CHAPTER ONE

HUMAN CAPITAL EXPENDITURE, POPULATION GROWTH AND ECONOMIC PROGRESS IN NIGERIA

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Abstract

This study explored the relationships among human capital expenditure, population growth, and economic progress in Nigeria from 1986--2023. Data analysis was conducted via the pairwise Granger causality test and the autoregressive distributed lag (ARDL) model. The findings revealed that government education and health expenditure Granger-cause economic progress in Nigeria, whereas a bidirectional causality exists between economic development and population growth. Additionally, the study revealed that government health expenditures unidirectionally influence education expenditures and that education expenditures unidirectionally affect population growth. The long-run ARDL results indicate that government spending on education and health significantly contributes to Nigeria's economic development. However, in the short term, such expenditures do not have a notable effect on economic progress. Conversely, population growth has a positive effect on short-term economic progress but shows an insignificant relationship over the long term. The study concluded that human capital expenditure and population growth spur economic growth. On the basis of these findings, the Nigerian government should adopt integrated policies that align education, health, and economic progress efforts with demographic trends.

Keywords: Human Capital Expenditure, Government Education Expenditure, Government Health Expenditure, Population Growth, Economic Progress

1. Introduction

The nexus between human capital expenditure, population growth, and economic progress is a critical area of study, particularly for developing countries such as Nigeria. Human capital, which includes the education and health of a population, is a vital driver of economic progress (Ogunjobi, Oladipo, & Oladipo, 2024). This is because an individual who is well educated but unhealthy can be as unproductive as someone who is healthy but lacks education. In recent decades, Nigeria has faced significant challenges in balancing rapid population growth with sustainable economic progress, making the study of these relationships even more pertinent. Nigeria, the most populous country in Africa, has experienced significant population growth in recent decades, with an estimated annual increase of approximately 3.2% (United Nations Population Fund, 2023). While population growth can provide a larger labor force and potentially stimulate economic progress, it can also pose significant challenges if not matched by adequate expenditure in human capital. A burgeoning population increases the demand for education, healthcare, and employment opportunities, placing additional pressure on government resources and infrastructure. If the quality of human capital does not keep pace with population growth, the result can be high levels of unemployment, poverty, and socioeconomic inequality (Apinoko, Olowu, & Ikporo, 2024). There are three primary insights into the link between population growth and economic progress. The pessimistic view, which aligns with Malthusian theory, predicts that unchecked population growth could outpace food production, leading to scarcity and potential famine. The optimistic view sees population growth as beneficial for economic progress, as it increases the supply of labor, reduces labor costs, and potentially lowers unemployment while increasing overall economic output (Boserup, 1965; Oluyemi & Oluwaseyi, 2021). The neutralist perspective maintains that population growth has no direct effect on economic development (Ali, Ali, & Amin, 2013).

In theory, human capital is fundamental to economic progress, making expenditures on human capital crucial for converting the

potential of a growing population into economic growth (Makiw, Romer, & Weil, 1992; Romer, 1989; Lucas, 1988). Without adequate expenditures on education and healthcare, a rapidly expanding population may result in a surplus of unskilled labor, increased unemployment, and increased pressure on limited resources (Ekperiware et al., 2022). This scenario can stifle economic growth, as the potential workforce is underutilized or remains in low-productivity jobs. On the other hand, strategic expenditures on human capital can mitigate these challenges, ensuring that population growth contributes positively to economic performance. However, expenditures on education and training enhance the knowledge and skills of individuals, fostering a workforce that can adapt to new technologies and contribute to the knowledge economy, whereas expenditures on healthcare ensure a healthier workforce that is more capable of sustained productivity and less prone to absenteeism. These expenditures create a virtuous cycle where improved human capital leads to higher economic output, which in turn provides the resources necessary for further expenditure on human capital. In this way, human capital expenditure is essential for realizing the economic benefits of population growth and fostering sustainable economic progress. Empirical evidence from Adeleye et al. (2022), Khanal (2023), and Egor et al. (2023) has shown that human capital expenditure drives economic growth in MENA countries, Nepal, and Nigeria, respectively. Additionally, research by Nwaeze and Ireokwu (2024), Balogun et al. (2023), and Krokeyi and Niyekpemi (2021) indicated that government investment in health and education enhances economic growth. Moreover, Amade and Ibrahim (2018) reported an advantageous effect of population increase on economic progress.

Despite the importance of human capital, Nigeria's human capital expenditure has historically been insufficient. Government spending on education and healthcare remains well below international benchmarks, with education and health spending averaging approximately 7% and 5% of the total budget over the years, which is below the UNESCO and WHO recommendations of

26% and 15%, respectively (BudgiT, 2024; Maduka, Okafor, Anaenugwu, & Ewurum, 2024). This has posed a significant challenge to Nigeria's economic progress. While the country has experienced periods of economic growth, this growth has not always translated into broad-based development, partly because of the inadequate expenditure of its human capital. The mismatch between a rapidly growing population and insufficient expenditures on education and healthcare has resulted in high unemployment rates, particularly among youth, and has hindered the country's ability to achieve sustained economic progress. Thus, understanding the relationships among human capital expenditure, population growth, and economic progress is essential for formulating effective policies that can harness the potential benefits of Nigeria's demographic trends. By examining these dynamics, policymakers can better understand how to allocate resources effectively to improve human capital, manage population growth, and achieve sustainable economic progress. This study aims to explore these relationships, providing insights that could help shape Nigeria's development strategy in the coming years.

2. Literature Review

Theoretical Framework

This research is grounded in theories of endogenous growth and Keynesian government expenditure. Endogenous growth theory, a framework developed in the 1980s by economists such as Paul Romer and Robert Lucas, asserts that economic progress is driven primarily by intrinsic elements rather than outside forces. This theory underscores the role of human capital, innovation, and knowledge as central components of economic development. Unlike traditional growth theories, which attribute growth to exogenous factors such as technological advancements, endogenous growth theory suggests that economic policies, such as investments in education and research and development (R&D), directly influence a country's long-term growth rate. Within this framework, human capital investment, particularly in education and skill development, is seen as a vital engine of growth. As a country's workforce becomes more skilled and educated,

productivity increases, leading to more significant innovation and technological advancements that further fuel economic expansion. Population growth has two functions in the context of endogenous growth theory. On the one hand, a growing population can provide a larger labor force, potentially increasing economic output. However, for population growth to positively impact economic growth, there must be substantial investment in human capital (Kuznets, Quandt, & Friedman, 1960). If a nation invests adequately in education and health, a growing population can enhance economic growth by providing a more skilled and healthier workforce that can contribute more effectively to productivity and innovation. Conversely, without sufficient human capital investment, a large population may strain resources, leading to unemployment and lower productivity, which can hinder economic growth. Therefore, the interplay between population growth, human capital investment, and economic growth under endogenous growth theory explains the relevance of strategic investments in human capital to harness the full potential of a growing population for sustained economic development.

Keynesian economics, formulated by John Maynard Keynes in response to the Great Depression, emphasized the role of government expenditures in managing economic cycles and stimulating growth, especially during periods of economic downturns. According to Keynes, government spending can increase aggregate demand, reduce unemployment, and accelerate economic recovery. In the context of human capital investment, Keynesian theory supports the idea that government expenditures on education, healthcare, and infrastructure can have a multiplier effect on economic progress. By investing in human capital, the government can increase the productivity of the workforce, which in turn can lead to higher levels of income and consumption, thereby driving economic expansion. This approach aligns with the Keynesian perspective that proactive fiscal policy, particularly during periods of economic slack, can create the conditions necessary for sustained growth. Population growth interacts with Keynesian theory through the lens of human capital expenditure and its implications for economic progress. As the population grows, the demand for public goods and services, such as

education and healthcare, increases. Keynesian theory advocates for government intervention to meet these rising needs, suggesting that increased government expenditure on human capital is essential to ensure that a growing population contributes positively to economic growth. If the government invests effectively in education and healthcare, it can improve the skills and health of a larger workforce, leading to increased productivity and economic output. Conversely, if population growth outpaces government expenditures on human capital, it can lead to resource shortages, higher unemployment, and slower economic growth. Thus, in a Keynesian framework, a strategic focus on government expenditures aimed at enhancing human capital in response to population growth is crucial for fostering long-term economic prosperity.

Empirical Review

Ogunjobi, Oladipo, and Oladipo (2024) investigated how population growth and the development of human capital influenced economic progress in Nigeria from 1988--2022. Their findings indicated that both factors negatively impact economic growth. In contrast, Adeleye et al. (2022) studied the influence of the interplay between population growth and economic progress in MENA countries from 1980–2020. The study concluded that although human capital and population growth independently contributed to economic progress, the overall effect of population growth remains predominantly positive when considering human capital.

The connection between the development of human capital and economic expansion in Nigeria from 1990–2022 was studied via the ordinary least squares (OLS) approach of Okoli, Ezenwobi, and Onugha (2024). Their results demonstrated that life expectancy and adult literacy had beneficial but insignificant effects on economic progress, whereas primary school enrollment, gross national income, and gross fixed capital formation significantly influenced economic expansion. Anigboro (2024) utilized an autoregressive distributive lag model and reported that real GDP was negatively related to capital expenditures on education and health but positively associated with recurrent expenditures in these sectors. Similarly, Nwaeze and

Ireokwu (2024) used a vector error correction model (VECM) to analyze data obtained from 1981–2020 and discovered that government education spending had a significant direct effect on economic expansion in both the long and short term, whereas health spending was significant only in the short term.

Balogun, Ajiboye, and Olorunmade (2023) utilized the VECM to find the effects of human capital expenditure and concluded that government health and education spending had a beneficial impact on Nigeria's economic progress. Khanal (2023) ascertained the link between human capital spending and economic progress in Nepal from 1985--2022 and reported that higher school enrollment positively affects GDP, whereas capital expenditure on education has an adverse impact; however, overall investment in human capital is positively correlated with economic progress over the extended term. Egor et al. (2023) also used OLS to show a favorable connection between the development of human capital and economic progress in Nigeria. Moreover, Krokeyi and Niyekpemi (2021) demonstrated that government expenditures on education significantly boosted real GDP, whereas spending on health had a positive but insignificant effect, according to the OLS method.

Furthermore, Habakurama and Mukanyandwi (2024) studied the impact of population changes on economic expansion in Rwanda between 1992 and 2022 and reported that population growth had a negative effect on economic prosperity. Tomi and Valeriani (2024) assessed the influence of Indonesia's aging population, fertility rates, and population growth on economic progress from 1961--2022 and reported that fertility rates had a significant negative impact, whereas population growth positively affected economic growth. Mec and Cermakova (2024) explored the relationship between population growth and GDP per capita in 30 African countries from 1960--2020, discovering diverse causal relationships across countries, including unidirectional, bidirectional, and no causality, via a bootstrapped panel Granger causality test. Apinoko, Olowu, and Ikporo (2024) employed an ARDL bounds test to examine population dynamics and economic progress in Nigeria and reported that higher population growth and infant mortality rates were harmful to the economy.

Bashir and Abubakar (2019) explored the influence of net population growth on Nigeria's economic progress from 1970--2017 through ARDL cointegration analysis, revealing a negative long-term connection between economic progress and net population growth, with causality running from net population growth to economic growth. Ogunleye, Owolabi, and Mubarak (2018) demonstrated that population growth positively and significantly influenced Nigeria's economic growth from 1981–2015. Similarly, Amade and Ibrahim (2018) studied African countries from 1980--2015 and revealed that population growth increased economic growth, whereas fertility rates had a negative effect. Finally, Ekperiware et al. (2022) investigated the causal link between population expansion and the development of human capital in Nigeria from 1970--2020, finding bidirectional causality through a Granger causality test.

3. Methodology

This research utilized econometric methods to analyze the effects of human capital expenditure, population growth, and economic progress in Nigeria over the period from 1986–2023. The econometric approaches applied in this study include the unit root test, causality test, and autoregressive distributed lag (ARDL) model. The study relies on secondary data, with population growth statistics obtained from World Bank data, whereas information on real GDP, gross fixed capital formation, and government spending on education and health was sourced from the CBN Bulletin.

Theoretical Model and Model Specification

The study model was constructed via an endogenous growth framework, specifically drawn from Lucas's (1988) model, which explicitly integrates human capital (H) as a critical factor of production along with physical capital (K) and labor (L). The general structure of the production function within an endogenous growth model can be articulated as outlined below:

$$Y = f(AK^{\alpha}H^{\beta}L^{1-\alpha-\beta}) \quad \text{……..……. (1)}$$

where Y reflects the total output (economic growth), A reflects the technology level, K reflects the physical capital stock, H represents the human capital stock, L represents labor or population growth, and α and β represent the elasticities of output for physical capital and human capital, respectively. Consequently, by transforming the model and applying the natural logarithm, we have:

$$\ln Y = A + \alpha \ln K + \beta \ln H + 1 - \alpha - \beta \ln L \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

Thus, equation (2) becomes:

$$\ln RGDP = f(\ln GFCF, \ln GEPXE, \ln GEPXH, \ln POP) \quad \ldots\ldots\ldots\ldots \quad (3)$$

where RGDP is real gross domestic product a proxy for economic growth, GFCF is gross fixed capital formation, GEXPE is government expenditure on education (both capital and recurrent expenditures), GEXPH is government expenditure on health (both capital and recurrent expenditures) and POP is population. Thus, by converting equation (3) into mathematical form, we have:

$$\ln RGDP_t = \beta_0 + \beta_1 \ln GFCF_t + \beta_2 \ln GEXPE_t + \beta_3 \ln GEXPH_t + \beta_4 \ln POP_t + \mu_t$$
$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

To examine the causal relationships among the variables, the Granger causality test was utilized, whereas ARDL was used to examine the relationships among the variables. The ARDL model, first established by Pesaran and Shin in 1999 and broadened upon Pesaran et al. in 2001, is designed to explore both long- and short-term relationships between variables. A key strength of the ARDL model is its ability to work effectively with variables that are integrated of order I(0), I(1), or a combination of both, providing accurate and efficient estimates regardless of the integration level of the variables. This makes it particularly useful for empirical research where the integration properties of the variables may not be uniform. Thus, the fundamental structure of the ARDL model is outlined below:

$$\Delta \ln RGDP_t = \beta_0 + \sum_{i=1}^{n} \beta_{1i} \Delta \ln RGDP_{t-1} + \sum_{i=1}^{n} \beta_{2i} \Delta \ln GFCF_{t-1} + \sum_{i=1}^{n} \beta_{3i} \Delta \ln GEXPE_{t-1} + \sum_{i=1}^{n} \beta_{4i} \Delta \ln GEXPH_{t-1} + \sum_{i=1}^{n} \beta_{5i} \Delta \ln POP_{t-1} + \alpha_1 \ln RGDP_{t-1} + \alpha_2 \ln GFCF_{t-1} + \alpha_3 \ln GEXPE_{t-1} + \alpha_4 \ln GEXPH_{t-1} + \alpha_5 \ln POP_{t-1} + \mu_t \quad \ldots\ldots (5)$$

The long-term relationship among the specified variables is established via an F statistic (Wald test) in comparison with the critical values (lower and upper bounds) introduced by Pesaran et al. (2001) for the cointegration test. If the F statistic exceeds the upper bound, a long-term relationship is confirmed, whereas if it falls below the lower bound, no such relationship exists. When the F statistic lies between these bounds, the inference regarding a long-term relationship remains inconclusive (Pesaran et al., 2001). Once long-term cointegration is confirmed, an error correction model is necessary to determine the speed of adjustments toward long-term equilibrium. The error correction term is obtained from the initial long-term equation as outlined below:

$$\Delta \ln RGDP_t = \beta_0 + \sum_{i=1}^{n} \beta_{1i} \Delta \ln RGDP_{t-1} + \sum_{i=1}^{n} \beta_{2i} \Delta \ln GFCF_{t-1} + \sum_{i=1}^{n} \beta_{3i} \Delta \ln GEXPE_{t-1} + \sum_{i=1}^{n} \beta_{4i} \Delta \ln GEXPH_{t-1} + \sum_{i=1}^{n} \beta_{5i} \Delta \ln POP_{t-1} + \alpha_1 \ln RGDP_{t-1} + \alpha_2 \ln GFCF_{t-1} + \alpha_3 \ln GEXPE_{t-1} + \alpha_4 \ln GEXPH_{t-1} + \alpha_5 \ln POP_{t-1} + \alpha_6 ECM_{t-1} + \mu_t \quad \ldots\ldots (6)$$

where ECM represents the error correction mechanism.

4. Results and Discussions

Unit Root Test Results

To assess the stationarity and econometric properties of the variables in question, the augmented Dickey–Fuller (ADF) test was conducted. This test plays a crucial role in selecting the most suitable estimation technique to analyze the relationships among human capital expenditure, population growth, and economic progress in Nigeria during the study period. The ADF test was specifically used to check

for the presence of a unit root, which helps eliminate uncertainty and strengthens the validity of the results. The findings are displayed in Table 1.

Table 1: Results of the Unit Root Test

Variables	At Level	First Difference	5% Critical Level	Remarks
lnRGDP	-0.477976 0.9802	-4.492403 0.0052**	-3.536601	I(1)
lnGFCF	-1.735447 0.7150	-4.788593 0.0024**	-3.536601	I(1)
lnGEXPE	-3.313516 0.0798	-6.363454 0.0000**	-3.536601	I(1)
lnGEXPH	-2.507847 0.3227	-11.56269 0.0000**	-3.536601	I(1)
lnPOP	-9.484424 0.0000**	-	-3.536601	I(0)

Source: Extraction from E-views 10 Output

The findings from Table 1 illustrate the outcomes of the stationarity tests. The findings revealed that most of the series did not achieve stationarity at their levels, with the exception of lnPOP. However, after the first difference, the remaining series (lnRGDP, lnGFCF, lnGEXPE, and lnGEXPH) became stationary. This indicated that all variables are free from unit root issues after being differenced once. This result further validates the use of the ARDL bound approach.

Causal Relationship between Population Growth, Human Capital Expenditure and Economic Growth in Nigeria

The Granger causality test is used to assess whether one time series can aid in forecasting another. The test results demonstrate the direction of causality among the variables lnRGDP, lnGFCF, lnGEXPE, lnGEXPH, and lnPOP in Nigeria at the 5% significance level. The study utilized pairwise Granger causality, with the outcomes summarized in Table 2.

Table 2: Pairwise Granger Causality

Null Hypothesis:	Obs	F-Statistic	Prob.
LNGEXPE does not Granger Cause LNRGDP	36	3.41427	0.0457
LNRGDP does not Granger Cause LNGEXPE		1.56501	0.2252
LNGEXPH does not Granger Cause LNRGDP	36	3.73022	0.0353
LNRGDP does not Granger Cause LNGEXPH		1.02144	0.3719
LNPOP does not Granger Cause LNRGDP	36	5.70407	0.0078
LNRGDP does not Granger Cause LNPOP		7.00056	0.0031
LNGEXPE does not Granger Cause LNGFCF	36	0.21789	0.8054
LNGFCF does not Granger Cause LNGEXPE		6.43135	0.0046
LNPOP does not Granger Cause LNGFCF	36	4.23263	0.0237
LNGFCF does not Granger Cause LNPOP		27.1150	2.E-07
LNGEXPH does not Granger Cause LNGEXPE	36	6.43425	0.0046
LNGEXPE does not Granger Cause LNGEXPH		2.96671	0.0662
LNPOP does not Granger Cause LNGEXPE	36	3.22425	0.0534
LNGEXPE does not Granger Cause LNPOP		9.98793	0.0004

Source: Extraction from E-views 10 Output.

The results in Table 2 show that government expenditures on education and health Granger cause economic progress in Nigeria. This suggests that increased funding for education can develop a more skilled workforce capable of driving productivity and innovation, whereas investment in health can enhance well-being, reduce disease burden, and increase labor force participation rates, both of which spur economic progress. Again, there is two-way causality between economic progress and population growth. This suggests that economic progress can result in more job opportunities, increased incomes, and enhanced living standards, which may encourage population growth through better health care and lower mortality rates. Conversely, a growing population can stimulate economic expansion by providing a larger labor force and increasing demand for goods and services as well as fostering innovation through a larger pool of human capital. This finding agreed with the findings of Mec and Cermakova (2024).

There was unidirectional causality running from gross fixed capital formation to government expenditure in education. This suggests that when a country invests more in its physical capital, it may result in increased resources or revenue that the government can allocate to educational initiatives. Population growth has a one-way causal relationship with gross fixed capital formation. By implication, as the population increases, the demand for goods and services also increases, which necessitates more investment in capital assets to meet this demand, which further stimulates economic progress. Furthermore, government expenditures on health have a one-way causation with government expenditures on education. This one-way causation suggests that investments in health can enhance educational outcomes by improving the overall well-being and cognitive abilities of students, thereby creating a healthier workforce better equipped for learning. This result aligns with the conclusions reached in the study of Akaakohol and Ijirshar (2018).

Finally, government expenditures on education have unidirectional causality with population growth. The economic implications of this are multifaceted. First, better educational facilities

and access can improve literacy rates, making the country more attractive for families to raise children, thereby increasing birth rates. Second, investing in education can impact demographic patterns, potentially by improving literacy, knowledge of family planning, and economic opportunities, which may lead to slower population growth as people prioritize careers and personal development. This relationship highlights the role of education in shaping demographic trends and promoting sustainable population growth, which can support long-term economic stability and development.

Relationships among population growth, human capital expenditures and economic growth in Nigeria

An ARDL bounds test was conducted to assess the long-term relationships among population growth, government spending on human capital, and economic development in Nigeria, with the results shown in Table 3.

Table 3: ARDL Bounds Test Results

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	**Value**	**Signif.**	**I(0)**	**I(1)**
		Asymptotic: n=1000		
F-statistic	5.574795	10%	3.03	4.06
K	4	5%	3.47	4.57
		2.5%	3.89	5.07
		1%	4.4	5.72
Actual Sample Size	36	Finite Sample: n=35		
		10%	3.334	4.438
		5%	3.958	5.226
		1%	5.376	7.092
		Finite Sample: n=30		
		10%	3.374	4.512
		5%	4.036	5.304
		1%	5.604	7.172

Source: Extraction from E-views 10 Output

The results in Table 3 indicate a long-run relationship among the variables at the 5% significance level. This conclusion is drawn from the F statistic value of 5.574795, which exceeds the Pesaran upper bound critical values of 5.226 for the actual sample size and 4.57 for the finite sample size at the same significance level. This finding suggests the existence of a long-run equilibrium relationship between the variables. Consequently, this allows for the estimation of both long-run and short-run coefficients to assess their impact on economic progress. The ARDL long-term results are displayed in Table 4.

Table 4: ARDL long-term results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnGFCF	0.633131	0.221321	2.860692	0.0088
lnGEXPE	0.675479	0.299479	2.255509	0.0339
lnGEXPH	0.976769	0.332196	2.940341	0.0073
lnPOP	47.22636	25.00269	1.888851	0.0716

Source: Extraction from E-views 10 Output

The results in Table 4 show that government expenditures on education have a positive and statistically significant relationship with economic progress in Nigeria at the 5% significance level. This means that a 1% increase in government spending on education would result in a 0.68% increase in economic progress. This finding aligns with economic theory, suggesting that investment in education boosts human capital development, which in turn contributes to the overall growth of the economy. This implies that government policies prioritizing education funding can lead to substantial economic benefits. By enhancing the quality of education and expanding access, the workforce becomes more skilled and productive, driving long-term economic growth. This underscores the relevance of education as a key area of investment for sustainable economic development in Nigeria. This finding agreed with the findings of Nwaeze and Ireokwu (2024), Balogun et al. (2023), Krokeyi and Niyekpemi (2021) and Akaakohol and Ijirshar (2018) but was different from that of Khanal (2023).

Similarly, the results indicate that government expenditures on health have a positive and statistically significant relationship with economic progress in Nigeria at the 5% significance level. This suggests that a 1% increase in government spending on health would lead to a 0.98% increase in economic progress. This outcome is consistent with economic theory, reinforcing the idea that investment in health contributes to the overall development of the economy. This finding implies that increasing government investment in healthcare can significantly boost economic growth. Improved health outcomes enhance worker productivity, reduce absenteeism, and extend the working lifespan of the population, leading to greater economic output. Therefore, prioritizing healthcare funding is crucial for promoting long-term sustainable economic progress in Nigeria. This finding agreed with the findings of Nwaeze and Ireokwu (2024), Balogun et al. (2023), Krokeyi and Niyekpemi (2021) and Akaakohol and Ijirshar (2018).

Additionally, population growth has a positive relationship with economic progress in Nigeria at the 5% significance level; however, this relationship is not statistically significant. This suggests that a 1% increase in population growth could lead to a 47.22% increase in economic progress, although the results lack statistical support. Nevertheless, the findings are theoretically consistent, as population growth can drive economic expansion through a larger labor force and increased consumption. The implication of this result is that while population growth may theoretically contribute to economic progress by providing a larger workforce and increasing demand, the lack of statistical significance raises questions about the strength of this relationship in practice, as merely increasing the number of people may not lead to substantial economic gains. This indicates that problems such as underemployment or insufficient investment in human capital development, where the economy's inability to integrate the growing workforce into productive roles prevents the anticipated benefits of population growth from being realized in Nigeria. This finding aligns with the findings of Tomi and Valeriani (2024), Adeleye et al. (2022), Ogunleye, Owolabi, and

Mubarak (2018) but differs from the findings of Ogunjobi, Oladipo, and Oladipo (2024), Habakurama and Mukanyandwi (2024), Apinoko, Olowu, Ikporo (2024), and Abubakar (2019).

Finally, gross fixed capital formation has a positive relationship with economic progress in Nigeria at the 5% significance level and is statistically significant. This implies that a unit change in gross fixed capital formation would lead to a 0.63% increase in economic progress. This is theoretically sound, as capital investment enhances productive capacity, fosters innovation, and supports long-term growth.

Owing to the existence of a long-run equilibrium relationship among the variables, an error correction model was established to analyze the speed of adjustment and short-run dynamics. The coefficients of the explanatory variables in this model illustrate the short-run relationships. The estimation results for this model are presented in Table 5.

Table 5: ARDL short-term results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNGEXPE)	0.004121	0.048470	0.085026	0.9330
D(LNGEXPE(-1))	0.058724	0.038028	1.544237	0.1362
D(LNGEXPH)	0.002761	0.056677	0.048710	0.9616
D(LNGEXPH(-1))	0.123977	0.044374	2.793921	0.0103
D(LNPOP)	263.2166	59.81689	4.400372	0.0002
D(LNPOP(-1))	267.2706	61.60512	4.338448	0.0002
CointEq(-1)*	-0.371478	0.064941	-5.720282	0.0000

Source: Extraction from E-views 10 Output

Table 5 shows that government expenditures on education have a positive relationship with economic progress both in the current and first lagged periods, but this relationship is not statistically significant at the 5% significance level. Similarly, government expenditure on health has a positive relationship with economic progress both in the current and first lagged periods, but it is statistically significant at the 5% significance level in the first lagged

period. This implies that government expenditures on education and health are long-term investments, as their significant impacts are only observed over an extended period. This finding corroborates the findings of Akaakohol and Ijirshar (2018).

Furthermore, population growth has a positive significant relationship with economic progress in Nigeria at the 5% significance level. In theory, population growth is beneficial for economic growth, as it increases the supply of labor, reduces labor costs, and potentially lowers unemployment while increasing overall economic output (Boserup, 1965; Oluyemi & Oluwaseyi, 2021). In the short run, the relationship between population growth and economic growth is statistically significant, whereas in the long run, it becomes insignificant due to diminishing returns to labor, resource constraints, changes in technology, shifts in capital accumulation, and the need for sustained increases in productivity. This finding is consistent with the findings of Tomi and Valeriani (2024), Adeleye et al. (2022), Ogunleye, Owolabi, and Mubarak (2018) but differs from the findings of Ogunjobi, Oladipo, and Oladipo (2024), Habakurama and Mukanyandwi (2024), Apinoko, Olowu, Ikporo (2024), and Abubakar (2019).

As needed, the coefficient of the error term is sufficiently negative (-0.371478) and statistically significant, with a t value of -5.720282 and a p value of 0.0000. This magnitude suggests that any deviation from equilibrium is corrected gradually, with approximately 37.15% of the disequilibrium being addressed each period (i.e., each year). The coefficient of multiple determination (R^2) indicates that the explanatory variables collectively account for approximately 77% of the variation in the dependent variable, with an adjusted R^2 of 70%. The overall significance of the model is reflected in the F statistic of 11.28305, which is significant at the 5% critical level.

ARDL Residual Test

A diagnostic check is essential to determine the validity of a model, helping identify any issues with its development. For this research, the diagnostic criteria used include the serial correlation LM test and the heteroskedasticity test to assess the significance of relationships.

Specifically, the Breusch–Godfrey serial correlation LM test was employed to verify the assumption of noncorrelated disturbances. The outcomes of these tests are presented in Tables 6 and 7.

Table 6: Breusch–Godfrey serial correlation LM test results

F-statistic	1.511845	Prob. F(2,21)	0.2435
Obs*R-squared	4.531062	Prob. Chi-Square(2)	0.1038

Source: Extraction from E-views 10 Output

The results in Table 6 reveal that there is an absence of serial correlation given the observed R-squared and F-statistics of 4.531062 and 1.511845, with insignificant probability values of 0.2435 > 0.05 and 0.1038 > 0.05, respectively. This implies that there is an absence of serial correlation in the model.

The results of the Breusch–Pagan–Godfrey heteroscedasticity test are summarized in Table 7.

Table 7: Heteroscedasticity Test: Breusch–Pagan–Godfrey Test Results

F-statistic	1.921541	Prob. F(11,24)	0.0877
Obs*R-squared	16.85825	Prob. Chi-Square(11)	0.1121
Scaled explained SS	10.54842	Prob. Chi-Square(11)	0.4818

Source: Extraction from E-views 10 Output

The results in Table 7 reveal that there is an absence of heteroskedasticity in the model, implying that the variables are homoscedastic. This is because the observed R-square and F-statistics of 16.85825 and 1.921541 have probability values of 0.1121 > 0.05 and 0.0877 > 0.05, respectively, which are statistically insignificant at the 5% critical level. Therefore, the null hypothesis is accepted, which implies that there is no covariance of the error term with the explanatory variables.

The cumulative sum of errors (CUSUM) and cumulative sum of squared errors (CUSUMSQ) were used to test whether the model was spurious. The test consists of two fundamental boundary lines,

known as the critical lines, set at a 5% critical level. Within this boundary, there is a graph, and if the graph intersects or surpasses any of the lines, it signifies that the model is spurious. Conversely, if the graph does not touch or cross either line, it indicates that the model is valid (Dufour, 1982). The CUSUM and CUSUMSQ test results are shown below in Figure 1.

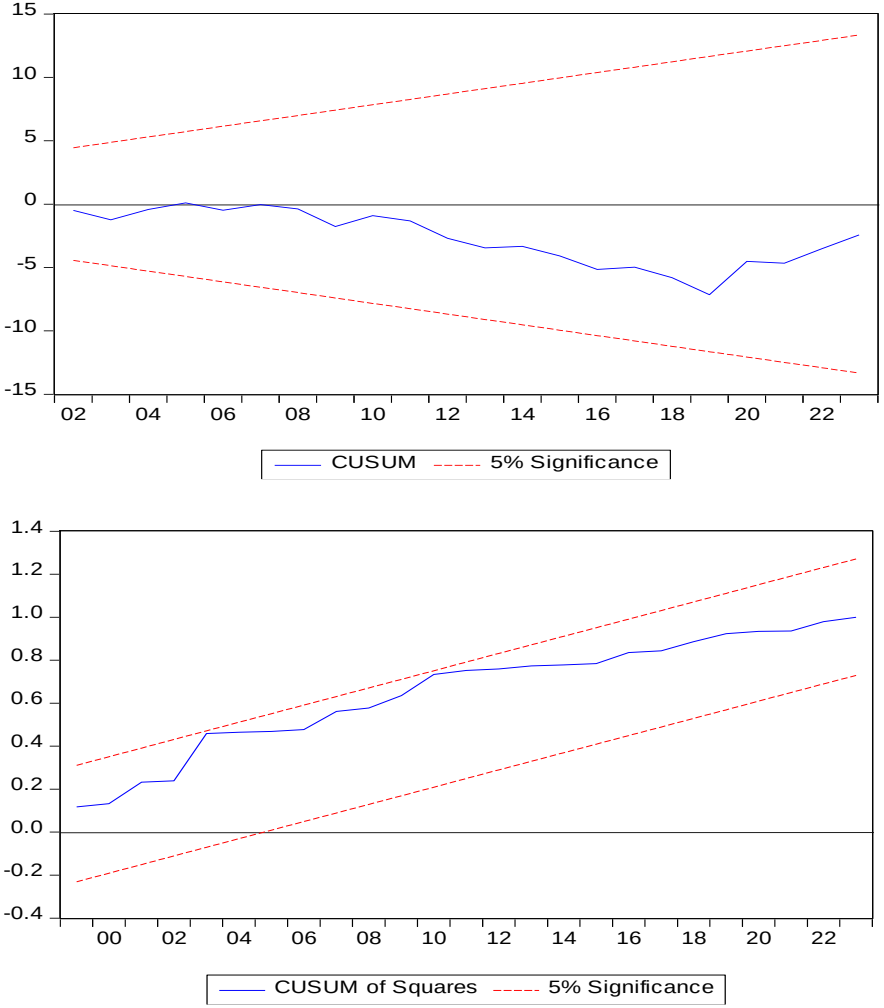

Figure 1: *Results of the CUSUM and CUSUMSQ tests*

The graphs in Figure 1 show that the model is not spurious because the CUSUM and CUSUMSQ test results indicate that the model is stable and produces reliable results.

5. Conclusion and Recommendations

In conclusion, this study has demonstrated a nuanced relationship between human capital expenditure, population growth, and economic progress in Nigeria. In the long run, expenditures on human capital, such as education and health, significantly contribute to Nigeria's economic progress. This highlights the importance of long-term commitments to human capital development for sustainable economic progress. However, in the short run, human capital expenditure does not have a significant effect on economic growth, suggesting that the benefits of such investments may take time to materialize. Conversely, population growth appears to have a positive effect on economic progress in the short term, likely due to increased labor force participation and demand for goods and services. However, over the long term, it does not automatically translate into economic progress because unchecked population growth without parallel investments in human capital may strain resources and hinder sustainable development. On the basis of these findings, the study recommended the following:

The government should maintain and increase investments in education and healthcare to ensure that the long-term benefits of human capital expenditure are realized, thus fostering sustained economic progress. While population growth can spur short-term economic activity, there is a need for policies that balance this growth with the availability of resources and opportunities. This includes investing in family planning and creating economic opportunities that can accommodate a growing population. To maximize the benefits of both human capital development and population growth, Nigeria should implement policies that expand access to quality education, improve healthcare systems with a focus on maternal and child health, and promote family planning services. Additionally, policies should encourage job creation through economic diversification beyond oil, support entrepreneurship, and invest in infrastructure to accommodate a growing population. Empowering youth through skill development

and ensuring social safety nets for vulnerable groups will also be crucial in aligning these efforts with Nigeria's demographic trends for sustainable growth.

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