MACROECONOMIC DETERMINANTS OF HUMAN CAPITAL DEVELOPMENT IN NIGERIA: EVIDENCE FROM AN ARDL BOUNDS-TESTING ANALYSIS, 1995-2025

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Abstract

The study analyzes some selected macroeconomic determinants of Human Capital Development (HCD) in Nigeria over the period 1995-2025 as a result of poor achievement of HCD despite a vast quantity of resource endowments. Time series data were employed based on annual sources: CBN Statistical Bulletin, World Bank Development Indicators, and UNDP Human Development Reports, used to analyze the influence of GEE, GEH, inflation rate, unemployment rate, and economic growth as a dummy to HCD; the ADF test found mixed orders of integration, and none of them was found to be integrated at second differencing. Therefore, the Autoregressive Distributed Lag bounds estimation technique was selected to analyze the cointegration test. The result of the cointegration test (F-statistic =57.06) indicates the existence of a stable long-run relationship. The results also show a correctly signed, statistically significant coefficient (2.69) and an approximate speed of adjustment of 16.3 percent per annum. The estimated long run shows a positive and significant relationship between GEH, unemployment rate, and economic growth and HCD. In terms of the variables, GEH and INF influenced Human Capital development negatively and significantly. The research therefore suggests that macroeconomic stability, an improvement of efficiency (not volume) in public spending on education, efficient budget execution, investment on health, a disciplined fiscal and monetary policy, as well as a strong emphasis on both inclusive growth and active labor market policy, will improve HC in Nigeria.

Keywords: Human capital Development; Macroeconomic Variables; Government Expenditure; Inflation; Unemployment; Economic Growth; ARDL Bounds Testing; Nigeria

1.0 Introduction

The importance of human capital in economic development (HCD) is indispensable: a nation's productivity capability can be defined in terms of the size and quality of human capital within the nation (Awujola, 2014). The concept of human capital development (HCD) - as the process of building up knowledge, skills, abilities, efficiency, competence, know-how and creativity within a nation, with the purpose of making it more dynamic and developing it further- are both a goal and an engine for development. However, human development outcomes in Nigeria are consistently poor, relative to its enormous resources (human and natural), paradoxically motivating this research.

Apart from weaknesses in the education and health sectors as frequently identified in earlier literature, the paper posits that macroeconomic instability (high and volatile inflation; high/increasing unemployment rates; unstable growth rates), adversely affects the country's fiscal capacity and individual households' investment in human capital development.

Most previous empirical research in Nigeria focused either on studying individuals or combinations of pairwise selected macroeconomic variables in determining human capital development while disregarding, in most cases, the mixed nature of I(0) and I(1) properties of individuals' time series; most research stops before the big shocks of the past decade (COVID-19 pandemic, petrol subsidy removal and the unification of exchange rates). COVID-19 disrupted schooling and health services and reduced household incomes, resulting in learning losses, school dropouts, and poorer nutrition, all of which undermine the skills and productivity of a generation. Removal of fuel subsidies and the exchange-rate reforms (devaluation and unification of the naira) have increased the price level, resulting in higher inflation, transport costs and prices of imported inputs such as medicines, textbooks, and equipment, putting pressure on families' ability to pay for education and health. Together, these shocks threaten to increase inequality of access to quality education and health, prolonging the brain drain of teachers and health workers, and reduce human capital in the long run unless they are cushioned by targeted cash transfers, increased and better-directed education and health budgets, and the reinvestment of subsidy savings in social services.

In order to bridge such gaps, this study jointly tests the hypotheses about the impact of five different macroeconomic variables, namely: GEE, GEH, inflation, unemployment, and economic growth on Human capital Development (represented by HDI) in Nigeria using an autoregressive distributed lag (ARDL) bound-testing approach to cointegration (Pesaran, Shin and Smith, 2001) for a sample size between 1995 and 2025. Therefore, the aims and objectives of the paper are to investigate the impact of GEE, GEH, inflation, unemployment, and economic growth on Human capital Development in Nigeria using annual time series data between 1995 and 2025. The ARDL bound test approach has been chosen for estimation, as it can handle a mix of I(0) and I(1) data efficiently in small samples.

2.0 Literature Review

The paper is based on Human Capital Theory (Schultz 1961, Becker 1993), which shows that public investments in education, health, and training increase individual productivity in the same way that fixed capital investments increase firm productivity. Because such human investments are forward-looking and subject to risk, optimal investments will also be affected by macroeconomic factors: the higher risk in the macroeconomic environment will make investments in health and education less attractive. This gives the following clear hypotheses: public education and health expenditures will increase human capital stocks; inflation will decrease them; unemployment will decrease them; growth will increase them. Three complementary views provide weight for these predictions. Endogenous growth theory (Lucas, 1988; Romer, 1990) considers human capital as the explanation of long-run growth, thus, an acceptable goal of public investment. According to the theory, constant investment in education and research leads to constant development in productivity and economic growth. Due to the fact that the theory places importance on knowledge and skills, human capital has a self-reinforcing relationship with growth because increased education contributes to an increase in innovation which in turn leads to increased growth (Romer, 1990). Wagner's Law (Wagner, 1883/1958) assumes an increase in social expenditure with rising national income, thus growth being a function of the level of human capital. The implication of Wagner's Law for the development of human capital is that economic growth ought to be accompanied over time by an increase in public spending on education and health, since with increased income there are increased funds and an increased demand for social services. In the case of an oil-export-dependent country like Nigeria, government revenues depend primarily on the revenues of oil exports instead of per capita income growth, and thus Wagner's Law may be affected by the unpredictability of oil revenues. Keynesian theory (Keynes, 1936) assumes a positive relationship between government expenditure and aggregate economic performance. Modernization theory considers that the transition from traditional society to a modern economy imposes a need for ever better educated, healthier and skilled populations.

The empirical framework of the study extends the established results from existing Nigeria-based empirical literature, both in terms of methodology and topic. While the Nigeria-based literature is informative, our study, however, provides novelties on how this is achieved, as it jointly estimates a five-variable ARDL on a 1995 – 2025 dataset that could not only investigate the long-run linkage among these five variables, but could also assess their short-run and long-run effects. Specifically, unlike Keji (2021), who regresses three variables, and Ndubuisi (2024), who uses only two key macro variables, both of whom investigate issues related to human capital and its determinants, our study uses 5 variables, a more reasonable set considering issues surrounding the specification, development, and policy implications concerning human capital.

Didiugwu Sandra Chinecherem (2024) examined the relationship between human capital development and poverty reduction in Nigeria using Ordinary Least Squares (OLS) with annual data from 1981–2022. Human Development Index (HDI) was used to measure human capital development, while education expenditure, health expenditure, inflation and poverty indicators were included in the model. The findings showed that education and health expenditures significantly improved human capital development, whereas inflation weakened improvements in human welfare. The study recommended sustained public investment in education and healthcare alongside macroeconomic stability.

Some empirical literature reviewed on the link between government spending on education and human capital development in Nigeria has found a positive relationship, this is evidenced in the study of Ogujiuba (2013), in his study of the relationship between government expenditure on education and human capital development in Nigeria; it concluded that a higher government education expenditure enhances human capital development.

In another study, Aigbedion (2021), in his study of econometric modeling of human capital development expenditures in Nigeria from 1990-2018 using the ARDL economic tool, found that government education capital expenditure in Nigeria, government health capital expenditure in Nigeria, government education recurrent expenditure in Nigeria, and government health recurrent expenditure in Nigeria have a positive and significant impact on human capital development in Nigeria. Imide and Dania (2019), as cited in later writers, studied the impact of human capital development on economic growth in Nigeria and were also part of those studies, discussing the inconclusive and insignificant relationship between the two variables.

Mbonigaba and George (2022) examined the combined effect of health expenditure and other macroeconomic determinants on health outcomes such as maternal mortality rate, newborn mortality rate, and child mortality rate using the ARDL approach and sample data from 1995 to 2020. Again, like in your case, the authors begin the analysis from 1995. The results indicated that health indicators had a negative correlation with most of the macroeconomic determinants, namely: household consumption, total health expenditure, and gross fixed capital, while the unemployment rate had a positive correlation with health indicators.

Eniekezimene, Wodu and Anda-Owei (2023) examined the impact of human capital development on economic growth in Nigeria. They used the ARDL approach to conduct the study and used data between 1981 and 2021. The findings of the study indicate that government expenditure on education and health had a long-run positive impact on economic growth, whereas the short-run estimate was found to be insignificant. They found that increased government expenditure on education and health would lead to improvement in human capital development and positively impact economic growth.

The study by Bakare (2018) on inflation, unemployment, and public expenditure effect on human capital did not use a cointegration framework that can distinctly disentangle long-run and short-run relationships; our proposed method, the Autoregressive Distributed Lag, is designed precisely for models with variables of varying degrees of stationarity, and it can simultaneously estimate these two relationships.

3.0 Methodology

The study employs secondary time-series data for 1995-2025 (31 observations). HCD is measured by the Human Development Index (HDI), published in the UNDP Human Development Reports. Government expenditure on education (GEE) and on health (GEH) are sources from the Central Bank of Nigeria Statistical Bulletin, while inflation rate (INF), unemployment rate (UNEMP), and growth rate of GDP (GDP) are from the World Bank World Development Indicators and the Nigerian Bureau of Statistics. The design is ex post facto, in which manipulation of the variables is impossible, and events have been predetermined. The study covers a period of 31 observations (1995–2025), which is adequate for the ARDL estimation procedure.

After the theoretical exposition and the empirical comparison of the hypotheses based on the disaggregated model of human capital development in Nigeria (Aigbedion, 2021), the functional form is: HCD = f(GEE, GEH, INF, UNEMP, GDP) and the econometric form is:

$HCD = \beta_0 + \beta_1 GEE + \beta_2 GEH + \beta_3 INF + \beta_4 UNEMP + \beta_5 GDP + \mu$
where β_0 = constant, β_1–β_5 are coefficients of the independent variables, and μ is the error term
Signs are expected to be positive for GEE, GEH, and GDP and negative for INF and UNEMP following the theory in section 2.0

Table 1:

Measurement of Variables

Variable	Description	Measurement	Sources
HCD	Human Capital Development	Human Development Index (HDI)	UNDP
GEE	Government Expenditure on Education	% of Government Budget or GDP	CBN
GEH	Government Expenditure on Health	% of Government Budget or GDP	CBN
INF	Inflation Rate	Annual Percentage (%)	World Bank
UNEMP	Unemployment Rate	Annual Percentage (%)	World Bank
GDP	Economic Growth	Annual GDP Growth Rate (%)	World Bank

Source: Author Compilation, 2026.

This analysis is carried out in five stages; first, descriptive statistics are used to characterize the distribution of each series. Second, tests for unit roots are obtained to assess the order of integration, which allows the rejection of spurious regression and confirms that no series is I(2) (Dickey, Fuller, 1979). Third, because the series are expected to be a mixture of I(0) and I(1), the ARDL bounds test of Pesaran, Shin and Smith (2001) is used to test for a long-run levels relationship. The computed F-statistic is compared with the lower I(0) and upper I(1) critical bounds: a value above the upper bound indicates cointegration, a value below the lower bound indicates none, and a value between them is inconclusive. Fourth, long-run coefficients and the short-run ECM are estimated; the ECM must have a negative and significant error correction term for a valid adjustment. Fifth, various diagnostic tests (notably, the Durbin-Watson statistic) are applied. The relevant hypotheses are tested at a 5 per cent level of significance.

4.0 Presentation of Results and Discussions

The mean of HCD over the period covered by the sample was 0.494, that is, 49.4%. It also presents low variance and normal behavior, as the Jarque-Bera value is 0.324, much higher than the critical level. GEE and GEH have values of, on average, 0.624 and 3.567, and can both be assumed to behave normally too, as their probability level is very high. Conversely to the other variables, and as expected, the most volatile is inflation which varies around its mean of 15.51% on the interval [5.39%, 72.84%], presenting extremely non-normal, right skewed behavior as Jarque-Bera test is 340.45, associated with p=0.000. The average unemployment rate is 4.04% with slightly non-normal behavior (p=0.02), whereas the average GDP Growth rate is 4.33%. However, the GDP Growth rate presents extreme variations in the interval [-6.37%, 15.33%] during the period.

Unit Root (Stationarity) Test Results

Because OLS-based inference on non-stationary series can produce spurious results, the Augmented Dickey-Fuller (ADF) test was conducted on each series at level and, where necessary, at first difference. The results are summarized in Table 4.2.

Table 2:

Augmented Dickey–Fuller unit root tests

Variable	ADF (Level)	ADF (1st Diff.)	1%, 5% And 10% Critical Value	Order of Integration
HCD	-2.2566	-3.0262	-2.9678	I(1)
GEE	-1.5122	-10.4386	-2.9763	I(1)
GEH	-3.1685	—	-2.9639	I(0)
INF	-8.5893	—	-2.9640	I(0)
UNEMP	-3.0410	—	-2.9678	I(0)
GDP	-3.0850	—	-2.9640	I(0)

Source: Author Compilation, 2026.

The results reveal a mixed order of integration among the variables. Human capital development (HCD) and government expenditure on education (GEE) are non-stationary at level but become stationary after first differencing, i.e., they are integrated of order one, I(1). In contrast, government expenditure on health (GEH), inflation (INF), unemployment (UNEMP) and GDP growth are stationary at level, i.e., integrated of order zero, I(0). Critically, none of the variables is integrated of order two, I(2). This mixed I(0)/I(1)

combination, with no variable of order I(2), satisfies the pre-condition for the application of the ARDL bounds-testing approach to cointegration (Pesaran, Shin & Smith, 2001), which is robust to a mixture of stationary and non-stationary regressors and is therefore the appropriate methodology adopted for this study rather than the conventional Engle-Granger or Johansen approaches, which require all series to be integrated of the same order.

Model selection and bounds test

Using automatic lag selection based on AIC, with a maximum lag order of 2, EViews searched through 486 alternative ARDL specifications and chose ARDL (1,1,0,2,2,2) as the best match for HCD as the dependent variable with GEE, GEH, INF, UNEMP and GDP as regressors (deplags = 2, reglags = 2). The choice had an enormously high fit. R-squared = 0.9994, adjusted R-squared= 0.9988, F-statistic 1639.54 (p 0.000), suggesting that the distributed-lag model of human capital development jointly explains very nearly all the variation observed in the sample period. A very highly significant lagged HCD (-1) of 0.837 (t = 32.39, p 0.000) confirm an enormous degree of path-dependency in human capital development over time.

Table 3:

ARDL bounds test for cointegration

Test Statistic	Value	Significance	I(0) Bound	I(1) Bound
F-statistic	57.0597	10%	2.407	3.517
		5%	2.910	4.193
		1%	4.134	5.761

Source: Author Compilation, 2026.

Table 3 reports the bounds test. The F-statistic of 57.06 exceeds the upper I(1) bound even at the 1 per cent level (5.761). The null hypothesis of no levels relationship is therefore rejected, providing overwhelming evidence of cointegration among HCD, GEE, GEH, INF, UNEMP and GDP.

Long-Run Estimates

Table 4:

Long-run coefficients (dependent variable: HCD)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GEE	-0.1794	0.0158	-11.3922	0.0000
GEH	0.0164	0.0051	3.2166	0.0041
INF	-0.0030	0.0008	-3.5112	0.0021
UNEMP	0.0513	0.0107	4.7986	0.0001
GDP	0.0110	0.0017	6.4186	0.0000
C	0.3630	0.0508	7.1428	0.0000

Source: Author Compilation, 2026.

All five regressors are statistically significant in the long run. Government education expenditures (GEE) have a negative and highly significant coefficient (-0.179; p=0.000), contrary to a priori expectations. The negative sign of GEE could be attributed to inefficiencies in allocations, lags in implementation, and leakages in the education sector, rather than the absence of an actual rate of return to schooling. Government health expenditures (GEH) have a significant positive coefficient (0.016; p=0.004) in line with theory.

Inflation has a negative and significant coefficient (-0.003; p=0.002).

High inflation may be causing depletion of individual real income and limiting investment opportunities in both the education and health sectors. The coefficient on unemployment is significant and positive (0.051; p=0.0001). This may imply that households in Nigeria may respond to high unemployment by increasing investment in schooling, a signaling method, in a state where the education returns might be very low relative to perceived "educated unemployment." GDP (economic growth rate) has a positive and significant coefficient (0.011; p=0.000) which is consistent with the sign predicted by theory.

Short-Run Dynamics and Error Correction

Table 5:

Short-run coefficients and error correction term

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ECT (CointEq(-1))	-0.1627	0.0258	-6.2955	0.0000
D(GEE)	-0.0102	0.0065	-1.5665	0.1412
D(GEH)	0.0027	0.0008	3.2551	0.0062
D(INF)	-0.0002	0.0001	-1.9352	0.0750
D(INF(-1))	0.0002	0.0001	2.9582	0.0111
D(UNEMP)	0.0042	0.0017	2.4485	0.0293
D(UNEMP(-1))	-0.0057	0.0018	-3.1676	0.0074
D(GDP)	0.0009	0.0002	5.4724	0.0001
D(GDP(-1))	-0.0005	0.0001	-3.1077	0.0083

Source: Author Compilation, 2026.

The error correction term signs correctly according to theory and is highly significant (-0.163, p=0.000), thus confirming stable long-run equilibrium and showing that about 16.3% of any deviation is corrected per year-this suggests it takes about six years after a shock for equilibrium to be reached-while government expenditure on education has an insignificant short-run effect (p=0.141). Government expenditure on health has a coefficient of 0.0027 with a p-value of 0.0062, showing that there is a positive, statistically significant relationship between government expenditure on health and human capital development in Nigeria. Inflation has a negative but weakly significant effect in the short run contemporaneously, and a positive effect with a one period lag, showing delayed effects and not consistently sign-alternating in the short run; both unemployment and growth show negative sign-alternating dynamics in the short run.

Diagnostics

The short-run/ECM shows an R-squared of 0.888 (adjusted 0.776) with an F statistic that is jointly significant at F-statistic = 7.94, p =0.0003. With a Durbin-Watson statistic of about 2.10, the residuals appear to be free of first-order serial correlation; also, the cointegrating residuals have an error band that revolves around an even mean without evidence of explosion and which trends around an unchanging mean.

Discussion of Findings

Government expenditure on education: The estimated long-run coefficient is negative and statistically significant, in contradiction of the theoretical expectation; but it should not be interpreted as discouragement of human capital outlays. Given the results, the possible interpretation of this finding is that the volume of spending is not a good indicator of value in terms of what one gets. Systemic issues such as weak budget performance, quality of expenditure, delay in release, corruption, weak procurement, etc., can imply that just more budget does not necessarily translate into more and/or improved schooling; this explanation is in line with already hinted discouraging returns on Nigerian human capital investments (Oluwatobi & Ogunrinola, 2011). It is also possible that the payoffs of education outlays appear with a lag in the HDI beyond the estimation horizon. The short-run estimate, however, did not find any significant result; this can also be interpreted as consistent with both above explanations. It should, however, be noted that this component is just part of the composite HDI; the series for government outlay in education reflects only the variable of interest, not actual output; thus, the above interpretations should be treated as possible explanations rather than untested effects.

Government expenditure on health: Health expenditures are positively and significantly associated with HCD, as expected, as population health is clearly one of the essential precursors of productivity and growth (Bloom & Canning, 2000). Given that life expectancy is one of the indicators of the HDI, this association is also partly mechanical, but the finding supports the case for public spending on health.

Inflation: The large negative long-run impact coefficient is as expected, reflecting the adverse impact of price fluctuations: higher prices lower households' real income, increase the costs of education and health-care, and give incentives for under-investment in them, consistent with the evidence from developed countries on the adverse consequences of high inflation (Bruno & Easterly, 1998). Inflation in 1995 was above 70 per cent, so the estimate is influenced by outliers, but the sign is similar in the long- and short-run results.

Unemployment: The unemployment coefficient is positive and significant in the long run. This sign is somewhat unexpected because unemployment, ceteris paribus, erodes HCD by diminishing the rewards to education, work experience and skills. This result should be interpreted with care, and it may be driven by the specification of HCD, the composition of the sample, fluctuations in labour-market participation, some omitted variable, or some other characteristic of the model that has been estimated It can be argued that this is not to suggest that more unemployed persons bring more ability to develop human capital. The result could

perhaps show a case of educated unemployment in Nigeria, as households continue to send their wards to school to acquire education, more, in a quest to increase their social capital or have an advantage even in an employment-saturated.

Economic growth: Growth is positively and significantly associated with HCD as expected. In addition, a larger economy increases the size of the flow of resources that governments and households have at their disposal for education and health. The short-term pattern of an immediate effect followed by partial reversal the next year implies that growth dividends on human capital are not automatic, but conditional on what happens to them. *Adjustment speed:* Error correction term evidence indicates a cointegrating relationship in the long run, but HCD lagging macro shocks seems slow. This is not surprising given that it is a composite of stocks that are inherently slow-moving (life expectancy, years of schooling).

5.0 Conclusions and Recommendations

This paper examined the macroeconomic determinants of human capital development in Nigeria for 1995–2025 using an ARDL bounds-testing framework. Health expenditure and economic growth are positively related to HCD in the long run, whereas inflation exerts a significant negative effect. Education expenditure is negatively associated with HCD, and unemployment positively so, results that point to inefficiency in how education spending is deployed and to distinctive features of the Nigerian labour market rather than to any weakness in the underlying theory. The significant error correction term confirms a stable equilibrium, but adjustment is slow. Several policy recommendations follow:

1. Improve Efficiency of Education Spending: With a negative long-run education expenditure coefficient and a statistically insignificant short-term education expenditure coefficient, the government must improve the connection between education expenditures and the results. To make sure funds are efficiently used for the purposes of enhancing the quality of teaching and learning environments and outcomes through appropriate monitoring and evaluation.

2. Increase Health Spending: The positive and significant short-run and long-run results for health expenditure support sustained investment in accessible and effective healthcare. Increase the health budget gradually to a minimum of 15% of the budget to invest more in health infrastructure, access to critical medicines and affordable healthcare.

3. Control Inflation: Adopt good fiscal and monetary policies that promote price stability, safeguard buying power, stimulate investment, and enhance the quality of life, since inflation has a negative and statistically significant long-run relationship with HCD

4. Align Education with Labour Market Needs: While the estimated unemployment coefficients are positive in the long run and in the current short run, the negative lagged short-run coefficient and the surprising long-run sign give us some pause. Policymakers should not take from this that unemployment is good. Instead, invest in vocational and technical training, digital skills, and entrepreneurship to decrease unemployment rates and increase productivity of the working-age population.

5. Promote Inclusive Economic Growth: The positive long-run and current short-run GDP coefficients suggest that growth can support human capital development. The government should support small business, agriculture, infrastructure, and jobs to help lift people out of poverty and inequality, and towards better human capital development and national growth.

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