EFFECT OF INEQUALITY AND CAPITAL INVESTMENTS ON ECONOMIC GROWTH IN EAST AFRICA

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A research project submitted to the School of Business, Economics and Tourism, in partial fulfillment of the requirements for the award of Master of Economics (Policy and Management) degree of Kenyatta University.

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DECLARATION

This research project is my original work and has not been presented for a degree in any other university.

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DEDICATION

I dedicate this research project to the loving and devoted memory of my mum (May her soul rest in eternal peace); my dad, Mr. Horizontal; my lovely kids, Khloe, Kaylah, and Juan; my dear wife, Lynn; my dad-in-law (may he R.I.P.) and the ever-gracious mum-in-law, Mary. Thank you all for your tireless encouragement, camaraderie and support.

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OPERATIONAL DEFINITION OF TERMS

Term	**Operational Definition**
Capital Investment	Government capital stock Annual spending and private annual capital stock in billions of constant 2011 international dollars.
Economic Growth	A change in the total outputs of services and goods produced by a country and a change in the capacity of services and goods of an economy, compared from one period (year) to another.
Educational Attainment	Refers to highest grade achieved in the most advanced level in an educational system of a nation where the said education is received. This study measures attainment as the average completed years of education of a population aged 25 years and older (excluding years spent repeating grades).
Gini Coefficient	A measure of statistical dispersion (ranging from 0-100) representing the wealth or income distribution of residents of a country.
Inequality	The relative magnitude and distribution of annual disposable household incomes in an economy
Human Capital	A measure of the education, stored knowledge or technology, skills, capacity, competencies, health,

	and other characteristics of labour, which affect their earning and productive capacity.
Physical Capital	Man-made factors of production, including astructure, equipment/machinery, vehicles, and ldings, used to produce and distribute both goods and vices.
Standardized World Income Inequality Database	A standardised database providing *income inequality* data that tries to optimise comparability between countries while at once providing the broadest possible coverage of nations and years

LIST OF ABBREVIATIONS AND ACRONYMS

ARDL	Autoregressive Distributed Lag
DFE	Dynamic Fixed Effects
FSE	Female Secondary Education
GDP	Gross Domestic Product
GMM	Generalized method of moments
IMF	International Monetary Fund
KGOV_RPPP	General government capital stock
KPRIV_RPPP	Private capital stock
LSDV	Least Squares Dummy Variable estimator
MENA	North Africa and the Middle East
MG	Mean Group
MLD	Mean Log Deviation
MSE	Male Secondary Education
OECD	The Organisation for Economic Co-operation and Development
PMG	Pooled Mean Group
PPPI	Purchasing Power Parity of Investment

Q1	Income share of the first Quintile/Quartile
Q2	Income share of second Quintile/Quartile
Q3	Income share of the third Quintile/Quartile
Q4	Income share of the fourth Quintile/Quartile
Q5	Income share of the fifth Quintile
SAM	Social Accounting Matrix
VAR	Vector Autoregressive Model
VIF	Variance Inflation Factors

Abstract

The more recent research indicates that the relationship between inequality and economic growth depends on, and is mediated by, the extent and nature of the inequality itself, the country's stage of development, as well as structural and institutional factors; such that this relationship may vary broadly across countries/regions. Kenya, Uganda and Tanzania posted intrinsically contradictory growth experiences in respect to the human capital, physical capital, and inequality trends over the period of analysis. This necessitated further research to ascertain inequality's effect on economic growth is realised through the theoretically expressed transmission mechanisms, as well as to determine the precise direction, magnitude, and significance of the causation between inequality and gross domestic product growth. The aim of this study is to determine the effect of inequality, human capital, and physical capital investments on gross domestic product growth in East Africa. The study draws on the augmented Solow Growth Model and panel data from 1990-2016. It estimates gross domestic product growth rate as a function of human capital development, and inequality. Data for private and government capital stock, gross domestic product, income inequality, and educational attainment were extracted from the International Monetary Fund Investment and Capital Dataset, the World Bank Development Indicators database, the Standardized World Income Inequality database, and the UNDP's Human Development Reports, respectively. Data were analysed using appropriate panel diagnostic techniques and estimated by way of the Autoregressive Distributed Lag technique. The results show that inequality is detrimental to long-run and short-term growth, while private physical capital investments spur long-run growth, even though their coefficients in the immediate term are not statistically significant. The coefficients of both government capital and human capital stock are statistically insignificant at five percent level. Consequently, the pursuit for rapid and sustainable economic growth is not inconsistent with the alleviation of income inequality and private capital accumulation. To achieve faster and equitable growth in East Africa, this study's findings lend credence to intensifying income redistribution or economic justice polices, and cultivating macroeconomic conditions to incentivise private capital investments.

CHAPTER ONE

INTRODUCTION

1.1 Background

Income inequality is the relative magnitude and distribution of annual disposable household incomes in an economy. Inequality has assumed increasing importance in economic policy-making, but mostly as a moral or equity issue as against an economic one (Ncube, Anyanwu, & Hausken, 2013). This chapter sets out the global and regional trends and perspectives on income inequality, growth, and physical/human capital investments. It concludes by presenting study's focal problem, objectives, questions, significance, and scope.

1.1.1 Global Perspectives on Growth and Inequality

In many large developed and developing economies, there are clear trends of rising income inequality. This situation has created a perception of rising global inequality when, in fact, global inequality has been declining over the last three decades (Lakner & Milanovic, 2016; Kanbur, 2019). At the core of this misperception, other than the availability, comparability, and quality of wealth and income inequality data, is the difference between inequality within nations and inequality between nations (Kanbur, 2019). In the period between 1988 and 2008, the standard Gini coefficient measure of income inequality reduced from 72.24 to 70.2 (Lakner & Milanovic, 2016). This trend remains true in the period between 2008 and 2020 (Solt, 2020). The between-nations Gini coefficient, which comprises the largest part of global inequality, fell from 83.2 to 76.7, mostly because poor nations like Vietnam, India, and China grew their economies much faster than developed countries such as the US, putting a disproportionately large downward impact on global inequality (Kanbur, 2019).

Within countries, inequality is more nuanced. Latin America, which has posted characteristically high-income inequality, experienced a decline after 1990 (Lakner & Milanovic, 2016; Kanbur, 2019). Brazil and Argentina, for example, saw a decline of 4 percent in 2001-2007 and 7 percent in 2002-2009, respectively. While the reasons for these falls are many, they mostly include redistributive fiscal policies, heavy capital investments, and increased secondary school-educated workers (Kanbur, 2019). In contrast to Latin America, Kanbur (2019) shows that large Asian economies saw a marked increase in inequality. China, for example, which has seen rapid GDP expansion and poverty reduction since 1978, saw the Gini coefficient increase from 35 to 53 in the period between 1995 and 2010 before falling to 50 in 2010-2014 and further to 47 in 2014-2019 (Kanbur, 2019). This scenario was largely due to contracting rural labour markets because of large-scale migration to urban centres and multiple state interventions in labour markets, health, and education (Kanbur, 2019; Lakner & Milanovic, 2016).

The recovery and increased pace of growth in Africa after 1995, on the other hand, has resulted in improvements in welfare and poverty reduction. While Sub-Saharan Africa has seen slower economic growth and faster population growth compared to other regions, its growth has been coupled with substantial investments in sanitation, infrastructure, and education (Kanbur, 2019). Absolute levels of deprivation, however, remain very high relative to the rest of the world (Arndt, McKay, & Tarp, 2016). See Figure 1.1.

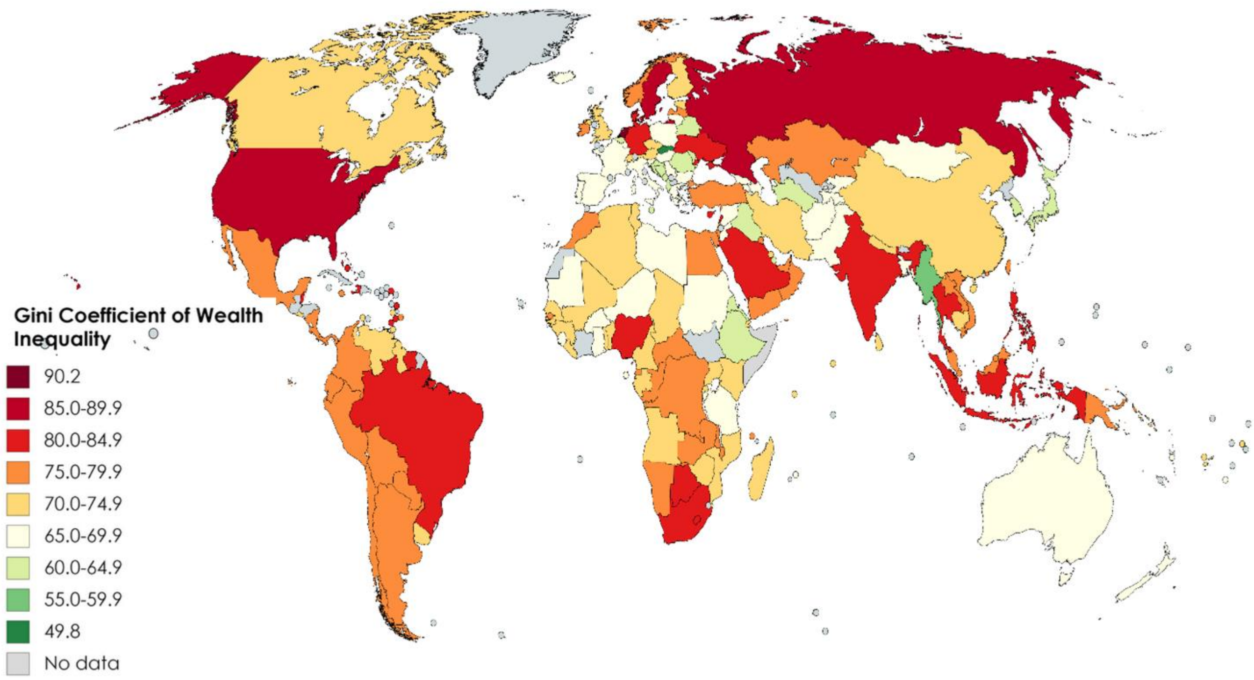

Figure 1.1: Market income inequality (before taxes and transfers) trends across the world

Source: Global Wealth Databook, Credit Suisse AG (2020, p. 74)

1.1.2 Overview of GDP and Income Inequality in East Africa

East Africa's economy posted strong growth, with the GDP growth rate averaging 6.2 percent in 2019 alone. The value of total trade, for instance, rose by $8.2 billion to reach $45.8 billion during the same year, even though imports still constituted 70 percent of the region's trade expansion. The GDP per capita has been rising steadily, although it has risen faster since 1995 than the preceding ten-year period. Kenya's GDP per capita is superior to both Uganda and Tanzania throughout the post-independence period except for the five years before 1990 when it was briefly overtaken by Uganda. Uganda's GDP per capita further fell below Tanzania just soon after 1997 and remains so to 2020 (World Bank, 2022). See Figure 1.2.

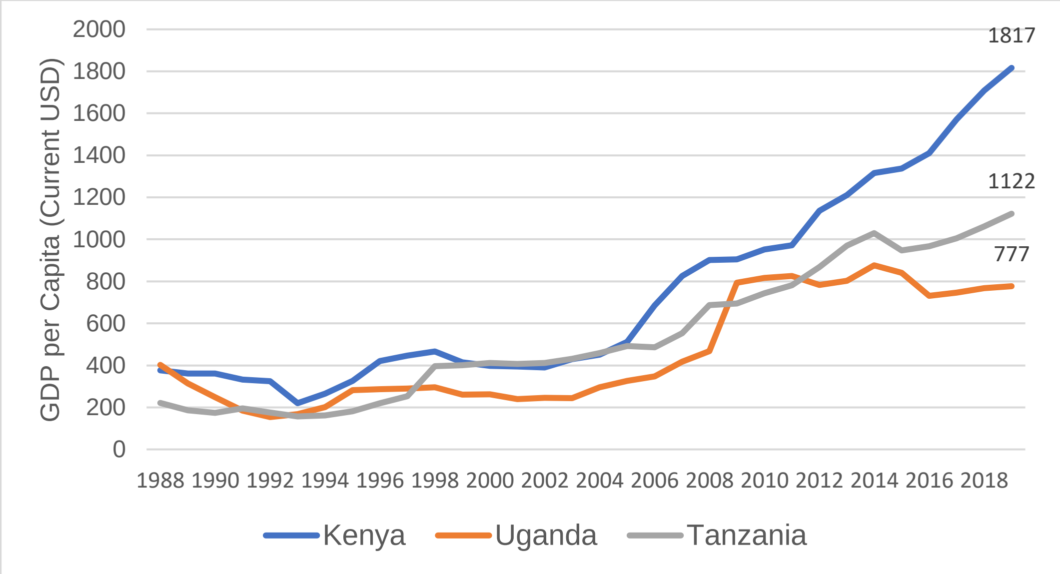

Figure 1.2: East Africa GDP per capita trends in US Dollars

Source: Author's computation using data from World Bank (2022)

1.1.3 Economic Growth in East Africa

Kenya's GDP per capita growth rate has been the lowest over the same period. Tanzania's growth rate has been the most stable, and it became the highest after 2010. Uganda posted the highest but equally unstable GDP per capita growth rate for the period between 1986 and 2010. Tanzania, on the other hand, boasted a more stable and steady growth rate up until 2010, when it rose above both Uganda and Kenya, whose GDP/capita growth rates fell below 6 percent. See the GDP per capita growth rates for Kenya, Uganda and Tanzania in Figure 1.3.

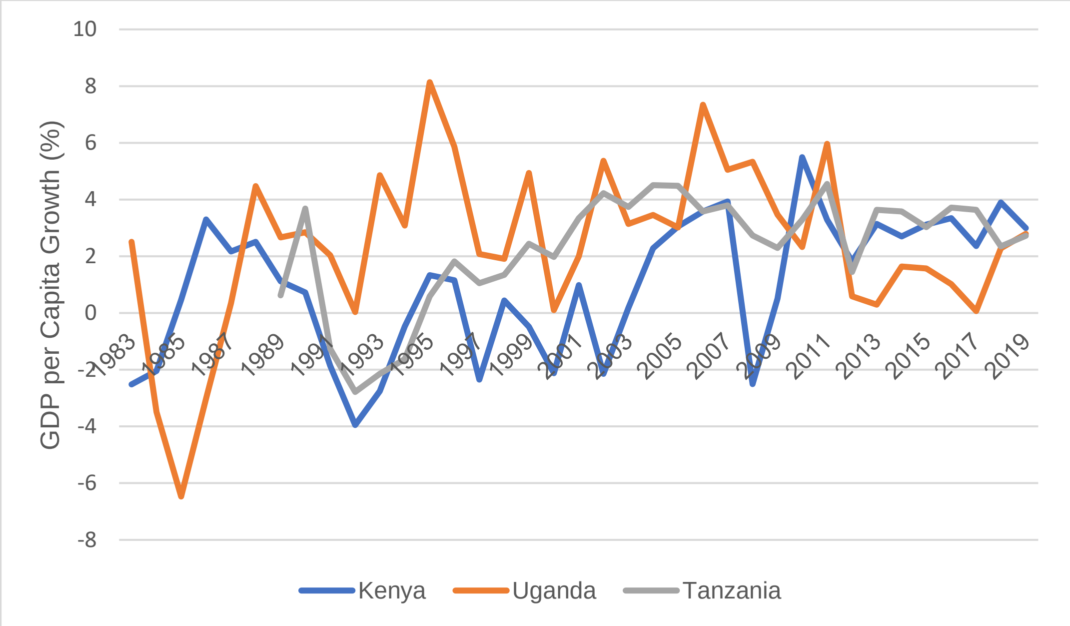

Figure 1.3: Percentage GDP/Capita Growth Rate

Source: Author's computation using data from World Bank (2022)

1.1.4 Income Inequality in East Africa

Kenya has the highest inequality compared to both Uganda and Tanzania (Solt, 2017). According to Kim & O'Brien (2015), the inequality in Kenya is such that ten percent of the population account for forty percent of the country's income, and the poorest ten percent only receive two percent of the income. One in four people live in extreme poverty (Kim & O'Brien, 2015). The trends in the Gini coefficient show that Kenya and Tanzania had opposite experiences in the period between 1976 and 2017. While Kenya's Gini coefficient fell steadily from 49.4 in 1976 to 46.3 in 2015, Tanzania's rose steadily from 39.2 to 44.6. Uganda posted a moderate and fairly constant Gini coefficient compared to both Kenya and Tanzania. See Figure 1.4.

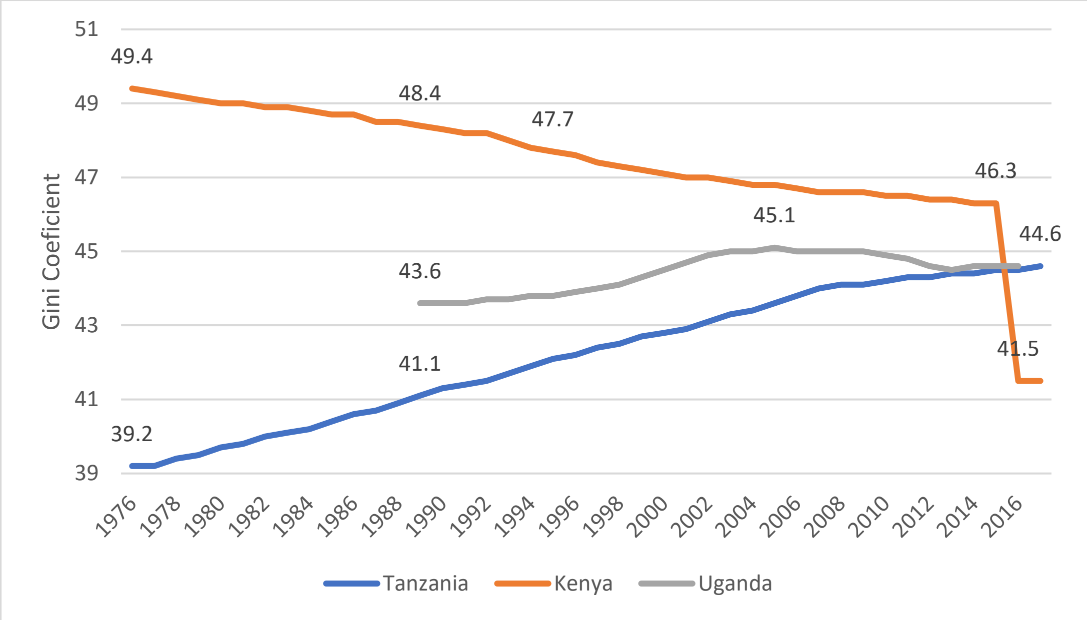

Figure 1.4: Income inequality has reduced but remains considerably high

Source: Author's computations using data from Solt (2020).

1.1.5 Inequality and Growth

The preliminary examination of the data as summarized in Figures 1.2, 1.3 and 1.4 shows that Uganda had the highest growth from 1990 to 2009 and the lowest thereafter. It had the highest inequality rate over the period (Gini coefficient of 45.4-48.3), suggesting a positive relationship between inequality and economic performance. Tanzania had a moderate but steadily increasing rate of growth in the period between 1980 and 2009, after which it had the highest rate of growth. Its inequality ranged from 39.2 in 1980 to 41.6 in 2019. This seems to suggest that equality is related to both positive and less fragile growth. Inequality for all the countries started falling after the year 2000, after which the growth rates for all the countries not only started trending downwards but also reversed so that Tanzania grew the fastest, followed by Kenya, suggesting that equality is inversely related to growth.

The inclusiveness of growth and the way growth is shared among the population could have implications for the rate of growth itself (Aghion, Caroli, & García-Peñalosa, 1999), and hence form the basis for policies. Inequality in opportunities and outcomes is one of East Africa's most pressing social challenges, which poses an existential risk to stability (Causa & Ruiz, 2014). Further, the structure of these economies is changing, with an increasing emphasis on human capital, which means that income will be distributed to sections of the population with access to education, investment spending, and credit (African Development Bank Group, 2018). While Kenya was the only economy in East Africa with a service sector of the economy bigger than agriculture in 2003, other economies in the region have moved towards the same, which means that income distribution will increasingly favour human capital as against labour (The Society for International Development and TradeMark East Africa, 2017). Effectively, while income inequality in East Africa has been falling for the most part since independence, considerable inequalities persist, with possible implications for growth, depending on the link between inequality and growth in the region (World Bank, 2022).

1.1.6 Inequality, Human Capital, and Pro-Poor Policy Frameworks

The experience of poverty/inequality also varies spatially and across gender, with women, rural areas, and historically marginalised regions exhibiting both the highest rates of extreme poverty and slow development (Oxfam, 2019; Kim & O'Brien, 2015). Vision 2030's economic and social pillars seek to not only boost economic growth and eradicate extreme poverty in one generation but also to create a "*just and cohesive society that enjoys equitable social development in a clean and secure environment*" (Republic of Kenya, 2007, p. 16). Heavy investments in human and physical capital have been made under the Kenya Vision 2030, both to fasten growth and to open up historically marginalised regions of the country. These include free primary education, subsidised secondary/tertiary education, and capital investment projects such as the Standard Gauge Railway (Republic of Kenya, 2007). Other than devolution, the Constitution of Kenya 2010, under Article 204, provides for the establishment of an Equalisation Fund to help reduce inequality. Similar policies that redistribute income include progressive taxation (Ostry, Berg, & Tsangarides, 2014), which may just become even more progressive amendments anticipated in the Tax Laws (Amendment) Act 2018.

While the three Kenya, Uganda's and Tanzania have mildly varying Gini coefficients and economic growth rates over the period between 1990 and 2019, they have had nearly similar policy responses, including investments in mega capital projects and pro-poor policies (African Development Bank Group, 2018). Uganda is one of the few nations that attained the Millennium Development Goal of cutting poverty by 50 percent from 1990 to 2015, largely due to Uganda Vision 2040 (World Bank, 2015). According to Jellema, Lustig, Haas, & Wolf (2016), a minimum of 1.5 percent of the GDP is allocated to major redistributive policies programmes, including in-kind transfers towards universal healthcare and capitation grants for primary/secondary education; direct cash transfers under programmes such as the Northern Uganda Social Action Fund; indirect subsidies to energy, water, and agricultural advisory services; and a low progressive taxation framework. An estimated 4.8 percent and 1.6 percent of the GDP are spent on education and healthcare (Jellema, Lustig, Haas, & Wolf, 2016). On its part, Tanzania is providing its vulnerable citizens with health subsidies, cash transfers to the elderly, increased access to employment opportunities, land ownership, and increased credit availability to the informal economies (World Bank, 2015; Ssewanyana, 2009).

1.1.7 Physical Capital Investments

Policy frameworks across Kenya, Uganda, and Tanzania strongly emphasize investment in infrastructure, manufacturing/equipment, and technology as a way of fast-tracking growth and development (African Development Bank Group, 2018). Vision 2030, for example, recognises infrastructure, manufacturing, and science/technology/innovation as three of the ten key sectors that the country needs to focus on to achieve faster growth/development (Republic of Kenya, 2007). Recent capital investments in physical capital in Kenya, include the $3.6 billion standard gauge railway project, the $16 billion Lamu Port and Lamu-Southern Sudan-Ethiopia Transport Corridor project, and the expansion of major airports and roads across the country (African Development Bank Group, 2018).

Similarly, Tanzania's Development Vision 2025 is built around achieving infrastructural development, science and technology education, as well as the promotion of information and communication technologies (The United Republic of Tanzania, 2000). Major, recent projects include the $1.46 billion standard gauge railway line. Lastly, Uganda Vision 2040 prioritizes the development of infrastructure; manufacturing; human capital; and minerals, gas, and oil (Republic of Uganda, 2015). Predictably, therefore, physical capital investments have been growing steadily since independence. Overall, Kenya's gross physical capital investments as a proportion of GDP ranged from 14 percent in 1965 and 29.7 percent in 1978, before falling steadily to reach a low of 15 percent in 1997-2002. Since then, investments have averaged 17 percent of the GDP. Uganda posted the lowest investments in physical capital as a fraction of GDP in 1964-1996, after which it overtook Kenya. Its investments ranged between 13.06 percent in 1964 and 5.6 percent in 1981, before increasing steadily to reach 16.6 percent in 1997 and 28.35 percent in 2013. Tanzania had the highest investments as part of its GDP for the most period for which data is available (World Bank, 2019). See the trends in physical capital investments as a proportion of GDP in Kenya, Uganda and Tanzania in Figure 1.5.

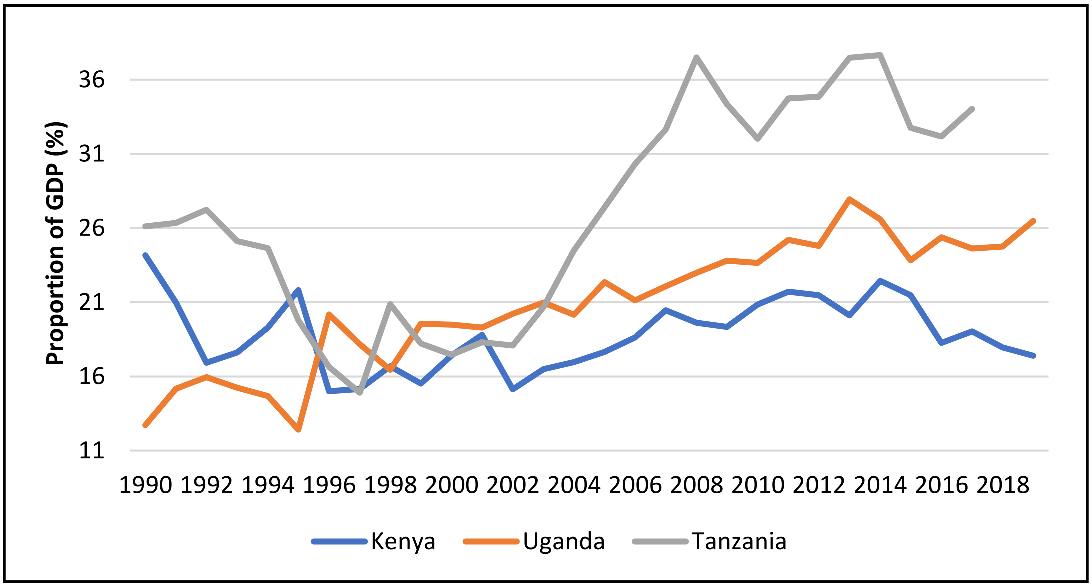

Figure 1.5: Physical capital investments as a proportion of GDP

Source: Author's computation using data from World Bank (2022)

1.1.8 Human Capital in East Africa

Unlike labour, human capital includes self-generating, elastic, transportable, storable, and shareable attributes whose accumulation, deployment and effectiveness is influenced by inequality, and in turn, inequality is also influenced by human capital accumulation (Kwon, 2009). Economic growth is, in no small part, dependent on the useful knowledge and abilities (acquired through, among others, education, apprenticeship, study, good health, and experience) of the population (Romer, 2012). Human capital is complex and difficult to measure, but one of its commonest proxies are school enrolment rates, expected years of schooling, school attainment rates, and accumulated years of schooling (Kwon, 2009; Topuz, 2022). Public education policies have the effect of redistributing income. Accordingly, growth models that include human capital are important to understanding the nexus among inequality, redistribution, and growth (Hellier & Lambrecht, 2012).

In the period between 1990 and 2016, Kenya had consistently higher mean years of schooling for adults aged 25 years or older, while Uganda posted the lowest. Kenya's mean years of schooling increased from a minimum of 3.7 years in 1990 to 6.6 years in 2016, while Uganda's and Tanzania's grew from 2.8 to 6.1 years and 3.6 to 6.2 years, respectively. See Figure 1.6

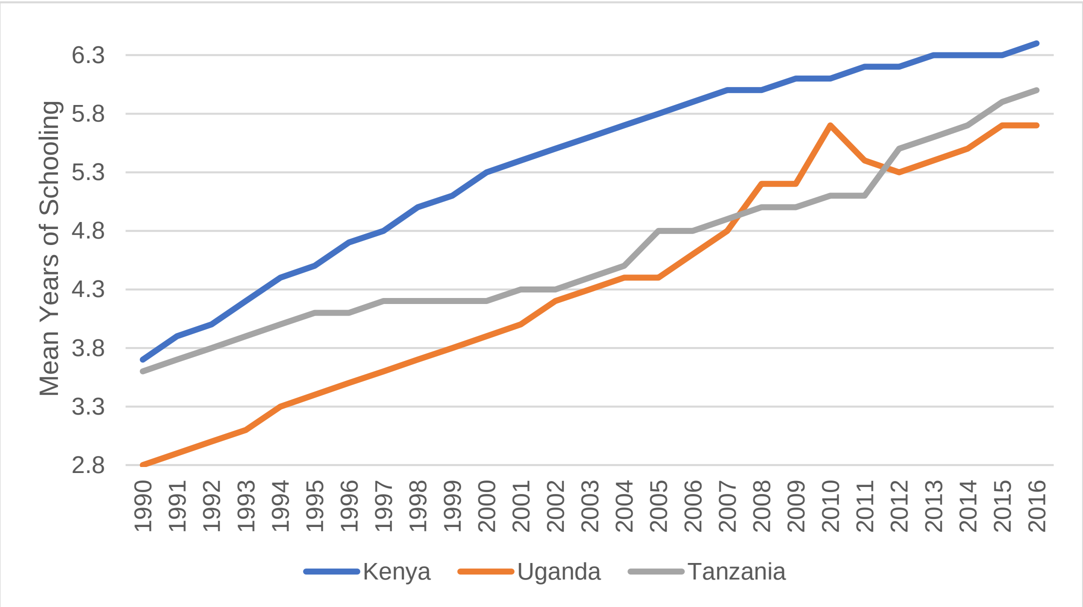

Figure 1.6: Mean years of schooling for population aged 25 years and older, excluding years spent repeating individual grades.

Source: Author's computation, using data from the United Nations Development Programme (2022).

Over the same period, and particularly between 1995 and 2003, Uganda posted the fastest growth in the expected years of schooling for children. The country's expected years of schooling rose from 5.7 in 1990, before falling to 5.1 in 1992 to 1995, but surged to 11.6 in 2003. Similarly, Tanzania posted robust growth between 1997 and 2009. While Kenya had the highest initial years of schooling at 9.1 years in 1990, it posted moderate years of expected schooling (and growth) relative to Uganda and Tanzania, in the period between 1998 and 2012. See Figure 1.7.

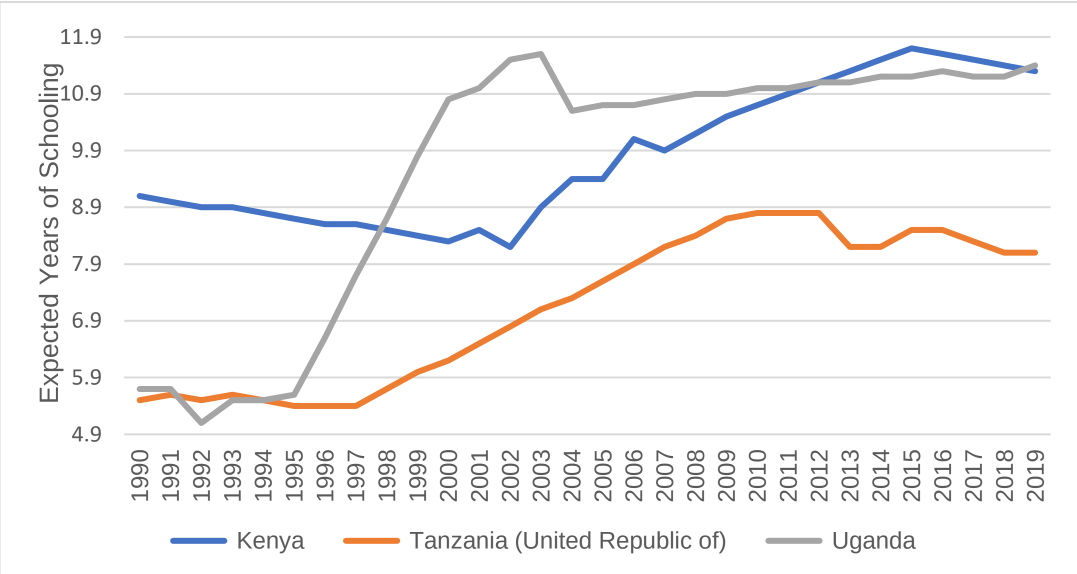

Figure 1.7: Expected years of schooling

Source: Author's computation, using data from United Nations Development Programme (2022).

While the increased years of expected and accumulated schooling reduce inequality and positively affect economic growth, at least in theory (Todaro, 1997; Romer, 2012), the effectiveness of human capital is a function of diverse factors, including technology (of which infrastructure or physical capital is key), health, labour market efficiency, life expectancy (Kwon, 2009). It is, therefore, critical to understand how the average years of schooling and the expected years of schooling for the three countries affected their individual and collective economic growth. This is especially so because there appear to be divergences in expected and acquired years of schooling for each of the three countries. Given the fact that there is little empirical research evidence on the effect of inequality, capital investments, and educational attainment/human capital on GDP growth in East Africa, even though this relationship may be different from other regions that have already been studied (Galor & Moav, 2004), this present study is warranted.

1.2 Statement of the problem

The extant theoretical and empirical literature as well as the preliminary data highlight the complexity of the impact of income inequality and capital investments on economic growth. The contradictory growth experiences of Kenya, Uganda, and Tanzania, in relation to diverse of inequality, growth, and capital investment trends raise questions as to the exact nature of the effect of inequality on growth, as well as whether the effects of inequality, human capital, and physical capital on economic growth, if any, are realised through the theoretically expressed transmission channels (Topuz, 2022; Kanbur, 2019). There is a theoretical consensus that physical and human capital accumulation fosters growth, but due to both the diminishing returns and diminishing marginal rate of substitution between physical capital and human capital, the actual degree of growth is contingent on the development stage and existence of excess capacity as well as the proportion of physical capital and human capital in the economy (Hellier & Lambrecht, 2012; Chen, Gong, & Marcus, 2014;

Topuz, 2022). In respect to inequality, theoretical models similarly suggest it may foster or impede growth (Aghion, Caroli, & Garcia-Penalosa, 1999; Romer, 2012). Empirically, the nature and magnitude of the relationship between inequality, capital accumulation, and economic growth remains uncertain across different model specifications, sample selections, and variable definitions (Ncube, Anyanwu, & Hausken, 2013; Forbes, 2000), but while many studies are exploring this relationship in various countries and regions in the world, this has not been the case in Eastern and Sub-Saharan Africa. This is significant, not least because some empirical literature, shows that inequality may encourage growth, but only within developed economies (Barro, 2000; Perotti, 1996; Kanbur, 2019). While there is no conclusive explanation of the divergences between developed and poor countries, the literature shows that this relationship is likely dependent on a broad range of dynamic factors, including the level of socioeconomic development, democratic institutions, capital accumulation, and regional factors (Forbes, 2000; Perotti, 1996). The overall impact of income inequality, educational attainment, and physical capital investments on growth, particularly in Sub-Saharan Africa, is still poorly understood, even though it is extremely vital for planning and investment policy-making (Cingano, 2014). While knowing whether cumulatively large or rapidly increasing inequality is a strictly moral issue or one that has implications for growth is critical for planning and investment policy-making, this information is not generally available for the region.

1.3 Research Questions

(i) What is the effect of human capital investment on GDP growth in East Africa?

(ii) What is the effect of physical stocks on GDP growth in East Africa?

(iii) How does income inequality affect GDP growth in East Africa?

1.4 General Objective

To estimate the role of inequality in the expansion of the GDP in East Africa.

1.4.1 Specific Objectives

(i) To estimate the effect of human capital on GDP growth in East Africa.

(ii) To estimate the impact of physical capital stocks on GDP growth in East Africa.

(iii) To estimate the effect of inequality on GDP growth in East Africa.

1.5 Significance of the Study

Large investments in infrastructure and education across Kenya, Uganda and Tanzania have elicited strong reactions as to their (opportunity) costs and benefits, particularly on account of debt financing and the neglect of more pressing sectors such as agriculture (African Development Bank Group, 2018; Ahmed, Hossain, & Tareque, 2020). The same is true of redistributive policies, perhaps the most illustrative of which is the *"one man, one vote, one shilling"* proposal under the Building Bridges Initiative (The Building Bridges to Unity Advisory Presidential Taskforce, 2022). This study's findings would be beneficial to the national and county/provincial governments in East Africa, as well as other agencies involved in allocating resources for infrastructure, education, development, poverty alleviation, and social protection. The outcome of this study helps understand the short- and long-term value of these policies. Other than contributing to the extant knowledge, which is both inconclusive and has largely not covered Eastern Africa, this study offers a justification or otherwise for government policies to bolster economic growth, increase capital stocks, redistribute income, and combat inequality in the region.

1.6 Scope of the Study

This research focuses on East Africa in 1990-2016 for three reasons. Firstly, Kenya, Uganda, and Tanzania share a socioeconomic and political bond stemming from the defunct East African Community, tightly-knit communities across the three borders, and economic integration under the East African Community (Oxfam, 2019). The literature strongly suggests that trade, socio-political institutions, and technology are the strongest explanatory causes of rising inequality and falling wages (Forbes, 2000). Secondly, reliable data on some variables/countries are mostly unavailable for the period before 1985. Thirdly, most Sub-Saharan countries posted dismal economic growth in the 1970s and early 1980s because of external shocks, including import price inflation, severe droughts, and declining export prices (Kanbur, 2019). Diverse internal factors such as poor economic policies, political instability, budgetary deficits, loss-making of public enterprises, and losses in international competitiveness also played a role (Arlt & Mandel, 2014; Kanbur, 2019). Owing to the diversity and complexity of each of these factors, as well as the fact that this study will not be controlling for them, it is best to avoid the period between 1970 and 1985.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This review highlights the theoretical literature that explains the existence, and lack thereof, of an association between income distribution and economic performance as well as the direction and magnitude of such a relationship. This is followed by the empirical literature on the same and a brief overview.

2.2 Theoretical Literature

2.2.1 Kuznets Hypothesis (1955)

Kuznet (1955) argues that income inequality may worsen economic growth in the initial developmental stages as the economy is transformed from agricultural to manufacturing and the population moves to urban areas. However, as the industrial labour force expands with skills/technology acquisition, experience, and increased participation, inequality should reduce, and the economy may expand (Romer, 2012). With income inequality at the earliest developmental stages, when the vast majority of the population is poor, redistributive government policies/taxation reduce the stability and extent of growth because they disincentivize the high-income population from accumulating capital and investing (Acemoglu & Guerrierie, 2008). Further, the use of progressive taxation means that the tax burden is loosely proportionate to every citizen's income, and thus, the optimal public expenditure is inversely proportionate to the income level, such that if more people in the population have low incomes, then they would prefer an expanded public social safety net. With the median voter determining the level of public taxation, high inequality results in higher taxation, which discourages savings and capital accumulation (Blanchard, Giavazzi, & Amighinim, 2013). Further, according to Todaro (1997), redistribution has inverse effects on growth since it reduces disparities in wealth and income, effectively lowering the economic growth rate.

This theory is relevant in the present study because unlike developed economies, Sub-Saharan African countries are at various stages of the transformation from agriculturally based economies to services and manufacturing (Kanbur, 2019). Accordingly, while the relative sizes of the traditional and modern sectors is uncertain (Topuz, 2022), it is certain that the predictions of this theory may be materially different in these three countries than in developed economies for which there is substantial research (Topuz, 2022; Hellier & Lambrecht, 2012). Thus, the Kuznet's hypothesis is relevant, both in justifying and predicting the possible outcomes of the present study.

Similarly, a micro-founded model of the Kuznet's hypothesis based on human capital accumulation offers a conceptual basis for incorporating human capital accumulation is this study, as it worsen inequality and potentially fosters growth. Depending on the constraints for education, if the parents' human capital is h_{t-1}, then their children's human capital h_t is a positive function of h_{t-1}, such that $h_t = H(h_{t-1})$. See below.

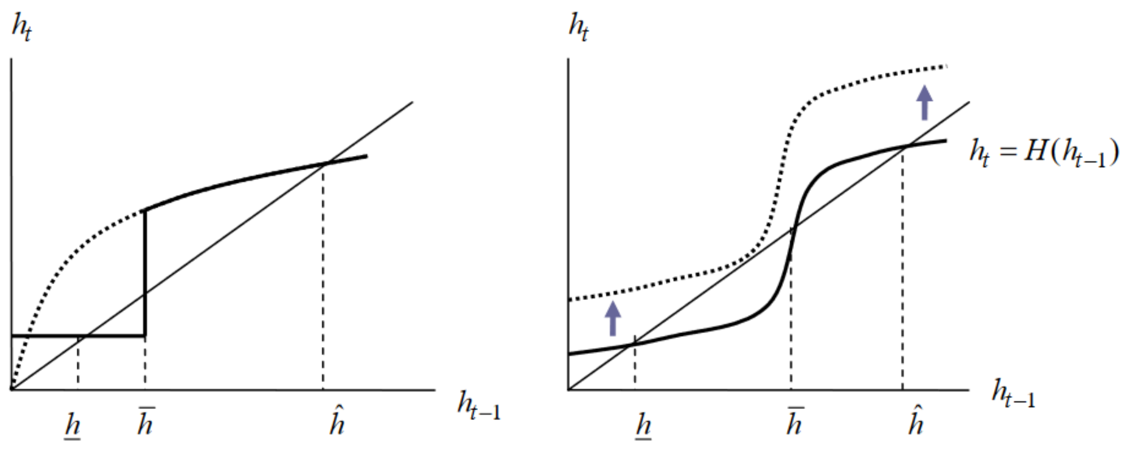

Figure 2.1: Fixed education cost and credit constraints (a) and S-shaped education function (b)

Source Hellier & Lambrecht (2012, 7)

In Figure 2.1 (a), a fixed cost of education is paid for by children and there are no credit markets for young individuals. Parents with human capital stock h^- , which is realizable by everyone that does not receive education, have an income that is too low to support/lend children who are in school. Human capital stock accumulation beyond the basic/compulsory education is a concave function. Panel (a) shows human capital h_t as a function of h_{t-1} when $h_- < h^-$. This creates diverse two-segment steady states where dynasties that are originally in the interval $[0, h^-]$ possess h_-, while those with initial capital higher than h^- possess ĥ. The size of dynasties in each group is a function of the distribution of dynasties period t-1 and the transition towards a steady state may take varied shapes in terms of inequality depending on the initial distribution of human capital for dynasties and the chosen measure of inequality (Hellier & Lambrecht, 2012).

According to Hellier & Lambrecht (2012), Panel (b) depicts an S-shaped education function modelled by, Galor & Tsiddon (1997). People whose parents have more than

h^{-} tend towards ĥ, while those with less than h^{-} tend towards h_{-}. In the long-term capital accumulation tends upwards resulting in human capital externality in the education function as population grows. Since higher education increases income, the levies for education also increase. Further, the technical progress associated with the effect of increasing education or R&D augments both education levies and income. Lastly, if the growth in human capital is sufficiently high to shift the convex portion of the S-shaped curve above the 45 degrees line, then the dynamics generate steady state by which dynasties have the same human capital in the longer term. This produces a U-shaped curve since inequality initially increases human capital stocks, but subsequently reduces as dynasties tend towards parity in human capital (Hellier & Lambrecht, 2012).

2.2.2 Kaldor's Hypothesis (1955-1956)

Kaldor (1957) draws from both the Harrod-Domar and Keynesian growth models. Production factors, capital, and labour are complementary, and the efficient capital-to-output ratio is constant. This model assumes two social groups: labourers and capital owners. The economy's aggregate savings rate is a weighted average of labourers and capital owners; such that higher returns to capital owners translate to a higher national savings rate (Hellier & Lambrecht, 2012). The model derives an optimal savings rate consistent with both the full employment level of the economy towards which an economy gravitates. This savings rate and growth of the economy are positively dependent on labour productivity growth, which is in turn, influenced by investments in technology and education. As such, technical progress and subsequent growth in labour productivity are higher when income is concentrated in the hands of capital owners (Forbes, 2000; Kaldor, 1957).

Kaldor's hypothesis is relevant in this study as it allows for predicting the possible nature and causation of the relationship between inequality or capital stocks on economic growth. This relationship should hinge on not only the actual rates of inequality, but also the levels of inequality at which the rich save and the magnitude of the savings/investments to generate growth (Aghion, Caroli, & García-Peñalosa, 1999; Ferreira, Gisselquist, & Tarp, 2022). This is further complicated by the existence of substantial credit market imperfections in East Africa, as with other developing economies with large informal sectors (Ahmed, Hossain, & Tareque, 2020), which hurt intermediation efficiency, implying that inequality may not necessarily generate predicted growth (Ferreira, Gisselquist, & Tarp, 2022).

2.2.3 Solow Growth Model

Joseph Stiglitz used Kaldor's model to modify Solow-Swan model, which had a linear savings function, with the aggregate behaviour being independent of the wealth distribution (Todaro, 1997). Growth occurs through the replacement capital stock in the subsequent period of production, which keeps the economy performing steadily and/or through the accumulation of more capital. By using a convex savings function, aggregate output depends on the initial income distribution, and when this is combined with an AK production function, then unequal economies should grow faster (Romer, 2012; Todaro, 1997). According to Todaro (1997), Solow's model derives output or GDP, Y; as a function of Savings, S; capital, K; Investments, I; labour, L; and effectiveness of labour or knowledge, A. If δ is the rate of depreciation, then K in time $t+1$ is given as:

$$K_{t+1} = (1-\delta)K_t + I_t \tag{2.1}$$

Since $I_t = S_t = sY_t$, the evolution of K is given by (see Appendix B):

$$K^{\cdot}(t) = sY(t) - \delta K(t) \quad (2.2)$$

Further, since *Y/AL* is given by $f(k)$ $k^{\cdot}(t) = sf(k(t)) - (n + g + \delta)k(t)$ (2.3)

Substituting the Cobb Douglas function for $Y_t in\ Equation$ 2.1:

$$K_{t+1} = (1 - \delta)K_t + s(AK_t^{\alpha}N_t^{1-\alpha})$$

$$\frac{K_{t+1}}{N_t} = (1 - \delta)\left(\frac{K_t}{N_t}\right) + sA\left(\frac{K_t^{\alpha}N_t^{1-\alpha}}{N_t}\right) = (1 - \delta)\left(\frac{K_t}{N_t}\right) + sA\left(\frac{K_t^{\alpha}N_t^{1-\alpha}}{N_t^{\alpha}N_t^{1-\alpha}}\right)$$

$$\left(\frac{N_{t+1}}{N_t}\right)\left(\frac{K_{t+1}}{N_{t+1}}\right) = (1 - \delta)\left(\frac{K_t}{N_t}\right) + sA\left(\frac{K_t^{\alpha}}{N_t^{\alpha}}\right)$$

$$(1 + n)K_{t+1} = (1 - \delta)K_t + sAK_t^{\alpha}$$

$$K_{t+1} = \left(\frac{1-\delta}{1+n}\right)K_t + (\frac{sA}{1+n})K_t^{\alpha} \quad (2.4)$$

$In\ a\ steady\ state, K_{t+1} = K_t = K^*. As\ such, solving\ for\ K^*\ gives$:

$$K^* = \left[\left(\frac{(1-\delta)}{(1+n)}\right)K^* + \left(\frac{sA}{1+n}\right)K^{*\alpha}\right] = \left[1 - \left(\frac{1-\delta}{1+n}\right)\right] = sA(K^*)^{1-\alpha}$$

$$\left[\left(\frac{(1+n)}{1+n}\right) - \left(\frac{1-\delta}{1+n}\right)\right] = \left[(K^*)^{\alpha-1}\left(\frac{SA}{1+n}\right)\right] = \left[\frac{sA}{1+n}\left(\frac{1}{(1+n)(K^*)^{1-\alpha}}\right)\right]$$

$$(K^*)^{1-\alpha} = \left(\frac{sA}{n+\delta}\right)$$

$$The\ steady\ state\ K^* = \left(\frac{sA}{n+\delta}\right)^{\frac{1}{1-\alpha}} \quad (2.5)$$

Hence, steady-state real income, savings, investment, and consumption may be derived from K^*. Growth is a function of income as well as all the other determinants of the steady-state, including inequality (Galor & Tsiddon, 1997; Topuz, 2022). These determinants were extended to include human capital by Mankiw, Greogory, & Weil (1992). Hoff & Stiglitz (2001), however, criticised this model's proposition that higher savings can only increase growth temporarily and that rural or low-income populations lack savings. Lastly, technological improvements similarly mean that countries can experience increasing returns to investments/scale (Fisher & Erickson, 2007). Solow's growth model forms the thereoretical basis for this present study. It explicitly coceptualizes economic growth as a function of human capital, physical capital, inequality, and the initial level of income. Thus it allows for these variables' impact on GDP growth to be assessed. See section 3.3.

2.2.4 Endogenous Growth Model

It assumes two sectors: goods-producing and knowledge-generating research and development (R&D). A, K, and L are initial levels of capital, which are positive. Assuming α_L and $(1 - \alpha_L)$ represent the proportion of labour used for the R&D and goods sector, respectfully, while α_K and A is the capital stock and knowledge stock used in both sectors, respectively (Romer, 2012). Output in time t is given by:

$$Y_t = (1 - a_K)K(t)]^{\alpha}[A(t)(1 - a_L)L(t)]^{1-\alpha}, \quad 0 < \alpha < 1 \qquad (2.6)$$

Producing ideas requires capital, labour, and technology, as follows (with B as the shift parameter):

$$A^{\cdot}(t) = B[a_K K(t)]^{\beta}[a_L\, L(t)]^{\gamma}\, A(t)^{\theta}, \quad B > 0, \beta \geq 0, \gamma \geq 0, \qquad (2.7)$$

The savings rate is exogenous, and depreciation is zero; capital evolution equals:

$$K^{\cdot}(t) = sY(t) \qquad (2.8)$$

Investments are determined by initial random endowments to individuals that live for two periods, with people choosing to either invest or consume their endowments. Savings transform into future consumption depending on the technology. In the absence of capital market imperfections, all economic agents would prefer future consumption regardless of their initial endowments because of the high opportunity cost of present consumption. Agents would save up to the level where the marginal product of capital just equals the interest rate, which means that people with more wealth above this rate lend, and those with less borrow, such that growth is unaffected by the distribution of wealth (Aghion, Caroli, & García-Peñalosa, 1999).

$$\mathrm{Y_t = f(k_t)} \tag{2.9}$$

Where k is aggregate capital in an economy at a time t, represented as:

$$\mathrm{K_t = \Sigma i k_{t_i}} \tag{2.10}$$

Capital market imperfections make it difficult to maintain this equilibrium, and when banks refuse to lend money to a particular economic agent, then the capital stock becomes a function of every agent's ability to accumulate the capital, such that:

$$\mathrm{y_t = \Sigma y_{i,t}} \tag{2.11}$$

Where the i^{th} agent's output is a function of their own accumulated capital given by:

$$\mathrm{y_{i,t} = f(k_i, t)} \tag{2.12}$$

This means that $\Sigma i f(k_I, t) \neq f(\Sigma i k_I, t)$. Effectively, credit market imperfections affect the economic agents' production possibilities. Naturally, the more people have in initial endowments, the more their marginal propensity to save, and thus generally, investments would be a positive function of the initial endowments (Aghion, Caroli,

& García-Peñalosa, 1999). Thus, due to the decreasing returns to individual investments and the fact that the marginal productivity of capital diminishes, means that the production function is convex. As such, greater inequality would reduce aggregate output for a given aggregate capital stock (Blanchard, Giavazzi, & Amighinim, 2013).

This theory is relevant for the present study because it provides a conceptual basis for explaining how human capital and inequality of initial endowments affect savings/investments, and ultimately economic growth. As with Kuznet's hypothesis, this model also emphasizes the fact that developing nations have comparably larger informal sectors and poor financial intermediation, which affect the efficiency of the transmission mechanisms through which savings/investments affect growth (Kanbur, 2019; Traoré & Ouedraogo, 2016; Acemoglu & Guerrierie, 2008).

2.3 Empirical Literature

Forbes (2000) estimated the average annual GDP expansion of 45 countries globally (selected based on data availability for at least two consecutive five-year periods in 1965-1995) as a function of the baseline inequality (as measured using the Deninger and Squire Gini coefficient), real GNP/capita, male secondary education, female secondary education, and investment price level. Forbes (2000) slightly modified Perotti's (1996) model by adding dummy variables to control for period and country-specific variables that potentially mediate the dynamics between inequality and growth. Data on inequality, income, male/female secondary education, and market distortions were drawn from the Deininger & Squire (1996) dataset, the World Bank STARS dataset, the Barro & Lee (1996:2017) dataset, and the Penn World Tables, respectfully. The study focused on five-year average growths from 1966 to 1995, with countries that did not have data for at least two consecutive periods excluded. Forty-five countries met the inclusion criterion. The estimation used fixed effects, random effects, the Chamberlain's p-matrix panel, and the Arellano-Bond GMM estimator, then compared the results and tests underlying assumptions. The results indicated that, in both the immediate period and the medium-term, the coefficient of income inequality was positive and statistically significant, even with different variable definitions, sample selections, and model specifications. The study found that a unit standard deviation increase the Gini index did not only yield a 1.3 percent expansion in annual average GDP in the subsequent five years, but the general nature of this relationship was robust across five models.

The coefficient of income was positive for all the models ((-0.027-0.076), SE=0.004-0.020) except the random effects model (0.017, SE=0.006). MSE had a negative coefficient when estimated using fixed effects (-0.014, SE= 0.031), Arellano-Bond (-0.008, SE=0.022), and ten-Year Period Fixed Effects (-0.002, SE= 0.028), but was positive when estimated using random effects (0.047, SE= 0.015) and Chamberlain's π Matrix (0.01, SE=0.054) models. On the other hand, the coefficient of FSE was positive when estimated using fixed effects (0.070, SE = 0.032), Chamberlain's π Matrix (0.054, SE=0.006), Arellano-Bond (0.074, SE=0.018), and ten-Year Period Fixed Effects (0.031, SE=0.030), even though a negative relationship was found when a random-effects model was used (-0.038, SE=0.016). Despite its acceptably high robustness, Forbes (2000) has been criticised by Banerjee & Duflo (2000) for the flaws of the Arellano-Bond estimator, use of the ad-hoc five-year averages to construct panel data, and the unnecessary restriction of data to Deininger and Squire's (1996) dataset. In respect to the present study, Forbes (2000) challenges the previous evidence that inequality necessarily undermines growth, and instead shows that the relationship is dynamically mediated by diverse factors that vary from region/country to the next. The experience of East Africa and each country in East Africa could be distinct from the rest of the world.

Panizza (2002) ascertained whether findings by cross-country studies such as Forbes (2000), still existed when a cross-state dataset was used and then used cross-state data to highlight the mechanisms mediating inequality and growth. Panizza (2002) built and used the cross-state panel and cross-sectional inequality data for 48 US states from 1940 to 1980 to counter the possible effects of country/region-specific, omitted variables such as those highlighted by Forbes (2000). While there were policy/taxation and regulatory differences across states, there was more in common to discount most of the omitted variables that trouble cross-country comparisons (Barro, 2008; Forbes, 2000; Perotti, 1996). Panizza (2002) built distributional income data by adjusting gross income data from the annual *Statistics of Income, Individual Income Tax Returns* by the US Internal Revenue Service. The study computed the Gini coefficient using a simple linear estimation of the Lorentz curve and used interpolation to generate population quintiles. It adopted basic GMM estimation of reduced-form regressions using panel data to estimate 10-, 25-, and 30-year GDP/capita growth rate using the baseline income, inequality (measured by income share of the third quintile (Q3), the third and fourth quintiles (Q3+Q4), the income share of the Q1/Q5, and the Gini coefficient), and a vector of dummies for various decades (augmented with a set of regressors correlated with income distribution adapted from Perotti (1996), including the percentage of adults with college and high school education, and fertility).

At five percent significance level, Paniza (2002) determined that the coefficients of Q3, Q3+Q4, and Q1/Q5 were positively and statistically significantly related to growth by 0.09 to 0.60, 0.12 to 0.91, and 0.13 to 0.86; respectively. The Gini coefficient ranged between -0.04 and -0.47. Paniza (2002) confirms the cross-country findings still hold, but not under minor changes in the econometric specification and data. It is equally notable that Partridge (1997) used pooled OLS estimation but found that the coefficients of both Q3 and the Gini coefficient were statistically significant and positively related to GDP growth. Panizza's (2002) structural estimations using the same data revealed some evidence supporting the fiscal channel relating inequality to growth. This is relevant to the present study's analysis of fiscal policy mechanisms like infrastructure and education investments on growth across Kenya, Uganda and Tanzania.

Using the Kenya 2003 Social Accounting Matrix (SAM) data, Gakuru & Mathenge (2011) derived the accounting fixed price multipliers matrix to track linkages between demand-driven shocks on income generation, GDP growth, and ultimately, on income distribution effects on various economic groups. The study investigated trends of inequality in Kenya and their implications on multiple policy options aimed at alleviating poverty. The researchers employed techniques based on the decomposed SAM-based multipliers to decompose individual elements of the accounting price multiplier matrix in order to identify detailed linkages between individual household group's incomes and other accounts for which income had been injected exogenously.

To develop the multiplier effect and transform SAM into a model that could simulate effects of injections/shocks from exogenous to endogenous variables as well as evaluate how the shocks are tramitted across the SAM system, the study assumes fixed prices, linearity of relations, existence of excess capacity, and existence of excess labour capaicty. To develop a multiplier model, the study designated each SAM account as either exogenous or endogenous. An accounting fixed price multipliers matrix was derived and using for a multiplier analysis to reveal sectoral linkages. The production activities sub-matrix revealed that any injections into individual production activities had different effects for related activity incomes because of activation of demand for intermediate products.

The multiplier analysis identified the main sectors that may be used to enhance generalised economic development in Kenya. Hotels, restaurants, and trade sectors; agriculture sector; and manufacturing sectors were shown to play the highest role in developing the domestic economy. The study also decomposed the global multipliers to identify microscopic details of linkages among household group incomes as well as productive sectors accounts (manufacturing and agriculture) whose incomes had been injected exogenously. The findings of this analysis showed that inequality was such that growth in both agriculture and manufacturing benefited wealthy urban household deciles that controlled the means to production. Unit injections onto production systems increased urban and rural household incomes by multipliers of 0.9698 and 0.5526, respectively, while exogenous injections into factor accounts increased urban and rural incomes by multipliers of 1.4445 and 1.1234, respectively. The study determined that the manufacturing sector doesn't overly rely on other sectors, but other sectors draw heavily on its outputs. Similarly, manufacturing had the least impact on household incomes. This study highlights the necessity of the country focusing on both growth and inequality so as to effectively allevaite poverty. On account of the key sectors analysed, agriculture produced the highest direct effects on rural household incomes, while manufacturing posted the highest direct effect on urban household incomes. This study's use of SAM helps offer a logical arrangement of annual statistical data in respect to income flows in Kenya's economy, effectively linking institutions and production factors/activities, as well as capture circular interdependence of the economic system. In respect to the present study, SAM offers a theoretical framework for understanding the distribution of factor incomes in a country, as well as income inequality (Gakuru & Mathenge, 2011). This study offers some visbility into the key premisses of Kuznet's hypothesis in respect to the relative contributions of the rural/traditional/agricultural and modern/urban sectors of the economy, as a transmission mechanism for the effect of innequality on capital accumulation and growth (Hellier & Lambrecht, 2012). Inconsistent with Kuznet's theory, Gakuru & Mathenge (2011) shows that in Kenya, both sectors concentrate wealth in the hands of the rich, thus the predictions of Kuznet's hyptihesis may not hold. This bears further investigation, which this present study does.

Ncube, Anyanwu, & Hausken (2013) used a cross-sectional time series drawn from North Africa and the Middle East (MENA) from 1985 to 2009 to study the patterns and causality between inequality and societal development (operationalised as economic growth and poverty reduction) in MENA. The researchers estimated growth as a function of the primary school enrolment ratio, inequality, the elasticity of growth to the initial GDP/capita, an infrastructure proxy, and the ratio of government consumption expenditure to the size of the GDP. At a five percent significance level, Ncube, Anyanwu, & Hausken (2013) show that income inequality leads to lower economic growth, -0.563 (t-stat =-3.71), and increases poverty levels, 0.777 (t-stat = 4.62). This study also found that the coefficients of government consumption expenditure or burden, foreign direct investment, rate of inflation, exchange rate, past levels of GDP growth, and primary schooling were positive and statistically significant. Variables with a positive association with growth included infrastructure development and domestic investment rate (Ncube, Anyanwu, &

Hausken, 2013). This study is relevant for the purposes of the present study because it is one of a few that addresses developing and poor countries, even though it relies on low-quality, unstandardised data.

Drawing on the Solow model and panel data in 1970-2010 from OECD Income Distribution Dataset, Cingano (2014) used system GMM to estimate real GDP/capita expansion in the OECD as a linear function of past year real GDP/capita, the Gini index at the outset of the growth spell, a vector of controls for human capital and physical capital, as well as country and period dummies. The results reveal a growing gap between the rich and poor, with the ten percent earning as much as 9.5 times more than the lowest ten percent, compared to the year 1980, when the ratio was 7:1. Further, the coefficient of inequality was negative and statistically significant. A unit Gini point change induced a 5.7 percent change in the steady-state GDP/capita. The approximate speed of convergence was ~0.029 years. By implication, reducing inequality by one Gini point should produce a three percent expansion in per capital GDP in ~25 years, representing ~0.12 percent average annual expansion in GDP (Cingano, 2014). Cingano (2014) arrives at the same conclusion as Ncube, Anyanwu, & Hausken (2013), asserting that long-term increases in inequality, driven by the wealthiest one percent growing richer, have curbed growth. However, unlike Ncube, Anyanwu, & Hausken (2013), the study finds that income redistribution through taxation and transfer policies does not necessarily hurt growth, provided these programs are implemented in a manner that incentivises human capital formation.

Wolde, Sera, & Merra (2022) investigated the nature, causal direction, and existence of a long-term relationship between inequality and GDP growth in Ethiopia. The study hypothesized the existence of causality between income inequality and GDP growth.

Inequality (measured by the Gini coefficient) was modelled as a function of GDP growth, trade openness, inflation, total population, government spending, and capital formation. Data on GDP and government spending were obtained from the World Bank and Ministry of Finance of Ethiopia, respectively, while data for total population, gross capital creation, inflation, and trade openness were obtained from the National Bank of Ethiopia. The model was estimated by way of Autoregressive Distributive Lag techniques and causality between inequality and growth was assessed using the vector error correction Granger causality technique. The findings show the long-term coefficient of the GDP per capita was negative and statistically significant, 0.0123 (p-value<0.005) while the coefficients of capital formation (0.4081) and inflation (0.8215) were positive and statistically significant, respectively, p-value<0.05. However, the coefficients of population and trade openness were not statistically significant. The error correction coefficient was −1.004961, p-value<0.05, implying a very high speed of recovery of the equilibrium from short-term disturbances. In the short-term, the coefficients of GDP per capita and gross capital formation were negative but statistically insignificant, even though the lagged GDP per capita was positive and statistically significant. The coefficient of consumer price index was positive and statistically significant (0.423440), p-value<0.01, even though it turned negative and statistically significant in the initial and second lagged periods. The coefficients for total population and capital formation were not statistically significant. The Granger causality test findings indicate that income inequality doesn't Granger cause GDP per capita in Ethiopia, both in the long- and the short-run (−3.018194) and (13.37863), respectively, p-value<0.01. The long-term coefficient of the error correction term is positive albeit statistically significant, showing absence of long-term convergence. There is a unidirectional causality that flows from GDP per capita growth to inequality in both time horizons (Wolde, Sera, & Merra, 2022). Accordingly, Wolde, Sera, & Merra (2022) back the trend of studies showing causality flowing from inequality to GDP per capita growth. Like Kenya, Uganda and Tanzania, Ethiopia is a low-income country (per capita GDP in 2017 was $1608 in PPP terms) that has directed substantial budgetary allocations to increasing growth, alleviating rural and urban poverty, building infrastructure, and education. Even so, Wolde, Sera, & Merra (2022) used time series data, which necessarily presents with problems relating to missing data points and difficulties controlling for omitted variable biases and the short-term shocks in the data (Greene, 2012). The present study improves on this methodological flaws by using panel data.

2.4 Overview of the literature

Theoretically, the Kuznets-Kaldor-Solow consensus suggests that inequality may be necessary for human and physical capital accumulation, that are in turn, necessary for growth but the relationship between inequality and economic performance hinges on a country's stage of economic growth (Romer, 2012; Cingano, 2014; Acemoglu & Guerrierie, 2008; Aghion, Caroli, & García-Peñalosa, 1999). Contrarily, the other models suggest inequality could undermine the social capital/consensus necessary for growth, limit investment opportunities, and create macroeconomic instability (Hellier & Lambrecht, 2012).

The empirical literature is predictably mixed on the nature, strength, and direction of the relationship between inequality, GDP performance, and capital accumulation (Forbes, 2000; Ncube, Anyanwu, & Hausken, 2013). There is evidence of a positive relationship between growth, human capital, and infrastructure development as well as domestic investment rate (Ncube, Anyanwu, & Hausken, 2013). With the emergence of more standardized cross-sectional and panel data on income, educational attainment, and inequality (Forbes, 2000), older research that leaned toward an inverse relationship between inequality and growth has largely been discounted (Forbes, 2000; Voitchovsky, 2005; Cingano, 2014). The latest studies show that the degree and nature of this relationship are hugely varied but likely mediated by physical/human capital accumulation as well as a broad range of other structural and contextual factors such as the level of development, fertility and political stability, and democracy (Perotti, 1996; Forbes, 2000). By implication, while the link between inequality as well as capital investments and growth is likely to vary across countries and regions, there is a paucity of empirical literature covering Sub-Saharan Africa (Cingano, 2014). Additionally, even the extant empirical literature outside Sub-Saharan Africa remains inconclusive. Partridge (1997), Forbes (2000) and Panizza (2002) find that the coefficients of inequality, in both the immediate period and the medium-term, were positive and statistically significant, even with different variable definitions. Studies in developing countries, including Cingano (2014) find that the coefficient of inequality was negative and statistically significant. Inconsistent with the Kuznet's hypothesis, Gakuru & Mathenge (2011) show that, irrespective of the sectors, growth in both agriculture and manufacturing benefited wealthy urban household deciles that controlled the means to production. The nature of this relationship in East Africa may be different from other regions in the world, and having found little empirical literature on the same, this study should help remove this gap. Wolde, Sera, & Merra's (2022) study in Sub-Saharan Africa even shows that the direction of causation possibly flows from economic growth to inequality as against from inequality to economic growth. To the researcher's knowledge, there are no similar studies in Kenya, Uganda, and Tanzania.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter outlines and critically justifies, inter alia, the study's design, the underpinning conceptual framework as well as the model estimated, diagnostic techniques, model estimation techniques, data sources, and data preparation techniques.

3.2 Research Design

This study's design may be characterised as a non-experimental panel design (Baltagi, 2013; Greene, 2012). Since this study compares three pre-existing groups/countries without manipulating the independent variables or randomly assigning participants to groups, the design is consistent with a causal cross-sectional non-experimental design (Greene, 2012). A panel design was appropriate because both theoretical and empirical research demonstrate a potential mediating role by numerous exogenous factors, including health, fertility and political stability as well as democracy and the baseline levels of development and inequality (Perotti, 1996; Forbes, 2000). While some of these factors could've been built into the model, most could not (Park, 2011). Panel analysis makes it possible to control these factors and thus makes it possible to isolate the effects of inequality on GDP growth (Baltagi, 2013). Other than taking heterogeneity among units and accounting for dynamic changes because of repeated cross-sectional observations, the panel approach also helps overcome data unavailability, particularly for developing nations that may be otherwise insufficient for fitting time series regression (Park, 2011).

3.3 Theoretical Framework

The augmented Solow Growth Model as set out under sub-section 2.2.3 offers the conceptual underpinning for this study. The Solow Growth Model makes two key assumptions. It assumes that that technological progress is exogenous and the neoclassical production function exhibits diminishing marginal productivity. Most of its key findings may be obtained with any other production function. The model is consistent with stylized facts of growth, and has been employed in numerous empirical investigations of the same nature (Chen, Gong, & Marcus, 2014; Cingano, 2014). See section 2.2.3. The aggregate production function in the period t, is as follows:

$$Y_t = f(K_t, L_t H_t) = K_t^{\alpha} H_t^{\beta} (A_t L_t)^{1-\alpha-\beta} \tag{3.1}$$

$Where\ Y, H, K, and\ L\ refer\ to\ the\ output, human\ capital, physical\ capital,$

$and\ labour, respectively.$ A is the labour-augmenting technology. On the other hand, α and β, refer to partial output elasticities of capital and human capital, respectively (Cingano, 2014; Todaro, 1997).

Assuming initial levels of labour-augmenting technology (A) and labour (L) are exogenous and grow at exogenously determined rates g and n, respectively, such that $A_t = A(0)e^{gt}$ and $L_t = L(0)e^{nt}$. $L(0)$, $A(0)$, and $A(0)L(0)$ are the initial levels of labour, technology, and effective labour (Cingano, 2014). Effective labour is given as:

$$A_t L_t = \big(A(0)L(0)\big)e^{(n+g)t} \tag{3.2}$$

Also, let s_k and s_h be the proportion of income allocated to physical capital and human capital, respectively, and let per capita notations of Y and K be y and k, respectively (Cingano, 2014), such that:

$$y = \frac{Y}{AL}, k = \frac{K}{AL}, and\ f(k) = f(k, 1) \quad (3.3)$$

According to Cingano (2014), since capital only expands when capital re-investments exceed depreciation, d, then the evolution of the economy can be represented as follows:

$$k^{\cdot}(t) = (n + g + d)[k(t)s_k y(t)] \text{ and } h^{\cdot}(t) = (n + g + d)[h(t)s_h y(t)] \quad (3.4)$$

If the assumption of decreasing marginal returns to factors holds, then the partial output elasticities are less than unity, i.e., $\alpha + \beta < 1$ (Chen, Gong, & Marcus, 2014; Cingano, 2014). As such, the above equations may be solved to obtain steady-state h* and k*:

$$k^* = \left(\frac{s_k^{1-\beta} s_h^{\beta}}{n+g+d}\right)^{\frac{1}{1-a-\beta}} \quad (3.5)$$

$$h^* = \left(\frac{s_k^{a} s_h^{1-a}}{a+g+d}\right)^{\frac{1}{1-a-\beta}} \quad (3.6)$$

Equations 3.5 and 3.6 imply that, in a steady-state, capital per effective unit of labour is positively related to the savings rate and inversely related to population growth (Mankiw, Greogory, & Weil, 1992). Inserting Equations 3.5 and 3.6 into Equation 3.1 and then taking natural logs on both sides yields an expression for the steady-state output in an intensive form (Cingano, 2014). This may be written as a function of either s_h or the steady state human capital stock $h*$ (Mankiw, Greogory, & Weil, 1992; Cingano, 2014). The economy's output in a steady-state can then be written thusly:

$$\ln\left(\frac{Y_t}{L_t}\right)^* = lnA(0) + gt + \left(\frac{\alpha}{1-\alpha-\beta}\right)\ln(s_k) + \left(\frac{\beta}{1-\beta-\alpha}\right)\ln(s_h) - \left(\frac{\alpha+\beta}{1-\alpha-\beta}\right)\ln(n+g+d) \quad (3.7)$$

If y* is the steady-state output in efficiency units and $y(t)$ is the steady-state output at a time t, then the speed of convergence is obtained be written as:

$$\left(\frac{\partial \mathrm{lny}}{\partial \mathrm{t}}\right) = \lambda(\mathrm{lny} * - \mathrm{lny}), \lambda \text{ is the convergence rate} = (\mathrm{n}+\mathrm{g}+\mathrm{d})(1-\alpha-\beta) \quad (3.8)$$

Again, under the assumption of decreasing marginal returns of factors, $\alpha + \beta < 1$, then equation 3.8 means that ln$y$ approaches lny* exponentially $(\text{Cingano}, 2014, \text{p.} 44)$, such that:

$$\ln y(t) - \ln y^* = e^{-\lambda\,\mathrm{t}}(\ln y(t-s) - \ln y^*) \quad (3.9)$$

Equation 3.9 may be rewritten as:

$$lny(t) - lny(t-s) = (1-e)^{-\lambda\,\mathrm{s}}\left(lny^* - lny(t-s)\right) \quad (3.10)$$

Replacing y* in equation 3.7 with $\phi(\lambda) = (1-\mathrm{e})^{-\lambda\,\mathrm{s}}$, and where $(t, t-s)$ is the time interval, then:

$$\ln y(t) - lny(t-s) = -\phi(\lambda)\, lny\,(t-s) + \phi(\lambda)\left(\frac{\alpha}{1-\alpha-\beta}\right)\ln(s_k) +$$

$$\phi(\lambda)\left(\frac{\beta}{1-\beta-\alpha}\right)\ln h^* - \phi(\lambda)\left(\frac{\alpha+\beta}{1-\alpha-\beta}\right)\ln(n+g+d) \quad (3.11)$$

According to Cingano (2014), the Solow model in equation 3.11 shows that GDP expansion is driven by the initial income level and any other steady-state determinant. Accordingly, estimating Equation 3.11 makes it possible to infer the effect of individual determinants of growth on growth. It can be shown that inequality is one of these determinants (Cingano, 2014). For this purpose, this study adopts Hellier & Lambrecht's (2012) derivation. See Appendix A. Assuming a convex savings function, such that:

$$s(y_i),\ 0 < \left(\frac{\delta s}{\delta y_i}\right) < 1, \frac{\delta^2 s}{\delta y_i^2} > 0, \tag{3.12}$$

$where\ y_i\ is\ the\ income\ for\ individual\ i.$ The capital growth rate, γ_K, is given by

$$\gamma_K = \frac{I-\delta K}{K} \tag{3.13}$$

Where I and δ are the investments and capital depreciation, respectively. Since Investments in an economy without the government is equal to savings, Equation 3.13 may be rewritten as:

$$\gamma_K = (\sum_h s(y_h) *\ y_h - \delta)/K\ = K^{-1} \sum_h s(y_h)\ x\ y_h - \delta \tag{3.14}$$

Where y_h refers to the income for household h and $s(y_h)$ is the saving rate for the same household. According to Bourguignon (1981), savings (s) may be assumed to depend on wealth and the rate of interest without modifications of the resulting conclusions. Assuming a convex savings function as shown in equation 3.9, then a change in income distribution for all households in a country is a vector of variation dy_h whereby$\sum_{h=1}^{z}(dy_h) = 0$. Supposing, higher inequality involves transferring income $dy\ >\ 0$ from a low-income household i to a relatively wealthier household j, such that $y_j > y_i$. Then the change in income distribution dy is given by $d_j +\ d_i = 0\ or\ d_j = d_i$. The rate of capital accumulation will be a function of the difference in the savings rates of households $i\ and\ j$. Upon re-arranging equation 3.14, this is represented as:

$$d\gamma_K = \left(\left(s(y_j) - s(y_i)\right) + \left(s'(y_j)y_j - s'(y_i)y_i\right)\right)K^{-1}dy \qquad (3.15)$$

$Since\ s(y_j) > s(y_i)$ because $\frac{\delta s}{\delta y_h} > 0\ and\ s'(y_j)y_j > s'(y_i)y_j\ because \frac{\delta^2 s}{\delta y_h^2} > 0$, the transfer $dy > 0$ expands growth because wealthier households have a higher marginal propensity to save the transferred income (Hellier & Lambrecht, 2012, p. 15). Combining Equations 3.11 and 3.15, then capital (k) accumulation is a function of inequality, $d\gamma_{K(t-s)}$, then:

$$\ln y(t) - lny(t-s) = -\phi(\lambda)\ lny\ (t-s) + \phi(\lambda)\left(\frac{a}{1-a-\beta}\right)\ln(s_k) +$$
$$\phi(\lambda)\left(\frac{\beta}{1-\beta-\alpha}\right)\ln(h^*) - \phi(\lambda)\left(\frac{\alpha+\beta}{1-a-\beta}\right)\ln(n+g+d) + \ln d\gamma_{K(t-s)} \qquad (3.16)$$

3.4 Model Specification

The model is, therefore, specified as follows:

$$\ln y_{(i,t)} - lny_{(i,t-1)} =$$
$$\beta_1 lny_{i,t-1} + \beta_2 S_{k_{i,t-1}} + \beta_3 \ln H_{EYSE_{i,t-1}} + \beta_4 \ln d\gamma_{GKi,t-1} + \beta_4 \ln d\gamma_{PKi,t-1}$$
$$(3.17)$$

3.5 Definition, Operatonalisation, and Measurement of Variables

Table 3.1 outlines the variables, their definitions, and measurements.

Table 3.1: Variable conceptualisation and operationalisation

Variable	**Notation**	**Conceptualisation**	**Operationalization**
Initial Income	$y_{i,t-1}$	Real income/capita for the ith country $in\ t-1$	Average annual GDP/capita PPP (current international $) in year $t-1$
GDP Growth	$\ln y_{i,t} - ln y_{i,t-1}$	GDP/capita growth for the ith country in 1 year	Average percentage change in GDP/capita in 1 year
Inequality	$d\gamma_{K(i,t-1)}$	Level of inequality for country i, during period $t-1$	Standardised cross-country Gini coefficient. 0-100 (representing total equality to total inequality, respectively)
Human Capital	$H_{EYS_{i,t-1}}$	Level of human capital development for country i, during period $t-1$.	Mean years of schooling for population older than 25.
Private Capital	$\boldsymbol{S_{Pk_{i,t-1}}}$	Private capital stock for the ith country in year $t-1$	Private annual capital stock in billions of constant 2011 international dollars.
Government Capital	$\boldsymbol{S_{Gk_{i,t-1}}}$	Government capital stock for the $\boldsymbol{ith}$ country in year $\boldsymbol{t-1}$	Government capital stock Annual spending in billions of constant 2011 international dollars.

3.6 Data Sources and Justification

The data was collected for the period 1995-2019, from the following sources:

(i) Inequality Data - The data was obtained from Solt (2019), available through the Harvard University Dataverse. Deininger & Squire (1996) and Solt (2019) provide a standardised, high-quality cross-country inequality dataset.

(ii) GDP/capita and GDP/capita growth rate - These were obtained from the World Bank WDI database.

(iii) Human Capital (Mean years of schooling for population aged 25 and above) Data - Kenya, Uganda, and Tanzania use different systems of education (World Bank, 2022). Barro & Lee's (2017) database of average primary, secondary, and tertiary schooling provides adjusted/standardized years of schooling that is directly comparable across the countries included. However, data points are only available in five-year intervals up to 2010. Instead, comparable data was obtained from United Nations Development Programme's Human Development Reports (2020).

(iv) Private capital and government capital data was obtained from the IMF Investment and Capital Dataset 1960-2015.

3.7 Summary Statistics

The descriptive statistics are particularly important in identifying, summarising, and highlighting general patterns and trends in the data. This study primarily relied on the mean, standard deviation, minimum, and maximum statistics. The statistics were presented using summary statistics as well as tabular and graphical formats.

3.8 Diagnostic Tests

3.8.1 Cross-sectional dependency test

A cross-dependency test, following an unrestricted estimation Model 3.17, was conducted prior to performing panel analysis. An increasing body of evidence shows that panel data may have substantial cross-sectional dependence in errors that emerge from the presence of unobserved components and common shocks that subsequently comprise the error term, spatial dependence, and random pairwise disturbances that are unaccompanied by patterns of spatial dependence or other common patterns (Hoyes & Sarafidis, 2006). According to Tugcu (2018), existence of cross-sectional dependence precludes subsequent paths of analysis that are built on the assumption of independence. There are multiple tests for detecting cross-sectional dependency, including the Pesaran CD test, the Breusch-Pagan LM test (most suited for panel observations drawn from a limited number of cross-sectional units), and Pesaran (2004) scaled LM test. These tests hypothesise that the data does not exhibit cross-sectional dependence (Tugcu, 2018).

3.8.2 Panel Unit Root

3.8.2.1 First-generation Tests

These tests employ pooled panel data because they assume cross-sectional independence (Tugcu, 2018). To begin with, the study ascertained whether the variable had a constant and/or a trend by regressing the variable against the constant C and @trend. Depending on the deterministic, five tests were run at level and at first difference.

3.8.2.1.1 Levin-Lin-Chu Test

Levin-Lin-Chu (2002) hypothesizes that all panels (or time series) have a unit root, i.e.

$$H_0 : \rho i = 1 \; for \; i = 1, \ldots, N,$$

$$H_1 : -1 < \rho i = \rho < 1 \; for \; i = 1, \ldots, N$$

The first-order serial correlation coefficient or lag order p is allowed to change across individuals. Under the alternative hypothesis, p is required to be the same across all units because the test statistic is calculated in a pooled way. The Levin-Lin-Chu statistic has high power when N ranges between 10 and 250 and T ranges between 5 and 250, respectively. This was the case in this study. This test, however, overly relies on the assumption of cross-sectional independence that did not hold in this present study (Nell, Zimmerman, & Kunst, 2011).

3.8.2.1.2 Im-Pesaran-Shin Test

This test hypothesizes that $H_0 : \rho i = 0$, but unlike Levin-Lin-Chu (2002), it has fewer restrictions on the heterogeneous coefficients i.e. $H_1 : \{ {}^{\rho i < 0 \; for \; i = 1,2,\ldots n \; N_1}_{\rho i = 0 \; for \; i = N_1 + 1, ---, N}$, where ρi is the individual t-statistic to test H_0 for all i. The test is based on individual unit root tests average. This test is more efficient when using small samples (Nell, Zimmerman, & Kunst, 2011).

3.8.2.1.3 Fisher-type Tests

This test employs p-values from individual stationarity tests for each cross-section. It can handle unbalanced panels and allows the lag lengths in every augmented Dickey-Fuller test to vary (Nell, Zimmerman, & Kunst, 2011).

3.8.2.2 Second Generation Tests

With cross-sectional dependence, the earlier tests could be inaccurate (Tugcu, 2018; Baltagi, 2013). Second-generation tests assume inter-cross-sectional heterogeneity, and thus the panels are heterogeneous since there is no common autoregressive structure in the series (Tugcu, 2018). Other than Harris et al. (2005) and Bai and Ng (2005), all second-generation tests' null hypotheses provide that the series are non-stationary. This study relies on the Pesaran (2007) CIPS test, supplemented by the first-generation tests. Thus, where there was a conflict between first generation and second-generation test results, the former were ignored.

3.8.3 Panel Cointegration

This study undertook multiple tests for cointegration and decision-making was based on the outcome of the majority of tests.

3.8.3.1 Kao Panel Data and Pedroni Panel Data Cointegration Tests

The panel cointegration link between GDP Growth and Inequality as well as other explanatory variables, was examined using Pedroni (1999) and Kao (1999). The Pedroni technique comprises two tests, each comprising four tests (Mujtaba, Jena, & Mukhopadhyay, 2020). The null hypothesis in both tests expects the non-existence of cointegration. The hypothesis in the Kao test is tested using (augmented or unadjusted) Dickey-Fuller statistics. In the Pedroni test, the hypothesis is tested using the Phillips-Perron, the modified Phillips-Perron and augmented Dickey-Fuller statistics (Greene, 2012).

3.8.3.2 Westerlund Panel-data Cointegration Test

While this test tests the same null hypothesis as the Kao and Pedroni tests, the alternative hypothesis provides that some (not necessarily all) panels are cointegrated. The variance ratio statistic is used to test the hypothesis (Stata, 2018). It provides four tests. Pt and Pa provide panel statistics, while Ga and Gt represent cross-sectional statistics. Rejecting the null hypothesis implies cointegration (Greene, 2012). Additionally, with cross-sectional dependence, the Westerlund test was given precedence where there were conflicts with other tests, since bootstrapping offered rigorous critical values (Baltagi, 2013).

3.8.3.3 Johansen-Fisher Panel Cointegration Test

This test assesses the system-wide cointegration for the panel set. If π is the p-value from each cointegration test for cross-section i, then H_0: No cointegration cannot be rejected (Arlt & Mandel, 2014).

3.9 Panel Estimation and Post-Estimation Diagnostics

3.9.1 Fixed and Random Effects Models

3.9.1.1 F-test

In a model, $y_{it} = a + \mu_i + X_{it}B + \varepsilon_{it}$, $H_0: \mu_1 = \cdots = \mu_{n-1} = 0$. Based upon the loss of goodness-of-fit, an F-test evaluates H_0 by contrasting the LSDV with the Pooled OLS method for changes in the R^2 and the sum of squared errors. If H_0 is rejected, then the fixed effect model is more efficient than pooled OLS (Park, 2011).

3.9.1.2 Lagrange Multiplier Test

It tests $H_0\colon \sigma_u^2 = 0$. Rejecting H_0 implies the existence of a significant random effect in the data, rendering the random effect estimation more efficient compared to pooled OLS, in dealing with the heterogeneity (Baltagi, 2013; Park, 2011).

3.9.1.3 Panel Multicollinearity

The Variance Inflation Factors (VIF) test would be used to test for multicollinearity (Perotti, 1996). $H_0\ VIF_{for\ variable\ k} < 4$. Thus if, the $VIFk = 1$, then variable k is not correlated with any other predictor variable. Variables that are highly correlated to others may be removed. The study similarly undertook a correlation analysis of the independent variables (Allison, 2012).

3.9.1.4 Panel Autocorrelation

The null hypothesis expects zero autocorrelation in the first differentiated errors; thus, the expected result of the rest provides strong evidence to reject H_0. Also, there should be no autocorrelation in the first differentiated errors at orders greater than 1 (Pillai, 2017).

3.9.1.5 Heteroskedasticity

3.9.1.5.1 The Breusch–Pagan Test

According to Perotti (1996), OLS regression assumes errors have similar but unknown variance, such that a random measurement error causes a downward bias in the coefficients of the inequality regressors. It hypothesizes that $H_0\colon \sigma_u^2 = 0$. Thus, while heteroscedasticity may exist, the errors are may have been uncorrelated with the dependent variable.

3.9.2 Panel Autoregressive Distributed Lag

Johansen's co-integrating test is recommended for series that are integrated at the same level (Pedroni, 1999; Kao, 1999). If all variables are both cointegrated and stationary at the same level, then their short-run elasticities may be calculated using vector error correction model (Greene, 2012). These conditions do not always hold. As long as none of the series is I (2), the Panel Autoregressive Distributed Lag (ARDL) cointegration approach is more efficient, particularly in the case of finite and small datasets (and when N is less than T). Panel ARDL can also be conducted in the event no cointegration is found using other methods (Chudik, Mohaddes, Pesaran, & Raissi, 2017).

CHAPTER FOUR

EMPIRICAL FINDINGS

4.1 Introduction

This chapter presents the results of the descriptive analysis, and various diagnostic tests, as well as the results of the estimation of the likely effect of inequality, educational attainment, capital formation, and initial GDP on GDP growth.

4.2 Summary Statistics

This section offers a description and summary of the data using measures of central location and variability. The summary results for individual countries and aggregations for the three countries are reported in Tables 4.1 (a) through to (c).

Table 4.1: Summary statistics (a)

Variable	Country	Mean	Max	Min	Std. Dev.
GDP per Capita (PPP) (USD)	Kenya	2006.33	3635.27	1464.97	605.97
	Uganda	1424.61	2271.65	669.36	551.14
	Tanzania	1546.99	2479.26	959.60	519.80
	Overall	1659.31	3635.3	669.36	601.34

Source: Author’s computations

Table 4.1: Summary statistics continuation (b)

GDP per Capita Growth (percent)	Kenya	3.48%	8.06%	-0.80%	2.25%
	Uganda	6.58%	11.52%	3.14%	2.23%
	Tanzania	5.23%	7.67%	0.58%	2.06%
	Total	5.10%	11.52%	-0.80%	2.49%
Gini Coefficient	Kenya	47.08	48.3	46.3	0.63
	Uganda	44.46	45.1	43.6	0.52
	Tanzania	43.16	44.5	41.3	1.07
	Overall	44.89	48.3	41.3	1.8
Private capital (billions of constant 2011 international dollars)	Kenya	65.2680	106.8359	48.0097	17.7895
	Uganda	49.4130	112.2146	20.7995	28.3335
	Tanzania	110.9713	229.9402	61.7519	48.9561
	Overall	75.2174	229.9402	20.7995	42.5203

Source: Author's computations

Table 4.1: Summary statistics continuation (c)

Government capital (billions of constant 2011 international dollars)	Kenya	31.7865	53.6082	23.7815	8.0300
	Uganda	19.5604	43.7957	7.7938	10.3895
	Tanzania	54.2343	80.3221	40.8291	10.8690
	Overall	35.1938	80.3221	7.7938	17.3006
Human Capital (years)	Kenya	5.39	6.4	3.7	0.84
	Uganda	4.5	6.2	2.8	1.05
	Tanzania	4.63	6	3.6	0.69
	Total	4.78	6.4	2.8	0.94

Source: Author’s computations

It is apparent that in the period under consideration in this study, Kenya had the highest average GDP per capita of USD 2,006.33, followed by Tanzania at USD 1,499.4 and Uganda at USD 1,547. The standard deviation of GDP per capita was the highest for Kenya and the lowest for Tanzania, implying greater variability in respect to Kenya that should potentially be reflected in the capital investments if there is a causal relationship.

Average and individual private capital stocks were more than double the size of general government capital stock across the three countries, with Tanzania accounting for about half of all private capital stock. Tanzania had 110.97 billion of 2011 international dollars, while Uganda saw the least in private capital flows with just 49.41 billion of 2011 international dollars. The same pattern was reflected in general government capital stock, with Tanzania accounting for about half of all investments, having realised an average of 54.23 billion of 2011 international dollars over the period, while Uganda had the lowest flows with 31.79 billion of 2011 international dollars. The data suggested the possibility of an existence of a link between capital formation and inequality on GDP growth, as Tanzania had the lowest 43.16 with a standard deviation of 1.07. The sizeable standard deviations for per capital GDP growth and gross capital formation showed that the data points were broadly dispersed from the mean. The GDP per capita fluctuated between 8.14 percent and -0.80 percent.

Kenya had the highest human capital score (measured by the mean years of schooling), having posted 5.39 years with a standard deviation of 0.84. Tanzania and Uganda had nearly the same average years of schooling, with 4.63 and 4.5 years, respectively. It had the lowest average and maximum years of schooling with the highest variability, proving that Uganda did worse that Kenya and Tanzania over the period of analysis.

4.2 Data Time series Properties

4.2.1 Cross-sectional dependence

The cross-sectional dependence was tested using three tests following a Least Squares regression. The cross-sectional dependency test is a residual test that was conducted after an unrestricted fixed effects estimation of the model (Eviews, 2017). Table 4.2 shows the results of the Pesaran scaled LM, Pesaran CD, and Breusch-Pagan LM tests.

Table 4.2: Cross-sectional dependence

Test	Statistic	d.f.	Probability
Pesaran scaled LM	2.212782		0.0269*
Pesaran CD	2.782651		0.0054**
Breusch-Pagan LM	8.420186	3	0.0381*

** and ** denote significance levels at 5% and 1%, respectively.*

Source: Author's computation

Accordingly, the null hypothesis for the three tests, i.e., $H_0: no\ cross-sectional\ independence$, was invariably rejected, $p<0.05$. By implication, shared shocks across Tanzania, Uganda, and Kenya arguably comprise idiosyncratic pairwise dependences, the error term, and random spatial disturbances (Hoyes & Sarafidis, 2006; Baltagi, 2013). These could have been due to socioeconomic and financial integration or even similar responses to shocks due to social norms, "herd" behaviour, neighbourhood effects, and interdependent preferences (De Hoyos & Sarafidis, 2006). Accordingly, panel causality analysis based on estimating a panel vector error-correction model or panel vector auto-regression by way of pooled ordinary least squares and of a generalised method of moments estimator were inappropriate. Instrumental variable estimators and generalised method of moments estimators, in particular, ignore cross-sectional dependence.

4.2.2 Panel Unit Root Tests

The efficiency of estimators would be reduced if variables in panel data are not stationary and co-integrated (Levin, Lin, & Chu, 2002; Tugcu, 2018). The finding of cross-sectional dependence precludes first-generation tests. Pesaran CIPS test, PANIC test, and other second-generation tests relax the steep assumption of cross-sectional independence (Tugcu, 2018). This study used the Pesaran CIPS test. According to Eviews (2013), the first step in performing a unit root analysis was ascertaining whether the variable had a constant and/or a trend by regressing the variable against the constant C and @trend. The results are presented in Table 4.4.

Table 4.3: Intercept and trend analysis of the variables

	Variable	Coefficient	Std. Error	t-Statistic	Probability
Human Capital	Constant	3.448325	0.106542	32.36588	0.0000***
	@Trend	0.102361	0.00703	14.55999	0.0000***
Inequality	Constant	44.43492	0.387695	114.6131	0.0000***
	@Trend	0.035206	0.025582	1.376162	0.1727
Initial Income	Constant	803.2708	67.14808	11.96268	0.0000***
	@Trend	65.84918	4.430825	14.86161	0.0000***
Private Capital	Constant	75.2174	4.845634	15.52272	0.0000***
	@Trend	5.445933	0.266633	20.4248	0.0000***
Government Capital	Constant	35.19376	1.97159	17.85044	0.0000***
	@Trend	2.377195	0.143526	16.56281	0.0000***
GDP Growth	Constant	5.098646	0.278278	18.32216	0.0000***
	@Trend	0.11003	0.032904	3.344006	0.0000***

**** denotes significance levels at 1%*

Source: Author’s computation.

The null hypothesis was that the series exhibited neither an intercept nor a trend. At five percent level, the null hypothesis was not rejected for the inequality variable, but only with respect to the trend. Initial income, government capital stock, private capital stock, and human capital exhibit both intercept and trend. See Table 4.4 and Appendix C for Pesaran CIPS test results and for first generation tests results, respectively.

Table 4.4: Pesaran CIPS test results for stationarity

Variable	**Deterministic**	**CIPS**	**Truncated CIPS**	**p-value**	**Stationary**
Level					
Ln Government Capital	Constant and trend	-2.0521	-2.0521	>=0.10	Not stationary
Ln Private Capital	Constant and trend	-3.5154	-3.5154	<0.01***	Stationary
GDP growth	Constant and trend	-4.1920	-4.1920	<0.01***	Stationary
Human capital	Constant and trend	-1.1512	-1.1512	>=0.10	Not stationary
Inequality	Constant	-2.0571	-2.0571	>=0.10	Not stationary
Initial Income	Constant and trend	-1.0990	-1.0990	>=0.10	Not stationary
First difference					
Ln Government Capital	Constant and trend	-4.6570	-4.6570	<0.01***	Stationary
Human Capital	Constant and trend	-4.6355	-4.6355	<0.01***	Stationary
Inequality	Constant	-3.2990	-3.2990	<0.01***	Stationary
Initial Income	Constant and trend	-3.3282	-3.3282	<0.01***	Stationary

*** *denotes significance levels at 1%.*

Source: Author’s computation

The Pesaran CIPS test tests a null hypothesis that the series is non-stationary. At five percent level of significance, private capital stock and GDP growth were stationary at level while government capital stock, human capital, initial income, and inequality were stationary at first difference.

4.2.3 Panel Cointegration

The existence of cointegration between GDP growth and government capital, private capital, human capital, and inequality was tested using the Westerlund-based panel cointegration test, the Pedroni tests, the Kao (Engle-Granger based) test, and the Fisher (combined Johansen) test. Table 4.5 presents the Westerlund-based panel cointegration test results.

Table 4.5: Westerlund-based panel cointegration tests results

Statistic	**Value**	**Z-value**	**P-value**	**Decision**
Gt	-3.816	-3.094	0.001***	Panel cointegration
Ga	-1.734	1.984	0.976	No panel cointegration
Pt	-5.519	-2.146	0.016**	Panel cointegration
Pa	-5.015	0.260	0.603	No panel cointegration

** and *** denote significance levels at 5% and 1%, respectively.

Source: Author's computations

The null hypothesis is rejected in respect with Gt and Pt at one percent significance level, implying the existence of error correction in (at least) some of the panels (Greene, 2012). The Kao (Engle-Granger-based) test results are reported in Table 4.6.

Table 4.6: Kao (1999) cointegration test results

	t-Statistic	Probability
ADF	-2.022822	0.0215**
Residual variance	5.873983	
HAC variance	2.397424	

** *denotes significance levels at 5%.*

Source: Author's computation

The Kao (1999) test null hypothesis of no cointegration was, at five percent level, rejected. The results supported the findings of Pedroni's (1999) test, where the null hypothesis was also rejected at a five percent level (Table 4.8). Similarly, the Fisher (combined Johansen) panel cointegration tests are reported in Table 4.9 produced similar results.

Table 4.8: Pedroni Cointegration test results

	Statistic	Probability	Statistic	Probability
Deterministic	**No deterministic trend**		**Deterministic intercept and trend**	
Within dimension tests				
Panel v-Statistic	-1.09639	0.8635	-1.9631	0.9752
Panel rho-Statistic	-0.79724	0.2127	-0.3006	0.3819
Panel PP-Statistic	-3.87977	0.0001***	-4.7831	0.0000***
Panel ADF-Statistic	-2.54231	0.0055**	-2.6261	0.0043**
Weighted				
Panel v-Statistic	-1.46378	0.9284	-2.3127	0.9896
Panel rho-Statistic	-1.19777	0.1155	-0.6143	0.2695
Panel PP-Statistic	-4.3597	0.0000***	-4.8024	0.0000***
Panel ADF-Statistic	-2.47253	0.0067***	-2.3451	0.0095***
Between-dimension				
Group rho-Statistic	-0.10685	0.4575	0.3843	0.6496
Group PP-Statistic	-3.96348	0.0000***	-5.8002	0.0000***
Group ADF-Statistic	-2.31646	0.0103**	-2.3109	0.0104**

** *and* *** *denote significance levels at 5% and 1%, respectively.*

Source: Author's computation

Table 4.9: Johansen-Fisher Panel Cointegration test

Number of CEs Hypothesized	Trace Test Fisher Statistic	Probability	Max-Eigen Fisher Statistic	Probability
0	100.3	0.0000***	57.19	0.0000***
At most 1	57.19	0.0000***	21.74	0.0013***
At most 2	41.44	0.0000***	20.73	0.0021***
At most 3	28.13	0.0001***	16.98	0.0094***
At most 4	19.86	0.0029***	19.86	0.0029***

*** *denotes significance levels at 1%.*

Source: Author's computation.

Under the null hypotheses, i.e., $H_0: no\ cointegration$, the Johansen-Fisher test results confirm the existence of cointegration, even at a one percent level of significance. Having established cointegration among the variables, it is proper to estimate long-run relationships among the variables (Mujtaba, Jena, & Mukhopadhyay, 2020).

4.3 Diagnostic Tests

4.3.1 Multicollinearity

A high correlation between any two regressors may render a significant variable insignificant by inflating its standard error. The detection of the existence of multicollinearity was done using correlation analysis. See Table 4.10.

Table 4.10: Correlation matrix for independent variables

Variable	Government Capital	Private Capital	Human Capital	Inequality	Initial Income
Government Capital	1				
Private Capital	0.4935	1			
Human Capital	0.4634	0.5564	1		
Inequality	-0.2753	-0.1383	0.4639	1	
Initial Income	0.4783	0.6011	0.9246	0.4728	1

Source: Author’s computations.

Initial income and human capital Investments are strongly correlated. Accordingly, one of these two variables was excluded Human capital, physical capital, and labour were integral predictor variables in the Solow Growth Model (See Equation 3.17), and hence initial income was subsequently dropped.

4.4 Effect of Income Inequality, Human Capital, and Physical Capital Investments on GDP Growth

4.4.1 Pooled OLS, Fixed Effects, Random Effects, and Arellano–Bond Estimations

According to Lin-Sea, et al. (2019), the choice of estimation techniques hinges on the power of tests, cross-sectional dependence, stationarity, cointegration relationship, direction of causality, homogeneity testing, and small sample bias issues. Since $T > N$, non-stationary panel analysis techniques (VECM, FMOLS, and DOLS) could have been appropriate compared to POLS, random effects, and fixed effects. Similarly, if all the variables were integrated at first difference, then panel VAR could have been ideal. However, none of these techniques were appropriate given the mix of variables that were stationary at level and at first difference (Tugcu, 2018; Lin-Sea, et al., 2019). The Arellano-Bond estimation corrects for biases from lagged endogenous variables and allows a measure of endogeneity in other regressors (Arellano & Bover, 1995; Forbes, 2000). The GMM estimator takes first difference forms of each variable to remove country-specific effects before using lagged values of each variable as instruments. However, two variables in the model were first differenced. Further, GMM and instrumental variable estimators were inconsistent and inefficient due to the existence of cross-sectional dependence as well as because they were generally unsuitable for small samples, particularly when $T > N$, as was in this study (Arellano & Bond, 1991; Eviews, 2019).

4.4.2 Panel Autoregressive Distributed Lag Model

Cointegration of variables permits using long-run estimation methods such as Dynamic Two-Way Fixed Effect (DFE) and Mean Group (MG) or Pooled Mean

Group (PMG) (Tugcu, 2018). Crucially, however, the unit root test results showed that human capital and GDP growth were stationary at level, while the remaining variables were found to be stationary only after they were differenced once (Baltagi, 2013). By implication, the cointegration tests excluded variables that were stationary at level as the tests ordinarily only include variables that are integrated at the same order. Effectively, inferring long-term cointegration among all the variables is unfounded (Pedroni, 1999; Baltagi, 2013). Even so, as long as the variables are stationary at either level or first difference, these conditions necessitate the panel Autoregressive Distributed Lag (ARDL) model (Baltagi, 2013). The ARDL technique treats each underlying variable as a single long-term relationship equation (Asteriou, Pilbeam, & Pratiwi, 2021). In the event that a cointegrating vector is found, the ARDL model of the vector is reparametrized into an error correction model. The reparametrized result then gives both immediate term and long run dynamics among variables of the single model equation as well as of the same form with the error correction model (Nkoro & Uko, 2016).

4.4.2.1 Mean Group, Pooled Mean Group, Dynamic Fixed Effects, and Autoregressive Distributed Lag Model Estimation Results

A specification test was run to determine the most efficient estimator between MG and PMG estimators, and subsequently between PMG and DFE estimators. To decide between MG and PMG, the Hausman test's null hypothesis that the difference in coefficients was unsystematic was not rejected, implying the PMG estimator was better than the MG estimator, $X^2(3) = 1.49, Prob. > X^2 = 0.6835$. The Hausman test between DFE and PMG was inconclusive. However, the Hausman test showed that the MG estimator was more efficient than the DFE estimator.

4.4.2.2 Bounds Test, Heteroskedasticity, Normality and Lag Selection

Bounds testing was not appropriate for panels (Eviews, 2017), and was, therefore, not done. Further, PMG/ARDL method restricts serial correlation, and thus it also dispensed with the need for testing for heteroskedasticity and serial correlation (Asteriou, Pilbeam, & Pratiwi, 2021). The Akaike information criterion offered the best fit for the VAR model, with the optimal lag for the system being 2. See Table 4.11.

Table 4.11: Optimal lag selection

Lag	**Log L**	**Akaike FPE**	**LR Stat., *p<0.05***	**Akaike Info. Criterion**	**Hanna - Quinn Info. Criterion**	**Schwarz Info. Criterion**
0	-853.20	135502.5	N/A	26.0061	26.0717	26.1720
1	-150.54	0.000164	1277.568	5.4709	5.8642	6.4662
2	-68.33	$2.93e^{-05}$*	137.016*	3.7373*	4.4583*	5.5620*
3	-46.78	$3.37e^{-05}$	32.6560	3.8417	4.8905	6.4959
4	-19.53	$3.36e^{-05}$	37.1603	3.7735	5.1500	7.2571

** denotes the lag order chosen by each criterion*

To establish the shape of the distribution of errors, the Jarque-Berra test was run. The null hypothesis, i.e., the errors were normally distributed, could not be rejected, Jarque-Bera=2.1762, p=0.3368. PMG estimation ensured that long-run equilibrium across the three countries was homogeneous while also permitting heterogeneity (intercepts as well as the short-term variance of errors and estimates) across the cross-sections in the short term (Asteriou, Pilbeam, & Pratiwi, 2021). The short-run equation captures the country-specific heterogeneity, resulting from differences in responses to, and of, inter alia, external shocks, anti-inequality/equalisation policies, and socio-political instability (Asteriou, Pilbeam, & Pratiwi, 2021; Galor & Moav, 2004). The long-term and short-term equilibria are conveyed in Table 4.12.

Table 4.12: ARDL estimation results

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
Long Run Equation				
Human capital	1.5284	0.7794	1.9610	0.0562*
Inequality	-1.4613	0.6271	-2.3301	0.0244**
Government capital	-0.3465	0.2161	-1.6035	0.1160
Private capital	0.3290	0.1203	2.7342	0.0090***
Short Run Equation				
COINTEQ01	-0.8267	0.3767	-2.1944	0.0335**
D(Human capital)	-3.8002	2.9790	-1.2756	0.2088
D(Human capital (-1))	4.4948	4.0620	1.1065	0.2745
D(Inequality)	-5.5738	5.7251	-0.9736	0.3356
D(Inequality(-1))	-4.2875	1.7886	-2.3971	0.0208**
D(Government capital)	1.4542	0.8205	1.7723	0.0833*
D(Government capital(-1))	-3.2513	2.8657	-1.1345	0.2627
D(Private capital)	0.7317	0.9081	0.8057	0.4247
D(Private capital (-1))	-2.3495	1.3864	-1.6947	0.0972*
C	50.3269	23.4674	2.1445	0.0376**
Mean dependent var	0.1007	S.D. dependent var		2.3974
S.E. of regression	1.3684	Akaike info criterion		3.5681
Sum squared residuals	82.3961	Schwarz criterion		4.5954
Log likelihood	-105.1570	Hannan-Quinn criteria		3.9794

*, **, and *** *denote significance levels at 10%, 5% and 1%, respectively.*

Source: Author's computation

4.4.2.3 Effect of Human Capital on GDP Growth

The long-term coefficient of educational attainment was positive and statistically insignificant at five percent significance level, *p-value=0.0562*. Accordingly, it is not possible to conclude with an acceptable degree of certainty that the effect observed in this model is not occasioned by sheer chance. It is notable, however, that the coefficient was only barely statistically insignificant, at five percent. In the short term, the coefficient of human capital was negative in the first period and positive in the second period, but at five percent level, neither coefficient was statistically significant. The finding that the coefficient of long-term educational attainment is only barely statistically insignificant bears further research in order to achieve more certainty. Ncube found similar results, but only in respect to primary education. Ncube, Anyanwu, & Hausken (2013) show that primary education is, on its own, inadequate to increase GDP growth, even though it mitigates extreme poverty. Arguably, therefore, there is a case for upskilling, further education, and training for populations with low education (Ncube, Anyanwu, & Hausken, 2013).

Other past studies, including Cingano (2014), Voitchovsky (2005), Barro & Lee (2017), Perotti (1996), and Knowles (2001) found a statistically significant and positive coefficient of human capital. As a case in point, Cingano (2014) determined that widening inequality lowered the outcomes of people from lower socio-economic backgrounds, but did not impact those of medium or high backgrounds. On their part, Barro & Lee (2017), Perotti (1996), and Knowles (2001) found that while the coefficients of both male and female secondary schooling were statistically significant, the coefficient for female secondary education was negative, while the coefficient for male secondary education was positive.

Unlike this present study, however, most studies used either primary or secondary school attainment as a measure of human capital, but crucially, separated male and female populations' educational attainment (Forbes, 2000; Voitchovsky, 2005; Cingano, 2014). In any event, the fact that the human capital variable is both complex and highly sensitive to measurement/operationalisation approaches adopted by different studies warrants more investigations with equally more diverse measurement/operationalizations. Human capital refers to the stock of skills and knowledge comprising the ability of a worker to perform and generate economic and non-economic value. It is a function of a combination of factors like informal learning, education, health, experience, intelligence, training, work habits, energy, initiative, and trustworthiness, which affect a worker's value marginal product. Several approaches are used to measure human capital, including the output-based approach (school enrolment/attainment) that was adopted in this study (Kwon, 2009; Ahmed, Hossain, & Tareque, 2020).

4.4.2.4 Effect of Physical Capital on GDP Growth

Table 4.12 shows that, in the long term, the coefficient of general government capital stock was negative but insignificant, at five percent level. The negative coefficient in the longer term is theoretically unexpected as the steady state output of an economy should expand with better efficiency-generating technology/infrastructure (Aghion, Caroli, & García-Peñalosa, 1999; Todaro, 1997; Romer, 2012). On their part, Ncube, Anyanwu, & Hausken (2013) found a positive but statistically insignificant coeficient of physical capital, even though physical capital was conceptualised as the ratio of real non-residential fixed capital formation to real GDP (PPP based 2005 USD prices).

The statistically insignificant coefficients are, according to Robinson & Torvik (2005) and Ansar, Flyvbjerg, Budzier, & Lunn (2016), possible because governments are inefficient in allocating capital investments. The possibility of *"white elephant"* infrastructure investments and discriminatory allocations of projects, ultimately worsen inequality by promoting growth in some regions to the detriment of others. In the short term, this study found the coefficient of general capital investments by the state to be positive in the first period and negative in the second period, but neither effect was significant at five percent level.

On the other hand, the long-run coefficient of private capital stock investments is positive and statistically significant at one percent level. Ceteris paribus, an investment of a billion constant 2011 international dollars by non-state agents is likely to result in 32.9 percent increase in the long-term growth rate (percentage) of the steady state level of per capita GDP. This further bolsters the argument that the private sector may be more efficient in allocating capital investments (Robinson & Torvik, 2005; Ansar, Flyvbjerg, Budzier, & Lunn, 2016). In the short run, the coefficient of private capital flows is positive in the first period, but this effect is not statistically significant at five percent. In the second period, the coefficient of private capital stock turns negative, but this effect is only significant at ten percent level. The positive coefficient in the first period could be explained by the fact that physical capital investments comprise expansionary fiscal policy, which necessarily spurs economic expansion (Ahmed, Hossain, & Tareque, 2020). However, the scale of these investments in any particular period is often small and their impact on per capita GDP is mostly negligible (Ding, Huang, Gao, & Min, 2021; Ahmed, Hossain, & Tareque, 2020).

4.4.2.5 Effect of Income Inequality on GDP Growth

This study's results show the long-term coefficient of inequality was negative and statistically significant at five percent level. Ceteris paribus, a one Gini point reduction in inequality increases the long-run average steady-state GDP per capita growth rate by 146.13 per cent. Similarly, the short-term coefficient of income inequality was also negative in both the first and second periods, but it was only statistically significant at five percent, in the second period. Accordingly, one Gini point reduction is likely to yield a 428.75 percent expansion in the average steady state GDP per capita growth rate (percentage) in the second period.

The negative association between economic growth and inequality is consistent with Ncube, Anyanwu, & Hausken (2013), Cingano (2014), Brueckner & Lederman (2015), and Causa & Ruiz (2014). Causa & Ruiz (2014), for example, found that a unit increase in inequality among OECD countries decelerates their GDP growth by 0.6-1.1 percent. The negative association between inequality and growth also reinforces the finding of a positive association between schooling and GDP (Forbes, 2000; Cingano, 2014; Panizza, 2002), not least because inequality is negatively associated with educational attainment (Cingano, 2014; Deininger & Squire, 1996). According to Cingano (2014), however, such an association is not in itself a confirmation of the human accumulation theory, unless the strength and sign of the relationship are demonstrated to differ across individuals depending on their economic and social backgrounds.

Even so, these findings are inconsistent with Forbes (2000), Perotti (1996), and Deininger & Squire (1996). It is possible that the divergence in the two streams of studies could be explained by methodological differences. According to Forbes (2000), for instance, using standardised data and controlling for country-specific factors likely produces a positive association between unequal income distribution and GDP, backing the trend set by many studies that used time series data.

More plausibly, the divergence could stem from the different developmental stages of the countries in the current study and many that are included in other studies on this topic. Importantly, this study adds to a minority of empirical literature focusing on developing countries, for which both Kuznet's hypothesis and some empirical works predicted slightly different results compared to developed countries. Perotti (1996), for example, found that the positive association between inequality and growth was not only weaker in poorer countries, but was also mediated by the existence of strong democratic institutions/stability and fertility. Similarly, Voitchovsky (2005) found that while the positive association between inequality and growth held at higher income quartiles/quintiles, it reversed at the low end of the income distribution. Using time series spanning 1990-2015 and ARDL, Manyeki, Kotosz, & Udvari (2018) also found a positive and statistically significant albeit weak coeficient of the Gini coefficient in Kenya. A similar study by Girma & Shete (2018), which focussed on Ethiopia in the period between 2002 and 2017, came to the same finding.

The present study confirms the validity of the Solow Growth model, as well as both the Kuznet's hypothesis and Kaldor's hypothesis, since Kenya, Uganda, and Tanzania are low-income countries. The Solow model conceptualises inequality as the transfer of income from poor to wealthier households, which given a convex savings function, have a higher marginal propensity to save, take risks, and re-invest the income (Hellier

& Lambrecht, 2012; Aghion, Caroli, & García-Peñalosa, 1999). Similarly, Kaldor's hypothesis attributes inequality's accelerating effect on growth to the concentration of productive resources into the hands of a few classes of the population who are more likely and capable of investing them (Forbes, 2000; Kaldor, 1957).

Finally, the error correction term (COINTEQ01) has a negative coefficient that is statistically significant at five percent level, indicating that, in the long-term, human capital and inequality, as well as private and government capital stocks do converge (i.e., they are cointegrated) (Asteriou, Pilbeam, & Pratiwi, 2021; Cingano, 2014). According to Cingano (2014), the COINTEQ01 coeficient indicates correction rate by which short-run shocks are restored to the long-term equilibrium, thus short-term shocks in this model should be corrected at the speed of 82.67 percent in every period.

CHAPTER FIVE

SUMMARY, CONCLUSIONS, AND POLICY IMPLICATIONS

5.1 Introduction

This terminal chapter offers an overview of entire study as well as of the principal conclusions ensuing from its main findings. The summary, conclusion, implications for policy, and areas for potential future research, are presented in subsections 5.2, 5.3, 5.4, and 5.5, respectively.

5.2 Summary

This study explored the effects of income inequality and capital investments on GDP growth across three East African countries. Governments in East Africa have made substantial investments in education, infrastructure, and income redistribution, whose impact on economic growth remains uncertain, particularly given these countries' respective experiences. While Uganda had a relatively constant inequality in 1990-2016, Tanzania posted steadily rising inequality, while Kenya experienced a steady fall in inequality (Figure 1.4). The physical and human capital investments increased steadily across the three countries, but the percentage growth in per capita GDP does not exactly reflect the capital and inequality trends across the three countries. Both the theoretical and empirical literature reflect these uncertainty. Given the fact that the inequality-growth relationship is dependent on a dynamic set of factors that are starkly different in developed countries compared to developing countries, the paucity of research in Sub-Saharan African left a substantial gap. This study adds to the extant empirical works on this topic as very little research has addressed this topic in the East African context and much less with the benefit of standardised inequality and education data.

To this end, the study first investigated the two transmission mechanisms through which income inequality is related to economic performance under the Solow Growth Model, namely human capital development and both private and government physical capital investment. This study relied on secondary data obtained from the United Nations Development Programme's Human Development Reports, the World Bank Development Indicators, the IMF Investment and Capital Dataset 1960-2015, and the Standardised World Income Inequality Dataset.

To satisfy the first objective, this study estimated the effect of human capital on GDP growth in East Africa. This study's findings are inconclusive as the results show the coefficient of human capital was not statistically significant at five percent. The second objective explored the effect of physical capital investment on GDP growth in East Africa. The expansionary government spending from capital stock investments bolsters and undermines growth in the immediate and in the subsequent short-term periods, respectively, but both effects are statistically insignificant. In the long-run, government investments in physical capital are similarly detrimental to growth and statistically insignificant. The long-run relationship revealed in this study was contrary to the predictions by the Solow Growth Model and the endogenous growth model. This finding is also contradictory compared to the mainstay of studies that studied the link between physical capital and GDP growth, but not in the context of inequality. Contrarily, while private capital stock investments have the same effect as government capital in the immediate term, they accelerate long term growth.

To satisfy the principal objective, this study estimated inequality's effect on the three countries' rate of growth. Its findings back the conclusion that inequality is detrimental to economic expansion, in both the immediate and longer terms. This finding is consistent with the mainstay of empirical and theoretical literature, particularly in the developing countries. The results lend credence to redistributive policies, particularly as they relate to human capital and physical capital investments in East Africa.

5.3 Conclusion

This study's findings support the conclusion that income inequality is detrimental to short- and long-run GDP per capita growth in East Africa. This study similarly shows that while private capital investments bolster growth in the long-term, it had no discernible impact in the short-term. It is arguable, therefore, that policies that seek to mitigate income inequality, historical marginalization, and extreme poverty are more than just a government moral imperative, but are intrinsically linked to growth and development. On the other hand, government physical capital investments had no statistically significant effect on economic growth in both the short-term and the long-run. Human capital investments are equally impotent in their effect on the long- and short-run economic growth. Overall, the findings in respect to inequality and private capital investments confirm the validity of the Solow-Kaldor-Kuznets consensus in East Africa.

5.4 Policy Recommendations

It is important to redouble policies aimed at redistributing income and alleviating historical marginalization, such as the Equalisation Fund under the Constitution of Kenya 2010, the Constituency Development Fund, and the Tax Laws (Amendment) Act No. 9 of 2018, in respect to their impact on both income inequality and growth. It is evident that economic justice and equality are not just important developmental pillars; they potentially accelerate long-run economic expansion. The three countries in East Africa have invested heavily in policies to combat structural factors causing inequality, develop infrastructure, reform land ownership, and build human capital. The finding that inequality is detrimental to GDP growth irrespective of the period, gives more weight to the policies that have hitherto been largely driven by a moral obligation to cure historical injustices and a desire to build social cohesion.

Further, this study emphasises the fact that the inequality and growth dynamic is mediated by private capital investments. The finding that private capital investment enhances long term GDP expansion highlights the importance of policymakers in East Africa creating conducive macroeconomic and investment conditions to incentivize existing and future local and foreign private capital flows. It is equally arguable that this finding lends credence to the Public-Private Partnership approach to financing, building, and operating infrastructure projects, as this could consolidate the growth benefits of private capital investments, while at once contributing to the development of the much-required infrastructure.

This study found no evidence to support drawing any conclusions findings in respect to human capital and general government capital investments. Even so, these findings must not mean that governments should abstain from human and physical capital investments. The role of government investments in projects that are unprofitable for private enterprises remains important, even if such investments may divert resources from more profitable private enterprise.

5.5 Areas of Further Research

The inconclusive results concerning the association between general government capital stock as well as human capital and GDP growth, along with the conflicting short-run associations between GDP growth and government capital stock, human capital, and private capital stock, warrant more investigation, with different models, datasets, and methods. It is potentially promising to explore the nature and effect of Public-Private Partnership on economic growth, to ascertain whether it replicates the effect identified in this study in respect to private capital investments.

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APPENDICES

Appendix A: Excerpt from Hellier & Lambrecht (2012, pp. 15-16) showing a mathematical derivation of a function relating inequality to growth

From a dynamic model based on Stiglitz' framework (1969), Bourguignon (1981) shows that non egalitarian distributions of wealth among households result in equilibria that are Pareto superior to the egalitarian equilibrium resulting from an equal distribution. This result

stems from the assumption of a convex saving function $s(y_i)$, $0 < \partial s / \partial y_i < 1$, $\partial^2 s / \partial y_i^2 > 0$, with y_i being individual i' s income.

More generally, it is easy to show that, if the rate of growth depends positively on savings through capital accumulation and if the household's marginal saving rate is an increasing function of income, then higher inequality, defined as a transfer of income from low income to higher income households, raises growth. The growth rate of capital K is $\gamma_K = (I - \delta K) / K$ with I being investment and δ the capital depreciation rate. As investment equals savings, we can write $\gamma_K = K^{-1} \sum_h s(y_h) \times y_h - \delta$, with y_h household h's income and $s(y_h)$ its saving rate that increases with income ($\partial s / \partial y_h > 0$). As the marginal saving rate is an increasing function of y_h, we have $\partial^2 s / \partial y_h^2 > 0$. A change in income distribution is a vector of variations $\{dy_h\}$ with $\sum_h dy_h = 0$. Suppose now an increase in inequality that takes the form of a transfer of income $dy > 0$ from a low income household i to a higher income household j ($y_j > y_i$ before and after the transfer): $dy = dy_j = -dy_i$ The resulting change in growth is after re-arranging $d\gamma_K = \Big(\big(s(y_j) - s(y_i) \big) + \big(s'(y_j) y_j - s'(y_i) y_i \big) \Big) K^{-1} dy$. As $s(y_j) > s(y_i)$ because $\partial s / \partial y_h > 0$ and $s'(y_j) y_j > s'(y_i) y_i$ because $\partial^2 s / \partial y_h^2 > 0$, the transfer $dy > 0$ increases growth. The reason is simply that the richer household saves a higher proportion of the transferred income than the poorer one.

Appendix B: Excerpt from Romer (2012, pp. 15-16))

Since the economy may be growing over time, it turns out to be much easier to focus on the capital stock per unit of effective labour, k, than on the unadjusted capital stock, K. Since k = K/AL, we can use the chain rule to find:

$$\begin{aligned}\dot{k}(t) &= \frac{\dot{K}(t)}{A(t)L(t)} - \frac{K(t)}{[A(t)L(t)]^2}[A(t)\dot{L}(t) + L(t)\dot{A}(t)] \\ &= \frac{\dot{K}(t)}{A(t)L(t)} - \frac{K(t)}{A(t)L(t)}\frac{\dot{L}(t)}{L(t)} - \frac{K(t)}{A(t)L(t)}\frac{\dot{A}(t)}{A(t)}.\end{aligned} \tag{1.16}$$

K/AL is simply k. From (1.8) and (1.9), $\dot{L}/L$ and $\dot{A}/A$ are n and g, respectively. $\dot{K}$ is given by (1.15). Substituting these facts into (1.16) yields

$$\begin{aligned}\dot{k}(t) &= \frac{sY(t) - \delta K(t)}{A(t)L(t)} - k(t)n - k(t)g \\ &= s\frac{Y(t)}{A(t)L(t)} - \delta k(t) - nk(t) - gk(t).\end{aligned} \tag{1.17}$$

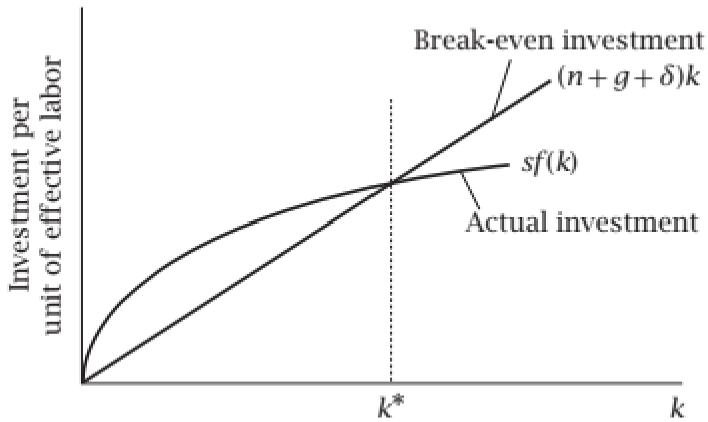


FIGURE 1.2 Actual and break-even investment

Finally, using the fact that *Y/AL* is given by *f* (*k*), we have

$$k^{\cdot}(t) = sf\left(k(t)\right) - (n + g + \delta)k(t). \tag{1.18}$$

Appendix C: Unit Root Test Results (First Generation)

		Individual Intercept	**Intercept and Trend**	**Individual Intercept**	**Intercept and Trend**
Variable	**Summary Tests**	Statistic	Statistic	Statistic	Statistic
Human Capital	LL&C t*	-4.40***	1.21	-2.25***	-8.15***
	ADF-Fisher Chi^2	20.73***	2.61	39.63***	82.30***
	Breitung		-1.31		-5.99***
	IPS	-0.72	2.16	-4.78***	-10.90***
	PP-Fisher Chi^2	25.68***	2.97	51.38***	92.33***
Inequality	LL&C t*	*-5.32****	0.9		
	PP-Fisher Chi^2	*24.63****	0.05		
	IPS	*-3.94****	3.39		
	ADF-Fisher Chi^2	*27.61****	0.36		
	Breit t-Statistic		-1.07		
Initial Income	LL&C t*	6.78	3.67	-3.15***	-3.27***
	ADF-Fisher Chi^2	0.40	1.82	24.87***	21.69***
	Breitung		6.2		-1.28***
	IPS	8.92	4.34	-3.31***	-3.35***
	PP-Fisher Chi^2	0.40	1.93	24.80***	24.23***
Private physical Capital Investment	LL&C t*	8.29	2.38	2.33	-0.25
	PP-Fisher Chi^2	0.00	0	0.65	2.56
	IPS	6.67	2.58	2.81	1.01
	ADF-Fisher Chi^2	0.18	9.56	1.96	2.98
	Breitung		-4.92***		3.11

****P<0.01. LL&C, Breitung, and IPS denote Levin, Lin & Chu t*, Breitung t-Statistic, and Im, Pesaran & Shin W-Statistic, respectively.*

Appendix D: Pooled OLS Estimate

Variable	Coeficient	Std Error	t-Statistic	Probability
Log (Initial Income)	9.8667	2.6331	3.7472	0.0003
Log (Inequality)	-37.9396	9.6094	-3.9482	0.0002
Log (Physical Capital)	-3.1218	1.4645	-2.1316	0.0363
Log (Human Capital)	-11.3171	3.9621	-2.8563	0.0055
C	100.9239	32.0859	3.1454	0.0024

R-squared	0.2176	Mean Dependent var	2.1100
Adjusted R-squared	0.1764	S.D. Dependent var	2.4489
S.E. of Regression	2.2225	AIC	4.4948
Sum squared resid.	375.3881	SC	4.6427
Log Likelihood	-177.0412	Hannan-Quinn criter.	4.5541
F-statistic	5.2840	Durbin-Watson stat.	1.0444
Prob (F-Statistic)	0.0008		

Appendix E: Fixed effects estimation results

Method: Panel EGLS (Cross+C2:G22-section SUR)
Sample: 1990 2016
Periods included: 27
Cross-sections included: 3
Total panel (balanced) observations: 81
Linear estimation after one-step weighting matrix

Variable	Coeficient	Std. Error	t-Statistic	Probability
Log (Initial Income)	8.8662	1.8926	4.6847	0.0000
Log (Inequality)	-3.0381	10.8822	-0.2792	0.7809
Log (Physical Capital)	-4.4455	1.1384	-3.9051	0.0002
Log (Human Capital)	-8.5460	2.9809	-2.8670	0.0054
C	-24.6999	35.0462	-0.7048	0.4832
Effects Specification				
Cross-section fixed (dummy variables)				
Weighted Statistics				
R-squared	0.4308	Mean dependent var		1.2211
Adjusted R-squared	0.3847	S.D. dependent var		1.3605
S.E. of regression	1.0404	Sum squared resid		80.1048
F-statistic	9.3356	Durbin-Watson stat		1.4047
Prob(F-Statistic)	0.0000			
Unweighted Statistics				
R-squared	0.3469	Mean dependent var		2.1100
Sum squared resid	313.3533	Durb-Watson stat		1.3081

Appendix F: Random Effects Results

Method: Panel EGLS (Cross-section random effects)
Sample: 1990 2016
Periods included: 27
Cross-sections included: 3
Total panel (balanced) observations: 81
Wansbeek and Kapteyn estimator of component variances

Variable	**Coeficient**	**Std. Error**	**t-Statistic**	**Probability**
Log (Initial Income)	8.2596	2.4727	3.3404	0.0013
Log (Inequality)	-15.2097	14.5404	-1.0460	0.2989
Log (Physical Capital)	-3.8249	1.5843	-2.4143	0.0182
Log (Human Capital)	-7.2245	3.8253	-1.8886	0.0628
C	22.1128	50.8608	0.4348	0.6650
Effects Specification				
			S.D.	Rho
Cross-section random			1.919485	0.4668
Idiosyncratic random			2.051471	0.5332
Weighted Statistics				
R-squared	0.2091	Mean dependent var		0.4251
Adjusted R-squared	0.1675	S.D. dependent var		2.2465
S.E. of regression	2.0497	Sum squared resid		319.3102
F-statistic	5.0242	Durbin-Watson stat		1.2716
Prob(F-Statistic)	0.0012			

Appendix G: VAR Model Estimates (a)

	GDP Growth	**Log (Human Capital)**	**Log (Inequality)**	**Log (Physical Capital)**
GDP Growth (-1)	0.476332	0.000368	3.28E-05	0.008592
	(0.11538)	(0.00113)	(9.3E-05)	(0.00678)
	[4.12843]	[0.32455]	[0.35075]	[1.26798]
GDP Growth (-2)	0.078244	0.000639	-8.28E-05	0.005320
	(0.11437)	(0.00112)	(9.3E-05)	(0.00672)
	[0.68411]	[0.56875]	[-0.89404]	[0.79207]
Log (Human Capital)(-1)	23.19034	0.681533	0.008557	0.908983
	(12.1281)	(0.11918)	(0.00982)	(0.71225)
	[1.91212]	[5.71832]	[0.87123]	[1.27622]
Log (Human Capital)(-2)	-20.03634	0.233737	-0.009573	-0.740373
	(11.3957)	(0.11199)	(0.00923)	(0.66924)
	[1.75824]	[2.08718]	[-1.03726]	[-1.10629]
Log (Inequality)(-1)	162.1069	0.502299	1.266521	-2.171141
	(139.571)	(1.37158)	(0.11303)	(8.19661)
	[1.16146]	[0.36622]	[11.2052]	[-0.26488]
Log (Inequality)(-2)	-170.3298	-0.201219	-0.302604	1.432696
	(133.526)	(1.31217)	(0.10813)	(7.84160)
	[1.27563]	[-0.15335]	[-2.79841]	[0.18270]
Log (Physical Capital)(-1)	-0.785236	0.019224	0.002691	0.685363
	(2.09592)	(0.02060)	(0.00170)	(0.12309)
	[0.37465]	[0.93334]	[1.58556]	[5.56810]
Standard errors ( ) and t-Statistic [ ]				

Source: Author’s computations

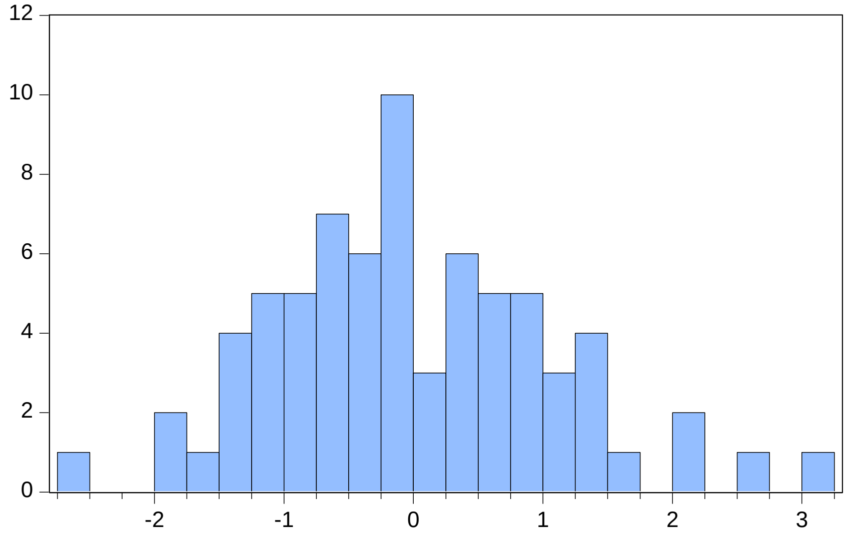
Appendix G: VAR Model Estimates (b)

	GDP Growth	Log (Human Capital)	Log (Inequality)	Log (Physical Capital)
Log(Physical Capital)(-2)	-0.937428	0.006871	-0.00272	0.125207
	(2.03941)	(0.02004)	(0.00165)	(0.11977)
	[0.45966]	[0.34286]	[-1.64697]	[1.04541]
C	32.10623	-1.068483	0.139213	3.090387
	(39.7274)	(0.39041)	(0.03217)	(2.33308)
	[0.80816]	[-2.73686]	[4.32706]	[1.32460]
R-squared	0.400979	0.990099	0.998297	0.811280
Adj. R-squared	0.328370	0.988899	0.998091	0.788405
Sum sq. resids	267.8489	0.025867	0.000176	0.923777
S.E. equation	2.014526	0.019797	0.001631	0.118307
F-statistic	5.522465	825.0412	4837.048	35.46562
Log Likelihood	-154.1554	192.5404	379.7455	58.45857
Akaike AIC	4.350812	-4.894411	-9.886547	-1.318895
Schwarz SC	4.628910	-4.616312	-9.608449	-1.040797
Mean dependent	2.196556	1.569567	3.804373	3.061565
S.D. dependent	2.458147	0.187900	0.037339	0.257193
Determinant resid covariance (dof adj.)		5.75E-11		
Determinant resid covariance		3.45E-11		
Log likelihood		477.7118		
AIC		-11.77898		
Schwarz criterion		-10.66659		
No. of coeficients		36		

Standard errors ( ) and t-Statistic [ ]

Source: Author’s computations

Appendix H: Jarque-Berra Test results



Series: Residuals
Sample 1990 2015
Observations 72

Mean	3.84e-15
Median	-0.117195
Maximum	3.089130
Minimum	-2.513947
Std. Dev.	1.077269
Skewness	0.415777
Kurtosis	3.184210
Jarque-Bera	2.176246
Probability	0.336848

Appendix I: Hausman specification test for DFE, MG, and PMG

	(b) DFE	(B) mg	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
Log (Physical Capital)	-6.244147	-4.934179	-1.309968	-
Log (Inequality)	37.20439	216.923	-179.7186	-
Log (Human Capital)	8.395996	17.61519	-9.219195	-

b=consistent under Ho and Ha; obtained from xtpmg

B=inconsistent under Ho and Ha; obtained from xtpmg

Test: Ho: difference in coefficients not systematic

chi2(3) = (b-B)'[(V_b-V_B^(-1)](b-B) =62.66

Prob>chi2 = 0.0000