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Article

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Human capital and income inequality in Africa: robust governance synergies and thresholds

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ABSTRACT

It has been widely documented that good governance reduces income inequality when it creates a conducive environment for quality human capital development. This study investigates the unconditional effects of human capital on income inequality and explores whether institutional quality mechanisms for corruption control and government effectiveness moderate the relationship. Results from the instrumental variable generalised method of moments estimator and data for an unbalanced panel data of 36 African over the period 2010-2020, shows that human capital increases income inequality. However, robust evidence from the interactive analysis reveals that corruption control and government effectiveness mitigate the income inequality-enhancing effect of human capital. This study underscores the need to improve structures and system government effectiveness and corruption control for human capital development to equalise income in Africa.

IMPACT STATEMENT

This study provides valuable insights into the relationship between human capital development and income inequality in Africa, challenging the conventional belief that human capital alone reduces inequality. Using an instrumental variable generalized method of moments estimator and data from 35 African countries over the period 2010-2020, the research finds that human capital, on its own, tends to exacerbate income inequality. However, the study also reveals that effective governance mechanisms, particularly corruption control and government effectiveness, can mitigate this adverse effect. By highlighting the crucial role of institutional quality in moderating the relationship between human capital and inequality, this research offers actionable recommendations for policymakers. The findings underscore the importance of strengthening governance structures to ensure that investments in human capital contribute to more equitable income distribution across Africa. This study significantly advances the discourse on governance, inequality, and human capital development in the context of African economies.

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1. Introduction

Income inequality is one of the key challenges facing the world today (Blau, 2018; World Bank, 2020). As a long-standing economic and social issue, income inequality is recognised to retard economic growth, waste human resources, deepen poverty, and create a favourable environment for the manifestation of other social vices (Alvaredo et al., 2021; Assouad, 2023). Consequently, the United Nations (2007) describes income inequality as a problem that requires a global solution. For unequal and marginalised societies, recent evidence affirms that understanding the underlying link between income inequality and human capital can enhance sustainability (World Bank, 2018, 2020).

Whereas income inequality [hence known as IE] everywhere is worthy of investigation, nowhere is knowledge on the IE and human capital nexus more critical than in Africa. If for nothing at all, the

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incidence of IE is more pervasive in Africa than in the rest of the world and hence should naturally attract more scholarly attention. For example, Odusola et al. (2017) advanced that ninety percent of the unequal countries in the world are in Africa. Meanwhile, it has been proven that IE creates sharp disparities in other socioeconomic opportunities including education (Coady & Dizioli, 2018), health (Wilkinson & Pickett, 2006), energy (Galvin & Healy, 2020), employment (United Nations, 2007), preferences for income redistribution (Roth & Wohlfart, 2018), life satisfaction (Suriyanrattakorn & Chang, 2022) as well as the quality of public services (Bhattacharya et al., 2016). The disparities in these other socioeconomic opportunities are equally more pronounced and devastating in Africa than in other continents (World Bank, 2020). This underscores the relevance of empirical research on the significant drivers of IE and the pathways through which IE can be successfully addressed. In this study, we contribute to income equalisation by paying attention to the role of good governance in enhancing the connection existing between IE and human capital. In our candid opinion, a sustainable solution to the IE problem is more probable if: (1) the economic and social environment in which people operate is fair and friendly, and (2) citizens have equal capacities and/or skills to identify opportunities, take risks and overcome shocks.

The criticality of human capital for income equality lies in its ability to increasing innovation and competitiveness in the labour market. This is cleverly articulated by Burzynski et al. (2020) and Lindgren et al. (2019) who reckoned that investments in human capital can address IE by increasing economic growth and creating several self-reinforcing positive externalities. This is more so considering the plethora of empirical evidence revealing that in settings where investment in human capital is high, economic agents tend to contribute immensely to socioeconomic development through increased innovation and enhanced productivity (Hanushek, 2013).

It is in this light that African leaders have agreed to increase the quality of education and healthcare in their respective countries. For instance, Kenya, Ghana, Zimbabwe and South Africa have all not only universalised access to basic education but have also implemented school feeding and subsidised healthcare policies for their citizens geared towards enhancing the quality of human capital (Duflo et al., 2021). Despite these efforts, concerns about the contribution of human capital to income equality in Africa have been raised. The first regards the quality of human capital in the continent. As reported by World Bank (2018), three out of every four children in Africa cannot count beyond 80 while 40 percent of them are unable to solve one-digit addition problems. With respect to literacy, 50 to 80 percent of children in Africa can neither read nor comprehend a short passage. The second has to do with Africa's weak capacity for checking corruption and increasing the contribution of human capital to shared prosperity.

Taking cues from Ofori et al. (2023), we argue that good governance can, both directly and indirectly, promote human capital development and foster fairer income distribution. Put differently, good governance is required to create efficient economic and social conditions that dismantle inequalities in skills, abilities and opportunities for all to gain favourably from growth. We pay attention to two governance indicators in this study: (i) government effectiveness, (ii) control of corruption. We keep tabs on these two governance dynamics as their relevance for fairer income distribution cuts across resource allocation and sound socioeconomic policies including freedom.

To begin with, government effectiveness is essential for determining how resources are allocated within the economy. Also, sound government effectiveness in the forms of social overheads can drive inclusive and shared growth (Asongu & Odhiambo, 2021). In our candid view, the role of government effectiveness in the equalisation of incomes goes beyond the correction of prices to include the rolling out of policies, systems and frameworks that support innovation, dexterity, and entrepreneurship. The role of control of corruption for social progress has also been highlighted in the literature. For instance, Acemoglu and Robinson (2010) advanced that effective control of corruption is vital for allocating the gains from growth and removing frameworks that hinder performance. However, considering the apparent lags in structures for government effectiveness and control of corruption in Africa (Doumbia, 2019; Nchoufoung & Asongu, 2022), these plausible human capital-governance synergies for equitable income distribution could prove elusive.

Examining the literature, we find that previous studies have only explored the unconditional effect of human capital development on income inequality in Africa (Anyawu et al., 2016; Friderichs et al., 2023; Jonathan Gimba et al., 2021; Nabassaga et al., 2020; Van Leeuwen et al., 2012). A glaring gap is that these studies have not examined the moderating effects of government effectiveness and control in the relationship between human capital and income inequality in Africa, leaving a gap in understanding how these

factors interact to shape economic outcomes. Our motivation stems from Africa's weak structures and systems for government effectiveness and corruption control, which can undermine human development efforts and by extension income inequality. Structured differently, although a plethora of research have studied the impacts of human capital and governance on income distribution, rigorous empirical contributions interrogating whether the former interacts with the latter to equalise incomes in Africa remain unknown. Finally, a conspicuous gap in literature is that previous studies have not examined the short to long-term benefits of channelling resources into the building of structures that ensure effective governance and transparency in Africa. This study seeks to fill this void in the IE literature on Africa. Accordingly, we address three objectives. First, we examine the impact of human capital on income inequality in Africa. Second, interact with human capital to equalise incomes in Africa. Second, we investigate whether corruption control and government effectiveness interact with human capital to reduce income inequality in Africa.

Our results from instrumental variable regression model and macroeconomic data for 36 countries over the 1960–2020 period reveal that human capital aids equitable income distribution in Africa. Further, we find corruption control as an effective means of propelling human capital towards income equalisation across the region. Finally, we confirm that the short to long-term income equality benefits of channelling resources toward control of corruption are remarkable.

This research builds on the body research examine the impact of human capital development on income inequality in developing countries. The contribution of this study to the extant scholarship are twofold. First and foremost, this study makes a unique contribution by investigating the contingency effect of government effectiveness and corruption control moderate the link between human capital and income inequality in Africa. Unlike previous studies that primarily focus on the direct effects of human capital, the moderation analysis in this study is critical as it brings to the fore the extent to which institution quality affects the link between human capital and income inequality. Second, we estimate the threshold effects of government effectiveness and corruption control in the relationship between human capital and income inequality. This analysis is policy-relevant as it provides evidence concerning how improving two critical institutional variables – government effectiveness and corruption – conditions human capital development to affect income inequality in Africa.

2. Literature review

2.1. Theoretical relationship between human capital and income inequality

The discourse on IE usually starts with the unified theory of inequality and growth as the common point of theoretical departure. As an amalgamated concept, this theory opines that physical capital and human capital accumulations are asymmetric in the development process (Galor & Moav, 2004). The asymmetric relationship between physical and human accumulation increases the utility of equality for human capital accumulation in the presence of credit constraints and inequality for physical capital accumulation under conditions of higher marginal propensity to save.

Unlike physical capital, whose contribution to economic growth and development is not dependent on how it is distributed across the population, human capital is embedded in people and thus its total stock is larger when it is widespread. The theory further stresses that because physical capital accumulation is an important driver of economic growth in the initial phases of development, inequality enhances the development process by transferring scarce resources to net-saving capital owners. But as economic growth and development advance, human capital overtakes physical capital as the propeller of economic growth because of the capital-skills nexus. Alternately, the accumulation of human capital through education, skills training and quality healthcare can make individuals competitive in the labour market and contribute to decline in inequality (Engelbrecht, 2003; Hendricks, 2002). Proponents of the institutional theory also emphasise the part played by good governance and effective institutions in enhancing human capital accumulation and equality (Faria et al., 2016; O'Neill & Bagchi-Sen, 2023; Uddin et al., 2021).

2.2. Empirical literature on human capital and income inequality

A plethora of research exists on human capital. But the majority of them tend to concentrate on the link between economic growth and human capital represented by either total income, per capita income or

productivity (Okunade et al., 2022), with the hope that high economic growth will generate beneficial spillovers to the poor in society (Škare & Družeta, 2016). This is, however, not synonymous with income equality or a decline in poverty. In fact, it has been well-documented that high economic growth can coexist with pronounced IE (Domhoff, 2012). In this section, we profile previous studies that directly interrogate the impacts of human capital on IE. As a taster, we admit that the evidence on how human capital affects IE is mixed, reflecting the debate on IE and human capital is far from being settled.

Savvides (1998) employed panel data on 41 countries to analyse the influence of human capital and trade openness on IE. Empirical estimates showed that both variables had a meaningful role in decreasing IE. Acemoglu and Dell (2010) maintained that about half of the between-municipality and between-country income differences are attributable to differences in human capital, which was measured using years of schooling and experience of the labour force. López-Bazo and Motellón (2012) obtained a similar outcome in their analysis of regional wage gaps in Spain. Similarly, Shahpari and Davoudi (2014) as well as Sheikh et al. (2016) found that human capital reduces IE. A significant and positive relationship between schooling inequality and IE was found by Coady and Dizioli (2018) who recommended to use of education expansion as a tool to make income distribution more equal. Evidence also suggests that declining schooling inequality has influenced the reduction in IE in Brazil (Lam et al., 2015).

Drawing on data from a panel of 95 economies, Lee and Lee (2018) found that educational expansion will likely lead to improved educational equality and more equal income distribution. Not only is education a key determinant of IE as observed by Yang and Qiu (2016), but available evidence reveals that widespread access to quality education reduces IE by enhancing participation in governance and labour market activities (Lindgren et al., 2019). Burzynski et al. (2020) studied the underlying factors responsible for the global distribution of skills and how that affected IE. These authors developed and parameterised a two-class, two-sector world economy model that endogenises mobility decisions and education as well as income differences within and across countries. Results from a static experiment showed that sectoral misallocation of skills and low access to education significantly influenced income in poor countries. Consequently, the authors concluded that policies targeting access to education at all levels will have a long-term effect on inequality and demographic growth. Arguments raised by Steinberg (2017) and Leamer et al. (1999) found that resource endowment increases IE by absorbing the flow of capital to manufacturing and depressing workers' incentive to accumulate skills. Unfortunately, these studies did not test the performance of human capital in the presence of confounding variables such as good governance. More recently, Hossain (2022) addressed this lacuna by assessing the function of good governance in fostering human capital to reduce IE. Unfortunately, the author gauged human capital with life expectancy at birth and adult literacy rate as a percentage of the total population which may not be a good measure of human capital compared to a diversified index that captures additional variables.

Nevertheless, other works have also observed a direct positive link between human capital and IE (Checchi, 2004; Menezes Filho & Kirschbaum, 2019). The third group of studies either found no relationship or a curvilinear relationship concerning IE and human capital. More recently, Castelló-Climent and Doménech (2021) found an inverted U-shaped association between human capital inequality and IE, but with substantial differences among countries concerning the turning points. The authors also observed that skill-biased technological change has the potential to weaken the relationship between earnings inequality and human capital. They reported that IE was directly and positively influenced by human capital inequality beyond that of earnings inequality. Similarly, using data for a panel of countries, Földvári and Leeuwen (2010) analysed the association between education inequality and IE and revealed that the impact of education inequality on IE was insignificant. Uddin et al. (2021) analysed how human capital and institutions influence economic growth in 120 developing economies and found human capital and institutions to have statistically significant and indirect interactive effects on economic growth in the studied countries. Although these authors did not investigate how human capital influences IE directly, the implications of their findings for IE are implicit. In particular, they argued that increasing human capital development investments impacts economic growth and equality negatively when institutions are weak and dysfunctional. And this is because additional investments tend to be misallocated through socially unproductive activities and rent-seeking. Unfortunately, this study did not test the threshold of institutions at which human capital tends to wreck or enhance IE. Finally, between human capital and IE, evidence of an inverted U-shape relationship was found by Lim and Tang (2008).

2.3. The link between good governance and income inequality

There is an array of literature on the effect of good governance on income around the globe. Evaluating the role of governance in wealth inequality among oil rich economies, for instance, Njangang et al. (2022) observed that while good governance reduces wealth inequality, these effects are felt when some appreciable levels of rule of law, regulation quality, corruption controls, and government effectiveness are in place. Good governance has also been recognised to have both an intrinsic value and a positive effect on development by ensuring equality in the distribution of wealth (Zhuang et al., 2010). In particular, these authors show that government effectiveness, rule of law, and regulatory quality, as measures of good governance reduce inequality. Huang et al. (2018) found similar results among developing and emerging economies in Asia. They observed that good governance has a reducing effect on IE. However, Huang and Ho opined that among advanced economies, the impact of good governance on IE was insignificant, reflecting that the mediation role of good governance on IE cannot be universalised.

The role of corruption in IE has been widely investigated. In assessing the effects of governance on economic welfare, Shafique et al. (2006) showed that improvement in public establishments' efficiency and corruption reduction has the potential to improve income distribution through increased economic growth. On the other hand, Wong (2017) argues that the effects of corruption on IE is mixed depending on the source of corruption. He shows that corruption that results in the sharing of looted funds among the populace reduces inequality while the type that leads to the concentration of looted funds in the hands of the elite tend to widen IE. Apergis et al. (2010) found a positive long run relationship between corruption and inequality, reflecting that inequality rises with corruption.

3. Methodology

3.1. Data

The empirical analysis in this study used macroeconomic data for 36 African countries from 2010–2020. The underlying dataset is unbalanced, arising from data availability issues in many African countries. Accordingly, we guard against unreliable inference by dropping countries that lack observations for at least three years, leading to a sample of 36 African countries. We contend that this sample is appropriate as it captures a more comprehensive picture of Africa's diverse socioeconomic and institutional experiences. By using unbalanced data, we ensure that insights from countries with just or two missing observations are not excluded, providing a more realistic analysis of the nuanced linkages between human capital, governance quality and income inequality.

Data for the analysis were obtained from free and open sources. The outcome variable employed in the analysis is the Palma ratio, which is measured as the share of national income owned by the top 10 percent richest quintile of a population relative to the share of the poorest 40 percent. Our attention on this measure follows the argument in Ofori et al. (2022) that compared to other IE indicators, the Palma ratio best captures both between-and within-household IE. In assessing the robustness of the estimates, we employ an alternative IE measure, that is the Gini (Table 4) as outcome variable. We mine datasets on these variables from the Standardized World Income Inequality Database (Solt, 2020).

As the main variable of interest in this study, human capital was captured with returns to education and years of schooling (Feenstra et al., 2015). The essence of human capital for IE has been clearly articulated. For our moderators, we pay attention to two governance dynamics: (1) institutional governance (proxied by control of corruption) and, (2) economic governance, which as pointed out in the introductory section, can mediate the human capital-income inequality relationship. In line with sound econometric procedures for multiple regression analysis, we keep tabs on some control variables to mitigate potential omitted variable bias and capture the implication of new economy, economic growth, resource allocation and employment for income distribution. Specifically, we control for economic growth, digital infrastructure, financial development and vulnerable employment in the conditioning information set. First, our attention on new economy is based on recent evidence in the IE discourse that access to and usage of digital infrastructure are effective tools for decreasing the disparity between the rich and the poor in access to information, economic opportunities and incomes (Adeleye et al.,

2021; Ofori & Asongu, 2021). The data for digital infrastructure is taken from the African Infrastructure Knowledge Program (African Development Bank, 2018). Second, mindful of the growing scholarly attention on the implication of resource allocation for IE, we consider financial development as a control variable. The relevance of financial development is anchored in the finance-led hypothesis that access to credit can propel private sector innovation, performance, and job creation (Adegboye & Iweriebor, 2018; Svyrydzenka, 2016). However, the effectiveness of financial development in the equalisation of incomes in settings like Africa has been questioned. The argument centres on the concern that financial polarisation, which is conspicuous in the rural-urban divide, can heighten inequalities in access to finance (Jauch & Watzka, 2016). Similar to Svyrydzenka (2016), we draw our financial development measures from the IMF's Financial Development Index.

Also, consistent with the Kuznets' hypothesis, we keep tabs on economic growth. However, the literature suggests that countries in their early stages of development, like those we consider in this study, have higher levels of IE (Fosu, 2018). Nonetheless, in latter stages of development, sound socioeconomic policies can deliver a shared growth (Ali & Son, 2007; Anand et al., 2013). Lastly, we take note of vulnerable employment to capture the nature of income growth and poverty alleviation on IE reduction. Although vulnerable employment can contribute to poverty alleviation at the individual level, widespread job precarity can widen the income disparity gap as such employment avenues: (1) attract low wages, and (2) lack safety nets that protect workers from socioeconomic shocks (Anand et al., 2013; Webster et al., 2017). Both economic growth and vulnerable employment are taken from World Development Indicators (World Bank, 2022). A thorough explanation of the variables is given in Table 1.

3.1.1. Estimation strategy

Following the empirical procedure in Ofori et al. (2022) and Bergh and Nilsson (2010), we begin our empirical models' specification by first interrogating how our control variables affects IE as seen in Equation (1):

$$palma_{it} = \alpha_0 + \alpha_1 palma_{it-1} + \delta_1 digit_{it} + \delta_2 vul_{it} + \delta_3 findep_{it} + \delta_4 grow_{it} + \epsilon_i + \mu_t + \varepsilon_{it} \quad (1)$$

Table 1. Description of variables and data sources.

Variables	Symbol	Description	Source
<i>Dependent variables</i>			
Palma ratio	Palma	The ratio of the share of incomes held by the richest 10% of the population to that of the poorest 40% of the population.	SWIID
Gini index	Gini	The average income inequality after taxes and transfers (0 denotes a case of perfect equality while 100 indicates a case of perfect inequality).	SWIID
<i>Main predictor</i>			
Human capital development	Hci	Index for years of schooling and returns to education	PWT
<i>Control variables</i>			
Economic growth	Grow	GDP per capita growth (annual)	WDI
Vulnerable employment	Vul	Number of contributory family and own-account workers (% total of total employment)	WDI
ICT infrastructure index	Ict	Composite index on the construction, extension, improvement, operation, and maintenance of communication systems (postal, telephone, telegraph, wireless, and satellite communication systems).	AIKP
Financial access	Findep	Credit to private sector as a percentage of GDP	WDI
<i>Moderating variable</i>			
Government effectiveness	Govef	Captures perceptions of the quality of public services, the civil service and the degree of their independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.	WGI
Control of corruption	Corrupt	Captures perceptions of the public on the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as 'capture' of the state by elites and private interests. (estimate)	WGI

Note. WDI: world development indicators; SWIID: standardized income inequality database; PWT Penn World Tables; WGI: world government indicators; and AIKP: Africa Infrastructure knowledge program.

That said, we turn attention to the specification of a full model consistent with Objectives 1 and 2 of this study and introduce the conditional and unconditional effects of human capital. Accordingly, we modify [equation \(1\)](#) as follows:

$$\begin{aligned} \text{palma}_{it} = & \alpha_0 + \alpha_1 \text{palma}_{it-1} + \delta_1 \text{digit}_{it} + \delta_2 \text{vul}_{it} + \delta_3 \text{fidev}_{it} + \delta_4 \text{grow}_{it} + \beta_1 \text{hci}_{it} + \beta_2 \text{gov}_{it} + \beta_3 (\text{hci}_{it} \times \text{gov}_{it}) \\ & + \epsilon_i + \mu_t + \varepsilon_{it}, \end{aligned} \quad (2)$$

where *palma* is Palma ratio; *i* is country; *t* is time in years; *digit* digital infrastructure; *fdev* is financial development; *grow* is GDP per capita growth rate; and *vul* is vulnerable to employment. Also, we use *hci* to signify human capital; *gov* is an indicator of our governance dynamics: corruption control (*corrupt*) and government effectiveness (*govef*). Additionally, we use (*hci* \times *gov*) to denote the interaction of human capital and our governance indicators; ε_{it} is the idiosyncratic error term; and ϵ_i is the country-specific effects. Mindful of endogeneity concerns, which could undermine our estimates, we do not estimate [Equations \(1\)](#) and [\(2\)](#) via the fixed effect, pooled least square, or random effect estimators. In this study, endogeneity is apparent considering the possible reverse causality between weak institutional quality and IE (see e.g., Acemoglu & Robinson, 2010; Kaufmann et al., 2010). The justification is that weak structures and frameworks for control and government effectiveness can lead to skew economic opportunities for just a few connected elite or affluent individuals, leading to high-income inequality. On the other hand, a higher level of income inequality can also weaken institutional quality as especially the elite households use informal channels to acquire services (e.g., access to electricity and water) in the shortest possible time or access opportunities. This can be a disadvantage to vulnerable households, further widening the income disparity gap.

In light of these concerns, this study employs the instrumental variable generalized method of moments (IV-GMM) regression put forward by Baum et al. (2010). Compared to the first-difference GMM technique of Arellano and Bover (1995), the IV-GMM is superior in yielding sound and robust estimates. This is because it has been shown to be reliable in the presence of strong persistence. Also, according to Ahn and Schmidt (1995), IV-GMM accounts for the viable information in the level relationship and in the relations between the level and the first differences. More importantly, the IV-GMM estimator produces reliable and asymptotically consistent estimates rather than the first-difference generalised method of moments. Another caveat for employing the two-step system generalised method of moments is that the period under consideration (11 years) is less than the count of countries in this study (36).

Further, the Baum et al. (2010) IV-GMM technique estimates is flexible to execute as allows one to use lagged first-differenced independent variables as instruments in the level equation with the lagged level covariates as instruments in the first-differenced estimation. Moreover, we recognise that endogeneity is not the econometric concern with data analysis. Accordingly, the study also employed the Driscoll and Kraay (1998) standard errors estimator to account for potential econometric issues such as heteroscedasticity, cross-sectional dependence and serial correlation, ensuring that our findings are robust and appropriate for inference.

With all that said, we proceed by presenting [Equations \(3\)](#) and [\(4\)](#), which in respective terms, encapsulate the level and first difference specification of the dynamic two-system generalised method of moments estimation.

$$\text{palma}_{it} = \alpha_0 + \alpha_1 \text{palma}_{it-1} + \beta_1 \text{hci}_{it} + \beta_2 \text{gov}_{it} + \sum_1^4 \delta_4 V_{kit-\tau} + I_i + \mu_t + \varepsilon_{it} \quad (3)$$

$$\begin{aligned} \text{palma}_{it} - \text{palma}_{it-\tau} = & \alpha_1 (\text{palma}_{it-\tau} - \text{palma}_{it-2\tau}) + \beta_1 (\text{hci}_{it} - \text{hci}_{it-\tau}) + \beta_2 (\text{gov}_{it} - \text{gov}_{it-\tau}) \\ & + \sum_1^4 \delta_4 (V_{kit-\tau} + V_{kit-2\tau}) + (\mu_t - \mu_{it-\tau}) + (\varepsilon_{it} - \varepsilon_{it-\tau}) \end{aligned} \quad (4)$$

Then, to account for the moderating role of governance in the human capital-income inequality relationship, we modify [Equation \(4\)](#) to get [Equation \(5\)](#):

$$\begin{aligned} \text{palma}_{it} - \text{palma}_{it-\tau} = & \alpha_1 (\text{palma}_{it-\tau} - \text{palma}_{it-2\tau}) + \beta_1 (\text{hci}_{it} - \text{hci}_{it-\tau}) + \beta_2 (\text{gov}_{it} - \text{gov}_{it-\tau}) \\ & + \beta_3 (\text{hci}_{it} \times \text{gov}_{it} - \text{hci}_{it-\tau} \times \text{gov}_{it-\tau}) + \sum_1^4 \delta_4 (V_{kit-\tau} + V_{kit-2\tau}) + (\mu_t - \mu_{it-\tau}) + (\varepsilon_{it} - \varepsilon_{it-\tau}) \end{aligned} \quad (5)$$

Finally, we present Equation (6), which captures the net effects of the human capital-governance interactions.

$$\frac{\partial(\text{palma}_{it})}{\partial(hci_{it})} = \beta_1 + \beta_3 (\text{gov}_{it}) \quad (6)$$

In line with the Kuznets hypothesis, we expect economic growth to increase IE while its squared term is expected to have income equality inducing effect. Also, with an expectation of financial access and digital infrastructure reducing IE, vulnerable employment is also expected to have a positive effect on IE.

It is worth noting that in line with contemporary scholarship in evaluating the robustness of system generalised method of moments estimates, several post-estimation tests are conducted. To begin with, we examine the suitability of the instruments employed in this study based on the Hansen's test of over-identification (Hansen, 1982). This test is gauged against the null hypothesis that the residuals and the set of instruments are uncorrelated. Thus, the robustness of our estimates based on the suitability of the instruments relies on the failure to reject the null hypothesis. This means that failure to reject the null hypothesis suggests that the set of identified instruments are robust, and the restrictions imposed by using the instruments are valid. Further, we test whether: (i) our models are jointly significant, (ii) there is an indication of no second-order serial correlation in the residuals, and (iii) the interaction term is significant. Employing regression analysis is instrumental for evidence-based policy recommendations. As though one can conjecture about the possible impact of human capital on income inequality, it is impossible to pinpoint the extent of the impact. Additionally, without regression analysis, it is implausible to quantify the joint impact of human capital and institutional quality (government effectiveness and corruption control) on income inequality. Regression analysis solves these challenges by providing robust causal inferences on the link between human capital, governance, and income inequality.

4. Results and discussion

4.1. Exploratory data analysis

The descriptive statistics of the variables employed for the analysis are reported in Table 2. Both income inequality scores depict a case of very high-income disparity in Africa. For instance, the average Palma ratio value of 5.009 indicates that the average income of the top 10 percent richest people in Africa is at least 5 more than that of the 40 percent poorest people. Table 2 also reveals a mean human capital score of 1.873 also indicates the low level of schooling years and return to education. The negative mean value for control of corruption (-0.542) and government effectiveness (-0.629) amply demonstrates the poor performance in the fight against corruption and enhancing governance efficiency within Africa. The statistics on financial development and ICT diffusion also reveal the prevalence of poor financial institutions and lack of good ICT infrastructure needed for individuals and businesses to thrive.

Figures 1–4 provide a pictorial analysis of IE, human capital, governance and IE in the sampled countries respectively. Overall, Figure 1 reveals that IE is generally high in Africa. It also shows that significant variations exist among countries in the levels of IE, with Algeria (1.35) and South Africa (10.79) having the least and highest inequalities respectively. For instance, the Palma ratio of 10.79 for South Africa reveals the sharp differences in the proportion of the nation's income under the control of the rich

Table 2. Summary statistics, 2010–2020.

Variable	Obs	Mean	Std. Dev	Min	Max
Palma ratio	350	5.009	2.223	1.255	15.137
Gini index	350	55.205	7.833	31.877	72.877
Human capital	350	1.873	0.464	1.166	2.939
ICT diffusion	374	11.433	12.020	0.014	71.813
Vulnerable employment	350	63.069	24.237	8.830	94.40
Financial access	350	26.737	26.228	4.769	128.838
GDP per capita growth	385	1.246	4.382	-36.778	17.661
GDP per capita growth (square)	385	20.704	79.125	0.000	1352.599
Corruption control	385	-0.542	0.543	-1.546	1.003
Government effectiveness	385	-0.629	0.549	-1.887	1.161

Note. Std. Dev: standard deviation; Min.: minimum; Max.: maximum.

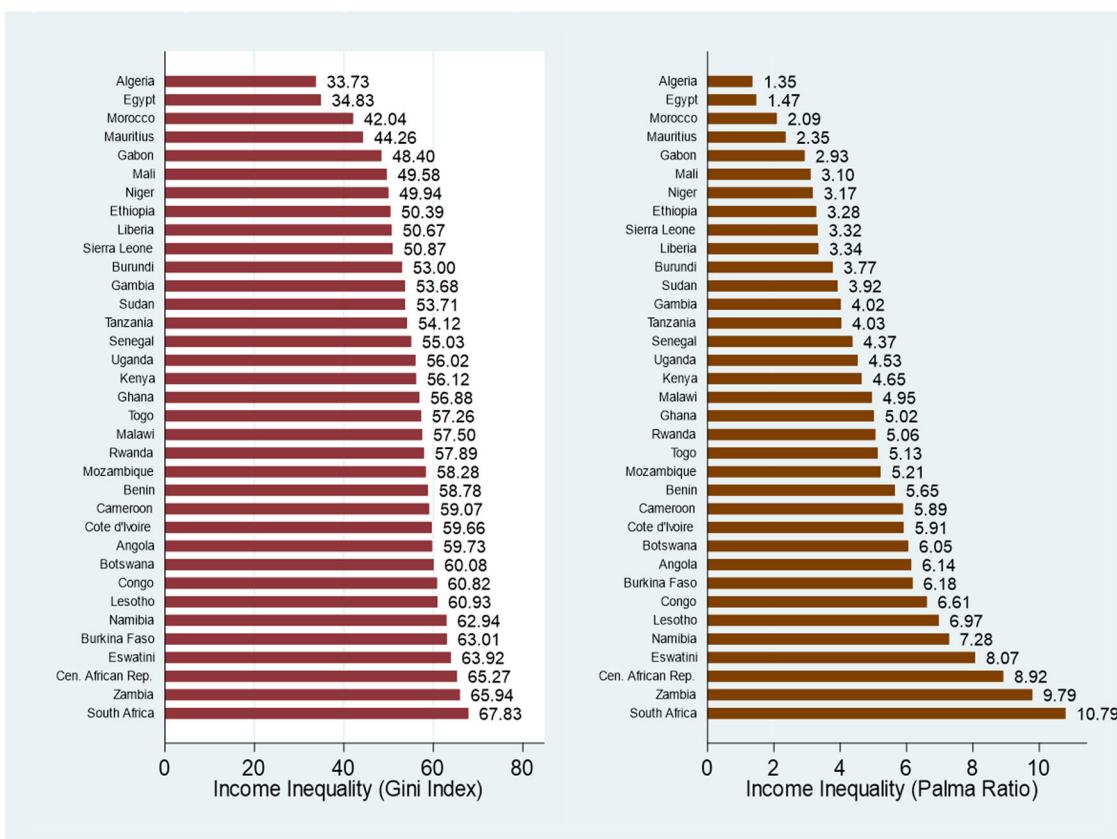


Figure 1. Average income inequality over the period 2010–2020.

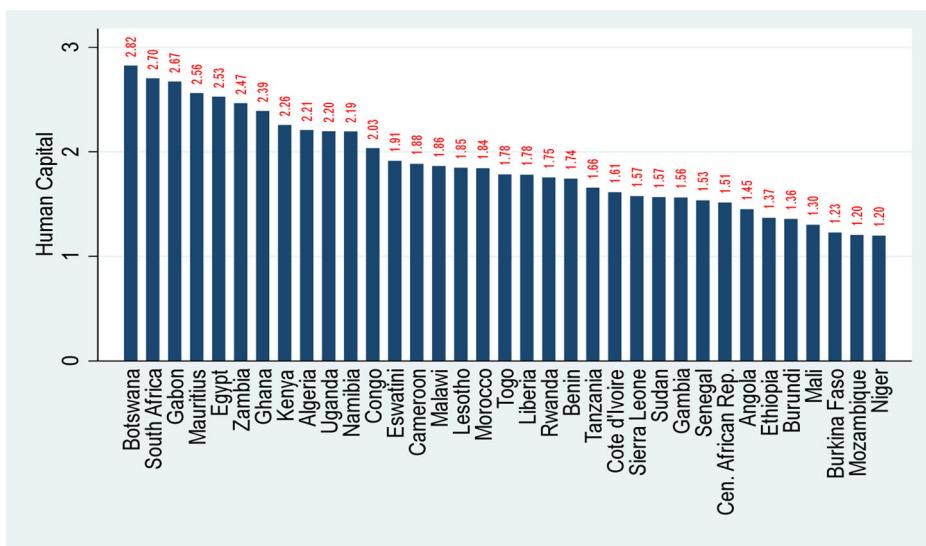


Figure 2. Average human capital development over the period 2010–2020.

compared to the poor. In particular, the value of 10.62 implies that the proportion of national income in the hands of the richest 10 percent of the population in South Africa is almost 11 times higher than that held by the poorest 40 percent.

Similarly, Figure 2 shows that variations in human capital are glaring. From the data, it is evident that while Botswana, South Africa, Gabon, Mauritius, and Egypt have mean human capital scores above 2.50, some countries have less than 1.50 (Niger, Mozambique, Burkina Faso, Mali, Burundi, Ethiopia, and Angola).

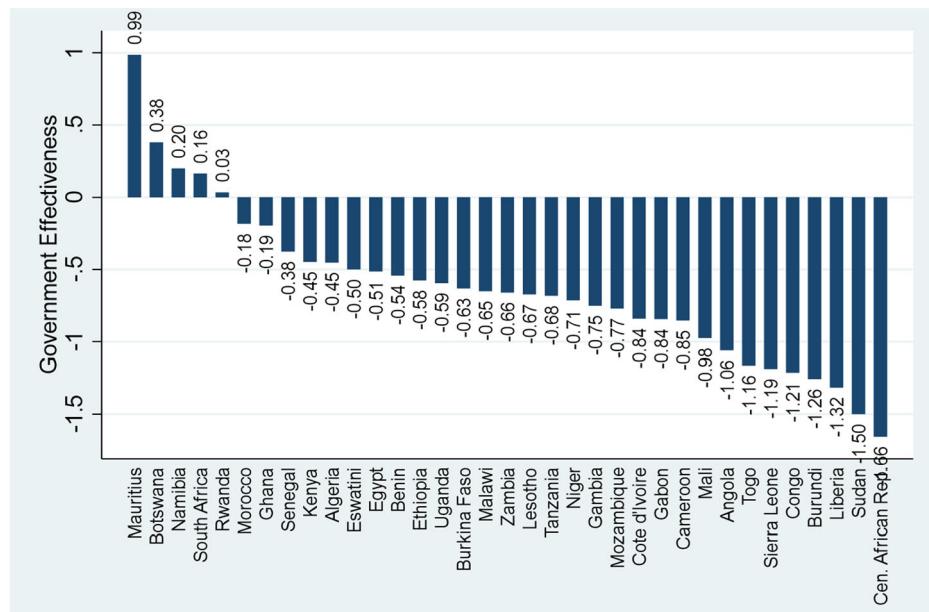


Figure 3. Average government effectiveness over the period 2010–2020.

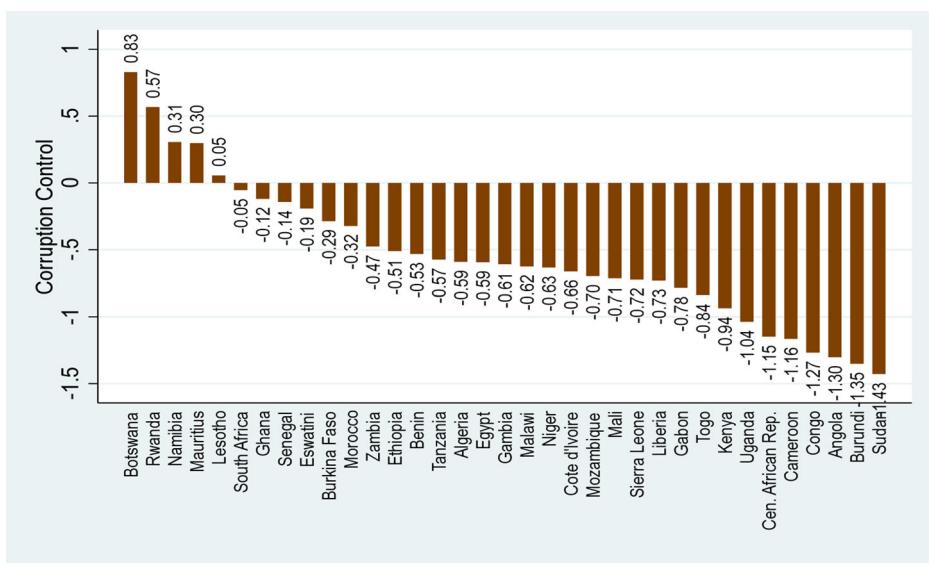


Figure 4. Average corruption control score over the period 2010–2020.

For our moderating variables (government effectiveness and control of corruption), Figures 3 and 4 indicate that Africa is a continent of weak economic and institutional governance. We arrive at this by locating the indexes of these governance indicators for African countries on the global governance indicators spectrum, which ranges from -2.5 to 2.5 (Kaufmann et al., 2010). It is evident from Figures 3 and 4 that most African countries score below the average threshold of zero for both measures. As can be observed from Figure 3, government effectiveness is weak. In fact, except Mauritius (0.99), even the few countries with positive measures for these variables scored below 0.5 (Botswana, Namibia, South Africa, and Rwanda).

This implies that most African countries provide poor-quality public and civil services, and institutions that are mandated to provide these services have a low degree of independence from political pressures. It also suggests that African governments formulate and/or implement policies poorly and are mostly not committed to them. Figure four also shows a case of a low level of corruption control in Africa. It is also evident that 5 of the 36 sampled countries, namely, Botswana, Rwanda, Namibia,

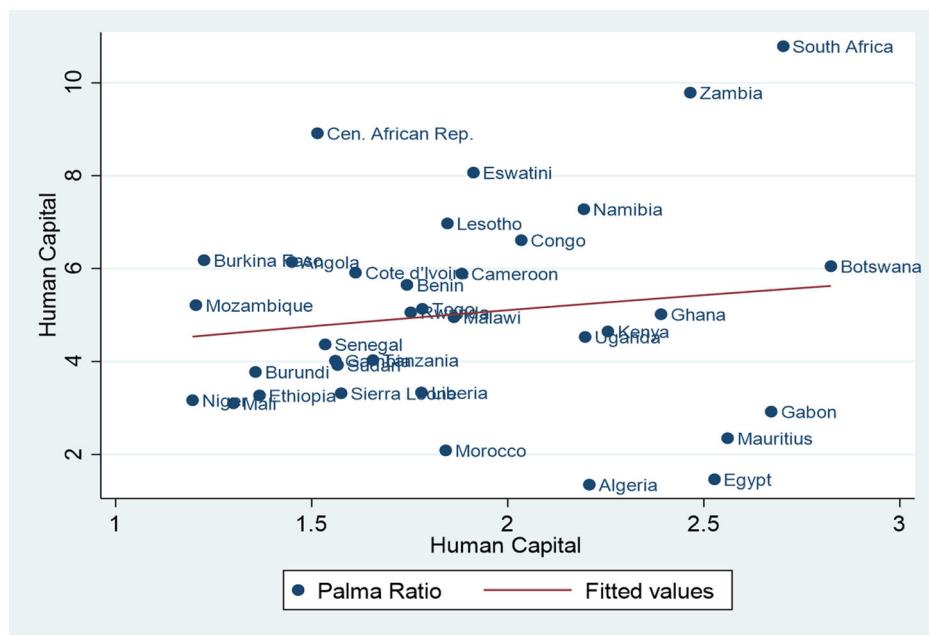


Figure 5. Human capital development and inequality over the period 2010–2020.

Mauritius, and Lesotho report impressive infrastructure for corruption control. Our observation of poor corruption control consolidates corruption reports from available sources (Pring & Vrushi, 2019).

We proceed by analysing how human capital is linked to IE. First, Figure 5 shows that the relationship between human capital and IE is generally linear. This relationship is positive, suggesting that human capital development can heighten IE in Africa. This is plausible considering the widespread inequalities in access to education and healthcare across Africa. This supports the rationale for this study, which is about exploring how government effectiveness and corruption control can provide the necessary incentives to boost human capital to foster equitable income distribution.

4.2. Impact of human capital on income inequality in Africa

Table 3 reports findings for the conditional and unconditional effects of human capital income inequality (IE) in Africa. Columns 1–6 document estimates based on DCK while Columns 7–10 are IV-GMM estimates.

First, concerning Objective 1 of this study, Table 3 reveals that the effect of human capital on IE in Africa is positive and statistically significant at one percent. This negative effect is consistent in all models. For example, the results reveal that with every one-point increase in human capital, intensifies income inequality by 2.39 (Column 10). This evidence suggests that African human capital development heightens income inequality in Africa. A possible explanation is that investment in education and health is costly. Therefore, in low-income economies such as Africa, affluent households are those with the financial mettle to invest in healthcare and education more substantially and consistently. This can polarise the skill and capacity development of a few, placing them in an advantageous position to land high-paying jobs.

The unconditional effect of governance effectiveness and corruption control on income inequality in Columns 9 and 10 of Table 3 are negative. Albeit not statistically significant, this evidence indicates that weak institutional governance frameworks for government effectiveness and corruption control have the potential to reduce income inequality in Africa. For instance, improving governance mechanisms for quality public and civil service delivery, effective policy formulation and implementation of productive policies can contribute to fairer income distribution.

That said, we now examine the indirect effects of human capital on income inequality. Precisely, we discuss how control of corruption and government effectiveness moderate the link between human capital and IE (Columns 9 and 10 of Table 3). First, the corruption control-human capital interactive term in Column 9 yields a total effect of 1.89. This marginal effect is computed by engaging the direct effect of

Table 3. Effect of human capital development on income inequality (Dependent variable: Palma ratio).

Variables	(1) DCK	(2) DCK	(3) DCK	(4) DCK	(5) DCK	(6) DCK	(7) IV-GMM	(8) IV-GMM	(9) IV-GMM	(10) IV-GMM
Human capital	0.6660*** (0.1281)	1.0315*** (0.1213)	1.6069*** (0.0702)	1.9620*** (0.0451)	2.0260*** (0.0947)	2.0406*** (0.0993)	1.9363*** (0.4147)	2.2033*** (0.4519)	2.1935*** (0.4894)	2.3916*** (0.6520)
ICT diffusion		-0.0285*** (0.0027)	-0.0161* (0.0086)	-0.0488*** (0.0057)	-0.0533*** (0.0051)	-0.0541*** (0.0056)	-0.0568*** (0.0218)	-0.0597*** (0.0217)	-0.0545*** (0.0220)	-0.0601*** (0.0217)
Vulnerable employment		0.0189*** (0.0044)	0.0390*** (0.0026)	0.0397*** (0.0034)	0.0402*** (0.0037)	0.0402*** (0.0037)	0.0450*** (0.0117)	0.0583*** (0.0111)	0.0459*** (0.0113)	0.0388*** (0.0114)
Financial access			0.0334*** (0.00038)	0.0352*** (0.0043)	0.0355*** (0.0049)	0.0342*** (0.0099)	0.0428*** (0.0105)	0.0331*** (0.0099)	0.0419*** (0.0106)	
GDP per capita				-0.0764*** (0.0227)	-0.0856*** (0.0227)	-0.1170*** (0.0277)	-0.0752*** (0.0288)	-0.1129*** (0.0277)	-0.0733*** (0.0287)	
GDP per capita growth					-0.0009 (0.0015)	-0.0015 (0.0011)	-0.0010 (0.0012)	-0.0010 (0.0011)	-0.0015 (0.0012)	-0.0010 (0.0012)
Corruption control					0.7595*** (0.1921)	0.7595*** (0.1921)				
Government effectiveness						-0.5222 (0.3307)				-1.1315 (1.4950)
Human capital x Corruption control								0.5465 (0.5162)		
Human capital x Government effectiveness									0.3002 (0.7190)	
Total effects	na	na	na	na	na	na	na	na	1.8972*** (0.4184)	2.2028*** (0.4516)
Constant	3.7619*** (0.2027)	3.3940*** (0.2317)	0.9922*** (0.2526)	-1.4796*** (0.2268)	-1.5138*** (0.3378)	-1.5405*** (0.3534)	-1.1161 (1.5028)	-2.2006 (1.6492)	-1.7638 (1.6953)	-2.6363 (1.9980)
Observations	350	340	340	313	313	313	280	280	280	280
R-squared	0.0193	0.0310	0.0472	0.1178	0.1361	0.1371	0.1592	0.1473	0.1648	0.1491
Countries	35	34	34	33	33	33	36	36	36	36
Wald/Fisher Statistic	27.03***	72.30***	5711***	3424***	1504***	1158***	7.681***	5.483***	7.205***	4.759***
Under identification Stats	na	na	na	na	na	na	92.75	113.5	59.35	73.45
Weak Identification Stats	na	na	na	na	na	na	1298	909.4	85.03	83.36
Craig-Donald Wald Stats	na	na	na	na	na	na	1497	905.2	65.06	85.26
Hansen J	na	na	na	na	na	na	4.847	2.521	4.583	2.488
Hansen p-value	na	na	na	na	na	na	0.303	0.641	0.333	0.647

Note. Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

human capital on income inequality (2.1935), the mean of corruption control (-0.5421) as well as the coefficient of the corruption control-human capital interaction term (0.5465). When this marginal effect, which is statistically significant at the 1 percent level, compared to the direct effect of human capital on income inequality, notable evidence from this study emerges. We demonstrate that corruption control mitigates (but not nullifies) the income inequality-enhancing effect of human capital development in Africa.

We proceed to analyse the joint effect of government effectiveness and human capital on income inequality. Accordingly, we pay attention to the estimates in Column 10 of [Table 3](#), where we calculate a total effect of 2.208. This total effect is also statistically significant at the 1 percent level. It is calculated by taking into account the impact of human capital on IE (2.3916), the coefficient of the interaction for government effectiveness and human capital on IE (0.3002) and the average government effectiveness score of -0.6288 . Details of the complete calculations are reported in [Supplementary Appendix A](#). This marginal effect is conspicuously lower than the direct effects of human capital (2.391), meaning that the government effectiveness is an important mechanism for compensating the adverse effect of human capital development on income inequality in Africa. The significant moderating roles of corruption control and government effectiveness in equalising incomes in Africa provide empirical support for our argument that in low-income countries, robust frameworks for corruption control can free-up resources for the central government to invest in the economic and create meaningful job opportunities for all. This can contribute to income inequality reduction. Additionally, proper policies and interventions in the real sector can incentivise both local and foreign direct investment, entrepreneurship, and private competition and growth. This can also promote sustainable economic growth, which is critical to income inequality reduction. Overall, the findings imply that African countries will be able to reduce IE more when there is high corruption control and government effectiveness.

Regarding the control variables, the results also show that ICT diffusion, vulnerable employment, financial access, and economic growth are significant drivers of IE in Africa (Columns 1–9). For instance, we find that ICT diffusion and economic growth reduce IE in Africa. The evidence indicates that for every percentage point increase in ICT diffusion, IE falls by 0.06 per cent (Column 10). Similarly, income inequality reduces by 0.07 points for every 1 per cent increase in economic growth. These impacts are not striking, which is possibly due to the glaring disparity of internet coverage and ICT usage across the rural-urban divide and the low levels of income in Africa ([Asongu & Odhiambo, 2018](#)). Also, we show that financial access and vulnerable employment worsen income inequality in Africa. The estimates in Column 9 reveal 0.033 points and 0.045 points increase in income inequality for every 1 percent increase in financial access and vulnerable employment, respectively. These findings align with [Ofori et al. \(2023\)](#).

4.2. Robustness checks

To ascertain the robustness of the estimates for inference, we subject the findings in [Table 3](#) to rigorous robustness checks by employing the Gini index as an alternative income inequality measure. These findings are reported in [Table 4](#).

Similar to the estimates reported in [Tables 3, Table 4](#) shows that the effect of human capital on Gini IE is positive, irrespective of the type of model specification. Specifically, we find that human capital increases income inequality by 7.2 per cent (see Column 10). Also, consistent with the findings in [Table 3](#), we show that both corruption control and government effectiveness are negatively related to income inequality but are statistically insignificant. We contend that these could be due to generally weak structures for corruption control and government effectiveness in Africa.

The results concerning the moderating roles of control of corruption and government effectiveness in the human capital- IE relationship also conform to our findings in [Table 3](#), providing robust evidence that corruption control and government effectiveness lessen the positive impact of human capital on income inequality in Africa. This is because these marginal effects of human capital are also lower than their corresponding direct effects. Specifically, whereas a total effect of 5.0882 is computed for the corruption control and human capital interaction term in Column 9, 5.609 is calculated for the human capital and government effectiveness interaction term in Column 10. The computations of these total effects are reported in [Appendix B](#).

Table 4. Effect of human capital development on income inequality (Dependent variable: Gini index).

Variables	(1) DCK	(2) DCK	(3) DCK	(4) DCK	(5) DCK	(6) DCK	(7) IV-GMM	(8) IV-GMM	(9) IV-GMM	(10) IV-GMM
Human capital	-1.0489*** (0.2805)	0.9303*** (0.1341)	4.4755*** (0.4411)	5.5027*** (0.2358)	5.6544*** (0.3218)	5.7169*** (0.2973)	5.2552*** (1.1936)	5.6142*** (1.3137)	7.0036*** (1.5624)	7.2476*** (2.1883)
ICT diffusion	-0.1475*** (0.0196)	-0.0712*** (0.0134)	-0.1531*** (0.0455)	-0.1637*** (0.0447)	-0.1673*** (0.0479)	-0.2165*** (0.0797)	-0.2247*** (0.0818)	-0.2069*** (0.0798)	-0.2289*** (0.0816)	-0.2289*** (0.0816)
Vulnerable employment	0.1167*** (0.0032)	0.1827*** (0.0085)	0.1842*** (0.0103)	0.1864*** (0.0090)	0.2043*** (0.0408)	0.1817*** (0.0412)	0.1817*** (0.0412)	0.2102*** (0.0412)	0.2102*** (0.0412)	0.1844*** (0.0411)
Financial access							0.1017*** (0.0228)	0.1041*** (0.0359)	0.1178*** (0.0389)	0.1084*** (0.0357)
GDP per capita							-0.2204* (0.0760)	-0.409*** (0.1128)	-0.2847*** (0.1008)	-0.3799*** (0.0934)
GDP per capita growth							-0.0039 (0.0050)	-0.0083*** (0.0035)	-0.0060 (0.0039)	-0.0064* (0.0038)
Corruption control							3.8816*** (0.6981)	3.8816*** (3.5751)	-3.2830 (0.6981)	-0.0083*** (3.5751)
Government effectiveness							0.4619 (1.0926)	0.4619 (1.0926)	-4.7422 (4.9823)	-4.7422 (4.9823)
Human capital x Corruption control									3.5333** (1.6790)	2.6080 (2.4907)
Human capital x Government effectiveness										5.6076*** (1.3070)
Total effects	na	na	na	na	na	na	na	na	na	5.0882*** (1.1875)
Constant	57.1696*** (0.5229)	55.0356*** (0.3982)	40.2374*** (0.8786)	32.24284*** (1.0986)	32.3474*** (1.3218)	32.2330*** (1.2749)	35.1125*** (5.0035)	33.5255*** (5.4894)	30.8679*** (5.8228)	29.9891*** (6.9049)
Observations	350	340	340	313	313	313	280	280	280	280
R-squared	0.0039	0.0332	0.0824	0.1481	0.1563	0.1576	0.2155	0.1705	0.2308	0.1796
Countries	35	34	34	33	33	33	36	36	36	36
Wald/Fisher Statistic	13.98***	29.50***	74.9***	171.7***	5491***	9.179***	6.034***	9.434***	9.434***	5.320***
Under identification Stats	na	na	na	na	na	na	92.75	113.5	59.35	73.45
Weak Identification Stats	na	na	na	na	na	na	1298	909.4	85.03	83.36
Craig-Donald Wald Stats	na	na	na	na	na	na	1497	905.2	65.06	85.26
Hansen J	na	na	na	na	na	na	6.204	3.539	5.692	3.449
Hansen p-value	na	na	na	na	na	na	0.184	0.472	0.223	0.486

Note. Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

5. Conclusion and policy recommendations

The study provides fresh evidence on the human capital-income inequality relationship in the context of Africa by investigating whether in the presence of government effectiveness and corruption control, human capital development promotes fairer income distribution. To this end, we employ macroeconomic data from a panel of 36 African countries from 2010–2020 for the analysis. The attendant findings are convincing and are based on a dynamic GMM estimator. The first finding is that human capital development deepens income inequality in Africa. Second, we demonstrate that two institutional quality variables namely, government effectiveness and corruption control, mitigate the positive impact of human capital development on income inequality in Africa. Based on these findings, the study concludes that while human capital development significantly increases income inequality, institutional frameworks and structures for government effectiveness and corruption control mitigate the impact.

Based on these findings, the following policy recommendations are proposed. First, the evidence calls for the need to scale up investments in quality education and healthcare in Africa. Thus, African leaders should invest heavily in quality education and healthcare, which are crucial for promoting the productive capacity of the working population and navigating the continent towards shared prosperity. This, we reckon, can be enhanced if institutions such as the World Health Organization, the United Nations Children Fund, the African Union Commission, and the Bill & Melinda Gates Foundation provide technical, financial, and logistical support that ensures widespread access to quality education among the populations. Particularly, healthcare access can be improved by implementing systems like Ghana's Health Insurance Scheme and Kenya's National Hospital Insurance Fund, which subsidises healthcare burden to vulnerable/low-income households. Second, the IE reducing effects of government effectiveness calls for the need to improve upon economic governance in Africa. To this end, prudent social and fiscal distribution could help breed economic freedom and support the masses in accessing socioeconomic opportunities. The IE-inducing effect of Africa's institutional; for corruption control highlights the relevance of reinforcing essential frameworks and systems that safeguard public funds and ensure that resources intended to promote social inclusivity and protection counts for all. To this end, we recommend that international organizations, such as the African Union and the World Bank, offer technical support, funding, and capacity-building programs to cushion African governments implement effective anti-corruption strategies.

Finally, concerning future contributions, we recommend that other researchers tailor their contributions to the specific growth conditions and policy needs of countries of interest. Also, examining the IE impacts of other human capital drivers such as general government expenditure and healthcare spending could be an interesting empirical exercise.

Authors' contributions

1. Jacob Nunoo: Conceptualisation, Analysis, Literature, Editing, Supervision.
2. Francis Taale: Conceptualisation, Methodology, Literature, Editing, Supervision.
3. Adams Sorekuong Yakubu Adama: Editing, Conceptualisation, Methodology.
4. Isaac K. Ofori: Conceptualisation, Analysis, Data curation, Methodology, Writing, Software, Visualisation, Review and Editing.
5. Peter Yeltulme Mwinlaaru: Editing, Literature review.

All authors have read and approved the final version of the manuscript.

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Data availability statement

The data supporting the findings of this study are from open-sourced databases and are available upon request.

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