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Option: QUANTITATIVE ECONOMICS

THE IMPACT OF POPULATION GROWTH RATE ON THE ECONOMIC GROWTH RATE OF SOME AFRICAN COUNTRIES [1985 – 2022]

THEME:

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ABSTRACT.

Africa stands at a critical juncture characterized by a complex economic landscape influenced by population growth, income per capita, investment rates, and life expectancy. This study delves into the relationship between these demographic and socioeconomic variables and economic growth across selected African countries: Uganda, Algeria, Egypt, Kenya, South Africa, Morocco, and Ghana. These countries exemplify the continent's diverse development experiences, each facing unique challenges and opportunities.

By employing rigorous quantitative analysis and econometric modeling (Panel analysis), this research uncovers patterns and causal relationships between demographic dynamics and economic outcomes. The study uses data sourced from World Development Indicators and African Development Bank databases to provide evidence-based insights. After tests for multicollinearity, autocorrelation, and heteroscedasticity on the random model, the Newey-West standard errors robust results using r-software showed a negative relationship between population growth and economic growth whereas the rest of the variables had positive impact on the economic growth of these countries. The results suggest targeted strategies for enhancing economic growth by addressing demographic trends, fostering human capital development, and improving governance and infrastructure in Africa. Ultimately, this research contributes to the broader understanding of the complex interplay between demographic factors and economic growth in Africa.

Résumé

L'Afrique se trouve à un moment critique caractérisé par un paysage économique complexe influencé par la croissance démographique, le revenu par habitant, les taux d'investissement et l'espérance de vie. Cette étude examine la relation entre ces variables démographiques et socio-économiques et la croissance économique dans certains pays africains : Ouganda, Algérie, Égypte, Kenya, Afrique du Sud, Maroc et Ghana. Ces pays illustrent la diversité des expériences de développement du continent, chacun étant confronté à des défis et des opportunités uniques.

En utilisant une analyse quantitative rigoureuse et une modélisation économétrique (analyse de panel), cette recherche révèle des modèles et des relations causales entre la dynamique démographique et les résultats économiques. L'étude utilise des données provenant

des indicateurs de développement dans le monde et des bases de données de la Banque africaine de développement pour fournir des informations fondées sur des preuves. Après des tests de multicolinéarité, d'autocorrélation et d'hétéroscédasticité sur le modèle aléatoire, les résultats robustes des erreurs types de Newey-West utilisant le logiciel r ont montré une relation négative entre la croissance démographique et la croissance économique alors que le reste des variables avait un impact positif sur la croissance économique de ces pays. Les résultats suggèrent des stratégies ciblées pour renforcer la croissance économique en s'attaquant aux tendances démographiques, en favorisant le développement du capital humain et en améliorant la gouvernance et les infrastructures en Afrique. En fin de compte, cette recherche contribue à une compréhension plus large de l'interaction complexe entre les facteurs démographiques et la croissance économique en Afrique.

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DEDICATIONS

With great love, I dedicate this research work to myself for believing in me, for the hard work and perseverance showcased during the whole study period. I also dedicate it to my dear parents, to my siblings for their support, to my relatives for their trust in me, to my only friend and friends for strengthening me, and lastly to my classmates and teachers for their invaluable contributions to my studies.

ABBREVIATIONS.

ADB: African Development Bank

ARDL: Autoregressive Distributed Lag

ECM: Error Correction Model

FE: Fixed Effects

FGLS: Feasible Generalized Least Squares

GDP: Gross Domestic Product

GFCF: Gross Fixed Capital Formation

GMM: Generalized Method of Moments

GNP: Gross National Product

GNI: Gross National Income

Log: Logarithm

IMF: International Monetary Fund

RE: Random Effects

RSE: Robust Standard Errors

OECD: Organization for Economic Co-operation and development

OLS: Ordinary Least Squares

UN: United Nation

VIF: Variance Inflation Factor

WB: World Bank

WBI: World Development indicators

WHO: World Health Organization

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GENERAL INTRODUCTION

Introduction:

Africa stands at a critical juncture, characterized by a complex economic landscape shaped by diverse factors such as population growth, income per capita, investment rates, and life expectancy at birth. This continent, often hailed for its immense potential, is home to some of the world's fastest-growing economies and burgeoning populations. Among the African nations, Uganda, Algeria, Egypt, Kenya, South Africa, Morocco, Ghana, and Nigeria stand out not only for their significant population sizes but also for their remarkable economic growth trajectories. These countries epitomize the varied landscape of African development, each facing its own set of challenges and opportunities.

The economic diversity across these nations is striking, reflecting disparities in levels of development, infrastructure, governance, and resource endowments. While countries like Nigeria and South Africa boast robust industrial sectors and diversified economies (World Bank, 2022), others, such as Uganda and Ghana, grapple with the challenges of poverty, underdevelopment, and inadequate infrastructure (African Development Bank Group, 2020). Meanwhile, Algeria and Morocco have emerged as regional economic powerhouses, leveraging their natural resource wealth to drive growth and development (International Monetary Fund, 2021). Egypt, with its strategic location and vibrant tourism industry, occupies a pivotal role in the regional economy (Central Agency for Public Mobilization and Statistics, 2021). However, persistent challenges such as corruption, political instability, and income inequality continue to hinder the full realization of their economic potential (African Union, 2019).

Against this backdrop, the proposed study aims to delve into the intricate relationship between demographic dynamics, socioeconomic variables, and economic growth in these selected African countries. By focusing on these nations, which collectively represent a diverse spectrum of African development experiences, the research seeks to uncover patterns, trends, and causal relationships that can provide valuable insights for policymakers, economists, and development practitioners.

The structure of this study will involve a comprehensive analysis of population growth, income per capita, investment rates, and life expectancy at birth as independent variables, with

economic growth serving as the dependent variable. Through rigorous quantitative analysis and empirical evidence, the research will endeavor to shed light on the complex interplay between these factors and economic development outcomes. The methodology will involve the use of robust statistical techniques and econometric modeling (Panel analysis) to analyze data sourced from reputable international organizations and national statistical agencies.

In essence, this study aspires to contribute to the existing body of knowledge on African development by offering fresh perspectives and evidence-based insights into the drivers of economic growth in the region. By understanding the underlying dynamics and challenges, policymakers can formulate targeted policies and strategies aimed at fostering inclusive and sustainable development across Africa.

Background of the study:

Africa has experienced significant population growth in the post-World War II era, contributing substantially to the global increase. The continent's population surged from 228.7 million in 1950 to 1.341 billion by July 1, 2020(Source: "World Population Prospects: The 2017 Revision," 2018) with projections indicating further growth to 1.6 billion inhabitants by 2030 and 2.4 billion by 2050 (projections by the United Nations 2023). The rapid growth, primarily in sub-Saharan Africa is expected to continue growing through 2100 and to contribute more than half of the global population increase anticipated through 2050 ("World Population Prospects 2022"). Africa has the most rapidly expanding population of any region in the world, even though the continent's birth and death rates are also the world's highest. There was some decline in overall death rates in the latter half of the 20th century, but infant and child mortality rates remained high, and average life expectancy at birth actually declined somewhat during the 1990s. On average, Africa's population is increasing at about 3 percent per annum, and that growth rate is associated with an increasingly youthful population: in nearly every African country, more than two fifths of the population is younger than 5 years of age ("Britannica: demographic patterns") presenting both opportunities and challenges for economic development.

Factors driving this population growth includes high fertility rates projected to decline from 4.155 births per woman in 2023(Source: Africa Fertility Rate 1950-2024 - Macrotrends) to 3.9 by 2030 and 2.4 by 2050 (United Nations, 2013a, 2013b). Mortality rates are also decreasing due to advancements in healthcare for example, under-five mortality rates are projected to

decline from 101 deaths per 1000 births to 44 by 2050 (United Nations, 2013a), leading to increasing life expectancy. Rapid urbanization with a majority of Africans projected to be living in urban areas by 2050 (United Nations, 2014) and migration which is also expected to surge due to increasing regional integration, globalization, and improved transportation infrastructure. Note that a large population can serve to ignite growth if it results in a large labor force that increases productivity and a large consumer market that can support the growth of local industries.

Despite all this, economic growth in Africa has been variable across countries and regions, with some countries experiencing robust growth while others lag behind. Key drivers of economic growth include natural resource endowments, infrastructure development, foreign investment, population growth rate, and political stability. However, Africa continues to face persistent challenges such as poverty, inequality, unemployment, and vulnerability to external shocks. The relationship between population growth and economic growth is complex and multifaceted. Proponents of the "population dividend" theory argue that a growing population can contribute to economic growth through increased labor supply, consumer demand, and innovation (Bloom, D. E., Canning, D., & Sevilla, J. (2003), Birdsall, N., Kelley, A. C., & Sinding, S. W. (2001)). However, rapid population growth can also strain resources, lead to environmental degradation, and exacerbate social and economic inequalities, thereby hindering economic development (Malthus, T. R. (1798)). The impact of population growth on economic growth varies depending on factors such as the age structure of the population, human capital development, and government policies.

African countries face a range of challenges related to population growth, including pressure on infrastructure, healthcare systems, and social services (African Union, 2019). At the same time, a growing population presents opportunities for economic diversification, entrepreneurship, and market expansion, particularly in sectors such as agriculture, manufacturing, and technology. Sustainable development strategies that address population dynamics alongside economic, social, and environmental factors are essential for maximizing the benefits of population growth while mitigating its negative consequences. The variation in the quality of the population depends on a range of factors unique to each country, such as education levels, healthcare access, and socioeconomic status. Therefore, the relationship between population growth rate and economic growth rate in African countries is a complex and dynamic issue that requires careful consideration of demographic trends, economic dynamics, and

development policies. By understanding the underlying drivers and implications of population growth, policymakers can formulate strategies to promote inclusive and sustainable economic development across the African continent.

Purpose and contributions of the study:

The purpose of this study is to comprehensively investigate the impact of population growth on economic growth in Africa, focusing on selected African countries. By examining the relationship between population dynamics and economic indicators, such as GDP growth, investment rates, and income levels, this research aims to contribute to a deeper understanding of the complex interplay between demographic trends and economic performance in the region. This study aims to explore several key questions, including why some highly populated countries exhibit lower economic growth rates compared to others and what factors contribute to these differences in economic performance. Through rigorous quantitative analysis and empirical evidence, the study endeavors to shed light on the mechanisms through which population growth influences economic development outcomes in Africa. Ultimately, the findings of this research are expected to provide valuable insights for policymakers, economists, and development practitioners, informing the design and implementation of evidence-based policies and strategies aimed at promoting sustainable economic growth and improving the well-being of populations across Africa.

Problem statement:

Africa's economic landscape is as diverse as its demographic trends, presenting a unique interplay between population growth and economic growth. Despite being rich in natural resources and having a significant growth potential, Africa, dubbed as a “hopeless continent” by Economist, in 2000 faces numerous challenges, including wars, famine, corruption, political instability, and diseases, often described as impediments to its progress. This study seeks to explore the intricate relationship between population growth and economic growth in Africa, with a specific focus on some of the most populated countries: Uganda, Algeria, Egypt, Kenya, Ghana, Morocco, South Africa and Nigeria. These nations provide a comprehensive backdrop due to their large populations and diverse economic statuses.

Throughout the 20th and 21st centuries, the proportion of Africans in the global population has steadily increased, from 9% in 1950 to 17.5% in 2021, according to the PubMed Central (PMC) Disclaimer article "The population of Africa under the conditions of Transformation of the World Order" by I.O. Abramova, published on 24 March 2023.This demographic surge places Africa at the forefront of global population growth, setting the stage for an in-depth analysis of its implications for economic development.

Historically, the debate on population growth's impact on economic prosperity has been polarized, with Thomas Malthus' seminal theory (1798) arguing that population growth negatively affects economic progress by straining natural resources. In contrast, more recent theories proposed by scholars such as 'Klasen and Nestmann (2006)', and 'Simon (1995)' posit a positive impact, suggesting that larger populations can drive economic development through increased labor supply, market demand, and innovation. This research aims to bridge these theories with the current African context, examining how historical perspectives align with contemporary data and trends.

By focusing exclusively on quantitative data, including GDP growth rates, population growth rates, and employment statistics, the research aims to dissect the nuanced relationship between demographic expansion and economic prosperity in selected populous African nations.
The core of this quantitative inquiry revolves around one critical question:

- How has population growth in Africa influenced its growth economically?

And two secondary questions:

- Is the effect of population growth in Africa related to any of the existent population growth theories?
- Which factors are behind the differences in the economic growth of the selected countries?

By leveraging statistical analysis and econometric modeling, this study intends to provide empirical insights into how population growth correlates with economic outcomes in Africa. It aims to parse out the extent to which demographic variables influence economic growth metrics, offering a grounded understanding that could inform policy decisions aimed at harnessing demographic trends for economic development.

In essence, this research is poised to make a significant contribution to the quantitative scholarship on population economics within the African context. It aspires not only to illuminate the statistical relationships between population dynamics and economic growth but also to suggest pathways through which African countries might leverage their demographic trends to fuel economic advancement, thereby achieving sustainable development and improved living standards despite the challenges of rapid population growth.

Objectives of the study:

- Primarily, to investigate the impact of population growth on economic growth on the selected African countries.
- To explore the role of income per capita in economic development.
- To assess the effect of the investment rate on economic growth.
- To examine the impact of life expectancy at Birth on economic growth.
- To identify policy implications and recommendations.

Hypotheses of the study:

H1: Population growth has a positive impact on the economic growth of a country.
H2: Income per capita has a positive effect on the economic growth of a country.
H3: There exists a positive relationship between Investment rate and economic growth.
H4: Life expectancy at Birth as a health indicator influences economic growth positively.

Methodology announcement:

The methodology employed in this study involves a rigorous quantitative analysis (descriptive analysis and econometric analysis) of data sourced from reputable databases namely the WBI (World Development indicators) and African Development Bank (ADB) Data for the African countries: Uganda, Algeria, Egypt, Kenya, Ghana, South Africa, and Morocco. The study utilizes panel data analysis techniques to examine the relationship between economic growth rate and population growth rate in Africa with supporting indicators namely Income per capita, Investment rate and Life expectancy at birth (a health indicator) that were identified

through the existing empirical studies that I employed in my study. The time frame of my study is between 1985 – 2022. Specifically, fixed-effect and random effects models will be employed to account for country-specific and time-specific effects. The data will be analyzed using statistical software namely R-software and Excel, with robustness checks and sensitivity analyses conducted to ensure the reliability and validity of the results. The descriptive analysis helped me to describe, demonstrate with graphs and patterns the economic and populous trends of these countries. It permitted me to conduct a population growth rate evolution analysis of the selected countries.

Additionally, the study incorporates literature reviews and theoretical frameworks indicated at the end each page where necessary and also within the text to contextualize the findings and provide theoretical underpinnings for the observed relationships.

Structure of the Study.

In order to study the impact of population growth on the economic growth of the African countries, my study consists of three chapters.

Chapter one focuses on exploitation of the population growth and economic growth concepts, and delves into the theoretical and empirical literature review on the topic in order to provide a comprehensive understanding of the underlying factors and mechanisms between these two variables.

Chapter two focuses on the evolution of economic growth in the African countries. This chapter provides an overview of the region and the selected African countries, and then examines the evolution of economic growth and population growth of the selected countries from 1985 to 2022 through descriptive analysis of GDP annual growth rates and population growth rate. Thus, exploring the factors influencing and linking these two together in the same countries.

Chapter three is the methodology and econometric analysis; it outlines the methodology used in the study, including data sources, variables and measurements. It also presents the econometric models employed for the analysis and interpretation of the empirical results and lastly conclusion remarks.

CHAPTER 1: THEORETICAL AND EMPIRICAL LITERATURE REVIEW

Introduction:

The chapter covers the theory on Population growth and Economic growth, related literature to the study objectives, and empirical literature. It will explore various theoretical perspectives like Malthusian theory, demographic transition theory and modern theories of population economics, to understand the mechanisms through which population dynamics influence economic growth. Additionally, it will examine empirical studies that have investigated this relationship. By synthesizing this body of literature, the chapter will provide insights into the complexities of population-economic dynamics in Africa and also provide the factors that drive this relationship.

1.1 Conceptual review:

This section reviews the concepts of population growth and economic growth as perceived by different scholars.

1.1.1: Population growth:

Population growth refers to the persistent increase in the number of human beings colonizing a given geographical area resulting from fertility, mortality and migrations as the major factors.[1]According to Melake Demena (July 2005), Population growth can also be defined as the result of the increase of births over deaths. By formular, Population growth (increase in population per 1000 population) is defined as the birth rate (number of births per 1000 population) minus the death rate (number of deaths per 1000 population) minus net emigration (United Nations).[2]Population growth magnifies the harmful impact of economic

[1] Melake Demena, Haramaya University (In collaboration with the Ethiopia Public Health Training Initiative, The Carter Center, the Ethiopia Ministry of Health, and the Ethiopia Ministry of Education; July 2005); USAID

[2] United Nations 2022

processes on the environment; yet the rise in per capita income has been more important than population growth in driving increased production and consumption.

Fertility, mortality and migrations are the dynamic elements of the population process and the driving forces of population growth and for any demographic analysis these factors are prioritized as the leading to change in the demographic structure and often in the social, economic and political structures of the society. Prof Mrs. Tara Kanitkar in principle of population studies 1990 defines fertility rate as the condition for which the human beings (female) grown up to the level of adolescence are able to conceive pregnancy and give birth to as many children as their ovaries can ably be fertilized. Therefore, Population can be defined as the number of people comprising any geographical territory, whereas under the concept of humanity in sociology it refers to a collection of human beings inhibiting a given geographical boundary over time.

1.1.2: Economic growth:

As per the Oxford dictionary; Economic growth is the increase in the production of goods and services per head of population over a stated period of time.

[3]According to Huart J.M (2003), "Economic growth is a quantitative process that results in the increase, over a long period of time, of an indicator that represents a country's wealth, most often the volume of gross domestic product (GDP), or gross national product (GNP)"

And also, according to [Paul Krugman, Robin Wells - (2015)], it is defined as the growing ability of the economy to produce goods and services.

Its measurement can be real or nominal. The real is adjustable for inflation. In the traditional setting, cumulative economic growth is measured in form of Gross Domestic Product or Gross National Product though at times there are metrics alternatively applied (Romer, 2021). In light with the current study, it is the GDP that was used to measure economic growth of which the factors that influence economic growth include: Population growth (Thomas Malthus, 1798), [4]Human and Physical capital plus Technology (Solow-Swen, 1956), Natural resources like minerals among others.

[3]Jean-Mark Huart (2003). Croissance et développement. p.12
[4]Organization for Economic Co-operation and development (OECD),2018, Pg 29)

The endogenous and exogenous theories of economic growth represent contrasting perspectives on the drivers of long-term economic development. Exogenous growth theory posits that external factors, such as technological progress or government policies, primarily drive economic growth independently of other economic variables. For instance, the neoclassical growth theory namely: Solow-Swan model (Solow-Swan, 1956) highlights the role of exogenous technological progress in driving economic growth. The other is the [5]Classical Growth theory (Adam Smith [1723-1790],[6]Thomas Robert Malthus. [1766-1834],[7]David Ricardo [1772-1823])

In contrast, endogenous growth theory argues that factors within the economic system itself, such as investment in human capital, research and development, and innovation, are the primary drivers of sustained economic growth. An example of this theory is the Paul Michael Romer's Model [1986] (Romer, 1990), which emphasizes the role of knowledge creation and innovation in fostering economic expansion. Others include Robert Lucas Jr's Model [1988] and Robert Barro's Model [1991]. These theories have significant implications for economic policy, as exogenous growth theory may advocate for policies that focus on external factors, while endogenous growth theory suggests policies to promote internal factors such as education, innovation, and institutional development.

The high rate of population growth to some extent can undermine the economic gains of a country however, if positively managed; it is a fundamental psychological postulate that can raise peoples' will to raise a lowering standard of living through increasing productivity to provide for the population thus bringing about economic growth. (The population secretariat2013 MFEPD).

1.1.3. The Impact of Population Dynamics on Economic Growth:

Fertility Rates: High fertility rates in Africa contribute to rapid population growth, which can strain resources and hinder economic progress (Akintunde et al., 2013).

Mortality Rates: High mortality rates, especially among infants and children, pose significant challenges to economic development in Africa, as they impact human capital formation and healthcare expenditures (UN World Population Prospects, 2019).

[5]The classical theory of economic growth by Walter Eltis, 1984: page 68 and Economic development and planning by Jan Tinbergen, 1974: pg.21
[6]Economic development and planning by Jan Tinbergen, 1974: pg.26
[7]Economic development and planning by Jan Tinbergen, 1974: pg.26

Technological Innovation: Technological advancements play a crucial role in mitigating the challenges posed by population growth, particularly in sectors such as agriculture, healthcare, and infrastructure (Sachs, 2008).

Labor Force Participation: The labor force's size and composition are directly influenced by population dynamics. A growing population, if healthy and well-educated, can expand the workforce, potentially boosting economic productivity. However, if the labor market cannot absorb this workforce, it might lead to higher unemployment and underemployment, negatively affecting economic growth (Bloom et al., 2020).

Urbanization: Increased population growth often leads to more urbanization, which can have both positive and negative impacts on economic development. Urbanization can lead to economies of scale and greater innovation but also to overcrowding and infrastructure strain if not managed (United Nations, 2018).

Education and Human Capital Development: The quality of education and skill development among the population determines how well a country can capitalize on its demographic dividend. Higher education levels lead to a more skilled workforce, boosting productivity and innovation. Conversely, inadequate education investment hinders growth (Hanushek and Woessmann, 2015).

Healthcare and Well-being: A healthy population is more productive. High mortality rates, especially among working-age adults, reduce productivity and increase healthcare costs, negatively impacting development. Improvements in healthcare that lead to longer life expectancy can enhance economic growth by keeping people productive for longer (World Health Organization, 2019).

Government Policies: Government policies on education, healthcare, labor, and economic diversification are crucial in determining the economic impact of population changes. Effective policies can mitigate the negative impacts of rapid population growth or aging and capitalize on potential benefits (IMF, 2020).

Economic Diversification: Economies that are diversified can better manage the challenges of population dynamics. Diversification helps spread risk and create growth opportunities as the population changes (African Development Bank, 2014).

Environmental Sustainability: Population growth can pressure natural resources and the environment, affecting economic sustainability. Wise resource management and investment in sustainable practices are crucial (World Bank, 2012).

1.2. Theoretical Literature Review:

According to Solow, Capital by itself cannot explain sustained economic growth, so to explain the sustained economic growth observed in most parts of the world. [N. GREGORY MANKIW (2010)] proposed to expand the Solow model to incorporate the other two sources of economic growth (population growth and technological progress). In this study we focus solely on the impact of population growth on economic growth. One of the most prominent theory of population growth is that of Thomas Malthus (1766 – 1834).

Malthusian Theory:

The Malthusian perspective, rooted in the work of Thomas Malthus in 1798 guided the study, He presented population growth as a potential hindrance to economic growth. The pessimistic theory traces its lineage to Thomas Malthus. [8]Writing in the 1790s, Malthus asked whether the future improvement of society was possible in the face of ever larger populations. He reached his famously dismal conclusion (David E. Bloom at al., 2001): [9]The theory states that population growth lowers the per capita production since demand growth cannot keep pace with population growth. Consequently, Malthus argued that in absence of regular checks on population growth, in a short period of time, thus the increasing number of individuals will require sharing the scarce resources among each of them. The theory contends that population increases at a faster rate than their food supply. While population is growing at a geometrical rate, production capacity or food is only increasing arithmetically.

The available food influences the size of the population, for instance if food is less, the population is likely to reduce. The greater the food production, the greater the size of the population and the more burden would be imposed on the little resources available thus reduced economic growth. The theory contends that increase in population reduces the standard of living

[8]ECONOMIC GROWTH AND THE DEMOGRAPHIC TRANSITION by David E. Bloom, David Canning, and Jaypee Sevilla, 2001 p7 -p8
[9]Malthus, T. R. (1798). An essay on the principle of population. London: J. Johnson.

of the people hence reduced economic development and growth. The theory explains that if more children are born, they may not be able to access proper education which may lower their standard of living thus reducing growth and development. However, theory suggested preventive checks and positive checks like diseases, wars and famines would help in curtailing the growth in population thus increasing development. This view, often characterized as pessimistic, suggests that unchecked population growth could lead to a collapse in living standards and societal well-being (David E. Bloom at al., 2001). However, critics note that Malthus's predictions failed to account for technological advancements, which have significantly boosted food productivity and resource utilization over time. (Ehrlich and Kim, 2005).

Neo-Malthusian theory:

The Neo-Malthusian theory, an extension of Thomas Malthus's ideas, delves into the environmental implications of population expansion. Neo-Malthusians emphasize the detrimental effects of overpopulation and resource depletion on ecosystems and natural resources. This perspective underscores the urgent need to address population growth to avert environmental crises. Prominent works like "The Population Bomb" by Paul R. Ehrlich and "The Tragedy of the Commons" by Garrett Hardin serve as poignant reminders of the pressing nature of this issue. Neo-Malthusians advocate for proactive population control measures, including family planning, contraception, and educational campaigns, to mitigate the adverse impacts of overpopulation on the environment. Overall, the Neo-Malthusian theory underscores the critical interplay between population dynamics and environmental sustainability, urging society to take decisive action to address these pressing challenges.

The Boserupian theory:

This theory, spearheaded by Ester Boserup, presents a compelling counterpoint to Malthusian perspectives on population growth and agricultural sustainability. Boserup's seminal work, "The Conditions of Agricultural Growth: The Economics of Agrarian Change under Population Pressure" (1965), fundamentally challenges the notion that population growth inevitably leads to resource scarcity and environmental degradation. Instead, Boserup contends that as populations expand, societies are driven to innovate and intensify agricultural practices to meet growing food demands. She argues that necessity compels communities to develop more

efficient cultivation techniques, invest in infrastructure, and adopt technological advancements. This process of agricultural intensification, fueled by demographic pressure, ultimately fosters increased productivity and food security. By highlighting the adaptive capacities of human societies in response to population growth, Boserup offers a more optimistic perspective on the relationship between demographic dynamics and agricultural development.

Demographic Transition Theory:

The demographic transition theory describes the shift from high to low birth and death rates as societies undergo industrialization and modernization. It identifies three stages: high birth rates in the pre-industrial phase, declining death rates with sustained high birth rates in the transitional phase, and low birth and death rates in the industrialized phase. This theory suggests that demographic changes, such as declining fertility rates and increasing life expectancy, play a crucial role in shaping economic development trajectories (J.Bongaarts and Bulatao, 1999). While most developed countries have completed this transition, many less developed countries, particularly in sub-Saharan Africa, are still in the early stages (Bamiwuye et al., 2015).

Dependency Theory:

This theory, championed by scholars such as Andre Gunder Frank and Walter Rodney, offers a critical lens through which to understand the relationship between population growth and economic development in developing countries. Frank's seminal work, "Capitalism and Underdevelopment in Latin America" (1967), and Rodney's influential book, "How Europe Underdeveloped Africa" (1972), serve as foundational texts for this theory. At its core, dependency theory argues that population growth in developing nations is intricately linked to historical and structural factors stemming from colonialism, exploitation, and unequal global economic relationships. These countries, often referred to as the periphery, are portrayed as being dependent on more developed nations at the core for capital, technology, and markets. As a result, population dynamics in these regions are shaped by external forces that perpetuate underdevelopment and economic marginalization. Dependency theorists highlight how historical legacies of colonization, unequal trade relations, and the extraction of resources contribute to population pressures and inhibit sustainable development efforts. By contextualizing population

growth within broader systems of power and exploitation, dependency theory challenges conventional narratives of demographic change and underscores the need for structural transformation to address the root causes of poverty and inequality in the Global South.

Optimistic Viewpoint:

Contrary to the Malthusian perspective, proponents of the optimistic view see population growth as conductive to economic progress. They argue that a larger population can lead to increased specialization, innovation, and productivity, ultimately driving economic development. According to this perspective, population growth can stimulate economic growth through various channels, including increased labor supply, larger consumer markets, and innovation spurred by diverse demographic profiles. Scholars supporting this viewpoint cite historical evidence of population growth coinciding with periods of economic expansion in many regions of the world. Barro, 1991, 2001; Klasen and Nestmann,2006; Simon, 1995; Kuznets, 1973 are the people that provided the proof to this argument thus in conclusion showing the positive impact of population growth on the economic growth.

Neutral position:

A neutral stance suggests that the relationship between population growth and economic growth is more complex and complex-dependent than the stark dichotomy presented by Malthusian and optimistic viewpoints. Neutralists argue that empirical evidence does not strongly support either pessimistic or optimistic views and that the impact of population growth on economic growth varies across different circumstances. They emphasize the need for nuanced analyses that consider factors such as institutional quality, technological progress, and policy environments in assessing the effects of population dynamics on economic outcomes. (Gallup et al., 1998: Freeman and Bloom, 1988; Bloom et al., 2003; Thornton, 2001).

1.3. Empirical literature:

For demographers and economists, as well as policymakers, the inquiry of if there exist a causal association between economic development and demographic expansion is still of great importance. Nonetheless, the linkage still remains debatable. Though theoretically, population expansion appears to have a detrimental consequence on an economy, there has been no

conclusive factual evidence to support this. This is not the case in certain countries such as the BRICS countries (Brazil, the Russian Federation, India, China, and South Africa), where population growth appears to be beneficial. As a result, interpretations of the impact of population expansion on the economy continue to diverge. Several studies have been conducted to obtain a common consensus on the relationship between the two, employing a variety of methodologies and data from different countries. However, the answer to this issue has remained uncertain since one study discovered a positive correlation while another reported a negative one. Regardless of how contradictory the conclusions on the connection are, many empirical-based research has been conducted on the relation between demography and economic development with mixed results. [Cassen (1976)] provided a good overview of the linkage or relationship between economic growth and population growth. This article explored factors influencing mortality and fertility and underlines the development type which affects population dynamics. There is also A. Peter and H. Bakari (2018), T.Chang, H. Chu, F. Deale, and R. Gupta (2014), N. Mamingi and J. Perch (2013), among others.

Sub-Saharan Africa is the poorest part of Africa and the most populated. According to the UN's World Population Prospect (2019), Sub-Saharan Africa will account for the majority of global population increase in the future decades, while numerous other areas will see population declines. The report also estimated that 1.05 billion (52 percent) of the supplementary 2 billion individuals who might join the world residents between 2019 and 2050 could be added to Sub-Saharan African countries. According to the estimate, the Sub-Saharan region would outnumber both Central and South-Eastern Asia and Eastern and Southern Asia in terms of population numbers by 2062, making it the most populous of the world's eight geographic zones.

Population growth, according to some research, has a detrimental consequence on economic growth. According to [10]Hamza (2015), demographic variables (net migration, mortality and birth sizes) and sustained growth was found to be negatively correlated in developing nations (Niger, Angola, Iraq among others). Other research, Oladeji, Akintunde, and Olomola (2013); Mora, Engelman, and Crist (2017), indicated that the demographic expansion in Sub-Saharan Africa has an adverse consequence on the economy, food security, and biodiversity. Nonetheless, in Sub-Saharan Africa, they discovered a favorable relation between life expectancy and growth in the economy. According to a study by Malaney, Bloom, and Canning

[10]The effect of population growth on the economic growth of 43 sub-Saharan African countries: Panel data analysis (1990-2019) by Tessema, Henok Fantahum. And Panel data analysis of population growth and it's implication on economic growth of developing countries by Labaran Hamza (2015)

(1999), demographic growth in Asia has a significant negative influence on the region's development. Contrary to this major finding, they discovered a positive correlation between growth in the economy and an expansion of the working-age population. To adjust for reverse causality in the model, the authors included instrumental variables and the results remained statistically significant. They also reported that population density along the shore was found to be beneficial, but the inland population density affected the population negatively. In addition, Arokiasamy, Barik, and Basu (2013) discovered that an increase in the proportion of the working-age population has a beneficial and substantial effect on the growth of the BRICS economies. This study's findings are similar to those of Canning, Malaney, and Bloom (1999). These studies, however, have failed to show a direct link between demographic growth and the economy. However, the fundamental concern here is not the effects of the economically fit population, but rather the general population. In addition to Essien (2016), studies by Mohammed, Peter, and Tartiyus (2015) and Okwara, Nwosu, and, Dike (2014) concluded that the country's expanding population has a beneficial impact on Nigeria's economic growth potential. As the review demonstrates, there are more optimists than pessimists when it comes to economic growth-population growth linkage.

By using panel data analytical methods which were applied on a cross-section of 30 developing nations from Asia, Latin America, and Africa for a period of 14 years (2001 -2014), Hamza (2015) studied their linkage. The random effect model, causality analysis, panel unit root analysis, and cointegration analysis were all used to examine the data. Pooled OLS was not used in this study, and as a result, the result ignored the influence of omitted variables. However, dynamic panels were not used to evaluate the linkage between demography and the economy in the study. The Gaussian Mixture Model (GMM) estimators have a high degree of consistency and remained asymptotically normally distributed. There was no analysis of the effect of the population on economic growth in developing nations; instead, only net migration, death rates, and birth rates were looked at and their consequence on the economy was assessed.

Olomola, Oladeji, and Akintunde (2013) used dynamic panel data analysis (difference and system GMM) to look at demographic changes and economic development in Sub-Saharan Africa. Because dynamic panels are convenient to investigate dynamic relationships within a panel data framework, no Pooled OLS, random, or fixed-effect models were used in this study. The study did offer descriptively important population and economic information, but it failed to

apply the causality test, which would have provided greater intuition. However, because the study did not apply Pooled OLS, the results were not likely influenced by omitted variable bias. For the period 1870 and 2013, Gupta, Chu Deale, and Chang (2015) applied a bootstrapped panel causality test to examine the link between demography and the economy. Static and dynamic estimate approaches were not used in this study, making it unique. Accordingly, the study pointed out the relationship between population and economic growth based on the causality test.

In addition, causation was shown to vary among different countries. Researchers Canning, Malaney, and Bloom conducted an analysis on demographic change and the Asian economy (1999). Multiple regression and dynamic panel analysis were used in the research. Since the study didn't employ Pooled OLS, the issue of estimation bias caused by omitted variables was avoided. The paper analyzed the effect on the economic progress of the economically fit population, including the impact of the population as a whole on economic development. Engelman, Mora, and Crist (2017) employed graphs to present descriptive statistics to demonstrate the connection between population growth and the environment.

Basu, Barik, and Arokiasamy (2013) employed panel data analysis to examine population variables of economic development in BRICS countries and a few other industrialized countries. Panel data analysis of random and fixed effect was mostly used, which prevented estimation bias owing to omitted variable bias. Essien (2016), Okwara, Nwosu, and Dike (2014), and Peter, Tartiyus, and Mohammed (2015) all applied time series analysis to examine the link between population growth and economic growth in Nigeria. Peter and Bakari (2019) employed dynamic panel data methods, difference and system GMM, to analyze the effect of population growth on the economy of 53 African nations for the year from 1980 to 2015. The authors reported that the fertility rate affects the economy negatively. However, the authors also reported that population growth affects economic growth positively. This result is somewhat confusing as the authors failed to explain the difference between population growth and fertility rates.

Chang, et al. (2014) applied the bootstrap panel causality test that takes into account both heterogeneity and dependency across countries to inspect the causal connection between the economy and population growth of 21 nations for the time 1870-2013. Accordingly, the authors reported one-way Granger causality flowing from population growth to economic growth. However, the authors did not mention whether the relationship is positive or negative. Another study by Akintunde et al. (2013) analyzed the impact of death and birth rates on economic

development in sub-Saharan Africa from 1979-2005 for the five-year average using pooled OLS and dynamic panel data analysis and conveyed that a total fertility rate negatively affects an economic development whereas life expectancy at birth had a desirable effect on the economy.

A panel data analysis of the long-run association between economic development and the population of 30 of the most populated nations by Sibe et al. (2016) using the Augmented Dickey-Fuller test of stationarity and Error Correction Model (ECM) revealed that there exists a long-run relationship and bidirectional causality between these two variables. Furthermore, a paper by Peterson (2017) on the connection between economic development and a population increase over the past 200 years confirmed that lower population growth in high-income countries is problematic, while high population growth in poor countries negatively affects their economic growth. Furoka (2009) looked at the long-run relationship between these two variables in the case of Thailand using the bound test and concluded that there exists a positive long-run equilibrium relationship and unidirectional causality from population growth to economic development.

A similar study on the effect of demographic pressure on the economic growth of Ethiopia applying Autoregressive Distributed Lag (ARDL) methodology over the period 1980/81-2018/19 using time series data, Alemu (2020) proved that a positive relationship and a strong bidirectional causality existed between these two variables. Another paper by Klasen and Lawson (2007) examined this similar issue using both macro and micro-econometric approaches for the Ugandan case and stated that the high demographic expansion in the country significantly and negatively affects per capita growth in the country. They also concluded that high population expansion is the major cause for a lower accomplishment in a misery avoidance journey and persistent families' poverty.

C. Mwaitete and P. Robert's study on the Impact of Population Growth on Economic Growth of Tanzania, conducted in 2020, delves into the relationship between population growth and economic development in Tanzania. The study builds on existing literature by employing time series data analysis, Granger causality tests, and cointegration analysis to investigate the impact of population growth on economic growth. Findings from the study reveal that population growth and inflation granger cause economic growth in Tanzania. Additionally, there is evidence of cointegration between population growth, inflation, and economic growth. The Vector Error Correction Model shows long-run causality from population growth and inflation to economic

growth, indicating that a higher population growth rate can lead to increased economic growth. These results contribute to the understanding of the dynamics between population growth and economic growth in Tanzania, emphasizing the importance of strategic population policies in fostering economic development.

The study on the link between population growth and (per capita) economic growth in Uganda by Stephan Kasen sheds light on the relationship between these variables. By utilizing cross-country growth regressions and panel data analysis, the study finds a consistent negative impact of population growth on per capita economic growth. The results indicate that a reduction in Uganda's population growth rate could lead to a significant increase in annual per capita GDP growth, potentially boosting economic development. Moreover, the study highlights the importance of addressing population dynamics in poverty reduction, inequality, education, and health outcomes in Uganda. These findings underscore the significance of targeted policies aimed at promoting smaller families and enhancing female education and employment to drive sustainable economic growth and development in Uganda.

Concerning realizing a demographic dividend, David E. Bloom et al. (2007) concluded that "with the right and concrete institutional setup and environment most African countries have the capability to earn the advantage of the demographic dividend, but that firm institution will be critical for its attainment". The authors defined an institution in terms of the presence of the rule of law, bureaucratic efficiency, liberty, corruption and risk of expropriation, an open political system, open market, non-black market, liberty of political expression, and lack of censorship. The authors recognized the unsuccessfulness of the population shift in achieving the demographic dividend in the absence of excellent institutions, which most Sub-Saharan African countries lack. Nations will also be sluggish to adjust to the shifting age structure if the proper policy framework is not in place, and will lose the chance of achieving huge progress. When an increase in the number of economically active citizens is not paired with an equal rise in work potentials, grave consequences will follow like growing joblessness, and likely more wrongdoings and political conflict. Robust organizations which can win the trusts of peoples and markets may assist nations in possibly reaping the benefits of demographic transitions.

In conclusion, while numerous studies have explored the relationship between economic development and demographic expansion, definitive conclusions remain elusive due to contradictory findings and methodological differences. Future research should aim to reconcile

these discrepancies and provide clearer insights into the complex interplay between demographic trends and economic growth.

CHAPTER 2: POPULATION GROWTH AND ECONOMIC GROWTH IN AFRICA

Introduction:

The present chapter examines the population-economic growth in Africa and to do this I have divided this chapter into two sections. In the first section, I present an overview of the region where I briefly observe the geographical exploration of the region, population growth and economic growth background synopsis over the whole region and a concise and summarized overview on the few chosen countries. Additionally, I elaborate on the selection criteria for these specific countries, considering factors such as regional diversity, economic significance, and availability of data, to provide a comprehensive rationale for their inclusion in the analysis. Then section two is a mirror, allowing me to scrutinize closely the population-economic performance in the African countries. Here, I discuss the descriptive analysis of the population growth evolution alongside the respective economic growth evolution in the few selected countries. This is done by analyzing their population growth rates and GDP growth rates using World Bank data for the period 1985-2022.

2.1 Overview on the studied countries.

2.1.1 Geographical overview of the region:

Africa, the world's second-largest and second-most populous continent, spans over 30 million square kilometers, including adjacent islands. It occupies about 20% of Earth's total land

area and [11]is a home to over 1.3 billion people (Worldometer), representing about 16% of the global population. Africa is encircled by the Mediterranean Sea to the north, the Suez Canal and the Red Sea to the northeast, the Indian Ocean to the southeast, and the Atlantic Ocean to the west (World Population Review).

Some of the geographical features in the region include:

Sahara Desert: Extending across much of North Africa, the Sahara is the largest hot desert in the world (World Atlas).

Nile River: The longest river in the world, the Nile flows over 6,600 kilometers (about 4,100 miles) northward through northeastern Africa, draining into the Mediterranean (Britannica).

Congo Basin: Home to the world's second-largest rainforest, the Congo Basin is crucial for the continent's climate and biodiversity (World Wildlife Fund).

Mount Kilimanjaro: Located in Tanzania, this is Africa's highest peak, reaching approximately 5,895 meters (19,341 feet) above sea level (National Geographic).

Great Rift Valley: A continuous geographic trench, running from Lebanon in Asia to Mozambique in Southeastern Africa, the Great Rift Valley is notable for its geological features, including numerous lakes (Encyclopedia Britannica).

Per region, Africa is commonly divided into five sub-regions as shown below:

[11] https://www.worldometers.info/world-population/africa-population/

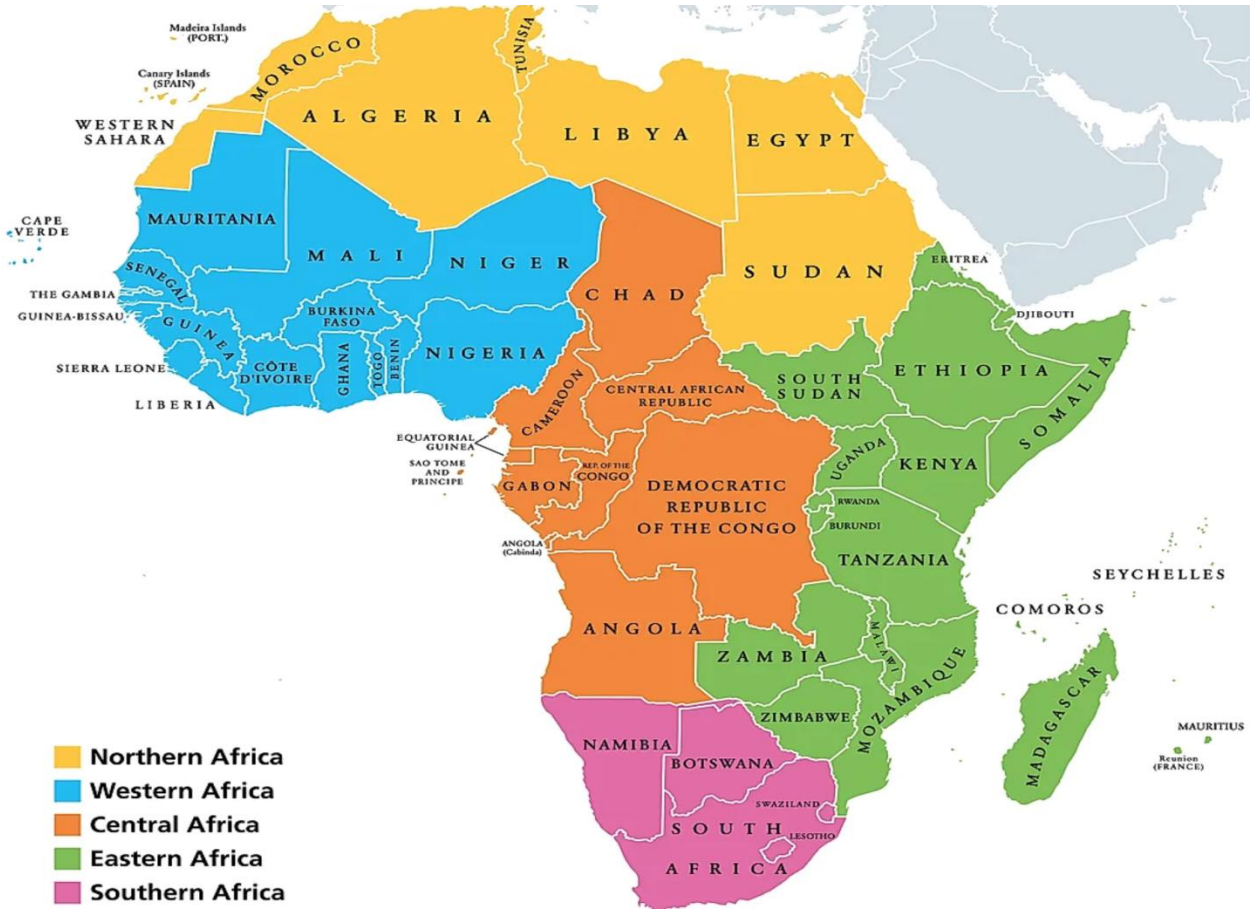


Figure 1 ***Source: World Atlas.***

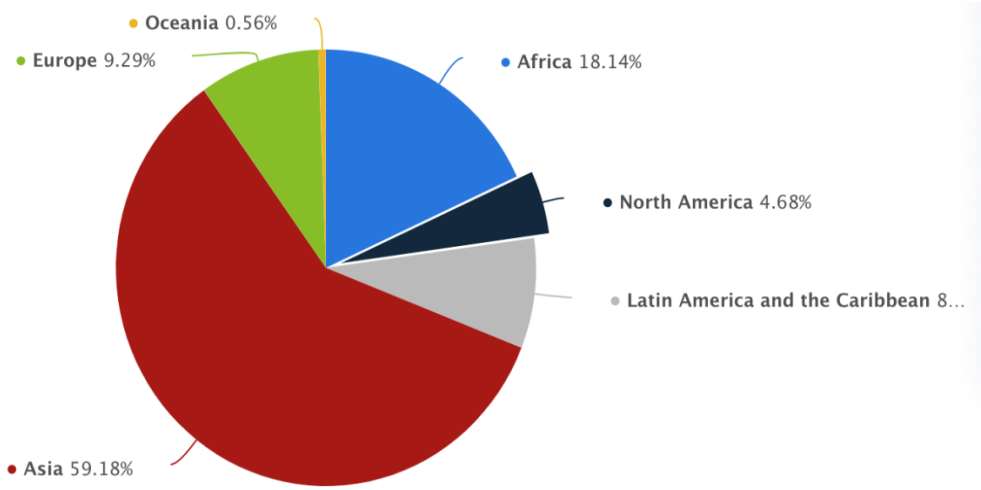
Sub-Saharan Africa occupies the western, central, eastern and southern parts of Africa. However, Africa's climate is distinctive and seasonal that ranges from tropical to subarctic on its highest peaks. Its central and eastern regions experience seasonal rains, while the desert areas, such as the Sahara (Northern Africa), are among the driest and hottest regions on Earth. The continent's biodiversity is vast, with numerous species of mammals, birds, fish, and plants, many of which are endemic to specific regions (United Nations Environment Programme).

Africa faces various challenges including climate change impacts, political instability in certain regions, epidemics and developmental issues especially in the less developed and developing countries like Kenya, Uganda, Nigeria among others. However, it also holds significant opportunities due to its abundant natural resources (like copper, uranium, oil, diamond, gold etc.), young population, and cultural richness. Africa's economic landscapes are rapidly evolving, with growing technology adoption, infrastructure development, and increasing integration into the global market (African Development Bank).

2.1.2 Background overview of population growth and economic growth in Africa:

Africa's population has surged dramatically in recent decades, driven by a decline in mortality rates and persistently high birth rates. This demographic boom presents both challenges and opportunities. A larger workforce can fuel economic growth, but can also strain resources and infrastructure. Demographically, [12]the current population of Africa is over 1.4 billion people with an equivalence of 17.89% of the total population of the World as shown in the figure below.

Figure 2: [13]Distribution of the global population 2023, by continent.



source: Statista

[14]The population density being 49 people per km^2, 44.7% of the population is urban as of 2023 record with a median age of 18.8 years. However, to dig deeper into the population overview, allow me to present the sub-regional contribution bellow.

Table1.

Subregions in Africa

Area	Population (2023)
Eastern Africa	(485,066,925)
Western Africa	(439,868,541)
Northern Africa	(264,205,998)
Middle Africa	(202,105,149)
Southern Africa	(69,235,158)

source: worldometers (www.worldometers.info)

[12]United Nations 2024
[13] https://www.statista.com/statistics/237584/distribution-of-the-world-population-by-continent/
[14]Worldometers: https://www.worldometers.info/world-population/africa-population/.

According to table1, Eastern Africa has the largest population with an estimated 485 million people in 2023, followed by Western Africa (440 million in 2023), then Northern Africa and lastly Southern Africa.

Besides this, population growth in Africa has been characterized by dynamic trends and patterns shaped by a myriad of factors. Historically, Africa has experienced fluctuations in population size due to events such as colonization, conflicts, and disease outbreaks (Akyeampong & Bates, 2002). However, in recent decades, the continent has witnessed substantial population growth driven primarily by high fertility rates and declining mortality rates (United Nations, 2019). This demographic expansion has been most pronounced in Sub-Saharan Africa, where rapid urbanization and improvements in healthcare have contributed to population increases (UN Department of Economic and Social Affairs, 2019). Despite efforts to promote family planning and reproductive health, fertility rates in many African countries remain among the highest globally, fueling continued population growth (World Bank, 2020). The consequences of this demographic trend are multifaceted, impacting areas such as healthcare, education, employment, and environmental sustainability. Understanding the dynamics of population growth in Africa is crucial for policymakers and development practitioners seeking to address the associated opportunities and challenges and foster sustainable development across the continent. The history of the population of Africa is as shown in Table 2 below.

Table2.

Population of Africa (2023 and historical)

Year	Population	Yearly % Change	Yearly Change	Migrants (net)	Median Age	Fertility Rate	Density (P/Km²)	Urban Pop %	Urban Population	Africa's Share of World Pop	World Population
2023	**1,460,481,772**	2.37 %	33,745,467	-535,151	18.8	4.18	49	44.7 %	652,206,412	18.2 %	8,045,311,447
2022	**1,426,736,305**	2.37 %	33,059,861	-540,455	18.7	4.24	48	44.2 %	630,139,701	17.9 %	7,975,105,156
2021	**1,393,676,444**	2.43 %	32,999,213	0	0.0	0.00	47	43.7 %	608,654,401	17.6 %	7,909,295,151
2020	**1,360,677,231**	2.48 %	32,976,068	-202,152	18.6	4.36	46	43.2 %	587,737,793	17.4 %	7,840,952,880
2019	**1,327,701,163**	2.50 %	32,436,114	-202,152	18.3	4.58	45	42.7 %	567,387,619	17.1 %	7,764,951,032
2018	**1,295,265,049**	2.53 %	31,931,316	-202,152	18.3	4.58	44	42.3 %	547,602,182	16.9 %	7,683,789,828
2017	**1,263,333,733**	2.53 %	31,222,130	-202,152	18.3	4.58	43	41.8 %	528,371,323	16.6 %	7,599,822,404
2016	**1,232,111,603**	2.58 %	31,003,665	-202,152	18.3	4.58	42	41.4 %	509,683,886	16.4 %	7,513,474,238
2015	**1,201,107,938**	2.62 %	29,174,908	-190,608	18.2	4.63	41	40.9 %	491,531,092	17.2 %	7,426,597,537
2010	**1,055,233,397**	2.61 %	25,467,059	-769,334	18.0	4.86	36	38.7 %	408,587,045	16.1 %	6,985,603,105
2005	**927,898,100**	2.53 %	21,789,209	-672,990	17.6	5.00	31	36.8 %	341,033,592	15.1 %	6,558,176,119
2000	**818,952,057**	2.49 %	18,924,077	-671,250	17.1	5.18	28	34.9 %	285,997,612	14.3 %	6,148,898,975
1995	**724,331,670**	2.57 %	17,234,887	-398,429	16.7	5.51	24	33.4 %	241,824,184	13.6 %	5,743,219,454
1990	**638,157,236**	2.81 %	16,500,921	-563,433	16.5	5.91	22	31.4 %	200,111,296	13.1 %	5,316,175,862

source: worldometers (www.worldometers.info)

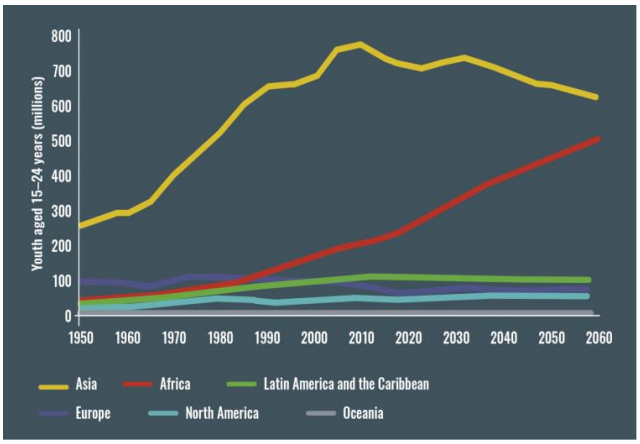
According to this table, Africa's population has grown steadily over this period, rising from just over 818 million in 2000 to over 1.46 billion in 2023. That's an increase of almost 650 million people in 23 years. However, while the population is still rising rapidly, the growth rate dipped slightly. In 2000, it was 2.49%, and it reached a peak of around 2.6% in mid-2010s. By 2023, it had slowed to 2.37%.

It also shows net migration, which is the difference between people entering and leaving Africa. The numbers have fluctuated over the years, but have generally been positive. This means more people are moving to Africa than leaving. The median age in Africa is also increasing, but it's still a relatively young continent. In 2000, it was 17.1 years, and by 2023 it had risen to 18.8 years. The percentage of people living in urban areas has risen from 28% in 2000 to 49% in 2023. This means more and more Africans are moving to cities. Africa's population is a growing share of the global total. In 2000, it accounted for 14.3% of the world's population. By 2023, that share had grown to 18.2%.

The UN predicts Africa's population will reach 2.5 billion by 2050, with Nigeria potentially becoming the world's third most populous country. While the growth rate is expected to slow down further in the long term, Africa is projected to be the main source of global population growth by the end of the 21st century. Graph 1 shows the trends of the young population on the different continents of the world and it’s through this that I present more clarity on Africa’s increasing population growth rate and future perditions by UN because it’s the

young people that contributes the biggest proportion[15] of the present and future population of the world. Therefore, this graph shows the population trend of the youths aged (15-24) years on the different continents.

Graph 1: Africa's youth population aged (15-24) years against world continents.



source: World Economic Forum (https://www.weforum.org/agenda/2020/01/the-children-s-continent/)

Globally, the population of youth aged 15-24 is expected to reach its peak around 2040 and then start to decline. Asia has the largest youth population throughout the entire period and is expected to reach a peak of around 1.8 billion in 2030 before declining. Africa shows a steady rise in its youth population throughout the whole period. By 2060, it's projected to have the largest youth population globally, surpassing Asia. Latin America and the Caribbean is expected to follow a similar trend to Asia, peaking around 2040 and then declining. Europe's youth population is expected to decline throughout the entire period. North America's youth population is also expected to show a decline throughout the whole period.

[16]The factors that have been influencing this growth rate include: Fertility Rates where Africa has some of the highest fertility rates globally. This is due to various reasons, including cultural emphasis on large families, lack of access to family planning services, and child mortality reduction leading to more children surviving to adulthood, Decreasing Mortality Rates supported by the advancements in medicine, sanitation, and nutrition has led to a significant decline in death rates, particularly among children. This allows for more people to reach

[15]World Economic Forum (https://www.weforum.org/agenda/2020/01/the-children-s-continent/)
[16]African development bank, United Nations, World Bank and Economy of Africa.

reproductive age and contribute to population growth. However, rapid urbanization, economic opportunities and strain on resources are the socioeconomic impacts of the dramatic growth.

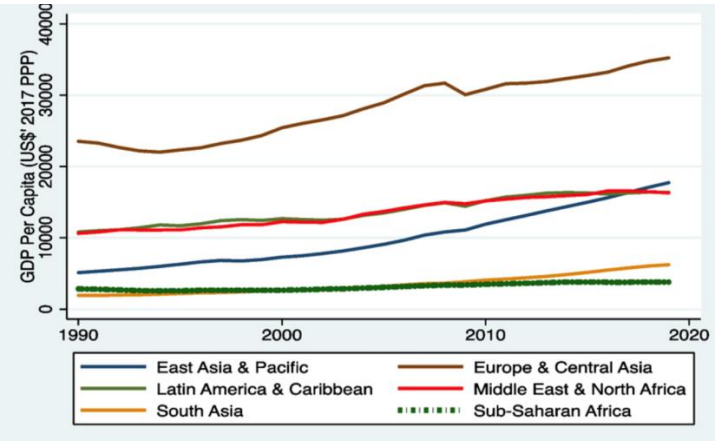
Economic growth in Africa has seen fluctuations over the years, influenced by GDP growth rates, per capita income, industrialization, and sectoral contributions to the economy (World Bank, 2020). Economic policies and reforms have played a significant role in shaping growth trajectories (Acemoglu et al., 2001). Africa's diverse regions exhibit significant variations in population dynamics and economic performance. Comparisons across regions and countries reveal disparities in growth trends and development outcomes (United Nations Africa Renewal, 2017).

The term "economic growth" has existed for many years, as far as before the scramble for Africa, with long-run growth traced back to the Industrial Revolution in Britain during the1800s. Prior to this period, the world economy experienced slow growth rates, leading to stagnant living standards for centuries. For example, according to economic historian [17]Angus Maddison from the years 1000 to 1800, the real aggregate output around the world grew less than 0.2% per year. This was the period for economic stagnation and unchanging living standards, which prevailed for all those centuries. Nevertheless long-run economic growth has increased significantly since 1800, more particularly to these developed countries that kept a sustained upward trend like United States.

Unfortunately, for some regions in Africa that is not the case, the economy has grown gradually, with very slow pace, such that there is now a huge gap between these regions and developed countries especially in the west. In addition to that, this region is a home today for many poorer countries in the world. Graph 2 below shows this sluggish growth for the past three decades where it observed that the trend of the sub-Saharan region of Africa is too slow in its growth except a few countries in the North like Algeria, Egypt, etc., whose growth is at least high compared to the rest of the nations.

[17]Paul Krugman, Robin Wells <<Macroeconomics>> 4th edition 2015, p.180

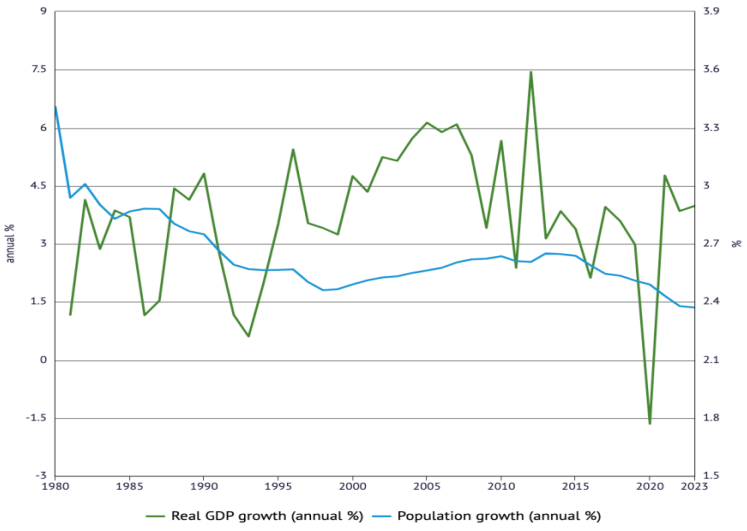
Graph 2: Trend of GDP per Capita across regions, 1990-2019



Source: Constructed by Ofori, Asongu, Obeng using data from WDI

Economic growth is considered to be an important indicator of the overall health and well-being of an economy, as it can lead to higher levels of employment, increased standards of living, and improved access to goods and services for individuals and households. In this study I am to clearly view its variation with the population of Africa. To clearly study this, I used the graph below to show the general trend of African economic growth with its population.

<u>Graph 3:</u> Trend of population growth and economic growth (GDP) of Africa [1980 – 2023].



source: constructed by author using African Development Bank.

Note: There two scales on this graph for the vertical axis, the left-hand scale is for Real GDP growth and the right one for Population growth.

Its observed that the population of Africa is and has been taking a slow and gradual falling trend over the years that is to say 3.5% in 1980 and 2.37% by 2023. And this can be explained firstly by the favorable climatic conditions, immigration into Africa, civilization, the growth of the health sector in Africa over the years and the reduction in the literacy levels about family planning methods among others. The line representing GDP growth is more volatile. There's a sharp rise in the early 1980s, followed by a decline in the late 1980s and early 1990s. Economic growth picks up again in the mid-1990s and continues a generally increasing trend through the 2000s and 2010s.

Therefore, economic growth-show seasonal and gradual rises over the years that can be explained by [18]political, social or economic developments like many African nations undertook economic reforms promoting liberalization, privatization, and improved investment climates[19]. Additionally, exploitation of abundant natural resources like minerals and oil provided a significant boost in some countries. Furthermore, debt relief initiatives and increased foreign direct investment likely played a role [20],this can explain the economic booms observed on the graph and the challenges faced in the different nations of Africa like wars in some nations [like Sudan (Al Jazeera news) and Nigeria just of recent], the debt crisis, political instability in some regions, or droughts affecting agricultural output[21] explains some of the falls in the growth. The economic growth of Africa fell much in 2020 to a -1.5% growth rate generally because of Covid-19 (in the whole world) where I myself witnessed quarantine[22] that I had never witnessed, businesses were closed hence the growth rate diminishing to this extent, however, after this incident, we see that the trend rose again to 4% in 2023.

Generally, the historical context of the population-economic growth in Africa is complex and multifaceted, and has been shaped by a range of factors over time where one effect on one

[18]African development Bank articles.
[19] The World Bank: Africa Overview: https://www.worldbank.org/en/region/afr/overview and Economy of Africa - Wikipedia: https://en.wikipedia.org/wiki/Economy_of_Africa
[20] Gross Domestic Product Africa Fact Sheet - OECD: https://stats.oecd.org/index.aspx?queryid=61433
[21]Economy of Africa - Wikipedia: https://en.wikipedia.org/wiki/Economy_of_Africa and The African Economic Growth Record: The Roles of Policy Syndromes and Governance: https://academic.oup.com/book/34599/chapter/294329790
[22]World news of 2019-2020 on BBC news, Al Jazeera among others.

affects the other as well take an example of wars where the population is affected negatively as well as economic growth. Therefore, understanding the context is important for developing effective policies and strategies for promoting sustained population growth, economic growth and development in the region. Many countries in Africa have been moving towards growth even way before colonialists came along with their impacts.

2.1.3. Overview of the chosen countries.

Due to the vastness of the region, the limited access to data for some countries on the international data platforms namely: World Bank Indicators, African Development Bank and IMF data portal. Out of the 54 countries in Africa, I chose the 20 most populous countries to study from each sub region of Africa also following the World Bank country classifications which classified them into income groups (low, lower-middle, upper-middle and high income). However, data limited me still on some like Nigeria, Tanzania, Sudan among others hence diminishing my study to 7 countries namely: North (Algeria, Morocco, Egypt), East (Kenya and Uganda), West (Ghana), and in the South (South Africa).

Here are brief overviews of each country based on World Bank data[23]:

1. **Uganda**: Located in East Africa, Uganda is classified as a low-income country with a Gross National Income (GNI) per capita of US$930 as of 2022. The economy is largely agricultural (Back born of Uganda), employing a significant portion (70%) of the population. Challenges include food insecurity, health, education, and infrastructure issues among others. The population was approximately 47.24 million in 2022, covering a land area of about 241,038 km² (World Bank, 2022).
2. **Kenya**: Kenya, a lower-middle-income country in East Africa, had a GNI per capita of US$2,170 in 2022. It has a diverse economy with substantial agriculture, service, and industrial sectors. Key challenges are poverty, corruption, and infrastructure need. Kenya's population was about 54.02 million in 2022, with a land area of approximately 580,367 km² (World Bank, 2022).

[23]World Bank: https://data.worldbank.org/indicator/NY.GNP.PCAP.CD?locations=UG
https://data.worldbank.org/indicator/SP.POP.TOTL?locations=UG&name_desc=false
World population prospects.

3. **Algeria**: This North African country is categorized as an upper-middle-income economy with a GNI per capita of US$3,920 in 2022. The economy is heavily reliant on hydrocarbons; oil and gas constitute the bulk of revenue. The population was around 44.9 million in 2022, spread over a land area of about 2,381,741 km². Challenges include economic diversification and youth unemployment (World Bank, 2022).
4. **Egypt**: Egypt, located in North Africa, is a lower-middle-income country with a GNI per capita of US$4,100 in 2022. It has a diversified economy with significant contributions from tourism, agriculture, and manufacturing. With a population of about 110.99 million in 2022, Egypt covers a land area of 1,001,450 km². Key issues include economic reform, unemployment, and social inequality (World Bank, 2022).
5. **Morocco**: As a lower-middle-income country, Morocco had a GNI per capita of US$3,670 in 2022. Its economy includes agriculture, tourism, and a growing industrial sector. The population was about 37.45 million in 2022, with a land area of 446,550 km². Challenges include economic modernization and reducing inequality (World Bank, 2022).
6. **Ghana**: Ghana is classified as a lower-middle-income country with a diverse economy that includes mining, lumber, and agriculture. It had a GNI per capita of US$2,380 in 2022. The population was approximately 33.47 million in 2022, inhabiting a land area of 238,533 km². Ghana faces challenges such as fiscal sustainability and infrastructure development (World Bank, 2022).
7. **South Africa**: South Africa, an upper-middle-income country, had a GNI per capita of US$6,780 in 2022. The economy is one of the most developed in Africa, with major sectors including mining, manufacturing, and services. With a population of about 59.89 million in 2022, the country covers a land area of 1,221,037 km². Challenges include economic inequality, unemployment, and social tensions (World Bank, 2022).
8. **Nigeria**: Nigeria, the most populous country in Africa, is a lower-middle-income country with a GNI per capita of US$2,160 in 2022. The economy is heavily dependent on oil, which accounts for the majority of government revenue and exports. The population stood at approximately 218 million in 2022, occupying a land area of 923,768 km². Challenges include economic diversification, corruption, and infrastructure development (World Bank, 2022).

2.2 Descriptive analysis of the population-economic growth evolution in the chosen African countries.

The following are the chosen variables that I am going to use in this analysis to observe the impact of population growth on the economic growth in Africa:

1. **Population growth (annual %):** This indicator represents the annual rate of change in a country's population size. It is calculated by subtracting the population at the beginning of the year from the population at the end of the year, divided by the population at the beginning of the year, and multiplied by 100 to express it as a percentage.
2. **GDP growth (annual %):** GDP growth measures the annual percentage change in a country's Gross Domestic Product (GDP) from one year to the next. It reflects the rate of expansion or contraction of a country's economy over a specific period, typically a year, after adjusting for inflation and its expressed as a percentage. This indicator represents economic growth.
3. **Life expectancy at birth, total (years):** This indicator represents the average number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life. It is calculated based on age-specific death rates and is expressed in years. This represents the health of the population.
4. **GNI per capita, Atlas method (current US$):** Gross National Income (GNI) per capita is the total income earned by a country's residents and businesses, including income from abroad, adjusted for inflation and converted into current US dollars, divided by the country's population. It provides a measure of the average income level per person in a country.
5. **Gross fixed capital formation (% of GDP):** This indicator measures the total value of fixed assets purchased by businesses, households, and the government, including machinery, equipment, and infrastructure, minus disposals. It is expressed as a percentage of Gross Domestic Product (GDP) and reflects the investment rate in a country's economy.

They are denoted as: Gross fixed capital formation: ***GFCF***, Population growth: ***Pop. Growth***, GDP growth: ***GDP Growth***, Life expectancy at birth: ***Life Exp.*** and GNI per capita: ***GNI per***

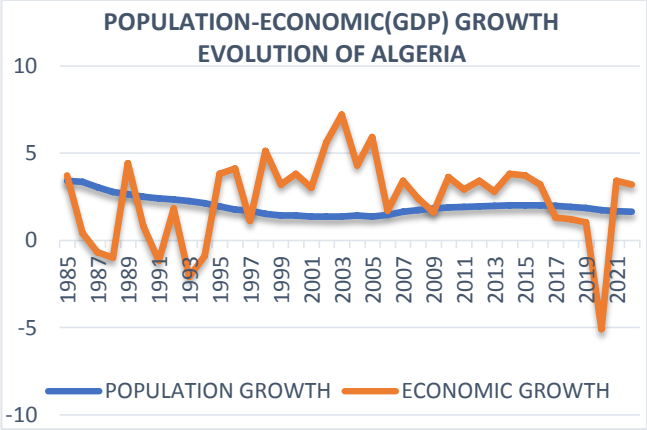
Capita. The main variables of my study are '***Pop. Growth' and*** '***GDP Growth'*** and the rest of the variables are supporting variables that give more weight to my analysis.

The descriptive analysis of the chosen countries is as follows;

Data source: World Bank Indicators.

1. **ALGERIA:**

Graph 4.1:



source: constructed by Author using Microsoft Excel.

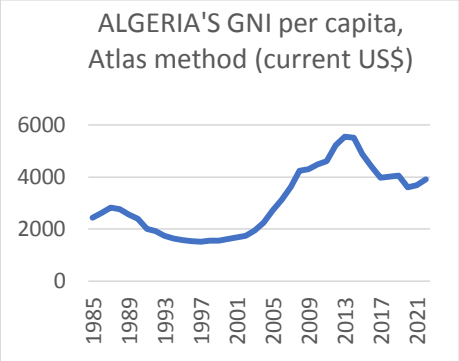
In analyzing the population and economic growth trends in Algeria from 1985 to 2021, it becomes evident that these trends have had a profound impact on the country's overall development and stability. The graph illustrates a juxtaposition of the relatively stable but gradually decreasing population growth rate from 3.6% in 1985 to 1.62% in 2022 with an average rate of 1.95% over the years explained by the high fertility rate, advancements in the health sector and the increased income per capita, against the volatile economic growth rate, with the latter experiencing significant fluctuations over the years. Generally, the period 1985 – 1989 was associated with [24]the socio-political discourse in Algeria and some of these include protests in several sites due to unemployment, Adoption by referendum of the revision of the Constitution among others. These explain the unstable trends in GDP growth (like -1.0% GDP growth in 1988) for this period and probably affected the sustainability of the GDP in the following years for example the Assassination of the President of the Higher State Council, Mr. Mohamed Boudiaf that happened on 29 June, 1992 justifies the political instabilities that existed at the time until the year 1995(GDP growth of 3.79%) when the political, social and economic

[24]Middle East Monitor: https://www.middleeastmonitor.com/20161006-why-algerias-black-october-in-1988-defined-its-role-in-the-arab-spring/
People's Democratic Republic of Algeria: Ministry of Foreign Affairs and National Community Abroad (https://www.mfa.gov.dz/discover-algeria/history-of-algeria)

situations where stabilizing slowly hence resources like oil were effectively being used to boost the economy among others.

The sharp decline in economic growth post-2013 raise concerns about economic stability and the challenges faced in sustaining growth momentum. In the period 2019-2020, the GDP growth dropped rapidly to -5,09% mostly due to the emergence of the Covid-19 pandemic in 2019 that almost froze every important sector in this nation due to lock-downs. This economic volatility, coupled with a steadily increasing population, underscores the need for strategic planning to address the demographic pressure and ensure sustainable development. Algeria's long-term development and stability hinge on diversifying its economy, reducing reliance on volatile sectors like oil, and investing in human capital to support a growing population. Managing these dynamics effectively is crucial for fostering economic resilience, social cohesion, and sustainable progress in Algeria's future trajectory.

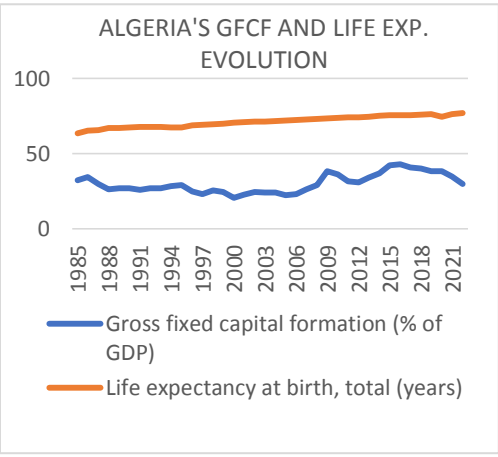
Graph 4.2:



The graph shows an upward trend in Algeria's GNI per capita over the years. GNI per capita increased from$1,530 in 1996 to $ 5,510 in 2014. This suggests that Algerians became wealthier on average over this time period. However a decrease to 3,920 in 2022 indicating an increase in the poverty rate.

source: constructed by Author using Microsoft Excel.

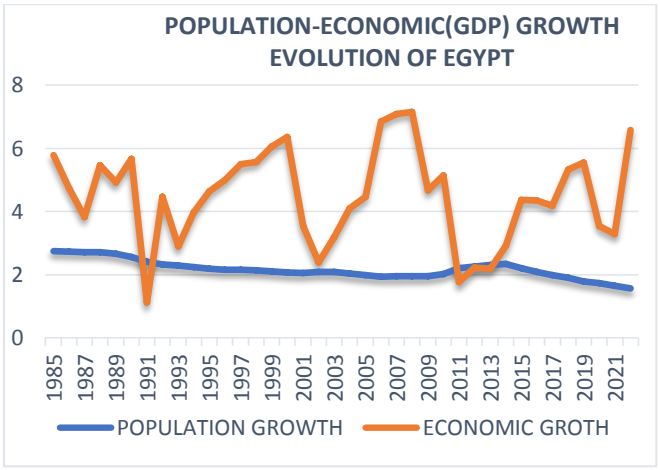
Graph 4.3:



GFCF is relatively stable through out the time frame. This indicates that the investment rate in Algeria has been significantly stable ranging between lowest the 20.6% in 2000 and the highest 43.07% in 2017 , finally 29.8% in 2022. Life Exp. generally shows a gradual increasing trend overtime. Indicating the growth and advancements in the health sector. Thus, these explaining a bit more on the GDP growth and population growth rise in the late years in Graph 4.1.

source: constructed by Author using Microsoft Excel.

2. **EGYPT:** *Graph 5.1:*



source: constructed by Author using Microsoft Excel.

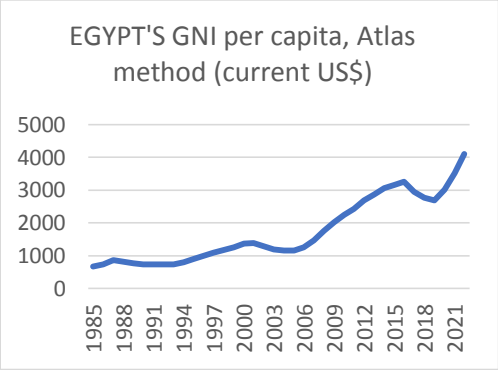
The graph also illustrates a juxtaposition of a gradually decreasing population growth rate (2.75% in 1985 to 1.56% in 2022) and volatile economic growth rate in Egypt that reflects a complex interplay of demographic and economic factors shaping the country's development trajectory. The observed peaks and troughs in GDP growth suggest a degree of economic instability over the years. The high peaks in GDP growth during periods such as 5.79% in 1985, average of 5% in the period of 1988-1990, 6.37% by 2000, 7.15% in 2008 and 6.58% in 2022 coincides with periods of increased tourism, relative political stability and government-led economic reforms aimed at liberalizing the economy and attracting foreign investment such as [25]national income was boosted by a dramatic increase in windfall revenues from the Suez Canal and from petroleum exports in 1985.

Conversely, the troughs observed in 1991 (1.12%), 2.39% in 2002, and 1.76% in 2011 are linked to external shocks and internal challenges like wars. The downturn in 1991 followed the Gulf War[26], oil price crush and the subsequent decline in remittances from Egyptian workers abroad. Global economic slowdown[27]following the September 11 attacks, which impacted tourism and foreign investment inflows in 2002 and the political unrest of the Arab Spring and

[25] ECONOMIC GROWTH IN EGYPT: CONSTRAINTS AND DETERMINANTS by Anton Dobronogov and Farrukh Iqbal [Working Paper 0420].
[26]History.com: https://www.history.com/topics/middle-east/persian-gulf-war
[27]Voice of America: https://www.voanews.com/a/a-13-a-2002-02-11-19-experts-66475482/552020.html

the subsequent uncertainty (protests[28] and demonstrations) that affected investor confidence and economic activity in 2011. The declining trend in population growth rate from 2.75% in 1985 to 1.56% in 2022 suggests a gradual demographic transition characterized by declining fertility rates and improved healthcare access. While this demographic shift may alleviate pressure on resources and infrastructure in the long term, it also poses challenges in terms of workforce dynamics and social welfare provision, particularly in sectors such as healthcare and education.

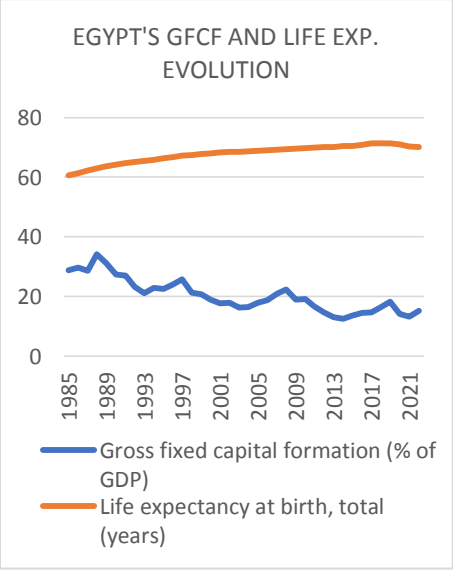
Graph 5.2:



The graph shows a gradual rise in Egypt's GNI per capita over the years. GNI per capita increased from $670 in 1985 to $4,100 in 2022. This suggests that Egyptians became wealthier on average over this time period.

source: constructed by Author using Microsoft Excel.

Graph 5.3:



GFCF in Egypt fluctuates generally with a gradual fall over the years from 34.12% in 1988 to 15.2% in 2022. This actually explains more on the volatility of the GDP growth trends in Graph 5.1 because we see the investment rates here fluctuating a lot in different years (like 1988) hence it's connection to the GDP growth curve above.

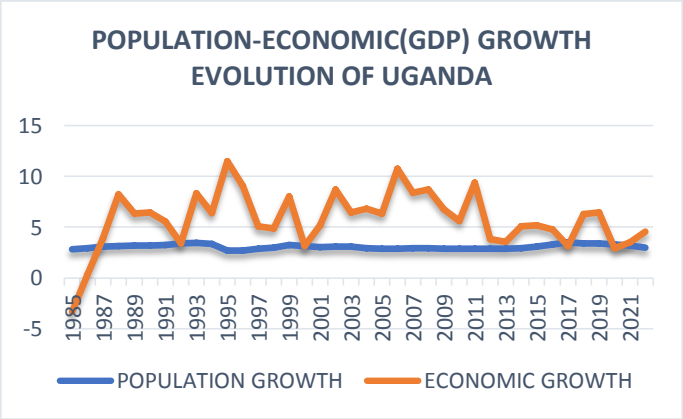
Life Exp. shows an increasing trend over time from 60.5 years in 1985 to 70.15 years in 2022 however, we see a slight decrease in 2022 compared to 2019's 71.36 years. Generally, Life Exp. Indicates the growth and advancements in the health sector.

source: constructed by Author using Microsoft Excel.

[28]BBC News: https://www.bbc.com/news/world-africa-13315719

Overall, the observed trends underscore the importance of addressing structural constraints and promoting inclusive growth policies to ensure sustainable development in Egypt. This entails strengthening institutional capacity, investing in human capital development, and fostering a conducive business environment to attract investment and stimulate economic diversification. Additionally, policies aimed at addressing demographic challenges, such as promoting women's empowerment and improving access to family planning services, can contribute to achieving more balanced and inclusive growth outcomes in the country.

3. **UGANDA:** *Graph 6.1:*

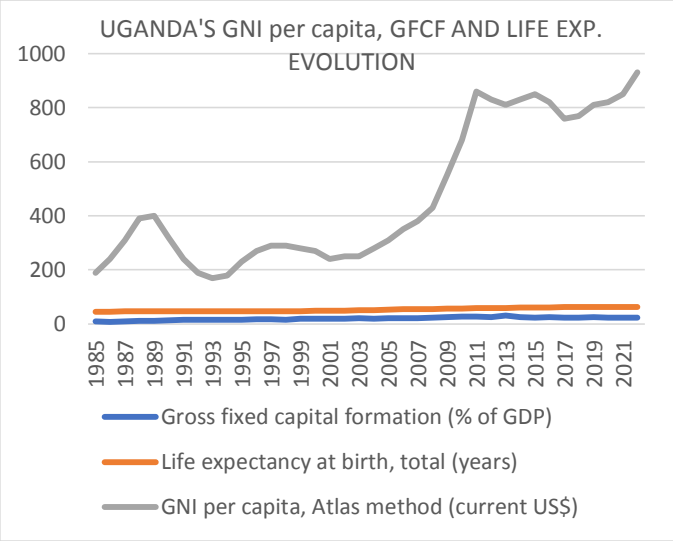


source: constructed by Author using Microsoft Excel.

There is a juxtaposition of a relatively stable population growth and volatile economic growth rates in Uganda which underscores the intricate relationship between demographic dynamics and economic performance. While Uganda has maintained a relatively steady population growth rate over the years with an average of 3.08%influenced mostly by factors like high fertility rates and developments in the health sector among others, Uganda has experienced a consistent and significant economic growth over the past few decades, with an average rate of 6% per year since the mid-1990s, with the poverty rate dropping from 56% in 1992 to 21.4% in 2020. The economy expanded from a GDP of$3.52billion in 1985 to $45.57billion in 2022, reflection an annual growth rate of 7.3%. The observed peaks in GDP growth, such as those in 1988 (8.26%), 1995 (11.52%), and 2006 (10.6%), reflect periods of robust economic expansion driven by factors such as increased government investment in agriculture and education, favorable global market conditions for agriculture products like coffee, Tourism, industrial evolution and foreign direct investment inflows among others.

Conversely, the low peaks of downturns in 1985 (-3.3%), 1992 (3.4%), and the period from 1997(5.1%) to 2005(6.33%) are indicative of economic challenges, often exacerbated by external shocks like global economic downturns or regional conflicts. The fluctuating downturn observed from 2006 to 2022 (4.58%) may be attributed to internal factors[29] such as political instability, corruption, high poverty rates[30], inadequate infrastructure, high inflation rates, Covid-19 pandemic in 2019, and limited access to finance among others, which hamper productivity and hinder sustained economic growth. These economic fluctuations have profound implications for Uganda's development agenda, affecting key areas such as poverty reduction, employment generation, and social welfare. Addressing these challenges and fostering an environment conducive to sustained economic growth are essential for Uganda's long-term development prospects.

Graph 6.2:



source: constructed by Author using Microsoft Excel.

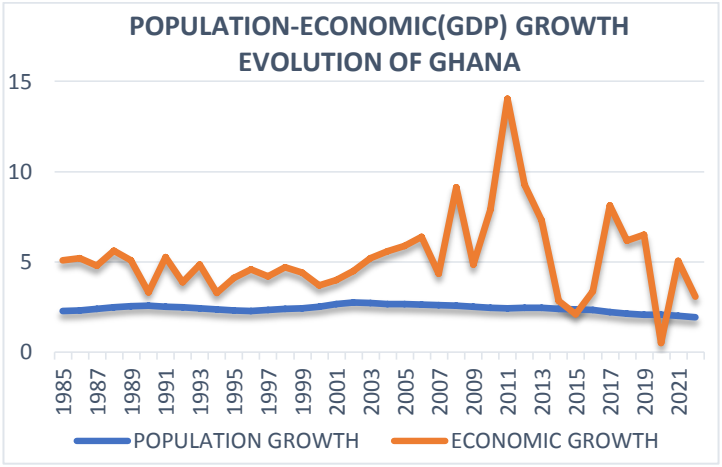
GNI per capita fluctuates throughout the time period, but with a general upward trend though its general where in 2022 a person could only earn $930 hence indicating that there are high poverty rates and also shows that the largest population in Uganda is actually poor with a few rich ones (high levels income inequalities) that influence the purchasing power hence

[29]a. Global Financial Crisis Discussion, Series Paper 9: Uganda by Sarah Ssewanyana, Lawrence Bategeka, Evarist Twimukye and Winnie Nabiddo

[30]Uganda Bureau of Statistics: https://www.ubos.org/wpcontent/uploads/publications/08_2022Multi_Poverty_Dimensional_Index_Report_2022.pdf

affecting the GDP growth negatively the GDP. Life Exp. shows general gradual increase overtime from 45.33 years in 1985 and 63.68 years in 2022. This shows the growth and advancements in the health sector hence a health population the over years. GFCF shows gradual increase also throughout the period from 8.73% in 1985 to 31.46% in 2013, through a gradual decrease to 23.44% by 2022. This generally shows the gradual increase in the investment rates over time that boosted the economy. Thus, explaining a bit more on the GDP growth trends and population growth rise in the late years in Graph 6.1.

4. **GHANA:** *Graph 7.1:*



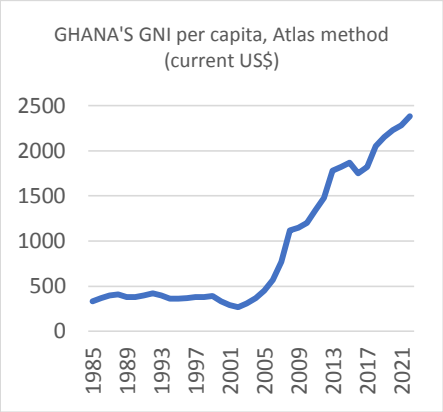
source: constructed by Author using Microsoft Excel.

In analyzing the population-economic trends of Ghana, a notable observation emerges: the juxtaposition of a relatively stable population growth rate with an average growth of 2.42% annually [1985-2022], explained mostly by high fertility rates and improvements in the health sector within the region, against a volatile economic growth rate that exhibits significant fluctuations over the years, indicating a degree of economic instability within the country's development trajectory. Examining the GDP (economic growth) trends reveals a complex pattern. From 1985 to 2007, Ghana experienced a relatively stable but low-fluctuating economic growth rate, with an average of 4.69%. However, this trend was disrupted by significant peaks and troughs in subsequent years. Notably, an economic boom was observed in 2011, with a remarkable growth rate of 14.04%. This surge was attributed generally due to the

[31]commencement of commercial production of oil, making it one of the fastest growing economies globally during that year, with[32]strong export growth.

Conversely, the sharp decline to 2.12% in 2015 may reflect external shocks or internal challenges affecting the economy, such as a [33]combination of declining commodity prices, energy rationing and fiscal consolidation under the program. The subsequent rapid fluctuations, including the drastic increase to 7.12% in 2017 followed by a sharp fall to 0.5% in 2020, suggest a lack of sustained economic stability, potentially due to factors like political uncertainty, fiscal mismanagement, or external debt burdens. The recent rebound in 2021, with a growth rate of 5.07%, followed by a slight decline to 3.07% in 2022 due to challenges related to macroeconomics such as high inflation rates, unemployment among others, underscores the need for Ghana to address structural vulnerabilities and pursue policies that promote long-term economic resilience and sustainable development.

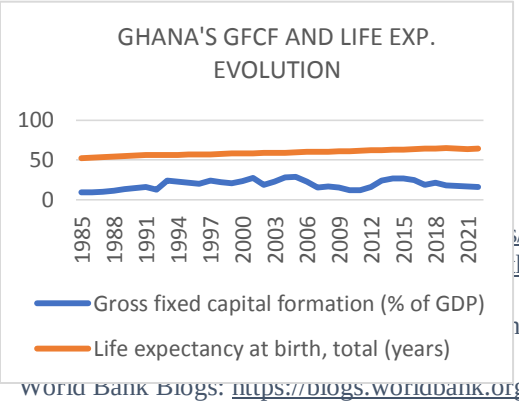
Graph 7.2:



The graph shows a relatively stable GNI per capita trend between 1985 ($330) to 2002($270), followed by a rapid increase of up to $2380 in 2022 which indicates by an increase in the income per capita (per person). This suggests that Ghanaians became wealthier on average especially in 2011 due to the commencement of commercial production of oil as stated above thus reflecting more on the population-economic growth evolution.

source: constructed by Author using Microsoft Excel.

Graph 7.3:



GFCF shows unstable fluctuations over the years which explains more on the volatility of the GDP growth curve above.

s/understanding-ghanas-growth-success-story-and-job-creation-h%20rate%20reached,of%20about%20%241%2C900%20in%2020

nnibpcajpcglclefindmkaj/https://www.bog.gov.gh/wp-

World Bank Blogs: https://blogs.worldbank.org/en/africacan/ghanas-growth-history-new-growth-momentum-since-the-1990s-helped-put-ghana-at-the-front-of-poverty

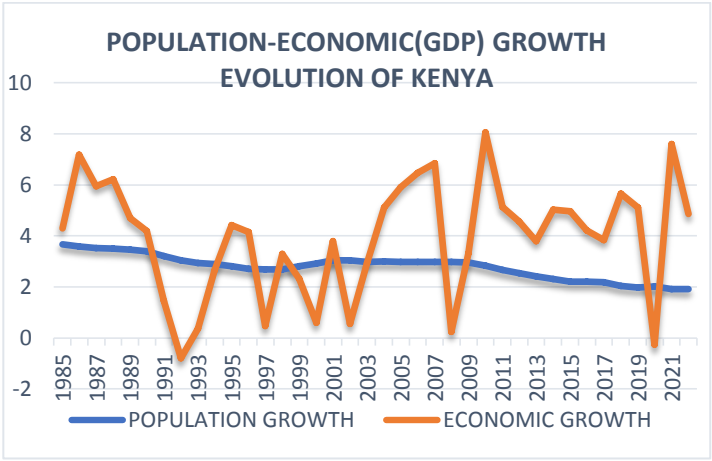
IMF: https://www.imf.org/external/pubs/ft/dsa/pdf/2015/dsacr15103.pdf

Whereas, Life Exp. shows a gradual increase over the years from 52.41 years in 1985 to 63.94 years in 2022. Signifying the improvements in health and justifying the population growth trend more.

source: constructed by Author using Microsoft Excel.

Overall, these trends highlight the intricate interplay between demographic dynamics and economic performance in shaping Ghana's development landscape, emphasizing the importance of holistic policy approaches to address underlying challenges and unlock the country's full growth potential.

5. **KENYA:** *Graph 8.1:*



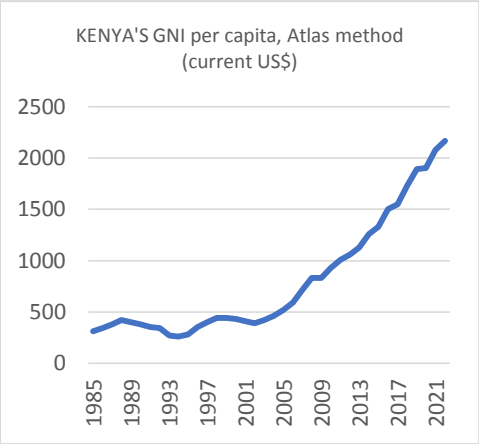
source: constructed by Author using Microsoft Excel.

In examining the population-economic trends of Kenya, a notable observation arises: a gradual decrease in the population growth rate from 3.65% in 1985 to 1.9% in 2022, with an average rate of 2.78%. This decline reflects a combination of factors such as high fertility rates in the region, supported by improvements in the healthcare sector, family planning initiatives, and reduced child mortality. Concurrently, Kenya's economic growth, as measured by GDP, exhibits significant volatility from 1985 to 2022, indicating a complex interplay of demographic and economic factors shaping the country's development trajectory. The rapid increase in GDP growth from 4.3% in 1985 to 7.17% in 1986 may be attributed to factors such as increased investment, favorable economic policies, and external economic conditions. However, this growth was short-lived, as evidenced by the sharp decrease to -0.799% in 1992, reflecting potential economic shocks or internal challenges. Subsequent years witnessed unstable GDP

growth, culminating in a peak of 6.85% in 2007, driven by factors such as infrastructure development and agricultural productivity improvements.

Yet, the sharp decrease to 0.23% in 2008 followed by a rapid increase to 8.05% in 2010 underscores the economy's vulnerability to external shocks and domestic policy inconsistencies. The years thereafter saw fluctuations in GDP growth, with significant volatility, including a decline to -0.27% in 2020 due to the adverse effects of the COVID-19 pandemic. The subsequent sharp increase to 7.59% in 2021 may reflect efforts to recover from the pandemic's impact through fiscal stimulus measures and rebounding global demand. According to the World Bank, Kenya faces several challenges in sustaining its growth momentum. These include high international food and fuel prices, drought exacerbated by conflict in the Horn of Africa, the Euro crisis, fiscal and current account deficits, inefficiency in the agriculture sector, elevated cost of living, and exchange rate pressures. These challenges impact both population and economic growth rates, highlighting the need for Kenya to address structural vulnerabilities, enhance policy coherence, and invest in sectors promoting long-term economic resilience and sustainable development.

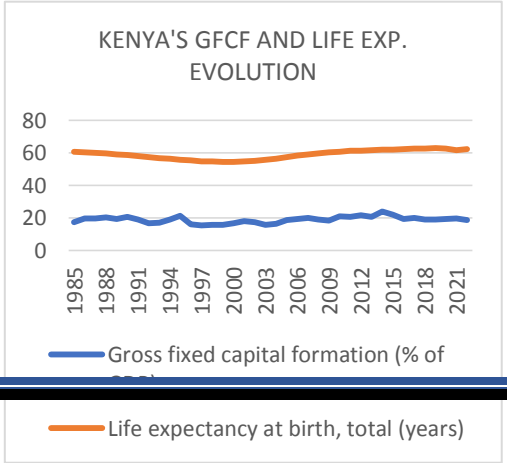
Graph 8.2:



source: constructed by Author using Microsoft Excel.

Kenya's GNI per capita has generally increased steadily over the years. In 1985, the GNI per capita was $310 US, maintained a relatively stable rise to 2005 where it increased steadily up to $2170 in 2022. This indicates that the population of Kenya became wealthier over time hence lowering the poverty rate and income inequality over the years. The GDP growth was affected too since the purchasing power increased due to the wealth.

Graph 8.3:

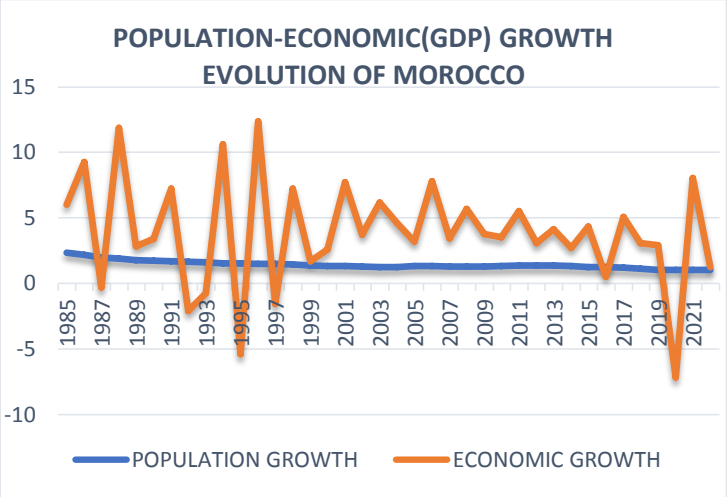


GFCF exhibits a consitentlysignificant and stable trendover the years with 18.71% rate by 2022, indicating that the investment rate has been fluctuating throughout explaining more on the volatility in the GDP curve.

Life Exp. shows a relatively stable trend over the years [1985-2022] with an average of 58.8 years and minimum of 54 years, which supports the population trend above. Generally, these two indicators explain and affect the population-economic evolution of Kenya.

source: constructed by Author using Microsoft Excel.

6. **MOROCCO:** *Graph 9.1:*



source: constructed by Author using Microsoft Excel.

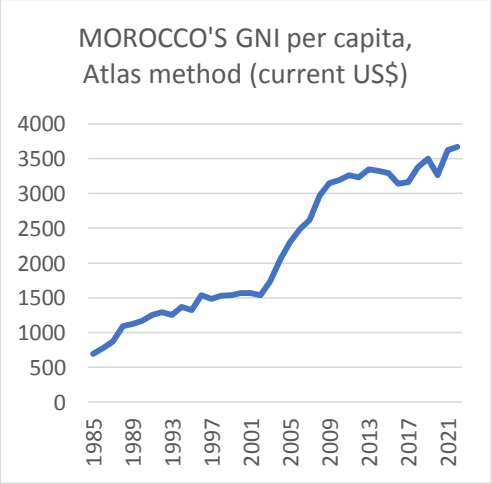
In examining the population-economic trends of Morocco, a notable pattern emerges: a gradual decrease in the population growth rate from 2.34% in 1985 to 1.25% in 2022, reflecting influences such as advancements in the health sector, high mortality rates, relatively high income per capita, and a persistent high fertility rate. This demographic trend is juxtaposed against a volatile economic growth rate, characterized by significant fluctuations from 1985 to 1999.The fluctuations in GDP growth during this period are multifaceted, influenced by a combination of factors. The sharp decline in GDP growth in 1992 (-2.09%) and the subsequent fluctuation from 10.58% in 1994 to -5.40% in 1995 can be attributed to external shocks and internal challenges, including political instability and demographic pressures.

Conversely, the sharp rise in GDP growth in 1996 (12.37%) may be linked to increased investment, improved infrastructure, and favorable global economic conditions. However, external factors such as global economic downturns and internal challenges like political instability and public debts also contributed to the fluctuations observed, including the sharp fall to -1.56% in 1997 followed by an increase to 7.23% in 1998.The significant and consistent yet unstable trend in GDP growth from 1998 to 2020 underscores ongoing challenges within

Morocco's economy, exacerbated by uncertainties mostly in the oil, natural gas, and coal production sectors that generate the highest GDP percentage to this nation.

The sharp decline to -7.17% in 2020, likely influenced by the global COVID-19 pandemic and associated economic disruptions, highlights the vulnerability of the Moroccan economy to external shocks. The subsequent sharp rise to 8.02% in 2021 and the subsequent decrease to 1.25% in 2022 reflect efforts to recover from the pandemic's impact, alongside challenges such as natural disasters such as earthquakes. These trends underscore the importance for Morocco to address structural vulnerabilities, enhance policy coherence, and invest in sectors promoting long-term economic resilience and sustainable development.

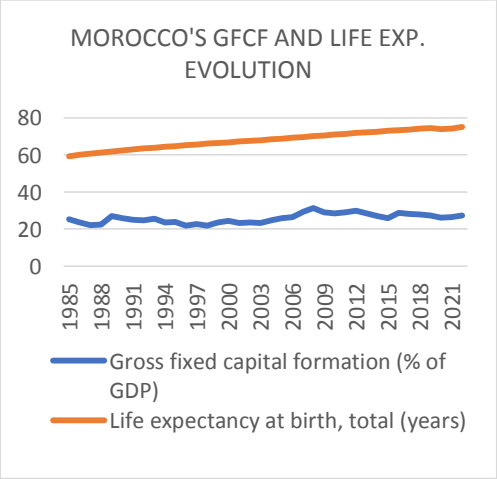
Graph 9.2:



Morocco's GNI per capita has increased steadily over the years. Increased rapidly between 2002- 2012 from $1540 to$3230 respectively. The GNI per capita show that on average most of the Moroccans are wealthy ($3670 per person by 2022), thus more clarity in the population trends and economic growth trends above where the high purchasing power of the people influenced the trends observed.

source: constructed by Author using Microsoft Excel.

Graph 9.3:



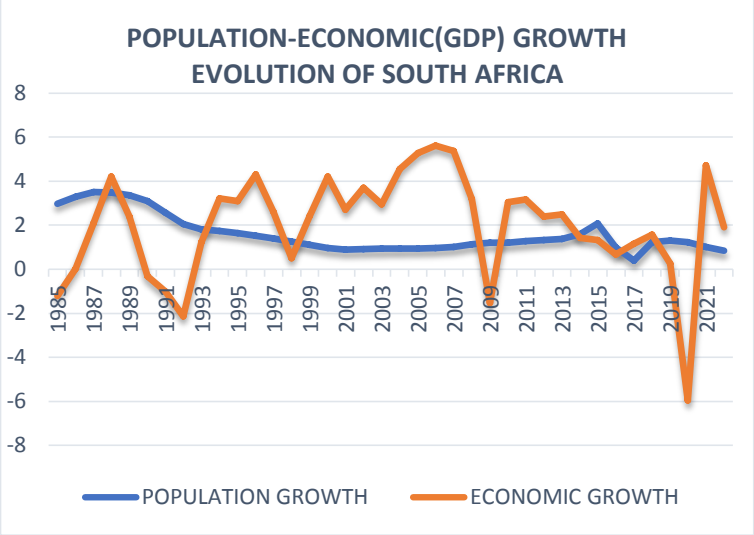
GFCF exhibits a consistently significant and stable trend throughout the time frame from 1985 to 2022, with rates of 25.21% and 27.12% respectively which explains the investment rate of Morocco that in return influenced the population-economic trends above.

Life Exp. shows a gradual increase over time from 59.28 years in 1985 to 74.97years in 2022 giving more

clarity on the population growth trend and advancements in the health sector.

source: constructed by Author using Microsoft Excel.

7. **SOUTH AFRICA:** *Graph 10.1:*



source: constructed by Author using Microsoft Excel.

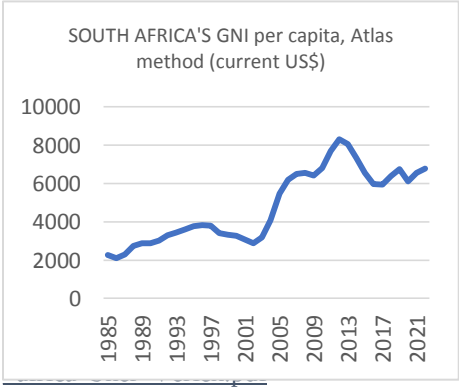
In the analysis of South Africa's demographic and economic patterns, the trends reveal a complex narrative of fluctuating population growth juxtaposed against an erratic GDP growth rate over the period from 1985 to 2022. The population growth rate demonstrates an initial increase from 2.96% in 1985 to a peak of 3.4% in 1987, followed by a gradual decline to 0.88% in 2001. This trend subsequently stabilized, with gradual increases peaking at 2.07% by 2015, before experiencing a sharp decline to 0.38% in 2017, and then rising again to 1.29% in 2019, only to decrease to 0.84% by 2022. These shifts can be attributed to various factors including changes in fertility rates, migration patterns, wars (like [34]Second Anglo-Boer War – 1899-1902) and government policies affecting health and social services. In 2018, births were the main driver of population growth in South Africa[35].

[34]South African History Online: https://www.sahistory.org.za/article/second-anglo-boer-war-1899-1902
[35]Statistics South Africa: https://www.statssa.gov.za/?p=12324#:~:text=In%202018%2C%20births%20were%20the,post%2DHIV%20interventions%20have%20increased

Economically, South Africa's GDP growth has been marked by significant volatility. Starting at -1.21% in 1985, there was a rapid recovery to 4.2% by 1988, but this was followed by a sharp downturn to -2.13% in 1992. The economy rebounded to 4.29% in 1996 and maintained a volatile yet significant growth trend until 2006, peaking at 5.6%. However, the global financial crisis of 2008-2009 impacted South Africa severely where [36]nearly a million jobs were lost in 2009 alone and the unemployment rate continued to remain high with 25%, leading to a steep decline to -1.5% in 2009. A recovery to 3.16% was observed by 2011 probably due to domestic private and public investments, but the growth rate gradually decreased until a substantial drop to -5.96% in 2020, largely due to the economic repercussions of the COVID-19 pandemic. A sharp recovery to 4.7% was recorded in 2021, although the rate moderated to 1.91% by 2022.The volatile economic performance is influenced by multiple factors, including global economic conditions, fluctuations in commodity prices, political instability, and domestic economic policies. The economic trajectory of South Africa has significant implications for its development. Periods of economic downturn have strained public resources, limited job creation, and exacerbated social inequalities, whereas phases of growth have enabled improvements in infrastructure, healthcare, and education, albeit inconsistently.

These observations underscore the challenges facing South Africa in achieving sustainable economic growth and equitable social development. The interplay between demographic changes and economic performance suggests that policy coherence and stability are crucial. Strategic investments in health, education, and infrastructure, alongside reforms to enhance economic resilience, are necessary to address the structural impediments to growth and ensure inclusive development for all South Africans.

Graph 10.2:



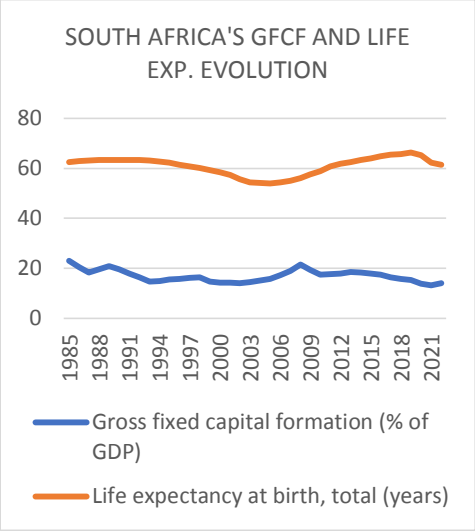
South Africa's GNI per capita has fluctuated somewhat over the years shown, but there has been a general increase. In 1985, GNI per capita was $2,270. By 2012, it had risen to over $8.320. However, it decreased to $5950 in 2017 and

igrated/publications/files/Verick_The_global_financial_crisis_and_south

gradually increased to $6780 in 2020. This justifies why the population-economic growth trends above are also unstable as it is with the wealth of South Africans.

source: constructed by Author using Microsoft Excel.

Graph 10.3:



Generally, GFCF shows a gradually decreasing trend from 23.04% in 1985 to 14.21% in 2022. Thus, showing a decrease in the investment rate of South Africa probably due to the same reasons stated above.

Life Exp. exhibits a consistently significant and stable trend throughout the time frame. It was 62,38 years in 1985 and 61.48 years by 2022 with an average number of 60.87 years throughout the time frame. This is probably influenced by the factors that influence population growth like improved health sectors as stated above.

source: constructed by Author using Microsoft Excel.

In conclusion, the analyses of population and economic trends across Algeria, Uganda, Kenya, Egypt, Ghana, Morocco, and South Africa from the mid-1980s to 2022 demonstrate diverse patterns of demographic changes and economic volatilities that have critical implications for each country's development trajectory. Each nation exhibits its own unique blend of gradually changing population growth rates juxtaposed against significantly fluctuating economic performances. These observations underscore the complex interplay between demographic trends and economic performance, where population dynamics often influence and are influenced by economic conditions. The variability in economic performance across these countries highlights the need for robust economic policies that are responsive to both demographic shifts and global economic trends.

CHAPTER 3: METHODOLOGY AND ECONOMETRIC ANALYSIS

Introduction:

This chapter concentrates on the steps, techniques used in the study. It describes the methodology used, the data sources and the models chosen for the practical analysis and explains why these models. It goes ahead to discuss the results obtained and suggest recommendations in accordance to the findings.

3.1. Methodology

3.1.1. Research Design:

In pursuit of answering the inquiry, "What is the impact of population growth rate on the economic growth of Africa?" the study adopts a constructivist approach. While constructivism is traditionally linked with qualitative research[37], it is pertinent in quantitative research as well, particularly for interpreting data and comprehending intricate social phenomena. Within the quantitative paradigm, a constructivist perspective acknowledges that the data collected reflect the constructed reality of participants, influenced by diverse contextual factors. Researchers employing a constructivist lens in quantitative inquiry strive to discern how individuals' perceptions and interpretations mold the observed patterns and relationships in the data. This philosophical stance resonates with the research objective of scrutinizing the influence of population growth rate on economic growth rate in Africa, as it underscores the utilization of quantitative data and statistical analysis to discern causal relationships among variables.

The research methodology employs a deductive approach, entailing the testing of existing theories and hypotheses. The investigation commences with the hypothesis that population

[37]Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. Educational Researcher, 33(7), 14-26.

growth rate exerts influence on economic growth rate in Africa, leveraging empirical data to substantiate or debunk this proposition. This methodological pathway enables the generation of conclusions grounded in logical reasoning and empirical evidence, thereby facilitating a robust exploration of the research question. My research strategy combines longitudinal analysis and econometric modeling. I analyzed data spanning multiple years to capture the long-term effects of population growth rate on economic growth rate in Africa. Additionally, I employed panel data modeling techniques to account for both cross-sectional and time-series variations across African countries.

Data collection spans a substantial time period, from 1985 – 2022, allowing me to examine trends and changes in population and economic indicators over time. I used a stratified sampling strategy to ensure representation from different regions and income groups within Africa, as defined by the World Bank classification and discussed earlier in the previous chapter. I gathered secondary data from reputable sources such as the World Bank Indicators and African Development Bank. This data includes information on population growth rate, economic indicators GDP (constant USD2015), GNI per capita, GFCF (Investment rate), and Life Exp.).
Econometric analysis involves employing regression models to estimate the relationship between population growth rate and economic growth rate while controlling for relevant covariates. Panel data techniques, such as pooled OLS, fixed effects or random effects models, are utilized to address issues of unobserved heterogeneity and endogeneity.

I used Excel and R Statistical software packages for my data manipulation, regression analysis, and visualization. These tools enable us to conduct robust statistical analyses and generate meaningful insights from the data. I adhered to ethical standards in data collection and analysis, ensuring the confidentiality and anonymity of study participants. Additionally, I acknowledged and cited the sources of all data used in my research to maintain academic integrity. I acknowledged potential limitations, such as data availability and quality, as well as the complexity of capturing all factors influencing economic growth in Africa. Future research could explore additional variables and employ more sophisticated econometric techniques to further enhance understanding of the population-economic link in the African context.

3.1.2: Panel data model analysis:

In this study I employed panel data analysis which is generally suitable for empirical

study with datasets containing both time series and cross-sectional observations at the same time. Our data, as expected follows this structure; we have a panel data for 7 African countries (cross-section) observed over the period (time series) 1985-2022.The panel will allow me to see how the GDP growth varies across different countries overtime and observe the effects the chosen variables especially population growth on the economic performance while controlling those factors that vary among countries yet are not observed in the data.

Panel Data: This refers to the pooling of observations on a cross-section of households, countries, firms, etc. over several time periods. This can be achieved by surveying a number of households or individuals and following them over time[38]. Panel analysis also known as longitudinal analysis, combines the study of a number of individuals (cross section data) over time (time series) consecutively. i.e.; same unit cross section is measured at different times. Some of the advantages of Panel Data include[39]:

- Allows for the analysis of both within-unit and between-unit variations.
- Captures individual heterogeneity and unobserved factors that may affect outcomes.
- Enhances statistical efficiency and power compared to cross-sectional or time-series data alone.
- Enables the investigation of dynamic relationships over time and also study more complicated behavioral models.

Initially, we assume that the X's are non-stochastic and that the error term follows the classical assumptions, namely, $E(\varepsilon_{it}) \sim N(0, \sigma^2)$[40].

The general equation form for panel data model can be expressed as follows:

$$Y_{it} = \beta_0 + \beta X_{it} + \varepsilon_{it} \quad \ldots\ldots (1)$$

Where Y represents the dependent variable, i - is the individual unit observed over time, $\beta_0$is constant for all variables, βis coefficient estimated of variables, X represents independent variables and ε is the error term that captures random variation and unobserved factors. It should be noted that;

$$\varepsilon_{it} = \mu_{it} + v_{it} \quad \ldots\ldots (2)$$

With μ_{it} as the error for observable or unobservable specific individual effects and v_{it} as the

[38]Badi. H. Baltagi (2005) «Econometric Analysis of panel» data Third edition, pg.1

[39] Gujarati, Damodar N. Basic Econometrics. 4th Edition. New York: McGraw-Hill, 2004, pages 637-638.

[40]Gujarati, Damodar N. Basic Econometrics. 4th Edition. New York: McGraw-Hill, 2004, page 640.

random errors. The estimation of equation (1) depends on the assumptions we make about the intercept, the slope coefficients, and the error term, u_{it}. There are several possibilities that enable us to identify the type of the model namely:

- Assume that the intercept and slope coefficients are constant across time and space and the error term capture differences over time and individuals. [Pooled OLS]

And the rest of the assumptions for the models below are for the Fixed Dummy effect models;

- The slope coefficients are constant but the intercept varies over individuals.
- The slope coefficients are constant but the intercept varies over individuals and time.
- All coefficients (the intercept as well as slope coefficients) vary over individuals.
- The intercept as well as slope coefficients vary over individuals and time.

In this part I will attempt to present a summary of the steps (methodology) undertaken to conduct my analysis. Firstly, I presented my sample data and defined my variables. I ensured that, there is consistency in variables for each country across different time periods [Balanced panel data type]. Secondly, I did the descriptive analysis of the data, showing the summary statistics that delve into distribution of the variables, i.e., number of observations, mean, standard deviation, maximum and minimum. And lastly, I did my equation estimates. I passed on to the model specification and in this part, I formulated my mathematical equation by incorporating my variables in Logarithm into the equation I was to estimate. So, the next step is for estimation of our specification with three panel data models including the pooled OLS (Ordinary Least Squares) model. However, in panel data analysis we deal with a problem of unobserved heterogeneity and in order to address this challenge there are two main models (Studenmund 2016) that the analysis employs, these are; Fixed effects and Random effect models.

a) Fixed Effects Model (FEM):

This is also known as Within Estimator, Covariance Model or the Least Squares Dummy Variable Model. This model estimates the panel data equations in a way that dummy variables are introduced in a model so that estimated coefficients will not be biased because of the omitted time invariant variables. It was also considered in this study because it assumes time-invariant characteristic of the individuals being perfectly collinear with the dummies by taking average

times of individuals always not consistent under the hypothesis H0: Cov (U_i,X_{it}) =0, hence fixing the problem of multicollinearity. The general equation form is expressed as:

$$Y_{it} = \beta_0 + \beta_1 X_{it} + \alpha_i + \varepsilon_{it} \quad \text{…………… …………………………………………………} \quad (3)$$

Where: Y_{it} represents the variable of interest for the i^{th} country at the time t. X_{it} represents the vector of explanatory variables for the country i at the time t. β_0 and β_1 are the coefficients associated with the explanatory variables, α_i is the intercept for each country, that represent individual (country) -specific fixed effect which captures time invariant heterogeneity. And ε_{it} is the error term that represents both unobserved factors and random errors.

This fixed effect model can be modified depending on the assumptions/possibilities stated above including dummy variables of individual or time effect on the intercept or slope coefficients[41].

b) Random Effects Model (REM):

This is also called Random Intercept or Partial Pooling Model. The random effects model[42] is based on the assumption that the intercept for each cross-sectional unit is drawn from a distribution that is centered around a mean intercept. Thus, each intercept is a random draw from an "intercept distribution" and therefore is independent of the error term for any particular observation. It assumes that there is no correlation between the fixed effects U_i with the regressors X_{it} under the hypothesis H_0: Cov(U_t /X_{it}) =0. It takes into consideration the differences or variations within each individual and between the units. The general form of the linear equation is written as follows:

$$Y_{it} = \beta_0 + \beta_1 X_{it} + \gamma_i + \varepsilon_{it} \quad \text{………………………………………………………………} \quad (4)$$

Where the difference from fixed effect equation is γ_i representing the individual-specific random effect which captures the unobserved heterogeneity which is assumed to be random and uncorrelated with the explanatory variables, and ε_{it} which is the error term for random errors specific to each observation.

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[41] Gujarati, Damodar N. Basic Econometrics. 4th Edition. New York: McGraw-Hill, 2004, pages 640 – 646.
[42] Using Econometrics, A Practical Guide (7th Edition) by A.H. Studenmund, page 483

The Hausman specification test (1978) which works under the null hypothesis of consistence of the errors is carried out on the variables so as to determine the most appropriate model between the fixed effects and random effects. It considers two hypotheses namely; H_0: random model is consistent meaning that $E(u_{it}/x_{it}) = 0$ and H_1: Fixed effects model is consistent. If the P-value of the test is greater than 0.05, the null hypothesis is accepted confirming that the random effect model is the preferred model but if the P-value is <0.05, H1 is accepted meaning hence the fixed effects model is preferred.

Different validation tests are carried out on the retained model. The tests that are carried out are Breusch-Godfrey (Wooldridge)test for autocorrelation of errors, this in order to observe the linear relationship between variables. This is done to analyze multicollinearity in between variables, which is explained by strong relational dependence between regressors, and also Wooldridge test for group-wise heteroskedasticity in the model. Once the null hypothesis (H_0: p-value >significant level at threshold of 1%, 5% and 10%) is accepted then the model is validated and can be used for the study analysis and also perform forecasts.

If the null hypothesis is rejected, then we are in the presence of heteroscedasticity, autocorrelation and multicollinearity which can lead to *biased and inefficient coefficient estimates, unreliable standard errors and incorrect statistical inferences*. As a result, to adequately address these problems, different appropriate methods like RSE (Robust Standard Errors), GMM (Generalized Method of Moments), FGLS (Feasible Generalized Least Squares) and Newey-West Standard Errors among others are applied., technique is a suitable approach for estimation. So, the retained model can be re-estimated for the analysis with the appropriate technique in order to solve for these problems and give robust results.

3.2: Econometric analysis

3.2.1: Data presentation

The data used in the study is panel data which is used in statistical analysis that combines both cross-sectional and time-series data. It entails studying multiple units such as countries or persons over several time periods, (Badi H.Baltagi 2013). Its benefits are; it improves the estimation efficiency and analysis, captures within-entity and between-entity variation enabling to identify both time-varying and time-invariant factors affecting GDP growth and it allows for

controlling unobserved heterogeneity and examining dynamic relationships by observing changes over time.

This part gives the data description of the components of our panel study.

a) The chosen African Countries.

My analysis study uses a balanced panel data of 7 countries from Africa's top populated countries, from the period of 1985 to 2022. The sample strategy depends on data availability. There are a number of countries like Nigeria that could have been incorporated in the sample which I omitted because of the unavailable data more specifically on the chosen variables. For example, I had selected a sample of 20 countries but I had to reduce to 7 countries due to insufficient data.

Table 3: The chosen countries.

Uganda	*Algeria*	*Egypt*	*Ghana*
Morocco	*Kenya*	*South Africa*	

Source: Elaborated by author using Microsoft word

b) The chosen variables.

Table 4 below shows the variables of interest; they are in logarithm in order to avoid the problems of heteroskedasticity, then their descriptions, the sources and the hypothesized outcome for each. I chose the real GDP growth as an indicator of economic growth, therefore a dependent variable that is to be explained essentially by population growth rate as the primary independent variable. The rest of the variables are supporting independent variables to add more weight to my study, which are potential key drivers also of economic growth in these countries.

Table 4: The chosen variables.

Variable	**Description**	**Source**	**Excepted Sign**
log_gdp2015	GDP (constant 2015 US$)	*World Bank (WDI)*	Dependent variable
log_pop_growth	Population growth rate (annual %)	*World Bank (WDI)*	-/+

log_gni_per_capita	GNI per capita, Atlas method (current US$)	*African Development Bank*	+
log_gfcf	Gross fixed capital formation (% of GDP)	*World Bank (WDI)*	+
log_life_exp.	Life expectancy at birth, total (years)	*World Bank (WDI)*	-/+

Source: Elaborated by author using Microsoft word

c) Description of the variables

→Dependent variable:

GDP (constant 2015 US$) *denoted as* ***GDP2015*** serves as a pivotal metric to gauge the economic performance of African nations over time. This indicator, sourced from the World Bank indicators, provides a standardized measure of the total economic output of each country, adjusted for inflation to maintain consistency across different years using constant 2015 prices. It represents the sum of all goods and services produced within a country's borders, valued at constant prices to eliminate the effects of inflation. It encompasses various economic activities, including consumption, investment, government spending, and net exports. As a measure of economic growth, GDP reflects the overall health and vitality of an economy, indicating whether it is expanding, contracting, or stagnating.

The formula to calculate GDP (constant 2015 US$) involves aggregating the value added by each sector of the economy. In mathematical terms, it can be expressed as:

$GDP = C + I + G + (X - M)$

Where:

- GDP is the gross domestic product
- C represents private consumption expenditure,
- I represents gross investment,
- G represents government spending,
- X represents exports of goods and services, and
- M represents imports of goods and services.

By examining changes in GDP over time, I can assess the pace and trajectory of economic growth within African countries. This allows me to understand how population dynamics, such as growth rates and demographic shifts, influence overall economic performance.

→Independent variables

These include; *Population growth rate (annual %),* plus the supporting variables namely: *GNI per capita, Atlas method (current US$), Gross fixed capital formation (% of GDP)* and *Life expectancy at birth*, total (years)which were explained in the previous chapter.

d) Descriptive statistics:

The table below shows the descriptive statistic of the chosen variables.

Tableau 5: Descriptive statistics

Variable	Obs	Mean	Std. dev.	Min	Max
log_gdp2015	266	24.95	1.073	22.34	26.84
log_pop_growth	266	0.72	0.371	-0.94	1.29
log_gfcf	266	3.02	0.295	2.133	3.76
log_gni_per_capita	266	7.17	0.985	5.13	9.02
log_life_exp.	266	4.13	0.120	3.81	4.34

Source: Prepared by author using R and Microsoft word.

The table above show the summary of the statistic description (mean, minimum, maximum and standard deviation) of the variables used in this study over 7 African countries in the period of 38 years. The number of observations is 266 for all the variables which shows that the panel is balanced.

3.2.2: Model Specification

In the objective of finding the impact of population growth rate on the economic growth rate of Africa, I identified some variables to include in my study after an analysis of the literature review. These are the variables that were high and likely to support and explain the relationship between population growth and economic growth of Africa: GDP2015, Pop. Growth, GFCF, GNI per capita, Life Exp. Therefore, the theoretical specification of the model takes this general linear functional form:

GDP2015 = f (Pop. Growth, GFCF, GNI per capita, Life Exp.) …… (5)

I employed a panel data regression. This is a balanced macro panel with a sample of 7 countries observed over a period of 38 years starting from 1985 to 2022. Balanced because there are no missing observations, Macro because N=7 countries with Varying from a minimum of 20 years and in this case, T=38years making it a balanced macro panel. As mentioned before the variables are in log form, it can be denoted as (logarithm= log)

Thus, the linear regression form of the equation to be estimated is written as follows:

$log\ (gdp2015)_{it} = ß_0 + ß_1 log(pop\ growth)_{it} + ß_2\ log(gfcf)_{it} + ß_3\ log(gni\ per\ capita)_{it} + ß_4 log\ (life\ exp.)_{it} + \varepsilon_{it}$…… (6)

Where:

i: indicates a country

t: indicates time period from 1985-2022

$ß_i$: i = 0.....4, represents the coefficients of the independent variables

ε_{it}: This is an error term that represents both unobserved factors and random

The model has five variables with *gdp2015* as the dependent variable and the remaining four variables as independent ones. *Gdp2015* stands for economic growth for the individual country 'i' studied over a time t. This specification is the general form for the 3 models from which I chose the most appropriate one.

3.2.3: Interpretation of results:

Table 6: *Estimation of the Pooling Model: Balanced Panel: n = 7, T = 38, N = 266*

Coefficients	**Coefficients**	**Std. Error**	**t-value**	**Pr(>|t|)**
Intercept	9.035659	1.372467	6.5835	*2.510e-10* ***
log_pop_growth	0.106154	0.115194	0.9215	*0.3576*

log_gfcf	-0.653013	0.126290	-5.1707	*4.646e-07* ***
log_gni_per_capita	0.771001	0.055005	14.0170	*< 2.2e-16* ***
log_life_exp	2.972726	0.423242	7.0237	*1.872e-11* ***

*Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

Residual Sum of Squares	***R-Squared***	***F-statistic***
60.778	0.80101	262.649 on 4 and 261 DF, p-value: *< 2.22e-16*

Source: Elaborated by author using results prepared by R software.

The pooled regression model reveals insightful findings regarding the determinants of economic growth (*log_gdp2015*) in Africa. While *log_pop_growth* does not exhibit a statistically significant relationship with *log_gdp2015*(P value = 0.357 < 0.05), variables such as *log_gfcf, log_gni_per_capita,* and *log_life_exp* emerge as significant predictors because their P-values are less than 0.05. The model is globally significant because the P-value of the F-statistic is less than 0.05 at a 5% significant level and the model is good due to its strong r-squared value 0.801 (80.1%) that is close to 100%. However, this model is not suitable for my study, firstly because it shows that there is no relationship between economic growth and population growth. Secondly, because the pool-ability test shown below shows that the pooling model above is unstable because its p-value 0.00 < 0.05 at 5% significance level thus rejecting the null hypothesis [H_o: The same coefficients apply to each individual (pooled OLS is stable)].

- ***Test result1***: *Pool-ability test*.

```
        F statistic

data:  log_gdp2015 ~ log_pop_growth + log_gfcf + log_gni_per_capita +  ...
F = 35.973, df1 = 24, df2 = 231, p-value < 2.2e-16
alternative hypothesis: unstability
```

Source: Elaborated by authors using results prepared by R-software.

After this test, I was left with two crucial models and that's the fixed effects model and random effects model to choose the best. Below are the results to these two models.

Table 7: Estimation of equation (6) using fixed effect model and random effect model.

Dependent variable: log_gdp2015						
Independent variables	Coefficients	Std. error	P-value	Coefficients	Std. error	z-value
Intercept				10.155209	0.717758	< *2.2e-16* ***
log_pop_growth	-0.338633	0.043292	*1.379e-13* ***	-0.336990	0.043735	*1.306e-14* ***
log_gfcf	0.210191	0.045867	*7.194e-06* ***	0.206395	0.046366	*8.529e-06* ***
log_gni_per_capita	0.439478	0.025369	< *2.2e-16* ***	0.442332	0.025593	< *2.2e-16* ***
log_life_exp	2.728370	0.208316	< *2.2e-16* ***	2.720943	0.210086	< *2.2e-16* ***
Model	**Fixed**			**Random**		
No. Obs	266			266		
No.Groups	7			7		
R-squared	0.90624(within)			0.90314(Overall)		
	F Stat: 616.2 *on 4 and 255 DF*			Chisq: 2433.57 *on 4 DF*		
	Prob > F(p-value): < 2.22e-16			*Prob >Chisq(p-value): < 2.22e-16*		
	*Signif. codes : 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*					

Source: Prepared by author using R and Microsoft word.

From the above results:

The number of observations in both models is 266 (7*38) meaning there are no missing values hence the panel data is balanced. The quality adjustment test of R-squared for both models are close to 1(within = 0.906, overall =0.903) which shows that both models are good for estimations. Both models are globally significant because the p-value of F Statistic (0.000) for the fixed effects model and that of Chi-square statistic (0.000) for the random effects

model are less than 0.05 at 5% significance level thus the two model are valid. The first column shows the independent variables, Models, number of observations, number of groups and R-Squared. The second and third big column contain values of the estimated coefficients of the variables, standard errors, and P-values that show the significance of each independent variable at the significance levels whose codes are in the last row of the table as retrieved from R - software estimation of the two models.

The constant coefficient (intercept) for the random effects model is 10.15 and its p-value is less than 0.05 hence statistically significant at 5% significance level despite the absence of this constant on the fixed effects model. The coefficients of population growth (log_pop_growth) for the fixed and random effects models are -0.338 and -0.337 respectively are negative and their p-values are less than 0.05 hence statistically significant at 5% significance level. This implies that population growth has a negative impact on economic growth.

The coefficients of gross fixed capital formation (log_gfcf) in both models are 0.210 and 0.206 respectively, they're positive and their p-values are less than 0.05 hence statistically significant at 5% significance level. This means that the variable gross fixed capital formation has an important positive impact on economic growth.

The coefficients of GNI per capita (log_gni_per_capita) are 0.439 and 0.442, they're also positive for both models and their p-values are less than 0.05 thus being significant at 5% significance level. This means that GNI per capita have a positive effect on economic growth.

The coefficients for life expectancy (log_life_exp) are 2.728 and 2.721 are positive in both models and their p-values are less than 0.05 hence significant at 5% significance level. This means that Life Expectancy has an important positive impact on economic growth.

In light of the preceding analysis, with regards to the estimated coefficients of both models, all the coefficients associated with variables (explanatory variables) appear to be statistically significant and have the expected signs, which is in agreement with the explained theories specifically Malthusian theory and empirical studies. Life expectancy in this case took the positive sign.

Therefore, both models well estimated the results for this study but only one best model can be retained to explain the study results. A Hausman test was run in order to determine the best model for the estimation of results for this study.

- **Hausman test**

Test result 2: *Specifications of Hausman test.*

```
        Hausman Test

data:  log_gdp2015 ~ log_pop_growth + log_gfcf + log_gni_per_capita +  ...
chisq = 1.2859, df = 4, p-value = 0.8638
alternative hypothesis: one model is inconsistent
```

Source: Elaborated by author using results prepared by R-software.

According to the test, there are two hypothesizes. The null hypothesis (H_0), were the random effects model is retained if the p value> 0,05 and also the hypothesis H_1 where the fixed effects model is retained if the p value <0,05. In this case, the results of the Hausman test show a Chi-square statistic = 1.2859 and the probability value is 0.8638 which is greater than 0.05 at 5% significance level. The null hypothesis is accepted hence retaining the random effects model as the most appropriate model that explains, for the case of panel of the retained countries, the link between the economic growth (GDP) and population growth plus other independent/supporting variables.

Validation of the random effects model.

Different validation tests were run on the Random effects model in order to know if there are no problems of auto-correlation of errors, multicollinearity, cross sectional dependency and the absence of heteroskedasticity;

- **The multicollinearity**

The Variance Inflation Factor (VIF) method was developed by statisticians to assess multicollinearity in regression analysis. It was first introduced by the economist John F. Kmenta in his book "Elements of Econometrics" in 1986 and also as discussed by A.H. Studenmund in his book "Using Econometrics: A Practical Guide" (2013), to test for multicollinearity in R-software. Studenmund explains VIF as a tool to identify the presence of multicollinearity between independent variables in regression models. The VIF measures the degree of multicollinearity among predictor variables by quantifying how much the variance of an estimated regression coefficient is inflated due to collinearity. Higher VIF values indicate

stronger multicollinearity, potentially leading to biased coefficient estimates and less reliable interpretations of the model. Addressing multicollinearity is crucial for ensuring the accuracy and validity of regression analysis results.

The VIF values indicate the extent of multicollinearity:

- VIF < 5: *Indicates low multicollinearity.*
- 5 <= VIF < 10: *Indicates moderate multicollinearity.*
- VIF >= 10: *Indicates high multicollinearity.*

Test result 3: *The VIF values*

log_pop_growth	log_gfcf	log_gni_per_capita	log_life_exp
1.284901	1.297155	2.509419	2.528072

Source: Elaborated by author using results prepared by R-software.

In this case, all VIF values are below 5, indicating that multicollinearity is not a significant concern for the random effects model.

- **The auto-correlation/serial correlation of errors**

Test result 4: *Breusch-Godfrey/Wooldridge test for serial correlation.*

```
        Breusch-Godfrey/Wooldridge test for serial correlation in panel models

data:  log_gdp2015 ~ log_pop_growth + log_gfcf + log_gni_per_capita +  ...
chisq = 211.82, df = 38, p-value < 2.2e-16
alternative hypothesis: serial correlation in idiosyncratic errors
```

Source: Elaborated by author using results prepared by R-software.

The Chi-square statistic *(211.82)* is substantially large, and the extremely small p-value (significantly less than 0.05) strongly rejects the null hypothesis of no serial correlation in the idiosyncratic errors. This means there is evidence of autocorrelation in the residuals of the random effects model. Autocorrelation in the residuals imply that the model's error terms are correlated across time, which can lead to inefficient estimates and biased standard errors. This affects the validity of hypothesis tests and confidence intervals.

- **Heteroskedasticity**

Test result 5: *studentized Breusch-Pagan test for Heteroskedasticity*

```
        studentized Breusch-Pagan test

data:  randomeffects
BP = 23.583, df = 4, p-value = 9.682e-05
```

Source: Elaborated by author using results prepared by R-software

The Breusch-Pagan test statistic of 23.583 with a p-value of 0.00009682 (or 9.682e-05) strongly suggests the rejection of the null hypothesis of homoscedasticity (constant variance of the error terms) in the random effects model. This indicates that there is significant heteroskedasticity in the model, meaning the variances of the error terms are not constant across observations.

Conclusively, the model is not valid to estimate the impact of the population growth on the economic growth (GDP) despite the insignificance concern of the effect of multicollinearity. In order to solve these technical problems (serial correlation, heteroskedasticity), there is need to re-estimate the regression equation using better and more advanced approaches such as the RSE (Robust Standard Errors), GMM (Generalized Method of Moments), FGLS (Feasible Generalized Least Squares) and Newey-West Standard Errors among others.

However, the Newey-West Standard Errors is most preferred here because it permits the use of robust estimators in the presence of auto-correlation and heteroskedasticity. The results obtained after the re-estimations are recorded below.

Results: The results of estimation of Newey-West Standard Errors using R.

	Coefficients	StandardErrors	tStatistics	pValues	LowerCI	UpperCI
(Intercept)	10.1552085	2.39933854	4.232503	2.311044e-05	5.4525914	14.8578257
log_pop_growth	-0.3369901	0.05735431	-5.875585	4.213539e-09	-0.4494024	-0.2245777
log_gfcf	0.2063947	0.18110097	1.139667	2.544252e-01	-0.1485567	0.5613461
log_gni_per_capita	0.4423316	0.06515407	6.789010	1.129060e-11	0.3146320	0.5700312
log_life_exp	2.7209428	0.64427682	4.223251	2.408033e-05	1.4581834	3.9837022

Source: Elaborated by author using results prepared by R-software

The coefficients and standard errors obtained using Newey-West standard errors represent the estimated parameters of the random effects model along with their precision.

Interpretation of the results:

The intercept represents the estimated value of log_gdp2015 when all independent variables are zero [log (1)]. In this case, it's estimated to be approximately 10.16. The t-statistic is 4.23, which is significant at the 5% level (p-value < 0.05), suggesting that the intercept is significantly different from zero or significant.

The effect of population growth rate (log_pop_growth) on economic growth shows that a one-unit increase in the population growth rate is associated with a decrease of approximately 0.34 in log_gdp2015 and the t-statistic is -5.88, indicating that this coefficient is statistically significant at the 5% level (p-value < 0.05).

The impact of the logarithm of gross fixed capital formation (investment rate) on economic growth is estimated to be approximately 0.21, The t-statistic is 1.14, indicating that this coefficient is not statistically significant at conventional levels (p-value > 0.05).

The effect of the logarithm of GNI per capita on economic growth indicates that a one-unit increase in GNI per capita is associated with an increase of approximately 0.44 in log_gdp2015. This coefficient is highly significant (t-statistic = 6.79, p-value < 0.05).

This effect of log_life_exp on economic growth indicates that a one-unit increase in life expectancy is associated with an increase of approximately 2.72 in log_gdp2015. This coefficient is statistically significant at the 5% level (t-statistic = 4.22, p-value < 0.05).

Overall, these results suggest that population growth rate, gross national income per capita, and life expectancy are significant determinants of log_gdp2015 in this relationship study, while the investment rate (log_gfcf) does not have a statistically significant effect on log_gdp2015 after taking into account the autocorrelation and heteroskedasticity problems. Conclusively, population growth rate indicates a negative impact well as, gross national income per capita, and life expectancy have a positive impact on the economic growth of Africa.

According to the results, the study shows that population growth rate is an important factor in determining the level of economic growth in a country. The negative impact observed between population growth rate and economic growth in the study suggests that higher population growth rates are associated with lower levels of economic growth in the selected

countries. This finding implies that rapid population growth poses challenges to economic development and may hinder the pace of economic expansion.

Several factors could explain this negative relationship. First, rapid population growth strains the limited resources and infrastructure, leading to lower productivity levels and inefficiencies in resource allocation more so in the low-income countries like Uganda. Additionally, a rapidly growing population may exacerbate unemployment and income inequality, further dampening economic growth prospects. Moreover, high population growth rates can put pressure on social services and healthcare systems, diverting resources away from productive investments no wonder, these shades lighter on the investment rate (GFCF) that became insignificant in the model relationship. This confirms the Malthusian theory and rejects the first hypothesis H1 of my study by giving evidence of a negative impact between population growth and economic growth.

Furthermore, the insignificance of the investment rate in influencing economic growth, as revealed by the study, underscores the complex dynamics at play within the African economic landscape. While investment in physical capital is traditionally viewed as a catalyst for economic development, its limited impact in this context highlights broader structural challenges and constraints faced by African nations. One key factor contributing to this insignificance is the inefficiency in resource allocation resulting from the negative impact of population growth rates on economic growth. High population growth rates can strain resources, infrastructure, and social services, diverting attention and resources away from productive investment activities. Additionally, the crowding-out effect, whereby increased investment is financed by reduced consumption or increased borrowing, further undermines the potential positive impact of investment on economic growth confirming hypothesis H3 of my studies. In many African countries like Ghana, Uganda etc., high levels of government debt and limited access to credit markets exacerbate this phenomenon, constraining the ability of firms to invest in productive ventures. The prevalence of imported goods and services, driven in part by the high population, can also undermine the effectiveness of domestic investment in stimulating economic growth. Import dependence can lead to trade imbalances, foreign exchange shortages, and reduced competitiveness in domestic industries, stifling investment incentives and hindering overall economic performance.

The positive impact of Gross National Income (GNI) per capita on economic growth, as indicated by the study findings confirms hypothesis H2 of my study, underscoring its critical role in driving overall economic development within a country. This relationship aligns with the broader theme of the study, which explores the influence of demographic factors, particularly population growth rates, on economic growth in Africa. A higher GNI per capita reflects increased income levels among the population, which, in turn, signifies greater purchasing power and consumption capacity. This heightened consumption potential stimulates demand for goods and services across various sectors of the economy, fostering increased production, investment, and employment opportunities. Moreover, a rising GNI per capita often corresponds with improvements in human capital development, such as increased access to education, healthcare, and skills training. These human capital advancements contribute to enhanced labor productivity, innovation, and technological progress, all of which are vital drivers of economic growth. Additionally, a higher GNI per capita signifies a more robust domestic market, which can attract foreign investment and stimulate exports, further fueling economic expansion.

The positive impact of Life Expectancy at Birth on economic growth, as indicated by the study findings, confirms hypothesis H4 of my study, which posits that demographic factors such as life expectancy play a significant role in shaping economic outcomes. This relationship underscores the intricate interplay between population health and economic development, particularly within the context of African nations. A higher life expectancy at birth reflects improved healthcare infrastructure, access to medical services, and overall public health standards. These advancements not only contribute to enhance individual well-being and quality of life but also have far-reaching implications for economic productivity and growth. Specifically, a healthier population is more productive and less susceptible to debilitating illnesses, thereby reducing absenteeism and healthcare costs for both individuals and the government. Moreover, a longer life expectancy signifies a larger working-age population relative to dependents, known as the demographic dividend, which can bolster savings, investment, and economic output. Additionally, improved health outcomes are associated with greater human capital accumulation, as individuals are better able to pursue education, acquire skills, and participate actively in the labor market. It can also attract foreign investment and spur economic activity by instilling confidence in the stability and resilience of the workforce.

Conclusion:

The aim of this chapter was to give an answer my original theme "The impact of population growth rate on the economic growth rate of Africa" and also see whether the hypotheses stated in the general introduction are proven. The study was based on 7 countries studied over a period of 38 years from 1985 to 2022. The data used was obtained from the World Bank development indicators and African development Bank analyzed using the panel data analysis because it studies the variation in time and the cross-section variation of variables. The results confirm that population growth greatly determines the rate of economic growth in Africa negatively. On the other hand, supporting variables: Income per capita and life expectancy at birth greatly influence the economic growth positively.

As a result of this study, I recommend that countries ought to address population dynamics in development strategies. Policymakers may need to implement measures to manage population growth effectively, such as promoting family planning, improving access to education and healthcare, and incentivizing sustainable demographic trends. Addressing the challenges highlighted by the insignificance of the investment rate in driving economic growth necessitates a holistic and strategic policy approach tailored to the socio-economic context of African nations. There's a need to prioritize policies that incentivize and facilitate productive investment in critical sectors such as infrastructure, education, healthcare, and technology. This involves streamlining regulatory processes, providing tax incentives, and enhancing access to finance for businesses and entrepreneurs.

Implementing the minimum wage legislation to reduce income inequalities more so in low-income countries like Uganda that exhibit this problem, implement progressive tax policies that redistribute wealth and income for example by imposing higher tax rates on high-income earners and corporations while providing tax breaks or credits for low-income individuals and households to improve income per capita and quality of the population. And lastly prioritizing healthcare infrastructure and public health initiatives and above all invest in education essentially to teach more doctors as integral components of sustainable development strategies in improving the health of the population in Africa. Also, most of the countries in Africa are dependent on agriculture, so mechanizing agriculture through the use of advanced machines would increase agricultural returns which leads to economic growth and also the policy makers can foresee the point to trade food staffs within the African continent for example countries like Uganda, Kenya

among others trading with countries in semi- desert and desert regions of Africa like Sudan Algeria, Egypt among others, this can reduce costs and create more income to invest in the lacking sectors like education at individual levels.

GENERAL CONCLUSION.

The population-economic growth relation in Africa, is a subject that will continue to be studied until all discoveries have been brought to book and taken into consideration for the region to attain sustainable growth and development. The main objective of this study was to investigate the effect of population growth on economic growth rate in Africa for the period 1985-2022.

Firstly, a study on the existing empirical works on this subject was considered and later an evolution study was carried out on sub-Saharan countries studied over a period from 1990 to 2019. Furthermore, an econometric study was carried out based on a sample of 7 countries chosen from the sub-regions of Africa studied between 1985 and 2022 based on the availability of data. There exist quite a number of variables but I scaled down to four variables based on the empirical, theoretical studies and data available. Population growth index based on population growth rate (annual%), Investment proxied by gross fixed capital formation (% of GDP), Income per capita proxied by GNI per capita and Health index based on Life expectancy at Birth are the independent variables while GDP (constant $2015) was the dependent variable representing economic growth in the region.

A panel data analysis was employed to analyze the impact and the variance of time using the Fixed effects and Random Effects models. Although the Hausman test favored the RE model, both the FE and RE models revealed a negative relationship between economic growth and population growth and positive and significant impact from other independent variables. Later, I passed on to a more advanced estimate (Newey-West Standard Errors) for more robust and valid results. The findings confirm the population-driven economic growth theory, which holds that a country's population expansion hinders economic growth and development (Malthusian theory of population). The other variables, life expectancy at birth and income per capita positively and significantly affect the economic growth rate (GDP) of the region yet Investment was rejected in

this relationship due to its insignificance. According to the evolution study of the chosen countries, population growth rates seem to take positive trends signifying the gradual increase in the number of people in Africa. And This can be supported by the evolutional positive trend of income per capita that somehow influences some people to produce more.

Furthermore, Population Growth and Economic Growth results confirm that population growth rate significantly influences the rate of economic growth in Africa, albeit negatively. Higher population growth rates are associated with lower levels of economic growth in the selected countries, highlighting the challenges posed by rapid population growth to economic development. Factors such as strained resources, infrastructure, and social services, as well as exacerbation of unemployment and income inequality, contribute to this negative relationship, echoing the Malthusian theory. The Role of Gross National Income (GNI) per Capita on the other hand, reveals a positive impact on economic growth, underscoring its critical role in driving overall economic development within a country. Higher GNI per capita signifies increased income levels among the population, leading to greater purchasing power, consumption capacity, and investment opportunities. Well as, the Impact of Life Expectancy at Birth also gives a positive relationship between life expectancy at birth and economic growth, highlighting the importance of population health in shaping economic outcomes. Improved healthcare infrastructure and public health standards contribute to enhanced individual well-being, productivity, and overall economic performance.

Policy Implications:

The findings of this study have important policy implications for African countries. To address the challenges posed by rapid population growth, policymakers should implement measures to manage population dynamics effectively, such as promoting family planning, improving access to education and healthcare, and incentivizing sustainable demographic trends. Additionally, addressing the insignificance of the investment rate in driving economic growth requires holistic policy approaches that prioritize productive investment in critical sectors such as infrastructure, education, healthcare, and technology. But most importantly policies that eliminate or fight corruption which leads to misuse of government funds and as a result affects investment for example carrying out secret investigations to monitor the use of government funds by its officials. Implementing minimum wage legislation for example countries like

Algeria, Kenya among others have this in place but can improve it, as well as countries without this like Uganda should try to foresee its advantages to its population through this study, progressive tax policies, and prioritizing healthcare infrastructure are also recommended to reduce income inequalities and improve population health.

Recommendations:

Based on the study findings, it is recommended that African countries prioritize policies aimed at managing population dynamics, promoting productive investment, fighting corruption, reducing income inequalities, and improving population health. These policies should be tailored to the socio-economic context of each country and implemented in a coordinated manner to foster sustainable economic development and improve the well-being of the population.

Conclusively, this study contributes to our understanding of the relationship between population growth and economic growth in Africa, providing valuable insights for policymakers, researchers, and development practitioners. By addressing the challenges highlighted in this study and implementing evidence-based policies, African countries can work towards achieving inclusive and sustainable economic development for the benefit of all citizens.

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APPENDICES

Appendix 01: GDP growth (annual %) from World Bank used for evolution analysis

Country Code	*UGA*	*DZA*	*EGY*	*GHA*	*KEN*	*MAR*	*ZAF*
1985	-3,306	3,700	5,792	5,092	4,301	6,008	-1,212
1986	0,390	0,400	4,745	5,199	7,178	9,271	0,018
1987	3,962	-0,700	3,833	4,795	5,937	-0,325	2,101
1988	8,267	-1,000	5,461	5,628	6,203	11,875	4,200
1989	6,362	4,400	4,921	5,086	4,690	2,846	2,395
1990	6,474	0,800	5,667	3,329	4,192	3,412	-0,318
1991	5,554	-1,200	1,125	5,282	1,438	7,216	-1,018
1992	3,418	1,800	4,473	3,879	-0,799	-2,098	-2,137
1993	8,326	-2,100	2,901	4,850	0,353	-0,741	1,234
1994	6,404	-0,900	3,973	3,300	2,633	10,588	3,200
1995	11,523	3,800	4,642	4,112	4,406	-5,405	3,100
1996	9,072	4,100	4,989	4,602	4,147	12,373	4,300
1997	5,100	1,100	5,492	4,196	0,475	-1,561	2,600
1998	4,905	5,100	5,575	4,700	3,290	7,239	0,500
1999	8,054	3,200	6,053	4,400	2,305	1,697	2,400
2000	3,142	3,800	6,370	3,700	0,600	2,582	4,200
2001	5,184	3,000	3,535	4,000	3,780	7,722	2,700
2002	8,733	5,600	2,390	4,500	0,547	3,730	3,700
2003	6,473	7,200	3,193	5,200	2,932	6,171	2,949

2004	6,807	4,300	4,092	5,600	5,104	4,571	4,555
2005	6,333	5,900	4,472	5,900	5,907	3,192	5,277
2006	10,785	1,700	6,844	6,400	6,472	7,791	5,604
2007	8,412	3,400	7,088	4,347	6,851	3,441	5,360
2008	8,709	2,400	7,156	9,150	0,232	5,685	3,191
2009	6,802	1,600	4,674	4,844	3,307	3,746	-1,538
2010	5,638	3,600	5,147	7,900	8,058	3,500	3,040
2011	9,392	2,900	1,765	14,047	5,121	5,525	3,169
2012	3,837	3,400	2,226	9,293	4,569	3,062	2,396
2013	3,587	2,800	2,185	7,313	3,798	4,122	2,485
2014	5,106	3,800	2,916	2,856	5,020	2,719	1,414
2015	5,188	3,700	4,372	2,121	4,968	4,345	1,322
2016	4,781	3,200	4,347	3,373	4,214	0,521	0,665
2017	3,131	1,300	4,181	8,129	3,838	5,058	1,158
2018	6,304	1,200	5,331	6,200	5,648	3,066	1,557
2019	6,439	1,000	5,552	6,508	5,114	2,891	0,260
2020	2,951	-5,100	3,550	0,514	-0,273	-7,178	-5,963
2021	3,537	3,400	3,291	5,076	7,590	8,021	4,703
2022	4,588	3,200	6,588	3,078	4,847	1,259	1,910

Appendix 02: Population growth (annual %) from World Bank used for evolution analysis

Country Code	***UGA***	***DZA***	***EGY***	***GHA***	***KEN***	***MAR***	***ZAF***
1985	2,839	3,398	2,754	2,289	3,660	2,346	2,961
1986	2,935	3,331	2,737	2,319	3,579	2,167	3,278
1987	3,099	3,028	2,718	2,398	3,515	1,976	3,498
1988	3,174	2,747	2,720	2,491	3,501	1,875	3,468
1989	3,218	2,632	2,667	2,562	3,461	1,786	3,352
1990	3,225	2,494	2,565	2,587	3,401	1,735	3,078
1991	3,274	2,385	2,411	2,534	3,212	1,684	2,558
1992	3,408	2,324	2,324	2,482	3,037	1,638	2,056
1993	3,455	2,240	2,296	2,446	2,942	1,586	1,815

1994	3,345	2,108	2,245	2,359	2,880	1,518	1,731
1995	2,724	1,918	2,192	2,309	2,809	1,506	1,646
1996	2,713	1,763	2,156	2,297	2,706	1,493	1,524
1997	2,910	1,681	2,155	2,349	2,674	1,463	1,386
1998	2,975	1,511	2,145	2,416	2,689	1,430	1,245
1999	3,237	1,398	2,113	2,439	2,801	1,376	1,112
2000	3,135	1,402	2,072	2,517	2,915	1,331	0,963
2001	3,045	1,376	2,056	2,660	3,029	1,307	0,886
2002	3,108	1,349	2,091	2,748	3,034	1,277	0,910
2003	3,120	1,354	2,088	2,714	2,967	1,219	0,924
2004	2,958	1,407	2,032	2,669	2,990	1,246	0,935
2005	2,906	1,364	1,983	2,660	2,977	1,319	0,945
2006	2,915	1,441	1,947	2,639	2,975	1,309	0,964
2007	2,934	1,628	1,952	2,605	2,966	1,288	1,014
2008	2,927	1,709	1,958	2,572	2,979	1,280	1,133
2009	2,916	1,796	1,956	2,536	2,961	1,281	1,189
2010	2,915	1,859	2,028	2,470	2,818	1,308	1,193
2011	2,907	1,898	2,208	2,438	2,655	1,343	1,263
2012	2,894	1,943	2,262	2,461	2,526	1,354	1,329
2013	2,877	1,967	2,316	2,452	2,410	1,344	1,362
2014	2,969	1,979	2,344	2,408	2,294	1,308	1,576
2015	3,091	2,000	2,205	2,364	2,200	1,253	2,074
2016	3,335	1,993	2,086	2,339	2,202	1,223	0,972
2017	3,496	1,957	1,990	2,235	2,176	1,192	0,387
2018	3,401	1,903	1,899	2,123	2,033	1,118	1,226
2019	3,395	1,839	1,794	2,089	1,978	1,044	1,295
2020	3,333	1,732	1,733	2,066	2,010	1,053	1,223
2021	3,211	1,658	1,658	2,008	1,943	1,051	0,999
2022	2,9986	1,6283	1,5691	1,9390	1,9095	1,0234	0,8411

Appendix 03: Random effects model results from R.

```
Oneway (individual) effect Random Effect Model
   (Swamy-Arora's transformation)

Call:
plm(formula = log_gdp2015 ~ log_pop_growth + log_gfcf + log_gni_per_capita +
    log_life_exp, data = Panel, model = "random")

Balanced Panel: n = 7, T = 38, N = 266

Effects:
                 var std.dev share
idiosyncratic 0.02168 0.14726 0.113
individual    0.17029 0.41266 0.887
theta: 0.9422

Residuals:
      Min.    1st Qu.     Median    3rd Qu.       Max.
-0.5465295 -0.0934772 -0.0078762  0.1040563  0.3479842

Coefficients:
                  Estimate Std. Error z-value  Pr(>|z|)
(Intercept)        10.155209   0.717758 14.1485 < 2.2e-16 ***
log_pop_growth     -0.336990   0.043735 -7.7052 1.306e-14 ***
log_gfcf            0.206395   0.046366  4.4515 8.529e-06 ***
log_gni_per_capita  0.442332   0.025593 17.2831 < 2.2e-16 ***
log_life_exp        2.720943   0.210086 12.9515 < 2.2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    59.8
Residual Sum of Squares: 5.7924
R-Squared:      0.90314
Adj. R-Squared: 0.90165
Chisq: 2433.57 on 4 DF, p-value: < 2.22e-16
```