywords: Human Capital Skills; Industrial Output; Economic Growth.
JEL CLASSIFICATION
J24; L11; and O57

Introduction

Over time, development economists have not drawn a consensus between human capital skills, industrial output, and economic growth, particularly in a small open economy like Nigeria. Given the fact that

industrialization and human capital skills advancement catalysed the integral part of economic development, which is instrumental for structural change. Therefore, understanding how human capital skills and industrial output affect economic growth is pertinent to address vital point of concern among economists. The reason is that industrial output accounts for the overall production of goods and services within the economy (Akinola & Mbonigaba, 2020; Keji, Akinola, & Mbonigaba, 2024), while human capital skills account for the overall human efforts, including potentials contributed to general productivity in an economy (Mbonigaba & Akinola, 2019; Friedrichs, 2021; Keji, 2021). The overall impact of human capital skills and industrial output are expected to transcend across all the sectors of the economy through the nation's mining, manufacturing, electricity, oil and service sectors (World Bank, 2023; OECD, 2024). Akinlo and Lawal (2015), (Uruakpa, 2019), Ozuzu and Isukul (2021) and Chukwu (2023) regarded industrial sector growth as the backbone and the engine of any contemporary economic development. This can be traced to the creation of jobs, expansion of the productive base of goods and services through the expansion of both domestic and foreign markets, and promotion of research and development for both human capital and nonhuman capital, among others.

Similarly, Nwogo and Orji (2019) opined that industrialization is the engine of economic growth, as it leads to rise in the production of export goods and services, hence resulting to expand net inflow of foreign exchange into the country. Meanwhile, Keji (2021) opined that Human capital development caused economic growth in Nigeria.

However, recently, the Nigerian human capital skills contributions and industrial sector growth performance have been trembling (Word Development Indicator, 2023). This was attributed to a consistent decrease in the sub-sectorial growth and poor skills development. Notably, the industrial sector output fell by 1.91 per cent, which was a standout element of the gross domestic product (GDP) in the third quarter (Q3) in 2021. This is one of the major quarterly drops in the industrial sector, since the Nigerian economy slid into a recession in 2020. It was also noticeable that the contribution of the industrial sector output to gross domestic product (GDP) decreased from 23.7% to 18.37%, the lowest level in the quarter (Q4) 2021. As of the first quarter of 2016, Nigeria's industrial sector generated 24% of the country's GDP. While it added 20.57% in the same quarter of 2021. Apart from the oil and gas industry, which led to the downturn in recent years, construction and manufacturing have also seen significant losses (Centre Bank of Nigeria, 2020; World Bank Development Index, 2023). For example, oil exploration as a proportion of GDP plummeted into 0.01% in the third quarter of 2022, while the

construction industry dropped to below 4% of total GDP. Manufacturing also fell to 8.59% in Q3 2022 compared to 8.96% in the corresponding quarter in 2021 (World Bank, 2022; Nigerian Bureau Statistics, 2023). However, the recent trends portrayed unimpressive performance against high returns recorded growth rate in the 1970s with 25% in 1970 due to the discovery of oil (World Bank Development Index, 2024).

Similarly, human capital skills development in Nigeria has become a mirage, which has been further compounded by poor political will to advance basic needs for human capital development such as health care, education, and vocational skills development (Keji, 2021; 2023). For example, the school enrolment rate, which was meant to be the basis for human capital skills, has decreased in recent years (World Bank Development Index, 2023). Many productive youths were out of school and lacked the requisite productive skills expected to advance economic growth. Hence, their contributions to economic growth were further compromised. To worsen the situation, the country's university graduate skills are characterized by incompatibility with the demands of workplace skills (Keji, 2025). The few available highly skilled labourers were enticed by better job opportunities abroad, mainly attributed to the "JAPA syndrome (Keji, 2025, pg. 430; World Migration Report, 2024)." The JAPA syndrome implies the incessant migration of able-bodied and productive youths and expertise from low income economy like Nigeria for greener pastures in advanced economies. This syndrome has further disrupted human capital skills' contribution to economic growth in recent years (World Migration Report, 2024).

Consequently, the Nigerian economy has plunged into various economic recessions and other social vices, which have been characterized by a downward trend of output growth. This was reflected in the industrial output growth, which disrupted the country's general economic activities, as the GDP fell to -1.8% in 2020. Though it recovered to 3.6% in 2021, it later fell to 3.3% in 2022. Importantly, the 2016 economic recession with -1.6% negative growth recorded an annual industrial output of 18,641.17 billion, a 547.41 billion decline as compared to the previous year (Centre Bank of Nigeria, 2024). A similar scenario occurred in 2020 and 2022. This pinpoints that the industrial sector only accounts for a fragment portion of the overall economic output, which calls for necessary improvement. This is connected to the pertinent roles of human capital skills and consumer's market demand. Meanwhile, Chukwu (2023) argued that the industrial sector has been one of Nigeria's major sectors driving economic growth over the years. Hence, its significance to economic growth cannot be overemphasized. Despite different policy measures, the impact of current industrial output growth tends to be fragmented, which

was complicated by poor human capital productive skills. In the 1970s, the government implemented a variety of industry-supporting policies, including the indigenization policy, the import substitution industrialization (ISI) programme, import taxes, tax breaks, and depreciation allowances. These policies were aimed at attracting foreign investment in the industrial sector of the economy while increasing local ownership and management of industries (Ekpo, 2014). Furthermore, during the Structural Adjustment Programme (SAP) era, the government pursued export promotion industrialization (EPI) policy with the intention of expanding the manufacturing subsector's export base in terms of value-added creation, which could increase the contribution of manufacturing output to GDP due to the failure of pre-SAP industrial policy, particularly ISI (Banjoko, Iwuji & Bagshaw, 2012). Consequently, those government efforts and policies remain ineffective, as the industrial sector was combated by problems and challenges which have slowed down the growth of the sector and consequently impeded the overall growth of the Nigeria's economy. The industrial sector is still battling with challenges such as poor human capital skills, dilapidated infrastructure, and requisite modern technology, among other important growth-driven factors. These challenges slowed down the performance of human capital contribution to productive activities through industrial sector growth, hence Nigeria's slow pace economic growth.

Similarly, there has been a non-consensus from the previous related studies. Moreover, in cognizance of the extant economic literature, human capital skills and industrial output are expected to cause economic growth (Mbonigaba & Akinola, 20219; Keji, 2021; 2023). However, based on the current economic indicators in Nigeria, the reverse has been the case, which motivated this research. Hence, this study intends to examine the impact of human capital skills and industrial output on economic growth in Nigeria for the period between 1986 and 2024. This is because industrial sector and human capital skills are expected to be the backbone of any small open economy such as Nigeria; hence, addressing negative and poor contributions of human capital and industrial output to economic growth, as against double digits which deserves pertinent attention.

Consequently, this study helped to determine the extent to which human capital skills and industrial output have influenced economic growth in Nigeria. The study highlights notable factors militating against Nigerian economic progress. Also, the study provided recommendations for policy-makers and investors to make informed decisions to promote efficient productivity and enhance general output growth.

Industrial Output Revolution and Human Capital Contributions

Human capital skill and industrial output have been the effective tools of economic growth (Becker, 1962; 1964), as they shape an economy towards productivity growth. According to Akinwale and Adekunle (2019), industrial output is regarded as a group of outputs across similar firms with the joint efforts of the human capital skills to transform factors of production into finished goods and services. In other words, the industrial sector serves as an instrument of sustainable growth and development via various means which include increasing productive capacity, enhancing revenue, creating employment opportunities, ensuring effective income distribution, poverty reduction, contribution to export and gross domestic product (Okoye, Nwakoby & Okories, 2016, as cited in Akinwale and Adekunle, 2019). Similarly, Nwogo (2019) alluded that Industrialization primarily integrated human efforts by building up the nation's capacity to convert raw materials and other inputs into finished goods. Industrial output is the total production through the activities of firms in an industry. It is the total production of the output by the industrial establishments within the economy and covers such sectors as mining, manufacturing, electricity, gas and steam and air-conditioning (Stephen, 2021)**.**

In modern history, the Industrial Revolution was a process of change or transformation from an agrarian economy into an economy dominated by industry and mechanized manufacturing (Ajah & Chigozie-Okwum, 2019). It entails the transformation of home manual factories to mechanized industries which is said to have had significant effects beyond mere technological advancements in the late 18th century. Some effects, including changes in social systems and ideologies, were noted to have shaped the economy (Emmanuel, 2016). According to Adeboye (2015), the general ensuing impact of Industrial Revolution was characterized by the employment of machines and chemicals for the mass production of goods and services in a shorter time, inadvertently lowering unit costs of goods; increasing the general quality of goods, contributing to urbanization, creating greater demand for raw processing products; and increased international trade.

Generally, scholars and academics acknowledged three phases of the Industrial Revolution, with the impending fourth revolution, through the dynamic transformation and innovations venting in the technological world (Adeboye, 2015; Ajah, & Chigozie-Okwum, 2019). Industrial revolution started through the 18th century till the early 19th century. (Ajah, and Chigozie-Okwum, 2019; Akinwale, and Adekunle, 2019; Zakari, Toplak, Ibtissem, Dagar & Khan, 2021). It was centered on

hydropower know-how as well as the development of machine implements. This saw the mechanical production facilities was adopted using water and steam energy. This led to mechanization, which upgraded agriculture produce with industry to lay the foundation of economic structure. A new form of energy source emerged via the steam engine that brought about huge extraction of coal for rail transportation, and consequently improved the economic and human interactions for trade.

Towards the late 19th century, the next industrial revolution surfaced. This attracted more advanced sources of energy via electricity, gas and oil (Akinwale, and Adekunle, 2019; Zakari et al., 2021). Therefore, the development of the ignition engine emerged to its full potential. Also, as the demand for steel rose, the steel industry grew. Chemical fusion was as well developed to address the needs for dyes, fertilizer and other fabrics. The means of communication were also transformed through telegraph and telephone inventions. Similarly, the transportation systems were developed through the automobile and the aircraft at starting in the 20th century (Ekpo, 2014; Ozuzu1 & Isukul, 2021; Raheman, 2022; Zakari et al., 2021). All these inventions were made possible by centralizing research and capital structured around the economy (Ajah & Chigozie-Okwum, 2019). The advanced countries such as United States of America, Japan and Germany felt the impact of the second revolution due to improved citizenry welfare, democratic society with mass production capability.

Furthermore, the third industrial revolution came to the limelight in the second half of the 20th century in the form of the green revolution, which was focused on cleaner energy technology, electronics and information technology (Emmanuel, 2016). The goal of the green revolution was to establish knowledge-based, low-carbon, resource-efficient economy that is connected to sustainable development. ICT, microelectronics, and cleaner technology used in biotechnology, recycling, and renewable raw resources will be the main forces behind this. High-speed rail networks, electricity-powered vehicles, and fuel-powered vehicles with low carbon emissions are the era's emerging transportation systems. Mobile devices with massive data capacities and fast Internet connections are replacing landlines in the telecommunications industry (Keji, Akinola & Mbonidaba, 2024). Production was automated through the use of electronics and information technology.

Changes brought about by advancements in engineering, technology, and Nano-science have defined the twenty-first century and are predicted to trigger human capital skills for the next industrial revolution. In the mid-20th century, the third industrial revolution blown to limelight with the digital revolution, which was built on by the fourth industrial revolution

that is currently underway. The merging of technology that completely uproots industries worldwide and blurs the boundaries between the physical, digital, and biological domains is what defines this fourth revolution, which is expanding exponentially (Ajah & Chigozie-Okwum, 2019).

Nigeria attempted to become an industrialized nation through several policies informed by the significance of industrialization to the country's economic development. The government enacted policy to encourage Nigerians to own various industries through the indigenisation policies instituted in 1972 and 1977. The indigenisation policy was another government response to the detrimental effects of globalization in Nigeria. The goal was to support homegrown businesses and provide skills for Nigerian women and men with opportunities to dominate the industrial sector of the nation's economy. This covers the handover of ownership and management to Nigerians from prior owners. However, foreigners now control the Nigerian economy due to the global delocalization of business.

Liberals criticized the policy of indigenization. The government implemented the Trade and Financial Liberalization Policy (TFLP) in 1989 and the Structural Adjustment Programme (SAP) in 1986 in response to criticism from globalization institutions, such as the World Bank and the International Monetary Fund (IMF). The former (SAP) aimed to stimulate investment and an economy driven by the private sector. The latter (TFLP) sought to promote efficiency in the financial sector and increase competition between domestic and foreign firms. Its goal was to lower tariff and non-tariff barriers within the nation in order to encourage foreign investment. These policies have far-reaching effects on domestic businesses. First, removing tariff and non-tariff barriers encouraged foreign competition, which was detrimental to the nation's struggling and weaker businesses at their lowest production level before the policy was introduced. Secondly, the process of privatization and commercialization was poorly executed; rather than promoting the goal of globalization, it promoted the sale of the majority of domestic companies to foreign investors. This brought back economic colonialism. The government of Nigeria took further action to encourage industrial development in the country in 2000 with the outline of the Bank for Industry (BOI) policy. Through the Nigerian Industrial Development Bank, Leasing Company of Nigerian Limited, Industrial and Insurance Broker, and Nigerian Bank for Commerce and Industry were recognized to support Nigerian industries with equity, loans, and improved financial access. Nevertheless, due to bureaucratic snags in their operations, these banks' goals have not been met, making it difficult for indigenous Nigerian businesses to compete favourably with foreign corporations.

Conceptualizing Economic Growth in Nigeria

Every nation's desire or goal is to achieve a sustainable increase in the nation's output over time. According to Jhingan (2003), cited in Ademola and Badiru (2016) and Keji (2021), economic growth is regarded as a process where the real per capita income of a country increases over a long period of time, which is measured by the increase in the amount of goods and services produced in a country. This connotes that for a country to achieve economic growth, there must be productive stability (Wells, 2015). However, there have been fluctuations in the growth process in Nigeria. According to historical data from the World Development Indicator, the gross domestic product growth rate decreased from 15.30% in 2002 to 7.30% in 2003. This was a significant plummet in the growth rate, proxy as GDP. Since 2003, GDP growth has been deteriorating on average till it entered a recession in 2016, when it recorded a negative growth rate of -1.60%. Since 2016, GDP have been oscillating. In 2021 and 2022, GDP growth stood at 3.60% and 3.10%. It can be deduced from recent data that industrial output contribution to gross domestic product fell from 31.41% to 30.78% in this period. However, despite the significant contribution of the industrial output to gross domestic product over time, GDP growth is still performing below expectation.

Fasoye, Olayiwola, and Kehinde (2021) examined the potential of domestic industrial output on economic growth in Nigeria for twenty-eight years (1990-2018). Autoregressive Distributed Lag (ARDL) was employed through the Central Bank of Nigeria (CBN) and the National Bureau of Statistics indicators. Based on the analysis of the study, it was observed that insignificant impact of domestic industrial output on economic growth due to worrisome image of "Made-in-Nigeria" goods. The study emphasized the need to improve local content and diversify domestic production to achieve sustainable growth in the industrial sector. Using the Error Correction Model (ECM) technique, Stephen (2021) examined the relationship between industrial output and economic growth in Nigeria for the period 1981-2018 and the data for the study was obtained from the World Bank. It was disclosed that capital expenditure and lending rates negatively influenced industrial output. Therefore it was further revealed minimal contribution of industrial sector to the overall Nigerian economy growth during the period. Consequently, the study suggested that greater budgetary allocations to the industrial sector. Abdul Rasheed, Dagar et al. (2021) investigated the influence of Nigeria's industrial sector on the rate of inefficiency for energy consumption in Nigeria, spanning the period of 1991-2014, making it 23 observatory years. The study used the Fisher ideal Index decomposition analysis and VEC model method of

analysis. Based on the analysis of the study, it was observed that energy inefficiency affected per capita income from the overall country's economic growth. Therefore, the study recommends that the need for government to implement policies that promote research and development.

Clement and Deekor (2021) examined the impact of industrial sector performance on economic growth in Nigeria covering a period of 38 years (1981-2019). The Error Correction Model (ECM) method. Findings indicated a long-term connection between industrial sector performance and economic growth. The study, consequently, suggested improvement in the productive sector to improve economic growth.

Nwoge and Orji (2019) examined the impact of industrialization on the growth of the Nigerian economy spanning from 1986-2016. Ex-post facto research design was employed to disclose positive and significant impact of the industrialisation on real gross domestic product.

Therefore, the study recommends that the need to invest massively in the petroleum industry and the solid mineral industry in order to connect solid mineral industry. Adekunle (2019) investigated the association between industrial policy and industrial sector productivity in Nigeria between 1986 and 2017. The study employed the error correction model, and the data for the study was obtained from the CBN data bank. The result showed that the exchange rate had a positive and insignificant effect on industrial output. Therefore, it was recommended that government should formulate industrial-driven policies to improve industrial output growth. Ning and Shun (2021) worked on how learning by doing affect human capital to influence economic growth. The study concluded that learning by doing and human capital influenced economic growth through inter-temporal elasticity of substitution which was equal to 1. Liening (2013) studied growth theory and endogenous human capital improvement, focusing on the contribution of the theory of complex systems. The study explored the dynamic models of human capital through the endogenous growth model to reveal factors determining economic growth. Therefore, it was concluded that dynamic models were more suitable for human capital growth than static or linear models. Raheman (2022) examined Sharonomics as radical theory of economic for the future industrial revolution and beyond. The methodology employed to explore blockchain technology to decentralize the whole ecosystem, as needs were shared from those who need to those who want the needs, which implied Sharonomics. Theoretical feasibility was explored to analyse the Sharonomics ecosystem through the level of the money supply to improve industrial productivity.

Zhang and Lian (2023) sustainable development of human capital Structure and Firm Performance—Based on Chinese A-share listed companies. The study adopted the peer human capital structure index to disclose the sustainable development of human capital as a factor in influencing firm performance. It concluded that there was a positive interaction mechanism between human capital and innovation, improving firm performance in China. Bahodurov, Khoshimov and Alsaoub (2025) assessed the impact of industrialization and foreign direct investment on economic growth across the Asian countries. The study adopted the two-system GMM to reveal that foreign direct investment and industrialization influenced the economy in the selected Asian countries. Chrisant, Kalwani, and Mushy (2024) examined the determinants of urban industrial location for sustainability and development across Mwanza city in Tanzania, using a mixed procedure through qualitative and quantitative methods. The study disclosed that necessary infrastructure such as water, electricity, and road network determined the industrial location in Mwanza City in Tanzania cooperation.

Okezi, Nwosu et al. (2017) analysed the relationship between industrialization and economic growth in Nigeria from 1985 to 2015 using the Ordinary Least Square (OLS) approach. It was observed in the study that indicators for industrial sector growth influenced economic growth in Nigeria. Therefore, the study long-run connect between industrialization and economic growth in Nigeria. Abdulrahman and Enwerem (2016) applied the Ordinary Least Square (OLS) technique in investigating the impact of industrialization on economic growth between the periods 2000 and 2013, and the data was sourced from the Central Bank of Nigeria Statistical Bulletin and the National Bureau of Statistics. Findings from the empirical research revealed industrialization negatively affect economic growth.

Akpan, Mboto et al. (2011) examined the role the industrial sector plays in driving the GDP of Nigeria spanning over 37 years, from 1970 to 2007, and the data sources from the Central Bank of Nigeria Statistical Bulletin using the Vector Error Correction Mechanism technique. The major findings reveal the uni-directional relationship from industrial production to non-oil exports. The study disclosed slow growth of industrial sector in the long run. It is suggested that stakeholders should invest in industrial sector through the Bankers' Committee, CBN etc., to ensure adequate disbursement of funds. Meanwhile, Badet (2025) assessed the link between skill selection and productivity growth. The study disclosed that skill selection influenced productivity gains in large industrial set-ups through the intermediate goods and average-level technological models.

Based on the earlier studies reviewed, there were lopsided arguments and consensus that either disclosed industrial output as the catalyst to economic growth or human capital as the cause of economic growth in Nigeria. However, there were scanty, if not none, from the previous works that emphasized on the joint effects of human capital skills and industrial output on economic growth in Nigeria. Consequently, this study attempted to fill the gaps in the literature and empirically investigate the joint impact of human capital skills and industrial output on the Nigerian economic growth within the period of 39 years (1986 - 2024). This is to expand the current scope of the previous studies to address current economic challenges in Nigeria.

Theoretical Framework

This study adopted the endogenous growth theories as its theoretical framework. The clew of endogenous model was sought in the study of Keji, Akinola, and Mbonigaba (2024), Keji (2021) and Ughulu (2021) with notable modification. The notion of this theory is that economic growth results from internal factors that influence output growth. The theory believes that for an economy to experience enhanced productivity, there has to be innovation through technological advances and more investment in human capital from the government and private sector. Hence, capital accumulation, investment in technology and human capital boost productivity.

On the other hand, the neo-classical hypothesis of Solow and Swan (1956) holds that technical advancement can improve long-run aggregate output. The rudiment of the model emphasized that capital accumulation is a wheel that drives economic growth in the short run through savings. Neo-classical theorists believe that growth in technological advances may drive production function upward, resulting in total economic growth. In the short run, an increase in the savings rate will result in a temporary increase in aggregate output, but in the long run, output will adjust to a new level, and savings accumulation will only affect aggregate output and not its growth rate (Ndako, 2010). They believed that in the long run, growth rates would revert to the rate of technological progress, which was assumed to be exogenously determined (Onyimadu, 2017). According to Masoud (2016), the neoclassical growth model, as developed by Solow (1956), developed an aggregate production function based on three key assumptions: the labour force grows at a constant exogenous rate. Output is the function of capital and labour, such as Y= F (K, L), which is the production function relating output to constant returns to scale. There is no independent investment: S=1=sY

The center piece of the standard neoclassical growth model developed by Solow is an aggregate production function of the form:

$Yt = F (Kt, Lt, At)$ ……..…… (2.1)

Where Y is output, K is capital, L is labour, and A is the measure of the level of technology or efficiency. The fundamental dynamic equation of the model relates the exogenous exponential of the Labour, capital and the level of technology grow. This theory assumes that countries use their resources efficiently and that there are diminishing returns to capital as labour increases (Solow, 1956). Notably, the formulation of the model is chosen to allow efficiency increases to offset the diminishing returns to capital (Acha, et al., 2019). However, with the endogenous assumption, the neo-classical theory can address the impact of industrial output on economic growth through the unrestricted neo-classical growth model of the Cobb-Douglas (C-D) type.

This type of growth model enables the introduction of modifications and extensions to bring it more in line with empirical phenomena of related variables accounting for increasing returns (Keji, 2021; Ndebbio, 2011). Thus, aligning with an emphasis of the neo-classical theorist on the role that capital and technological advancement play in economic development, increased industrial output often involves the expansion of physical capital, such as machinery and infrastructure and technological innovations; hence, growth in industrial production fosters capital accumulation, enhances technological progress and stimulates savings and investment which consequently contributes to long term economic growth. However, this has been empirically criticised based on simplicity and the complexities of real-world economics. The exogenous growth theory challenged its reliance on exogenous technological progress, which states that deliberate human activities can influence technological changes.

Following the objections and shortcomings of the neoclassical growth model, the endogenous growth model emerged, which progressively emphasized the significance of technological advancement in the cause of economic growth. The endogenous growth model states that the pace of aggregate production growth can be predicted endogenously within the model rather than exogenously outside through human capital accumulation, such as human capital skills. The industrial sector, with increasing returns to scale, can stimulate knowledge spillovers and foster a dynamic environment where advancements in one industry area positively affect others, thereby contributing to overall economic growth (Keji et al., 2024). Also, the theory supported human capital development. As the theorist asserted that training a skilled workforce within the industrial sector can lead to increased productivity and innovation, contributing to long-term economic growth (Keji, Akinola & Mbonigaba,

2024). Consequently, this study used the neo-classical growth model in Cobb Douglas form, which is expressed as:

$Y = AK^{\alpha}L(h)^{\alpha-1}$ …… (2.2)

Research Methodology

Model specification

To examine the impact of human capital and industrial output on economic growth in Nigeria, the model used in this research was in line with the adopted models in Keji, Akinola, and Mbonigaba (2024), Keji (2021) and Ughulu (2021) with slight adjustment, as shown below:

RGDP= f (IDO, SER, LPR, GCF, FDI)

(1)

Transforming the above explicit function gives;

$$RGDP_i = \beta_0 + \beta_1 IDO + \beta_2 SER + \beta_3 LPR + \beta_4 FDI + \beta_5 GCF + U_i \quad (2)$$

Where;

RGDP = Real gross domestic product.

IDO = industrial output

SER = School Enrolment Rate

LPR = Labour Participation Rate

FDI = Foreign Direct Investment.

GCF = Gross Capital Formation.

β_0 = intercept or a constant term

β1, β2, β3, β4, and β5 are the coefficients of industrial output (IDO), School Enrolment Rate (SER), Foreign Direct Investment (FDI), Labour Participation Rate (LPR), Gross Capital Formation (GCF), respectively.

μ = stochastic or error term

Theoretical Expectation

The apriori probability provides the expected coefficient and statistical estimates of the value for the parameter evaluation within the model. These expected coefficients are then utilized to draw conclusions from the estimated explanatory and the dependent variables in the model. Ideally, it is expected that β1, β2, β3, β4, and β5 should be greater than zero. To achieve the purpose and objectives of the study, this study employed the appropriate econometric method as predicted by the unit root test results.

The data collections for this study are time-series data covering the period from (1986 - 2024) which are obtained from the recent CBN statistical bulletin and the World Development Indicator (WDI).

Results and discussions

Concept of Unit Root Test

This unit root test is pertinent in time series data analysis. It is adopted to check for the availability of unit roots integral values. That is, the unit root provides whether the series is stationary or not. This is achieved through the Augmented Dickey-Fuller (ADF) statistics. For example, when the ADF test statistic is greater than the 5 per cent critical value, it important to accept the null hypothesis that the series has unit root. However, if the ADF test statistic is less than the 5 per cent of the conventional level, the null hypothesis is rejected.

In this section, the outcomes and the explanations of the data analyses were presented. It was initiated with summary statistics, the unit root test through an Augmented Dickey-Fuller test to determine the time series qualities of each variable, followed by Auto regressive Distributed Lag and Error Correction Model analysis to test for the short run and the long run speed of adjustments within the variables in the model. Lastly, post estimation diagnostics tests such as the Serial LM test and normality tests, among others, were carried out to test the stability and validity of the estimated models.

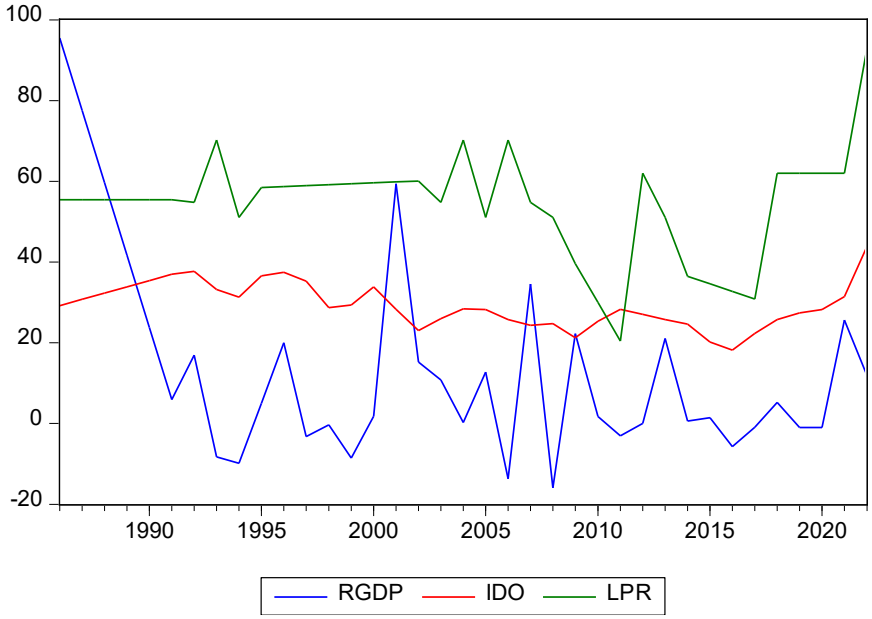
Table 4.1: Unit Root Test

UNIT ROOT TEST	ADF T-STATISTICS	ORDER OF INTEGRATION	PROB. VALUE
RGDP	**-4.102128**	**I(O)**	**0.0028**
IDO	**-5.929058**	**I(O)**	**0.0000**
SER	**-2.746495**	**I(O)**	**0.0463**
LPR	**-3.706776**	**I(O)**	**0.0080**
GCF	**-6.778385**	**I(O)**	**0.0000**
FDI	**-3.728444**	**I(O)**	**0.0076**

Source: Author's computation.

The Unit root outcomes in Table 4.2 disclosed all the attributes of the series in the model. It showed that the estimates were of ordinary levels of integration among the variables employed in the model. The null hypothesis means that each series has a unit root; that is, each variable is non-stationary. Automatically, the null hypothesis cannot be rejected if the ADF statistic is greater than the ADF statistical value at various significance levels. Augmented Dickey-Fuller discloses that RGDP, IDO, SER, LPR, GCF, and FDI are integrated of order zero, i.e. I (0). Following the unique outcome in the order of integration, the conditions for the ordinary Least Square were met.

Figure 1: THE TREND ANALYSIS OF HUMAN CAPITAL SKILLS, INDUSTRIAL OUTPUT AND ECONOMIC GROWTH INDICATORS



Source: Author's computation, 2025.

It can be witnessed that industrial output indicators such as industrial value added (IDO) and labour participation rate (LPR) proxy as human capital skill disclosed trend along economic growth (RGDP) over the years. The trend curves disclosed an unstable flow of industrial output and human skills. For example, the industrial output started to drop in the mid-1990s but rose sharply from 1995 and dropped quickly between 2000 and increased in 2005. Later on, it dropped mostly in 2016 and later rose from 2019 to 2020, with a continuous steady flow until 2024. Meanwhile, the indicator for human capital skills disclosed a sharp fall to its lowest in 2010 and rose afterwards until 2014, when it dropped again before rising in 2018 to its steady improvement until recent years. Whereas the real domestic product indicator disclosed different trends over the period under review. The country's output growth went to its lowest in 2008 during the global financial crisis, and the economy recovered again in early 2010. However, the growth level stumbled in late 2015 until a slight improvement in mid-2020 and later dropped afterwards, especially in recent years.

The Ordinary Least Squares Analysis

In this subsection, based on the outcomes from the unit root tests, the Ordinary Least Square were employed. Consequently, the results obtained

from estimating the Ordinary Least Square Analysis (OLS) in the equation were presented. Following this result, this study examined long-run dynamics effects of Human Capital Skills and Industrial Output Growth on Economic Growth.

Table 4.2: Empirical Results (OLS)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IDO	0.388342	0.090916	4.271446	0.0002
SER	-0.216489	0.185878	-1.164685	0.2528
LPR	0.091361	0.053371	1.711825	0.0066
GCF	0.000292	0.006684	0.043661	0.9654
FDI	0.791500	0.584462	1.754237	0.0851
C	3.370218	1.878529	1.794073	0.0823
R-squared	0.816888	Mean dependent var	4.208496	
Adjusted R-squared	0.741402	S.D. dependent var	3.812218	
S.E. of regression	2.849230	Akaike info criterion	5.075914	
Sum squared resid	259.7796	Schwarz criterion	5.334480	
Log likelihood	-90.44237	Hannan-Quinn criter.	5.167910	
F-statistic	6.847446	**Durbin-Watson stat**	2.021855	
Prob(F-statistic)	0.000191			

Source: Author's computation 2025.

The findings disclosed a significant impact of human capital skills and industrial output on economic growth in Nigeria. For example, IDO-Industrial Output Growth and LPR-Labour Participation Rate significantly influenced RGDP-Real Gross Domestic Product in Nigeria; that is, a 1% rise in industrial output growth and human capital skills caused about 38.98% and a 9.1% rise in Nigeria's economic growth, respectively. Also, other control variables for industrial output and human capital skills, such as FDI-Foreign Direct Investment, were statistically significant at 10% levels of significance. While other control variables, such as SER-school

enrolment rate and GCF-gross capital formation, were not statistically significant across all the conventional levels of significance.

The coefficient of determination was explained through the R-square statistics based on the model. The coefficient of R-square coefficient at 0.816888 signals 81.7% of the human capital skills and industrial output indicators determining economic growth in Nigeria, as explained within the model, while the remaining 18.3% of the indicators of economic growth were caused by other indicators not within the model. Durbin-Watson statistics at 2.021855 means absence of autocorrelation in the model employed. Also, the F-statistic coefficient at 6.847446 indicates the overall significance of the mode employed in the study. Consequently, the Ordinary Least Square (OLS) model employed in the study statistically explained the significant effect of human capital skills and industrial output on economic growth in Nigeria.

Diagnostic Tests Results

Table 4.3: Breusch-Godfrey Serial Correlation LM Test

F-statistic	1.666378	Prob. F(2,9)	0.2059
Obs*R-squared	3.799407	Prob. Chi-Square(2)	0.1496

Source: Author's computation, 2025.

Table 4.4: Heteroskedasticity Test: Breusch-Pagan-Godfrey

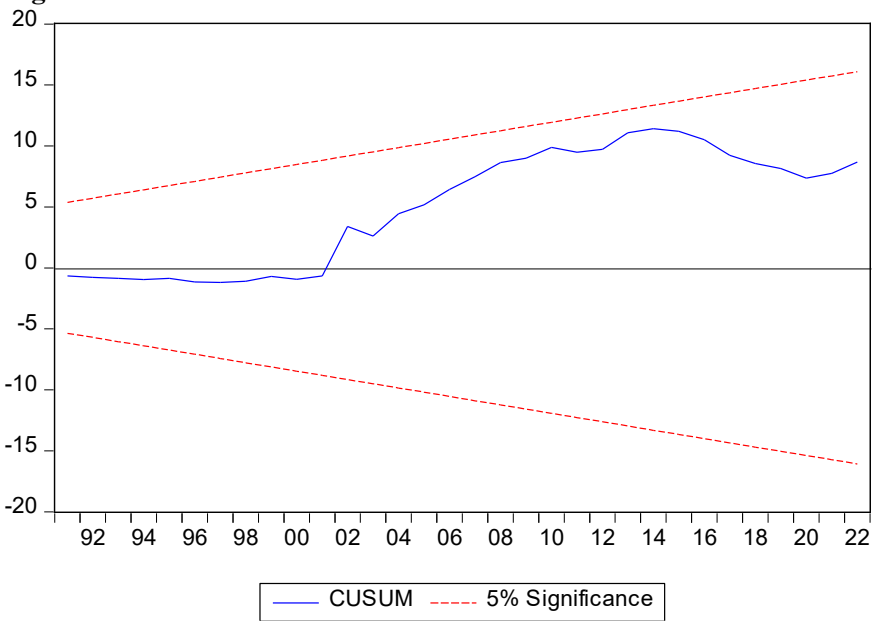
F-statistic	0.769223	Prob. F(19,11)	0.5789
Obs*R-squared	4.077217	Prob. Chi-Square(19)	0.5384

Source: Author's computation, 2025.

Table 4.5: Ramsey RESET Test: **Specification Test: RGDP IDO SER LPR GCF FDI C**

t-statistic	1.068183	Probability 31	0.2937
F-statistic	1.141015	Probability (1, 31)	0.2937

Figure 2: CUSUM Curve



Tables 4.3 and 4.4 disclosed the validity and consistency of the models adopted in the study. For example, the Breusch-Godfrey Serial Correlation LM test disclosed the absence of serial correlation among the series in the model, as indicated within the margin of the CUSUM curve. While the Heteroskedasticity test via the Breusch-Pagan-Godfrey approach disclosed that the series was free from high volumes of outliers, i.e. the series employed were Homoskedastic in nature. Meanwhile, the Ramsey RESET test explained the extent of specification error in the model employed in the study. Based on the estimated outcomes in Table 4.5, it was disclosed that the models adopted in the study were free from any form of specification error. Hence, the model best explained the impact of human capital skills and industrial output on economic growth in Nigeria. Whereas the CUSUM curve discloses the stability of the OLS models adopted in the study.

Conclusion and Recommendations

Having empirically sought for the impact of human capital skills and industrial output on the Nigeria's economy between 1986 and 2024, it is concluded that there existed long-run effects of both human capital and industrial output on economic growth in Nigeria. Consequently, it can be concluded that Human capital skills and industrial output significantly affect the Nigerian economic growth throughout the years under evaluation. Moreover, it is concluded that Ordinary Least Square (OLS)

outcomes confirmed that the estimated variables have one form of nexus or the other. This conclusion is in line with the summation of Keji, Akinola, and Mbonigaba (2024), Keji (2023) and Kutu and Ngalawa (2016).

This study focuses on assessing the impact of human capital skills and industrial output on economic growth in Nigeria. Based on the results presented and discussed in the previous section, it is pertinent to recommend policy measures to address the problems emerging from the study. This is to show the way forward out of the current slow economic growth, as discovered in this study. Hence, the following recommendations were highlighted for future policymakers to take into consideration where obligatory.

There is a need to adopt technological tools for productive goods. That is, the government needs to advance productivity across the industrial sector through technological means of production to develop output growth. This would advance international competitiveness. Consequently, this increases the production base, which increases economic growth and lowers unemployment.

It is pertinent for government intervention in regulating and sustaining industrial policy. Government should come up with interventions through proactive policy processes to safeguard local industries. This is expected to address shoddy and corrupt businesses in the sector. Also, industrial estate should be established across all the geo-political zones in Nigeria. Industries should be located and localized massively across geopolitical zones in Nigeria. This is to improve the general size of the country's industrial output base.

Massive infrastructural setups should be prioritized across the country's education sector. The government needs to promote infrastructure network across the country's education sector to improve human capital skills development. Lastly, government should redesign school curriculum that is adaptable to workplace skills.

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