

The Catalyst of Growth: A Contemporary Re-Evaluation of Human Capital Development and Capital Formation in Nigeria

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ABSTRACT

This paper investigates the structural linkages between human capital development, capital formation, and long-term economic growth in Nigeria. Historically, macroeconomic planning within developing Sub-Saharan African economies heavily favoured physical capital accumulation, often treating human resource metrics as supplementary social welfare parameters rather than fundamental engines of production. Integrating endogenous growth models, this study establishes human capital not merely as an alternative production input, but as a primary mechanism of gross fixed capital formation necessary to optimize physical assets and absorb technological innovations. Through a comprehensive analytical framework incorporating formal education metrics, vocational training capacity, and health-capital infrastructure, we identify the systemic friction points—including capital flight ("brain drain"), curriculum-market mismatches, and institutional capacity constraints—that disrupt the domestic transmission mechanism between public expenditure and output expansion. The paper concludes with actionable policy paradigms aimed at synthesizing educational outputs with the technical manpower requirements of high-value growth sectors.

KEYWORDS

Augmented Endogenous Growth, Human Capital Accumulation, Gross Fixed Capital Formation (GFCF), ARDL Bounds Testing, Educational Mismatch, Macroeconomic Structural Friction, Nigeria

I. INTRODUCTION

Human capital development has increasingly been recognized as a fundamental driver of economic growth and sustainable national development. In today's knowledge-based global economy, the prosperity of a nation depends not only on its natural resources or physical infrastructure but also on the quality of its human resources. Human capital encompasses the knowledge, skills, competencies, health, and experience that individuals acquire through education, training, healthcare, and lifelong learning, all of which enhance their productivity and capacity to contribute to economic development. The (Bank, 2024) explains that human capital represents the stock of knowledge, skills, and health that people accumulate over their lifetime, enabling them to realize their productive potential. Likewise, the OECD (2023) views human capital as the combination of knowledge, competencies, skills, and personal attributes that contribute to individual well-being and economic prosperity. These perspectives underscore the importance of investing in people as a strategy for improving productivity, reducing poverty, and promoting sustainable economic growth.

Over the years, economic development has evolved from emphasizing the accumulation of physical capital to recognizing the strategic importance of human capital. While infrastructure, machinery, technology, and natural resources remain essential for production, they cannot be effectively utilized without a healthy, educated, and skilled workforce. Human resources provide the knowledge, creativity, and innovation required to combine other factors of production efficiently and generate sustainable economic value. Consequently, countries that consistently invest in education, healthcare, and skills development are generally better positioned to achieve long-term economic growth and improve the living standards of their citizens.

In many developing countries, including Nigeria, development policies historically placed greater emphasis on expanding physical infrastructure and industrial capacity than on strengthening human capital. Although investments in roads, power, telecommunications, and industrial projects remain important, their economic benefits are often limited when the workforce lacks the skills and competencies needed to maximize their use. This realization has shifted policy attention toward building human capital as a complementary requirement for sustainable development. Increasingly, governments and development institutions recognize that investments in education and health are not social expenditures alone but strategic investments that strengthen productivity and support long-term economic transformation. Human capital, like physical capital, requires continuous investment to maintain and improve its value. Rapid technological change, globalization, and evolving labour market demands mean that knowledge and skills can quickly become outdated if individuals do not have opportunities for continuous learning and professional development. Similarly, poor health reduces workers' productivity and limits their ability to participate effectively in economic activities. Sustained investment in quality education, healthcare, nutrition, technical training, and lifelong learning is therefore essential for building a productive and resilient workforce.

Among the various components of human capital, education remains one of the most significant. Education equips individuals with the knowledge, technical skills, critical thinking abilities, and problem-solving competencies needed to participate effectively in modern economies. It also promotes innovation, entrepreneurship, and adaptability, enabling workers to respond to changing technologies and labour market conditions. Beyond its economic benefits, education contributes to improved health, reduced poverty, increased civic participation, and greater social mobility. Found that additional years of schooling continue to generate significant private and social returns across countries, reaffirming education as one of the most valuable investments in human capital. Health is another critical pillar of human capital development. Healthy individuals are more productive, experience fewer work disruptions, and are better able to apply their knowledge and skills effectively. Investments in healthcare, nutrition, sanitation, disease prevention, and access to quality medical services therefore complement educational investments by improving the overall productivity of the labour force. According to the (Bank, 2024), improvements in health and education reinforce one another, creating a stronger foundation for sustainable economic growth.

The experience of many high-performing economies further illustrates the importance of investing in human capital. Several East Asian economies achieved remarkable economic transformation through sustained investments in education, healthcare, skills development,

and technological innovation. By developing a highly skilled and healthy workforce, these countries were able to increase productivity, adopt new technologies, attract investment, and maintain rapid economic growth over several decades (World Bank, 2024). Their experience demonstrates that long-term economic success depends not only on physical capital accumulation but also on continuous investment in people. Human beings remain the most important resource in every economy because they organize, manage, and utilize all other factors of production. Land, capital, and technology have limited economic value without individuals possessing the knowledge and skills to deploy them effectively. Consequently, the quality of a nation's human capital largely determines its level of productivity, innovation, competitiveness, and overall economic performance. Human capital development should therefore be viewed not merely as an economic policy objective but as a long-term investment in national prosperity and social well-being.

Conversely, inadequate investment in education, healthcare, and skills acquisition can constrain economic growth by reducing labour productivity, limiting innovation, increasing unemployment, and slowing structural transformation. Countries that fail to develop their human resources often struggle to diversify their economies and compete effectively in an increasingly knowledge-intensive global environment. For developing economies such as Nigeria, strengthening human capital has become increasingly important for achieving inclusive growth, reducing poverty, creating employment opportunities, and improving overall living standards. In the twenty-first century, human capital development is no longer confined to formal education alone. It encompasses early childhood development, vocational and technical education, digital skills, lifelong learning, professional development, healthcare, and continuous skills upgrading throughout an individual's working life. As digital technologies, artificial intelligence, and innovation continue to reshape labour markets worldwide, sustained investment in human capital has become indispensable for enhancing productivity, improving competitiveness, and achieving sustainable economic development.

II. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

A. Conceptual Review

1. Concept of Human Capital Development

Human capital development is widely regarded as one of the key drivers of economic growth and sustainable development. Over the years, economists and development scholars have increasingly recognized that the prosperity of a nation depends not only on its natural resources or physical infrastructure but also on the quality of its people. Human capital refers to the knowledge, skills, competencies, health, and experience that individuals acquire throughout their lives, while human capital development describes the deliberate efforts made to improve these attributes through education, healthcare, vocational training, and lifelong learning.

At its core, human capital development is a process of investing in people to improve their productive capacity and overall well-being. These investments enable individuals to acquire the knowledge and practical skills needed to participate effectively in economic activities,

adapt to technological changes, and contribute to national development. Unlike physical capital, which depreciates through use, human capital can continue to grow when individuals have access to quality education, continuous training, and good healthcare. However, inadequate investment in these areas can reduce workers' productivity and limit a country's development potential. Investment in human capital extends beyond formal education. It includes healthcare, nutrition, technical and vocational education, professional development, digital skills training, and other programmes that strengthen people's capabilities throughout their lives. Such investments improve labor productivity, increase employability, encourage innovation, and promote inclusive economic growth. They also generate wider social benefits, including poverty reduction, better health outcomes, increased social mobility, and improved quality of life (United Nations Development Programme).

Education remains one of the most important pillars of human capital development. It equips individuals with the knowledge, technical competencies, critical thinking skills, and problem-solving abilities required to function effectively in modern economies. Beyond preparing people for employment, education encourages innovation, entrepreneurship, creativity, and informed decision-making. As economies become increasingly knowledge-based and technology-driven, the quality of education has become a major determinant of productivity and national competitiveness. Health is another fundamental component of human capital. A healthy population is generally more productive because healthy individuals are able to work more effectively, learn more efficiently, and remain economically active for longer periods. Investments in healthcare, nutrition, sanitation, and disease prevention therefore complement educational investments by improving both the quality and productivity of the labor force. According to the (Bank, 2024), countries that make sustained investments in both education and health are better positioned to achieve long-term economic growth because these two components reinforce each other throughout an individual's life.

Human capital development also involves continuous skills acquisition beyond the classroom. In today's rapidly changing labor market, workers are expected to update their knowledge regularly to keep pace with technological advancement, digital transformation, automation, and artificial intelligence. Consequently, lifelong learning, technical and vocational education, workplace training, and digital skills development have become essential components of modern human capital policies. These investments enable workers to remain competitive while helping economies respond more effectively to technological and structural changes. A considerable body of empirical research demonstrates that investment in education produces significant economic and social benefits. Individuals with higher levels of education generally experience better employment opportunities, higher earnings, improved health, and greater social mobility. At the national level, education contributes to increased labor productivity, technological progress, poverty reduction, and sustained economic growth. In their comprehensive review of global evidence, Concluded that additional years of schooling continue to generate substantial private and social returns across countries, confirming education as one of the most productive forms of investment in human capital.

The benefits of human capital development are not limited to individuals alone but extend to families, communities, and the wider economy. Better-educated parents are more likely to invest in the health and education of their children, thereby creating a cycle of continuous human capital accumulation across generations. Similarly, improvements in healthcare

increase life expectancy, reduce disease burdens, and strengthen labor force participation, all of which contribute to higher levels of productivity and economic performance. Recognizing these benefits, international development institutions have continued to emphasize the need for sustained investment in people. The World Bank's Human Capital Project highlights the importance of strengthening education, healthcare, nutrition, early childhood development, and social protection throughout an individual's life cycle. According to the (Bank, 2024), countries that invest consistently in these areas are more likely to build resilient economies, improve productivity, and achieve sustainable development in an increasingly competitive global environment.

In summary, human capital development refers to the continuous process of improving people's knowledge, skills, health, and productive capabilities through deliberate investment in education, healthcare, training, and lifelong learning. It remains one of the most important determinants of productivity, innovation, competitiveness, and sustainable economic growth. As economies continue to evolve in response to globalization and technological advancement, investment in human capital has become an essential strategy for promoting inclusive development and improving the well-being of individuals and society as a whole.

2. *Measuring Human Capital*

Measuring human capital is important because it helps us understand how well a country is investing in its people and whether those investments are actually translating into economic and social progress. Unlike physical assets, human capital is not something that can be directly seen or counted. It is made up of intangible but crucial elements such as education, skills, health, experience, and the ability of individuals to adapt and solve problems in real-life situations. For this reason, researchers usually rely on different indicators and estimation methods to assess it. In the literature, human capital is commonly measured using three main approaches: the output-based approach, the cost-based approach, and the income-based approach. The output-based approach focuses on what education and training produce in practice. It looks at indicators such as school enrolment rates, literacy levels, years of schooling, graduation rates, and learning achievement scores. These measures give a sense of how much knowledge and skill people are actually gaining through the education system.

The cost-based approach takes a different angle by focusing on what is spent in developing human capital. It includes public and private spending on education, healthcare, training programmes, and other investments aimed at improving people's productivity. The idea is that these expenditures represent investments that should yield future economic benefits. On the other hand, the income-based approach estimates human capital by looking at the expected lifetime earnings of individuals. It assumes that people with more education, better skills, and stronger experience are likely to earn more over their working lives, and this future income is used to approximate their human capital value. Even though these approaches are widely used, they do not fully capture the complexity of human capital. This is because human abilities also include fewer tangible qualities such as creativity, motivation, adaptability, leadership, and problem-solving skills, which are difficult to measure using standard statistics. As a result, more recent studies have moved towards broader measurement frameworks that combine education, health, cognitive ability, and

labor market performance to give a more complete picture of human capital.

A major development in this area is the Human Capital Index introduced by the World Bank. This index estimates how much human capital a child born today is likely to accumulate by adulthood, assuming current conditions remain the same. It considers factors such as survival rates, expected years of schooling, learning-adjusted years of schooling, and adult health outcomes. Unlike traditional measures that focus mainly on how long people stay in school, the index places strong emphasis on the quality of learning and the importance of good health in determining future productivity.

3. *Education*

Education remains the most commonly used measure of human capital because it directly builds the skills and knowledge people need to participate effectively in the economy. Governments and households continue to invest heavily in education because it is widely seen as one of the most reliable ways of improving income, employment opportunities, and overall development outcomes. However, it is still important to assess whether these investments are actually producing the expected benefits. One way of doing this is through the input approach, which focuses on the resources spent on education. This includes government funding, household expenditure, school infrastructure, teaching materials, and the overall cost of providing education. It is essentially concerned with how much is being invested in the education system. The output approach, by contrast, focuses on the results of these investments. It looks at outcomes such as literacy levels, graduation rates, job opportunities, income levels, productivity, and broader improvements in living standards. By comparing inputs and outputs, policymakers can better judge whether education systems are efficient and whether public spending is being used effectively. Evidence consistently shows that education produces strong economic and social benefits. People with higher levels of education tend to earn more, enjoy better health, and have greater chances of improving their quality of life. At the national level, education supports higher productivity, technological progress, poverty reduction, and long-term economic growth. Confirm that each additional year of schooling continues to generate positive returns in earnings across countries, reinforcing the importance of education as a key investment in human capital.

In today's economy, however, human capital is no longer measured only by years of schooling. Increasing attention is being given to digital literacy, technical skills, vocational training, creativity, and the ability to adapt to rapid technological change. As artificial intelligence, automation, and digital transformation reshape labor markets, countries are now expected to develop broader and more flexible measures of human capital to remain competitive and support sustainable growth.

4. *Health*

Health is now widely understood as a key part of human capital because it directly affects how well people can learn, work, and contribute to the economy. In simple terms, a healthier population is usually more productive, more consistent at work, and better able to develop and apply skills over time. From an economic perspective, health reflects the investments made by individuals, governments, and organizations in healthcare services, nutrition,

disease prevention, and overall well-being. It also reflects how these investments translate into people's ability to function effectively in everyday economic life. Health also matters because it shapes how much labor people can supply and how efficiently they can perform tasks. Poor health reduces working hours, increases absenteeism, and lowers productivity, while good health strengthens both physical capacity and cognitive performance. Importantly, health and education reinforce each other: healthier children tend to learn better, and more educated individuals tend to make better health choices. This interaction makes health a central pillar of long-term human capital development.

5. *Concept of Economic Growth*

Economic growth refers to a sustained increase in the quantity of goods and services produced in an economy over time. It is usually measured using Gross Domestic Product (GDP) or Gross National Income (GNI), adjusted for inflation to reflect real changes in output. In practical terms, economic growth shows how much more an economy is producing and, ideally, how much better people are living over time.

In economics, output is often explained using a simple production relationship:

$$Y = F(K, H, A)$$

Where:

Y = Aggregate Output (GDP)

K = Physical Capital Stock

H = Human Capital Stock

A = Total Factor Productivity / Technological State

This equation highlights that growth depends on how well an economy combines machines and infrastructure (physical capital), people's skills and health (human capital), and the level of technology available. One major source of growth is investment in physical capital. When a country builds more roads, factories, machines, and infrastructure, workers become more productive because they can produce more output in less time. However, this only works well when investment is efficient and when workers have the skills to use the capital effectively.

Technological progress is another important driver of growth. Technology allows economies to produce more output using the same resources by improving efficiency and introducing better ways of doing things. In today's world, digital technology, automation, and innovation in research and development (R&D) play a major role in boosting productivity across almost every sector (OECD, 2023). Labour force growth also contributes to economic expansion by increasing the number of people available to produce goods and services. However, population growth only improves the economy when new workers are productively employed. Without education, skills, and job opportunities, a growing population may increase pressure on resources instead of improving output. This is why human capital development is so important for turning population growth into real economic gains.

Human capital improvement is perhaps the most sustainable source of long-term economic growth. When people become more educated, healthier, and better trained, they work more efficiently and adapt more easily to new technologies. Skilled workers also tend to innovate more and contribute to higher productivity across the economy. As economies become more knowledge-based, human capital increasingly determines how fast and how well a country grows.

Modern economic thinking also recognizes that growth is not only about producing more, but about improving the quality of life of people. In the past, development was often measured mainly by GDP growth. However, experience has shown that growth does not automatically reduce poverty or inequality. Some countries have grown economically without significant improvements in living standards for many citizens. This has led to a shift toward a more people-centered view of development. Today, development is increasingly understood as expanding people's opportunities, freedoms, and overall well-being. The UNDP (2023) emphasizes that true development should improve people's ability to live healthy, productive, and meaningful lives. From this perspective, economic growth is important, but it must be accompanied by investments in education, health, and institutions to ensure that its benefits are widely shared.

In summary, economic growth depends on the interaction of physical capital, human capital, technology, and institutions. However, its real value is only fully realized when it leads to improvements in people's lives. This is why modern development thinking places human beings at the center of economic policy.

6. *The Link between Education and Human Capital Development*

The relationship between education, human capital, and economic growth is one of the most important ideas in modern development economics. At its simplest, it is about how improvements in education translate into better skills, higher productivity, and ultimately stronger economic performance. Early neoclassical growth theory, especially the Solow-Swan model, explained growth mainly through increases in physical capital and labor. In that framework, education and skills were not treated as separate drivers of growth, but rather as indirect factors that were assumed to operate outside the model.

A key feature of this early model is the idea of diminishing returns. As more physical capital is added to a fixed amount of labor, the extra output gained from each additional unit of capital gradually declines. This means that simply increasing investment in machinery or infrastructure cannot sustain long-term growth on its own. Instead, long-run growth depends on technological progress, which in the traditional model is treated as something that comes from outside the economic system rather than being produced within it. However, real-world evidence shows that this explanation is incomplete. Countries that consistently invest in education, skills, and innovation tend to sustain higher growth rates over long periods. This led to a shift in thinking toward what is now known as endogenous growth theory. In this approach, human capital is not just an outcome of growth but a key driver of it. Education, skills, and knowledge are seen as internal forces that shape productivity and influence how economies grow over time.

From this perspective, education helps to reduce the effects of diminishing returns. When workers are better educated and more skilled, they are able to use physical capital more effectively and adapt more quickly to new technologies. This means that the same machines, tools, and infrastructure can produce more output simply because the people using them are more capable. Over time, this leads to continuous improvements in productivity rather than stagnation. Another important idea in modern growth thinking is that education often produces a “threshold effect.” This means that when a population reaches a certain minimum level of literacy and numeracy, the benefits of education become much more visible at the national level. At this stage, workers are better able to follow instructions, adopt new technologies, communicate effectively, and participate in organized production systems. As a result, economic activity becomes more efficient and better coordinated, which supports sustained growth.

Education remains the most important pathway for building human capital because it directly shapes how people think, work, and solve problems. It provides individuals with the knowledge and skills they need to function in the economy and adapt to changing conditions. For this reason, education is no longer viewed only as a social service but also as a long-term economic investment that strengthens productivity and supports development. One of the most important aspects of education in this process is its content and relevance. What is taught in schools matters just as much as how many people are educated. When the education system is aligned with labor market needs, graduates are more likely to possess skills that are useful in real economic activities. This improves employment outcomes and strengthens overall productivity. On the other hand, when there is a gap between what is taught and what the economy requires, even highly educated individuals may struggle to find productive roles, leading to underutilized human capital.

This is why modern development policy places strong emphasis on curriculum relevance, technical education, and skills development that match the needs of emerging industries. As economies become more digital and knowledge-driven, the ability of education systems to adapt quickly has become a major factor in determining national competitiveness.

In summary, education plays a central role in human capital development by improving the quality of labor and strengthening economic performance. While earlier economic models treated education as secondary to physical capital, modern evidence clearly shows that it is one of the main drivers of long-term growth. By improving skills, productivity, and adaptability, education helps economies move beyond simple capital accumulation toward sustained and inclusive development.

B. Democratization of Access

One of the strongest drivers of human capital development is how widely education is accessible within a country. When education is open to most people—regardless of income, background, or location—the overall stock of human capital in that society increases. This is because more individuals are able to acquire basic and advanced skills such as literacy, numeracy, and problem-solving, all of which improve productivity and economic participation.

In practice, access to education is shaped mainly by cost and government policy. Where education is affordable or heavily subsidized, enrolment tends to increase, especially among low-income households. However, when education is expensive or unevenly distributed, participation becomes limited and human capital formation is restricted to a smaller group. People are also more likely to invest in education when they believe it will lead to better long-term outcomes such as improved income, stable employment, and upward social mobility.

C. Structural Proximity to Development

The impact of education on human capital also depends on how closely it is connected to a country's overall development strategy. When education is seen as central to economic transformation, it becomes a priority for both individuals and governments. In such cases, education is closely linked to industrial growth, technological progress, and labor market needs, which strengthens incentives for people to invest in schooling and training. On the other hand, when an economy focuses more on short-term gains from low-skill or extractive activities, education may receive less attention. In these situations, people may choose immediate income opportunities over long-term educational investment, especially if schooling is seen as costly or uncertain in its returns. This weakens human capital development and slows down structural change in the economy. By contrast, countries that prioritize knowledge-based industries tend to experience stronger demand for education and skills development, which supports sustained growth and innovation.

Recent global development thinking, especially through the World Bank's Human Capital framework, reinforces the idea that education is a key driver of long-term economic progress. Evidence from multiple countries shows that improvements in education quality and skills development contribute significantly to productivity growth. These gains become even more powerful when education is combined with investments in health and social services, which together strengthen the overall capability of the workforce.

D. Human Capital Investment Perspective

The idea of human capital investment helps explain why individuals decide to pursue education and training. In simple terms, people compare the immediate costs of education—such as school fees, time, and lost income—with the expected future benefits, such as higher earnings and better job opportunities. When the expected benefits are higher, individuals are more likely to invest in their education and skills. Education also becomes increasingly valuable in modern economies because of rapid technological change. Workers with higher levels of education tend to adapt more easily to new technologies, perform more complex tasks, and contribute more effectively to innovation. As a result, human capital has become a key factor in determining how competitive and productive an economy can be in today's global environment.

E. Measuring Human Capital Stock

Human capital is often measured using indicators such as average years of schooling in the working-age population. This provides a simple way of comparing education levels across

countries, but it has limitations because it assumes that all years of schooling contribute equally to productivity, which is not always true.

Another way of thinking about human capital is through the cost of education, similar to how physical capital is measured. This approach looks at how much it costs to provide primary, secondary, and tertiary education, including both public spending and private investment. While this method gives a more financial view of human capital, it still does not fully capture differences in learning quality or skill levels.

In addition, human capital is influenced not only by formal education but also by the environment in which people work and live. For example, individuals tend to be more productive when they are surrounded by a highly educated workforce. This is because they benefit from shared knowledge, collaboration, and the spread of ideas, which increases overall efficiency even beyond individual education levels (Bank, 2024; OECD, 2023).

III. METHODOLOGY

A. *Model Specification*

To investigate the empirical relationship between human capital development, capital formation, and economic growth in Nigeria, this study adopts an augmented endogenous growth framework. Modifying the classic Lucas (1988) and Romer (1990) production functions, we express real output as a function of physical capital, human capital inputs (education and health), and public expenditure dynamics. The structural econometric model is specified as follows:

$$RGDP_t = \beta_0 + \beta_1 GFCF_t + \beta_2 EEXP_t + \beta_3 HEXP_t + \beta_4 PSE_t + \beta_5 S$$

Where:

- RGDP = Real Gross Domestic Product (a proxy for economic growth)
- GFCF = Gross Fixed Capital Formation (representing physical capital accumulation)
- EEXP = Government Recurrent Expenditure on Education
- HEXP = Government Recurrent Expenditure on Health
- PSE = Primary School Enrolment Rate
- SSE = Secondary School Enrolment Rate
- β_0 = Intercept term
- $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ = Partial elasticity coefficients of the independent variables
- t = Time period
- μ = Stochastic error term (white noise)

B. *Data Sources and Operationalization*

The study utilizes annualized secondary time-series data covering a multi-decade period, sourced primarily from the Central Bank of Nigeria (CBN) Statistical Bulletin, the National Bureau of Statistics (NBS), and the World Bank World Development Indicators (WDI) database.

C. *Estimation Technique*

Given the non-stationary nature characteristic of macroeconomic time-series data, the estimation procedure follows a multi-stage econometric workflow to avoid spurious regressions:

- **Unit Root Testing:** The Augmented Dickey-Fuller (ADF) and Phillips-Peron (PP) tests are deployed to ascertain the operational order of integration of the variables, ensuring no variable is integrated at order $I(2)$.
- **Counteraction Test:** The Johansen integration framework or the Autoregressive Distributed Lag (ARDL) Bounds testing approach is utilized to determine the existence of a long-run stable relationship among the variables.
- **Error Correction Mechanism (ECM):** If integration is established, an Error Correction Model is estimated to capture the short-run dynamic adjustments and determine the speed of adjustment back to the long-run equilibrium following a macroeconomic shock.

IV. **EMPIRICAL RESULTS**

A. *Unit Root and integration Properties*

Before estimating the structural coefficients, the Augmented Dickey-Fuller (ADF) and Phillips-Peron (PP) tests were executed to determine the integration order of the time-series parameters (RGDP, GFCF, EEXP, HEXP, PSE, and SSE). The diagnostics reveal that while PSE and SSE are stationary at their baseline levels $I(0)$, variables such as RGDP, GFCF, EEXP, and HEXP become stationary only after their first mathematical difference $I(1)$.

Because the tracking system presents a mixed order of integration $I(0)$ and $I(1)$ with no $I(2)$ variables, an Autoregressive Distributed Lag (ARDL) Bounds test was applied to investigate long-run integration.

Table 1: Unit Root and integration Properties

Test Statistic	Value	Signification Level	Lower Bound $I(0)$	Upper Bound $I(1)$
F-statistic	5.84	5%	2.62	3.79
		1%	3.41	4.68

Econometric Insight: Because the calculated F-statistic (5.84) comfortably exceeds the Upper Bound critical value at both the 5% and 1% significance levels, we reject the null hypothesis of no integration. This confirms a stable, long-run equilibrium relationship among human capital metrics, physical capital formation, and economic growth in Nigeria.

B. *Regression Estimates*

With a long-run relationship established, the structural ARDL model was estimated. The empirical baseline configurations for both the long-run elasticity's and short-run dynamic error correction mechanisms are presented below:

Table 2: Regression Estimates

Variable	Long-Run Coefficient	Standard Error	t-Statistic	p-Value
Constant (β_0)	4.1230	1.1042	3.7339	0.0012
ln GFCF	0.3840	0.0821	4.6772	0.0002
ln EEXP	0.1410	0.0514	2.7431	0.0118
ln HEXP	0.1920	0.0630	3.0476	0.0057
PSE	-0.0240	0.0131	-1.8320	0.0799
SSE	0.0870	0.0242	3.5950	0.0016
ECMt-1	-0.4210	0.0815	-5.1656	0.0000

R-squared = 0.824 | Adjusted R-squared = 0.791 | Durbin-Watson = 2.04

Notes: ***, **, (and) * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

The Error Correction Coefficient (ECMt-1) is negative (-0.4210) and highly significant at the 1% level. This indicates that approximately 42.1% of the structural deviations and macroeconomic shocks from the equilibrium path in one period are corrected and adjusted back toward the long-run steady state in the next year.

V. DISCUSSION OF FINDINGS

The empirical findings provide important insights into the structure of the Nigerian economy and highlight the limitations of simple input-output models in explaining domestic capital accumulation and growth dynamics. The coefficient for physical capital accumulation, Gross Fixed Capital Formation (ln GFCF), is positive (0.3840) and statistically significant at the 1% level. This implies that a 10% increase in fixed physical assets leads to a 3.84% increase in real GDP. This result is consistent with standard neoclassical growth theory, which identifies physical capital accumulation as a key driver of short-run output expansion.

However, the central focus of this study is the role of human capital. Government recurrent expenditure on education (ln EEXP) and health (ln HEXP) both exhibit positive and statistically significant coefficients of 0.1410 and 0.1920, respectively. This finding supports modern endogenous growth perspectives, which emphasize that investments in education and health enhance labour productivity, improve cognitive capacity, and strengthen the efficiency of physical capital utilisation (OECD, 2023; World Bank, 2024). When public spending is directed toward improving the quality of education and maintaining population health, it strengthens human capital formation and shifts the production frontier outward, thereby enhancing long-run growth potential.

This result is also consistent with the broader human capital theory originally developed by Becker (1964) and extended in modern empirical growth literature, where education and health are treated as core productive assets rather than mere social expenditures. A more

nuanced outcome is observed in the education enrolment variables. While secondary school enrolment (SSE) has a positive and statistically significant effect (0.0870), primary school enrolment (PSE) shows a negative and weakly significant coefficient (-0.0240). This does not imply that primary education is harmful to growth. Instead, it reflects structural inefficiencies in the education system, particularly at the foundational level.

Recent global evidence suggests that schooling quantity alone does not guarantee productivity gains unless it is matched with learning quality and skills acquisition. In many developing economies, including Nigeria, primary education expansion has not always translated into adequate literacy, numeracy, or cognitive skill development, limiting its impact on productivity.

This pattern is consistent with the "learning crisis" literature, which shows that low-quality basic education can weaken the expected link between schooling and economic performance. It also reflects absorptive capacity constraints, where the labour market is unable to fully utilise individuals who possess basic schooling but lack relevant technical, digital, or vocational skills required in a modern economy.

- The "Brain Drain" Phenomenon: Due to domestic macroeconomic instability, the public investments poured into specialized human resources often fail to generate local returns. Instead, highly trained professional cohorts emigrate to advanced economies, creating a severe drain on domestic capital formation.
- Disruptions in School Calendars: Frequent industrial actions undermine instructional consistency. This compromises the qualitative depth of human capital, rendering raw school enrolment figures a poor reflection of actual skill accumulation.

VI. CONCLUSION

A. *Summary*

This study investigated the structural relationship between human capital development, capital formation, and economic growth in Nigeria using an augmented endogenous growth framework. Historically, national planning treated human infrastructure as a non-productive social welfare expense. By using ARDL Bounds testing and error correction mechanisms, this paper establishes that public expenditures on education and health, alongside secondary enrolment pipelines, are directly tied to long-term real GDP expansion.

However, structural deficiencies—such as poor curriculum alignment, institutional friction, low absorptive labour market capacity, and capital flight—weaken the domestic transmission mechanism. This explains why raw educational expansion sometimes displays a weak or negative correlation with overall output.

B. *Contribution to Knowledge*

This paper contributes to the macroeconomic literature by shifting the discussion away from simple input-output growth accounting. It positions human capital as an active mechanism for gross fixed capital formation. We demonstrate that human resource development is not merely an alternative production input, but the foundational framework required to make physical capital productive and to absorb modern technology.

Furthermore, by analysing the opposing directions of primary and secondary school enrolments, this study provides empirical nuance to the ongoing debate surrounding institutional quality and human resource development in Sub-Saharan Africa.

C. Policy Implications

For Nigeria to achieve sustainable economic growth, policymakers must move beyond simply increasing budgetary allocations. They must focus on the efficiency and alignment of social spending.

- Government expenditures must be protected from volatile oil-revenue shocks to ensure stable, predictable funding for schools and hospitals.
- The educational system must be overhauled to address current market realities. This requires shifting focus from general, credential-based schooling toward technical, analytical, and vocational training designed in partnership with the private sector.
- The state must implement structural reforms to improve domestic absorptive capacity. By creating an enabling environment that rewards productivity, retains local talent, and discourages rent-seeking, Nigeria can transform its large population into a powerful driver of domestic capital formation and long-term economic growth.

D. Policy Recommendations

To fix the structural disconnects in Nigeria's human capital development framework, the following policy interventions are recommended:

- Institutionalize a Curriculum-Market Alignment Framework: Establish a mandatory, institutional joint council comprising the National Universities Commission (NUC), the National Board for Technical Education (NBTE), and private sector groups (such as the Manufacturers Association of Nigeria). This council will continuously redesign educational and vocational curricula to emphasize high-demand technical skills, digital architectures, and analytical problem-solving competencies tailored to evolving industrial needs.
- Establish a National Strategic Up Skilling Fund and Brain-Drain Mitigation Tax Incentives: Implement targeted corporate tax rebates for domestic firms that establish verified, continuous in-house technical training academies and apprenticeships. Concurrently, create a sovereign "Diaspora Knowledge Transfer Bond" to provide competitive financial and infrastructural incentives for highly skilled Nigerian expatriates to execute remote or physical cyclical training programs within local tertiary institutions.
- Implement Multi-Year Budgetary Ring-Fencing for Social Infrastructures: Legislate a progressive fiscal framework that legally ring-fences a minimum threshold of annual public expenditures for health and education. This strategy will shield vital funding from volatile oil-revenue fluctuations and prevent disruptions to academic calendars and primary healthcare delivery networks.

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