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Untangling the Nexus between Human Capital Development and Manufacturing Output in Nigeria

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Abstract. This study investigated the nexus between human capital development and manufacturing sector output in Nigeria over the period 1980–2023. Secondary data obtained from the Central Bank of Nigeria's Statistical Bulletin were analyzed using the Autoregressive Distributed Lag (ARDL) approach to capture both short-run and long-run relationships. The empirical findings revealed that primary school enrollment had a negative and statistically insignificant effect on manufacturing output, suggesting a misalignment between educational outcomes and the skill requirements of the manufacturing sector. Government expenditures on education and health exhibited positive but statistically insignificant coefficients, indicating that public investment in human capital had not yet translated into measurable productivity gains. In contrast, population growth had a positive and statistically significant impact, highlighting its role in expanding the labor force and market size that stimulated industrial activity. Conversely, life expectancy exerted a negative and significant influence, reflecting demographic pressures such as aging and higher dependency ratios. The study concluded that improving the quality and relevance of human capital development, rather than merely expanding access, was essential for strengthening the link between human capital and manufacturing output in Nigeria. It further recommended targeted education reforms, efficient public health spending, and population management strategies to unlock the productivity potential of the Nigerian manufacturing sector.

Keywords: Human Capital Development, Manufacturing sector Output, ARDL model

1. Introduction

The development of human capital has become a fundamental pillar of sustainable economic growth and industrial competitiveness. Human capital—comprising the education, skills, health, and productive capacity of the workforce—remains a decisive factor shaping economic outcomes across nations (World Bank, 2023; UNDP, 2024). In both advanced and developing economies, the ability to generate, adapt, and apply knowledge is a key determinant of productivity and industrial transformation. Countries that prioritize investment in human capital tend to experience stronger and more inclusive economic growth, particularly within the manufacturing sector, which relies heavily on skilled labor and technological adaptability (Ojo & Adeyemi, 2024).

Despite Nigeria's vast natural and material resources, the country continues to experience sluggish industrial expansion, weak manufacturing productivity, and persistent unemployment. This paradox underscores the argument that natural resource abundance alone cannot guarantee sustainable development without a well-developed and effectively utilized human resource base (UNDP, 2024). Nigeria's human development indicators reflect persistent challenges. The United Nations Development Programme (2022) ranked Nigeria 163rd out of 191 countries globally and 25th in Africa, revealing low achievements in health, education, and income dimensions. These statistics highlight the inadequacy of the country's human capital to drive meaningful industrialization.

The development of human capital in Nigeria has historically lagged behind other emerging economies due to inadequate public investment, weak policy implementation, and systemic inefficiencies within the education and health sectors (World Bank, 2023). Budgetary allocations to these sectors consistently fall short of international benchmarks—UNESCO's 26% recommendation for education and the African Union's 15% target for health (UNESCO, 2023; African Union, 2023). The consequences of these funding gaps are evident in poor educational outcomes, recurrent industrial actions by academic and health workers, deteriorating infrastructure, and declining quality of service delivery. These challenges collectively undermine the skill base and health status of Nigeria's workforce, thereby constraining productivity growth, particularly within the manufacturing sector (Okoye & Nwosu, 2023).

Although nominal expenditures on education and health have increased, real growth has remained sluggish and insufficient to meet rising demographic pressures and industrial labor demands (Okoye & Nwosu, 2023). The Federal Government has implemented several policy initiatives—such as the Universal Basic Education (UBE) programme, the National Health Insurance Scheme (NHIS), and targeted scholarship schemes—to improve human capital outcomes (Federal Ministry of Education, 2022; NHIS, 2023). However, the overall impact of these interventions on industrial productivity and manufacturing performance remains unclear, raising concerns about the effectiveness and alignment of human capital policies with Nigeria's industrial development goals.

Scholars have also emphasized that Nigeria's overdependence on oil revenues has weakened its industrial base, hindered diversification efforts, and exacerbated the decline of manufacturing output (Ojo & Adeyemi, 2024; FAO, 2023). Historically, revenues from agriculture supported education, healthcare, and industrial infrastructure, but the shift toward oil dependence diverted attention from human capital investment and technological innovation. Consequently, Nigeria's manufacturing sector faces structural challenges, including obsolete technology, low labor productivity, and a shortage of technically skilled workers capable of driving industrial modernization (Ojo & Adeyemi, 2024).

Understanding the interaction between human capital development and manufacturing output is critical for formulating effective economic and industrial policies. Existing studies have largely examined human capital's role in aggregate economic growth, with limited empirical focus on its direct impact on manufacturing productivity in Nigeria. This study therefore aimed to untangle the nexus between human capital development and manufacturing output in Nigeria, addressing a critical research gap identified in the literature (Ojo & Adeyemi, 2024; Federal Ministry of Education, 2022). By doing so, the study sought to provide empirical insights that could guide policymakers in aligning education, health, and labor market strategies toward revitalizing Nigeria's manufacturing sector and enhancing overall economic resilience.

1.1 Objectives of the Study

The broad objective of this study is to determine the impact of human capital development on manufacturing firms' output in Nigeria using time series data from 1980 to 2023.
The specific objectives are:

- To examine the impact of primary School Enrollment on manufacturing Sector productivity in Nigeria.
- To determine the impact of Government's expenditure Education on manufacturing Sector productivity in Nigeria.
- To assess the impact of Government Expenditure on Health on manufacturing Sector productivity in Nigeria.
- To investigate the impact of Life Expectancy Manufacturing Sector productivity in Nigeria.
- To examine the effect of Population growth rate on Manufacturing Sector productivity in Nigeria

2. Literature Review

2.1 Conceptual Review

2.1.1 Human Capital Development

Human capital represents the total stock of knowledge, skills, competencies, health status, and other attributes embodied in individuals that enable them to create economic value and contribute to national development. The Organization for Economic Cooperation and Development (OECD, 2021) described human capital as the knowledge, skills, competencies, and attributes embodied in individuals that facilitate the creation of personal, social, and economic well-being. Similarly, Rastogi (2022) viewed human capital as an essential input for improving employee capabilities through continuous learning, skills enhancement, and innovation. Human capital therefore remains a critical determinant of output and economic transformation, especially in labor-intensive sectors such as manufacturing.

According to Nwokoye (2020), human capital encompasses the stock of knowledge, skills, and attitudes that enable individuals to manipulate other productive resources—such as land, technology, and physical capital—to generate goods and services. This perspective underscores that investment in people is central to sustainable economic growth and national competitiveness. The World Bank (2023) further emphasized that countries investing substantially in education, health, and workforce development experience higher levels of industrial output and economic diversification.

Human capital development refers to the intentional process of enhancing individuals' productive capacities through education, training, healthcare, and skills acquisition programs (IMF, 2022; UNDP, 2024). It involves not only increasing the number of educated and trained individuals but also improving the quality and relevance of their skills to meet the evolving needs of the industrial sector. In this regard, human capital development serves as a bridge between knowledge creation and productive application, ensuring that individuals' intellectual and physical capacities align with the strategic requirements of the manufacturing sector.

In Nigeria, human capital development remains a decisive factor in addressing the persistent challenges of low industrial output. The Federal Ministry of Education (2022) and the National Health Insurance Scheme (NHIS, 2023) have identified education and health as the twin foundations of human capital formation. Nevertheless, inadequate funding, infrastructural decay, and policy inconsistency continue to constrain the development of a skilled and healthy workforce capable of driving manufacturing growth. Strengthening human capital development is therefore essential for stimulating higher manufacturing output and achieving long-term economic sustainability (Ojo & Adeyemi, 2024).

Manufacturing Output: Manufacturing output refers to the total value of goods and services produced within the manufacturing sector over a specified period. It captures the efficiency and capacity of industrial activities to transform inputs—such as labor, raw materials, and technology—into finished products. According to the Central Bank of Nigeria (CBN, 2021), manufacturing output represents the aggregate value generated by the manufacturing industry and serves as an indicator of industrial growth and economic performance. Adekunle and Aghedo (2021) further described output as the tangible measure of a firm's or sector's productive performance, reflecting both the quantity and quality of goods produced.

Manufacturing output is directly influenced by the quality of human capital, as a skilled and healthy workforce enhances operational efficiency, innovation, and technological adaptability. The World Bank (2023) noted that improvements in education and health significantly increase labor efficiency and production capacity, which in turn boost industrial output. In contrast, weak human capital development often leads to low labor productivity, inefficient resource utilization, and reduced competitiveness in the manufacturing sector (UNDP, 2024). In this study, manufacturing value-added serves as the proxy for output in Nigeria's manufacturing sector. Manufacturing output is therefore operationally defined as the total value of goods and services produced within the manufacturing industry after accounting for input costs. This measure reflects the sector's overall performance and its contribution to national economic growth.

2.2 Theoretical framework

2.2.1 Solow-Swan Model of Economic Growth

The Solow–Swan model, independently developed by Robert Solow and Trevor Swan in 1956, is a neoclassical growth theory that explains long-run economic growth through capital accumulation, labor expansion, and technological progress. Solow (1956) criticized the Harrod–Domar model for its unrealistic fixed-proportion assumption and introduced a flexible production function that allowed diminishing returns and convergence toward a steady-state equilibrium.

The model expresses output as a function of capital and labor, Y=F(K,L)Y = F(K, L)Y=F(K,L), where part of each period's output is saved and invested, while growth in output depends on savings, population growth, and technological progress. Over time, diminishing returns to capital imply that sustained output growth can only occur through improvements in technology and labor quality—both influenced by human capital development. In this context, the Solow–Swan framework provides the theoretical basis for linking education, health, and population dynamics to manufacturing output in Nigeria. It suggests that investment in human capital enhances labor efficiency and technological adaptation, thereby driving long-term industrial growth and output expansion.

2.3 Empirical Literature

Patel and Nguyen (2024) examined the effects of government expenditure on health and education on manufacturing sector growth across emerging economies using a cross-country panel dataset. Applying the Generalized Method of Moments (GMM) to address endogeneity, their model incorporated macroeconomic variables such as inflation, trade openness, and demographic factors. The findings revealed a positive, though statistically insignificant, relationship between health and education spending and manufacturing growth, suggesting suboptimal allocation and utilization of resources. They concluded that more targeted public investment in education and health is necessary to enhance the productive capacity of the manufacturing sector.

Okoh et al. (2023) examined how globalization influenced human capital development in Nigeria between 1980 and 2021 using the ARDL approach. The findings revealed that globalization—measured by trade openness—had a negative and statistically significant effect on human capital development in the long run, but a positive and insignificant effect in the short run. Additionally, control variables such as money supply and exchange rate were found to have positive and significant impacts on human capital development. Similarly, Okoye et al. (2023) analyzed the impact of entrepreneurial finance from commercial and microfinance banks on unemployment reduction in Nigeria from 1992 to 2017. Applying the ARDL method, their study found that entrepreneurial finance positively contributed to reducing unemployment, though its effectiveness was influenced by regulatory and economic policy conditions.

Jones and Smith (2023) analyzed the influence of primary school enrollment on manufacturing output growth in developing countries over two decades using a longitudinal panel design. Employing fixed-effects estimation to control for country-specific differences, they found that primary school enrollment exerted a negative but statistically insignificant impact on manufacturing output. This result implied a misalignment between basic education outcomes and industrial labor needs, calling for greater emphasis on technical and vocational education to strengthen workforce relevance.

Okoh et al. (2022) investigated the relationship between entrepreneurship financing and human capital development in Nigeria from 1992 to 2021 using the Autoregressive Distributed Lag (ARDL) model. The study found that credit to small and medium-scale enterprises (SMEs) significantly enhanced human capital development in the long run, while interest rates had no meaningful effect in either the short or long run. Exchange rate fluctuations, however, positively influenced human capital development in the short term. In another study, Okoh et al. (2022) explored the impact of human capital development on Nigeria’s manufacturing sector from 1981 to 2021 using OLS and ARDL bounds testing. Results indicated a significant negative relationship between human capital development and manufacturing value added, suggesting inefficiencies in skill utilization. Population growth, however, exhibited a significant positive effect on manufacturing performance. The authors recommended policies focused on technical training and technological investment to enhance sectoral productivity.

Anumudu (2020) assessed the effect of human capital on labor productivity in manufacturing firms across Enugu and Anambra States using OLS and Principal Component Analysis. Findings showed a strong positive relationship between training, education, medical care, and research on industrial productivity. The study identified underinvestment in human capital across firms and recommended improved resource allocation to enhance workforce efficiency and industrial performance.

Adelakun (2021) examined the role of human capital development in Nigeria’s economic growth using GDP as a proxy for output and education and health expenditure as proxies for human capital. Employing an OLS approach, the study confirmed a strong positive relationship between human capital development and economic growth, emphasizing the need for pragmatic strategies and institutional frameworks to align manpower development with sectoral growth needs.

Udu and Ewans (2021) investigated the relationship between human capital development and employee job performance at Double Diamond Plastic Manufacturing Firm, Aba. Using a correlational research design and Pearson’s correlation analysis, the study found a strong positive relationship between on-the-job training and employee performance (r = 0.97), as well as between off-the-job training and worker efficiency. The authors concluded that continuous staff development significantly enhances manufacturing performance.

Sankay et al. (2020) analyzed the impact of human capital development on Nigeria's economic growth between 1970 and 2008 using Johansen co-integration and vector error correction techniques. The results showed that human capital development significantly influenced economic growth, underscoring education and labor force participation as key growth drivers.

Halidu (2020) examined the effects of training and development on workers' productivity using evidence from TETFund-sponsored academic staff development programs. The results demonstrated that training initiatives substantially improved employees' technical competence and workplace performance, affirming the importance of structured human capital investment.

2.4 Research Gaps

Existing studies on human capital and economic performance in Nigeria (Okoye et al., 2018; Adebayo & Olaniyi, 2023; Adaeagbo et al., 2024) have largely concentrated on aggregate economic growth, with limited attention to the manufacturing sector. Few, such as Anumudu (2020) and Udu & Ewans (2021), examined manufacturing productivity but within restricted state-level scopes, leaving national dynamics underexplored. Moreover, most analyses employed data ending before 2016, neglecting recent policy and demographic shifts influencing human capital formation. Additionally, none incorporated minimum wage as a proxy for income-driven investment in education and health. This study therefore fills these gaps by providing an updated, national-level assessment of how human capital development shapes manufacturing output in Nigeria.

3. Research Methodology

3.1 Research Design

The research design adopted in this study is ex-post facto, allowing the researchers to rely on historical time series data. This design was chosen to investigate the impact of human capital development on manufacturing sector productivity in Nigeria. The study employed a simple production function, Y = f(L, K), to analyze how the independent variables influence the dependent variable over the specified period. The study relied on secondary data sources, with key variables obtained from the Central Bank of Nigeria (CBN) Statistical Bulletin and the World Bank Development Index (WDI) for the period 1980-2023. These sources provided comprehensive and reliable data necessary for the analysis.

3.2 Model Specification

In the study, the list of policy variables is expanded to include, population growth rate, primary, enrolments, Government expenditure on education, Government expenditure on health and life expectancy. the model is therefore stated as follows:

$$MANQ = F(\text{ENROL}, GEXE, GEXH, LEXP, POPGR) \ldots\ldots\ldots\ldots\ldots\ldots\ldots..(1)$$

where

MANQ= Manufacturing value added (As a proxy for manufacturing sector growth)
ENROL = Primary enrolments
GEXE = Government expenditure on education
GEXH = Government expenditure on health
LEXP = Life expectancy
POPGR = POPULATION GROWTH RATE

The econometric form of the model above is stated as:

$$MANQ_t = \beta_0 + \beta_1 ENROL_t + \beta_2 GEXE_t + \beta_3\, GEXH_t + \beta_4 LEXP_t + \beta_5 POPGR_t + \mu_t \ldots(2)$$

μ_t = stochastic error term

β_0, α_0 = constant intercept

$\beta_1, \alpha_1 - \beta_5, \alpha_5$ = co-efficient of the associated variables

However, the dependent and some of the independent variables were not in the same unit, hence, they were logged so as to bring the data to the same level. Thus, the above equation can be re-specified as;

$$LOG(MANQ)_t = \beta_0 + \beta_1 LOG(ENROL)_t + \beta_2 \mathrm{GEXE}_t + \beta_3 \mathrm{LOG(GEXH)}_t + \beta_4 \mathrm{LOG}(LEXP)_t + \beta_5 POPGR_t + \varepsilon_t$$

………. (3)

where

$LOG(MANQ)_t$ = natural log of manufacturing output

ε_t = stochastic error term

Method of result evaluation: This study employed the Augmented Dickey-Fuller (ADF) test to examine the stationarity properties of the variables, while the Ordinary Least Squares (OLS) estimation technique was used for parameter estimation. To assess the validity and robustness of the estimated parameters, three evaluation criteria were applied: economic or a priori, statistical, and econometric criteria. The economic or a priori criterion, grounded in economic theory, evaluates whether the estimated coefficients exhibit the expected signs and magnitudes consistent with theoretical postulates. In line with theoretical expectations, the coefficients of life expectancy (β_1), government expenditure on health (β_2), and government expenditure on education (β_3) are all expected to be positive:

4. Data Presentation, Analysis and Discussion

The Descriptive Statistics

	MANQ	ENROL	GEXE	GEXH	LEXP	POPGR
Mean	3255.172	35.24210	134.6614	82.28607	48.57290	123.3687
Median	1058.170	41.67313	61.37000	28.89500	46.67150	120.5905
Maximum	16781.06	43.83000	465.3000	296.4400	54.23000	173.9380
Minimum	26.89000	13.60000	0.160000	0.040000	45.63500	68.44700
Std. Dev.	4262.954	8.600384	156.8444	101.2903	3.102034	36.36469
Skewness	1.355773	-0.792356	0.769635	0.853379	0.620612	0.070089
Kurtosis	3.934074	2.360151	1.947658	2.098313	1.716651	1.581089
Jarque-Bera	14.39372	5.111258	6.084364	6.520605	5.578340	3.557679
Probability	0.000749	0.077643	0.047731	0.038377	0.061472	0.168834
Sum	136717.2	1480.168	5655.780	3456.015	2040.062	5181.486
Sum Sq. Dev.	7.45E+08	3032.631	1008607.	420648.9	394.5272	54218.03
Observations	44	44	44	44	44	44

Source: *Author's computation from the E-views result, 2025*

From the result table, the descriptive statistics indicates that all the variables have a positive mean values with 44 observations. The standard deviation showed that the highest standard deviation is recorded by the MANQ while the least standard deviation is recorded by LEXP. The skewness statistics from the table revealed that five of the variables are positively skewed while one variable is skewed negatively; the kurtosis coefficients showed that one of the variables are leptokurtic, suggesting that the distributions are high relative to normal distribution; two variables are mesokurtic, indicating not too flat topped, while two variables are platikurtic, suggesting a flat topped The probabilities of Jarque-Bera test of normality for the variables indicates that five of the variables have values less than 5% level of significance. This implies that the variables are not normally distributed.

Correlation

The relationships among the studied variables depicted in the model were tested using correlation matrix and the result presented below:

Correlation matrix

	MANQ	ENROL	GEXE	GEXH	LEXP	POPGR
MANQ	1.000000	0.603082	0.933424	0.949510	0.926543	0.860931
ENROL	0.603082	1.000000	0.688139	0.661806	0.707837	0.873777
GEXE	0.933424	0.688139	1.000000	0.982891	0.971283	0.924494
GEXH	0.949510	0.661806	0.982891	1.000000	0.966699	0.911620
LEXP	0.926543	0.707837	0.971283	0.966699	1.000000	0.939709
POPGR	0.860931	0.873777	0.924494	0.911620	0.939709	1.000000

Source: *Author's computation from the Eviews result, 2025*

The correlation result shows that all of the variables have positive values ranging from 60%, 93%, 94%, 92% and 86% respectively. This result suggests all the variables under consideration are positively related to the manufacturing sector growth.

The results of the Augmented Dickey Fuller (ADF) test obtained are as follow:

The Unit root test

Variable	**Level difference**	**Probability**	**Order of integration**	**First difference**	**probability**	**Order of integration**
MANQ	9.013745	1.0000		-5.443476	0.0001	I(1)
ENROL	-2.948273	0.0485		-4.988289	0.0002	I(1)
GEXE	-0.044625	0.9486		-5.388085	0.0001	I(1)
GEXH	-0.442375	0.8920		-6.555931	0.0000	I(1)
LEXP	-2.515661	0.1210		-3.183597	0.0301	I(1)
POPGR	-1.274241	0.6318		-12.10859	0.0000	I(1)

Source: *Author's computation from the Eviews result, 2025*

From the table above the results shows that none of the variables are stationary at level, while six of the variables are integrated of order one at 5% level of significance in ADF test procedure.

The long run relationships between HUMANCAP manufacturing Sector Productivity

Dependent Variable: LOG(MANQ)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	54.36710	10.06670	5.400689	0.0000
LOG(ENROL)	-0.144374	0.244364	-0.590816	0.5583
GEXE	0.000469	0.000774	0.605965	0.5483
LOG(GEXH)	0.087547	0.051820	1.689442	0.0998
LOG(LEXP)	-14.51647	2.701161	-5.374157	0.0000
POPGR	0.072207	0.007618	9.478191	0.0000
R-squared	0.993422	Mean dependent var		6.690898
Adjusted R-squared	0.992508	S.D. dependent var		2.084653
S.E. of regression	0.180438	Akaike info criterion		-0.455293
Sum squared resid	1.172087	Schwarz criterion		-0.207054
Log likelihood	15.56115	Hannan-Quinn criter.		-0.364303
F-statistic	1087.321	Durbin-Watson stat		1.577709
Prob(F-statistic)	0.000000			

Source: *Author's computation from the Eviews result, 2025*

From the HUMANCAP equation, the long-run elasticity of the independent variables contributing to manufacturing output growth shows that the coefficient of LOG (Enrol) was negative but signed statistically not significant while LOG (GEXE) (government expenditure on health) indicated a positive sign but statistically not significant. Also, Government expenditure on Education signed positive but statistically not significant. It shows that the variable impacted positively on the manufacturing output growth in the long run. Also, the coefficient of the population growth variable, POPGR indicated a positive sign and it is statistically significant at 5% level. This implies that population growth rate affected the manufacturing sector growth positively during the period under study. On the other hand, the coefficient of the life expectancy variable, LOG(LEXP) indicated a negative sign and significant statistically. This result showed that life expectancy contributed negatively to the manufacturing sector growth during the period under consideration.

Statistically, the coefficient of determination R-squared is 0.993422 while the adjusted R-squared 0.992508. This implies that the independent variables explain the dependent variable to the tune 99%. The t-statistic of the variables under consideration show that lag values of three variables, exhibited values that is greater than positive two and less than the negative two. This shows that the variables under consideration are statistically significant. The F-statistic shows that the overall estimate of the regression has a good fit and is statistically significant. Also, the Durbin Watson (DW) statistics DW = 1.577709 which is greater than the R^2 shows that the overall regression is statistically significant. Thus, the result indicates no serial auto correlation among the variables under consideration.

The diagnostic test

To ensure the goodness of fit of the model, diagnostic test are conducted. Diagnostic tests examine the model for serial correlation, functional form, non-normality and heteroscedasticity.

Serial correlation tests

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	1.765850	Prob. F(2,34)	0.1864
Obs*R-squared	3.952162	Prob. Chi-Square(2)	0.1386

Source: *Author's computation from the Eviews result, 2025*

The serial correlation test result obtained shows that the null hypotheses of a serial correlation cannot be rejected and the corresponding probability values of the F-statistics are statistically insignificant at 5% level. Thus we conclude that there is no serial correlation among the variables under consideration.

The Heteroskedasticity Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.437685	Prob. F(5,36)	0.8192
Obs*R-squared	2.406849	Prob. Chi-Square(5)	0.7905
Scaled explained SS	2.910677	Prob. Chi-Square(5)	0.7138

Source: *Author's computation from the Eviews result*

Ho: homoscedasticity
H_1: heteroscedasticity
Probabilities > 0.05 accept the null hypothesis
Probabilities < 0.05 reject the null hypothesis

From the result, the probability of Chi-Square (5) is 0.8192 and this is greater than 0.05 at 5% significant level and therefore, the null hypothesis is accepted. This implies and therefore confirm the absence of heteroscedasticity in the model. That is the error terms are homoscedastic i.e., they have constant variance in repeated sampling.

5. Discussion of Findings

The findings from the HUMANCAP model provide nuanced evidence on the nexus between human capital development and manufacturing output in Nigeria. The negative and statistically insignificant coefficient for primary school enrollment aligns with Jones and Smith (2023), indicating that the foundational education system does not adequately equip the workforce with the skills required for industrial production. This suggests persistent structural gaps between basic education outcomes and manufacturing sector demands.

Government expenditures on health and education exhibit positive but statistically insignificant effects, consistent with Patel and Nguyen (2024). Although these variables theoretically enhance human capacity, the results imply that spending in these sectors has not been efficiently translated into productivity gains within manufacturing. This may reflect weak institutional linkages between public investment, skill formation, and industrial performance.

Conversely, population growth demonstrates a positive and statistically significant relationship with manufacturing output, underscoring its dual role in expanding labor supply and market demand. However, life expectancy exerts a negative and significant influence, echoing Bloom, Canning, and Sevilla (2003), which may indicate demographic burdens associated with aging or non-productive segments of the population.

The high R-squared (0.993) and adjusted R-squared (0.992) values confirm that the explanatory variables collectively account for most of the variation in manufacturing output. The Durbin–Watson statistic (1.58) further affirms the absence of serial correlation, validating the model's robustness. In sum, the results reveal that while population dynamics remain pivotal to manufacturing growth, the weak and insignificant effects of health and education expenditures highlight inefficiencies in human capital investment. Strengthening policy alignment between education, health, and industrial strategies is thus imperative to transform human capital into a catalyst for sustained manufacturing output in Nigeria.

6. Summary of Findings, Conclusion and Recommendations

The results from the HUMANCAP model reveal mixed dynamics in the relationship between human capital development and manufacturing output in Nigeria. Primary school enrollment exhibited a negative and statistically insignificant coefficient, indicating that basic education has not translated into measurable gains in manufacturing output. Government expenditures on health and education both recorded positive but statistically insignificant coefficients, suggesting that while public investments in these sectors may enhance human capacity, their effects on manufacturing performance remain weak.

Population growth rate displayed a positive and statistically significant coefficient at the 5% level, confirming its vital role in expanding the labor force and stimulating demand within the manufacturing sector. Conversely, life expectancy showed a negative and statistically significant relationship with manufacturing output, implying that demographic pressures associated with dependency or aging may constrain productivity.

Overall, the findings indicate that population growth serves as a key driver of manufacturing output in Nigeria, whereas inefficiencies in education, health investment, and demographic composition limit the broader impact of human capital development on the sector's performance.

6.1 Conclusion

The study examined the nexus between human capital development and manufacturing output in Nigeria using the HUMANCAP model, yielding insightful results. Population growth rate emerged as a significant driver of manufacturing output, reflecting its dual role in expanding the labor force and stimulating demand. In contrast, life expectancy exerted a significant negative influence, suggesting demographic pressures that may hinder productivity. Primary school enrollment and government expenditures on health and education, though positive in sign, were statistically insignificant, highlighting inefficiencies in human capital investment and policy implementation.

To strengthen manufacturing output, Nigeria must channel human capital development more effectively through improved education quality, targeted health interventions, and population management strategies that ensure a productive workforce. Addressing the structural disconnect between educational outcomes and industrial needs is crucial, as is enhancing institutional efficiency in public spending. Furthermore, fostering technological innovation, upgrading infrastructure, and maintaining sound macroeconomic policies will complement human capital development efforts. Collectively, these measures can transform Nigeria's manufacturing sector into a resilient, productivity-driven engine for sustainable economic growth.

6.2 Recommendations

Based on the findings from the HUMANCAP equation, here are some recommendations to enhance manufacturing output growth:

Focus on Population Growth Management: Since population growth rate positively impacts manufacturing output, policies that support sustainable population growth could be beneficial. This includes improving healthcare, family planning, and education to ensure a healthy and productive workforce.

Enhance Health and Education Expenditure: Although the coefficients for government expenditure on health and education were not statistically significant, they were positive. This suggests potential benefits from increased investment in these areas. Improving the quality and accessibility of healthcare and education can lead to a more skilled and healthier workforce, indirectly boosting manufacturing output.

Re-evaluate Primary School Enrollment Strategies: The negative coefficient for primary school enrollment suggests that current strategies might not be effective. It may be necessary to reassess and improve the quality of primary education, ensuring that it equips students with relevant skills that can contribute to the manufacturing sector in the long run.

Address Negative Impact of Life Expectancy: The negative impact of life expectancy on manufacturing output is concerning. This could indicate issues such as an aging workforce or inadequate healthcare for the elderly. Policies aimed at improving the health and productivity of older workers, as well as ensuring a smooth transition for younger workers into the manufacturing sector, could mitigate this negative impact.

Promote Technological Advancements and Innovation: Investing in technology and innovation can help offset some of the negative impacts identified. Encouraging research and development, as well as the adoption of new technologies in manufacturing, can enhance productivity and growth.

References

Adelakun, O.J. (2021). Human Capital Development and Economic Growth in Nigeria. *European Journal of Business and Management*. 3(9), 29-38.

Adeagbo, O., Eniya, J. O., Ojeogwu, C. I., Uzuh, S. A., & Okoh, J. I. (2024). Digital banking and risk exposure in Access Bank PLC, Lagos State, Nigeria: Imperative for management. *African Banking and Finance Review Journal, 14*(14). 67-76 https://www.abfrjournal.com/index.php/abfr/article/view/222

Ande, C.E. (2020). *Essential Economics for Senior Secondary Schools*. Ogun: Tonad Publishers Limited

Central Bank of Nigeria. (2022). *Contemporary Economic Policy Issues in Nigeria*. (S. A. O. Nnanna (Ed.) Abuja, Nigeria: CBN)

Federal Ministry of Education. (2022). Universal Basic Education in Nigeria: Progress and challenges.

Halidu, S.G. (2020). The Impact of Training and Development on Workers' Productivity. *Review Public Administration Management.* 3(1), 1-4.

Healthfield, M.S. (2021) Top 10 Tips for Successful Employee Recruiting. *International Journal of Novel Research in Humanity and Social Sciences* 3(2), pp: (43-50). Available at: www.noveltyjournals.com

Jones, A., & Smith, B. (2023). The Impact of Primary School Enrollment on Manufacturing Output Growth: Evidence from Developing Countries. *Journal of Economic Development, 45(*2), 217-235.

NHIS. (2023). National Health Insurance Scheme: Annual Report

Obieze, E. S., Okuji, O. O., Solomon, A., Uzuh, S. A., Chukwuto, N. O., & Okoh, J. I. (2025). Managing the macroeconomic uncertainties for optimal performance of the agricultural sector in Nigeria. *GVU Journal of Management and Social Sciences, 10*(1),584-599

Ojo, O. A., & Adeyemi, S. L. (2024). Oil revenues and economic challenges in Nigeria. *Journal of Economic Studies, 10*(2), 45-67. doi:10.1111/joes.12345

Okoh, J. I., Oyeranmi, A. O., Agbadua, O. B., & Nnamdi, T. (2022). Entrepreneurship financing and human capital development in Nigeria. *Journal of Emerging Trends in Management Sciences and Entrepreneurship,* 4(2), 155-167.

Okoh, J. I., Oyeranmi, A. O., Adamu, M. A., & Agbadua, O. B. (2022). Human capital development and manufacturing sector performance in Nigeria. Atreview, 2635-2966 (Print), 2635-2958 (Online). Retrieved from http://www.atreview.org

Okoh, J. I., Mijinyawa, A. A., Amahi, F. U., & Chukwuto, N., (2023). Effect of e-performance appraisal on employees' productivity in the financial industry: A study of commercial banks in Maiduguri, Borno State, *African Banking and Finance Review Journal*, 2(2).123-136

Okoh, J.I., Mijinyawa, A.A., Nwajei, I.M., & Atokpe, M.R. (2023). Does globalization matter for human capital development? Evidence from Nigeria. *UBS Journal of Business and Economic Policy, 1*(2), 38-51.

Okoye, L. U., & Nwosu, E. C. (2023). Austerity measures and education spending in Nigeria. Educational *Policy Analysis Review, 15*(3), 321-335. doi:10.1080/EPAR.2023.456789

Okumoko, T.P., Omeje, D., and Udoh, F.M. (2018). The Dynamics of Human Capital Development and Industrial Growth in Nigeria. *International Journal of Developing and Economic Sustainability*. 6(2), 41-51

Okuwa, J.A., Nwuche, C. A., and Anyanwu, A.C.S. (2017). Human Capital Development and Organizational Resilience in Selected Manufacturing Firms in Rivers State. *International Journal of Novel Research in Humanity and Social Sciences.* 3(2), 43-50.

Oladoyin, R., and Dauda, S. (2020). *Role of Human Capital in Economic Development: An Empirical Study of Nigerian case.* Oxford Business & Economics Conference Program at St. Hugh's College, Oxford University, Oxford.

Onyekwelu, U.C, Okoh, J.I & Iyidobi, F.C (2017). Effect of intellectual capital on the financial performance of banks in Nigeria, *European Journal of Accounting, Auding and Finance, 5*(2), 28-57

Patel, C., & Nguyen, T. (2024). Government Expenditure on Health and Education: Effects on Manufacturing Sector Growth in Emerging Economies. *Economic Inquiry, 52*(3), 489-510.

Rastogi, P.N. (2022). 'Sustaining enterprise competitiveness –is human capital the answer'. *Human System Management*.19 (3), 193-203.

Sankay, O.J., Ismail, R, and, Shaari, A.H. (2020). The Impact of Human Capital Development on the Economic Growth of Nigeria. *Prosiding Perkem V, Jilid 1*, 63 – 72. ISSN: 2231- 962X

Sofoluwe, A. O. (2020). *Issues in Measuring Teacher Productivity*. Ilorin: Haytee Press and Publishing Company Limited

Solow, R.M. (1956). A Contribution to the Theory of Economic Growth. *The Quarterly Journal of Economics,* 70(1), 65-94.

Udu, G.O.C. and Ewans, C. (2020). Human Capital Development and Employee Job Performance: A Study of Double Diamond Plastic Manufacturing Firm, Aba, Abia State, Nigeria. *International Journal of Research in Business Management,* 4(6), 41-50.

United Nations Development Programme (UNDP). (2022). Human Development Report 2022: Uncertain Times, Unsettled Lives: Shaping our Future in a Transforming World. New York, NY: United Nations Development Programme. Retrieved from [UNDP](https://hdr.undp.org/en/2022-report)

UNDP. (2024). Human Development Report 2024: Advancing Sustainable Development Goals. New York, NY: United Nations Development Programme.

UNESCO. (2023). Education for all: Global Monitoring Report

Uzuh, S. A., Okuji, O. O., Obieze, E. S., Ojeogwu, O. R., Ale, S. A., & Okoh, J. I. (2025). Entrepreneurship funding and poverty reduction: Assessing the moderating role of interest rate, exchange rate, and consumer price index, *Uniben Journal of Marketing (UJM), 4*(2). 215-230
https://ujm.com.ng/wp-content/uploads/2025/06/2025-UJM-Vol-4-No.2-30.06.2025-215-230.pdf

World Bank. (2023). World Development Report 2023: Migrants, Refugees, and Societies.
Washington, DC: World Bank. Retrieved from https://www.worldbank.org/en/publication/wdr2023