Human Capital Development and Economic Growth in Nigeria: An Application of Autoregressive Distributed Lag (ARDL) Model Approach

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DOI: 10.56201/ijssmr.v10.no10.2024.pg134.155

Abstract

This study examined the impact of human capital development on economic growth in Nigeria from 1990 to 2020. The study adopted an ex post facto research design, to make an empirical investigation on the impact of human capital development proxy by Immunization against measles, infant mortality rate, and government expenditure on health and education as well as total energy consumption and on economic growth proxy by the growth rate of GDP. The study employed the ADF unit root test; the bounds test approach to cointegration, ARDL long and Short-run estimations as well as some post-estimation tests. Accordingly, the unit root test result showed that the variables under consideration are integrated at different orders 1 and 0. The bound test confirmed the presence of a long-run relationship among the variables under discourse. The ARDL estimation in the long run showed that a 1% decrease in infant mortality resulted in a 0.91% increase in GDPG. Also, a 1% increase in government expenditure on education and health increased GDPG by 0.23% and 0.05% respectively. The study recommended the prioritization of investment in education and healthcare to reduce infant mortality rates.

***Keywords**: Infant mortality, Immunization, Human capital development, Economic growth*

1. Introduction

Most economic development theorists agree that economic growth is strongly, influenced by the quality of human capital. "Human capital" refers to the proficiencies, expertise, and understanding that a country's human capital has accumulated, primarily via education, training, and experience. Both organizational effectiveness and the future economic prosperity of the country depend on these attributes, competencies, and expertise. Therefore, the deliberate and continuous process of acquiring and increasing the number of people with the requisite education, training, experience, and knowledge that are critical to a country's economic progress is the development of these human resources (Halidu, 2016). The concept of human capital encompasses all investments made to improve human capacities, such as formal education, informal education, on-the-job training, and learning by doing.

It also includes other aspects, such as health, that facilitate the effective use of human potential. The quality of human capital fosters innovation, which is praised as the growth engine and serves as the basis for new technologies for new goods and services (Malamud & Zucchi, 2018). Therefore, investing human capital in innovative sectors of any economy increases endogenous economic growth. Standards that offer incentives for innovation, however, can enhance this (Kirilenko, Neklyudova-Khairullina, Neklyudov & Tucci, 2018).

A nation's socioeconomic success depends on its human capital development, which includes women's affairs, labour and employment, health, and education (Ogujiuba, 2013). It was underlined that investment in human capital development is essential to guarantee that the nation's endowment of human resources is knowledgeable, competent, productive, and healthy to allow for the best possible exploitation and utilization of other resources to promote growth and development. According to a reexamination of Ogujiuba's (2013) argument, a country cannot attain economic growth and development unless it has a workforce that is highly qualified, talented, and competent and that can make the most of the country's resources.

Economic growth is necessary for long-term investment. Raising the standard of living for a growing population is usually difficult for a country without economic growth. The main strategies for accomplishing this latter aspect of growth are improving health and education services, encouraging both foreign and local investment, and developing and maintaining infrastructure. Many government programs are specifically created to promote equitable and consistent economic growth. Over time, public spending has had a major impact on the development of both human and physical capital. Education is crucial to human capital, which propels productivity in both individual worker output and overall productivity, both of which support economic growth in the country (Grant, 2017).

It is therefore essential to the future of any economy. The World Bank (2016) asserts that as education gives people a range of abilities that allow them to create innovative ideas for products, services, and technology, it is an investment in economic growth. According to policymakers, education is a crucial instrument for a nation's long-term development. This is emphasized by the fact that it transcends the social, cultural, political, and economic fabric of the community. In this regard, it is crucial to stress that a nation's structure or system will unavoidably have problems if it lacks the human capital (health and educational ability) and the skills necessary to make use of its natural resources, regardless of those resources (Olure-Bank & Olayiwola 2017).

Economic growth is mostly driven by increased productivity, as education raises the workforce's overall capacity to complete jobs faster. The dissemination of knowledge about new information, goods, and technology is also centered on secondary and postsecondary education. Last but not least, education encourages innovation to boost the country's ability to create its own new products, technologies, and information. Health investment is a substantial component of human capital, even though it is a welfare-enhancing activity. Health investments therefore improve the welfare of the population since happy people are healthier. Additionally, these investments boost people's productivity and earning capacity, which helps entire nations. Furthermore, healthy people consistently and successfully apply the skills and knowledge they have learnt in school, which amplifies the beneficial effects of education on growth.

As a result, improved health expands the pool of human capital available for higher incomes and outputs for the nation and its citizens. In most parts of the world, there is low growth, high income poverty rates, and insufficient infrastructural development. One of the main causes of the underdevelopment observed in most of these locations is poor health. This is because a nation's economic development is generally correlated with its capital formation as well as the knowledge and abilities of its people. Whereas knowledge and skills depend on factors like child nutrition, home resources, and educational chances, capital formation is determined by the degree of savings rate, which is also a result of adult health.

Therefore, there is a good possibility that health gains, such as higher life expectancies at birth, will increase economic growth. Therefore, good health is important for the process of economic and social growth because it boosts worker efficiency. However, advancements in people's health can also be connected to economic growth. As a result, higher levels of development result in improved nutrition and sanitation, as well as advances in medical knowledge and technologies that increase life expectancy at birth or a specific age and reduce population mortality. Health improvements that have been connected to a country's economic performance include longer life expectancies and lower rates of child mortality. Immunization is one way to improve health conditions.

One of the criteria used to monitor progress in reducing child morbidity and mortality is vaccination coverage, which is one of the most cost-effective public health interventions (National Population Commission and ICF, 2019). Kurt (2015) asserted that an increase in the percentage of the population that is ill has more significant effects and losses on production power than in developed countries, and that it reduces productivity and causes more workforce loss in developing countries whose economies and economic growth depend on labour. In this case, the low cost of labour prevents underdeveloped countries from reaping the full benefits. They deteriorate more, and their situation is already unstable. The condition of the labour markets, society, and healthcare spending are therefore becoming more and more important for growing countries.

The significance and applicability of human capital development in attaining notable and sustained economic growth and development have been widely acknowledged by several research. Growth has the capacity to generate prosperous and opportunity-filled cycles. Parents are more inclined to send their children to school as an investment in their education when they have good job and growth opportunities. This might lead to a strong and growing group of entrepreneurs, which should encourage the government to improve governance. Thus, strong economic expansion promotes human development, which in turn promotes economic growth. Without substantial investments in the development of human capital, sustained economic growth and development would only be a pipe dream and never a reality in any country.

Thus, the contribution of human capital development to economic advancement cannot be overstated. One essential prerequisite for a country's socioeconomic and political transition is the growth of its human capital. One of the well-known contributing factors to the outstanding economic success of most industrialized and emerging countries is their extraordinary dedication to developing human capital.

Any country that wants to make steady economic success needs skilled human resources. Accordingly, countries need to invest in the development of their human capital (Rehman, Tariq, & Khan, 2018). Only a small portion of Nigeria's financial resources have gone towards human capital development. This insufficient investment in human capital is the main cause of Nigeria's problems.

However, because of the always changing business environment, nations must strive for stronger competitive advantages through dynamic economic ecosystems that promote creativity and innovation. To put it simply, this is essential to their buoyancy and long-term survival. Without a doubt, improving a nation's competitiveness depends heavily on its human resource contributions. It is interesting to observe that although Nigeria's education system is one of the fastest-growing in the world, poverty and a drop in citizen income are causing the country to enter some form of recession. The real growth rate for education services in the 2018 fiscal year was -0.67 percent. Higher education access remains inadequate in Nigeria.

Furthermore, there is a discrepancy between the quality of education offered in Nigeria's educational system and the educational demands of the economy and society. The facilities at the classrooms are appallingly poor. The teacher-to-student ratio is roughly 1: 40, which is higher than the recommended goal of 1: 10. In all, Nigeria has 11,651 public junior secondary schools in 2014 (WDI, 2024). Over 4.4 million youngsters attend public junior secondary schools for their elementary education. Nigeria has undoubtedly invested comparatively less in human capital at all educational levels when compared to the overall budget projections. As a result, even if the Federal Ministry of Education's budgetary share of the overall budget has decreased from a high of 12.46 percent in 2015 to a low of 7.38 per cent in 2018, it is still far less than the 26% UNESCO benchmark.

In terms of training, research, and intellectual capacity, it is unable to significantly advance the human element in the sector. Nigeria's progress in building its human capital can also be gauged using a numberof health indicators. Nigeria has one of the highest infant mortality rates in Africa, with over 250,000 deaths per year, with a neonatal mortality rate of 35.9 per 1000 live births in 2019 (WDI, 2024). Nigeria now has one of the highest rates of preventable pregnancy-related deaths globally, second only to India, and worse than the other 53 African countries, even though the maternal mortality ratio has been cut in half over the last 20 years, from 1200 in 1990 to about 360 per 10,000 in 2019 (WDI, 2024). A complete examination of all budget line items revealed that the health sector budgetary allocation in 2014, 2015, 2016, 2017, and 2018 was N339.38 billion, N347.26 billion, N353.54 billion, N380.16 billion, and N528.14 billion, respectively. The health sector's allocation, 5.79 percent of the federal government's 2018 expenditure plan, is very minor in compared to the Nigerian government's pledge of 15%. As a result, the purpose of this study is to empirically examine the influence of human capital development on economic growth in Nigeria, using the assumption that human capital directly adds to a country's prosperity.

2. Literature Review

2.1. Theoretical Review

2.1.1. Human Capital Theory

Paul Romer (1986) proposed the human capital hypothesis, which emphasizes how education improves workers' cognitive capacities, resulting in increased productivity and efficiency. In 1961, Schultz developed the idea that investing in education enhances one's stock of human capital. These expenses cover areas such as health and nutrition, education, and on-the-job training. Such expenditures, although reducing current consumption, increase future productive capabilities. However, only when gross investment outpaces depreciation over time, whether owing to heavy or occasional use, can the stock of human capital grow. Proponents of the human capital theory argue that investing in education is a profitable method to invest in people, even more so than investing in physical capital. According to current estimates, investing in human capital is three times more effective than investing in physical capital. Human capital theorists believe that basic literacy boosts worker productivity in low-skilled occupations. They also argue that people in high-skilled or professional occupations have better marginal production when they receive training that demands logical or analytical thinking or transmits technical and specialized knowledge. It has been established that the more educational possibilities accessible, the greater the community's human capital pool, and hence the higher the rates of economic growth and national productivity.

2.1.2 Neo-Classical theory of growth

Neoclassical growth theory is a paradigm in economics that articulates the processes that drive a consistent rate of economic growth through the interaction of three key factors: labour, capital, and technology. The beginnings of neoclassical growth theory may be traced back to the scholarly contributions of Marshall (1898), Ramsey (1928), Solow (1956), Swan (1956), Cass (1965), and Koopmans (1965), as well as major inputs from economists such as Meade (1961), Phelps (1962), and Johnson. According to the idea, short-term equilibrium is attained by adjusting the proportions of labour and capital in the production function.

Furthermore, it asserts that technical innovation has a significant impact on economic systems, making sustained economic growth impossible in the absence of technological progress. In essence, this theoretical framework maintains that economic growth is dependent on labour productivity, technological innovations, and the aggregate volume of capital resources, while also emphasizing the importance of declining returns on each factor of production—particularly labour and capital—as well as a consistent elasticity of substitution among these inputs, as articulated by Anyanwu and Oaikhenan (1995). This theoretical construct proposes that the accumulation of capital within an economic framework, together with the effective utilization of that wealth by individuals, is critical for promoting economic growth (Anyanwu et al., 1997).

Furthermore, the interaction of capital and labour within an economy is important in influencing overall output. Finally, technology is regarded as a catalyst that improves labour productivity and magnifies the production potential of labour.

2.2. Empirical Review

Agbarakwe (2019) investigated the relationship between human capital investment and economic growth throughout the period 1980-2018. The Gross Domestic Product (GDP), used as an indication of economic growth, was explained using a set of macroeconomic variables, including Primary School Enrolment (PSE), Public Expenditure on Education (PEE), and Public Expenditure on Health (PEH). The study used multiple regression analysis, specifically the vector error correction model, to estimate the short-term and long-term relationships between the independent factors and the dependent variable. The results showed that the selected macroeconomic variables had a positive but limited effect and contribution to economic growth.

Furthermore, the Granger causality test revealed a unidirectional relationship between primary school enrolment and economic growth in Nigeria. Mongale and Masipa (2019) investigated the relationship between human capital development, regulatory quality, and economic growth in the setting of South Africa. Using the Autoregressive Distributed Lag technique, the study found that total fixed capital creation, total consolidated health expenditure, and regulatory quality all had a positive association with economic growth. In contrast, total consolidated educational expenditure was found to be adversely correlated with economic growth. In a similar line, Okumoko, Omeje, and Udoh (2018) investigated how human capital development affects industrial growth in Nigeria.

The study used time series data from 1976 to 2016 for relevant variables. The investigation included both descriptive and econometric approaches. The Augmented Dickey-Fuller (ADF) test procedures were used to determine the variables' stationarity. The findings revealed that the variables tend to balance out in the long run, as well as that recurring education and health spending had a negative impact on industrial growth. Rangongo and Ngwakwe (2019) investigated the link between human capital investment and economic growth in two Sub-Saharan African countries: Kenya and South Africa. This study used a quantitative approach, collecting secondary data from World Bank economic and education indices from 1987 to 2016 (30 years).

The usage of a cross-sectional panel data framework resulted in a total of 60 observations, on which fixed effect panel regression was performed. The findings revealed a positive relationship between human capital investment and economic growth in both sub-Saharan African countries. Furthermore, the findings highlighted the importance of temporal considerations in empirical analyses of this relationship, implying that investments in education would yield positive economic growth outcomes when timing is properly considered, thus advocating for a prudent approach to human capital investment.

Olure-Bank and Usman (2017) investigated the influence of human capital, as measured by capital expenditures on education and health, on economic growth in Nigeria. In this study, time series data from 1986 to 2016 were included into the Cobb-Douglas production function using econometric approaches, specifically the ordinary least squares (OLS) multiple regression analytical method. The empirical results confirmed that time series characteristics show a strong and positive correlation between health expenditures and economic growth, while a significant but negative relationship was found between education expenditures and economic growth. Oru and

Kalu (2016) evaluated the influence of human capital on Nigeria's economic growth using the neoclassical growth model and time series data spanning the period 1961 to 2010.

The estimated econometric model used Gross Domestic Product (GDP) as the dependent variable, with gross fixed capital creation, labour force participation, and health and education spending serving as independent explanatory factors. The model was estimated using an error-correction method. The findings suggested that gross fixed capital formation has a beneficial impact on economic production. Similarly, the labour force has a positive and statistically significant influence, indicating that the concrete features of human capital development help to drive economic growth. In contrast, the coefficients associated with the non-tangible components of human capital, particularly education and health expenditures, are negative, though the health variable is statistically insignificant.

The outcomes of this study suggest that the characteristics of physical capital are more conducive to supporting economic growth in Nigeria than the non-physical factors represented by education and health. Jaiyeoba (2015) did an empirical research to investigate the association between investments in education and health in Nigeria, using time series data from 1982 to 2011. The study used trend analysis, Johansen cointegration, and the ordinary least squares technique. However, empirical findings revealed a long-term link between government investment on education and health and economic growth.

Health and education expenditures, secondary and tertiary enrolment rates, and gross fixed capital creation all showed the expected positive indicators and were statistically significant, with the exception of government education spending and the primary enrolment rate. These findings have far-reaching consequences for education and health policies, especially given the ongoing discussions in the country. Boachie (2015) explored the growth implications of health in Ghana between 1982 and 2012. The study used life expectancy at birth as a proxy for health status and real per capita GDP as a measure of economic development.

Using the autoregressive distributed lag (ARDL) bounds testing approach for cointegration and controlling for the effects of education, international trade, foreign direct investment, inflation, and physical capital accumulation, the study discovered that health significantly drives economic growth in both the short and long term. However, the short-term positive growth effect of health was found to be lower. These data imply that improvements in the population's health status have a favourable economic impact. Adekunle and Aghedo (2015) focused on assessing the influence of selected human capital development indicators, such as government capital expenditure on education, recurrent government expenditure on education, literacy rates, and school enrolment rates, on Nigerian productivity.

The study used secondary data spanning the years 1980 to 2013. The error correction modeling (ECM) technique was used to examine the link between human capital development and productivity growth during the chosen timeframe using the ordinary least squares (OLS) framework. It was concluded that government recurrent expenditure on education, literacy rates, and school enrolment rates have a positive and statistically significant impact on Nigerian productivity growth. Conversely, government capital expenditure on education has a negative but statistically significant link with productivity growth. The authors proposed that the negative impact of education on growth may be due to widespread corruption in the distribution and utilization of monies earmarked for public projects. Several discoveries in the critically analyzed empirical literature have revealed contradictory results.

A subset of these studies (Rangongo and Ngwakwe (2019); Jaiyeoba (2015)) link governmental education spending to increased economic growth, while other studies (Mongale and Masipa (2019); Adekunle and Aghedo (2015) link governmental education spending to decreased economic growth. It is critical to recognize that the differences in the findings of these research may be due to the many explanatory factors used in different configurations and circumstances.

Notwithstanding this, it was discovered that the bulk of the studies analyzed were either cross-national analysis or single-country investigations distinct from Nigeria, making generalizations potentially misleading. In light of these findings, the purpose of this study is to address the highlighted flaws within the scope of this research endeavor.

3. Methodology

3.1. Model Specification

The study modified Keji's (2021) enhanced Solow human capital growth model to more accurately depict the relationship between human capital development and economic growth in Nigeria. Specifically, the improved Solow human-capital growth model adds human capital into the Solow growth model. Because of this alteration, the model is better adapted and hence easier to adapt to the Nigerian setting. The premise of this strategy is that improving worker quality through education boosts productivity.
The augmented Solow model is therefore specified as:

$$Y_t = AK_t^{\alpha}\left(hL\right)^{\alpha} \quad \text{eq 1}$$

Where:

Y_t is the output (GDP) at time t

A_t represents technological progress

K_t is the stock of physical capital

h is the level of human capital

L_t is the labour force

α and β represent the output elasticities of physical and human capital respectively

To linearize the model;

$$In(Y_t) = In(A_t) + \alpha In(K_t) + \beta In(H_t) + (1-\alpha-\beta)In(L_t) + \varepsilon_t \quad \text{eq2}$$

$In(Y_t)$ is the natural log of economic output

$In(A_t)$ is the natural log of technological progress

$In(K_t)$ is the natural log of physical capital

$In(H_t)$ is the natural log of human capital

$In(L_t)$ is the natural log of the labor force

To achieve a robust result in the context of the Nigerian environment, the augmented Solow human-capital growth model was modified. The modified model is stated in the equation below:

$$GDPG = \beta_0 + \beta_1 IAM_t + \beta_2 IFMR_t + \beta_3 EDUEXP_t + \beta_4 HEXP_t + \beta_5 TEC_t + \ell \qquad \text{eq3}$$

Where:
GDPG = Growth of GDP
IAM=Immunization against measles
IFMR=Infant Mortality Rate
EDUEXP = Government Expenditure on Education
HEXP = Government Expenditure on Health
TEC = Total Energy Consumption.

3.2. Description of Variable and A priori Expectations

Table 1: Data Description

Variables	Description	A priori expectation
GDPG	Growth of GDP	Dependent variable
IAM	Immunization against measles	+
IFMR	Infant Mortality Rate	_
EDUEXP	Government Expenditure on Education	+
HEXP	Government Expenditure on Health	+
TEC	Total energy consumption	+

Source : Authors Compilations, 2024

3.3. Estimation Procedure and Techniques

There were various diagnostic and deterministic evaluations of the entire series. These include the Co-integration ARDL Bounds Test and the Unit Root Test. Following confirmation of co-integration, the study calculated short- and long-term ARDL estimates, as well as additional post-estimation checks.

4. Results and Discussion

4.1. Unit Root Test

The variables were subjected to a unit root test to determine the series' unit root property in terms of integration order. This study used the Augmented Dickey-Fuller (ADF) unit root test, which is displayed in Table 2 below.

Table 2: ADF Unit Root

Variables	ADF TEST	5% Critical value	ADF TEST @	5% Critical value	Decision
	LEVEL (**Constant &Trend)**		1st DIFF. (**Constant &Trend)**		
GDPG	-3.206273	-3.568379	-4.743954	-3.587527	I(1)

EDUEXP	-2.192498	-3.568379	-4.876368	-3.574244	I(1)
HEXP	-2.603914	-3.568379	-7.325608	-3.580623	I(1)
IAM	-3.167896	-3.574244	-4.731399	-3.574244	I(1)
TEC	-2.213175	-3.568379	-5.085624	-3.574244	I(1)
IFMR	-6.612403	-3.574244			I(0)

Source: Compilation from E-view 9, 2024

As shown in Table 2, all of the other variables (GDPG, EDUEXP, HEXP, IAM, and TEC) were integrated into order one, except infant mortality rate (IFMR), which stayed fixed at levels. The ARDL Table Test for cointegration was used during the estimation phase to confirm or deny the presence of a long-term relationship between the variables in the model due to changes in integration order.

4.2. ARDL Bound Test

Thus, to determine the presence of co-integration in the study, the ARDL Bond Test was used. The results of the ARDL bound test are presented in table 3.

Table 3: ARDL Bound Test

Test Statistic	Value	k
F-statistic	6.466784	5
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.26	3.35
5%	2.62	3.79
2.5%	2.96	4.18
1%	3.41	4.68

Source: Researcher's compilation, 2024 from Eviews 9

The F-statistic for the bound test, as given in Table 3 above, is around 6.46, and at the 5% level of significance, the critical values for the upper and lower bounds are 3.79 and 2.62. A careful review of these statistics reveals that the F-statistic value (6.46) is greater than the upper bound (3.79) and lower bound (2.62) critical values. Because the variables in the ARDL model have a long-term relationship, both the short-run and long-run versions must be estimated using these statistics.

4.2. ARDL Long-Run Result

The results of the ARDL long-run study, as shown in Table 4, show that a 1% increase in infant mortality correlates to a 0.91% decrease in GDP growth. The discovery that high newborn mortality rates indicate inadequate health infrastructure reinforces the idea that the inverse association between GDP growth and infant mortality rate is consistent with theoretical predictions. Furthermore, each unit increase in measles immunization is associated with a 0.76 per cent reduction in GDP growth. This finding differs from theoretical expectations, implying that the immunization rate may not have a direct impact on immediate economic growth, possibly due to variables such as a lack of trust in vaccines and the associated healthcare infrastructure costs, which are not accounted for in the model.

Similarly, the analysis indicated that total energy consumption has a negative influence on economic production, with a 1% rise in total energy consumption leading to a 2.24% decline in GDP growth. This inverse relationship may indicate the presence of energy inefficiencies. In contrast, 1% increases in government spending on education and health care lead to 0.23% and 0.05% improvements in GDP growth, respectively. These positive associations highlight the importance of education in the development of human capital, which in turn boosts productivity and contributes to long-term economic growth, much like how greater health produces a more efficient workforce.

Table 4: ARDL Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IAM	-0.756920	0.363151	-2.084312	0.0559
IFMR	-0.907629	0.328994	-2.758800	0.0154
TEC	-2.238185	0.973696	-2.298649	0.0374
EDUEXP	0.234272	0.103044	2.273518	0.0393
HEXP	0.054950	0.080917	0.679085	0.5082
C	3.822986	152.474490	2.507296	0.0251

Source: Researcher's compilation, 2024 from Eviews 9

4.3. ARDL Short-Run Result

The short-run results are shown in Table 5 below. According to these data, a unitary rise in immunisation rates, total energy consumption, and government health expenditures reduce GDP growth by 0.28%, 0.085%, and 0.024%, respectively, throughout the current era. Regarding the negative impact of government health spending on economic growth, the findings suggest that, in the near run, increased health-care allocations may reallocate resources away from other productive sectors of the economy, slowing growth. In contrast, a unitary increase in newborn mortality rate results in a 0.46% increase in GDP growth.

Although this conclusion appears contradictory, it could indicate short-term anomalies or fundamental issues in Nigeria's economy, where reductions in infant mortality do not always coincide with economic progress. In the lagged period, a 1% increase in measles immunisation coverage and total energy consumption over the preceding period resulted in GDP growth of 0.56% and 1.02%, respectively. Simultaneously, a 1% increase in government spending on education over the prior period reduces GDP growth by 0.06%. The observed lagged negative effect suggests that allocating resources immediately to education does not always provide instantaneous economic returns, demanding time to reap long-term benefits.

Table 5: ARDL Short run Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(IAM)	-0.278730	0.113073	-2.465041	0.0272
D (IAM (-1))	0.560763	0.184421	3.040677	0.0088
D(IFMR)	0.460148	0.591258	0.778253	0.4494
D(TEC)	-0.085200	0.193186	-0.441025	0.6659
D(TEC (-1))	1.026211	0.287596	3.568235	0.0031
D(EDUEXP)	0.083366	0.030704	2.715158	0.0168
D(EDUEXP(-1))	-0.069288	0.021178	-3.271723	0.0056
D(HEXP)	-0.023614	0.031248	-0.755700	0.4624
CointEq(-1)	-0.698149	0.220382	-3.167906	0.0068

Source: Researcher's compilation, 2024 from Eviews 9

The error term's coefficient was fractional, negative, and significant. According to the ARDL short-run cointegration findings, the error correction term was -0.698149. This implies that 69% adjustment speed is utilized to correct the long-term equilibrium divergence. The system appears to be approaching equilibrium, as evidenced by the negative coefficient. The analysis shows that elements associated to human capital development, such as health, education, and immunization investment, have varying short-term benefits on Nigeria's economy. The lag effects (particularly for energy consumption and immunization) show that there are long-term benefits, even if the immediate implications are ambiguous. However, the infant mortality rate's short-term positive coefficient may indicate structural challenges in translating human capital gains into economic growth.

4.4. Post Estimation Test

The estimated model was then submitted to several diagnostic and stability checks to avoid false regression analysis while also confirming that the residuals from the fitted model were independent. The study conducted the following tests to ensure robustness:

4.4.1. Hheteroskedasticity Tests

Table 6 below contains the outcome of the Heteroskedasticity Tests conducted in this study:

Table 6: Heteroskedasticity Test

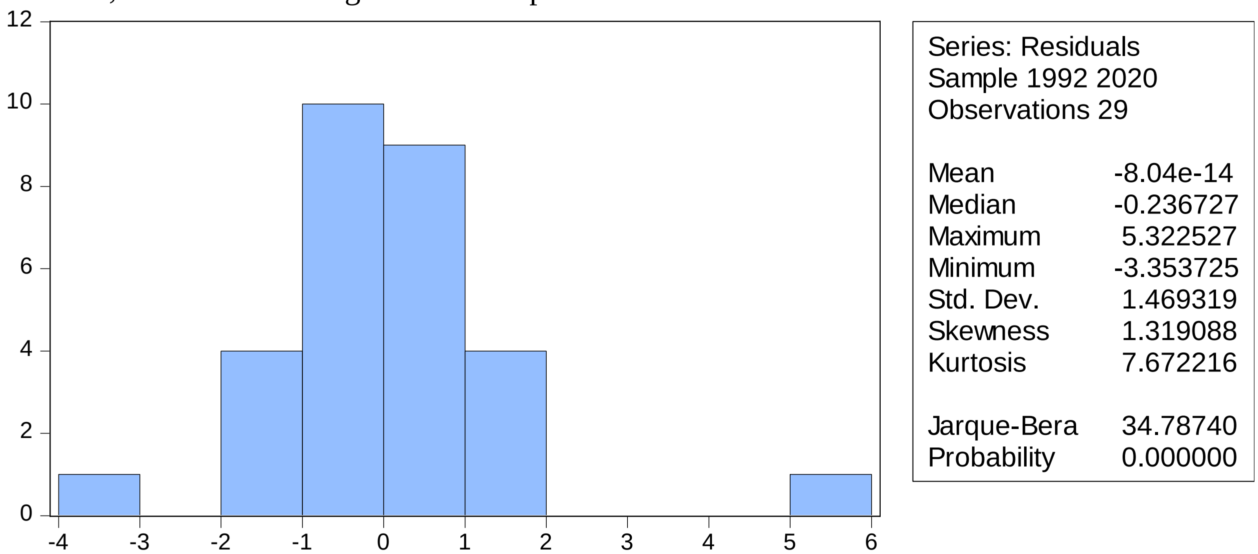
Breusch-Pagan-Godfrey			
F-statistic	0.705079	Prob. F(14,14)	0.7391
Obs*R-squared	11.99199	Prob. Chi-Square(14)	0.6069

Source: Researcher's compilation, 2024 from Eviews 9

According to Heteroskedasticity Test parameter estimates, the observed R-squared has a probability value of 0.6069, which exceeds the 0.05 level of significance. As a result, the study concludes that the computed model has no heteroskedasticity and supports the null hypothesis.

4.4.2. Normality Test

If the probability value is zero, the null hypothesis of a multivariate normal distribution is rejected at the 5% significance level, according to the Normality Test based on the Jarque-Bera Test Statistic, as illustrated in figure 1. It is implied that the residuals do not have a normal distribution.



4.4.3. Serial Correlation Test

Table 7: Serial Correlation Test:

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	2.426059	Prob. F(2,12)	0.1304
Obs*R-squared	8.349777	Prob. Chi-Square(2)	0.1154

Source: Researcher's compilation, 2024 from Eviews 9

The estimated Breusch-Godfrey Serial Correlation LM Test, which correlates to the Obs*R-squared, has a probability value of 0.1, which is above the acceptable level of significance of 0.05, as shown in Table 7 above. It is implied that the model does not have a serial correlation. As a result, the null hypothesis (no serial connection) cannot be rejected.

5. Conclusion and Recommendations

Health and education issues, as instrumental mechanisms for improving human capital development, have consistently taken a central position on succeeding governments' policy agendas. This prioritization stems from the understanding that human capital development is a critical driver of economic transformation and the promotion of sustainable living. This analysis focused on the impact of human capital development on economic growth in Nigeria between 1990 and 2020. Several amazing findings were revealed. The use of Autoregressive Distributed Lag (ARDL) estimation approaches revealed that government expenditures in the sectors of education and health had a positive influence on the economy.

Consistent with theoretical projections, the incidence of infant mortality reduced GDP growth. Conversely, total energy consumption hurt economic growth, which can be linked to inefficiencies in the energy industry. Similarly, the influence of measles immunization on economic growth produced an unexpected outcome, demonstrating an adverse association. This negative connection may indicate that an increase in immunization rates does not directly transfer into quick economic growth, maybe due to the high expenditures involved with healthcare infrastructure. Furthermore, people may avoid immunization due to widespread ideas about the dangers of vaccines. The primary result of this study is that human capital development has a substantial impact on Nigeria's economic growth. As a result, the policy consequence is that to stimulate economic growth, the government should prioritize educational measures that improve skill acquisition and productivity. Furthermore, the study found that health expenditure has a beneficial impact on GDP growth. It is therefore suggested that increases in healthcare funding be complemented by project monitoring and policy review. To ensure that human capital development has a beneficial impact on economic growth, the report recommends that the government prioritize spending in healthcare, particularly efforts to lower newborn mortality rates in Nigeria.

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ARDL Bounds Test
Date: 10/11/24 Time: 16:22
Sample: 1992 2020
Included observations: 29
Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k
F-statistic	6.466784	5

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	2.26	3.35
5%	2.62	3.79
2.5%	2.96	4.18
1%	3.41	4.68

Test Equation:
Dependent Variable: D(GDPG)
Method: Least Squares
Date: 10/11/24 Time: 16:22
Sample: 1992 2020
Included observations: 29

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(IAM)	-0.278730	0.113073	-2.465041	0.0272
D(IAM(-1))	0.560763	0.184421	3.040677	0.0088
D(IFMR)	0.460148	0.591258	0.778253	0.4494
D(TEC)	-0.085200	0.193186	-0.441025	0.6659
D(TEC(-1))	1.026211	0.287596	3.568235	0.0031
D(EDUEXP)	0.083366	0.030704	2.715158	0.0168
D(EDUEXP(-1))	-0.069288	0.021178	-3.271723	0.0056
D(HEXP)	-0.023614	0.031248	-0.755700	0.4624
C	266.9013	71.44454	3.735783	0.0022
IAM(-1)	-0.528443	0.183073	-2.886512	0.0120
IFMR(-1)	-0.633660	0.170144	-3.724248	0.0023
TEC(-1)	-1.562586	0.430819	-3.627013	0.0027
EDUEXP(-1)	0.163557	0.039056	4.187710	0.0009

HEXP(-1)	0.038363	0.053887	0.711920	0.4882
GDPG(-1)	-0.698149	0.220382	-3.167906	0.0068

R-squared	0.824909	Mean dependent var	-0.074228
Adjusted R-squared	0.649818	S.D. dependent var	3.511428
S.E. of regression	2.077930	Akaike info criterion	4.606866
Sum squared resid	60.44912	Schwarz criterion	5.314088
Log likelihood	-51.79956	Hannan-Quinn criter.	4.828359
F-statistic	4.711308	Durbin-Watson stat	2.468918
Prob(F-statistic)	0.003218		

Dependent Variable: GDPG
Method: ARDL
Date: 10/11/24 Time: 16:23
Sample (adjusted): 1992 2020
Included observations: 29 after adjustments
Maximum dependent lags: 2 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (2 lags, automatic): IAM IFMR TEC EDUEXP HEXP

Fixed regressors: C
Number of models evalulated: 486
Selected Model: ARDL(1, 2, 1, 2, 2, 1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
GDPG(-1)	0.301851	0.220382	1.369674	0.1924
IAM	-0.278730	0.113073	-2.465041	0.0272
IAM(-1)	0.311050	0.132861	2.341168	0.0345
IAM(-2)	-0.560763	0.184421	-3.040677	0.0088
IFMR	0.460148	0.591258	0.778253	0.4494
IFMR(-1)	-1.093808	0.696108	-1.571320	0.1384
TEC	-0.085200	0.193186	-0.441025	0.6659
TEC(-1)	-0.451175	0.298606	-1.510937	0.1530
TEC(-2)	-1.026211	0.287596	-3.568235	0.0031
EDUEXP	0.083366	0.030704	2.715158	0.0168
EDUEXP(-1)	0.010903	0.022818	0.477822	0.6402
EDUEXP(-2)	0.069288	0.021178	3.271723	0.0056
HEXP	-0.023614	0.031248	-0.755700	0.4624

HEXP(-1)	0.061977	0.036035	1.719891	0.1075
C	266.9013	71.44454	3.735783	0.0022

R-squared	0.858845	Mean dependent var	4.222801
Adjusted R-squared	0.717691	S.D. dependent var	3.910824
S.E. of regression	2.077930	Akaike info criterion	4.606866
Sum squared resid	60.44912	Schwarz criterion	5.314088
Log likelihood	-51.79956	Hannan-Quinn criter.	4.828359
F-statistic	6.084426	Durbin-Watson stat	2.468918
Prob(F-statistic)	0.000873		

*Note: p-values and any subsequent tests do not account for model selection.

ARDL Cointegrating And Long Run Form
Dependent Variable: GDPG
Selected Model: ARDL(1, 2, 1, 2, 2, 1)
Date: 10/11/24 Time: 16:23
Sample: 1990 2020
Included observations: 29

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(IAM)	-0.278730	0.113073	-2.465041	0.0272
D(IAM(-1))	0.560763	0.184421	3.040677	0.0088
D(IFMR)	0.460148	0.591258	0.778253	0.4494
D(TEC)	-0.085200	0.193186	-0.441025	0.6659
D(TEC(-1))	1.026211	0.287596	3.568235	0.0031
D(EDUEXP)	0.083366	0.030704	2.715158	0.0168
D(EDUEXP(-1))	-0.069288	0.021178	-3.271723	0.0056
D(HEXP)	-0.023614	0.031248	-0.755700	0.4624
CointEq(-1)	-0.698149	0.220382	-3.167906	0.0068

Cointeq = GDPG - (-0.7569*IAM -0.9076*IFMR -2.2382*TEC + 0.2343
*EDUEXP + 0.0549*HEXP + 382.2986)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IAM	-0.756920	0.363151	-2.084312	0.0559
IFMR	-0.907629	0.328994	-2.758800	0.0154
TEC	-2.238185	0.973696	-2.298649	0.0374
EDUEXP	0.234272	0.103044	2.273518	0.0393
HEXP	0.054950	0.080917	0.679085	0.5082
C	382.29864 5	152.474490	2.507296	0.0251

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.705079	Prob. F(14,14)	0.7391
Obs*R-squared	11.99199	Prob. Chi-Square(14)	0.6069
Scaled explained SS	9.323769	Prob. Chi-Square(14)	0.8098

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 10/11/24 Time: 16:24
Sample: 1992 2020
Included observations: 29

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	198.1774	204.0459	0.971240	0.3479
GDPG(-1)	0.531119	0.629411	0.843834	0.4129
IAM	-0.373721	0.322937	-1.157256	0.2665
IAM(-1)	0.251247	0.379452	0.662131	0.5186
IAM(-2)	-0.500322	0.526706	-0.949908	0.3583
IFMR	-0.266355	1.688635	-0.157734	0.8769
IFMR(-1)	-0.081816	1.988087	-0.041153	0.9678
TEC	-0.497990	0.551740	-0.902581	0.3820
TEC(-1)	-0.636605	0.852819	-0.746471	0.4677
TEC(-2)	-0.235321	0.821376	-0.286496	0.7787
EDUEXP	0.135120	0.087690	1.540871	0.1456
EDUEXP(-1)	-0.095344	0.065167	-1.463066	0.1655
EDUEXP(-2)	0.061760	0.060484	1.021100	0.3245
HEXP	0.051738	0.089244	0.579740	0.5713
HEXP(-1)	0.116177	0.102917	1.128836	0.2779

R-squared	0.413517	Mean dependent var	2.084452
Adjusted R-squared	-0.172966	S.D. dependent var	5.479577
S.E. of regression	5.934576	Akaike info criterion	6.705713
Sum squared resid	493.0688	Schwarz criterion	7.412935
Log likelihood	-82.23283	Hannan-Quinn criter.	6.927206
F-statistic	0.705079	Durbin-Watson stat	2.509822
Prob(F-statistic)	0.739108		

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	2.426059	Prob. F(2,12)	0.1304
Obs*R-squared	8.349777	Prob. Chi-Square(2)	0.1154

Test Equation:
Dependent Variable: RESID
Method: ARDL
Date: 10/11/24 Time: 16:26
Sample: 1992 2020
Included observations: 29
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDPG(-1)	0.495609	0.311076	1.593210	0.1371
IAM	0.070405	0.110774	0.635578	0.5370
IAM(-1)	0.141441	0.137071	1.031882	0.3225
IAM(-2)	-0.150609	0.181836	-0.828270	0.4237
IFMR	0.103477	0.541103	0.191233	0.8515
IFMR(-1)	0.037804	0.635108	0.059523	0.9535
TEC	-0.160451	0.191159	-0.839362	0.4177
TEC(-1)	0.093180	0.275792	0.337863	0.7413
TEC(-2)	0.123083	0.268159	0.458994	0.6544
EDUEXP	0.030858	0.031296	0.986013	0.3436
EDUEXP(-1)	-0.020294	0.022842	-0.888466	0.3918
EDUEXP(-2)	-0.004540	0.019544	-0.232301	0.8202
HEXP	-0.000979	0.028485	-0.034358	0.9732
HEXP(-1)	0.011630	0.033311	0.349115	0.7331
C	-34.98481	67.85019	-0.515618	0.6155
RESID(-1)	-0.829732	0.407051	-2.038398	0.0642
RESID(-2)	-0.462332	0.288096	-1.604785	0.1345

R-squared	0.287923	Mean dependent var	-8.04E-14
Adjusted R-squared	-0.661512	S.D. dependent var	1.469319
S.E. of regression	1.893947	Akaike info criterion	4.405227
Sum squared resid	43.04441	Schwarz criterion	5.206746
Log likelihood	-46.87580	Hannan-Quinn criter.	4.656253
F-statistic	0.303257	Durbin-Watson stat	2.340017
Prob(F-statistic)	0.985920		