DETERMINANTS OF HUMAN CAPITAL FORMATION IN KENYA: A STUDY ON KENYAN COUNTIES

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"***FACULTY RESEARCH - HUMAN CAPITAL DEVELOPMENT***"

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Abstract

Human capital is an essential driver of sustainable economic growth and poverty reduction and many nations commit to investment in human capital accumulation. Since independence Kenya's governments have implemented various policies and programs aimed at promoting social economic development, reducing poverty and ensuring human capital development. As a result Kenya has made significant progress in human capital development. In Kenya, counties need new ways to keep their competitive advantage in face of present challenges such as globalization and technological progresses. People and their skills constitute valuable resources for their county and provides the edge to progress its performance or even outpace other counties. Thus, it is indispensable to attempt and comprehend what determines the accumulation of human capital in a county in order to help improve the existing human capital stock. The human capital index (HCI) for Kenya has improved from 52 percent in 2018 to 55 percent in 2020 before COVID-19 pandemic. Though this is higher than the average for Sub-Saharan Africa region and Lower middle income countries it is however, lower than the global average which is 56 percent. This shows that a child born in Kenya in 2020 before Covid-19 pandemic struck could expect to attain an average of 55 percent of his/her potential productivity as a future worker. Hence, need to invest more on education and health the key components of the human capital index. In addition, this national average could masks considerable variation across counties in Kenya as reflected by various education and health outcomes key components of HCI. The object of this study was to analyze the determinants of human capital development in Kenya using a cross-sectional data from all 47 counties in Kenya for 2013 and 2019. The data was collected from published government documents such as County profiles 2013 and the Kenya Population and Housing Census 2019. The study constructed a human capital index, based on education, Health and innovation/creativity. This allowed us to capture broader aspects of effective labour force. The cross-sectional regressions results shown that the key determinants of human capital development in Kenya with the biggest effect was Gross County Product Per Capital, population density, out of pocket health expenditure, infrastructure expenditure, health worker density and proportion of primary schools connected to electricity. The policy implication of these findings is that for counties and Kenya to accumulate human capital the governments should invest on improving health workers density by employing more health workers.

Introduction

Globally economic development and growth agenda has shifted to a more knowledge-based development, and any nation that doesn't address the skills, ability, expertise, education and knowledge gap is bound not only to be left behind but also fail to make a meaningful development. Human capital is a key ingredient for the accelerated growth and expansion for many nations that commit to investment in human capital. Human capital is a key factor that drive economic growth (Lucas, 1988 and Mankiw *et al.,* 1992). A noteworthy benefit in producing a steady atmosphere for economic growth is that the nation should have the expanded high quality human capital in arenas of health, science, management, education, and other fields. Thus, the core components of human capital is human beings. However, the principal component are skill, creative, educated, and enterprising people with a high level of professionalism. Human capital in a nation manages the dominant share of the national wealth. Hence, considered the most important resource of the nation, which is more powerful than nature, wealth or even physical capital. Human capital if well utilized is more central determinant of economic realization than any other resource (World Economic Forum, 2013).

Human capital results to innovations in the areas of production and other related activities and it also creates the capability to absorb new technologies. This in turn leads to more growth. Human capital rises labour productivity. For example trained workers will use the physical capital more efficiently while knowledgeable and skilled workers can make better use of resources at their disposal. This raises production and levels and lead to economic growth. By enlightening the productive processes of the labour force, the human capital formation increases the opportunities for excellent employment. This leads to a high rate of participation in the labour force which reduces the gap between the poor and the rich. According to World Bank (2020) human capital investment can boosts social unity and justice while reinforcing people's trust in institutions. In most nations, human capital defines the rate of development, economic growth, technological, and scientific progress.

Nations require innovative behaviors to preserve their competitive advantage when confronted with current challenges like globalization and high-tech progress. People and their skills represent valuable assets for their nations and can help provide the edge it to improving its performance or even outpace others. Allover the world a considerable amount of attention has been devoted to

human capital accumulation. Research has shown that human capital plays a key role in in the economic development process and emphasizes the fact that many developing economies that have experienced fast increases in growth have also experienced considerable increases in human capital. In addition, human capital has a direct effect on human welfare. Human capital is a complex object with many different dimensions (Attanasio et al. 2015). The multidimensionality of human capital is also important in understanding the process of its formation, which is a very complex one. It is, thus, necessary to attempt and know what determines the accumulation of human capital in a nation in order to help improve the existing stock.

Kenya has made significant progress in human capital development, the human capital index (HCI) for Kenya has improved from 52 percent in 2018 to 55 percent in 2020 (World Bank, 2018; 2020). However, it remains modest by global standards. For example according to World Bank (2020) a child born in Kenya today will be 55 percent as productive when he/she grows up as he/she could be if he/she enjoyed complete education and full health. Though this is higher than the average for Sub-Saharan Africa region and Lower middle income countries it is lower than the global average which is 56 percent. This shows that a child born in Kenya in 2020 before Covid-19 pandemic struck could expect to attain an average of 55 percent of his/her potential productivity as a future worker. Hence, need to invest more on education and health the key components of the human capital index. In addition, this national average could masks considerable variation across counties in Kenya as reflected by various education and health indicators.

For instance, while Kenya's life expectancy has improved through the years, some counties have rates below the national average of 60.6 years for male and 66.5 years for females. Homa Bay County has the lowest life expectancy of 50.5 years for male and 60.2 years for females while Nyeri County has the highest life expectancy of 66.4 years for male and 75.8 years for females (KNBS, 2019). This implies that a newborn boy in Nyeri County on average is expected to live 16 years longer than one born in Homa Bay County. This state of inequality is reflected in all social economic indicators across counties in Kenya. It is also expected that a child born in a county with inferior health and education outcomes could expect to be lower as productive as if he/she had full education and full health compared to counties with better outcomes. If these inequalities in health and education outcomes are not urgently addressed, will perpetuate the

inequality since these outcomes shapes the productivity of the future generation of workers. This calls for urgency of addressing human capital gaps in such settings.

In addition, the Covid-19 disruption of education and health services such as closure of schools combined with family hardship, losses in income and worsening nutrition are expected to adversely affect the accumulation of human capital for the current generation. Furthermore, external shocks and internal conflict and natural disasters such as famine have destructive impacts both on countries' existing human capital stock and on the human capital formation. This weakens the core of sustainable and equitable economic development in a nation. Urgent actions are required to preserve hard-won developments in human capital, mostly among the poor and the most vulnerable groups. In doing so calls for a concerted effort designing interventions and targeting them to achieve highest effectiveness, while navigating trade-offs particularly this time of reduced fiscal space.

To enhance productivity of the future generation of workers Kenya need to strengthen and adopt a coordinated policy and financing strategies to deliver better health and education outcomes across counties. Additionally, concerted efforts are needed in order to protect human capital gains against setbacks such as COVID-19 pandemic and accelerate the progress. To achieve this and to have a full prognosis of the impact of human capital development on economic growth and development can only be achieved if the determinants of human capital formation are known (Shuaibu and Oladayo, 2016).

Empirical research on the determinants of human capital formation is inadequate and only a few studies (Rastogi and Gaikwad, 2017; Shuaibu and Oladayo, 2016; Tsaurai, 2018; Attanasio, 2015; Behrman and Schneider, 1992; Praise and George-Anokwuru, 2018; Hasan, 2000 and Zulkifli *et al.,* 2017). Shuaibu and Oladayo (2016) and Oketch (2006) studied Africa as bloc. These studies' had methodological weaknesses such as focusing on a few variables, so they were not broad enough to be a true representative of the whole African continent. Praise and George-Anokwuru (2018) focused on a single country, Nigeria, whose results cannot be generalized across the African continent. In a Kenyan context, what influences human capital development has not been adequately researched. Therefore, research on the determinants of human capital development in Kenya is still undeveloped and unexplored. The current study will fill in this void.

It is against this background that this study investigated the determinants of human capital development in the Kenyan context. This study will focus on the questions: how can Kenya accumulate human capital? And what determines the allocation of resources to Human capital formation in Kenya? Thus the purpose of this study will be to investigate the determinants of human capital development in Kenya. Since it is commonly acknowledged how valuable human capital is to the whole society, it would be worthwhile to understand its formation in order to help improve the existing stock. In this way, implications can be drawn for policymakers to adjust their actions towards more successful accumulation of human capital in their respective counties. This study will attempt to shed light on these implications to help develop efficient policies for creation and accumulation of human capital in Kenya. This study will focus on Kenyan 47 counties using cross-section data from Kenya Population and Housing Census (KPHC) 2019.

2.0 Literature review

2.1 Theoretical background

2.1.1 Individual level

Although the study on human capital began in earnest in the 1960s, Adam Smith (1776) had already posited that a nation's wealth could be categorized into three parts, one of which was fixed capital. Apart from the obvious components like machinery, buildings, and land, Smith highlighted the valuable abilities of all members of society. He argued that investing in education and skills was akin to investing in fixed capital, such as machines, which initially incurs costs but yields returns in the form of increased productivity over time. This perspective aligns with modern human capital theory, as articulated by Backman (2013), which emphasizes that investments in human capital by individuals and organizations are driven by expectations of future gains, both financial and non-financial.

Schultz (1961) characterized human capital as comparable to an asset. He aimed to expand upon the traditional notion of the labor force and asserted that "the productive capacity of human beings now exceeds that of all other forms of wealth combined" (p. 2). This viewpoint has been widely embraced by subsequent researchers. Building on Schultz's framework, other studies have demonstrated that human capital is intricately linked with factors such as knowledge, skills, education, health and abilities (Garavan et al., 2001; Youndt et al., 2004).

The acquisition of knowledge and skills plays a crucial role in human capital, leading to the recognition that learning is fundamental to its growth. Today, it is widely accepted that "the foundational basis of human capital hinges on elements such as knowledge and skills acquired through individual learning endeavors" (Kwon, 2009). Given that knowledge encompasses components of human capital such as skills, experience, and competence, it is commonly acknowledged that human capital and the broader concept of 'knowledge' are synonymous expressions. After extensive deliberation, a consensus has emerged suggesting significant private returns to human capital (Moretti, 2004). According to Moretti's empirical findings, individuals with an additional year of education typically earn between 8 to 12 percent more annually, holding other factors constant.

On Health of an individual Grossman (1972) argued that health is a durable capital good that can be inherited and diminishes gradually over time with age. The investment in health involves expenditures on medical care and related inputs, while depreciation signifies the natural decline in health as an individual ages. Health accumulates or gains value from investments in previous periods, but it also depreciates over time. Just like others form of capital, health also has a rate of return: investments in health now have consequences for the future. Better health means more productive time, which means more time to work or more investments in health for the future. In addition, Longevity can imply an increase in labour supply and in productivity because, firstly, workers are potentially available for a longer time period and, secondly, healthy workers may invest in and update their skills more since their return will occur over a longer working life.

2.1.2 Regional level

Florida (2002) observed that the presence of highly educated and productive individuals plays a more crucial role in regional growth than simply lowering business operating costs. These individuals are the driving force behind regional development, and the concentration of educated people with significant human capital is even more impactful than the clustering of firms. This is because their influence is less restricted by traditional factors like strategic geographic locations, access to raw materials, or proximity to densely populated areas (Kotkin, 2001 cited in Florida, 2002a, p. 221).

Human capital exerts influence on society and individuals through spillover effects. According to Moretti (2004), in addition to private returns, human capital can generate significant social returns

that surpass the former and are not captured by them. He defines social returns as "the aggregate benefits that society gains from an overall increase in education levels." Although quantifying these returns is challenging due to the difficulty in measuring spillovers and externalities. Moretti (2004) identified three types of externalities where social returns differ from private returns.

Firstly, he examined productivity spillovers, which reflected how increased education levels among individuals can enhance overall economic productivity beyond their individual gains. Secondly, he explored the impact of education on reducing criminal activities, suggesting that higher education levels may decrease the likelihood of engaging in behaviors that impose negative externalities on society. Lastly, he discusses the externalities related to voting and policymaking, indicating that educated individuals may contribute positively to these processes, thereby benefiting societal outcomes beyond their personal economic returns.

Consumption externalities are deemed highly significant by Haveman and Wolfe (1984), encompassing various welfare effects within the social environment that generally benefit the population. According to Blundell et al. (1999), a key advantage lies in increased rates of democratic participation and social cohesion, which are influenced by the education levels and literacy rates of the populace. Enhanced human capital allows individuals to access information more readily, enabling them to make better-informed electoral decisions that ultimately benefit society as a whole (Friedman, 1962; Smith, 1776; Hanushek, 2002).

Moretti (2004) underscored education's positive impact on reducing crime levels as among the most significant social returns from education. Elevated human capital also brings about additional social benefits such as improved public services (e.g., well-functioning schools), amenities (e.g., theaters and restaurants) (Gemmell, 1997; Glaeser et al., 2001), and heightened civic engagement in personal, familial, and public health improvements (Gemmell, 1997).

Another category of externalities involves pecuniary externalities stemming from market transactions. Human capital externalities arise from the interdependence between physical and human capital, as noted by Acemoglu (1996; 1998). When the aggregate level of human capital rises, firms tend to increase their investments in physical capital. Consequently, individuals with lower levels of human capital end up working with more physical capital, as matching less skilled workers with capital-intensive technologies incurs significant costs (Acemoglu, 1996).

Human capital may also lead to negative externalities. For instance, this occurs when a factor of human capital, such as education, serves primarily as an indicator of unobservable abilities rather than directly boosting productivity (Spence, 1973).

2.2 Empirical Literature

Plenty literature articulated the importance of human capital in the development of a nation. As a theory, human capital has broader acceptance (Sheltuz, 1961; Mencer, 1958; and Beker, 1964/1993). Who shifted the thinking philosophy of policymakers by emphasizing the centrality of human capital in the development process. Mincer (1958), who noted that the huge difference in earnings could be significantly explained by his model of human capital. Nevertheless, remarkable input to economics in the field of human capital was through (Becker, 1964/1993). Whose view was that human capital is directly valuable in the production function. That is human capital increases worker's productivity in all tasks, though possibly differentially in different tasks, organizations, and situations. Since 1960s, these economists enthused myriad of others to follow this line of research and at present there are thousands of studies focusing on various aspects of human capital.

According to Becker (1964/1993) human capital is embodied in persons and cannot be separated from the individual. Therefore, the supply of human capital rests on one's mobility across locations and firms. The implication of this is that one's knowledge and skills (human capital) cannot be lost as opposed to losing their physical or financial capital. Thus, when someone invests money into his education, it is generally an insured investment. In addition, if there is a significant change in working environment, it can be difficult to relocate or reinvest one's human capital. Lucas (1988) and Romer (1990) in their endogenous growth theory, shows that states and provinces that display advanced levels of human capital should expect greater growth rates than areas with inferior levels.

Glaeser and Gottlieb (2009) accentuated that population density boosts productivity due to agglomeration economies and propose a few reasons why agglomeration economies can exist. These were reduced transportation costs and easier transmission of ideas. Bjerke (2012) contends that the regions with decreasing population growth will encounter complications in both attracting and retaining individuals with higher education. Qian et al., (2012) asserted that in regions with higher population density there is an easier access to other individuals. As a result, there is a higher opportunity for face-to-face communication which is the main channel through which knowledge

may spill over leading to increases in human capital. Education expenditures are key to human capital formation (Idrees and Siddiqi, 2013). Thus, public spending on education or health will increase the human capital formation. However, according to Rosenzweig (1990), rapid population growth at the national level diverts some resources toward food procurement that could otherwise be used for implementing quality education and skills enhancement programs, essential for human capital development. Indirectly, high population growth also creates a market that attracts foreign direct investment (FDI). This FDI, in turn, fosters human capital development by bringing in skills, technology, and managerial expertise (Jorgenson, 1963).

Mellander and Florida (2006) argued that diversity within regions permits a more open-minded and tolerant cultural, social, and economic environment. According to Marlet and Van Woerkens (2004) persons who are more innovative and educated have a greater income and are more active in the city life, therefore they spend a larger share of their incomes in local bars, restaurants and theatres, creating amenities and quality-of-place and stimulating employment growth in local services. Tiebout (1956) showed that the preference of amenities can be illustrated through the choice of the city to live in.

Moreover, Abel and Deitz (2011) proved that universities can influence the growth in local human capital levels by increasing both the supply (graduates) of and demand (researchers, teachers) for greatly educated individuals within urban areas. The same study ascertains that academic research and development activities are also vital in the growth in a region's human capital stock, which implies that a demand for skilled workers is created through spillovers effects into the area's economy. Regions with greater education activities most often also have a larger portion of workers employed in high human capital occupations (Abel and Deitz, 2011). The main results of this study showed that there is a association between the activities of universities and the composition of local labour markets. It appears that more degrees obtained in a high human capital field results in more workers in comparable occupations.

Zulkifli et al., (2017) applied time series data 1982-2014 and found that Education level had a significant positive impact on human capital development while unemployment had an insignificant influence on human capital development in Malaysia. In Nigeria Economic growth and health element of human capital development were found to have a bi-directional relationship. Increasing government expenditure reduced mortality rate (Praise and George Anokwuru, 2018).

3.0 Empirical strategy

Conceptually, human capital is the stock of knowledge, habits, and social and personality attributes, including creativity, embedded in the ability to perform labor to produce economic values (Halide, 2016). It was further argued that HC is the collection of resources including knowledge, talents, skills, abilities, experience, intelligence, training, judgment, and wisdom possessed individually and collectively by individuals in the population (Halide, 2016).

Endogenous growth model provided a theoretical framework for this study of human capital development in Kenya. In this framework, the production of new knowledge is the function of socio-economic activities that create opportunities and incentives to produce human capital. Endogenous growth models put human capital and its development processes at the center stage of economic growth, which exhibits increasing returns to scale. It indicates that new knowledge is more important than existing knowledge in the economic development process.

The endogenous growth model,

$Y(t) = f(K(t), H(t), L(t), A(t))$, ……..……..*(1)*

Where *Y* is per capita GDP growth, K is capital accumulation in the economy, *H* is human capital development, *L* is labor force and *A* is technological progress. Lucas (1988), Grossman and Helpman (1991), and Romer (1990) argued that level of output depends on the level of endogenously generated human capital. They indicated that human capital is the knowledge that is produced through education and training. In addition existing human capital is considered essential for generating new knowledge and increasing future human capital. Higher productivity in the education and knowledge sector increases the marginal productivity of the labor force, higher earning, and output growth. The increase in human capital may also accelerate innovation and technological change, essential for long-term sustainable development.

Assuming a Cobb-Douglas production function:

$Y(t) = H(t)^{\theta} K(t)^{\alpha} [A(t)L(t)]^{1-\alpha}$……..(2)

Where $H(t)$ is the stock of human capital, $K(t)$ is the stock of physical capital, $L(t)$ is the labor, $A(t)$ is the economy level of technology, $\boldsymbol{\theta}$ measures human capital elasticity of aggregate production, and $\boldsymbol{\alpha}$ is the share of capital. By taking natural logarithm on both sides and rearranging, the model (2) can be linearized as follows:

$\ln Y(t) = \theta lnH(t) + \alpha lnK(t) + (1-\alpha)[lnA(t) + lnL(t)]$……(3)

Acemoglu et al., (2014), postulated that human capital depends on the schooling decision of individuals who are faced with exogenously given prices in the capital markets. He stated that individuals are born with some level of human capital (i.e., $H(0) > 0$), and human capital evolves according to the following differential equation:

$$\dot{H}(t) = f(F(t), H(t-1), S(t), X(t)) \quad \ldots\ldots(4)$$

Where $S(t)$ is the fraction of resources devoted to education, and $\boldsymbol{F(t)}$ determines how human capital changes as a function of time, the existing stock of human capital, schooling decisions, and other socioeconomic factors $(X(t))$. Papageorgiou and Perez-Sebastian (2006) showed that evolution of human capital over time depends on the percentage of people in education and population growth. Combining equations (3) and (4), the human capital growth model can be specified as:

$$\dot{H}(t) = f(F(t), Y(t), K(t), L(t), H(t-1), S(t), X(t)) \quad \ldots\ldots(5)$$

Where $K(t)$ captures the externality effect of physical capital accumulation on human capital. However, for a country like Kenya with limited fiscal space, human capital and physical capital may compete for scarce resources. That is investing more in physical infrastructure may reduce funds for investment in education and health.

Data, Variables, and Empirical Models

All data used in this study was collected from the Kenya National Bureau of Statistics (KNBS). The dataset covered data on all counties in Kenya for the year 2019, with addition to data on Education and Health from 2013. The data source for 2019 was the Kenya Population and Housing Census 2019 and for 2013 was the county profile documents which provided the baseline for this study.

Human capital index (HCI)

This study measured human capital as an overall index based on three human capital pillars. This allowed to capture the multi–dimensional concept of human capital. The study compiled a much simpler index than that of World Economic Forum (WEF) (2013) and World Bank (2018; 2020), based only on three pillars and without additional segregation. The first pillar captured education to be measured by proportion of population with secondary education, (Edu). This is because secondary education is the highest level of basic education in Kenya which is compulsory. In addition, completion of secondary education in Kenya is associated with attainment of 18 years.

The second pillar took into consideration innovation expressed by a share of population accessing internet (Inn). The third pillar consisted of a health proxy measured by life expectancy at birth (Hth).

The study logical creation of index followed the Global Innovation Index (2014). Primarily all the three pillars were normalized into (0,100) scale, where 100 was the best outcome and 0 the worst by the following formulas:

$$\frac{Respective\ Value - Min}{Max - Min} * 100 \quad \ldots\ldots 6$$

Meaning that the high value represents positive situation for (*edu, Inn and Hth*). To calculate HCI for each county the study calculate mean average of the three values for each county for the year 2013 and 2019. Evidently these three pillars interact, but since the precise mechanisms are hard to define, the study did not use different weights. After getting the value of human capital index (*HCI*) for each year, then a relative change (*diff HCI*) to be used as regressant were computed based on following equation:

$$diff\ HCI = lnHCI_{2019} - lnHCI_{2013} \quad \ldots\ldots 7$$

The study also used the same method to calculate differences in the levels of education, innovation and health:

$$diff\ Edu = lnEdu_{2019} - lnEdu_{2013} \quad \ldots\ldots 8$$

$$diff\ Inn = lnInn_{2019} - lnInn_{2013} \quad \ldots\ldots 9$$

$$diff\ Hth = lnHth_{2019} - lnHth_{2013} \quad \ldots\ldots 10$$

The study use logarithmic transformation through the natural logarithm in some variables in order to reduce the non-linear relationships, solve the problem of heteroscedasticity and also to facilitate the interpretation of coefficient, which were then equal to the elasticities.

To guarantee robustness of the model, the study will run four different regressions, where the right-hand-side does not change, but use all the pillars of the human capital index separately as dependent variable, as well as the HCI itself. In all of them the dependent variable will be relative change between two points in time (2013 and 2019). The empirical model specified as follows:

$$[\boldsymbol{ln\ Y_{2019} - lnY_{2013}}]_i = \alpha + ln\boldsymbol{X_i} + \mu_i \quad \ldots\ldots 11$$

Where $\boldsymbol{Y}$ stands for education (Edu), Innovation (Inn), health (Hth) and human capital index (HCI) respectively. $\boldsymbol{X_i}$ is vector of covariate variables that influence human capital formation

(education expenditure, Health expenditure, population density, cultural diversity, amenities, proximity to social amenities, distance to university, among others).

Justification of Variables

Gross County Product Per Capita (GCPPC)

An increase in the per capita income of parents let them allow investing in the education and health of their children, which in turn affects human capital development (Chevalier, Harmon, O'Sullivon and Walker, 2013). The ability of households to invest in education and health is often constrained by their economic status. Poor households are less likely to afford quality education and healthcare, which perpetuates the cycle of poverty and limits human capital development. Moreover, unemployment, especially among the youth, has been identified as a major barrier to human capital development in Kenya (Omolo, 2010). High unemployment rates discourage investment in education and skill development, as the returns on such investments are perceived to be low.

Population density (Pop)

Population Density is a key control variable reflecting the number of inhabitants in a county and encapsulating the region's size. As highlighted by Qian et al. (2012), population density is often positively correlated with human capital. This relationship stems from the ease of access to other individuals and the facilitation of face-to-face interactions, which are critical for knowledge spillovers. While Qian et al. (2012) acknowledge that population density is not a flawless measure owing to its inability to capture variations in density it remains a standard metric in the literature (Crescenzi et al., 2007). For analytical purposes, this variable was used in natural logarithm.

Education expenditure (edu_exp)

County spending on education and training as a proportion of county total expenditure. Lin (1998) asserts that increased education expenditure, which extends the time students spend in school, unequivocally leads to higher human capital. Conversely, even if increased spending results in less time spent in school, human capital can still rise if the initial spending was sufficiently low. Therefore, a positive relationship is anticipated. For analysis, this variable was regressed using the natural logarithm.

Health Expenditure (Hea_exp)

County health expenditure as a proportion of total county expenditure. Health expenditure, a key component of public and private investment in human capital, plays a significant role in shaping

the health outcomes of a population, which directly impacts productivity, educational attainment, and overall economic development. The literature suggests a strong positive relationship between health expenditure and human capital development. Investing in health not only improves individual well-being but also enhances educational outcomes, labor productivity, and economic growth. However, the impact of health expenditure is contingent upon the efficient allocation of resources and the broader socio-economic context. Thus, need to focus on identifying the optimal levels of health investment needed to maximize human capital development, as well as exploring the specific pathways through which health expenditure affects different aspects of human capital.

Human Capital Development Expenditure as a percentage of GCP (hci_exp)

Total county expenditure on health and education as a proportion of GCP. This represented the proportion of a country's Gross County Product (GCP) spent on health care and education. A higher percentage indicates a significant investment in human capital, which can contribute to human capital development.

Physical Capital expenditure (Infrastructure Development expenditure)- (Inf_exp)

This was meant to captures the externality effect of physical capital accumulation on human capital. Investments in physical capital can significantly enhance the quality and accessibility of education, healthcare, and other services, thereby contributing to the improvement of human capital. However, for a country like Kenya with limited fiscal space, human capital and physical capital may compete for scarce resources i.e. investing more in physical infrastructure may reduce funds for investment in education and health.

Cultural Diversity (cult_div)

Cultural diversity, the presence of diverse cultural groups within a society, can have profound implications for human capital development. As societies become increasingly multicultural due to globalization, migration, and demographic changes, understanding the effects of cultural diversity on human capital comprising education, skills, health, and productivity is crucial. Diverse cultural backgrounds can contribute to a broader range of skills, perspectives, and ideas, enhancing human capital. This study used Herfindahl-Hirschman Index (HHI) measure based on ethnic groups in a county. This variable was regressed with natural logarithm and the equation employed for the HHI is the following: $HHI = s_1^2 + s_2^2 + \cdots s_n^2$

Where: s_i =the Population share percentage of ethnic group *i* expressed as a whole number, not a decimal and n is the total number of distinct ethnic groups in the county.

HHI ranges from close to zero to 10,000, with 0 value indicating maximum diversity, where every individual belongs to a different ethnic group while 10,000 indicates perfect homogeneity, meaning the population is entirely composed of one ethnic group.

University (dum_Uni)

To capture the effect of distance to universities the study used a dummy variables *(dum_muni),* a value equal to 1 means the presence of university directly in the county, 0 means that there is no university located there.

Out-of-Pocket Health Expenditure (oop_exp)

This measures the share of health expenses paid directly by household rather than covered by insurance or the government. High out-of-pocket costs can be a barrier to accessing health care and may indicate inadequate health coverage hence hindering human capital development.

Health Workforce Density (hea_den)

This includes the number of health workers (doctors, nurses, midwives) per 10,000 population. A higher density suggests better access to health care services, which can improve health outcomes.

Health Facility Density (hfd)

Health facility density, which refers to the number of health facilities (hospitals, clinics, health centers, etc.) per 10,000 people, plays a significant role in influencing human capital development. Sufficient infrastructure is critical for delivering quality health care. Higher health facility density ensures that health services are more accessible to a larger portion of the population. This reduces travel time and costs, making it easier for individuals to seek medical attention when needed. In addition, when health facilities are nearby, people are more likely to seek early diagnosis and treatment for illnesses, reducing the severity of diseases and preventing long-term health complications.

Health Insurance coverage (heins_cov)

This is the proportion of households with a medical insurance cover. Insurance coverage significantly affects human capital development by improving access to health care, reducing financial barriers to care, and promoting better health outcomes.

Child Nutritional Status (cns)

Percentage of children under age 5 who are stunted. Child nutrition is a foundational aspect of human capital development, as it directly impacts a child's physical health, cognitive development, educational outcomes, and future economic productivity. Proper nutrition in early childhood sets the stage for lifelong health and success.

Access to electricity (ele)

Access to electricity is a key component that promotes the social and economic development of households and communities. Electricity in households contributes to improvements in health services, education, and water access and to overall human output thus increasing the overall productivity of households. Used as a proportion of household with access to electricity.

Access to improved sanitation (san) - The WHO defines improved sanitation to include use of covered latrines, flush toilets or covered latrines connected to main sewer lines, Ventilated Improved Pit latrines (VIPs), septic tanks, cesspools and conservancy tanks or covered cisterns. This study used % households with improved sanitation

Pupils Teachers Ratio (PTR)- (ptr)

Number of pupils per teacher, a key indicator of teaching load and potential quality. The pupil-teacher ratio (PTR) is a critical factor influencing human capital development, particularly in educational contexts. The PTR significantly affects human capital development by influencing the quality of education, student performance, teacher effectiveness, and long-term socio-economic outcomes. A lower PTR allows teachers to give more individualized attention to each student, manage the classroom more effectively, creating a conducive learning environment that often translates into a higher quality of education.

Road Network/Road Infrastructure (RAI)

This was captured by Rural Access Index (RAI) i.e proportions of population accessing a motorable road within two kilometers.

Primary schools connected to electricity (pry_ele)

The proportion of primary schools in a county that are connected to electricity was used to capture the school infrastructure development in the counties.

Location Quotients (LQs)

To capture county knowledge concentration, the study used Location Quotients (LQs) as a measure of specialization for knowledge-based manufacturing and services, as developed by Hildebrand and Mace (1950). This was used as an estimate of share of GCP in manufacturing sector (Contribution of the manufacturing sector to GCP) relatively to the national share. The LQ was calculated based on following equation:

$$LQ_c = \frac{\frac{g_c}{G_c}}{\frac{g_n}{G_n}} = \frac{County\ c\ Manufacturing\ sector\ share\ of\ GCP}{nation\ Manufacturing\ sector\ share\ of\ GDP}$$

Where

g_c = contribution of the manufacturing sector to GCP in county c

G_c = GCP for county c

g_n = National contribution of the manufacturing sector to GDP

G_n = Gross Domestic Product (GDP)

If the county LQ is 1.0 it means that the county and the nation are equally specialized in manufacturing; while a LQ greater than means that the county has a higher concentration in manufacturing than the nation.

Policy and Governance (pol_gov) – the study used the county bribery index to capture the governance issues at the county.

Women Empowerement (wep) - Percentage of women age 15–49 who participate in major household decisions (

Table 1 summarizes all variables used in regressions, as well as their expected signs.

Table 1: Variables

Variable	**Variable Description**	**Source**	**Expected Sign**
$diff\ HCI$	Relative difference in human capital index between 2013 and 2022		
$diff\ Edu$	Relative difference of share of population with secondary education or above between 2013 and 2022		
$diff\ Inn$	Relative difference of share of population with access to internet between 2013 and 2022		
$diff\ Hth$	Relative difference of life expectancy at birth between 2013 and 2022		
GCPPC	Gross County Product Per Capita		+
Pop	Population density (people per sq. km)		+

Edu_exp	Expenditure on education as a share of total county expenditure		+
Hea_exp	Expenditure on Health as a share of total county expenditure		+
hci_exp	Expenditure on Human Capital Development as a percentage of GCP		+
Inf_exp	Physical Capital expenditure (Infrastructure Development expenditure)		+/-
cult_div	Cultural Diversity - Herfindahl-Hirschman Index (HHI) based on ethnic groups in a county		+/-
dum_Uni	University - Dummy for presence of university in the same county		+
oop_exp	Out-of-Pocket Health Expenditure		-
hea_den	Health Workforce Density - number of health workers (doctors, nurses, midwives) per 10,000 population		+
hfd	Health Facility Density - number of health facilities (hospitals, clinics, health centers, etc.) per 10,000 people		+
heins_cov	Health Insurance coverage - %		+
cns	Child Nutritional Status - Percentage of children under age 5 who are stunted		-
ele	Access to electricity – proportion of households with access to electricity		+
san	Access to improved sanitation - % households with improved sanitation		+
Ptr-pry	Pupils Teachers Ratio (PTR) for primary school - Number of pupils per teacher		-
Ptr-ecd	Pupils Teachers Ratio (PTR) for ECD - Number of pupils per ECD teacher		-
Ptr-sec	Student Teachers Ratio (PTR) for secondary school - Number of students per teacher		-
RAI	Road Network/Road Infrastructure - captured by Rural Access Index (RAI) i.e proportions of population accessing a motorable road within two kilometers		-/+
pry_ele	Proportion of Primary schools connected to electricity		+
LQs	Location Quotients (LQs)- to capture county knowledge concentration		+
hnp	Health and Nutrition Programs **-** Dummy for presence of Nutrition/school feeding programme in the county		
pol_gov	Policy and Governance – Dummy for presence of health/education legislation in the county.		
Mag	Marginalization – Dummy1 for marginalized county; 0 otherwise		

RESULTS AND FINDINGS

Descriptive Statistics

Table 2 shows the descriptive statistics for all the variables we used in this study.

Table 2: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
HCI2013	47	47.83947	15.78562	10.46451	93.10811
HCI2019	47	48.39228	17.67845	18.67189	88.83781
Diff_HCI	47	0.0043163	0.3095097	-0.5481829	1.18359
Diff_edu	47	0.4501336	0.200627	0.1131772	1.138419
Diff_Inn	45	0.8860073	0.4507297	-0.1863907	1.839562
Diff_Hth	45	-0.3785877	0.8416808	-3.398694	2.541477
LnGCPPC	47	12.08949	0.4542875	11.12015	13.49163
LnPop	47	5.039777	1.611237	1.791759	8.739857
Edu_exp	47	7.728972	3.236916	1.848839	15.2533
Hea_Exp	47	26.05314	10.18007	3.165897	43.2915
hci_exp	47	33.78211	11.90319	6.076336	51.21134
Inf_expA	47	6.49e+08	4.62e+08	3.75e+07	2.43e+09
Inf_exp	47	6.698048	3.101461	0.637366	17.95996
dum_Uni	47	0.6382979	0.4856879	0	1
oop_exp	47	1841.83	653.5458	690	3680
hea_den	47	15.02128	7.069498	5	34
hfd	47	2.921277	0.8174553	1.5	5.5
heins_cov	47	23.19149	11.3207	5	46
cns	47	18.06383	5.972416	9	37
ele	47	38.72128	21.34736	8.8	96.7
san	47	74.54043	19.99676	24.3	96.4
Ptrpry	47	39.51064	11.91249	23	80
Ptrecd	47	41.68085	27.01783	21	188
Ptrsec	47	29.93617	5.410956	19	43
RAI	47	62.85106	29.68163	2	98
pry_ele	47	77.08511	30.76463	4.9	100
Corr_lbry	47	0.8704255	0.2621065	0.4	2.02
Corr_Brypr	47	77.3617	18.65525	40	100
gini	47	35.62979	4.790612	27.2	55.9
Pov_hc	47	33.62553	11.65335	14.8	65.5
hhsz	47	4.312766	0.9035238	2.9	7
hhctrs	47	18.56809	8.620605	8.5	61.4
ach_cc	47	22.92979	11.15191	0.7	49.6
Ltmigr	47	26.90638	18.19506	1.3	81.9
Plny	47	11.82766	10.1268	1.2	47.6
wep	47	65.03617	12.78643	35.8	90.6

A keen look at the above descriptive statistics masks substantial regional inequalities in Kenya. The computed HCI for year 2013 shows that Siaya County had the lowest HCI of 10.47 while Nairobi County had the highest 93.12. In the year 2019, Migori County recorded the lowest HCI of 18.67 whereas Kiambu County had the highest HCI of 88.84. This state of inequality is frequent in all other socio-economic indicators.

From the descriptive statistics of dependent variables, we observe that all the counties had an increase in the share of persons with secondary education *(diff_edu)*. However, this is not the same for share of population with access to internet *(diff_inn)* and Health *(diff_Hth),* which in some counties increased, while in others decreased though on average, were positive. Human capital index in general experienced a decrease in some counties, but in most of them it increased *(diff_HCI)*.

The purpose of this study was to analyze the determinants of human capital development in Kenya. For this objective the study chose to study Kenyan counties and the difference between their level of education, innovation and health over time. It combined these three pillars into a human capital index and used it in the regression together with suggestions on possible determinants that are extracted from the existing literature.

In our regression analysis, the study adopted a cross-sectional approach. A key feature of cross-sectional studies is their ability to compare various population groups at a specific moment in time. This method allows us to observe differences across these groups within the same period, providing useful insights into existing relationships. However, it is important to note that cross-sectional studies have limitations in establishing cause-and-effect relationships. Since they capture a snapshot at a single point in time, they lack the temporal dimension necessary to observe changes or trends before or after the moment being studied. Consequently, while cross-sectional analysis is valuable for identifying associations, it does not inherently clarify causal links between variables.

This study carried several tests to check the validity of the econometrical model. In order to check for multicollinearity, the study created a correlation matrix based on Pearson correlations presented in table 3. If multicollinearity is present, it is impossible to allocate the individual effects of the collinear variables, which results in inefficient estimates with high variance.

Table 3: Correlation matrix

	diffHCI	diffEdu	diffInn	diffHth	LnGCPPC	LnPop	Edu_exp	Hea_Exp	hci_exp	Inf_exp	dum_Uni	hea_den	heins_cov	ele	ltmigr	wep
Diff_HCI	1.0000															
Diff_Edu	0.3717	1.0000														
Diff_Inn	0.5808	0.1689	1.0000													
Diff_Hth	0.6657	0.1181	0.0806	1.0000												
LnGCPPC	0.4335	0.1351	0.3406	0.2592	1.0000											
LnPop	0.4563	-0.0498	0.2513	0.2982	0.6050	1.0000										
Edu_exp	-0.2666	0.0385	-0.4257	-0.0772	-0.1859	0.0657	1.0000									
Hea_Exp	0.1691	0.1290	0.0363	0.1137	0.1244	0.2144	0.4586	1.0000								
hci_exp	0.0853	0.1214	-0.0675	0.0811	0.0651	0.2022	0.6326	0.9784	1.0000							
Inf_exp	-0.0850	0.0249	-0.0276	-0.0395	0.1494	0.3299	0.3009	0.2172	0.2594	1.0000						
dum_Uni	0.2765	-0.1835	0.3115	0.1710	0.3323	0.3833	-0.2136	0.1623	0.0917	0.1102	1.0000					
hea_den	0.6378	0.3304	0.2903	0.3883	0.5393	0.1688	-0.1650	0.2750	0.2013	0.0382	0.2960	1.0000				
heins_cov	0.4368	0.3296	0.3837	0.1110	0.7559	0.3619	-0.2360	0.1492	0.0751	0.0991	0.2989	0.6183	1.0000			
ele	0.6045	0.3674	0.3181	0.2612	0.7473	0.4956	-0.0853	0.2551	0.2025	-0.0165	0.3563	0.6973	0.7565	1.0000		
Ltmigr	0.4665	0.3305	0.3755	0.1216	0.4995	0.2482	-0.2171	0.0627	0.0041	0.0748	0.2665	0.5180	0.5615	0.6626	1.0000	
wep	0.0105	-0.2776	0.0001	0.0358	0.2306	0.0930	-0.0820	0.0463	0.0213	-0.3513	0.0815	0.1978	0.1068	0.1612	0.0993	1.000

The study data shown quite well, with only a few value above 0.5 therefore presenting a danger of highly correlated variables. Gross County Product Per Capita (GCPPC) was highly correlated with population density and a few other predictors. Therefore, it was excluded from the model. In addition, as it was expected Human capital expenditure was highly correlated with health expenditure hence excluded in the analysis. Since the other remaining values were only slightly above 0.5, it should not inflate the variances so much. This was confirmed through a robustness test, where the study compared values of all variables with regression containing both variables, then excluding *one of the affected variable* and later excluding *other one* for all the regressors respectively. There were no significant difference and the signs were always the same, therefore the study used all variables with exception of *GCPPC* and *hci_ exp* in the same estimation. As a second check for multicollinearity, VIF test was conducted since the variance inflation factors are all below 2, it confirmed that multicollinearity is truly not a problem.

It is expected to see a strong correlation between the dependent variables diff_Hth and diff_HCI, which underscores the significant role health plays in influencing human capital. A high correlation between dependent variables is not a cause for concern; in fact, it's logical given that human capital index is derived from these variables. Similarly, a strong correlation between

dependent and independent variables is a positive indicator, as it suggests the expected relationship that forms the basis of regression analysis.

To check for heteroscedasticity, the study applied the formal Breusch-Pagan and White tests, both of which confirmed the presence of heteroscedasticity in the models. As a result, to prevent bias in the standard errors due to their varying variance, the study employed robust standard errors.

Analysis

Table 4 presents a summary of our four models and their results.

Table 4: Results of OLS regressions for respective dependent variables with robust standard errors

Variable	HCI	EDU	HEALTH	Innovation
Pop	0.0004063*** (0.0000954)	-4.4506 (0.0000487)	0.0002372*** (0.0000648)	-0000444 (0000342)
Edu_exp	0.0328335 (0.02721)	0.0116859 (0.100994)	0.0236889 (0.0207686)	0.003425 (0.0205285)
Hea_Exp	-0.0032899 (0.0050927)	0.0000903 (0021969)	-0.0018511 (0.0043567)	-0.0003076 (0.0049465)
Inf_exp	-0.031885* (0.0191205)	-0.0073104 (0.0078149)	-0.0040605 (0.0221208)	-0.0036163 (0.0114156)
dum_Uni	0.1673647 (0.1495436)	0.1108288** (0.0470141)	0.1482833 (0.1385113)	0.0684364 (0.1047761)
oop_exp	0.0002987*** (0.0001102)	-0.0000576 (0.0000515)	0.0002831** (0.0001193)	-
hea_den	0.0311727** (0.0125464)	-0.0036459 (0.0051758)	0.0237813* (0.0126107)	-
Hfd	-0.0806511 (0.1331792)	-0.0370382 (0.0429681)	-0.0400608 (0.0866123)	-
heins_cov	0.0477955*** (0.0125652)	-0.0059637 0.0049899)	0.0365537** (0.152614)	-
Cns	-0.0131136 (0.0143795)	0.0147874*** (0.0051671)	-0.0113175 (0.0166673)	-
ele	-0.0132393 (0.0082523)	0.0024108 (0.0026422)	-0.0186693 (0.0113601)	0.01738*** (0.0048537)
san	-0.0134013 (0.0121037)	0.0015302 (0.0050465)	-0.0144963 (0.0096122)	-
Ptr_pry	0.118478 (0.0150401)	-0.0181614*** (0.0066661)	0.0253912 (0.0233159)	0.0031108 (0.007616)
Ptr_ecd	-0.0162119*** (0.0043528)	0.0023016 (0.001979)	-0.0133944** (0.0069817)	0.0011379 (0.0021398)
Ptr_sec	0.0469531* (0.0258558)	0.0219454** (0.010678)	0.0181608 (0.03344019)	0.0104807 (0.107886
RAI	-0.0179944*** (0.0052209)	0.0002449 (0.0021889)	-0.0123222*** (0.0048183)	-0.0038658 (0.002897)
pry_ele	0.0277207*** (0.0055369)	-0.004435 (0.0028482)	0.0217171*** (0.0075186)	0.0015568 (0.0035196)
Corr_lbry	-0.1353454 (0.1884213)	0.0736111 (0.1023585)	-0.0714922 (0.1656764)	0.1085192 (0.1432407)
hhsz	-0.4798617** (0.2085186)	-0.0601372 (0.0949206)	-0.5816118* (0.3104365)	-0.0010679* 0.1137208
Ltmigr	-.0057321 (0.0050363)	-0.0007499 (0.0012371)	-0.0065062 (0.0045372)	0.0047093* (0.0030151)
wep	.0018204 (0.003351)	0.0006929 (0.0016385)	0.0018204 (0.003351)	
consant	-.635634 (1.330794)	-0.0355472 (0.8685572)	-0.635634 (1.330794)	2.136162*** (0.7057577)
Prob > F	0.0000	0.0000	0.0002	0.0000
Number of obs	47	47	47	47
F(20, 26)	42.13	19.73	5.60	85.87
R-squared	0.8768	0.8947	0.7093	0.9126
Root MSE	0.26184	0.10406	0.26678	0.21321

****. Parameter is significant at the 0.01 level*

***. Parameter is significant at the 0.05 level*

**. Parameter is significant at the 0.1 level*

Notes : Robust standard errors in parentheses

The R^2 and F-statistics indicate that the models accounts for a substantial portion of the variation in the dependent variables. Additionally, all models showed overall statistical significance, with p-values too small to measure to four decimal places. To maintain clarity, we organize the next section based on the dependent variables, which are also expected to be key factors influencing human capital development.

The coefficient for population density (*pop)* is significant for human capital and health and their relationship appears to be positive, which is consistent with initial expectations. These results conforms to Becker et al. (1999) that it is likely that the population density raises the production of human capital as a higher density results into larger market and more specialization. However, this coefficient is insignificant for education model.

Expenditure on education coefficient (*edu_exp*) was found not significant on all models. These results are consistent with Hanushek (1997) who argued that simply increasing spending on education does not necessarily lead to better educational results, emphasizing that how the funds are used matters more than the amount spent. For instance, inefficient resource allocation, bureaucratic inefficiencies, and lack of accountability can undermine the potential benefits of higher expenditure. However, this result is not surprising for Kenya since the study used county level expenditure and education is a national government function hence results could be different if national figures were used.

Expenditure on health coefficient (*Hea_exp*) was not significant in the human capital index, and all the three pillars of human capital. This is interesting given that health is a key function of county governments in Kenya. This raises questions on efficiency and effectives of health spending. As counties continue to grapple with rising healthcare costs and crisis future research is needed to better understand how health expenditure can be optimized to achieve the greatest possible improvements in population health.

Even though expenditure on infrastructure (*inf_exp*) was not significantly affecting the human capital index and its three pillars, it had a negative sign all through. Implying that human capital and physical capital competes for scarce resources. However it is insignificant, therefore we cannot draw any conclusions.

The hypothesis that the presence of university in the county (*dum_Uni*) leads to more human capital development was confirmed only in the education model. This study found out that counties that have a university within its jurisdiction, on average have a higher proportion of population with secondary education with a factor of 0.111 than those who don't have a university. This is consistent with the findings of Glaeser et al. (2005), who highlight the significant role universities play in creating initial advantages in the development of human capital. However, this coefficient was statistically insignificant in the HCI and health model. In comparison, Moretti (2004) discovered that being close to universities has little effect on individual traits, which can also be interpreted as having minimal influence on human capital development.

Contrary to a priori expected hypothesis, the study reveals that out of pocket expenditure *(oop_exp)* has a positive and statistically significant effect on human capital development and Health. This finding could be due to income inequality in the sense that those who are able to pay for health care service enjoy good health and more human capital development. This has a policy implication on health access and equity.

As expected Health Workforce Density *(hea_den)* had a positive significant coefficient on HCI and Health model. Counties with higher health workforce density will enjoy more human capital development with a coefficient of 0.0237813. In spite of the a priori expected sign, the coefficient of health facility density *(hfd)* is not significant enough to support the hypothesis that higher health facility density would lead to better health and human capital development. Thus, what is important in effectively attaining human capital development may not be the expansion/construction of new health facilities but changing the health workforce density of the counties by employing more health workers.

Health insurance coverage *(heins_cov)* had a positive and significant coefficient as hypothesized. The coefficient of *heins_cov)* was equal to 0.0477955 and 0.0365537 for HCI and Health model respectively. This means a one percentage point increase the proportion of housed with a health insurance cover will increase HCI by 0.048 and life expectancy at birth by 0.037. These results are consistent with (Levy & Meltzer, 2008) who found a positive relationship between health insurance coverage and health-related outcomes. This result is significant for Kenya as it seeks to enhance the health of its population and achieve its Universal Health Coverage (UHC) objectives.

ECD Pupil-Teacher ratio (*ptrecd*) had a negative and statistically significant coefficient for HCI imply that lowering the ratio by employing more ECD teachers would increase human capital development. This is crucial for counties, considering that Early Childhood Development (ECD) is a devolved function. The pupil-teacher ratio significantly affects human capital development by influencing the quality of education, student performance, teacher effectiveness, and long-term socio-economic outcomes. Policies aimed at reducing PTRs can have a profound impact on enhancing the development of human capital, particularly in counties with high pupil-to-teacher ratio.

The proportion of the population accessing a motorable road within two kilometers, represented by the Rural Access Index (RAI) as a proxy for infrastructure investment, had a negative and significant coefficient, confirming earlier findings that human capital development and infrastructure investment are substitutes in Kenya. Therefore, they compete for scarce resources hence a trade-off is necessary.

As expected the proportion primary schools connected with electricity (*pry_ele*) had a positive and significant coefficient. This finding is important for counties and national government in Kenya considering regional inequalities on the proportion of primary school connected with electricity. While some counties like Nyeri has 100% Mandera has 4.9%. To enhance and sustain human capital development these inequalities should be addressed.

Household size (*hhsz)* as hypothesized had a negative and significant coefficient. Larger household leads to lower human capital development. This may be as a result of per capita resource dilution i.e larger household sizes often result in more competition for limited resources, such as income, time, and attention. In larger families, resources like food, educational materials, and healthcare services must be distributed among more individuals, potentially leading to lower investments in each child's education, health, and overall human development. The findings have several policy implications for fertility, particularly in the areas of family planning, household economic empowerment, and human capital financing in Kenya.

Evidence on the effects of other variables included in the models are not strong enough to support the a priori expected hypothesizes. On innovation model the only significant coefficient is that of proportion of the households connected with electricity *(ele)*.

Conclusion

The aim of this study was to examine the factors influencing human capital development in Kenya. To achieve this, the study focused on Kenyan counties and assessed the variations in education, health, and innovation levels over time. These three pillars were combined to form a Human Capital Index (HCI), which was then utilized in a regression analysis, along with potential determinants identified from the literature.

Based on the findings of our analysis, we offer the following recommendations for policymakers aiming to enhance human capital accumulation in their counties:

Health workforce density *(hea_den)* was found to have a significant positive effect on Human Capital Development (HCD), whereas the effect of health facility density (*hfd)* was not significantly different from zero. Therefore, to effectively achieve human capital development in Kenyan counties, it may be more crucial to focus on increasing the health workforce density by employing more health workers rather than simply constructing new health facilities.

The pupil-teacher ratio in Early Childhood Development (ECD) was found to significantly influence human capital development by affecting education quality, student performance, teacher effectiveness, and long-term socio-economic outcomes. Policies designed to lower pupil-teacher ratios can have a substantial impact on fostering human capital development, especially in areas where ratios are excessively high.

To expand health insurance coverage, which has positive effects on human capital development, the government should implement social health insurance to protect poor and vulnerable populations and promote equitable access to healthcare. Policy reforms are needed to reduce out-of-pocket (OOP) expenses and address the limitations of current health insurance in providing access and financial protection. Comprehensive, adequate, and accessible health insurance benefit packages are essential, and this can be achieved by strengthening the healthcare system to improve service access. Government initiatives, such as the Social Health Insurance Fund (SHIF), are steps in the right direction toward achieving Universal Health Coverage (UHC).

Given that education expenditure is statistically insignificant from zero, it appears that spending on education has little to no impact on human capital. Therefore, we recommend thoroughly evaluating every investment decision in education, as large financial allocations do not necessarily

ensure efficient use. A well-targeted investment with minimal resources can significantly improve education quality, while spending large sums on unnecessary initiatives may yield no substantial change.

Household size was found to have a significant negative effect on Human Capital Development (HCD) in Kenya. Thus, household size plays a crucial role in human capital development, particularly in resource-constrained environments. Larger households often encounter challenges related to resource allocation, educational attainment, and health outcomes, which can limit the human capital potential of children. Counties can develop population policies aimed at reducing household size, specifically addressing unmet family planning needs. However, implementing such policies may be challenging in some counties due to the politics surrounding population size and its impact on national resource allocation.

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