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ANALYSIS OF THE IMPACT OF POPULATION GROWTH ON ECONOMIC GROWTH IN KENYA (1960 – 2021).

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Dedication

This study is dedicated to my parents for their efforts in supporting and educating me to this far.

I as well dedicate it to my siblings and friends for their support.

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List of Abbreviations

AD: Anno Domini

ADF: Augmented Dick-Fuller

ADRL: Auto Regressive Distributed Lag

AIC: Akaike Information Criteria

EGS: Exports of Goods and Services

GGFCE: General Government Final Consumer Expenditure

GDPPC: Gross Domestic Product Per Capita

GDP: Gross Domestic Product growth rate

GoK: Government of Kenya

HIV/AIDS: Human Immunodeficiency Virus/ Acquired Immune Deficiency Syndrome

HNPISHS: Household Non-Profit Institution Serving Households

K: Capital

KCSE: Kenya Certificate of Secondary Education

KCPE: Kenya Certificate of Primary Education

KNBS: Kenya National Bureau of Statistics

KNEC: Kenya National Examination Council

KPHC: Kenya Population and Housing Census

KSH: Kenya Shillings

L: Labor

LE: Life Expectancy

MoH: Ministry of Health

NCPD: National Council for Population and Development

List of Abbreviations

P: Production

PCA: Principal Component Analysis

PG: Population Growth

S: Savings

TFR: Total Fertility Ratio

UN: United Nations

UNDESAPD: United Nations Development of Economic and Social Affairs Population Division

USA: United States of America

USD: United States Dollar

VAR: Vector Autoregressive

WB: World Bank

WHO: World Health Organization

WW: World War

Y: Output

Summary

General introduction

Many homes consider large family as a source of wealth while others consider it an engine for poverty. For families that consider it a source of wealth are those living below life average and so they believe having many children will secure better life in future or they can act as substitutes of family income that is to say if one member in the family doesn't have finances the second member will have and if this second person doesn't have the third person will have and this process continues finally leading to larger family. Those who consider it as a way to poverty are particularly pessimists because they worry about the future needs of their offspring and therefore end up having one or two children. They believe much of their resources will be exhausted in rearing children which will cause poverty to them and through this fear, general population in a country is affected. Another category believes that small family is fashionable which includes people living above the standards of life, high class or rich people

In a similar manner, the above three situations can affect the country at large. High population in the country can bring poverty or riches. This is explained by the fact that gross domestic product per capita is significant in countries with small population and lower in countries with high population. Although population size is not the only means to affect gross domestic product per capita, an important contribution comes from it and we all know that gross domestic product per capita measures the growth of a country by economic growth per person. India is one of the most populated country in the world yet with the poorest living standards. Population in Luxembourg reads in thousands and that of India in billions yet living standards in the former is far much better than that of latter. In fact, Luxembourg has the highest GDP per capita in the world (International Monetary Fund). Looking at these two conditions, it is clear that population growth can affect economic growth in the country either positively or negatively. However, some theories argue that if population increases, the output per worker and labor are increased therefore increasing productivity and finally economic growth while others like Malthusian theory say that increased population reduces economic growth through shallowing of resources.

Population and economic growth are ambiguous and interlinked, one affects the other in many ways. One role of the macroeconomic is studying the relationships between economic aggregates like gross domestic product, consumption, revenue etc. Production is an indicator of macroeconomic performance which shows economic growth or recession

and to measure overall output of a country we use gross domestic product. It can tell whether the country is increasing the production or not and if there is economic growth or decline. On the other hand, production is affected by population (large or small). Larger population coincides with pessimism notion in Malthusian theory which concerns about the fitness of natural resources – since population increases faster than subsistence, there will be reduction in revenue and as a consequence death rate increases while birth rate reduces. These two consequences have an impact in endogenous theory because they interfere with labor which is seen as a source of productivity. Savings and investments are macroeconomic variables and in their own way are affected by demographic impact. These two elements are pointed out in Harrod-Domar model as engines of economic growth. Besides this model, high population influences them negatively which transmits an impact to economic growth. Generally, population growth and economic growth are complex elements and they need better understanding so that they can be beneficial to the country.

One thing leads to another is a true saying. Malthusian theory is one of the oldest and it mainly focused on almost negative effects of population growth on economic growth and it didn't take other factors into consideration. Later, other economists and authors commonly referred to as anti-Malthusian theory who are discussed in our first chapter showed up and outlined more positive impacts that comes along with high population and have a positive impact on economic growth such as labor, technology, capital widening etc. Despite the emergence of anti-Malthusians, there were ideologies that led to further research on how factors within economy and population leads to growth of the economy.

Controversial ideas have been debated occasionally whether population growth has a positive or negative impact on economic growth. Economists and authors of various books and articles came up with theories and empirical tests to prove their argument on this effect. Some have proved it favors while others it doesn't and so we are always stuck in these controversial ideas. In Kenya, looking period 1960 – 2021 is associated with a population of 7, 751, 435 and 53, 005, 614 respectively (World Bank) and within these 61 years, the population has increased by 45, 254, 179 which on average and by estimation is an increase of over 700,000 people per year. One of the main factors behind this increase is fertility which was characterized by 8.1 children per woman in 1970s which means the momentum of childbirth created that time has an impact to present date because the largest population in Kenya comprises of the youths.

Despite the population being in seven million in 1960, the country was never recorded anywhere leading in gross domestic product or GDP per capita. In 2021, when the population increased to 53 million still the country has not registered a recognizable GDP. From theoretical part, we know the economy of a country is better when GDP per capita is high as a result of small population. Technology and innovations are instigated by high population. High technology provokes new means of production which calls for extension of trade (exports) due to availability of surplus goods and eventually through this economy grows which is a positive effect. However, this increased population can sabotage the economy through increased problems such as diseases, food, air pollution, low savings, poor infrastructure and many more. Since in Kenya population has increased with significant figures, it gave us a curiosity to know the impact of population growth on economic growth in Kenya.

Out of this concern, there arise some questions like; does population growth favor economic growth in Kenya? Is it a negative or positive relationship between the two elements? After reading the work of Gideon K. T., Gachanja P. and Obere A., we assume that population growth favors economic growth in Kenya and there is a positive relationship between them.

This study will help solve the puzzle that has existed for a long time about the exact implications of population growth on economic growth. If it has a positive effect, our study will be helpful to the government of Kenya or any legal institution dealing with policy making process because they will put measures that will favor growth of population in order to have better economy. Similarly, if the effect is negative the study will be helpful as well since they will lay down rules and regulations to control population growth such as use of contraceptives and family planning. Besides this, irrespective of whether the effect is positive or negative there are other elements or variables that are responsible in fueling these effects. In our case study these elements are called independent/exogenous or explanatory variables and after we identify them through analysis, it will be important the government to deal with each variable according to the effect it exerts on population or economic growth at large.

Our hypotheses need a methodological approach to be affirmed or repudiated. Since so many authors have conducted similar thesis, we saw it important to use deductive method – progressing from general ideas to a specific conclusion and therefore we were bound to

do the following procedures. We first read bibliographical work relating to our theme, then choosing to read recent articles over old articles because the recent ones are comprehensively structured compared to the old ones which might be lacking some of the things that happened recently. These articles can either be homogeneous to our research topic or those related to it reflecting case study of Kenya or another country. We also consulted websites relating to our topic and finally collected data from an authentic source in order to carry out an empirical study which is conducted using auto regressive distributed lag.

Finally, our work is formatted in three chapters. Chapter one is on economic growth theories which gives us a light on how economic growth can be stimulated. It also tells us how different economists view drivers of economic growth. These theories give recommendations on how we can change into a better economy. In addition, it touches the two main elements of our theme (population and economic growth) where by effects of population growth are clearly outlined in each theory.

The second chapter is about population and economic growth. Here, we discussed on general determinants of population growth then focused on the case study (Kenya) and we grouped them into demographic and social economic factors. In depth we discussed demography and economic growth in Kenya – evolution of population and basic sources for growth of the Kenyan economy.

In our last chapter – three, we did analysis concerning our theme, thereafter interpreted the results and gave specific conclusions.

Chapter 01: Economic growth theories

Introduction

Economic growth is the backbone of a country which in a broader view determines the level of income an individual is likely to earn. Different theories of economic growth have been developed by various economist (classic, neo-classic and modern economists). It is important to understand some of these theories before the analysis of the framework of the theme. These theories give a view of the modern economy we are living in and how we can manipulate the available resources and situations to gain a better living.

Theories rely on assumptions which can be true or not true. In order to make a critical assumption, one must draw reasonable and realistic conclusions so that when interpretations are made, we can conclude that the assumption is correct otherwise it's not.

Most of these theories were developed after the 1st and 2nd WW with the intention to reestablish the economy after it was severely damaged. In addition, the economic shock experienced from 1929 – 1939 that affected most countries across the world after the fall in stock prices in United States (Great Depression) was among the reasons for developing economic growth theories.

To date, we live under capitalist and socialist economy. So many political, economic and social consequences affected the lives of people after the war. To point out, millions of people were left poor in extreme low living conditions. As a result of this, the authority confronted the capitalist to engage in to determine which system between capitalist and socialist could quickly change the living standards that were prevailing.

To fight all this, there was a need of developing economic models and theories which would help investors, government, private and public sectors and all economic entities to reestablish the economy. The first chapter is divided into two section where by section one is about endogenous economic growth theories and section two exogenous economic growth theories.

Section 01: Endogenous growth theories.

From neoclassical's perspective, if innovations and technological advancement do not exist in the economy, there is no doubt that it will remain at zero growth. The endogenous model explains economic growth of an economy caused by internal factors. It further suggests

that growth and development of human capital will cultivate way for new types of technologies hence promoting economic growth. This model can respond to questions like, why the recent economies produce more quantities of goods than they did in the old days and the function of human capital in the economic growth. The developers of the endogenous growth theories are, Romer (1990), Lucas (1988) and Barro.

1-1 Adam Smith's theory of economic growth (1776)

He built his theory in a book known as The Wealth of Nations in 1776. Agriculture and industry contributes a big role in his theory though agriculture is seen to have more important implications on growth than industry. In supporting his ideas, he argued the above two factors can induce growth through enlargement of markets and augmented specialization of functions. He was optimistic unlike other classic economists like Ricardo and Malthus who were pessimists – they believed in diminishing returns. Adam brought the concept of increasing returns which is caused by division of labor and specialization. He introduced the notion of invisible hand which gives market a stable condition. Invisible hand means individual interest ends up benefiting others in the society. For example, in a case where an individual decides to set up a business for his own interest such as acquiring profits but it also benefits other people like offering employment to them yet at the beginning it was purposely for his own interests. Through this decision, the entire market is stabilized and he added by saying that by doing this, "he frequently promotes the interests of the society more effectually than when he really intends to promote it" (Adam Smith, 1776, P.364).

1-1-1 Division of Labor

Enlarging the market gives space for increment of division of labor therefore augmenting labor productivity because work specialization minimizes time spent in changing tasks and workers become highly competent in doing a specific work. In other words, it is seen as the engine in increasing the productivity powers of labor. The separation of various trade is mostly carried out in places where there is highest degree of industry improvement. He highlights some advantages of division of labor which includes; large increase in the quantity of work, increase of dexterity in each worker – skill performing tasks especially with the hands, it saves time which is mostly consumed and wasted by passing from one type of work to another and finally it allows invention of machines which in return facilitate and reduces labor. He further states that amelioration of the dexterity of the

worker makes him increase an amount of the work he can carry out in a day while division of labor which makes him perform particular task in his life time increases his skill performing tasks very high.

For easy benefiting from division of labor, Smith points out that it's good to intensely allocate workers who manufacture a product in one place and adding more number of workers will further lead to subdivision of task which will lead to higher labor productivity. The latter gives a need to introduce machines and the productivity increases. To increase this productivity, you need to do more subdivisions of tasks and this will be possible if there will be more adding of the workers. So if this process (of further subdivisions of tasks and adding more number of workers) continues, the economic development of a country will increase.

Smith argued that it is by agreement, exchange and by buying we get from one another the goods we are in need of and through this principle division of labor was born. He points out that division of labor is limited by the size of the market and when it is insignificant no one can have the incites to commit himself fully to one type of work. As a result of this, production in big quantities and specialization is limited. He therefore suggested for international exchange which enlarges the size of the market which in turn require more capital accumulation to operate.

1-2 Nicholas Kaldor model

Nicholas developed this model 1908 - 1986 in the 20th century. He focused on industrial structure and the role of demand in determining the economic growth of a country. Kaldor, N. 1966 and 1967 "Causes of the Slow Rate of Economic Growth in the United Kingdom" and "Strategic Factors in Economic Development" respectively highlights manufacturing industry as the engine to economic growth as well as the reasons why there exist different rates of growth in different countries.

According to Causes of the Slow Rate of Economic Growth in the United Kingdom, manufacturing is the engine for economic growth – there is a positive relation between industry and output growth. On the other hand, the role played by demand towards economic growth is quite crucial since for it to grow there is necessity of foreign trade. According to him, an explosive growth is when the country grows into a net exporter of capital goods and by this economic growth is achieved. He also highlighted that growth in

agriculture and export induces manufacturing because they create demand in the industries for the purposes of production. Later, the output from the industries increases productivity which leads to economic growth.

However, Kaldor's point of view is that the same way demand promotes economic growth, a country's supply restraints can hinder its growth in two major ways; restraints on the balance of payments and labor availability.

The record of all foreign trade and foreign transactions made by a country's residents is known as balance of payments and when the country's imports are more than exports is referred to as balance of payments negative/deficit while when the exports are more than the imports it is referred to as balance of payments positive/surplus. Therefore, in case of balance of payments deficit, automatically it means there is zero economic growth. On the other hand, we see restraints related to labor availability or inadequate labor which hinders efficient production and this brings us to conclusion of Nicholas judgement; the slow rate of economic growth of the United Kingdom was as a result of depletion of supplies of labor simply because it had attained "economic maturity" (Anthony Philip Thirlwall, 2017) which means retarded growth.

1-3 Lucas (1988)

Luca's mechanisms for studying economic growth are two endogenous factors, physical capital and human capital (through schooling and learning-by-doing). Human capital is general skill level of an individual. Lucas pointed out that time can affect an individual's current productivity and future skill level depending on how he spends it. He further simplified this notion by saying, "capital levels affect current production and the current time allocation affects the accumulation of human capital" (Robert E. Lucas, 1988, P. 17). From the above statement, we understand that the more time you spend to acquire new knowledge will finally make you an expert in the same field. Experts will make more changes in the sector of technological advancement which leads to increased productivity hence increasing economic growth.

Lucas advocated for Rosen's theory which says that the current individuals with human capital should pass it to the younger generations so that in future there will be availability of stock in human capital to ensure economic growth in long-term bases. He therefore

derived the insight from Rosen's theory that "human capital accumulation is a social activity involving groups of people" (Robert E. Lucas, 1988, P.19).

Human capital can as well be acquired through schooling and learning–by-doing or job training. This means that skills are accumulated by continually doing what one is best at and it leads to comparative advantage

1-4 Paul M. Romer (1990)

According to him, economic growth is brought by stock of human capital (education and job training). He agrees with Solow's model (1956) that technological advancements and changes increases the output hence causing economic growth.

Paul M. Romer talked about research and development as a factor to economic growth. To generate new ideas/knowledge, this field of research combines human capital and the available or old knowledge. When more research is done, it leads to increased technological achievements which can increase productivity and therefore creates long-term growth.

In addition, this research promotes innovation within a firm which encourages competition among other firms. To avoid the monopoly and maintain competition, the competitors lodge innovations as well and by this process technological changes will keep improving leading to more productivity which will increase economic growth.

Equally, countries that are poor and underdeveloped have no good human capital and this explains why their economy do not grow. It also answers the main question *–why do some countries grow faster than others* that is found in the Wealth of Nations by Adam Smith.

1-5 Robert J. Barro (1991)

Barro developed this model to show the significance of government expenditure towards economic growth. He emphasized mostly on education which is considered like a public investment.

Besides education, he considers the function of government as an instrument of input to private production such that this function establishes a relation among private sectors, government and growth. He further states that the firm's production is bought by the same government and it's distributed to households. For example, considering a private firm that

produces power/electricity, government can give necessary subsidies to facilitate production and since not many people can afford to pay the expenses of electricity installation, the government takes the charges. Power demand increases and the production company will continue to produce more. At long last, several small entrepreneurs will have electricity and they will carry out so many economic activities with the power operating machines and this will increase production therefore facilitating economic growth.

Barro's thought is human investment includes education and training and he highlights when government spends on education, it accumulates human capital. Generally, education is a continuous process which can take up to twenty years and it also takes levels. He related the number of years spent on schooling as years of accumulating knowledge and the levels involved as steps of knowledge improvement or changing from low- medium- high.

Section 02: Exogenous growth theories

The key elements of growth in neoclassic are external factors such as innovations, saving rates and technological progress and thus according to exogenous growth, factors determining economic growth are also external and independent of the economy that is to say they aren't incorporated in the model. It further suggests that all economies that use identical technologies should have converging productivity growth rates (Solow 1991).

2-1 Harrod – Domar Growth Model

This model was developed by two economists, Roy Harrod (1939) and Evsey Domar (1946). The Harrod – Domar emphasis the usefulness of savings and investment as principle elements which determines growth of the economy. These two factors are the main agents of economic growth according to them because the more the savings the more number of investments thus the latter increases productivity within the economy. The model also explains how growth can be achieved in the economy and it comprises of two parts, demand and supply. The origin of these two are derived from Keynesian general theory because as Keynes was arguing how macroeconomic policies could be driven to achieve full employment, he concentrated on aggregate demand precisely on investment. Harrod – Domar extended Keynes theory by arguing that investment transformed the two parts of the economy (demand and supply).

"Harrod and Domar pointed out that investment changed the economy's supply side as well as the demand side, and full employment could be maintained only if investment and the other sources of aggregate demand grew just fast enough to exactly absorb the increased output that the new investment made possible" (Van den Berg, Hendrick, 2013, P.8). In other words, there should be a second investment firm to utilize what the first firm produced if it was an intermediate good. Therefore, this model is the extension of Keynesian macroeconomic model though it studies long run problems with the short run tools from Keynes.

2-1-1 Supply part

The main insight here is that investment enlarges the capacities of productivity because the capital stock (increase of the existing physical capital) increases thus the output.

Earlier on, we stated that investment and savings are the main factors for economic growth in Harrod and Domar model and so we conclude that the speed of economic growth is the same as the ratio of savings speed.

2-1-2 Demand part

Keynes noted that "future events cannot be accurately estimated from the past events because the economy is not ergodic" (John. M. Keynes, 1936, P. 162) and so we understand investment is hindered by lack of certainty and in such a case it will reduce and the demand will fall such that it can't absorb the increased output from the last period of investment.

However, some investors may decide to invest despite the lack of certainty and by doing this investment increases leading to economic growth. As a result of this growth, the economy's capacity is reached and inflation develops.

The above two situations experienced by the economy are known as *knife's edge* of the Harrod and Domar model meaning whatever deviates the economy away from its equilibrium state leads to a continuous process of deviating it further. They finally advised for the need of regulations that can modify the demand in case of nonstable equilibrium.

2-1-2-1 Assumptions

- There is full employment in the economy

- A closed economy
- Savings (S) within the economy should be invested into production (P)
- Absence of possibility of substituting labor for capital in production
- Investments and savings are equal
- Propensity to save does not vary

2-2 Harrod's Model

"In Harrod's terms the critical question of balance boils down to a comparison between the natural rate of growth which depends, in the absence of technological change, on the increase of the labor force, and the warranted rate of growth which depends on the saving and investing habits of households and firms" (Robert M. Solow, 1956, P.65). Another type of growth in his model is actual growth which denotes real rate of increase in a country's gross domestic product per year. Warranted growth, Actual and Natural growth are abbreviated as gw, g and gn respectively.

In summary, increasing the level of investment by supporting savings and enhancing technology progression that will make companies produce more output with less capital is the main path towards achieving economic growth in the Harrod – Domar model.

2-3 The Solow growth model.

It was developed by neo-classical economists Solow (1956) and Swan (1956) basing themselves on neoclassical thinking on growth – capital accumulation. This model further highlights that increase in growth must be accompanied by technological progress.

2-3-1 Assumptions

1. All consumers save a certain constant proportion of their income which is noted as "s".
2. Similar technology of production where capital and labor are considered as factors of production/inputs.
3. It is a closed economy
4. All capital and labor are fully and efficiently employed

This model was developed on two bases, capital accumulation and the production function meaning how inputs (capital "K" and labor "L") are transformed into output "Y".

Increased capital per worker (k = K/L) leads to increase in yields of output per worker (y = Y/L) and this production function is characterized by constant returns to scale.

In every production operation, there are losses that accrue into a business which are normally referred to as depreciations and therefore, capital accumulation is given by investments minus these losses or depreciations. In other words, In Solow's assumption number one above, all the savings are considered as investments which gives rise to capital accumulation. This accumulated capital is not just saved in the banks but it is given to other companies in form of credits to carry out production activities. These activities therefore increase Gross Domestic Product of a country hence increasing economic growth.

Solow also highlights possibilities of economic growth if the amount of investment is superior to the amount of capital. This process is called capital deepening which also leads to increase in the marginal product of labor because of availability of more units of capital per worker. Irrespective of saving rate, the growth of output will be the same as the growth of labor and this is the condition Solow referred to as steady state growth where capital and labor grow at the same rate. Nevertheless, when investment and capital are the same, the situation is also referred as steady state meaning no economic growth that will occur.

In a case where the population has increased, the capital-labor ratio which measures the magnitude of capital in the economy or company declines leading to low and poor living style. In other words, population increase cause resource shallowing.

In case where there are more savings and investments, increased capital per worker accumulates leading to increased output per worker. Therefore, in such an economy the living style is higher as well as tendency of people being rich.

Solow continues to argue that improvement in technology leads to continuous economic growth because of development of labor productivity. He pointed out that economy will remain in a constant state of zero growth if there are no innovations and technological advancements. He therefore advocated for changes in the field of technology in order to increase the output in the economy.

In summary, the consequences from rise of a population, consequences from increased saving and investment and finally consequences from advancement in technology gives the

implications of the Solow model. The latter is seen to be the principle element that determines economic growth in Solow's model.

2-4 Malthusian theory (1798)

His theory is based on An Essay on the Principle of Population 1798, that the increase in population is detrimental to economic growth. He stated that if population is not controlled, it increases in a geometrical ratio while the means of subsistence of man in an arithmetical ratio. According to his model, more rise in economic growth leads to increase in population by inducing early marriages, more birth rates and reducing mortality rates that could be caused by malnutrition.

However, we see a contrast in his model where this increased population reduces economic development through diminishing returns. Lack of food and space for living are some of the obstacles to the future needs of one's offspring. A man feels stopped from having a big family by the fear of facing challenges in supporting their needs in terms of lowering their standards of living and not providing well for the family. If these fears do not prevail, population increases beyond the means of subsistence and as soon as it reaches such a level, it must decrease and as a result, the difficulty of feeding is a constant obstacle to the growth of human population.

To illustrate his model, Malthus used an example of an Island to compare population growth to that of food. The produce of an Island maybe doubled in the first twenty-five years by the quantity of subsistence equal to its present production and at the end of a century the population would be 112 million while the means of subsistence as 35 million hence leaving behind a population of 77 million totally none provided for (Thomas Malthus, 1798). This leads to movement of people from one place to another in search for better conditions of living.

The human species will grow in the progression of, for example "1, 2, 4, 8, 16, 32, 64, 128, 256, 512 etc. while the means of subsistence as 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, etc. In two centuries and a quarter, the population would be to the means of subsistence as 512 to 10: in three centuries as 4096 to 13, and after two thousand years the difference would be almost incalculable" (Thomas Malthus, 1798, P.9).

From his model, we understand that the growth rate from period to period exceeds the one of subsistence growth.

Conclusion

The contribution of Adam Smith involves agriculture and industry which induces economic growth through expansion of markets and increasing specialization. According to him, the former gives space for increasing and specialization of labor. Lucas also highlighted a similar concept to that of Adam such that the more time you spend on something the more you become an expert. This has an effect of determining the amount of productivity to be produced. In addition, he said that economic growth is brought by physical and human capital while Paul Romer believed it is generated by technological progress and research. Robert Barro had a different view from the others because he said it is through government expenditure that economic growth increases.

Harrod and Domar highlighted the importance of savings and investments while Solow talked on capital accumulation and production functions of inputs being capital and labor. Finally, Malthus said rhythm of subsistence increase is not the same as that of population growth therefore population growth is harmful to economic growth

Chapter 02: Population and Economic growth

Introduction

Fluctuations in population size cause changes on economic growth because the latter depends on the former for production functions of the inputs in ways like labor, machines, capital etc. Population growth affects the demand for savings as well as consumption which are necessary for economic growth. Several demographical characteristics affects population growth that finally affects performance of the economy therefore population is seen as a base for economic growth. In this chapter we shall study the general determinants of population growth then extract those that affects Kenya. Finally, we shall study evolution of population and economic growth in the country.

Section 01: Main determinants of population growth

Population change is determined by several factors that can be grouped into demographic characteristics, social economic conditions, natural amenities, transportation accessibility and land use and development however we shall study the first the first two because they are the main determinants (Alvarez-D., D'Hombres B., Lewis D., Claudia G. and Nicola P., 2021),

1-1 Demographic characteristics

This group constitutes of factors such as natural population growth (mortality and birth rates), migration, age and population distribution and density

1-1-1 Natural population growth

This includes birth and mortality rate.

- *Birth rate*

Nuptiality, that is to say the state of being married, has main goal of consecration with intention to procreate and therefore it influences birth rate. However, in the current generation we have many children born out of wedlock although we don't marry solely to get children.

Birth rate is the number of new born in a single year per 1000 people in a population therefore natural population growth occurs when birth rate is higher than mortality rate in other words, when there are more births than deaths in a single year.

Birth rate can be affected by HIV/AIDS and it influences population size (mostly decrease) either voluntarily or involuntarily. People infected with HIV have no desire to give birth in fear of affecting or transmitting it to their children with the same virus during birth. Apart from this, generally these people have no hopes for a long life and therefore they find it not worth giving birth to many children because they can be deceased anytime.

Proximate to this effect, is the fertility connected behavior caused by HIV condition where the victims deliberately interfere with fertility. Birth rate is therefore reduced voluntarily as well as population.

On the other hand, HIV affects fertility of women such that HIV positive women have lower fertility than HIV negative women. In addition, the information from prenatal clinic shows low fertility of HIV positive in many countries (Zaba and Gregson 1988). Low fertility means few births will take place therefore involuntarily population reduction takes place.

- *Mortality rate*

It is the rate at which people die or number of deaths in each year per 1000 people in a population therefore natural population decrease rate will occur if the number of deaths is higher than the number of births in a single year.

- *Main causes of mortality*

These can be grouped into two main categories namely exceptional and natural causes. Exceptional causes include wars, natural disasters, epidemics and pandemics. Epidemic relates to diseases that affects huge number of people in the same geographical area while pandemic relates to an epidemic that affects many parts of the world. Good examples are cholera or malaria and Covid 19 virus or the 1918 Spanish flu respectively

Natural causes include alcoholism and smoking or drug abuse, road accidents, death due to occupational sickness, due to diseases such as heart attack, stroke, cancer, infections etc. and due to environmental conditions.

1-1-2 Migration

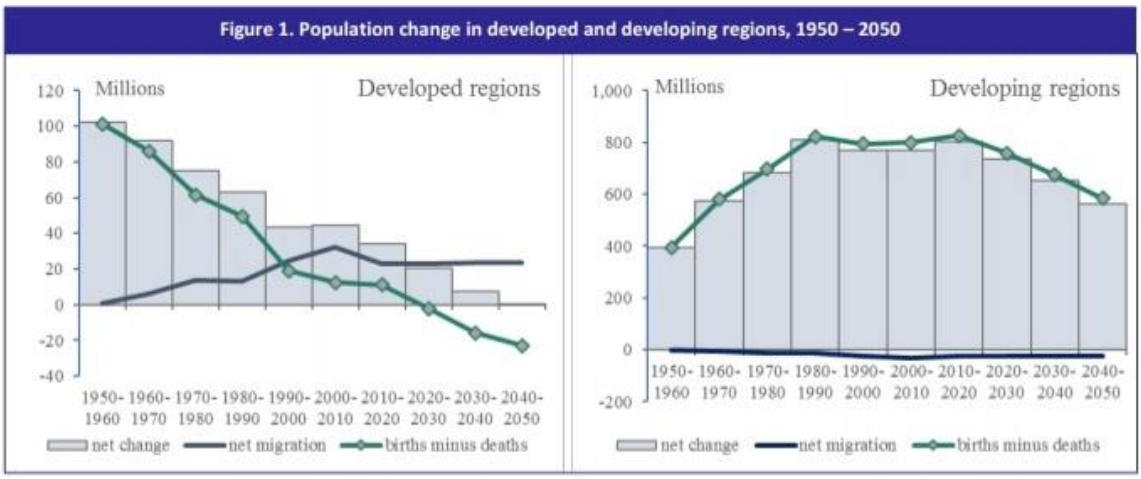
Due to migration, UN has projected a decrease in population between 2040 and 2050 in countries that have already developed and an increase to the countries in the process of development. Kenya is a developing country and so the population is expected to increase due to high number of immigrants.

As stated earlier on, fertility is the principle cause of births and in countries facing infertility problems their population is likely to decline but with contribution of migration as a factor determining population, these countries will increase their population (there will be exchange of fertile immigrants and emigrants).

Basically migration already renders a significance contribution to population growth. From 1950 to 2010, United Nations has noticed developed countries have ceaselessly increased population as a result of positive net migration (the difference between figures of immigrants and emigrants, who come or leave from a specific region in a given period, regardless of their nativity or citizenship).

However, by 2050 the population in these countries is expected to fall because the net inflow of expatriates will not be enough to offset the high mortality over low birth rate. Again, the already developed countries will have reached economic maturity unlike the developing countries.

Figure 01: Population change in developed and developing regions, 1950 -2050.



Source: UNDESAPD, December 2017

1-1-3 Age and population distribution

Juvenile population is characterized by high fertility rate while old population is characterized with very low or zero fertility rate and therefore the fertileness in the juvenile population leads to high birth rates hence causing population growth. Contrary to the old population, there are minimal or zero births which results to low or no population growth. Similarly, if only ageing population is distributed in one region little growth is observed but if young population is distributed to one region high population growth occurs. In summary, young children below 14 years cannot give birth, youths are fully capable of giving births and the elderly population can rarely give births because they have limited chances.

1-1-4 Density

Population density is accumulation of people in a given geographical region and mainly associated with urbanization and calculated as population per square kilometer (Km^2). Density is associated with two effects; agglomeration (positive) and congestion (negative)

- *Congestion*

Congestion is associated with overpopulation and population increase causes resource shallowing (a concept in Malthusian growth theory) and then it enters into a reverse system that is to say the population starts to decline due to scramble of the available resources.

Density-dependent factors influence population growth in respect to density (either if the density is high or low). Diseases, competition and predators are some examples of density-dependent factors. In other words, these factors influence the population according to its size for example if population increases, the examples of density dependent factors as well increases therefore limiting population increase and if population decreases the examples named above also reduces because population growth is limited at low densities. A general example is when a place is densely populated the possible consequences are emergence of different diseases and intensifying the existing ones which affects the health of inhabitants and finally causing death – a way in which population is reduced. A recent case of Covid-19 Virus which could spread faster in a densely populated area causing more deaths and when the lockdown system was introduced as a measure to reduce spread of the virus, death rate reduced.

Luc. A. Wauters and Luc Lens (1995) did a research on the effects of food availability and density on red squirrel *(Sciurus Vulgaris)* reproduction. A red squirrel is a small gnawer that is commonly found in Europe and Asia. After research, Lack (1954) concluded that density-dependent reproductive rate may be the result of all individuals in a population suffering reduced fecundity when density increases while Luc. A. Wauteurs and Luc Lens found that when the red squirrel density was at peak, some female squirrels were exiled to poor places (places with limited food) and thus they could not reproduce at their normal rate (reduced births occurred) which reduced the population of red squirrel. On the other hand, when the density was low, there was no banishment of any female squirrel to poor places with limited food therefore their birth rate was not affected and it lead to population increase. The three authors, Wauters, Lens and Lack came into a similar conclusion showing a shortcoming /restriction in population growth in regard to population density.

- *Agglomeration*

Rural-urban migration results to increased urban agglomeration. Agglomeration occurs when people shift to central cities mainly to seek employment rendering it heavily populated. Also, due to demand of labor in urban areas leads to densely population therefore increasing population growth.

1-2 Social Economic Conditions

Among other social economic conditions like employment and unemployment we shall discuss on education and diseases because they have greater influence towards population growth.

1-2-1 Education

At the World Education Forum held in Dakar, 2000, education was acknowledged vital in accomplishing demographic development. In the development of economic theories, we noted R. J. Barro insisted on expenditure by the government towards education because by financing it, it accumulates human capital.

- *Education and entry into reproduction life*

The relation between education and birth rate has been a notable debate across many countries and through studies and research, it has been concluded that as the level of education increases for women low births occur. At personal and population level, once

people have attained mass education or higher education fertility goes to low levels (Caldwell 1980). Highly educated women get few children and at late ages because of the confinement by their profession as well as much time spent on education / school therefore procrastinating the beginning of their family. Robert. J. B., 1991 defined education as a continuous process that can take up to 20 years and it occurs in levels.

Entrance into marriage and onset of sexual relationships are mostly exerted by cultural rules and socio-economic factors. For example, in regions where lengthy or extended education doesn't have a motive boys and girls end up marrying at tender ages. Education makes people to be self-dependence therefore the likelihood of being exposed into early marriages is minimal which could be possible because of poverty but education gives one an opportunity to stop dependency.

Both early marriages and onset of sexual relationships leads to early childbearing while education can prevent this problem because schooling will procrastinate both of them therefore avoiding early reproduction that will cause population growth. There exists a negative correlation between marriages and high level of education – marriages decrease as education increase.

- *Relationship between education and fertility*

Most research has shown a negative correlation between fertility and education level such that places characterized by high level of education have low level of fertility while places characterized by low education have higher fertility. Fertility is a major determinant to population change.

- *Connection between Education, Health and Mortality*

Recent studies show that children who come from illiterate families are vulnerable to death at tender ages than children who come from families with primary literacy. In the same manner, children from families with primary literacy have higher mortality than children who come from families with secondary literacy. Practically, literate women have some knowledge on how to treat some diseases that affect young children than illiterate women for example solutions to diarrhea, recommendations for immunizations and best diet for babies.

Literate mothers are in a better position to practice good and quality prenatal care than illiterate mothers which can cause death due to complications developed during pregnancy.

- *Linkage between Education and International Migration*

Most countries that experience highest immigration in search of education are, Australia, Canada, and USA (Borjas, 1994 and 1999). Today, so many students are living their mother country to go and study overseas through programs such as scholarships that give full or partial support to the students concerned. However, level of income also influences international education and due to prestigious reasons parents with high level of income supports their children to study at international level. As a result of this – so many students studying overseas, the universities from the mother country have established cordial relationships at international level therefore facilitating more students to go and study abroad.

In some cases, students don't return to their country after studies and this increases population as well by the fact that they intermarry and produce young ones. Due to other economic reasons associated with the country students opt to remain and not to go back to their country. Developed countries are the ones that attract foreign students and through this mobility population growth is affected.

Other than determinants of population growth listed by Chi and Ventura, we have various diseases.

1-3 Diseases

Some main diseases across the world that lead to death of millions are; cardiovascular diseases, traumas, respiratory diseases, HIV, perinatal diseases, malaria, cancer and tuberculosis.

Section 02: Factors determining population growth in Kenya

Population is rapidly increasing in Kenya and from 1960 to 2021 it has increased by 9.6%. In most cases, when the population keeps on increasing apparently there are favorable factors such as good health behind the increase although the country might be struggling as well to meet the needs of that population. This section gives an overview of the key drivers to population growth specifically Kenya.

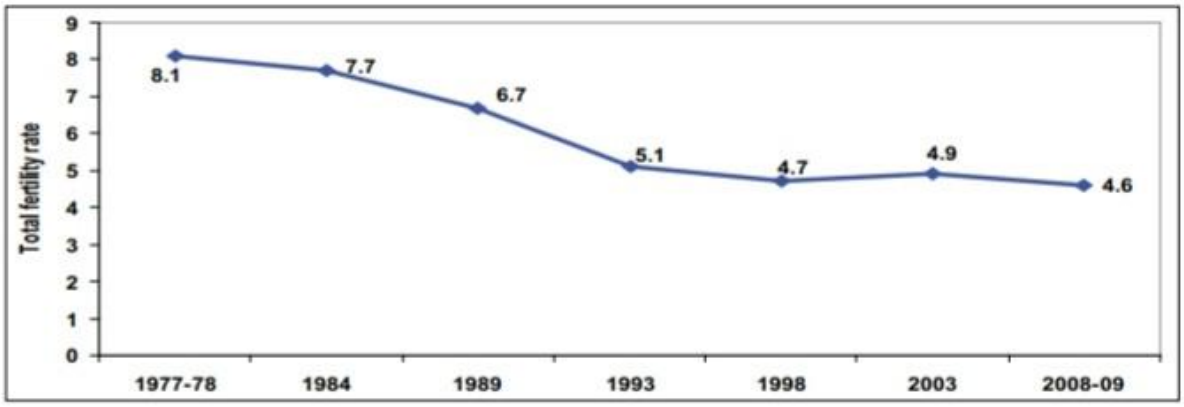
2-1 Fertility

It is considered as a powerful determinant to population change. The youthful population makes the biggest percentage of fertility carriers and this implies that population will spin for a long period of time if programs and policies will not be initiated to control and reduce fertility level that is prevailing in the country. Around 1978 the fertility was 8.1 children per woman and the usage of contraceptives was very low, only 7%. However, it relatively reduced in 2008 to 4.6 children per woman because people started using family planning through contraceptive methods and further creating awareness will lower fertility levels. Therefore, the quality of being fertile seems to change population at a greater scale.

2-1-1 Fertility levels and trends in Kenya

There was a notable decline in fertility rate at the beginning of 1980s to late 1990s as shown in figure 02 because of widespread usage of contraceptives that was promoted at national and international levels (NCDP, 2013).

Figure 02: Trends in Total Fertility Rate, Kenya 1977/78 – 2008/09.



Sources: KNBS

Kenya's fertility change is characterized by the state of stagnation that occurred from 1998 to 2008 as seen in figure 02 above. The cause of stagnation took three different versions; reproduction deportments, social-economic and institutional versions.

Regarding reproduction deportments, it is because the usage of contraceptives was equalized among all women (educated and non-educated, poor and rich) yet the rich and educated had broader means of reducing their fertility compared to the poor and non-educated. The latter category of the population was supposed to get the contraceptives at a

higher rate than the rich. Second, the ratio of women who wanted few or no children verses the ratio of women who wanted more children became equal therefore causing stagnation.

Concerning social-economic version, the number of women with high education fell as well as levels of income therefore causing a steady growth. Institutional version played a big role in the stagnation because of increased HIV/AIDS. Fertility levels in Kenya declined because of wide usage of contraceptives that was promoted through programs at national and international levels. However, with increased rate of HIV/AIDS, more of national and international aid was taken to sectors dealing with HIV in order to reduce deaths because it was causing more harm than fertility therefore putting contraceptive aid aside.

2-1-2 Possible determinants of fertility in Kenya

High fertility in Kenya is associated with early onset of childbearing and marriage, low status of women, low levels of female education, limited access to contraception mostly for women and youths who live in rural areas and sometimes cultural practices that favor high fertility.

2-2 Life expectancy

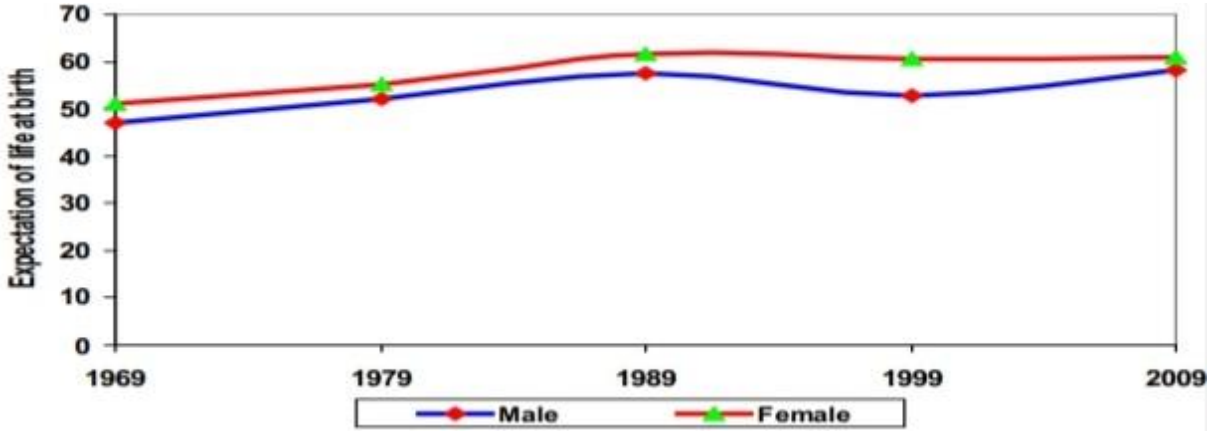
Since 1960, life expectancy has increased although there have been little fluctuations. In 1960, it was at 48.68 years then it hiked up to 61.16 years in 1981. It dropped to 54.41 years in 2000 and a significant increase in 2021 which was 63.9 years. This information is extracted from the data released by WB. Increased life expectancy is caused by decrease in child and adult mortality (the state of Kenya population 2017, 2018)

Life expectancy and mortality rate depends on the health status while decline in mortality increases life expectancy. In fact, 10% increase of life expectancy generates 0.4% growth of gross domestic product (WHO, 2014). The drop of life expectancy in 2000 was as a result of high level of non-communicable diseases, maternal and neonatal problems. These diseases affect the health of an individual therefore reducing his longevity.

Figure 03 shows that females have a higher life expectancy than males also the report released by world health organization showed that when both genders are faced with similar diseases women seek healthcare more than men. In addition, women have several

checkups before going to the delivery room therefore all this makes them to live longer than men.

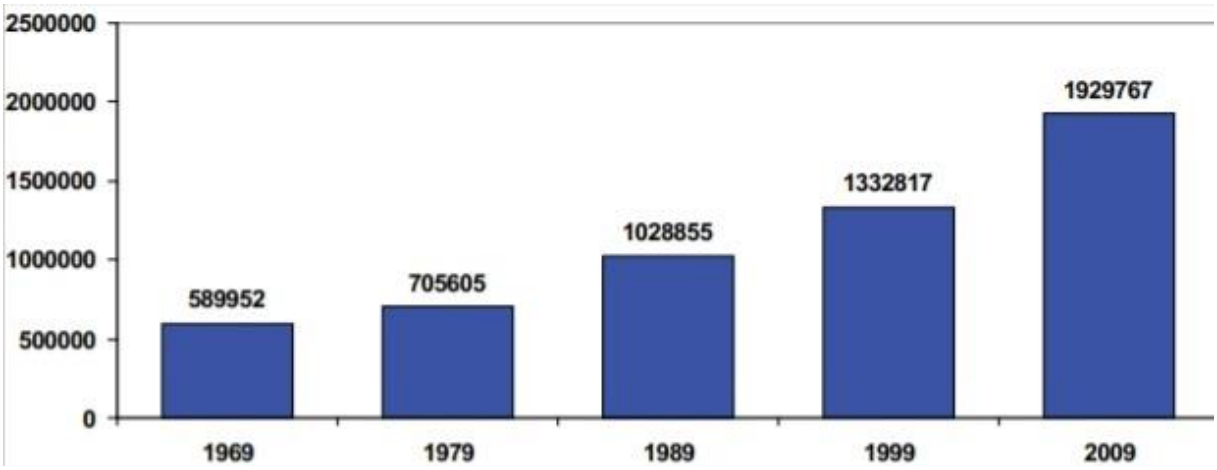
Figure 03: Life expectancy at birth by gender, Kenya, 1969 – 2009



Source: Kenya population situation analysis (2013)

Old people are susceptible to minor ailments however the trend in Kenya seems to be contrary because the size of the elderly population- 60 years is showing an upward trend since 1969 in the figure below.

Figure 04: Upward trend in population aged 60 and above in Kenya, 1969 – 2009



Source: Kenya population situation analysis (2013)

2-3 Mortality rate

Death is one of the determining factor to population change and in Kenya it is mostly associated to factors like gender, age, race or ethnicity, occupation, social class, quality and state of health and living standards (NCPD, 2018).

2-3-1 General Mortality Rate in Kenya

1970s and 1980s are marked by two great demographic phenomenon distinguished as follows; late 1970s Kenya was characterized by highest fertility level and early 1980s marked the start of fall of this fertility. At the same time, in 1970s and 1980s the country faced quick declines in mortality rates. However, in 1990s the country experienced high mortality such that life expectancy at birth fell by 4 years for both females and males 61 – 57 and 58 – 54 years respectively in 2008 but the effect was insignificance because of the preceded high fertility. Towards the end of a decade from 2008, life expectancy rose again up to 61 and 58 for females and males respectively according to 2009 census.

2-3-2 Infant and Childhood Mortality

Childhood mortality is death that occurs below five years while infant mortality occurs before one year as described by World Health Organization (WHO). Kenya kicked off declines in childhood mortality in the late 1940s (National Council for Population and Development, 2018) though in 1990s there were increase which affected majority of the infants because of the following reasons.

2-3-3 Causes of childhood mortality in 1990s

According to Ettarh R and Kimani J 2012, regions of inhabitants – more deaths in rural areas because postpartum checkups concerning health of babies was not adhered to than in urban centers, level of education of the mother either illiterate or with primary knowledge, duration of breastfeeding – babies who breastfed for a period longer than six months had high chances of surviving than those of below six months, place of delivery – public or private institutions, mothers age – children of mothers beyond 32 years had higher chances of survival than mothers with less than 32 years

- *Measures to Mortality Rate*

Death is a negative effect to population and to ensure prosperity, all factors that are responsible for upsurge in mortality should be controlled. Some of these control measures are, implementing polices to reduce poverty level, government to provide food relieve especially to the poor population, subsidies of health sector to accommodate both the poor and rich to ensure better delivery services, launch some health services in rural areas to

help people who can't access facilities in urban centers, ensure cleanliness in urban centers and proper sewerage system and regulate the spread of HIV/AIDS (Lawrence D. E., 2004)

2-4 Education in Kenya

Education is a long term investment that can affect economic growth positively through innovations and technology according to Robert Barro.

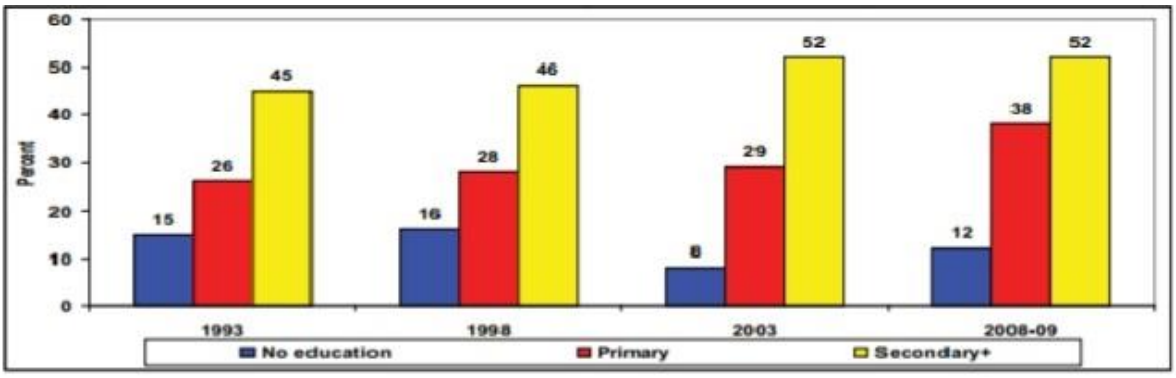
2-4-1 Trends on Kenyan Education

Investing in education and other main factors to population growth is vital in reducing fertility rate through various ways. Early marriages in Kenya are taking upward trend but imposing a compulsory primary education can help to solve it because there will be delays in marriages. In 2009, Kenyan population was 37.7 million and out of this 2.8 million eligible for school wasn't yet enrolled and the ones who were already enrolled a bigger percentage of them stopped after secondary school and the exposure to early marriages and sexual relationships was at risk therefore contributing to population growth. Furthermore, report released by the Kenya National and Literacy Survey in 2007 had 7.8 million illiterate adults and majority of them were ladies. This was another indicator of population growth in Kenya. Number of learning institutions in Kenya are 31,200 primary schools, 1,250 secondary schools, 2,348 colleges and 74 universities

2-4-2 Education and use of Contraceptives in Kenya

Many women without education rarely know neither use the contraceptives. Figure 05 shows the gap among women with no education, with primary and secondary education.

Figure 05: Use of modern contraceptives by education level, Kenya



Source : Kenya population situation analyses, 2013

2-4-3 Transition in Education in Kenya

The transition from primary to secondary school has remained low because of incapability to pay secondary fees, school drop-outs and early marriages. Besides these problems, others include institutional and social economic challenges. A good indicator that shows the transition from primary to secondary school is the Kenya National Examination Council – KNEC which includes (Kenya Certificate of Primary Education – KCPE and Kenya Certificate of Secondary Education – KCSE) for primary and secondary respectively. Table 01 below shows transition in education for various years.

Table 01: Transition from primary to secondary school

Number of pupils who did KCPE	Year when KCPE was done	Number of students enrolled in secondary school	Year of enrollment	Transition from primary to secondary school
741,507	2010	1,767,720	2011	Positive
776,214	2011	1,914,823	2012	Positive

Source: Authors computation based on the data from Kenya National Bureau of Statistics and education sector report 2013/14 – 2015/16.

Table 02: Transition from secondary to the university

Number of students who did KCSE	Year when KCSE was done	Number of students enrolled in the university	Year of enrollment	Transition from secondary to university
333,816	2009	182,253	2010	Negative
336,015	2010	185,264	2011	Negative
410,586	2011	239,362	2012	Negative
615,591	2017	542,005	2018	Negative
664,479	2018	547,133	2019	Negative
699,706	2019	566,042	2020	Negative

Source: Authors computation based on the data from Kenya National Bureau of Statistics and education sector report 2022/23-2024/25

Section 03: Demography and economic growth of Kenya

Since the impact of population growth on economic growth has been ambiguous, it is necessary to first elicit different opinions by some economists about it then we shall proceed to study the history, demography and economic growth in Kenya.

3-1 Theoretical literature review

Numerous theorists have discussed the relationship between population growth and economic growth and have ended up with very controversial results. Therefore, under this subsection we shall review some of these results.

Thomas Malthus (1798) believed that population growth harms economic growth because it increases at a higher rate than that of resources. This is to say that while population is growing at geometric rate, subsistence grows at arithmetic rate. Therefore, if this population is not restrained the possible outcome is scarcity of resources which will lead to sharing of the resources that will be available and sometimes this causes conflicts among the people. This is explained by the fact that this increased population exhausts all the surplus that could be used for developments and investments, more labor supply degrades amount of wages thus lowering demand and finally tendencies of dependency effect.

Boserup (1970), is an anti-Malthus because according to her population growth has a positive effect on economic growth. Most of opponents of Malthusian theory argue that one should find ways that are adaptable to population growth. Boserup said that unbearable conditions that could be caused by high population renders people to be more creative and it is through this she highlighted population growth as a positive factor to economic growth because it is seen as an engine for agricultural developments. This is due to marginal product of labor and division of labor in the agricultural sector. Also, agricultural demand increases when population increases therefore people are obliged to be efficient in agricultural practices that will increase food and later production process. In short and according to her, increase in populations accelerates land productivity because of the above mentioned reasons.

According to Kelly and Schmidt (2005), effects of population growth on economic growth depends on the country and the era of study. They did a study using seventeen countries and the results showed disparities such that in some countries the effect was positive while

in some it was negative. They further highlighted that the disparities in the results was as well contributed by socio-economic factors and evolution of age patterns.

The work of Bloom and Williamson (1997) indicates that economic growth in East Asia was facilitated by demographic transition such that the working population grew at a higher rate than non-working population. These countries had a conducive art of governance, social, economic and political institutions that amplified the economic growth that was caused by demographic transition. Therefore, their work shows the importance of population growth (transitional effect) and this effect is only possible under the following condition; if the working population and dependent populations have no same rate of growth otherwise it will exert negative effects on economic growth.

3-2 History of Kenya

Around 4 millennia ago, the country called Kenya was originally occupied by Cushites who moved from North Africa and stopped in East Africa – the today Kenya. Bantus from West Africa and Nilotes from river Nile followed the Cushites during the 1st millennium AD and they settled at the interior part of the country. The third group to arrive in Kenya were the Arabs who settled in coast.

Kenya is a British colony and this colonialization was brought about by the Berlin Conference in 1885. This conference was purposely to debate on the partitioning of Africa and British was therefore given East – African territory (Kenya) and it became their Protectorate in 1920. British colonialism was associated with brutality and this led to formation of movements against this kind of colonialism.

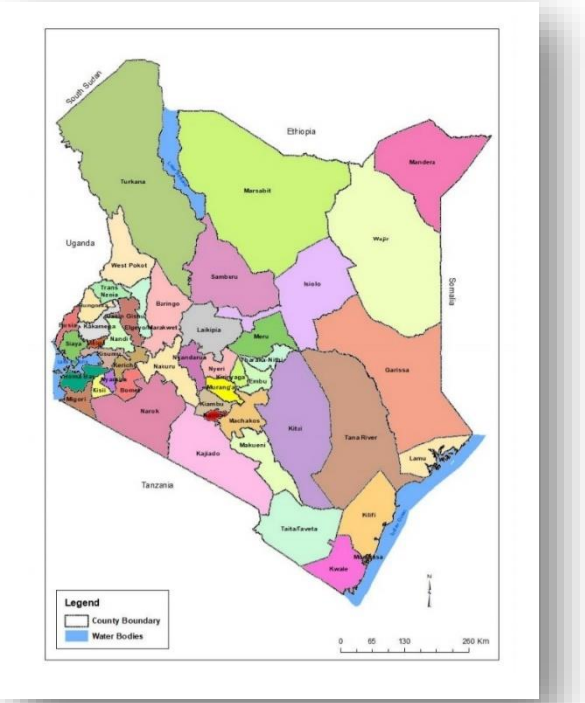
Around 1942, most of the Bantu speakers (Kikuyu, Meru, Embu and Kamba people) took oaths of unity and concealment to drive the country out of colonialism. The war came to an end when a great freedom fighter by the name Dedan Kimathi was captured and executed by hanging in 1956.

In 1954, many Africans joined the Europeans and Asians in the law making process where 1957 just after the death of Dedan Kimathi a group of leaders officially became a legislative body and they demanded for the release of Jomo Kenyatta. Five years later, he was released and in the subsequent year Kenya got independence (12th/12/1963) and in 1964 it became a republic with him as the first president.

3-2-1 General overview of Kenya

Kenya is found on the east of Africa with a population of 47.6 million people as per the last census report by KPHC which was held in 2019 and the most recent available report (2021) by World Bank says its current population is 53 million people. Worldwide it is ranked position 27 and 7th in Africa after Nigeria, Ethiopia, Egypt, Congo Demo Rep, Tanzania, and South Africa as the most populated countries.

Map 01: Map of Kenya with 47 counties



Source: 2019 Kenya Population and Housing Census: Volume III

It occupies an area of 582,650 kilometer squared, 11,000 kilometer squared of water regions included and it has five bordering countries namely; Sudan, Ethiopia, Somali, Uganda and Tanzania. It has 47 counties, 44 different communities each with its own language and Kikuyu, Luo, Kalenjin, Kamba, Luhya, Mijikenda, Meru and Kisii are the communities that have the biggest number of people with Nairobi as the capital city.

It is found between latitude 4°21'N and 4°28 and between longitude 34° and 42°E. On the east there is Indian Ocean and there are four topographical regions in the country namely; the savannah lands, arid and semi-arid, fertile low lands and agricultural highlands. The

Great Rift Valley which is the Western region all the way to Lake Victoria and the Eastern region which includes Mount Kenya and the Aberdare forest are the two halves in which the country is divided into.

Kenya being around the equator receives tropical climate and have two rainy seasons which are the long rains and the short rains in the months of March – May and October – December respectively however August– September are characterized by dry periods. Due to the state of elevation the highlands receive more rain as well as the forest regions due to presence of equatorial climate while low lying regions have low rainfall. The rainfall pattern in the country is not reliable as only 12% of the country can rely on it therefore 88% affects agriculture leading to drought and famine in the country.

There were droughts in 2010 – 2011 (was the worst because it affected over 3 million people in terms of food problem), 2016 – 2017 (affected half number of the counties) with 2.7 million people found with food insecurity. Intense droughts happen in the arid and semi-arid regions like Turkana. Temperatures change according to the altitude but generally there are 10°C and 34°C as the minimum and maximum respectively.

3-3 Demography of Kenya

Demography refers to quantitative and qualitative study of populations and their evolutions from basic characteristics such as birth, death, fertility and migrations while population is a set of individuals who form a self-reproducing system such birth verses death or immigration verses emigration and they live in the same region.

Population growth, comprising of two different terms, population as defined above while growth means an increase or enlargement of a thing.

3-3-1 Evolution of human population in Kenya

The first population census in Kenya was carried out in 1897 which took the form of headcount. The second was done in 1948 followed by another one in 1962. Six years after Kenya's independence fourth census was carried out and henceforth it has been conducted after every ten years mainly on the midnight of 24th or 25th August being the reference dates.

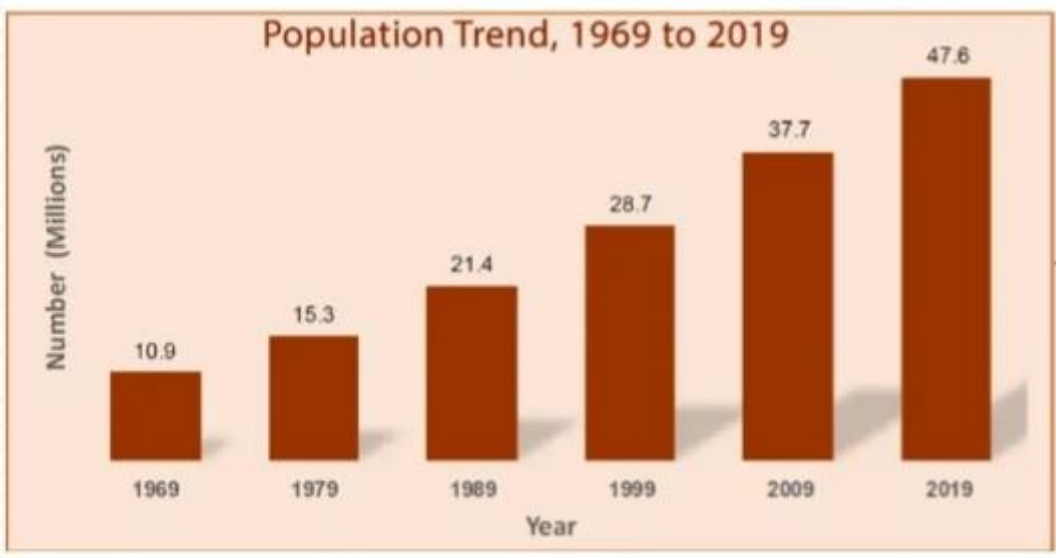
There is an upward trend with a significant increase of population with more than two million from the previous period as shown in table 03 and figure 06.

Table 03: Summary of Census Counts in Kenya

Year	Population (millions)
1897	**2.5**
1948	**5.4**
1962	**8.6**
1969	**10.9**
1979	**15.3**
1989	**21.4**
1999	**28.7**
2009	**37.7**
2019	**47.6**

Source: 2019 Kenya Population and Housing Census; Volume III

Figure 06: Population trend in Kenya since independence



Source: Kenya National Bureau of Statistics

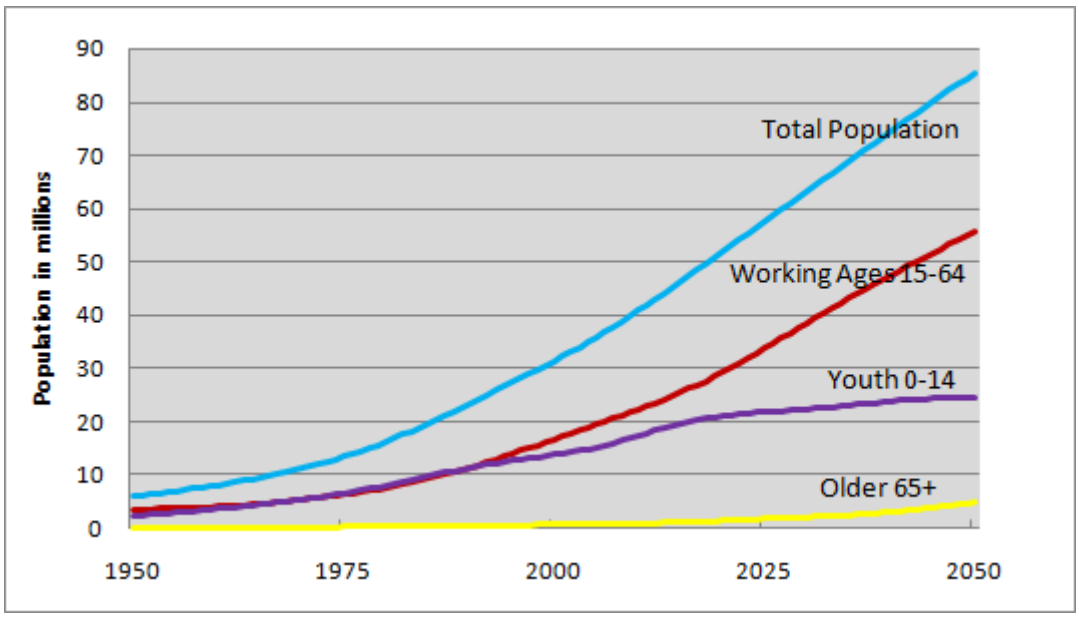
3-3-2 Demographic features in Kenya

It is observed that the population keep on increasing because of the former four decenniums hasten birth rate. This generated several households and therefore the number

of children from each household is on a progressive growth. It is also observed that Kenyans have a longer lifespan and it is estimated to reach 68 years by the year 2050.

The fecundity rate started to drop since late 1970s and this can help Kenya reach demographic transition however if birth rates will not be controlled the trend will reverse upwards. This is explained by the fact that as the fecundity rate reduces, change in dependency ratio will occur because (working age population) will largely grow than the non-working population.

Figure 07: Kenya's demographic transformation



Source: World Bank computations based on United Nations, 2009, World Population Prospects.

3-3-3 Demographic indicators in Kenya

The principal characteristics of a population structure are known as demographic indicators and they provide general overview of the population. The most important indicator is the distribution of a country and it is always in form of pyramids for easy comparison between the elements that are being studied.

3-3-3-1 Population distribution in Kenya

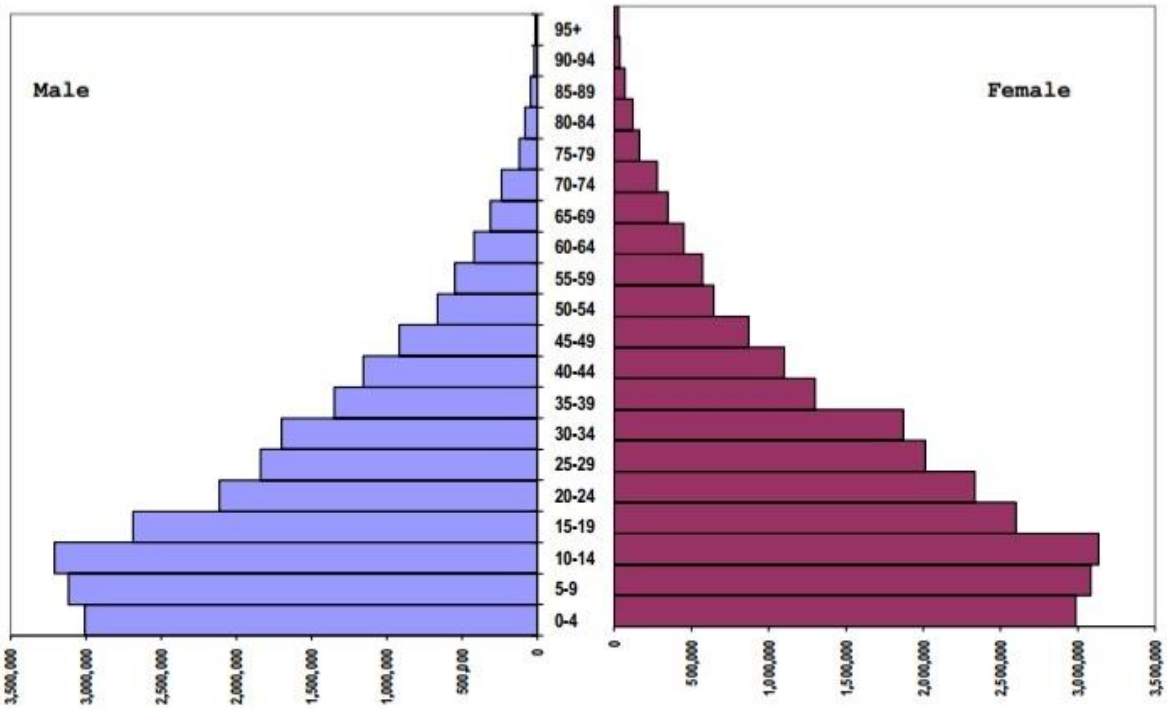
Kenya is facing various challenges such as increased number of youths who are unemployed despite being educated, social crimes among the youth due to unemployment

and dependency in almost all the households as a result of population growth. With increased population, a significant percentage of population has shifted to urban centers due to various reasons such as employment (people who found jobs in town), unemployment (people who have shifted to town to search for jobs) and personal interest. The combination of all these factors has led to negative impacts such as increased crimes, poor sewage disposal, destruction of the infrastructure among many others. Visualization of various pyramids will help in better understanding of population distribution in the country.

- **Population pyramid**

It indicates the age-sex structure of the population either country wide or region wide.

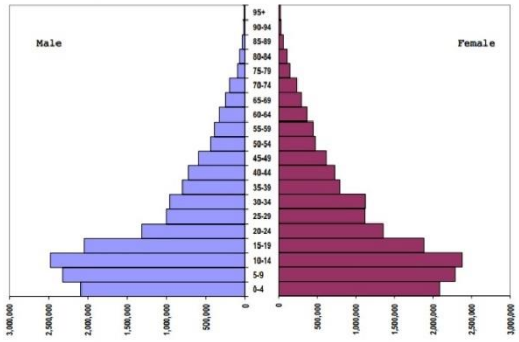
Figure 08: National population pyramid, 2019



Source: Kenya Population and Housing Census: Volume III

Figure 08 shows that Kenyan population mostly constitutes of youths and we can breakdown the age as follows. 0 – 14 children, 15 – 34 youths, 15 – 64 working age and 65 and above as elders. We can conclude that in the year 2019 the dependency ratio was less because majority of the population was active. If the young plus the elderly population exceeds the working population therefore there is age dependency.

Figure 09: Rural population pyramid, 2019

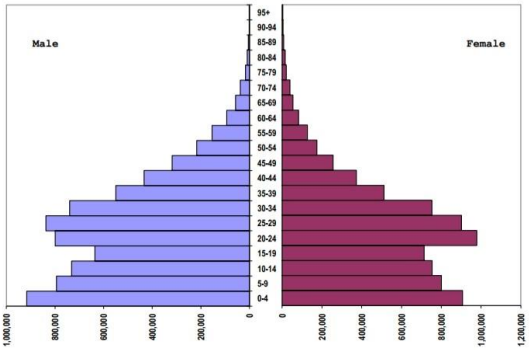


Source: Kenya Population and Housing Census: Volume III

Figure 09 shows that majority of population- children and elders are found in rural areas. Demographically this is correct because the two populations are dependent and don't work therefore they are mainly at homes (rural). Also the attribution of more young and elderly population in rural is due to propensity of giving births in rural areas and relocation of urban-rural after retirement respectively.

However, there is an exceptional case where few working population is concentrated in rural due to unemployment.

Figure 10: Urban population pyramid,2019



Source: KPHC, Volume III

Figure 10 shows that the majority of population aged 20 to 34 are in urban centers because either they are working or searching for employment, few children in urban centers because of low birth rate (people are confined in school and employment institutions therefore they hardly have time for raising children).

3-3-3-2 Household size and composition

KPHC defined household as a person or group of them who live in the same homestead but not necessarily in the same dwelling place, have similar cooking plans and are responsible to the head of the same household.

In Kenya household size has a correlation with level of poverty such that the ones with more people are poorer than the ones with few people. The last census shows that average household size has declined statistically from 4.2 in 2009 to 3.9 in 2019 the same way it had declined from the 4^{th} to 7^{th} (5.7 to 4.5 respectively) census.

Generally, households with three or less members account for 41.5% national wide, 33.22% in rural and 54.84% in urban while the ones with seven members and more account for 20.09% national wide, 25.44% in rural and 11.47% in urban (KNBS publication). From this, it is clear that rural areas are associated with high population which is the same finding in the rural population pyramid by KPHC.

Furthermore, the report from the two sources corresponds because according to the KPHC 2019 report there were 32, 732, 596 people in rural verses 14, 831, 700 in urban while from KNBS publication there were 25% in rural verses 11% in urban. Economic growth can be negatively affected in rural areas due to dependency coming from large households which further leads to poverty.

3-3-3-3 Household types and headship in Kenya

Nuclear households (father, mother and their children) are commonly found in rural areas while non-family households (people living together though they are not related) are found in urban.

Another type is extended (an extension of nuclear household) and composite household (includes either nuclear or composite household plus at least one nonrelative). The same way household size is correlated with poverty, it is in the same manner in which households managed by women are poorer than the ones managed by men.

3-3-3-4 Dependency ratios

This is a very powerful indicator in a country because it affects economic growth and by definition it is the proportion of dependent population aged from 0 to 15 years and above

64 years over the one aged between 15 and 64 years. It is equally important because it shows the effect of changes in age structure. If a country has to lower its dependency ratio it has to put measures that will help to lower fertility so that income levels can increase and through this, it can benefit from economic dividend. On the other hand, high dependency ratios are brought up by few working people, uncontrolled fertility, illiteracy and large households.

3-4 Economic growth

Introduction

Capital (*Kt*) and labor (*Lt*) are the factors of production and they belong to the first step towards achieving economic growth in year *t*. Capital consists of machines, factories, land, transport and many more while labor includes human capital such as skills, education and technology. The combination of these two produce what is called output (gross domestic product) and to get the net domestic product (total income *Yt*) we deduct the capital depreciated. Part of this income *Yt* is used for consumption *Ct* and investments *It* purposes. Investment is added to the initial capital (*Kt)* and is used as the initial capital *(Kt + It = Kt + 1*) for the following year (*t + 1*) such that in the latter year capital will have increased by the same amount that was invested in year *t* as well as labor but not in the same ratio. Therefore, at the start of year *t + 1*, *Kt +1* and *Lt +1* are bigger than *Kt* and *Lt.* Kt +1 and Lt +1 will be the new factors of production in year *t + 1* to produce *Yt + 1* greater than *Yt* and this is what is called ***growth process***. Through this process we derive the first definition of economic growth as an increase of income per person.

Second definition is increase (normally yearly) in a country's gross domestic product (GDP). How does economic growth determine health of people? Certainly, there are better living standards in countries that have managed to be economically developed or have attained higher GDP because it has amplified economic related sections such as medical and pharmaceutical which in turn has facilitated people to have a healthier life and further giving them a prolonged life than they could have if health was deteriorated. The opposite is true in under developed and poor countries. Some of these poor countries are found in Africa and it is believed their todays per capital income can't be compared (very low) to that of yesterdays in European countries therefore it is important for African countries to understand the engines of economic growth.

What makes some countries rich and others poor? Is a question many economists have asked since the time of Adam Smith. Income per capital is used to determine income earned by each person in a country in order to evaluate their living standards. GPD differs with GDP per capita of a country in sense that the former measures the value of a country's economy or performance while the latter is derived by dividing GPD by country's total number of population. If a country has a higher GDP and high population then GDP per capita is low therefore in such a country the living standards are poor and low despite having a higher gross domestic product. On the other hand, if the GDP is high and population size is small then GDP per capita will be high resulting to better living standards.

Most of the countries today benchmark their economic performances to those of the seven world largest and emerging economies. The countries include; United States, Germany, Japan, Canada, Italy, France, United Kingdom and India, China, Brazil, Mexico, Russia, Turkey, Indonesia respectively. The main sources of growth in these countries are capital accumulation, information and communications technology capital, labor input which consists of hours worked and labor quality and finally total factor productivity which implies efficiency and structural change in production (Caselli and Coleman, 2001, Jorgenson and Dietrich, 2012).

3-4-1 Economic growth in Kenya

Poverty reduction shows the progressing nature of the country and in 1997/98 it was at 52.3% then in 2015/16 it dropped to 36.1% however this reduction is not proportional with the growth of gross domestic product because of problems like income and consumption disparities. Furthermore, there is higher level of poverty in local areas and unemployment across the country have greatly contributed to this disproportionate.

Population in rural areas are mainly dependent of agriculture which might not be productive at all the times due to rainfall failure therefore they end up being engulfed by poverty. Manufacturing industries are not found in rural areas thus disproportionality of income.

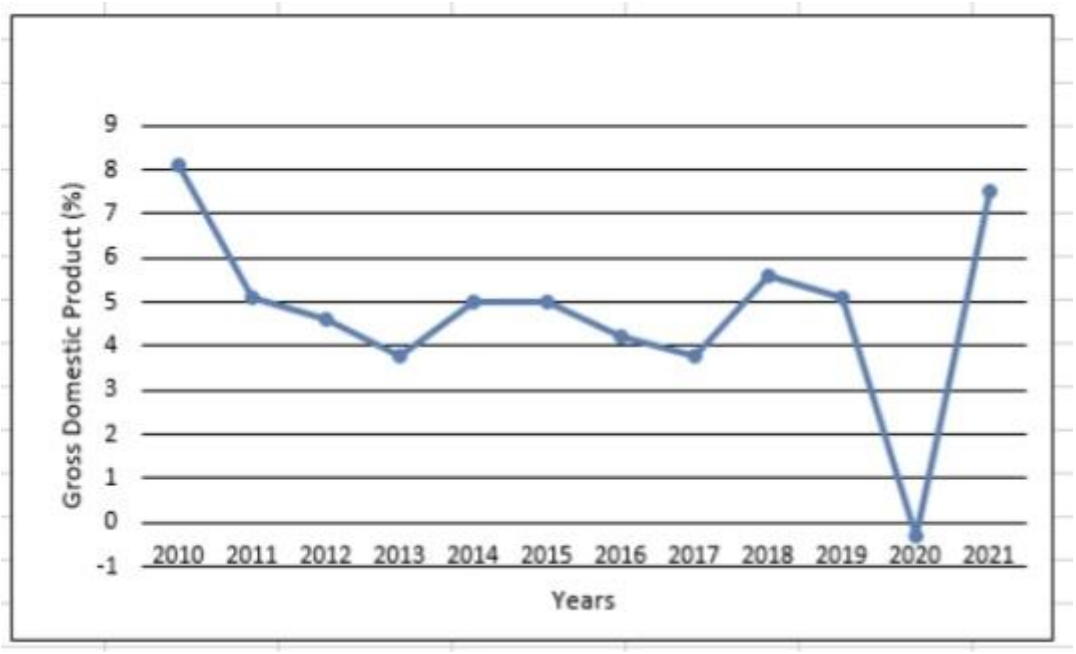
Poverty means poor health and a non-healthy person cannot work efficiently because of body weakness hence aggregate demand falls. This part highlights the basics of economic growth in Kenya.

3-4-1-1 Gross Domestic Product (GDP)

Covid-19 virus affected Kenya's economy in 2020 which translated up to a decline of negative 0.3% of the gross domestic product and for the previous two decades it was highest in 2010. Though agriculture, manufacturing and tourism economies in Kenya fluctuate depending on the prevailing conditions in the country, they remain to be the most contributors of gross domestic product.

Government has neglected general employment apart from essential sectors such as health, security and education therefore affecting growth of GDP. It does this with an aim of reducing the expenses to cover up some extra services. This process has an effective of harming the neglected services therefore causing non-equality in all sectors and limiting sources of production which reduces economic growth. Figure 11 show trends in gross domestic product since 2010 – 2022.

Figure 11: Trends in Kenya Gross Domestic Product (%) from 2010 - 2021



Source: Authors computation based on data from World Bank

3-4-1-2 Agriculture sector in Kenya

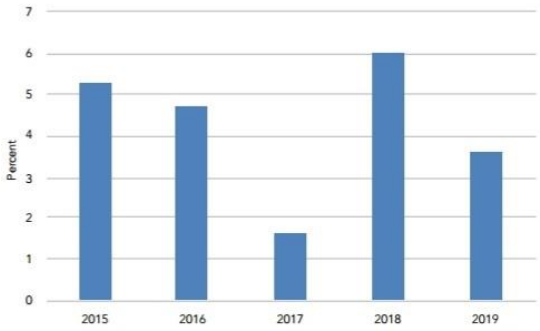
It is the backbone to Kenya's economy and it accounts for 25% of the total gross domestic product and 65% of the total exports. It is also the source of livelihood for most of Kenyans because it gives food security and it helps to reduce poverty levels and famines. A

significance percentage of population (3/4) depend on farming which a portion of it is used for consumption and commercialization purposes. The part used for commercial purposes generates income which serves as a tool to improve living standards in terms of health and education. Agriculture sector encompasses various sectors like growth of crops, horticulture (cut flowers, fruits and vegetables), livestock, fishery and forestry. Horticulture and growth of crops makes agriculture to contributor a greater percentage in terms of gross domestic product.

The country mainly produces tea and coffee which are the main exports along with horticulture. In 2020 the total income from tea was KSH 122,200,000,000 while in 2021 it increased to KSH 126,100,000,000 which is 3.2% increase. This was the same case for coffee in the same years, there were KSH 10,800,000,000 earning in 2020 and KSH 18,600,000,000 in 2021. There were 15.5% increase in total exports in 2021 and a bigger percentage came from agriculture.

Generally, tea is the main export in Kenya and it accounts for one billion US dollars per year. Figure 12 indicates a summary of agricultural growth.

Figure 12: Trends in agricultural growth from 2015 – 2019



Data source: Kenya National Bureau of Statistics (2020), Economic survey

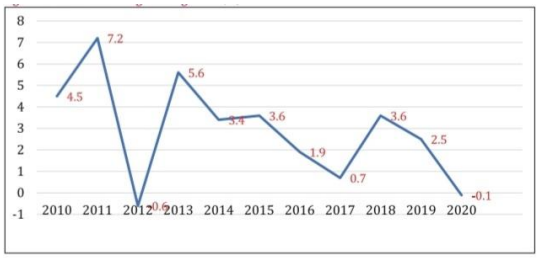
3-4-1-3 Manufacturing sector in Kenya

Just like agriculture and tourism in Kenya manufacturing has helped to raise the country's gross domestic product accounting for around 10% - 13%, creating employment (318,100 and 352,100 opportunities in 2020 and 2021 respectively) and reducing poverty. Development in this sector has been mainly induced by agriculture and services through provision of raw materials. For the last two decades 2012 and 2020 recorded the worst

growths negative 0.6 and negative 0.1 respectively however the latter was affected by the effects of Covid-19 virus.

On average, for nine years since Kenya became a republic manufacturing sector contributed 10% of gross domestic product and 13.6% from 1990 to 2007 before it stagnated on 10%. This sector has various sub sections and they are small and medium enterprises. They include; textile and apparel sector, food and beverages sector, automotive sector, metal and allied sector, pharmaceutical and medical equipment sector, leather products sector, timber, wood and furniture sector and plastic sector

Figure 13 :Trends in manufacturing growth, 2010 – 2020



Source : Kenya Association of Manufacturers 2020

3-4-1-4 Tourism sector in Kenya

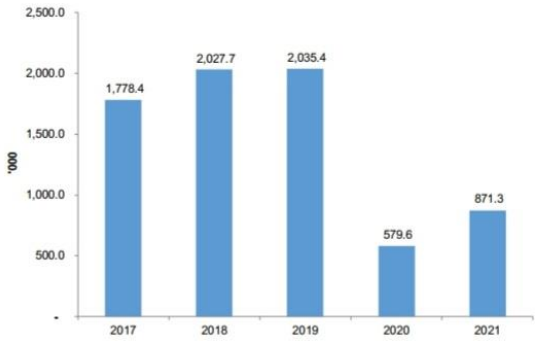
Kenya is among the leading tourism economy in Africa and the growth of tourism has triggered economic growth both at local and national level since it creates job opportunities across the country. There are various tourist attractions such as beach areas, wildlife habitats such Nairobi national park, Amboseli national park, Masai mara national park, Tsavo east national park and many others, archaeological sites and finally scenic landforms.

Tourism contributes about 10% of the total GDP rendering it position three among the main contributors to gross domestic product where it is preceded by agriculture and manufacturing (GoK, 2011). In 2018 it contributed to 8.8% of the total GDP equivalent to USD 7,900,000,000 (standard media group, 2019). In the same year Ministry of Tourism and Wildlife reported that 8.3 % jobs were as a result of tourism.

Hotel bed-nights is one of the indicators for tourism sector in Kenya. Both local and international hotel bed-nights accounts for development where locally it accounted for 69.4% in 2021. Another indicator is international conferences and in 2021 there were 292

conferences compared to 28 in 2020. Equally the local conferences were 1,176 in 2020 and 8,117 in 2021. Frequencies in wildlife habitats also increased between the two durations. The figure 14 shows the trend of visitors in Kenya from 2017 to 2021 however it was affected by confinement during the Covid-19 period especially 2020 which registered a significance drop from the previous years but it started to pick up in the subsequent year after confinement was banned.

Figure 14: Trends in international visitor arrivals in Kenya between 2017 and 2021



Source: Economic survey 2022 based on the data from KNBS

3-4-1-5 Exports of goods and services

Agriculture being the main export, it affects the latter thus gross domestic product. Generally, Kenya's main exports depends on natural factors such as rainfall that can easily undermine the production of goods in case of inconsistency. Less shares of international markets, lack of diversification of export products and markets has affected the growth of the economy. Figure 15 below shows these major exports and their contribution for the year 2019.

Export services includes filling out application and licensing forms, giving guidelines on the procedures, clearing and approving exporters and marketing which includes knowledge of the international markets. The report given by Kenya Export Development Support shows that there are no specialized firms in providing these services and for those providing, they end up wasting time and resources because they have neither knowledge nor comparative advantage.

We therefore note that export process zones are faced with challenges of inadequate personnel and that of non-diversification.

Figure 15: Kenya's main exports

Source: KIPPRA

3-4-1-6 Household consumption

The highest aggregate demand comes from household consumption however through taxes, government affects this demand because consumption by low income households is reduced therefore affecting GDP. Also failure to subsidize the production, food prices increases therefore reducing the demand. Furthermore, unemployment in Kenya has never been good and this means demand is as well pulled down however in the opposite case of the above mentioned situations, household consumption is high therefore improving GDP.

Conclusion

In this chapter, we have studied demographic and social economic conditions as the principal determinants of population change. Education influences fertility level which in turn determines the size of the population.

One of the reasons behind population growth in Kenya today is the effect of 1970s fertility rate and the highest percentage of population is made up of the youths. It is observed that most of the youths are located in urban centers while the elderly population in rural areas. The main contributors of gross domestic product are agriculture, manufacturing and tourism.

Chapter 03: Empirical study of impacts of population growth on economic growth in Kenya

Introduction

In our first chapter we have learnt about different theories explaining how population growth can affect economic growth but they didn't end into a similar conclusion. We also learnt how each theory supports the emergence of economic growth while in second chapter we have learnt how different factors determines population growth. In this last chapter we shall carry out an empirical study which will help us to agree or disagree with theories explained in chapter one. In addition, this study on effects of population growth on economic growth in Kenya will help us to know if there exist any relationship between population and economic growth. Before we proceed with our analysis, we shall first highlight some empirical literature reviews and presentation of variables.

Section 01: Empirical literature review and presentation of variables

In this section, we will deal with principal component analysis but before that, we need to define the variables to use in our analysis and present main works in relation with our research.

1-1 Nomenclature of empirical variables used

In the theories of economic growth - first chapter, we selected the variables that are related to economic growth, in the second chapter the main elements which relates to population and finally from the literature reviews we selected some of the variables that authors used in their study. All the data was derived from World Bank

Life expectancy (LE): number of years a newborn infant would live if prevailing patterns of death at the time of its birth remain constant the entire of its life

Total fertility rate (TFR): the number of children that a woman can get if she lived up to the end of her childbearing years and get children in accordance with age specific fertility rates of the specified year

Population growth (PG): an increase in size of the population from its preceding year

Exports of goods and services (EGS): the value of goods and services sold to foreign countries

Gross domestic product per capita (GDPPC): it is gross domestic product divided by size of the population

General government final consumption expenditure (GGFCE): this is the general consumption by the government such as costs of buying goods and services and all other expenditures.

Gross domestic product growth rate (GDP): is the percentage change of real GDP that is based on constant prices. Real GDP is the measure of GDP and it measures the economic performance of a country.

Households and NPISHs final consumption expenditure (HNPISHs): it referred to as private consumption which includes all goods and services bought by households.

1-2 Empirical literature review

Many authors have carried out empirical studies with an aim of determining the effects of population growth on the economy and out of the many studies conducted, we shall pick some of them which are listed below.

Gideon, Gachanja and Obera (2013) studied the relationship between population growth and economic growth in Kenya. They considered the data since Kenya gained independence (1963) up to 2009 and Vector Auto Regression was used as their mode of analysis. Their study suggested the two are positively correlated and therefore they concurred that population growth stimulates economic growth in the country and so does economic growth.

Tanui Kiprotich (2020) provides an overview on the effects of population change in Kenya on Gross Domestic Product and he explored his study using Time Series data from 1963 to 2013. The review investigated the co-integration relationship between Gross Domestic Product growth rates and total population and the results highlighted that for a unit increase in total population there is rise of 2.221% in Gross Domestic Product.

The work done by Alemayehu Temesgen and Berhanu Alemu (2022) on the effects of population growth on economic growth in Ethiopia showed a positive significance to economic growth. All the variables they used were found to have a long run relationship and ADRL model was used with the data ranging from 1980 to 2020.

Contribution of Dao (2012) shows that population growth has a negative impact on economic growth. His work involved 43 countries and he considered an era of 18 years that is to say from 1990 – 2008. A second key point from his work is that there are challenges of droughts and famine and unemployment in places with high population. However, he noted that population growth and economic growth can have a positive relationship only if the former is accompanied by low dependency ratio.

1-3 Principal Component Analysis (PCA)

One of our objective in using principal component analysis is to facilitate a multidimensional analysis of our variables.

It is one of the most important dimensionality reduction techniques as well as method of data analysis that helps in reducing dimension while keeping the relevant information found in a dataset. It also groups and visualize important information and therefore it was good we applied it before starting our analysis because it cleaned our data.

This was made possible by the use of correlation matrix which helped in identifying the variables with high correlation and excluding those with low correlation. The below are results from this analysis.

Table 04: The correlation matrix

Variables	LE	TFR	PG	EGS	GDP PC	GGFCE	GDP	HNPISHs
LE	**1**	**-0.6256**	**-0.6521**	**0.6788**	**0.9067**	**0.7078**	-0.0670	**0.7284**
TFR	**-0.6256**	**1**	**0.9324**	**-0.9539**	**-0.8040**	**-0.9405**	0.1983	**-0.9493**
PG	**-0.6521**	**0.9324**	**1**	**-0.9198**	**-0.8582**	**-0.9495**	0.1494	**-0.9415**
EGS	**0.6788**	**-0.9539**	**-0.9198**	**1**	**0.7974**	**0.9362**	-0.0957	**0.9568**
GDP PC	**0.9067**	**-0.8040**	**-0.8582**	**0.7974**	**1**	**0.8587**	-0.0757	**0.8657**
GGFCE	**0.7078**	**-0.9405**	**-0.9495**	**0.9362**	**0.8587**	**1**	-0.1203	**0.9921**
GDP	-0.0670	0.1983	0.1494	-0.0957	-0.0757	-0.1203	**1**	-0.1015
HNPISHS	**0.7284**	**-0.9493**	**-0.9415**	**0.9568**	**0.8657**	**0.9921**	-0.1015	**1**

Source: Established by the authors using XLSTAT

1-3-1 Correlation matrix

Table 04 shows all the eight variables with different correlation matrix coefficients preceded by either a positive or negative sign where positive one means the variables are moving in the same direction while negative means variables move in opposite direction. We grouped the correlation strength into three categories namely strong, weak and

uncorrelated. A strong correlation is represented by a coefficient close to 1, weak 0.3 to 0.6 and uncorrelated close to 0. Correlation means there is relationship while uncorrelated there is no relationship between the variables.

PG and GDPPC are negatively correlated with a coefficient of -0.8582. This means they evolve differently, if one increases the other decreases. Increased labor supply reduces the level of wages which in turn reduces the demand thus gross domestic product per capita. All this effect is brought by increased population which also rises dependency ratio and therefore decreasing the level of income intended for saving.

There exists a weak negative correlation between PG and LE of coefficient -0.6521. Malthus said there is non-equality between high population and economic growth because it depletes off the resources making survival to be hard which reduces life expectancy due to health and feeding complications. Life expectancy influences economic growth positively and from our analysis there is a strong positive correlation between GDPPC and LE of coefficient 0.9067.

PG and TFR are strongly and positively correlated. Naturally this is true because increased population multiplies the number of women and men therefore allowing a wide scale for more births. Other variables with strong negative correlation with PG are; EGS, GGFCE and HNPISHS with coefficients of (-0.9198, -0.9495 and- 0.9415) respectively. GDP growth rate and all the other variables shows almost zero correlation.

Table 05: Eigenvectors

	F1	F2	F3	F4	F5	F6	F7	F8
Valeur prop	6.1707	0.9987	0.5824	0.1189	0.0678	0.0444	0.0133	0.0039
Variabilité (	77.1339	12.4844	7.2799	1.4857	0.8470	0.5550	0.1659	0.0482
% cumulé	77.1339	89.6183	96.8982	98.3839	99.2310	99.7859	99.9518	100.0000

Source: Established by the author using XLSTAT

1-3-2 Eigenvectors

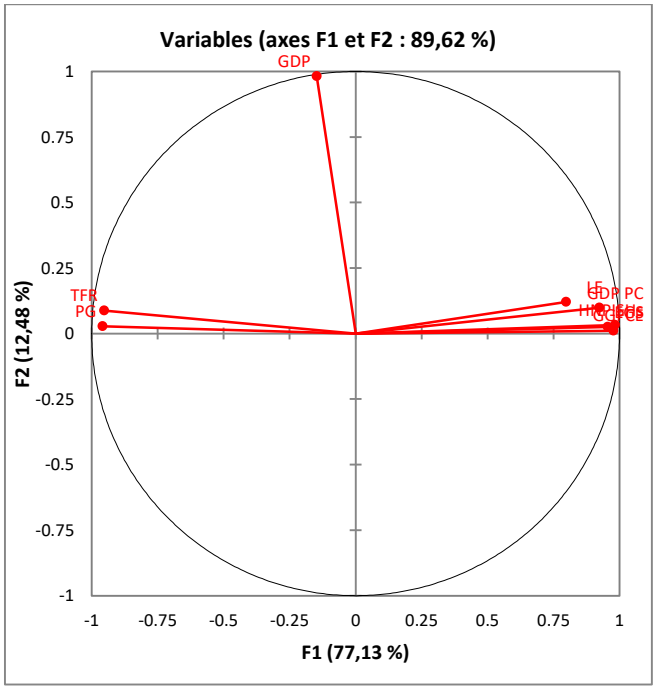
They signify total variability or total information that contains in array of data. Since we can't plot a graph with eight axes which represents the number of variables, PCA analyzed

and presented them in F1 to F8 where by each F carries the maximum information and since we can plot a graph of two axes we only selected those with maximum information which are F1 and F2. The first eigenvector 6.1707 (F1) when converted to percentage of the total information becomes 77.1339%. In other words, F1 explains 77.1339% of the total information in the dataset. The second eigenvector 0.9987 (F2) represents 12.4844% of the total information. Therefore, we retain two dimensions F1&F2 (first factorial axes) which represents 89.6183% of the total information.

1-3-3 Circle of correlations

It helps to eliminate variables that are located close to 0 since they indicate absence of correlation. For variables to be correlated, they must be situated near positive 1 or negative 1. Those that are found near +1 are positively correlated, those found near -1 are said to be negatively correlated while the ones located near 0 are said to be uncorrelated. In our case, all the eight variables are well represented in the circle of correlation some positively and others negatively correlated. Gross domestic product growth rate explains axis 2 because it has the peaks in 1966, 1971 and 1972 unlike the other years and it is this feature that ruled it out of the others.

Figure 16: Circle of correlations of the variables



Source: Established by the author using XLSTAT

Section 02: Specification of the econometric model; Autoregressive Distributed Lag (ARDL).

After carrying out PCA, we found out that all the variables are good that is to say there was no redundancies and therefore to determine the effects of population growth on economic growth in Kenya from the period of 1960 to 2022 we used ARDL model.

It is used either if the variables are integrated of different orders – combination of I (0) and I (I) or if all the variables are integrated of order I (1) – stationary after first difference. However, this model can't be applied if variables are integrated of order I (2). Both lagged dependent and independent variables can be introduced into the model. The term "autoregressive" means the lagged dependent variable has the possibility of determining the present dependent variable. Autoregressive models have the ability of taking into account temporal dynamics (lag adjustments) in the explanation of a time series or variable which allows for better decisions. "Distributed lag" means delay of independent variables or model with explanatory variables.

We chose this model because it can allow maximum number of lags in data generating process, methodologically it can allow variables integrated of different order provided not of order 2, a simple form of equation is used compared to other models which use number of equations and finally the ARDL Bound test will allow us to use different lags between dependent and independent variables which is not possible in VAR models because different lags are not allowed.

ARDL puts in relation the dependent variable (to be explained) {GDPPC} and the independent variables (explanatory) {LE, PG, TFR, NHPISHS, GGFCE, EGS and GDP}. The equation will be written in the following manner;

$$Y_t = \beta_0 + \beta_{1x1,} + \beta_{2x2,} + \beta_{3x3,} + \beta_{4x4,} + \beta_{5x5,} + \beta_{6x6,} + \beta_{7x7} + \varepsilon_t \qquad i = 1, 2, 3, 4, 5, 6, 7$$

Where; Y_t: is the dependent variable

β: is the parameter / coefficient of the explanatory variables

$x_{i:}$ represents the $_i$ value for the explanatory variable $_x$ and ε_t: is the specification of errors.

$$GDPPC_t = \beta_0 + \beta_1 LE_t + \beta_2 PG_t + \beta_3 TFR_t + \beta_4 HNPISHS_t + \beta_5 GGFCE_t + \beta_6 EGS_t + \beta_7 GDP_t + \varepsilon_t$$

2-1 Application of the ARDL

To apply this model, we tested for stationarity, specified the lags of the variable, tested for existence of long and short run relationships and finally validated our model with various tests.

2-1-1 Graphical representation of the data series (see in the annex – Series graph at level)

This helps to know if the series are stationary or not and after plotting the graphs we found out that all our series are non –stationary therefore we tested for the order of stationarity using Augmented Dick-Fuller test

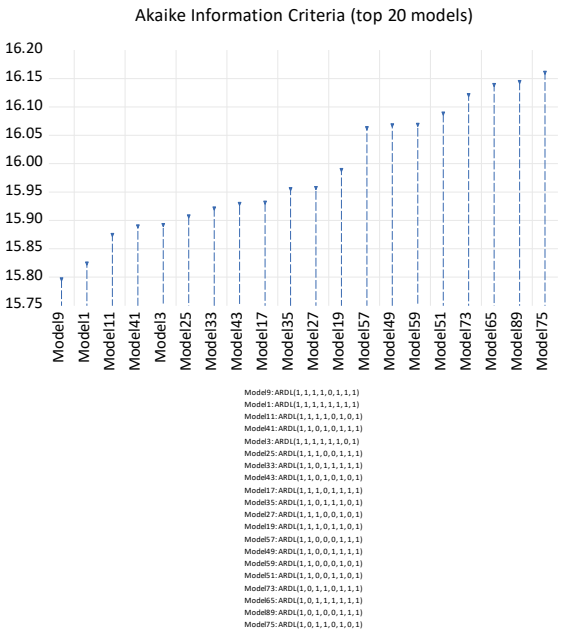
2-1-2 Stationarity test (Augmented Dickey - Fuller tests)

After performing the stationarity test (ADF), (see in the annex - Augmented Dick – Fuller tests) some variables were not stationary at level and therefore we differentiated to make them stationary at first difference.

2-1-3 Determining lag length

Using AIC or SBC we choose the optimal model

Figure 17: Lag graph by AIC of ARDL



Source: Established by the author using Eviews 12

From figure 25, according to AIC the model ARDL is suitable at model 9 (1, 1, 1, 1, 0, 1, 1, 1) because that is the lowest value.

2-1-4 Estimation of the ARDL model (1, 1, 1, 1, 0, 1, 1, 1)

This model can as well be estimated in the figure below.

Table 06: Result of the ARDL estimation

Dependent Variable: GDPPC
Method: ARDL
Date: 05/14/23 Time: 19:21
Sample (adjusted): 1961 2021
Included observations: 61 after adjustments
Maximum dependent lags: 1 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (1 lag, automatic): GDP LE PG TFR HNPISHS GGFCE EGS
Fixed regressors:
Number of models evalulated: 128
Selected Model: ARDL(1, 1, 1, 1, 0, 1, 1, 1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
GDPPC(-1)	0.968083	0.023157	41.80460	0.0000
GDP	833.6938	23.93471	34.83201	0.0000
GDP(-1)	91.95630	20.45410	4.495739	0.0000
LE	596.2747	192.4587	3.098196	0.0033
LE(-1)	-416.3740	165.6447	-2.513658	0.0154
PG	1126.062	1097.190	1.026315	0.3100
PG(-1)	-3657.594	1355.948	-2.697445	0.0097
TFR	-85.94426	243.4916	-0.352966	0.7257
HNPISHS	5.26E-09	8.96E-10	5.867656	0.0000
HNPISHS(-1)	-5.05E-09	8.88E-10	-5.694299	0.0000
GGFCE	9.29E-09	4.02E-09	2.313285	0.0251
GGFCE(-1)	-9.51E-09	4.05E-09	-2.350800	0.0230
EGS	6.93E-09	2.02E-09	3.433805	0.0013
EGS(-1)	-1.06E-08	2.06E-09	-5.156222	0.0000

R-squared	0.999518	Mean dependent var	124886.0
Adjusted R-squared	0.999384	S.D. dependent var	23771.23
S.E. of regression	589.9573	Akaike info criterion	15.79627
Sum squared resid	16358334	Schwarz criterion	16.28073
Log likelihood	-467.7862	Hannan-Quinn criter.	15.98613
Durbin-Watson stat	2.174257		

Source: Established by the author using Eviews 12

The quality of adjustment (R^2) of the model is 99.95%. This means that the total variability of GDPPC is explained at 99.95% by the chosen independent variables.

From these results, we can re-write our equation as follows;

$$GDPPC = 0.96GDPPC(-1) + 833.69GDP + 91.95GDP(-1) + 596.27LE - 416.37LE(-1) + 1126.06PG - 3657.59PG(-1) - 85.94TFR + 5.26HNPISHS - 5.05HNPISHS(-1) + 9.29GGFCE - 9.51GGFCE(-1) + 6.93EGS - 1.06EGS(-1) + e_t$$

2-1-5 Test for cointegration of the estimated ARDL model

The existence of cointegration is tested using Pesaran et al (2001)

Table 07: Result of the cointegration test of the model ARDL

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	149.9901	10%	1.7	2.83
k	7	5%	1.97	3.18
		2.5%	2.22	3.49
		1%	2.54	3.91

Source: Established by the author using Eviews 12

We notice a long term relationship between dependent and independent variables because F-statistic (149.9) is greater than the upper limit at 5%. This allows us to estimate both long and short run relationship and their effects.

2-1-6 Estimation of the long-term relationship of the ARDL model (see annex table N°08)

At long term the model looks as below;

$$GDPPC = 29001.9GDP + 5636.5LE - 79316.4PG - 2692.7TFR + 6.3HNPISHS - 6.8GGFCE - 1.1EGS + e_t$$

2-1-7 Estimation of the short-term relation (see annex table N°09)

The error correction term or speed of adjustment is negative, less than 1 and statistically significant at α=5%. R^2 (coefficient of determination) is 98.52% and it tells us that the model is of good quality hence statistically it is validated. The short term equation is as below;

$$\Delta GDPPC_t = 833.6\Delta GDP + 596.2\Delta LE + 1126.0\Delta PG + 5.2\Delta HNPISHS + 9.2\Delta GGFCE + 6.9\Delta EGS - 0.03ECM_{t-1} + e_t$$

- **a- Statistical interpretation:** we must validate the long and short term estimates
- ✓ ***Long term relationship***

The probability and coefficients of PG and EGS are significant, lower than the critical threshold α= 10% while that of LE at α=5%. This is to say they have a significant effect on gross domestic product.

The coefficients of GDP, TFR, HNPISHS and GGFCE are not significant. Indeed, their respective probabilities (0.17, 0.7, 0.7 and 0.9) are higher than the critical threshold α=10% therefore they play no role on growth of gross domestic product.

- ✓ ***Short term relationship***

The p-value and coefficients of ΔGDP, ΔLE, ΔHNPISHS, ΔGGFCE and ΔEGS are significantly lower than the critical threshold α= 5%. In other words, they play a role on growth of gross domestic product.

We note that the coefficient of ΔPG is not significant. The associated probability (0.23) is greater than critical threshold α=10%

b- Economical interpretation,

- ✓ ***Long term relationship***

The negative sign associated with population growth means that when population increases by one-unit gross domestic product per capita decreases by 79316.43 units. Malthus argued that increased population affects economic growth negatively because it increases expenditure therefore decreasing savings and accumulation of capital and finally this reduces economic growth.

1% increase in exports reduces gross domestic product per capita by 1.15%. There is no diversification of exports in Kenya. Indeed, agriculture is the main export with a contribution of 65% of the total exports. Raw and unprocessed agricultural products form the main exports which really don't generate strong effects on gross domestic product per capita because of price fluctuations. Another possible reason is seasonality in the country and this changes demand from time to time hence interfering with stability. Lack of export diversification reduces the level of productivity system because one cannot produce more without the knowledge of the market. Kenya is also not an industrialized country yet industrial goods can play a positive impact on gross domestic per capita.

A unit increase of life expectancy generates an increase to gross domestic product per capita by 5636.54 units. Life expectancy depends on quality of living and availability of health services. Good health facility reduces mortality rate hence increasing life expectancy therefore existence of more investments and long lasting human capital whereby endogenous growth theories recognizes human capital as a greater asset for achieving economic growth. Again, a healthy person is more productive because he is

always active with better intellectual abilities which enables him to acquire new skills and knowledge that are important on innovatory side. Anybody living longer will save more for better future and these savings will increase stock of physical capital such as machines for production and this will finally increase gross domestic product per capita. Furthermore, anybody with visions of living for longer period will secure his future life in the present through education which is a factor that favors economic growth at long term basis.

Gross domestic product growth rate has no role on growth of GDPPC. Some of the reasons that causes high gross domestic product per capita is increased real GDP that is caused by a suitable economy. Already we have seen population growth has a negative effect on economic growth therefore the same effect is transmitted to GDPPC.

Fertility delays demographic transition that is responsible in accelerating economic growth and this explains why it is not significant in our results. Kenya has not yet attained this transition due to high fertility that existed in 1970s and this effect has been confirmed by our analysis.

HNPISHS produces non-market goods and services which plays no role in building gross domestic product. Government expenditure is not significant to growth of gross domestic product per capita for some reasons. One, when it is used for imports purposes. Kenya mainly produces agricultural products therefore it means the government has to import what is not produced in the country. Two, if the expenditure is not directly related to services that have direct impact to economic growth. Too much expenditure on imports by the government reduces household's income therefore slowing down productivity. With low income consumers purchase is minimal and also it makes human capital less important. It also results to deficit in balance of payment.

- ✓ ***Interpretations of the short term results***

A unit increase in GDP growth rate increase GDPPC by 833.69 units. This is due to the fact that when employee's income increases, productivity of average worker is as well increased or employer's output increases. Purchasing power also increases which leads to high demand therefore more productions.

Life expectancy has the same impact on gross domestic product per capita as in the long run relationship however at short run a unit increase provokes an increase in GDPPC by 596.27 units.

When HNPISHS increases by 1%, gross domestic product per capita increases by 5.26%. The consumption by the households cause a positive impact to the economy when the level of income and wages increase because it increases the demand.

1% increase in government expenditure increases gross domestic product per capita by 9.29%. Even though the government spends mostly on imports, at short term relation there is positive impact because things like imported medical drugs helps in improving health which leads to more productivity

A unit increase in exports of goods and services generates 6.93% increase in gross domestic product per capita. The low income generated from agricultural exports reflects little and positive impact on GDPPC. If population increases by one unit GDPPC reduces by 1126.06 units because it takes time for young population to stop being dependent.

2-1-8 Validation test of the estimated ARDL model

We validated our model with four statistical analyses namely residual normality test, serial correlation test, heteroscedasticities and stability test.

- *Residual normality test (see annex figure N°18)*

The residuals in the model are normally distributed because we accepted null hypothesis (probability is greater than 5%. {0.69> 0.05})

- *Serial correlation test (see annex table N°10)*

This test confirms if the residuals are auto correlated or not and after test we accepted null hypothesis and confirmed absence of auto correlation of errors since the probability is greater than 5% (0.54 > 0.05)

- *Heteroscedasticity test (see annex table N°11)*

This test confirms if the residuals are homoscedastic or heteroscedastic and through Breusch – Pegan – Godfrey's test we accepted null hypothesis or the residuals are homoscedastic since null hypothesis is accepted, probability is greater than 5%. (0.17 > 0.05)

- *Stability test*

This test helps to know if the variables will or not change with time. After test we concluded the model is stable because according to Ramsey's test the associated

probability is greater than α=5% **(see annex table N°12).** Also Cusum test shows that the model is stable since the blue curve is in between the two critical lines at 10%. **(see annex figure N°19)**

Conclusion

To determine the effects of population growth on economic growth in Kenya, we first used Principal Component Analysis with an objective of removing redundant and detecting related variables or those that look alike in the grouped variables. Thereafter we specified and applied our econometric model with gross domestic product per capita as endogenous variable. The main conclusions we have gotten from the empirical study are grouped into two categories as discussed below.

One, Principal Component Analysis gave us an approval of the variables to be used in this study. Indeed, all eight variables are well represented in the circle. We detected that gross domestic product growth rate has no relationship with the other variables because its evolution was different. Indeed, it explains axis 2 because it has the highest values in 1966, 1971 and 1972 unlike the other years therefore it was separated from the rest and it is for this reason we didn't consider it as dependent variable. However, we couldn't eliminate it from our study because it is not misrepresented but well represented on axis 2 and provides information that is different from the other variables. On the other side, gross domestic product per capita has significant relationship with all the variables in the analysis and it is for this reason we considered it as a dependent variable.

Two, the model we used helped us to know the effects of each explanatory variable to the variable explained and these effects are summarized as follows. LE was found to be significant both at long and short term relation. Our result is similar to the contribution of Kelvin M. Misango who studied on effects of life expectancy in Kenya. At long run PG is significant with a negative impact contrary to short term where it is insignificant. When Bloom, Canning and Malaney (1999) researched on effects of population growth on economic growth in 119 countries they found similar results to ours. EGS is significant both at long and short term however but with negative impact at long term. Our result is in agreement with Peter S. and Maureen W. (2021), a study case of Kenya on effects of exports on GDPPC.

General conclusion

Economic growth measures the success of a country though it is engulfed by several factors and most important demographical as we have seen. Indeed, the impact population growth causes on economy has never been clear because while others say larger population stimulates economic growth others turn down this opinion. Un common outcomes of population growth on the economy have caused more debates because part of outcome shows population increase demotes economic growth while the other part show it promotes. Others like Malthus showed a causation between these two elements. According to him, when the economy is at the peak population is stimulated through accelerated birth rates or decelerated mortality rate that could be caused by food problems. Contrary, population growth causes an economic depression through shallowing of resources.

Through these controversial ideas and outcomes, we learnt that population growth can have positive or negative effects to the economy depending on the geographical regions and locations. That is to say for example population growth in Germany causes economic growth while increase in population in Argentina causes a recession. After examining population size in Kenya in 1960s and in 2021 we noted a significant increase and this provoked us to carry a research on effects of population increase on Kenyan economy.

This research could not be successful without following some protocols and among them were consulting bibliographical work, reading articles and websites that are associated with our research topic. We also asked secondary questions that helped to tackle our main problem. Finally, we formulated hypothesis on what we expected after analysis.

Our first protocol as stated above helped in understanding and getting insights of various authors who had different opinions on the effects of population growth on economic growth. Here, we were able to see different population and economic variables used by these authors in their research regardless of their opinions. Apart from geographical location, it is through these variables they also got divergent results and views from the study.

These variables were not only included in our empirical study but also helped in constructing a working plan where different economic theories are discussed in chapter one, population and economic evolution in Kenya in chapter two and empirical research in chapter three.

We used auto regressive distributed lag to facilitate our research a model applicable when variables are integrated of different orders: I (0), I (1) or combination of the two.

We used gross domestic product per capita as our dependent variable explained by life expectancy, population growth, total fertility ratio, household non-profit institution serving household, gross domestic product growth rate, export of goods and services and general government final consumer expenditure.

The coefficients that are significant contributes to the main results of our analysis which includes:

- When there is one unit of population increase, gross domestic product per capita decreases by 79316.43 units. Our result refutes the work of Tanui Kiprotich (2020) who found that population growth in Kenya promotes economic growth and corporates that of Bucci (2003) findings.
- If life expectancy increases by one-unit gross domestic product per capita increases by 5636.54 units. Philippe Aghion (2009), a professor at Harvard University argued that adding 10 years of life facilitates in increasing gross domestic product per capita by one point and therefore his findings are similar to ours.
- 1% increase in exports of goods and services provokes 1.15% decrease in gross domestic product per capita. Peter Simiyu & Maureen Were (2021) results are in consistent with ours.
- At short run the study suggested most variables are significant and with a positive impact on GDPPC. Only population growth is not significant

Through these results we can attest that population growth has a negative impact on economic growth in Kenya and all our hypothesis are refuted.

The main limitation we encountered in our research revolved around data in the following manner:

- Lack of data from the national sources like Kenya National Bureau of Statistics which is assigned to produce country's data. However, we can't completely deny the little data it produced – only for few years mostly five which are not sufficient to conduct a research. This made us to collect all the data from an outside source – World Bank.

- The World Bank we depended on to extract the data could not also produce essential data that reflected our theme. Such data includes trends in education and technological progress which we believe could have impact on economic growth as discussed in our first chapter.
- World Bank, as well could not produce data for all years we needed therefore we were forced not to include the concerned variable in our study.

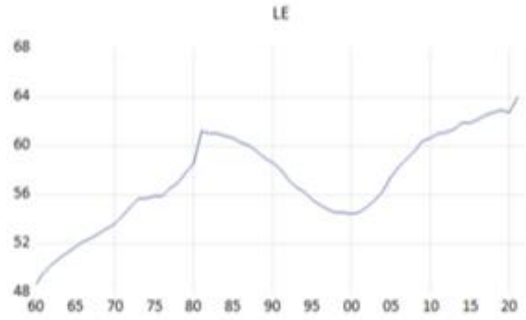
Our study will not be helpful to the policy making organ in the country if we don't give some recommendations based on these findings.

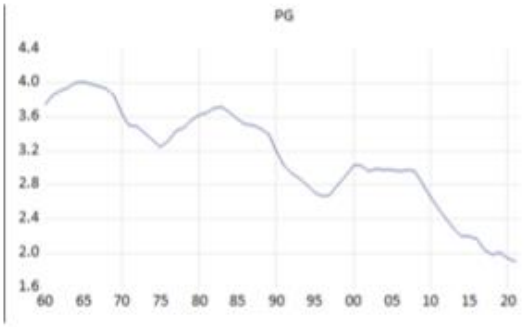
- Besides other factors, population growth is caused by high fertility and if it is suppressed through use of contraceptives therefore the problem is controlled.
- Government should improve health facilities because they help in improving people's life therefore ensuring long life that promotes economic growth.
- Diversification of exports should be highly encouraged to attract more income. Industrialization should also be encouraged to produce industrial goods such as machines which when exported will attract high income. Government should ensure this by regulating the fiscal policy
- It is recommended for the government to spend on investments that have direct impact to growth of gross domestic product per capita and minimize imports through ensuring that whatever is imported is produced in the country and this will help in avoiding deficit in balance of payment.
- Government should make awareness of family planning and subsidize them so that everybody can afford them. If this is not taken into consideration the economy will continue sinking and finally fall into a recession. The retard in demographic dividend in Kenya is caused by high fertility. Family planning will also help in reducing dependency ratio especially the young dependency and intensify the working population.

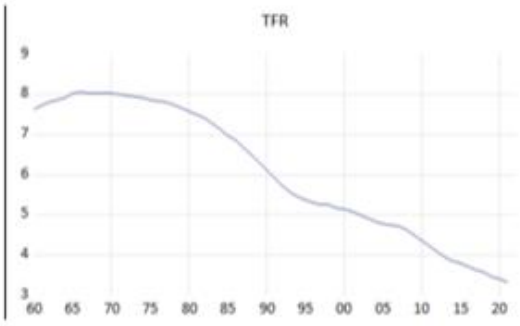
We end our research by inviting more scholars to use different variables other than the ones we used in order to visualize effects of population growth in Kenya at a broader view. More research on this theme will also give light to the government in ways it can improve the economy so that every citizen can benefit.

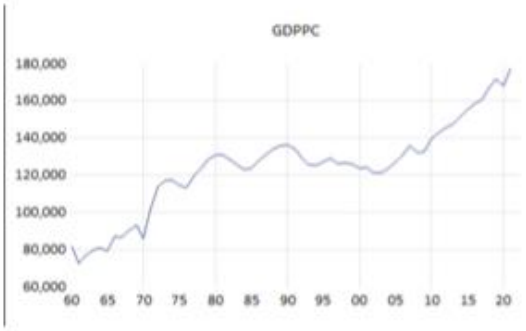
Annexes

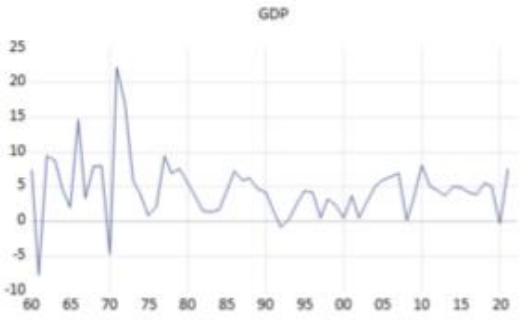
Series graph at level

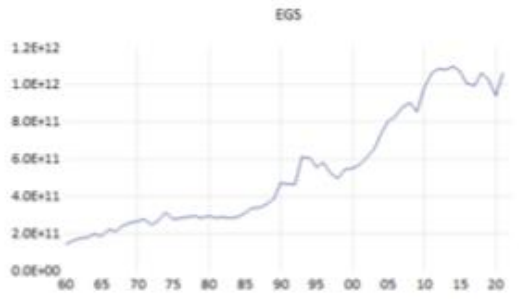


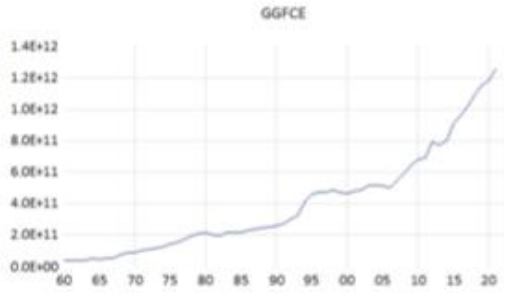


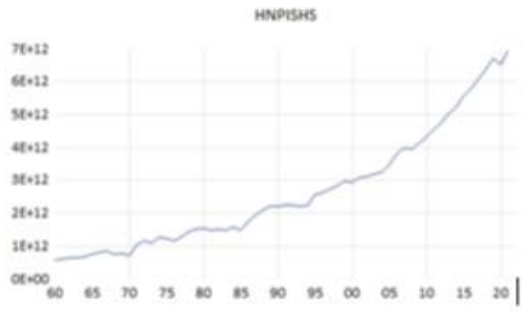












Annexes

Augmented Dicky-Fuller tests

LE

Augmented Dickey-Fuller Unit Root Test on LE

Null Hypothesis: LE has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.176667	0.6789
Test critical values:	1% level	-3.546099	
	5% level	-2.911730	
	10% level	-2.593551	

Augmented Dickey-Fuller Unit Root Test on LE

Null Hypothesis: LE has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 2 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.115757	0.5264
Test critical values:	1% level	-4.121303	
	5% level	-3.487845	
	10% level	-3.172314	

Augmented Dickey-Fuller Unit Root Test on LE

Null Hypothesis: LE has a unit root
Exogenous: None
Lag Length: 2 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.971151	0.9104
Test critical values:	1% level	-2.604746	
	5% level	-1.946447	
	10% level	-1.613238	

Augmented Dickey-Fuller Unit Root Test on D(LE)

Null Hypothesis: D(LE) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.496514	0.1215
Test critical values:	1% level	-3.546099	
	5% level	-2.911730	
	10% level	-2.593551	

Augmented Dickey-Fuller Unit Root Test on D(LE)

Null Hypothesis: D(LE) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.395628	0.3780
Test critical values:	1% level	-4.121303	
	5% level	-3.487845	
	10% level	-3.172314	

Augmented Dickey-Fuller Unit Root Test on D(LE)

Null Hypothesis: D(LE) has a unit root
Exogenous: None
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.262154	0.0240
Test critical values:	1% level	-2.604746	
	5% level	-1.946447	
	10% level	-1.613238	

GDPCC

Augmented Dickey-Fuller Unit Root Test on GDPPC

Null Hypothesis: GDPPC has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.052460	0.9494
Test critical values:	1% level	-3.542097	
	5% level	-2.910019	
	10% level	-2.592645	

Augmented Dickey-Fuller Unit Root Test on GDPPC

Null Hypothesis: GDPPC has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.663785	0.7550
Test critical values:	1% level	-4.118444	
	5% level	-3.486509	
	10% level	-3.171541	

Augmented Dickey-Fuller Unit Root Test on GDPPC

Null Hypothesis: GDPPC has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		2.771475	0.9984
Test critical values:	1% level	-2.603423	
	5% level	-1.946253	
	10% level	-1.613346	

Augmented Dickey-Fuller Unit Root Test on D(GDPPC)

Null Hypothesis: D(GDPPC) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.948880	0.0000
Test critical values:	1% level	-3.544063	
	5% level	-2.910860	
	10% level	-2.593090	

Annexes

EGS

Augmented Dickey-Fuller Unit Root Test on EGS

Null Hypothesis: EGS has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.273626	0.9220
Test critical values:	1% level	-3.548208	
	5% level	-2.912631	
	10% level	-2.594027	

Augmented Dickey-Fuller Unit Root Test on EGS

Null Hypothesis: EGS has a unit root
Exogenous: None
Lag Length: 3 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		1.237589	0.9434
Test critical values:	1% level	-2.605442	
	5% level	-1.946549	
	10% level	-1.613181	

EGS

Augmented Dickey-Fuller Unit Root Test on EGS

Null Hypothesis: EGS has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 3 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.365151	0.3934
Test critical values:	1% level	-4.124265	
	5% level	-3.489228	
	10% level	-3.173114	

Augmented Dickey-Fuller Unit Root Test on D(EGS)

Null Hypothesis: D(EGS) has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.158893	0.0277
Test critical values:	1% level	-3.548208	
	5% level	-2.912631	
	10% level	-2.594027	

HNPISHS

Augmented Dickey-Fuller Unit Root Test on HNPISHS

Null Hypothesis: HNPISHS has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		4.373519	1.0000
Test critical values:	1% level	-3.542097	
	5% level	-2.910019	
	10% level	-2.592645	

Augmented Dickey-Fuller Unit Root Test on HNPISHS

Null Hypothesis: HNPISHS has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		8.363270	1.0000
Test critical values:	1% level	-2.603423	
	5% level	-1.946253	
	10% level	-1.613346	

HNPISHS

Augmented Dickey-Fuller Unit Root Test on HNPISHS

Null Hypothesis: HNPISHS has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.650185	0.9995
Test critical values:	1% level	-4.115684	
	5% level	-3.485218	
	10% level	-3.170793	

Augmented Dickey-Fuller Unit Root Test on D(HNPISHS)

Null Hypothesis: D(HNPISHS) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.278213	0.0000
Test critical values:	1% level	-3.544063	
	5% level	-2.910860	
	10% level	-2.593090	

PG

Augmented Dickey-Fuller Unit Root Test on PG

Null Hypothesis: PG has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.802116	0.8112
Test critical values:	1% level	-3.544063	
	5% level	-2.910860	
	10% level	-2.593090	

PG

Augmented Dickey-Fuller Unit Root Test on PG

Null Hypothesis: PG has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 3 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.708700	0.0296
Test critical values:	1% level	-4.124265	
	5% level	-3.489228	
	10% level	-3.173114	

Annexes

GGFCE

Augmented Dickey-Fuller Unit Root Test on GGFCE

Null Hypothesis: GGFCE has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		5.264054	1.0000
Test critical values:	1% level	-3.542097	
	5% level	-2.910019	
	10% level	-2.592645	

Augmented Dickey-Fuller Unit Root Test on GGFCE

Null Hypothesis: GGFCE has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		8.759334	1.0000
Test critical values:	1% level	-2.603423	
	5% level	-1.946253	
	10% level	-1.613346	

GGCFE

Augmented Dickey-Fuller Unit Root Test on GGFCE

Null Hypothesis: GGFCE has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		1.847821	1.0000
Test critical values:	1% level	-4.115684	
	5% level	-3.485218	
	10% level	-3.170793	

Augmented Dickey-Fuller Unit Root Test on D(GGFCE)

Null Hypothesis: D(GGFCE) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.825136	0.0002
Test critical values:	1% level	-3.544063	
	5% level	-2.910860	
	10% level	-2.593090	

TFR

Augmented Dickey-Fuller Unit Root Test on TFR

Null Hypothesis: TFR has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.759508	0.8230
Test critical values:	1% level	-3.544063	
	5% level	-2.910860	
	10% level	-2.593090	

Augmented Dickey-Fuller Unit Root Test on TFR

Null Hypothesis: TFR has a unit root
Exogenous: None
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.357200	0.0190
Test critical values:	1% level	-2.604073	
	5% level	-1.946348	
	10% level	-1.613293	

TFR

Augmented Dickey-Fuller Unit Root Test on TFR

Null Hypothesis: TFR has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.031668	0.1325
Test critical values:	1% level	-4.118444	
	5% level	-3.486509	
	10% level	-3.171541	

GDP

Augmented Dickey-Fuller Unit Root Test on GDP

Null Hypothesis: GDP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.376509	0.0000
Test critical values:	1% level	-3.542097	
	5% level	-2.910019	
	10% level	-2.592645	

Annexes

Table 08: Results of the estimated long term relation

Levels Equation
Case 1: No Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP	29001.91	21148.57	1.371341	0.1768
LE	5636.540	1288.842	4.373338	0.0001
PG	-79316.43	40661.21	-1.950666	0.0571
TFR	-2692.754	6952.731	-0.387294	0.7003
HNPISHS	6.38E-09	1.68E-08	0.379486	0.7060
GGFCE	-6.89E-09	8.02E-08	-0.085970	0.9319
EGS	-1.15E-07	6.44E-08	-1.784232	0.0808

EC = GDPPC - (29001.9118*GDP + 5636.5402*LE -79316.4323*PG
-2692.7536*TFR + 0.0000*HNPISHS -0.0000*GGFCE -0.0000*EGS)

Table 09: Results of the estimated short term relation

ARDL Error Correction Regression
Dependent Variable: D(GDPPC)
Selected Model: ARDL(1, 1, 1, 1, 0, 1, 1, 1)
Case 1: No Constant and No Trend
Date: 05/14/23 Time: 19:28
Sample: 1960 2022
Included observations: 61

ECM Regression
Case 1: No Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP)	833.6938	18.05233	46.18207	0.0000
D(LE)	596.2747	126.8322	4.701287	0.0000
D(PG)	1126.062	945.3940	1.191103	0.2396
D(HNPISHS)	5.26E-09	6.12E-10	8.585209	0.0000
D(GGFCE)	9.29E-09	2.76E-09	3.366552	0.0015
D(EGS)	6.93E-09	1.67E-09	4.157696	0.0001
CointEq(-1)*	-0.031917	0.000860	-37.12994	0.0000

R-squared	0.985276	Mean dependent var	1563.510
Adjusted R-squared	0.983640	S.D. dependent var	4303.031
S.E. of regression	550.3927	Akaike info criterion	15.56676
Sum squared resid	16358334	Schwarz criterion	15.80899
Log likelihood	-467.7862	Hannan-Quinn criter.	15.66169
Durbin-Watson stat	2.174257		

Table 10: Auto correlation test

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	0.463792	Prob. F(2,45)	0.6319
Obs*R-squared	1.231997	Prob. Chi-Square(2)	0.5401

Table 11: Heteroscedasticity test

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	1.465320	Prob. F(14,46)	0.1630
Obs*R-squared	18.81369	Prob. Chi-Square(14)	0.1722
Scaled explained SS	8.218586	Prob. Chi-Square(14)	0.8776

Table 12: Ramsey stability test

Ramsey RESET Test
Equation: UNTITLED
Omitted Variables: Squares of fitted values
Specification: GDPPC GDPPC(-1) GDP GDP(-1) LE LE(-1) PG PG(-1) TFR HNPISHS HNPISHS(-1) GGFCE GGFCE(-1) EGS EGS(-1)

	Value	df	Probability
t-statistic	1.439817	46	0.1567
F-statistic	2.073072	(1, 46)	0.1567
Likelihood ratio	2.688928	1	0.1010

Figure 18: Normality test

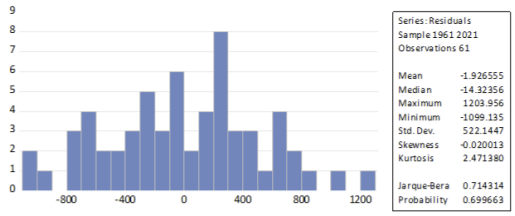
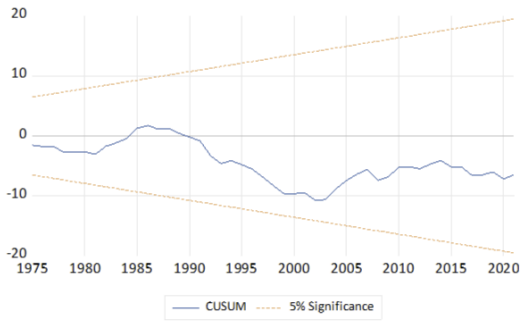


Figure 19: Cusum test



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Abstract

The objective of this work is to study the impacts of population growth on economic growth in Kenya using demographic and macroeconomic variables that have links to economic growth theories and economy of Kenya, these variables are; life expectancy, population growth, total fertility ratio, gross domestic product growth rate, household non-profit institution serving households, gross domestic product per capita, exports of goods and service and general government final consumption expenditure for the period 1960 – 2021.

We first used principal component analysis to detect redundant variables and essential correlations and we noticed that gross domestic product growth rate has no important correlation with all the variables and therefore we used gross domestic product per capita as our dependent variable since it had important correlations with the variables used. Thereafter, we used auto regressive distributed lag and the results showed that population growth affects the performance of the economy negatively.

Key words: GDP, fertility, government expenditure, exports, per capita, population and economic growth.