DOES INCOME INEQUALITY MATTER IN THE CONTRIBUTION OF HEALTH CAPITAL TO ECONOMIC GROWTH? EVIDENCE FROM SUB-SAHARAN AFRICAN COUNTRIES

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ABSTRACT

Investment in healthcare is of paramount importance as it builds up the stock of health capital, which is primordial to economic growth. However, a high level of income inequality can impair an economy's human capital insofar as low-income people do not have sufficient access to health facilities or health care (Ray and Linden, 2018). This study attempts to unveil the contribution of health capital to economic growth in a situation of rising income disparity in sub-Saharan African countries. The study employs a dynamic model of the Generalized Method of Moments in 38 countries using annual data from 1998 to 2018. Empirical results show that rising income inequality reduces the positive effect of health capital on economic growth. This study suggests that health care financing should be a government priority while ensuring that effective redistributive measures are put in place to reduce income inequality.

Key words: health, human capital, income inequality, economic growth, SGMM
JEL Classification: I150, C11, C23

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1. INTRODUCTION

The third sustainable development goal of good health and wellbeing may only be attained with sustainable healthcare financing (Oyedele, 2023). The wealth and poverty of nations can and have often been analyzed in terms of the state of their citizens' health. Health is fundamental to economic growth and development and is one of the key determinants of economic performance both at the micro and macro levels. This is because health is both a direct component of human well-being and a form of human capital that increases the capabilities of individuals (Bloom and Canning, 2003). Therefore, the stock of human capital in health can affect the growth rate of per capita income in countries (Gyimah-Brempong and Wilson, 2004). The latter indicated that the structure of the relationship between health human capital and the growth rate of income in Sub-Saharan Africa and OECD countries is similar, and the growth impact of health human capital decreases at relatively large endowments of health stock. Although human capital in general has positive effects on economic growth, the contribution of health is relatively larger than the growth effect of education (Ogundari and Awokuse, 2018).

Although there is no evidence that health human capital can help the Sahara out of the poverty trap, a significant effect on poverty reduction has been observed in the short term. Further arguments indicate that there is a threshold effect in the poverty reduction model of healthy human capital, and when economic development levels reach the threshold, the effect of poverty reduction becomes more obvious and deeper (Qiu-su et al. 2021). This could be closely related to local income inequality, where large gaps between the poor and the rich dampen the poverty reduction effect of health capital. The Africa human capital project launched in 2019 by the World Bank was set to boast Africa's potential through its components such as the health, knowledge, skills, and resilience of its people, and as such, human capital remains the greatest resource on the continent and is well identified as the key to prosperity.

Inequality appears to be the primary major source of poverty, and the latter plays a vital role in the link between growth and poverty reduction. According to Ines et al. (2022), inequality and growth are important factors to be considered in formulating strategies and policies to achieve poverty reduction[2]. The theoretical literature has identified various transmission mechanisms by which income inequality is linked to economic growth, namely the level of economic development, the level of technological development, social-political unrest, the political economy, the imperfection of credit markets, the savings rate, institutions, and the fertility rate. According to these models, the relationship between income inequality and growth can be negative, positive, or inconclusive (Mdingi and Sin-Yu, 2021). For example, based on the level of economic and technological development, the relationship between inequality and growth is positive and becomes negative as the level of development progresses. Inconclusive results are reported by the social-political unrest model, showing that the rise in socio-political unrest stemming from high-income inequality could either dampen or promote growth. In addition, theories on the political economy, the imperfection of credit markets, and institutions, and the fertility rate report that income inequality is negatively

[2] Growth has traditionally been considered the main engine for poverty reduction and the critical role of income distribution in poverty reduction is spelt out in great detail in the seminal studies of Datt and Ravallion (1992) and Kakwani (1993), inter alia. The level of inequality in a country determines the responsiveness of poverty reduction to economic growth and is a mediating factor in the relationship (Fosu 2016, among others). Ferreira (2010) reports that (iii) the absolute value of the poverty–growth elasticity falls with inequality, meaning that the poverty reduction response to economic growth is stronger among low-inequality countries (see also Fosu 2017; Kwasi 2010).

related to growth. The only theory that supported the positive relationship between income inequality and growth was the theory of savings rates (Mdingi and Sin-Yu, 2021).

However, merely focusing on the contribution of health capital to growth is insufficient if the inequality levels of countries' economies are not addressed. The effectiveness of health capital on growth depends on the level of inequality and its links with growth. As stated in Ray and Linden (2018), a high level of income inequality can impair an economy's human or health capital insofar as low-income people do not have sufficient access to health facilities or health care. Typically, a high level of income concentration leads to a situation where economic power is used to exert political influence to reduce taxes (Bernstein 2013). Considering that health and incomes are closely related to each other, reducing inequality between incomes will reduce inequality in health. This paper examines the moderating role of health capital on the nexus between inequality and growth. Contrary to our expectations that investment in the health sector will reduce inequality between incomes, increase labor productivity, and promote economic growth, empirical findings show that rising income inequality reduces the positive effect of health capital on economic growth.

The rest of the study is organized as follows: the next section dwells on the literature review, both theoretical highlights and the existing empirical literature on the health capital-growth relationship, followed by methodology comprising the description of data, method of data analysis and model formulation. This is followed by the presentation of results, discussion, conclusion, and recommendation.

2. LITERATURE REVIEW

2.1 Theoretical highlights and measurement issues of health capital

In endogenous growth theories articulated by Romer (1986), Lucas (1988), and Rebelo (1991), the aggregate production function is augmented by human capital, which relies on good health status as one of its determinants on the grounds that better health status influences the working conditions of workers (see also Halici-Tülüce et al. 2016). The human capital generated by health investment has special production functions and is an indispensable prerequisite and input factor for the production process.

Human capital, which relates to the education, skills, and health of people, has a big role to play in the transformation of most economies. For instance, improved health spurs economic growth as it reduces production losses that could have been caused by workers' illnesses and enables a country to transfer resources that would have been spent treating illness to other alternative uses (Odhiambo, 2021). Health investment does not only affect an individual's labor productivity; it also affects the production time and the reward of education investment, which influence the individual's effective working time. It impacts labor supply by affecting mortality and life expectancy, which impinge on the production function. Human capital investment has an influence on economic growth by affecting human capital and physical capital according to utility function (Grossman, 1972). Grossman's (1972) utility theory relies heavily on Becker's theory of the allocation of time" to develop a household production model where individuals could spend resources and time on investments to improve health (Becker, 1965). According to Soares (2014), the benefits from improvements in health materialize over time as increased stocks of health capital deliver future utility flows (consumption value of good health), increased time available in each period of life for market and non-market production (akin to reduced morbidity from the incapacitation perspective), and potentially increased length of life (reduced mortality).

Health human capital is sometimes considered an improvement in health status, and based on Shultz's (1999) argument that child mortality rate is the best indicator of the stock of a nation's health human capital, some studies use child mortality or life expectancy as proxies for health human capital. However, these are health outcomes that occur from investments in health. For instance, in human capital development, health is more important than education since once the health of a child is affected, parents will invest primarily in health and then in education. Further, when people are healthy, they can do anything, while education will distinguish the categories of work. As Mihalache (2019) puts it, "a healthy child will be educated, and an educated child will become an educated and healthy adult because it will be aware of the effects of food and harmful habits on health. An educated child will become a healthy adult, but a healthy child will not necessarily become an educated adult; only a healthy child can be educated. A healthy adult will have the ability to develop professionally, work, and thus lead to economic growth". However, as cited in Mushkin (1962), Chadwick pointed to health expenditures as an investment in human capital, and as such, health expenditures are a related variable for the evolution of health capital. Several studies (Gyimah-Brempong and Wilson, 2004; Sarpong et al., 2020; Qiu-Su et al., 2021 used health expenditure to measure human capital.

2.2 Empirical literature: health, human capital and growth nexus

Human capital has been identified as an influence on economic growth and can help develop an economy by expanding the knowledge and skills of its people. The literature on the effect of health capital on economic growth is not conclusive and plagued with varied results on the relationship.

A good number of studies have found a positive link between health capital and economic growth, such as those by Odhiambo (2021); Sarpong et al. (2020); Ogundari and Awokuse (2018); Gyimah-Brempong and Wilson (2004); Halici-Tülüce et al. (2016). Odhiambo (2021) uses panel data from sub-Saharan African countries covering the period from 2008 to 2017 to examine the causal relationship between health expenditure and economic growth. Health expenditure was decomposed into private and public health expenditure, while acknowledging the fact that health expenditure and economic growth depend on a country's level of income. When life expectancy was incorporated as the linking variable between health and economic growth using the Panel ECM-based Granger causality model, it was found that when public expenditure is used as a proxy, a distinct unidirectional causality from health expenditure to economic growth is found to prevail in low-income countries, but no causality is found to exist in middle-income countries. However, when private health expenditure was used, a short-run causality from economic growth to health expenditure was found to prevail in middle-income countries, but no causality was found to exist in low-income countries.

Sarpong et al. (2020) examined the effect of health on long-run economics in 35 selected SSAs using data covering the period 1997-2016. He found that health capital is a significant determinant of long-run economic growth in SSA and that the causal link between economic growth and health is bidirectional. Ogundari and Awokuse (2018) investigate the human capital-growth nexus for 35 SSA countries using a host of proxy variables for health (proxied by life expectancy) and education (proxied by average years of schooling and government expenditure on schooling). Despite all human capital proxies exerting a positive and significant effect on economic growth, the contributions of the health proxies are larger than those of their education counterparts. Gyimah-Brempong and Wilson (2004) employ an augmented Solow model for a panel of 21 SSA and 22 OECD countries and employ three measures of human capital (ratio of healthcare expenditure to GDP, child mortality rate, and average years of educational attainment) in their analysis. The authors uncover a positive and significant relationship between all human capital measures and economic growth among both groups of countries.

Halici-Tülüce et al. (2016), while examining the relationship between health expenditure and economic growth in 25 high-income and 19 low-income economies for the periods of 1995–2012 and 1997–2009, respectively, found that there is a positive relationship between public health expenditure and economic growth. Piabuo and Tieguhong (2017) compared the impact of health expenditure on economic growth between CEMAC countries and five other African countries that achieved the Abuja Declaration and found that health expenditure has a positive and significant effect on economic growth in both samples. In addition, the long-run relationship between health expenditure and economic growth was also found to exist in both groups of countries.
On the other hand, some studies found a negative relationship between the effect of health human capital and economic growth, such as Eggoh et al. (2015), Frimpong and Adu (2014). For example, Eggoh et al. (2015), while examining the relationship between human capital (measured by education and health-related variables) and economic growth for a large sample of 49 African countries during the period 1996–2010, found that public expenditures on education and health have a negative impact on economic growth. Frimpong and Adu (2014), for example, investigated the extent to which the health of the population affects economic performance using panel data for 30 sub-Saharan African countries during the period 1970–2010 and noted that the health status of the population has not significantly driven economic performance. Meanwhile, other studies found no evidence to support the significance of health on economic growth. Acemoglu and Johnson (2006) studied the health-growth nexus using a panel of 59 countries from Western Europe, Oceania, the Americas, and Asia between 1940 and 1980. Based on the two-stage least squares estimates, they found no evidence to support the claim that improvements in life expectancy resulted in faster economic growth in the 1940s. The tripartite relation of health, health outcomes, and economic growth by Ogunleye (2014) used a panel of 40 SSA countries over the period of 1980–2005 to investigate the growth effect of life expectancy and child mortality. Employing the Arellano-Bond dynamic generalized method of moment's estimation technique, the study reported an insignificant relationship between health outcome and economic growth in SSA.

Thus, despite the positive effect of health capital on economic growth, inequality can dampen the link between health capital and growth in the growth-inequality nexus. This study contributes to the literature by finding out if health human capital can be used as a modulating factor in the inequality-growth nexus in sub-Saharan Africa, a region characterized by health inequality. A high level of income inequality can impair an economy's health capital insofar as low-income people do not have sufficient access to health facilities or health care.

3. METHODOLOGY AND DATA

3.1 Methodology

3.1.1 Generalized method of moments (GMM)

The GMM technique is centered on two main techniques: the difference GMM (Arellano & Bond, 1991) and the system GMM (Arellano & Bover, 1995; Blundell & Bond, 1998). The difference GMM corrects for endogeneity by transforming all regressors through differencing and removing fixed effect estimates. The difference GMM is however limited in that it subtracts the previous observation from the contemporaneous one thereby magnifies gaps in an unbalanced panel. This implies that a data set with an unbalanced panel may weaken the results to some extent. Unlike the difference GMM, the system GMM also corrects endogeneity by introducing more instruments to dramatically improve efficiency of the estimator. It also transforms the instruments to make them uncorrelated (exogeneous) with the fixed effects. The system GMM builds a system of two equations where the first equation is the original equation and the second is the transformed equation.

3.1.2 System-GMM Specification

This study adopts the System GMM technique which aligns with current GMM-centric literature common with growth studies such as Tchamyou (2019) and Asongu and Nwachukwu (2016a). Bond et al., (2001) indicated that the system GMM is the preferred approach for empirical growth models while Asongu and Odhiambo (2020) also justified that the GMM-centric approach limits elements in the conditioning information set if adoption is motivated by the desire to obtain robust estimated coefficients and if this can help alleviate the underlying concern of sometimes biased estimated coefficients resulting from instrument proliferation. The system GMM is also advantageous in that it uses orthogonal deviations instead of subtracting the previous observation from the contemporaneous one; it subtracts the average of all future available observations of the variable regardless of the gaps. For the system GMM, the outcome variables are persistent, as evidenced by a strong correlation between their level and first level series (Tchamyou et al., 2019) and the GMM has ability to use internal instruments to handle endogeneity issues that may arise from reverse causality or endogenous covariates as well as its potency to account for cross-country differences during estimation (Asongu et al., 2020). A dynamic panel model that is designed for situations with small time periods (T) and large panel units (N) or for N>T and N (i.e., 38) is substantially higher than T (i.e., 21). However, it is also important to note that the minimum T for a GMM is five (i.e., T must be >=5) and higher T creates instrument proliferation. We addressed the concern here by adopting data averages in terms of non-overlapping intervals. For instance, given a T=21, three-year data averages were done to produce 7 data points so that T=7.

Furthermore, the GMM estimates only linear functions, and the dependent variable is dynamic as it depends on its own past realizations. The independent variables are not strictly exogeneous as they may be correlated with past and possibly current error term; they run fixed individual effects and show heteroscedasticity and autocorrelation within individuals but not across them. It is important to note that with the GMM technique, the number of instruments must be greater than or equal to the number of exogenous variables and the number of instruments must be less than or equal to the number of panel units. The system GMM builds a system of two equations where the first equation is the original equation or equation at levels (Eq.1) and the second is the transformed equation or first difference (Eq.2):

$LGDPpc_{it} = \beta_0 + \beta 1 LGDPpc_{i,t-\tau} + \beta_2 LHC_{i,t} + \beta_3 LIQ_{i,t} + \beta_4 L(IQ*HC)_{i,t} + \beta_5 xp\sum_k^6 Z_{k,it-\tau} + \Omega_i + \mathcal{E}_t + \mu_{i,t}$….(Eq. 1)

$LGDPpc_{it} - LGDPpc_{it-\tau} = \beta_1(LGDPpc_{i,t-\tau} - LGDPpc_{i,t-\tau}) + \beta_2(LHC_{i,t} - LHC_{i,t}) + \beta_3 (LIQ_{,i,t} - LIQ_{,i,t}) + \beta_4 [L_{,}(IQ*HC)_{i,t)} - L(IQ*HC)_{,i,t}] + \beta_5 \sum_\rho^6 \chi\rho(Z_{j,i,t} - Z_{j,i,t-\tau}) + \Omega_i + (\mathcal{E}_t - \mathcal{E}_{t-\tau}) + (\mu_{it} - \mu_{it-\tau}) +$………(Eq. 2)

Where:

LGDPpc is the log of Gross Domestic Product per capita of country I in period t, β_0 is a constant; LHC denotes the log of health human capital measure; IQ denotes the inequality measure (GINI index); IQ*HC is a vector of the interactive variable that is the product of the inequality measure and the health capita measure; Z is the vector of control variables (including Education, Investment, trade openness , Foreign Direct investment, Governance indicator and population growth); τ represents the coefficient of auto-regression; Ω_i captures the country-specific effect; $\mathcal{E}_t$ represents the time-specific constant and $\mu_{i,t}$ reflects the idiosyncratic error term.

3.1.3 Identification and Exclusion Restrictions

As a sequel to the recent GMM-centric literature, as reaffirmed by Asongu and Nwachukwu (2016b), Boateng et al. (2018), and Tchamyou et al. (2019), a robust specification calls for a description of the identification strategy and the corresponding exclusion restrictions for the GMM specification to yield accurate and reliable estimates. In this context, we acknowledge that years exhibit strict exogeneity because not even first differencing makes them endogenous (Roodman, 2009; Tchamyou & Asongu, 2017; Asongu & Odhiambo, 2020), whereas the predetermined variables are regarded as the basic components of the conditioning information set and the relevant independent variables (see Asongu et al., 2020). We switch from the modern instrumental variable approach, where the identification strategy's validity is assessed by rejecting the Sargan/Hansen over identifying restrictions test, to the GMM strategy, which makes use of forward orthogonal variations within the purview of the Difference in Hansen Test (DHT) to evaluate the validity of exclusion restrictions and related strategies. Failure to reject the DHT's null hypothesis thus denotes the validity of the instruments in that they solely use the exogenous parts of the pre-set indicators to describe the outcome variable.

The Hansen (1982) J test and the Sargan (1985) test of over-identification restrictions are used to test for instruments validity in GMM. It is necessary to test the null hypothesis of overall validity of the instruments used as failure to reject the null hypothesis gives support to the choice of the instruments. Test for autocorrelation/serial correlation are also necessary. The null hypothesis corresponding to the first order autocorrelation, AR (1) or most importantly, the second-order Arellano and Bond autocorrelation test AR (2) in difference which is a position on the absence of autocorrelation in the residuals should not be rejected. The validity of system GMM seriously depend on the satisfaction of these two hypotheses namely absence of autocorrelation most essentially the second-order AR (2) and the over identification restriction which is the Hansen (1982) J test for joint validity of the full instrument set. In this regard, high insignificant p-values of the AR (2) and a small p-value of the Hansen test are desirable since they respectively signify the absence of first order serial correlation and validity of the instruments. Under the null of joint validity of all instruments, the empirical moments are anticipated to have zero expectation and so the J statistic is distributed with degree of freedom equal to the degree of over identification, meaning the number of instruments included and excluded minus the number of explanatory variables. According to Roodman (2009a), a Hansen p-value above 0.10 is a good benchmark for validity of instrument. He advised that p-value close to .025 and above should be observed with great concern since it shows the weakening of system GMM model because of instrument proliferation. The Sargan/Hansen statistics can also be used to test the validity of subsets of instruments.

Lastly, the difference in Hansen test (DHT) for the endogenity of instrument is also employed to assess the validity of result from the Hansen over identification restriction test or the C test. The test examines the validity of the exclusion restrictions and related identification strategy. When the null hypothesis of the DHT is not rejected it implies that instruments are valid in that they explain the outcome variables entirely through the exogenous components of the pre-determined indicators. It checks for the validity of a subset of instruments.

Moreover, we are persuaded by the approach of Asongu et al. (2020) in addressing the simultaneity concerns associated with the modeling approach adopted by employing lagged regressors as instruments for forward-differenced variables, as well as the use of the Helmert transformation in the regressions, as in the accompanying GMM-centric literature (Arellano & Bover, 1995; Love & Zicchino, 2006), to accommodate the fixed effects that are liable to influence the relationships of interest.

3.2 Data

In this study, we employ annual panel data of 38 Sub-Saharan African countries from 1998-2018 obtained from world development indicators and other sources such as sourced from the Global Consumption and Income Project (GCIP) for the inequality data. Our choice of periods and countries was adopted from the following review: based on data availability coupled with what Sarpong et al. (2020) indicates that the periods from 1997 to 2016 constitutes a period of increased commitment of African countries to their health sector motivated by the Abuja Declaration (2001), Ababa Declaration (2006), and the Ouagadougou Declaration (2008).

The 38 countries used in the study are Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Chad, Côte d'Ivoire, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, South Africa, Swaziland, Tanzania, Togo, Uganda, Zambia, and Zimbabwe. The current study included other countries like Central African Republic, Democratic Republic of Congo, Congo Republic, Sierra Leone, Sudan, and Seychelles.

The study has attempted to determine the contribution of health capital (unconditional effect) to economic growth and as well the effect of health capital conditioned by a situation of income disparity amongst the population. The definitions and sources of variables are provided in Appendix 1, the summary statistics in Appendix 2, and the correlation matrix in Appendix 3. Multicollinearity was an issue as we noticed collinearity between the interaction variable and health capital. Das (2009) suggests that multicollinearity is a problem if the correlation coefficient exceeds 0.8 and can be reduced by centering the collinear variable. Alternatively, transforming variable by differencing can also provide a solution. However, when we centered the health capital variable and computed a new interaction term, inequality became highly collinear with the interaction term. We decided to difference the health capital and a valid solution was obtained as observed in appendix 3. Additionally, the descriptive statistics (mean, standard deviation, minimum and maximum values) confirm that our estimates are within the anticipated ranges (see Appendix 1), establishing the estimates' dependability.

4. RESULTS AND DISCUSSION OF FINDINGS

4.1 Presentation of results

This section presents the regression results on Table 1, which dwells on the interrelationships between health capital, inequality and economic growth as observed in four columns (columns 2 to 4). Column 2 shows the baseline model where only health capital and inequality are considered, and in column 3, the interaction term is then added to observe the conditional effect of health capital on GDP per capita. In the fourth column which depicts the third model, all the control variables are plunged into the model but because of instrument proliferation such that number of instruments became more than number of cross sections or countries, spending on education and foreign direct investment which had insignificant coefficients were dropped, and this decision led to model 4 in the fifth column. As concerns the diagnostic test, the second-order Arellano and Bond autocorrelation test (AR (2)) does not reject the null hypothesis, (conveniently since AR(2) p-value is 0.229 (p >0.5) and the Sargan and Hansen over-identification restrictions (OIR) tests are not significant, attesting to the fact that the used instruments are valid and uncorrelated with the error terms.

The purpose of this study is to examine the effect of health capital and inequality and their interaction on economic growth in sub-Saharan Africa and using a similar reflection to the approach of Asongu (2018) to establish if inequality that peters out the favourable impact of health capital on growth. The baseline model examines the effects of these key constructs on economic growth that is the GDP per capita as a proxy for growth, the gini coefficients for inequality and the health capital. Based on the firth column (model 4), the coefficients of health capital and inequality are both positive, indicating that both variables contribute to rising economic growth. The health capital growth effects are supported by works such as Odhiambo (2021), Sarpong et al. (2020), Ogundari and Awokuse, (2018), Gyimah-Brempong and Wilson, (2004), Halici-Tülüce et al. (2016). Odhiambo (2021) uses panel data from Sub-Saharan African countries covering the period from 2008-2017 to examine the causal relationship between health expenditure and economic growth. Health expenditure was decomposed into private and public health expenditures meanwhile acknowledging the fact that health expenditure and economic growth depends on a country's level of income. Life expectancy was incorporated as the linking variable between health and economic growth using Panel ECM based Granger causality model, it was found that when public expenditure is used as a proxy, a distinct unidirectional causality from health expenditure to economic growth is found to prevail in low-income countries, but no causality is found to exist in middle-income countries. However, when private health expenditure was used, a short-run causality from economic growth to health expenditure was found to prevail in middle-income countries, but no causality was found to exist in low-income countries. Sarpong et al. (2020) examine the effect of health on long-run economic growth in 35 selected SSA using data covering the period 1997-2016. He found that health capital is a significant determinant of long run economic growth in SSA and that the causal link between economic growth and health is bidirectional.

As regards the inequality-growth nexus, the theoretical literature has identified various transmission mechanisms in which income inequality is linked to economic growth, and the relationship between income inequality and growth can be negative, positive, or inconclusive

(Chengfang and Zhao, 2023; Ines et al., 2022; Mdingi and Sin-Yu, 2021). For example, based on the level of economic and technological development, the relationship between inequality and growth is positive and becomes negative as the level of development progresses. Inconclusive results are reported by the social-political unrest model, showing that the rise in socio-political unrest stemming from high-income inequality could either dampen or promote growth. In addition, theories on the political economy, the imperfection of credit markets, institutions, and the fertility rate, reported that income inequality was negatively related to growth. The only theory which supported the positive relationship between income inequality and growth was the theory of savings rates. Mdingi and Sin-Yu (2021) indicated that numerous studies joined the debate and testing the relationship between income inequality and economic growth. Some found a positive relationship, while others identified a negative impact. Some studies yielded inconclusive findings. Most found that the relationship was positive in high-income countries and negative in low-income countries. For instance, Hauwa and Okoh (2021) found a negative relationship between income inequality as proxied by gini coefficient and per capita income in Nigeria. Several studies documented no relationship between income inequality and economic growth. Our results indicate a positive effect of inequality on growth. However, the conditional effect provides a different story.

Regarding the interaction term (between health capital and inequality), it seems to have enhanced the model's overall functionality as observed in column 5. The coefficient of the interaction term (-0.030) maintained a significant negative effect on growth at the 1 percent level of significance. This result might be corroborating the growth theories such as MRW (1992), Lucas (1988), and Romer (1990). Additionally, it supports the empirical findings of Gyimah-Brempong and Wilson (2004), Aghion et al. (2010), and Heshmati (2001) that rising healthcare costs have a negative impact on long-term economic growth and such rising health cost could come from the rising income disparity among the population. As stated in Ray and Linden (2018), a high level of income inequality can impair an economy's human or health capital insofar as low-income people do not have sufficient access to health facilities or health care. Typically, high level of income concentration leads to a situation where economic power is used to exert political influence to reduce taxes (Bernstein 2013). Decline in state revenues can cause reduction in investments in public health infrastructure. The resulting undersupply of public health services dampens economic growth through a lack of public infrastructure and low productivity because of low expenditures (Galor 2011). Thus, the effectiveness of health capital on growth depends on the level of inequality and the negative sign shows that the negative effect of inequality on growth is sustained or attributed to the pre-existing high-level gini disposable and overrides the growth effect of health capital. Health capital is unable to moderate the relationship between inequality and growth. Considering that health and incomes are closely related to each other, reduction of inequality between incomes will cause reduction of inequality of health. Therefore, we expected that investment in the health sector will reduce inequality between incomes, increase labour productivity and promote economic growth. The inferences of the above results are indicative of the fact that, although, inequality and health human capital individually enhance growth in Africa, its effect get debouched when inequality levels exceed certain bounds. Finally, other control variables such as domestic investment, trade openness and governance had the expected positive effects on economic growth.

Table 1: Health capital, inequality, and GDP per capita

Variables	Model1	Model 2	Model 3	Model 4
First lagged of log of GDP per capita	0.985*** (0.134)	0.975*** (0.072)	0.935*** (0.016)	0.954*** (0.010)
D.Log of health capital	0.016* (0.006)	0.013* (0.005)	0.012** (0.004)	0.013*** (0.002)
Inequality/Gini coefficient	0.046 (0.201)	-0.208 (0.137)	0.260*** (0.063)	0.287*** (0.079)
Interaction term (inequality*Gini)		0.038 (0.025)	-0.019 (0.0015)	-0.030*** (0.009)
Log of Government spending on education			-0.001 (0.003)	
Log of domestic Investment			0.017*** (0.003)	0.010* (0.004)
Log of population			-0.016** (0.006)	-0.001 (0.004)
Log of foreign direct investment			0.003 (0.002)	
Trade openness			0.0002** (0.0001)	0.0001*** (0.0001)
General Governance			0.023*** (0.007)	0.032*** (0.005)
Time effects	Yes	Yes	Yes	Yes
Constant	0.888 (0.556)	0.255 (0.505)	0.202 (0.230)	0.202 (0.230)
AR (1)	0.024	0.006	0.008	0.005
AR (2)	0.119	0.094	0.137	0.229
Sargan OIR	0.001	0.000	0.048	0.001
Hansen OIR	0.834	0.609	0.818	0.216
DHT for instruments (a)Instruments in levels	0.868	0.822	0.199	0.391
H excluding group Diff (null, H =	0.665	0.399	0.975	0.192
exogenous (b) IV (years, eq(diff)	0.336	0.446	0.353	0.286
H excluding group	0.859	0.611	0.100	0.224
Fisher	9846.2***	54695.4***	6.63e+06	6.621e+06
Instruments	17	21	45	37
Countries	38	38	37	38
Observations	758	758	667	725

Note: Models 1 is the baseline regression having health capital and inequality as covariates of economic growth while the interaction between health capital and inequality is included in model 2. In model 3 all independent variables are considered but insignificant ones like spending on education and foreign direct investment dropped in model 4 to avoid instrument proliferation. Standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

Source: Author's conceptualization

5. CONCLUSION AND POLICY RECOMMENDATIONS

The World Bank Group and WHO found that in 2015, there were still 400 million people without access to basic health services, and that 6% of people in low- and middle-income countries experienced extreme poverty or further worsened poverty because of medical expenses. Africa being the most unequal region in the world after Latin America, the tendency is that inequality remains the key factor inhibiting the transmission of economic growth into poverty reduction. This study then attempts to assess how health capital can be used as a policy variable to modulate the effect of income inequality in undermining the powerful influence of the growth in reducing poverty in the Sub-Saharan African region. Specifically, it set out to analyse the effects of health capital and inequality and their interaction effects on economic growth using panel data on 38 African countries spanning the period 1998-2018. Investing in human capital, as currently understood, is preferable to doing so with physical resources (Andow et al.2023).

Based on the GMM regression estimate, this study concludes that there is an increasing effect of health capital on economic growth and as well, a positive relationship is found between inequality and growth thus, confirming early studies, referred to as the classical approach that argued that there is a positive effect of inequality on growth via savings or incentives. Supporters of this positive relationship between inequality and growth indicates that, savings are a function of income and as income earned increases, so the savings rate rises, and vice versa. In the presence of high-income inequality, rich people earn high incomes which help them to save more, because their marginal propensity to save is relatively high. This increases the aggregate savings, leading to a rise in capital accumulation, thereby enhancing economic growth in the long run.

The interaction between health capital and inequality in relation to per capita GDP is negative and significant implying that investing in health care and persistent increase in inequality to some degree will impede growth in the region. There are indications that inequality impairs the positive effect of health capital on GDP per capita. It might also be that transmission mechanisms in which income inequality is linked to economic gets distorted with a preponderance of the negative effect channels such as the level of economic development, the level of technological development, social-political unrest, etc.

According to Roseman (1972), a person purchases medical services to retain "good health." Therefore, if "health" is a standard good, then health investment will keep rising along with economic growth and could displace physical capital investment, slowing down economic growth over time. Implicitly, any growth-enhancing measure adopted in Africa without considering the degree of income disparity and health expenditure will eventually have the opposite of the intended effect. Therefore, it is necessary to implement steps to reduce inequality while also ensuring effective health care expenditure. Even though exhaustive, the empirical findings of this research are by no means conclusive, as the issue under investigation is recent. Further research is needed to expound on the implications of health care financing in situations underdevelopment and rising income disparity.

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APPENDIX

Appendix 1: Sources of variables and Definition

Variables	Designation	Description	Source
GDP per capita growth	GDPpcg	Gross domestic product, GDP, per capita based on constant 2015 U.S. dollars.	World Development Indicators from the World Bank
Health capital	HC	Domestic general government health expenditure per capita, (current USD)	World Development Indicators from the World Bank
Gini Coefficient	Gini	The Gini coefficient is a measurement of the income distribution of a country's residents. It ranges from 0 to 100, where 0 represents perfect equality while 100 represents perfect inequality.	GCIP, Global Consumption and Income Project
Governance/institutional quality		Institutions or governance is defined as the traditions and institutions by which authority in a country is exercised. It is computed as an average of Kaufmann's six indicators of governance or institutional quality. Each of the six variables below range from −2.5 (weak institutions) to 2.5 (strong institutions).	World Governance Indicators developed by Kaufmann et al. (2011).
Trade openness	Trade	Trade captures the degree of openness or liberalization of an economy measured by the sum of exports and imports as a share of GDP.	World Development Indicators from the World Bank
Foreign direct investment	FDI	Foreign direct investment flow (net inflows % of GDP)	World Development Indicators from the World Bank
Education	EDU	Government expenditure on education in U S dollars	World Development Indicators from the World Bank
Investment	IV	Gross fixed capital formation per capita, which measures physical capital accumulation (current US dollars)	World Development Indicators from the World Bank
Population	Pop	Population growth in current U S dollars	World Development Indicators from the World Bank

Appendix 2: Summary statistics (1998–2018)

Variable		Mean	Standard deviation	Minimum	maximum	Observation
GDPpc	Overall	1949.919	2574.048	248.8657	15810.27	n=38
	Between		2555.353	306.8853	12395.95	T=21
	Within		509.6628	-707.439	5364.24	N=798
HC	Overall	40.2975	84.13191	-.329349	620.3916	n=38
	Between		79.28117	.4691453	381.0843	T=21
	Within		30.82861	-118.0189	279.6048	N=798
IQ	Overall	.4374087	.0789004	.2962399	.8751824	n=38
	Between		.072796	.3180359	.6673288	T=21
	Within		.036375	.32048	.6452623	N=798
EDU	Overall	3.954921	2.308506	-.6239406	17.07344	n=37
	Between		2.075433	.9520417	10.55719	T=21
	Within		1.064327	.1190586	10.47117	N=777
IV	Overall	5.81e+10	4.28e+11	-6.52e+10	5.32e+12	n=38
	Between		3.28e+11	-1.03e+10	2.03e+12	T=21
	Within		2.80e+11	-2.01e+12	3.35e+12	N=798
TO	Overall	82.75129	103.4486	1.295054	1077.426	n=38
	Between		103.4486	24.06981	608.0659	T=21
	Within		46.2634	-315.3274	552.1115	N=798
POP	Overall	2.05e+07	2.89e+07	78846	1.96e+08	n=38
	Between		2.87e+07	86896.95	1.52e+08	T=21
	Within		5711369	-1.57e+07	6.39e+07	N=798
FDI	Overall	6.47e+08	1.41e+09	-7.40e+09	1.00e+10	n=38
	Between		9.19e+08	1.25e+07	4.00e+09	T=21
	Within		1.08e+09	-6.78e+09	1.06e+10	N=798
GOV	Overall	-1.476515	1.444527	-5.114908	2.141245	n=38
	Between		1.409232	-4.07555	1.856279	T=21
	Within		.3880195	-3.185076	-.1022401	N=798

Appendix 3: Matrix correlation

Matrix of correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) D.LGDPpc	1.000										
(2) IQ1	0.084	1.000									
(3) D.LHC	0.100	0.023	1.000								
(4) LHC1c_sq	-0.051	-0.057	-0.014	1.000							
(5) LEDU	0.066	0.140	0.025	-0.541	1.000						
(6) LIV	0.132	-0.034	-0.024	-0.143	0.144	1.000					
(7) LPOP	0.093	-0.015	0.050	0.453	-0.127	0.580	1.000				
(8) LFDI	0.187	-0.083	-0.029	-0.226	0.033	0.751	0.392	1.000			
(9) TO1	0.093	-0.070	-0.010	-0.389	0.267	-0.112	-0.554	0.051	1.000		
(10) GOV	0.105	0.122	0.019	-0.650	0.555	0.092	-0.336	0.130	0.234	1.000	
(11) interaction term	0.075	0.590	0.023	-0.797	0.506	0.137	-0.302	0.167	0.235	0.600	1.000