RESOURCE RENT, HUMAN CAPITAL AND HEALTH OUTCOMES IN NIGERIA

Nurudeen Abiodun LAWAL [1]

Gabriel Olusegun ODUYEMI [2]

Adesola Olalere ALABI [3]

&

Tolani Dorcas ADEDIRAN [4]

ABSTRACT

This study investigated the relationship between resource rents, human capital and health outcomes in Nigeria using co-integration, vector error correction modelling (VECM) and Granger Causality test over the period of 1980–2023. This study was premised on human capital theory and co-integration tests confirm the existence of a long run equilibrium relationship between resource rents, human capital and health outcome. The study also found that the effect of resource rent on human capital is negative, but the transmitted effect from human capital to infant mortality rate is found to be positive and significant. The effect of resource rent on gross fixed capital formation is negative and transmitted into a negative effect on life expectancy, but both of them are not significant. This indicates that resource rents were not effectively converted into productive physical capital and better health outcomes (life expectancy). In light of these findings, the study recommended that there should be targeted efforts to reinvest these resource rents into healthcare system. Investing directly in these areas would help mitigate the negative impact and improve long-term human capital development. In addition to this, the government should prioritise diversifying the economy and could reduce over-reliance on resource rents.

Keywords: *Resource Rents; Human Capital; Life Expectancy; Infant Mortality Rate; Health Outcomes.*

JEL Classification: Q33; J24; I15

3. Corresponding Author: Economics Department, College of Social and Management Sciences, Tai Solarin University of Education, Ijagun, Ogun State, Nigeria; Email: Adesolaolalere91@gmail.com
1, 2, 4. Economics Department, College of Social and Management Sciences, Tai Solarin University of Education, Ijagun, Ogun State, Nigeria.
Email: 1. lawalna@tasued.edu.ng 2. oduyemigo@tasued.edu.ng 3. adesolaolalere91@gmail.com

INTRODUCTION

Resource rent is the excess return generated from natural resources beyond the cost of extraction (Auty, 1994), which can significantly influence a nation's economy, especially, a developing nation like Nigeria. It often provides the financial means necessary for investment in human capital, which includes education, skills development, and healthcare. Improved human capital, in turn, correlates with enhanced health outcomes, as a more educated workforce is typically better equipped to make informed health choices and access healthcare services effectively. Auty and Gelb (1986) regarded resource rent as a persistent inclination towards an overextended condition; this phenomenon is identified as a defining trait of resource abundance, particularly among mineral-exporting nations. They delineated three principal pathways of redistribution, specifically prolonged durations of protection for sectors competing with imports; the establishment of employment opportunities via the expansion of the public sector; and excessive public expenditure. They posited that all three mechanisms diminish the advantages associated with a substantial endowment of natural resources. Furthermore, resource rents could be allocated towards initiatives in health and education (Papyrakis, 2017). However, the concept of human capital on resource rent according to Stredwick (2013), simply refers to the fact that human beings invest in themselves, by means of education, training, or other activities, which raises their future income by increasing their level of productivity and overall health outcomes.

Resource rent plays a significant role in human capital development in Nigeria, particularly by providing the financial resources necessary to invest in education and training programmes. With a substantial portion of the country's revenue derived from oil exports, resource rents can be channelled into improving educational infrastructure, increasing access to quality education, and providing skill development opportunities. Proper investment in human capital can foster a more skilled and educated workforce, which is essential for better health outcomes and high level of productivity. Becker (2009), Schultz and Schultz (1982), Ben and Krammer (2016) and Raymond and Ekponaanuadum (2021) among others posited

that the advancement and application of human capital is pivotal to a nation's economic advancement. In any scenario, no nation can achieve sustained economic progress without considerable investment in human capital. It can be contended that a significant portion of planning in Nigeria has predominantly focused on the accumulation of physical capital to facilitate rapid growth and development, while insufficient emphasis has been placed on the critical role that human capital plays in the developmental process (Vinokur, 2020).

In terms of health outcomes, resource rents can be crucial in funding public health programmes, improving healthcare infrastructure, and providing access to essential medical services. The Nigerian government has the potential to use oil revenues to strengthen its healthcare system, reduce maternal and child mortality rates, and tackle infectious diseases that disproportionately affect its population. Countries that have effectively managed resource rents often invest these funds in public health initiatives, leading to improved overall health outcomes (Opeloyeru, Lawal, & Agbatogun, 2021). Unfortunately, Nigeria's health sector remains underfunded, with resource rents often being misallocated and resulting in poor health services and low life expectancy (World Health Organization, 2023). Despite the vast resources available, Nigeria's health sector continues to struggle with resource rents not being effectively directed toward improving public health. The country's healthcare system faces numerous challenges, including a shortage of medical professionals, inadequate health infrastructure, and limited access to essential medicines. This failure to invest resource rents into these critical areas has caused health disparities and resulted in poor health outcomes. For example, Nigeria is one of the countries with highest rates of maternal and child mortality in the world, and life expectancy barely 56 years (World Health Organization, 2023). All these problems are linked to inadequate healthcare funding and the misallocation of funds.

Despite the presence of abundant resources, Nigeria has yet to realise its full developmental potential. Today, many nations and multilateral organisations are prioritising sustainable human capital development and focusing on people-centred

approaches that also improve health outcomes and overall well-being of an individual. The high rate of waste or squander of resource which emanated as a result ofilliteracy and high number of unskilled workers with usage of outmoded capital, equipment and methods of production are major problems in Nigeria (Nikzadian, Agheli, Arani & Sadeghi, 2019). As a consequence, their marginal productivity is markedly diminished, which results in inadequate real income, insufficient savings, limited investment, and ultimately a diminished rate of capital formation. Over time, the ensuing challenges associated with this concept have persisted without resolution: inequitable distribution of skilled labour, misallocation of human capital within Nigeria, and an ineffective reward system that impedes the acquisition and enhancement of human capital. It is on this note this study was carried out using time frame of 1980-2023 which is a period of 43 years. It is thought that this period is sufficient to capture the relationship among resource rent, components of human capital and indicators of health outcomes in Nigeria.

LITERATURE REVIEW

Conceptual Review

Concept of Natural Resources

Natural resources encompass various materials derived from the earth, which are instrumental in sustaining life and fulfilling human requirements. Any naturally occurring substance that is harnessed by humanity qualifies as a natural resource. Examples of such resources include petroleum, coal, natural gas, various metals, stone, and sand (Akpan & Chuku, 2014). Additionally, other natural resources comprise air, sunlight, soil, and water. Furthermore, both fauna and flora constitute natural resources as well. Natural resources serve as essential inputs for the production of sustenance, energy, and raw materials necessary for manufacturing goods. Moreover, natural resources provide the foundational materials utilised in the creation of products that are integral to our daily lives. The term natural resources pertains to the materials and components located within the environment that are exploited by humans for diverse applications. These natural resources can be categorised into renewable resources, exemplified by solar energy and timber, which

possess the capacity for natural replenishment, and non-renewable resources, which include fossil fuels and minerals that are available in limited quantities (Chitadze, 2023).

Concept of Natural Resources Rent

Natural resource rent refers to the economic return derived from the extraction and utilisation of natural resources, which are often considered non-reproducible. This concept is central to resource economics, as it highlights the difference between the income generated from resource extraction and the costs of production. Essentially, natural resource rent can be viewed as the excess profit earned by resource owners due to the scarcity and value of these resources (Beach, 2019). The concept of rent is particularly relevant in discussions about resource management and policy. For instance, governments may impose taxes or royalties on natural resource extraction to capture a portion of this rent for public benefit. This can help address issues of inequality and ensure that the wealth generated from finite resources contributes to broader societal needs (Wilson, 2014).

Concept of Human Capital

The term human capital denotes the economic significance attributed to an individual's experience and competencies. Human capital encompasses various assets such as education, training, cognitive abilities, skill sets, health, and other attributes that employers regard favourably, including loyalty and punctuality (Adamu, 2013). Human capital is regarded as a factor that enhances productivity and, by extension, profitability. The greater the investment a corporation allocates to its workforce, the more pronounced the prospects for increased productivity and overall success. Furthermore, human capital comprises the knowledge, skills, and health that individuals accumulate throughout their lifetimes, thereby facilitating their capacity to fulfil their potential as productive participants within society: The eradication of extreme poverty and the establishment of more inclusive societies can be achieved through the advancement of human capital (Oyinlola *et al*., 2019). This necessitates the allocation of resources towards individuals through nutrition,

healthcare, high-quality education, in-service training, and skills development.

Theoretical Review

Theories of Human Capital

The human capital theory, initially articulated by Adam Smith, posits that every individual possesses a repertoire of competencies and skills that can be augmented through structured training and educational opportunities. However, it is noteworthy that Gary Becker, Theodore Schultz, Schultz/Nelson-Phelps, Bowles-Gintis and Spence have significantly contributed to the refinement and elaboration of this theoretical framework.

(1) The Becker perspective: Human Capital Theory, as articulated by Gary Becker **(**1964), posits that investments in people through education, training, health, and other forms of skill development enhance their productivity and value in the economy. From Becker's (1964) perspective, human capital is considered analogous to physical capital (such as machinery or infrastructure), as it requires investment but yields returns over time. Becker (1964) emphasised that individuals, like firms, make decisions about investing in their own skills, health, and education in order to improve their future earnings and productivity. Becker (1964) argued that the returns on human capital investments are not limited to individuals but extend to society as a whole. A more educated and skilled workforce contributes to higher economic productivity, innovation, and growth. In his framework, the returns on education, for example, are seen as not just an increase in individual income but also as contributing to broader social and economic improvements. Becker (1964) also highlighted the role of family in human capital development, suggesting that parental investment in children's education and well-being is crucial for long-term human capital accumulation and economic progress. Becker (1964) viewed human capital as encompassing not just education and skills, but also the physical and mental well-being that enables individuals to be productive over their lifetime. This comprehensive view has informed policies around human capital development, influencing both educational reforms and healthcare investments aimed at enhancing overall societal welfare.

(2) The Schultz's perspective: In contrast to the more individualistic approach of Gary Becker, Schultz's (1961) view emphasised the broader social and economic benefits of human capital. Schultz (1961) saw human capital as a collective resource that can contribute to national prosperity. He argued that human capital investments are not just beneficial for individual earnings but also have significant external benefits for society, such as reducing poverty and improving living standards. Schultz (1961) highlighted that nations should prioritise human capital development by investing in education, vocational training, and healthcare to foster more productive, healthier, and wealthier populations. According to Schultz (1961), these investments would ultimately lead to more robust economic growth, particularly in developing countries where human capital was often underdeveloped. Schultz (1961) also emphasised the connection between health and human capital. He proposed that better health improves the effectiveness of education and labour, making individuals more productive. By improving nutrition, access to medical care, and health infrastructure, societies could ensure that people are not only better educated but also able to participate more fully in economic activities. Thus, Schultz (1961) integrated health outcomes into the broader human capital framework, arguing that the state of a nation's health plays a crucial role in determining the potential productivity of its workforce. His work laid the foundation for understanding how health, along with education and training, contributes to economic development and human capital formation.

(3) The Schultz/Nelson-Phelps perspective: Human capital is primarily conceptualised as the ability to adapt effectively. Within this framework, human capital is particularly advantageous in navigating "disequilibrium" scenarios or, more broadly, in contexts characterised by environmental dynamism, necessitating that workers develop adaptive responses. They argued that a country's ability to adopt and integrate new technologies is closely tied to the education and skills of its workforce. According to their theory, human capital specifically the skills and knowledge necessary to absorb and apply new technologies, plays a key role in driving long-term economic growth. In their view, the rate at which a nation can

innovate and improve productivity depends on the human capital available to utilise these innovations. Moreover, they suggested that countries with higher levels of human capital are more adaptable to changes in technology and more capable of sustaining high growth rates. This insight emphasises the dynamic relationship between human capital and technological change, positioning human capital as not only a driver of productivity but also a crucial factor in technological advancement.

(4) The Bowles-Gintis perspective: Bowles and Gintis (1975) take on a critical dimension, focusing on the interplay between education, social structure, and economic outcomes, with an emphasis on how human capital is shaped by broader socio-economic forces. They argued that education, rather than being a purely meritocratic process that enhances individual skills and abilities, often functions as a mechanism for reproducing class structures and reinforcing economic inequalities. According to Bowles and Gintis (1975), the skills acquired through education are often tailored to the needs of the capitalist labour market, where the focus is on teaching individuals to accept their roles within a hierarchical system rather than fostering critical thinking or creativity.

The term "human capital" is interpreted as the capacity to function within organisational structures, adhere to directives, and, in essence, acclimatise to the realities of a hierarchical and capitalist society. From this standpoint, the principal function of educational institutions is to impart the "appropriate" ideology and mindset towards societal engagement.

(5) The Spence perspective: Michael Spence's perspective, particularly his work on signalling theory, offers an interesting extension of the traditional views on human capital. Observable indicators of human capital are perceived more as signals of inherent ability rather than as attributes that possess independent utility within the production process. Spence's signalling theory (1973) posits that individuals use education as a signal to employers about their underlying abilities, traits, or potential productivity. In other words, education and other credentials serve not just to enhance one's skills (as traditional human capital theory suggests) but also to indicate a person's ability to succeed in the labour market. According to Spence,

employers often cannot directly observe an individual's productivity, so they rely on signals, such as degrees or certifications, to infer an individual's capabilities. Therefore, the value of education in the labour market is not purely about what one learns but also about what the signal of educational attainment communicates to employers about a person's general ability, work ethic, or other desirable traits (Spence, 1973). This perspective introduces the idea that the return on education may be more about its role in signalling competence and less about the direct enhancement of human capital.

This theory relates to this study as it provides insight into how investments in human capital whether through education, health, or skills development can be influenced by resource rents, particularly in resource-rich countries like Nigeria, and how these investments impact both economic outcomes and health indicators. Health outcomes are a critical aspect of human capital. According to Schultz and Becker, health is directly linked to human capital because healthier individuals are more productive, take fewer sick days, and live longer, thus contributing to sustained and increased level of production (Schultz, 1961). Resource rents can play a crucial role in improving health outcomes by providing funds for healthcare infrastructure, medical services, and nutrition programmes, which are key to developing a productive workforce.

Health Belief Model (HBM)

The Health Belief Model (HBM) was developed by Irwin M. Rosenstock in the 1950s. The Model suggests that individuals are more likely to engage in health-promoting behaviours if they believe they are susceptible to a health issue, perceive the condition as serious, believe that taking a specific action would reduce their risk, and perceive few barriers to taking that action (Kulvisaechana, 2016). The HBM posits that individual health behaviours are primarily influenced by the following key components:

Perceived Susceptibility: The greater the perceived susceptibility, the more likely an individual is to engage in health-promoting behaviours.

Perceived Severity: This component addresses an individual's beliefs about the seriousness of a health issue and its potential consequences.

Perceived Benefits: This aspect reflects an individual's belief in the effectiveness of taking a specific action to reduce the risk of a health problem or to improve health status.

In resource-rich countries like Nigeria, which derive substantial income from natural resources such as oil, resource rents offer the potential to invest in public health infrastructure, education, and healthcare services. However, to effectively use these resources to improve health outcomes, it is crucial to consider how the population perceives health risks and benefits. According to the Health Belief Model, individuals are more likely to engage in health-promoting behaviours if they believe they are susceptible to a health threat (perceived susceptibility), view the consequences of the threat as severe (perceived severity), and perceive the health action to have benefits that outweigh the barriers (perceived benefits and barriers). When resource rents are used to improve public health programmes and if these programmes are effectively communicated and tailored to address the health beliefs of the population, individuals are more likely to take preventive health actions such as participating in vaccination campaigns, health screenings, or adopting healthier lifestyles.

Empirical Review

Alemu (2025) employed descriptive statistical methodologies, Feasible Generalised Least Squares (FGLS), and the system Generalised Method of Moments (GMM) panel data analysis to investigate the influences exerted by natural resource rents, institutional quality, and foreign direct investment (FDI) on the advancement of human capital, specifically in the context of Sub-Saharan African nations. The research disclosed that across the region, from 2010 to 2022, the mean growth rates of natural resource rents as a percentage of GDP, FDI, and human capital were recorded at 10%, 4.5%, and 1.8%, respectively. Since the year 2010, there has been a notable deficiency in institutional quality within the region, as evidenced by institutional quality scores ranging from 0 to -2.5. The empirical findings

substantiated that human capital is adversely influenced by proxies of institutional quality (including control of corruption, protection of economic and social rights, adherence to the rule of law, and regulatory quality), along with foreign direct investment and natural resource rents.

Conversely, it is positively influenced by certain proxies of institutional quality (namely government effectiveness and political stability) as well as the historical levels of education and returns on education. The conclusions drawn indicate that natural resource rents and inadequate institutional quality have contributed to a decline in years of schooling, while robust institutional quality fosters the development of human capital. The study advocated for the expansion of foreign direct investment that prioritises highly skilled labour to enhance educational outcomes in the region; it further recommended that natural resource rents be allocated towards educational investments rather than additional investments in the mining sector, which contributes to increased school dropout rates; and emphasised the importance of establishing strong institutions for effective governance, capable of equipping students to sustainably navigate future challenges.

Amoaning, Obeng and Cantah (2024) utilised the system Generalised Method of Moments (GMM) econometric technique on a panel comprising 32 Sub-Saharan African nations during the timeframe spanning from 2004 to 2019. The research aimed to scrutinise the ramifications of natural resource rents on human welfare through the intermediary of human capital, ultimately identifying the essential minimum human capital threshold necessary to alleviate the resource curse prevalent in Sub-Saharan Africa. The study uncovered several significant findings: Firstly, evidence confirming the existence of a resource curse was established, indicating that benefits derived from natural resources hinder human advancement within the region. Moreover, it was determined that investing in the development of human capital not only plays a critical role in addressing deprivation but also serves to mitigate the adverse effects arising from the connections between natural resources and well-being, potentially transforming the curse into a blessing. Thirdly, it was observed that achieving a higher human capital score and a tertiary school

enrolment rate exceeding 2.4 units and 23.21%, respectively, may serve to avert the prosperity curse. Additionally, for a natural resource to alleviate poverty rates, the human capital score and tertiary school enrolment rate must surpass the thresholds of 2.34 points and 19.55%, respectively. Lastly, the engagement in international trade and the presence of democratic governance were identified as factors that contribute synergistically to human prosperity.

Yang, Qi, Yu and Lyu (2024) employed fixed-effect regression utilising the Drisc/Krayy standard error framework, thereby elucidating the complex interconnections that contribute to societal well-being through an analysis of the dynamics surrounding natural resource utilisation, human capital enhancement, and foreign direct investment in the framework of OECD member nations. The results indicate that effective resource management, investment in human capital, and equitable growth facilitated by foreign direct investment significantly bolster well-being, thereby contesting existing notions pertaining to the resource curse. This study concludes that natural resources exert a considerable and favourable impact on individual well-being, implying that such resources serve as a significant advantage for society. Furthermore, the research underscores the importance of sustainable environmental practices, enhanced institutional quality, and equitable economic development as fundamental to fostering overall advancement. In addition to offering essential scientific insights, this investigation provides actionable policy recommendations for governments aspiring to elevate the quality of life for their constituents. Policymakers may adeptly navigate the complexities inherent in resource-abundant economies while prioritising the welfare of their citizenry by adopting prudent resource management strategies, investing in human capital development, and promoting inclusive growth.

Nchofoung, Achuo and Asongu (2021) utilised Tobit regression to investigate the relationship between resource rents and inclusive human development in developing nations. The findings reveal that natural resource rents exert a positive direct

influence on inclusive human development in these countries, with this relationship exhibiting variation according to regional classifications, income strata, levels of development, and export structures. Analysing the transmission mechanisms, the introduction of governance and environmental quality as interactive variables demonstrates that the governance channel produces a robust negative synergy effect within the developing country sample, while yielding positive synergy effects specifically for Africa and low-income nations. When the interactive variable of CO2 emissions is examined for Africa, a negative net effect of natural resource rents on inclusive human development is discerned, persisting until a policy threshold of 25.4412 for CO2 emissions, at which point the adverse effect is mitigated. For Asia and Latin America and the Caribbean, a positive net effect is identified, extending up to CO2 emission thresholds of 29.038 and 3.6752 respectively, beyond which the positive effect is nullified. Moreover, high-income and upper-middle-income countries demonstrate a negative net effect of resource rents on inclusive human development when modulated by CO2 emissions, with respective positive CO2 emission thresholds of 37.9365 and 23.6257.

Nikzadian *et al.* (2019) undertook a study examining the implications of resource rent, human capital, and governmental efficacy on health expenditure within the context of the Organization of the Petroleum Exporting Countries (OPEC). The research applied the Panel Fully Modified Ordinary Least Squares (Panel-FMOLS) methodology. The results indicate that resource rent, the human development index, and governmental efficacy directly influence governmental health expenditure, provided that interactions among the explanatory variables are not considered. In contrast, the signs and magnitudes of the coefficients exhibit variability when

interaction terms are integrated into the regression models. Oil rents significantly impact the healthcare sector within the OPEC framework.

Raheem, Isah, and Adedeji (2018) employed panel regression models to investigate the interrelations between inclusive growth, human capital advancement, and natural resource rents within the context of Sub-Saharan Africa (SSA). The outcomes demonstrated that both forms of governmental expenditure are statistically significant in clarifying the patterns of growth observed in SSA. However, the augmentation of health-related expenditures derived from natural resource allocations appears to possess a more profound impact on the promotion of an inclusive growth trajectory. Moreover, the results obtained from the simulation analysis suggest that an increment in governmental expenditures directed towards health could potentially enhance GDP per capita growth by more than 3.1%.

METHODOLOGY

This research adopted an ex-post-facto research design. The ex-post-facto research design facilitates the investigation of the influence of one variable on another; and this study also utilised secondary data acquired from various editions of the Statistical Bulletin and Annual Reports released by the Central Bank of Nigeria (CBN) spanning the years 1980 to 2023.

Model Specification

The models for this work were structured in a way to empirically show resources rent, human capital and health outcome in Nigeria. Some of the variables used are Resources Rent (RR), Human Capital (HC), Gross Fixed Capital Formation (GFCF) Infant Mortality Rate (IMR), Life Expectancy (LE).The model for this study is stated below;

$IMR = f(RRt\text{-}n + HC)$---------- (1)

$LE = f(HCt\text{-}n, + GFCF)$ ----------(2)

Equations (1) and (2) can be transformed into a log-linear form as:

$L_nIMR_t = b_o + b_1RR_t + b_2HC_t + U_t$ ----------(3)

$L_nLE_t = b_o + b_1HC_t + b_3GFCF_t + U_t$----------(4)

The bounds procedure according to Tang (2013) is based on ARDL model for test of cointegration relationship. Following this lead, the two models as analysed by this research is re-specified as:

$$DL_nIMR_t = b_o + \Sigma b_1 DL_nLE_{t-1} + \Sigma b_2 DL_nHC_{t-1} + \Sigma b_3 DL_nGFCF_{t-1} + b_4 DL_nRR_{t-1} + U_t \text{-------} (5)$$

$$DL_nLE_t = b_o + \Sigma b_1 DL_nGFCF_{t-1} + \Sigma b_2 DL_nRR_{t-1} + + b_3 DL_nIMR_{t-1} + b_4 DL_nRR_{t-1} + U_t \text{----------} (6)$$

Where D is the first difference series (i.e. $L_nX_t - L_nX_{t-1}$)

Where U_t is an error term which represents other factors that affect the model but were not captured and L_n is natural logarithm. Resources Rent (RR), Human Capital (HC), Gross Fixed Capital Formation (GFCF), Infant Mortality Rate (IMR), Life Expectancy (LE) where IMR and LE were used as a proxy for health outcomes.

RESULTS AND DISCUSSIONS

Preliminary Analysis

Table 1. Unit toot test results

	ADF	PP	ADF	PP
	Level		First Difference	
L(IMR)	- 0.621	- 0.645	ΔL(IMR) - 6.765 *	- 6.109 *
L(RR)	- 0.463	- 0.585	ΔL(RR) - 6.875 *	- 6.094 *
L(HC)	- 2.494	- 2.476	ΔL(HC) - 7.981 *	- 6.760 *
L(LE)	1.312	0.612	ΔL(LE) - 7.651 *	- 14.098 *
L(GFCF)	- 1.407	- 1.550	ΔL(GFCF) - 4.522 *	- 4.085 *

*** Indicates significance at 1% level, i.e., rejection of the hypothesis of no co-integration.**

As articulated by Granger (1986) and Engle and Granger (1987), if the individual series are stationary following differencing yet a linear combination of their levels exhibits stationarity, then the series are classified as co-integrated. Co-integration signifies the existence of a long-term equilibrium relationship among the variables, which can be empirically tested through the application of multivariate vector error correction (VEC) techniques as proposed by Johansen (1988) and Johansen and Juselius (1990). This methodology is employed under the assumptions of constant only, as well as constant and trend within the time series, utilising both trace statistics and maximum eigenvalue to ascertain co-integration.

Table 2. Co-integration test results

	Intercept			Intercept and Trend		
H0	Eigen Value	Trace Statistic	Max-Eigen Statistic	Eigen Value	Trace Statistic	Max-Eigen Statistic
r = 0	0.744	226.663 *	58.573 *	0.899	288.297 *	98.529 *
r ≤1	0.711	168.090 *	53.412 *	0.713	189.768 *	53.649 *
r ≤2	0.562	114.678 *	35.470	0.591	136.119 *	38.430
r ≤3	0.503	79.207 *	30.038	0.504	97.689 *	30.120
r ≤4	0.435	49.169 *	24.526	0.435	67.569 *	24.526
r ≤5	0.275	24.643	13.817	0.401	43.043 *	22.023

Note: * denotes rejection of the null hypothesis at the 0.05 level.

A long run equilibrium relationship between resource rents, human capital and health outcome in Nigeria is established. The results of the co-integration test you provided are based on two models: one with an intercept only and one with both an intercept and a trend. The test uses both the Trace Statistic and the Max-Eigen Statistic to test for the number of co-integrating relationships (denoted by r). **r = 0**: Both the Trace Statistic (226.663) and Max-Eigen Statistic (58.573) are significant at the 5% level (indicated by *), meaning the null hypothesis of no co-integrating relationships is rejected. So, there is evidence of at least 1 co-integrating relationship.

r ≤1: The Trace Statistic (168.090) and Max-Eigen Statistic (53.412) are significant, so we reject the null hypothesis of one or fewer co-integrating relationships.

Evidence suggests there are 2 co-integrating relationships. **r ≤2**: The Trace Statistic (114.678) is significant, but the Max-Eigen Statistic (35.470) is not. This suggests that there is evidence of at least 3 co-integrating relationships, but no strong evidence for a 4th one. **r ≤3**: Both statistics are significant, suggesting the presence of 4 co-integrating relationships. **r ≤4**: Both statistics are significant, indicating 5 co-integrating relationships. **r ≤5**: The Trace Statistic (24.643) is not significant, so we fail to reject the null hypothesis of 5 or fewer co-integrating relationships. Thus, evidence suggests there are exactly 5 co-integrating relationships.

Table 3.VAR lag order selection criteria

Lag	LL	LR	FPE	AIC	SC	HQ
0	- 378.620	NA	0.009	17.982	18.310	18.103
1	- 97.867	443.981	3.92×10^{-7}*	7.901	10.850*	8.988 *
2	- 27.967	84.531*	4.08×10^{-7}	7.626	13.197	9.681
3	38.105	55.316	9.74×10^{-7}	7.530 *	15.722	10.551

Indicates lag order selected by the criterion; LR: sequential modified LR test statistic (each test at 5% level); FPE: Final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion; HQ: Hannan-Quinn information criterion.

Log-Likelihood (LL) = -378.620: The model fit is not very good. FPE is large at 0.009, suggesting poor predictive performance. AIC (17.982), SC (18.310), HQ (18.103): These values are higher than at other lags, suggesting this is not an optimal lag choice. Lag 1: Log-Likelihood (LL) = -97.867: Much better than Lag 0, indicating an improved model fit. LR = 443.981: This is significantly larger than for Lag 0, indicating a strong improvement in model fit. FPE (3.92×10^{-7}): This is extremely low, suggesting a good predictive performance. AIC (7.901), SC (10.850), HQ (8.988): These values are much lower compared to Lag 0, suggesting Lag 1 is a much better fit for the data.

Lag 2: Log-Likelihood (LL) = -27.967: The log-likelihood improves further, indicating even better model fit. LR = 84.531: A strong likelihood ratio, suggesting that the model has improved with the addition of the second lag. FPE (4.08×10^{-7}): Still a low FPE, suggesting good predictive ability. AIC (7.626), SC (13.197), HQ (9.681): AIC is lower than Lag 1, suggesting this might be an even better fit.

However, SC and HQ values are higher, indicating that Lag 2 introduces complexity that might not be justified by the improvement in fit.

Lag 3: Log-Likelihood (LL) = 38.105: This is the highest LL value among all the lags, indicating the best model fit in terms of likelihood. LR = 55.316: Still significant but less so than for Lag 1. FPE (9.74×10^{-7}): Slightly higher than Lag 1 and Lag 2, suggesting the model might not be improving much in terms of prediction. AIC (7.530), SC (15.722), HQ (10.551): AIC is the lowest, suggesting it might be the best choice in terms of fit versus complexity. However, SC and HQ are higher, indicating potential overfitting with the additional lag.

Table 4.Summary results of the VECM

VECMShortRunDynamics				VECMLongRunEquilibrium		
Variable	**Coefficientβ**	**TStat.**	**Prob.**	**Variable**	**Coefficientα**	**TStat.**
ECT$_{t-1}$	- 0.58	- 3.761	0.000 ***	C	29.90	
dL(RR)$_{t-1}$	0.07	2.435	0.016 **	L(RR)$_{t-1}$	0.22	1.617
dL(RR)$_{t-2}$	0.08	2.360	0.019 **	L(RR)$_{t-1}$	- 1.09	- 2.176*
dL(HC)$_{t-1}$	0.12	2.149	0.033 **	L(HC)$_{t-1}$	- 8.75	- 2.615**
dL(HC)$_{t-2}$	0.12	1.700	0.091 *	L(HC)$_{t-1}$	- 0.36	- 8.071***
dL(IMR)$_{t-1}$	- 0.04	- 0.454	0.650	L(IMR)$_{t-1}$	- 0.00	- 0.246
dL(IMR)$_{t-2}$	- 0.07	- 0.753	0.452	L(IMR)$_{t-1}$	- 7.02	- 2.315**
dL(GFCF)$_{t-1}$	- 0.51	- 1.113	0.267	L(GFCF)$_{t-1}$	- 0.36	- 6.096***
dL(GFCF)$_{t-2}$	0.41	1.801	0.097 *	L(GFCF)$_{t-1}$	- 2.09	- 2.698**
dL(LE)$_{t-1}$	- 0.12	- 0.651	0.870	L(LE)$_{t-1}$	- 0.30	- 3.021***
$dL(LE)t-1$	- 0.52	- 0.102	0.726	L(LE)t- 1	- 0.82	- 1.092***
			VECM imposes 7 units, none is out the unit root circle			

***,** and* indicate significance at 1%, 5% and 10% level respectively.

The negative coefficient indicates a significant long-run adjustment process. This means that, if the system is out of equilibrium, 58% of the disequilibrium from the previous period is corrected in the current period. The high significance (p-value < 0.01) suggests a strong and reliable adjustment back to equilibrium. The positive coefficients suggest that past values of RR (lagged) have a positive influence on the current change in the system. Since both are significant at the 5% level, they show that past changes in RR positively affect the current values of the dependent variable.

Past values of HC also have a positive effect on the dependent variable. The first lag is significant at the 5% level, while the second lag is marginally significant (p-value close to 0.10). This represents the constant term in the long-run equilibrium equation, which suggests a baseline level of the dependent variable when all the other variables are at equilibrium.

Table 5. Direct and indirect effects of RR on health outcome

Causality	*B*	Signif.	Causality	*B*	Signif.	Remark
RR→HC	- 0.08	(- 0.829)	HC→IMR	0.12	(2.149) *	Negative from RR to HC but Positive from HC to IMR
RR→GFCF	- 0.06	(- 0.491)	LE→RR	- 0.07	GFCF (- 0.454)	Negative from RR to and Negative from LE to RR
LE→GFCF	- 0.01	(- 0.795)	HC→LE	- 0.51	GFCF(- 1.113)	Negative from LE to Negative from HC to LE

Note: RC indicates existence of resource curse;**and* indicate significance at 1% and 5% respectively.

As in Table 5, the effect of resource rent on human capital is found to be negative, but the transmitted effect from human capital to infant mortality rate is found to be positive and significant. The effect of resource rent on gross fixed capital formation is negative and transmitted into a negative effect on life expectancy, but both of them are not significant. This indicates that resource rents were not effectively converted into productive physical capital and better health outcomes (life expectancy).The effect of life expectancy on gross fixed capital formation is negative and transmits into a negative effect on human capital. This result is partly in line with Mosquera (2019) who identifies that the phenomenon of resource booms has a detrimental impact on the attainment of developmental objectives in Ecuador subsequent to the oil discovery in 1973. Although the influence of resource rents (RR) on life expectancy is determined to be positive, the subsequent effect from life expectancy to economic growth is ascertained to be negative, substantial, and statistically significant. Collectively, these findings are consistent with extant literature that demonstrates that resource abundance tends to impede the formation of both physical and human capital. The influence of RR on

financial development is observed to be negative; however, it is transmitted into a positive effect on economic growth, albeit not to a statistically significant degree. The impact of RR on the current account deficit is positive, yet the subsequent effect from the current account deficit to human capital (HC) is negative. The adverse influence of the current account deficit on HC is corroborated in the work of Mohamed (2020) which suggests that resource rent does not directly induce a resource curse, but rather does so indirectly, primarily through health indicators such as life expectancy at birth, followed by school enrolment and investment.

CONCLUSION AND RECOMMENDATIONS

This study concluded that the effect of resource rent on human capital is found to be negative, but the transmitted effect from human capital to infant mortality rate is found to be positive and significant.The effect of resource rent on gross fixed capital formation is negative and transmitted into a negative effect on life expectancy, but both of them are not significant.This indicates that resource rents were not effectively converted into productive physical capital and better health outcomes (life expectancy). The effect of life expectancy on gross fixed capital formation is negative and transmits into a negative effect on human capital. The co-integration test found a long run relationship between resource rents, human capital and health outcome in Nigeria.

In light of these findings, the following recommendations are suggested: Given the negative effect of resource rents on human capital, there should be targeted efforts to reinvest these resource rents into education, vocational training, and healthcare. Investing directly in these areas would help mitigate the negative impact and improve long-term human capital development. There needs to be better governance of resource rents. Transparent management, accountability, and ensuring that funds are allocated efficiently to education, healthcare, and infrastructure could help reduce the inefficiency in resource utilisation and improve the effectiveness of these rents.

Given the observed negative relationship between resource rents and life expectancy, it may be necessary to bolster social safety nets (e.g., healthcare insurance, social welfare programmes). These programmes can help protect citizens, especially in times of economic stress or when natural resource wealth is not effectively translated into public goods. Since the study shows that resource rents are not effectively converted into productive physical capital or improved health outcomes, the government should prioritise diversifying the economy. This could reduce over-reliance on resource rents and foster a more sustainable growth path by investing in industries such as manufacturing, technology, and agriculture.

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