

UNIVERSITY OF LUSAKA

**TOPIC: THE IMPACT OF POPULATION GROWTH ON SOCIO-ECONOMIC
DEVELOPMENT IN ZAMBIA**

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Dedications

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I dedicate this work to fellow citizens in Zambia who are faced with economic challenges caused by high population especially in high density areas that government can devise policies that address these challenges arising from inadequate resources due to population growth which is not commensurate with economic growth and hope the standard of living can be improved through targeted economic growth policies.

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ABSTRACT

The main objective of the study is to assess the impact of population growth on socio-economic development in Zambia using secondary time series data economic growth, life expectancy, employment and population growth rate. Data was collected from Ministry of Finance, Central Statistics, World Bank for Gross Domestic Product, life expectancy rates, population growth rates and unemployment rates for 58 years i.e. from 1964 to 2021. Population growth is the independent variable while life expectancy, Gross Domestic Product and Employment rates are dependent variables helps to measure socio-economic development. There are many other factors of population growth, however, this study is limited to the three variables. The study uses the vector autocorrelation model with data analysis including co-integration testing, unit root test, lag length, and the Vector Auto-Regressive Model (VAR) whose output is presented. Results from post-diagnostic testing which included the autocorrelation, heteroscedasticity, normality tests and stability, were also conducted.

Research results indicate that population growth and socio-economic development have a significant relationship. Socio-economic development in this study is represented by Gross domestic product which depicts economic growth, employment rate where when it increases is a sign of a better performing economy and life expectancy. Population growth affects economic growth in terms of Gross Domestic Product increases in developed countries because of it provides more labour supply which is absorbed in the already available infrastructure and industry. On the contrary, population growth in least developed countries has a negative effect on socio-economic development by producing worse outcomes such as a strain on infrastructure because the existing one cannot absorb more numbers. Population growth has been found to lead to competition in the job market with high labour supply thereby reducing wage rates which reduces disposable income for people. The situation leads to high unemployment especially among the youths and women. Population growth strains the available resources which are to improve people 's living standards thereby worsening life expectancy. Public infrastructure such as schools become overcrowded compromising the quality of education children receive. Hospitals become overcrowded which becomes a challenge for government to provide quality medical care and provision of essential drugs. The

road infrastructure becomes too small leading to unnecessary delays due to traffic. Government should target policies that grow the economy commensurate to growth in the population. Energy crisis is significant when the population increases hence high demand for power and there should be policies that expand the generating capacity of power to match the increasing demands.

CHAPTER ONE: INTRODUCTION

Zambia 's population was only about 3 million people at independence and Gross Domestic Product of 0.84 billion US dollars. The population has grown to over 20 million by 2020 with Gross Domestic Product of around 23 billion US dollars. The population is projected to rise to 24.1 million by 2030 (Central Statistics Office, 2020). One of the issues the country grapples with is socio-economic development as population grows over the years (World Bank, 2022). It is a complicated issue that cannot be solved in the short run and include factors such as poverty, employment, income per capita etc. that affect the standard of living of citizens (United Nations, 2020).

The relationship between population growth and socio-economic development has been a topic of discussion for economists, demographers, and development experts for years now. There is assertion that a growing population increases economic activity, improves technology and entrepreneurial spirit as a large workforce stirs productivity and output (Bloom & Canning, 2004). Growth in population widens the market which includes demand for goods and services. This growth is also significant for labour which is a key driver of growth in the economy and development. Nevertheless, a fast growing population can be detrimental to social services, infrastructure and natural resources which decreases economic development and increasing poverty and degradation of the environment (Cohen, 1995). Additionally, a growing population negatively affects the provision of social amenities such as education and health with reduced quality of life.

The relationship between population growth and socio-economic development becomes a complicated subject as it has many dimensions and facets to it. Studies have shown that an increase in population creates an opportunity where creativity and entrepreneurship flourish which increases economic effort (Canning, 2008). Population growth creates a high labour supply to address labour shortages that a growing economy may be facing.

In spite of the rise in population over the years, Zambia has made progress in uplifting the standard of living of her citizens by reducing poverty, access to education and health and economic development (World Bank, 2022). However, the country still faces socio-economic development challenges. It is in this regard that the study aims at

investigating the impact of population growth on socio-economic development for the period 1964 to 2021. The study will examine how gross domestic product, employment and life expectancy are affected by rapid population growth.

1.1. Background

Population world over has grown and it's becoming a serious issue to manage, especially in the Sub-Sahara countries. This has caused economic difficulties due to shortages that arise from the rising population (Martin, 2009). Demography asserts that population growth comes because of migration. However, further research has shown that population growth is driven by fertility and improved mortality rates due to health outcome (Martin, 2009). Economists, however, hold the view that population growth increases economic activity but at the same time has a detrimental effect of putting pressure on resources and infrastructure that do not expand in line with the growth. This increases poverty resulting in crime to support themselves illegally. Other economists have asserted that population growth has no effects on economic growth.

Zambia's population has been growing rapidly, with an average annual growth rate of 3.2% between 2000 and 2020 (World Bank, 2022). This rapid population growth has been linked to various socio-economic challenges, including rising poverty levels, lack of job opportunities, and increased income inequality.

According to the Zambia Central Statistical Office (2020), the country's poverty levels have been increasing, with approximately 54% of the population living below the poverty line. The poverty headcount ratio at the national level increased from 50.8% in 2015 to 54.4% in 2020 (Zambia Central Statistical Office, 2020).

In terms of unemployment, the Zambia Central Statistical Office (2020) reported that the unemployment rate increased from 11.4% in 2015 to 12.2% in 2020. The youth unemployment rate is particularly high, with approximately 25.6% of youth aged 15-24 unemployed (Zambia Central Statistical Office, 2020).

Furthermore, Zambia's income inequality has been increasing, with a Gini coefficient of 0.65 (World Bank, 2022). The richest 10% of the population hold approximately 35.6%

of the country's wealth, while the poorest 10% hold less than 1% (Zambia Central Statistical Office, 2020).

The rapid population growth has also put pressure on Zambia's education and healthcare systems. According to the Ministry of General Education (2020), the pupil-teacher ratio increased from 43.6 in 2015 to 45.6 in 2020. In terms of healthcare, the Ministry of Health (2020) reported that the country has a shortage of healthcare workers, with a doctor-patient ratio of 1: 12,000.

Several studies have investigated the link between population growth and socio-economic development in Zambia. A study by the African Development Bank (2019) found that rapid population growth in Zambia has put pressure on the country's resources, infrastructure, and social services, leading to decreased economic growth and increased poverty.

Another study by the World Bank (2018) found that Zambia's rapid population growth has led to increased income inequality, as the wealthy tend to have greater access to resources, education, and job opportunities.

A study by Chikwa et al. (2020) found that population growth has a significant impact on poverty reduction in Zambia. The study found that a 1% increase in population growth leads to a 0.6% decrease in poverty reduction.

It has been observed that population growth leads into food shortages as population people attempt to allocate available resources. The Malthus theory says that the relation between socio-economic development and population growth is two ways. It was observed that population growth in some cases arises due to early marriages that fosters high birth rates and improvement in health care which has reduced mortality rates. The rise in population which does not match with available economic resources causes negative effects on the economy. Theories recognize that high population is detrimental to the growth of the economy. The Malthusian model advocates that a balanced influence on population in the long run equilibrium which involves changes with the correlation of population growth and economic growth. On the contrary, Freeman (1998) countered the Malthusian theory that population growth causes famine

and malnutrition due to food shortages that arise but argued that food shortages are as result of inadequate disposable income necessary to support expenditure for necessities and poverty experienced at household level. He argued that households should work hard to accumulate enough income to meet daily needs. Countries should deliberately devise policies that target increase in the disposable income of citizens such as exports, receive necessary support in foreign aid and where possible contract debt to meet food needs.

Malthus indicated that rapid increase in population becomes a challenge to any society because increased numbers require food to survive and food fall short of supply (Malthus 1798). He showed that countries could avoid starvation by growing their foreign exchange to gain in trade with savings that enable them to import the deficit (Malthus 1798). He showed that when population increases there are diminishing returns to labour per unit hence GDP does not commensurately result into reduced income per capita. Government was urged to expand its infrastructure in manufacturing, health, education, transport etc. to accommodate the increase in population.

When there are food shortages, the country is forced to import and creates market for foreign countries. Imports would create a problem in the balance of payments, and this forces the country to develop its own manufacturing base where new factories are opened and support the growing population with employment opportunities. These new factories create a knowledge and skills gap which creates demand for education to help those joining the labour market. The growth of the economy is dependent upon its citizens' ability to produce goods and services to support the manufacturing policies. Therefore, citizens should access necessary training and education to be ready for such opportunities (Martin, 2009). Economic growth propels human capital development in that individuals tend to specialize and promote returns for the market on knowledge and skills. Consumption per person grows at a slower rate than human capital when there is stability in the growth of the economy when the population grows if there is diminishing returns in the production of goods and services.

1.2. Statement of the problem

Several authors have investigated the impact of population growth on socio-economic development. They have highlighted the benefits and drawbacks of rising population in relation to economic development. They do not agree on the same principles in terms of the effects of a rising population on socio-economic development (Martin 2009). Those who have attributed benefits consider rising population as a platform for creating demand for goods and services. Whereas, those who say there are drawbacks consider in terms of the strain on resources rising population puts as well as the inadequate infrastructure (Malthus 1798). The view that whether population grows comes with negative implications for the economy has persisted. When the population increases, competition increases also. The increase in competition forces entrepreneurs to innovate. Innovation helps businesses to improve on their products and promote sales. The increased demand translates into economic prospects that leads businesses to employ (Simon, 1992). Malthusian contends that population tends to grow at a faster rate which only do not bring food shortages but social implications (Malthus 1798). Malthus indicated when population increases it has a negative correlation to food supply and the depletion of the natural resources. He further highlighted that rapid population results into disease outbreak which is a cost on drugs government should provide while hunger, poverty and income inequality arises. Zambia 's Gini coefficient was 61.7 in 2019 portraying a gap between the rich and poor (World Bank, 2021). 35.6% of the total wealth is held by 10% of the country 's richest while the poorest hold less than 1% of the wealth. Additionally, the country's inequality index was 38.3 in 2019 (World Bank, 2021). This creates a need for policies for income inequality reduction and promote economic growth to benefit the entire population. Government is forced to expand infrastructure which resources may not accommodate. While others argue that population growth has no effect on economic growth, as a result the effects are brought by the other factors that were identified in the traditional sector (Amundsen 2022).

Zambia 's population growth is linked to have brought about the rising poverty levels, reduced job opportunities and a situation where wealth is concentrated in the hands of few wealth individuals (income inequality) that control it which has brought problems on socio-economic development (Kanyanga, 2019). World bank estimates the country 's

poverty to be around 54 per cent of the population living below the poverty line in 2020(World Bank, 2021).

The nation 's poverty headcount ratio has increased from 50.8% in 2015 to 54.4% in 2020 (Central Statistical Office, 2020). The 2018 child poverty report by UNICEF found that 41% of children suffer from at least three deprivations at a time, experiencing four deprivations on average (UNICEF, 2018).

The government of the republic of Zambia has attempted to enhance economic growth through various policies by the efforts are adversely affected by population growth at 2.9% while the economy grows at a lower rate. This has put pressure to expand infrastructure and social services(Central Statistics Office, 2020).

World Bank has concluded that this rapid expansion in population has caused socio-economic challenges through inadequate employment opportunities, health care and education. In general, it is difficult for the government to devise one policy that would address all issues because the nature of Zambia 's economic system is affected by several factors that include lack of adequate job opportunities, income inequality and poverty (World Bank, 2022). The world bank reported that Zambia 's poverty rate as of 2022 was 54.1%. World further reported that abject poverty was 41.1%. This could have been led by the unemployment rate is 12.2% as of 2020 statistics (Central Statistics Office, 2020). The statistics indicate that the country should effect policies and strategies to address the complex relationship between population growth, poverty, lack of employment opportunities unemployment, and socio-economic development in Zambia. All these discussions and debates are clear evidence that there is no concrete conclusion on the relationship population growth and socio-economic development in Zambia due to mixed results in the current research on the subject. Some studies indicate a positive impact of population growth on economic growth by promoting innovation and economic activity. Others argue that rapid population expansion has caused poverty, reduction of employment opportunities and income inequality. Income inequality comes as result of businesses taking advantage of the high labour supply that lowers wage rates and the population scrambles for few opportunities available because the growth in population is not commensurate with the growth in the economy to support

this all citizens (Bloom D. E., 2017). Research that has been conducted in most countries at the global level indicate that population growth depending on the prevailing circumstances can have negative effects and sometimes not on socio-economic development.

The economy of Zambia has continued to experience socio-economic issues that includes lack of access quality health care to support better life expectancy, high poverty levels leading to crime, income inequality causing wealth distortions, and education facilities (Kanyanga, 2019). Population continues to grow at an average of 2.8% per year in recent the past which has not grown at the same proportion with economic growth. There is resource endowment which is not exploited due to lack of local owned technology and the necessary infrastructure to support sustainable development.

In August 2021, the country voted for a new United Party for National Development that anchored a shift of policy from the previous Patriotic Front. The new regime extended the free education to Grade 12 from previously Grade 7. There was an increase in the number of children attending school with classes being overcrowded to as far as 90-100 per classroom against one teacher. This put pressure on the educational infrastructure as schools could not accommodate the overwhelming numbers and teachers were not adequate to provide necessary quality education. The government responded by employing 30,000 teachers to alleviate the situation. The policy is to provide citizens with quality knowledge and skills where they can be masters of their destiny and be of economic relevance to the nation. The government has also been trying to effect health policies that affords citizens with quality health care in an effort to have a better life expectancy but the health infrastructure is overwhelmed with the increased population and lack of human capital development in specialist areas where some citizens have to be flown to India and South Africa for treatment at the expense of treasury resource which would be used to develop the economy and better economic outcomes for citizens.

There has been lack of focused empirical studies in specific areas on the impact of population growth on socio-economic development in Zambia. The country has devised

policies to address socio-economic challenges even through the introduction of constituency development funds to alleviate local people 's challenges but a significant gap has been noted and developmental experts question policy makers and associated organisations pushing the development agenda whether they are sticking to the reality on the ground. This study has been designed to address these gaps and further investigate the correlation relationship between a rising population and the socio-economic development in Zambia on GDP, employment and life expectancy. The study will help economists and development experts to appreciate the complex issues on the subject matter in Zambia. There is a problem in appreciating the effect of variables like life expectancy which has not been studied and researched in depth on how it affects economic development visa vis population growth. Several studies conducted have been concentrated at the regional level in Southern African Development Community (SADC)with less focus on Zambia. Whilst results have been generalised it's important to address country specific areas as each country in SADC has its own demographic landscape and different economic issues while resource endowments critical for sustainable development of the countries differ one to another.

Zambia 's economic rapid population growth is a threat with a potential to reverse gains leading to the decline in GDP per capital. The country 's unemployment rate as of 2020 was 12.2%. The growing population does not match with the growth in the economy a situation which has led to the scarcity of jobs especially among youths and women and worse for the differently abled persons. Previous studies have not shown that the level of economic growth that is needed to support a given population. In 2020, Zambia recorded one of the lowest life expectancies in Africa at 63.1 years. However, a fast-rising population has continued to affect the quality of life due to inadequate health facilities to enhance health outcomes and promote better life expectancy, education and provision of better sanitation, especially in crowded areas that have given rise to outbreaks of cholera and lives lost. This has worsened the economic outcome in general.

1.3. Research Objectives

- i. To establish the correlation relationship between population growth and Gross Domestic Product in Zambia
- ii. To determine whether the type of relationship between population growth and Employment in Zambia
- iii. To establish whether there is a relationship between population growth and Life Expectancy in Zambia

1.4. Research Questions

- i. What is the relationship between population growth and Gross Domestic Product in Zambia?
- ii. What is the causal relationship between population growth and Employment in Zambia?
- iii. What is the causal relationship between population growth and Life Expectancy in Zambia?

1.5. Significance of Study

A large population is a reservoir for knowledge, skills and experience that promotes and enhances innovation. Economists have had different conclusions on this subject matter to investigate the relationship between population growth and socio-economic development. The study aims at adding knowledge to the subject matter by examining extricate issues surrounding the topic. Policy makers need information to make informed decisions in the development process of the country and its important pertinent information is available to make this process easier. The findings in this study should help to make this information available to help experts make decisions in tandem with community needs. The study seeks to aid policymakers to critically evaluate the quality of policies attempting to address socio-economic issues and where necessary find a new way of doing these in line with dynamic changes in the environment. The study will provide information for the media to keep the by citizens are aware of their economic situation and be proactive in addressing it. The study will assist in providing relevant information for the private sector necessary to make decisions on the demand and supply schedules to complement the development agenda of the country. This

knowledge will also be critical to non-governmental organisation involved to improve community welfare to devise targeted and well-informed policies that address society 's needs.

Several organisations have advocated for the use of family planning methods to control birth from the early 2000s. study has been one-sided and focused on controlling the growth of population amidst prevailing economic challenges that exist among citizens. China years back introduced one child policy while Japan controlled population to a level where there are more aged people than energetic one needed to drive the economy. The west has also experienced this phenomenon. The study will help in examining the effects of such policies to economic considering the demand and market fundamentals.

The study will highlight current issues in understanding and appreciating trends surrounding population growth as it relates to socio-economic development. There are many complex demographic issues that intertwine with economic factors and need a closer study and it is important for policy makers to bear in mind as they set the developmental agenda of the country. In some cases, they end up devising policies that do not address the needs of the community due to limited appreciation of these complex factors. Poverty, unfair distribution of wealth, quality of life and access to education are in the developmental process and they need to be thoroughly examined and show how they are linked to the development process. This will help policy makers to be attached and closer to reality.

The findings of the study will act as input to different stakeholders including politicians who need information to influence their voters, non-government organisations that need information to draft projects for funding from prospective donors and private sector institutions to help and smoothen their market research efforts. The study will also help entrepreneurs to identify areas of business opportunity and innovate goods and services to address market needs and profit from the initiatives while contributing to economic growth.

The study will help in reviewing previous research methodologies and seek to contribute to new research methodologies and data analysis techniques that would be relevant to

related population and economic growth trends. It will demonstrate how a mixed research methodology including quantitative and qualitative methods can be applied to the subject matter in examining the casual relation between population growth and economic growth. The study comes at a time when Zambia is facing economic issues that have lowered the standard of living leading to worse outcomes. Therefore, it may provide solutions to some of the challenges being experienced.

The study will help in assessing Zambia 's progress towards the achievement of United Nations sustainable development goals. Sustainable Development goal numbers 1, 8 and 10. In goal No.1, it is required that countries eliminate poverty and provide quality of life for citizens through targeted economic empowerment policies. Goal No.8 requires countries to create decent work and promote economic growth and Goal No.10 ensures that countries promote income equality by devising policies that promote fair distribution of wealth. The study will, therefore, assess how the country has progressed in the achievement of these goals. The sustainable development goals align well with socio-economic development under study and economic growth.

1.6. Scope and limitations

Population growth and economic growth are global subjects that attract the attention of world leaders, leaders of industry, multilateral institutions such as the world bank, world health organisation among others. Some issues under study do not only affect one country by a region, continent even globally. This study, however, will focus on Zambia 's population and economic growth and that means results may not be generalised to other countries that do not have similar demographic and economic trends with similar economic size and population. There are many other socio-economic issues that are affected by population growth such inflation, mortality rate among others but this study will concentrate on Gross Domestic Product, Unemployment rate and life expectancy.

The data sources have been restricted to the Zambia Bureau of Statistics to provide demographic information, World Bank and Ministry of Finance of the republic of Zambia to provide economic s statistics and United Nations to appreciate the annual assessment of the country. The study will be restricted to data collected from these official resources. The period has been restricted to 58 years i.e. from 1964-2021. This

time series data will not be available on a monthly or quarterly basis due to non-availability from the sources and the nature of such information as in most cases its available on annual basis.

CHAPTER TWO: LITERATURE REVIEW

2.1. Introduction

The main objective of the study is to investigate the relationship between population growth measured by the growth and socio-economic development whose factors under considers for the purposes of this study are limited to gross domestic product, employment and life expectancy. Economists, demographers and other experts have had a lot to say on the subject matter and books, journals, reports and articles have been written trying to address social challenges. There has been related research at national level, regional level and global level with organisations like the United Nations being interested in the subject matter that has gone ahead to set goals should meet. This chapter contains the empirical review that critically what has been written examining the methodologies used, type of data, the findings and the conclusion from each author(s). The second part will include the theoretical framework that will be used in this study by showing the independent variables and dependent variables depicted in the diagrammatical form.

2.3. Empirical Review

The empirical review is intended to give an overview the existing journals, reports and articles on the impact of population growth and socio-economic development in Zambia. The systematic review will include methodology used in the study, type of data, the findings and conclusions. The focus will be to review the variables such as gross domestic product, unemployment and life expectancy. The review will help in appreciating the current literature on the subject matter. Scholars have investigated the relationship between population growth and socio-economic development in Zambia, the region and global level. There have been specific studies on the subject matter and those related which will be reviewed in this section.

2.3.1. Global Literature review

The relationship between population growth and socio-economic development has been a topical issue around the globe among researchers and policymakers. Research indicate that population growth can have a positive and negative influence on socio-economic development. The positive side is that population growth increases the level

economic activity as the increased population contributes to high labour force (Bloom & Canning, 2004). It increases technology thereby innovation and entrepreneurial spirit (Kelley & Schmidt, 2005). Adversely, population growth puts a strain on the resources, infrastructure and social amenities which affects economic growth (Cohen, 1995). In addition, these issues compound into poverty and inequality and competition for jobs (Ravallion, 2001).

In 2017, Fox and Sohnesen used a regression analysis methodology using cross sectional data examining employment and economic growth. They also observed that inadequate research had been conducted on the subject matter (Fox and Sohnesen, 2017). They concluded that the population growth does not automatically increase economic growth.

The International Labour Organization (ILO) the global organisation on labour matters conducted a study on the effects of the population growth on youth employment by conducting surveys on targeted countries (ILO, 2020). The organisations used descriptive analysis methodology. It was found that countries need targeted policies addressing youth unemployment.

The world health organization in 2019 examined the relationship economic development and life expectancy. The organization used the descriptive analysis methodology by reviewing global trends in health. The report indicates that there were gaps in searching of the subject matter. It was pointed out that countries needed to improve their health care systems. The conclusion was that a fast-rising population stresses the health care system thereby affecting health outcomes. The study did not indicate the longevity of a worker with regards to experience one brings to improve the economic outcomes.

Bloom investigated the effects of population growth on employment and labour supply using the structuring framework methodology (Bloom D. E., 1986). They found that it affects employment and the labour market through the accounting component and demographic composition. Demographic factors that influence population growth include migration, fertility and low mortality. Population growth was found to have a significant influence on population growth by creating supplying workers for the labour

market. They concluded that countries could benefit from population growth if they exploit labour markets with targeted policies.

Kelly also agreed that population growth has a positive relationship with socio-economic development Kelly (1988). He argued that only population growing at a slower rate would increase economic growth. Studies from different countries showed that it had effects on economic development. He indicated that low population involves GDP per capita income and stated that 1% increase in population is equivalent to 2.5% per capita income. Similarly, (Bucci, 2003), investigated how the relationship between human and physical capital as inputs in population growth and observed that there a relationship between population growth and economic growth. He used income per capita and concluded that population growth is negatively correlated with economic growth. This finding is like the Malthusian school of thought that used food supply as a variable. When the analysis is done in the context of variables like income per capita and food supply, the relationship between population growth and socio-economic development is negative.

Boserup conducted studies on agricultural growth in the Agrarian economy and observed that population growth has a positive relationship to agricultural output in that agriculture was labour intensive then and required population to provide necessary number workers to support the production (Boserup, 1965). Therefore, he supported high population growth to support socio-economic development. The study concluded that socio-economic development can be better with soil fertility and good population to supply labour.

Simon was interest in outlining the advantages of population growth (Simon, 1992). He observed that in the short run population increase puts pressure on the available resources necessary for survival. However, in the long run, the benefits are seen in advancement of technology as competition arises leading to innovation and human capital which tend to improve output there providing enough resources to the population and improve people 's wellbeing. In the long term, knowledge improves which boosts productivity with efficient production outcomes. Countries should plan by investing for the projected increase in population.

2.3.2. Regional Literature review

Bloom attempted to examine population growth and economic development. He reviewed twenty-five previous studies employing a systematic review methodology (Bloom D. E., 2017). The review showed that there was a lack of adequate research on the subject matter in Africa. He noted that such research had not been adequately funded due to limited resources. The only support was from multilateral institutions who had other interests that were different from the country's needs. He recommended that need to invest resources and support such research that would help in policy formulation. These studies would shape the policy of the country to meet the needs of the citizens (Bloom, 2017). The nature of such studies is extensive and requires funding and dedicated personnel to produce credible and reliable results. Bloom concluded that a percentage growth in population results in the decline in GDP by 0.5% in countries that are still developing.

Malmberg investigated the relationship between population growth and socio-economic development (Malmberg, 2016). His methodology was the regression analysis using the panel data over 40 southern African countries. The geographical area became too vast, making the study too cumbersome. He recommended that the study would be effective if it was narrowed to specific countries as they have different geographical and economic factors. Countries' population and economic growth rates are different. There are cases where the country's population is high, but its economic growth is lower than expected and in other cases countries with low population tend to have high economic growth. Therefore, underlying variables need to be fully investigated specifically to a country of interest. These factors include resource endowment, culture, work attitude and ethics, and industry development that supports manufacturing and agricultural transformations. Malmberg concluded his study by stating that population growth has a negative impact on economic growth as was seen in declining GDP per capita.

Multilateral institutions have also conducted studies on population and economic growth. The African Development bank in 2019 used the country level analysis methodology and noted that Southern African Development Community had differences

in research on the subject. This coincides with the Zambia Bureau of Statistics that conducted a demographic survey on health using the descriptive analysis methodology. They noted that there was need for the local dynamics and disparities with Urban and rural areas in health care access. They did not establish the relationship between life expectancy and economic development.

2.3.3. Local Literature review

In 2019, Kanyanga and others examined the effects of population on economic growth in Zambia. They used the Autoregressive Distributed Lag (ARDL) model to test the time series data combining the Autoregressive and distributed lag because of the flexibility, robustness and reliable estimates the model offers. This study despite being designed specifically for Zambia, they concluded that more research is needed. They, however, indicated that a large population tends to lower down the level of economic development. The study was too generalised, but it does not show the extent of generalization(Kanyanga, 2019).

Munyinda and Mulenga in 2020 investigated the causes and consequences of population growth in relation to economic growth. They used a case study method to review country circumstances on the subject matter (Munyinda and Mulenga, 2020). They found out that population growth and economic growth has different dynamic that must be considered. Their research concluded that there was a need to formulate research specifically for the country. It was found that that population has a negative effect on unemployment as it reduces job opportunities.

Population growth in relation to health by evaluating the outcomes was researched by Bongaarts and Sobotka in 2017. They used the systematic review method on 15 studies (Sabotka, 2017). They highlighted that in Africa research had not been adequately conducted. However, the findings indicate a negative correlation of population growth on health outcomes subsequently affecting life expectancy in developing countries.

Chabala and Mwilu jointly conducted a study focused on Zambia. They examined the impact of population growth on health outcomes (Mwilu, 2020). They used population growth as independent variable while health outcomes as a dependent variable by employing the regression analysis of the Zambia's health survey data (Mwilu, 2020). He

indicated that the study needed more research, and his findings were that rapid population strains health care system and leads to worse outcomes in Zambia.

In the context of Zambia, research has shown that population growth has had a significant impact on socio-economic development. For example, a study by the World Bank found that Zambia's rapid population growth has led to increased poverty and inequality, as well as decreased economic growth and development (World Bank, 2018). Another study found that population growth has led to increased pressure on natural resources, infrastructure, and social services in Zambia (Zambia Central Statistical Office, 2020).

2.3. Theoretical framework

The theoretical framework reviews concepts of population growth and its impact on socio-economic development. It is grounded on the Demographic Transition Theory, Malthusian Theory, dependence theory and Human Capital Theory. The framework uses these theories and models to explain the relationship.

2.3.1. Malthusian theory

The theory was proposed by Thomas Robert Malthus in 1798. The Malthusian theory contended that the population tends to grow faster than the resources which causes shortages in food supply hence famine. Production facilities do not automatically adjust to production in commensurate with the population increase due to capital that may be scarce. Malthus argued that in the short run, the limited resources need to be allocated to the grown population (Malthus, 1798). He suggested that population growth should be controlled to avoid pressure on limited resources. The measures would include positive and preventive. On the positive measure, people should make logical decisions on how they will support their families considering the current and prospective future income. This can be done through investment in education and social security. The preventive measures include the use of contraceptives, sexual education, maternal education etc. This was suggested to avoid population growing to a level where it leads to hunger and social unrest. This would ensure resources are adequate to support the population.

The Malthusian theory tend to agree with the current happenings in Zambia with regards to the negative relationship that population growth has on economic growth (CSO, 2020). For instance, a study by the Central Statistical Office found that the poverty rate in Zambia increased from 54.4% in 2015 to 57.1% in 2020 (CSO, 2020). Overcrowding has caused limitations with public infrastructure such as roads as traffic can be seen building up slowing movements, schools that are crowded and health facilities that are stressed (World Bank, 2018). The theory has met critics due to non-consideration of progress in technology for economic development to reduce poverty and inequality (Boserup, 1965). For instance, in Zambia economic development and technological progress have increased food production and improved access to healthcare and education (World Bank, 2018). Consequently, while the Malthusian Theory provides a useful framework for understanding the relationships between population growth and socio-economic development, it should be considered in together with other factors, such as economic development and technological progress

2.3.2. Demographic Transition

The model describes the changes in growth rates of population and demographic characteristics that happen as the country 's economic development (Thompson, 1929). The model is four staged as high birth and death rates, which reduces population growth (Note stein, 1945). The second stage death rates reduce and birth rates increase increasing population. Zambia is in this stage as there has a population growth rate of 3.2% per annum between 2010 and 2020 (World Bank, 2020). The third stage involve birth rates and death rates declining resulting into slow population growth (Thompson, 1929). The fourth stage both birth and death rates are low, leading to stable or declining population growth rates. The model has been criticized for its simplicity of the demographic changes and lack of consideration of environmental factors such as culture and social norms (Caldwell, 1997). The model is important for addressing rapid population challenges in Zambia. Investment in education and health can transition Zambia into the third stage (World Bank, 2018). This would aid in can poverty and inequality reduction and promote sustainable development.

The demographic transition theory holds that view that population growth has a positive correlation with socio-economic development. They view population to be an avenue for

the supply of labour with the necessary knowledge and skills necessary to promote innovation and drive economic growth. This helps in improving social outcomes and enhance urbanization. This theory is like the human capital theory. Human capital also considers population growth as an opportunity for human capital development through transfer of knowledge and skills necessary to drive economic growth. This means that a country should invest in education while maintaining a health system that helps the population acquire the necessary knowledge and skills.

2.3.3. Human Capital Theory

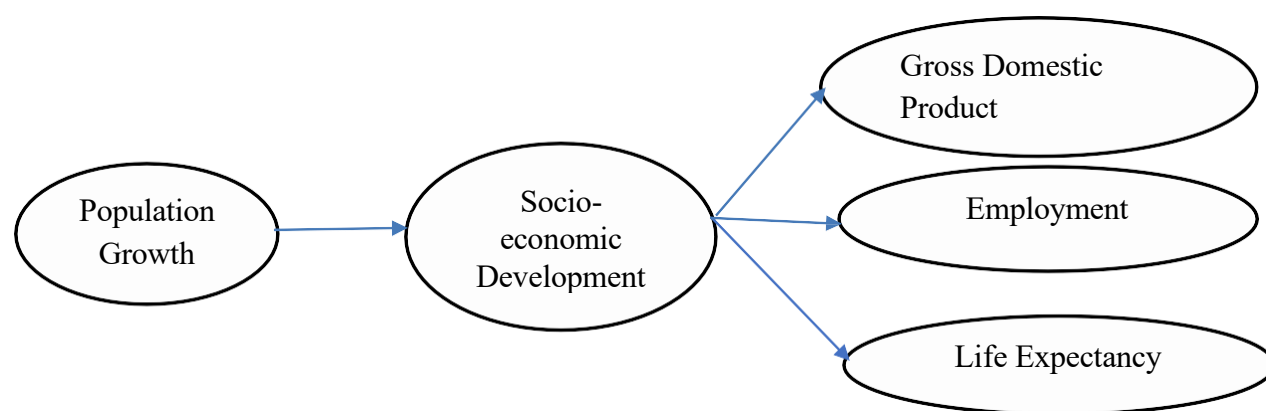
The Human Capital Theory, developed by Gary Becker, Jacob Mincer, and Theodore Schultz, posits that investments in human capital, such as education, training, and healthcare, can increase an individual's productivity and earnings potential (Becker, 1962; Mincer, 1958; Schultz, 1961). Human capital refers to the knowledge, skills, and abilities that individuals possess, which enable them to produce goods and services. According to this theory, investments in human capital are critical for economic growth and development, as they enable individuals to increase their productivity and earnings potential.

In Zambia, investments in human capital are critical for increasing productivity and earnings potential. The Zambian government has recognized the importance of human capital investments and has implemented policies to improve access to education and healthcare (World Bank, 2018). However, challenges remain, including inadequate infrastructure, limited access to quality education and healthcare, and high levels of poverty and inequality (CSO, 2020). To address these challenges, it is essential for Zambia to continue investing in human capital, particularly in education and healthcare.

Studies have shown that investments in human capital can have significant returns, including increased productivity and earnings potential (Psacharopoulos, 1994). In Zambia, investments in education have been shown to increase earnings potential, with each additional year of education resulting in a 10-15% increase in earnings (Kanyamuna, 2015). Similarly, investments in healthcare have been shown to improve health outcomes and increase productivity (WHO, 2019).

2.3 Conceptual Framework

The framework shows that population growth being a variable influences socio-economic development. Socio-economic development in this study is to be measured by Gross Domestic Product, Employment and Life Expectancy. The framework presents population growth as one that influences the three variables although the influence can be bi-directional. A rise in population is expected to grow the GDP because there is more labour supply(Chatterji, 2015). A rise in population if the economy does not grow at the commensurate level should create competition in the labour market and create unemployment. When there is economic because of high population causing labour supply and innovation, income per capita improves which translates into better living standards which also improves life expectancy(Acemoglu, 2014). Citizens can afford better education and health and nutrition to improve their standard of living(Riley, 2019).



2.4 Summary

The chapter consisted of the literature review, both the empirical review and the theoretical framework of previous studies considering of the research methodology used and conclusions from such studies. The researcher identified important theories on the subject matter including Malthusian, Demographic Transition, Human Capital and dependence. The theories tend to conflict with one another in their assertions while some seem to agree and correlate to some degree. These theories formed the basis upon the systematic review of existing literature by examining the methodology, findings and conclusions of previous studies on the subject matter. Existing research has shown that population growth has a negative relation to economic growth as in the case of Malthusian theory. In some case it has shown that population growth has a positive

relationship with economic growth in that population growth provides a huge labour force that is innovative with necessary knowledge and skills to drive economic activity. This helps increase income levels for the citizens that afford them access to decent health care and education. This improves life expectancy as people can afford better nutrition and dedicate more years to their trade, yielding better knowledge, skills and experience that are passed on to the young generation.

On the other hand, population growth has been found to be reducing employment opportunities because population does not grow proportionally to economic growth level that creates adequate job opportunities in the short-term population has been found to exert pressure on scarce resources. The situation leads to starvation and poverty which breed unrest and crime due to dissatisfaction in society.

The literature that has been reviewed has not concluded on the number of issues on the subject matter. Researchers have indicated the need for further research. There are many factors that affect the relationship between population and socio-economic development that cannot be examined and concluded in one research. There is also still a gap in examining the bi-directional relationship and to what extent they affect each other. Some of the data reviewed is too old and may not fit well in today 's dynamic economic environment for example Malthus suggested that population should be controlled by positive and preventive measures which may include contraceptives which is now a human rights issue such that you may not dictate how many children one should have. There is a further need to use other methodologies and a more quantitative approach. The existing literature is important to begin with in assessing the impact of population growth on economic growth.

CHAPTER THREE: RESEARCH METHODOLOGIES

3.0. Introduction

This chapter presents and discusses how the research questions will be addressed. It will discuss the possible models that can be used in this study on the variables. Research questions are centered on population growth, GDP, Employment and Life Expectancy. The discussion will highlight how the times series, the estimation methods with diagnostics tests to ensure the credibility of the model.

3.1. Research design

The study examines the impact of population growth on socio-economic development. Time series data set for a period of 58 years from 1964 to 2021. The period reflects from the time Zambia got her independence. The study will employ the Generalized Least Squares method. The study will use the quantitative method of the data gathered from secondary sources i.e. annual reports from government and multilateral institutions such as the World Bank and International Monetary Fund.

3.1.1. Research Approach

The study used quantitative methods to provide a comprehensive understanding of the impact of population growth on socio-economic development in Zambia for the period 1964 to 2021 using secondary data from sources such as the Zambia Central Statistical Office, World Bank, and United Nations to analyze the relationship between population growth and socio-economic development indicators such as GDP growth rate, poverty rate, and human development index.

3.1.2. Data Collection

Secondary data collection: Collecting data from existing sources such as the Ministry of Finance, Zambia Central Statistical Office, World Bank, and United Nations.

3.1.3. Data Analysis

The analysis used descriptive statistics such as means, medians, and standard deviations to summarize the data.

3.2. Model specification

The linear multiple regression model will be used in this study to evaluate the impact of population growth on socio-economic development which takes the form of

Equation 1: $\log(\text{GDP}) = \beta_0 + \beta_1 * \log(\text{Population Growth}) + \varepsilon$

Equation 2: $\log(\text{Employment Rate}) = \beta_0 + \beta_1 * \log(\text{Population Growth}) + \varepsilon$

Equation 3: $\log(\text{Life Expectancy Rate}) = \beta_0 + \beta_1 * \log(\text{Population Growth}) + \varepsilon$

3.3. Data sources and variable definition

The study will employ secondary data which will be sourced from Ministry of Finance of Zambia, Zambia Bureau of Statistics, World Bank and World Health Organization and other credible sources. The Zambia Bureau of Statistics provides insightful information on demographics including population growth. Bank of Zambia and World Bank provides information on economic variables including GDP, Interest rates, unemployment rate and inflation however, its GDP and unemployment rates that are of interest in this study. The International Labour Organization provides information on employment. The World Health Organization provides information on life expectancy and the United Nations provides reports on Sustainable Development goals.

3.3.1. Independent variable

Population growth is caused by several factors including birth rates, reduced mortality, migration etc. This will focus on GDP, Employment and Life expectancy in understanding population growth. The study seeks to measure how these variables affect the growth in population such as does growth in GDP associated with increase in population, how is the relationship between increase in population and life expectancy and subsequently employment levels.

3.3.2. Dependent variables

Socio-economic development is the dependent variable in this study. Socio-economic development will be measured using Gross Domestic Product, Life Expectancy and Employment.

- 3.3.2.1. Gross Domestic Product measures the total value of goods and services produced within a nation. Theory suggests that people should only increase the number of children when they have the capacity to take care of them. Higher GDP means higher income per capita which should motivate people to have more children thereby increasing the population. On the other hand,

the increase in populations is expected to have a positive relationship with GDP as more workforce is available on the labour market and more innovation hence technological advancement to promote efficient production at low cost.

3.3.2.2. Life expectancy is the expected number of years' people live. It is affected by several factors including nutrition, health standards, education etc. Life expectancy has a direct relationship with population in that a better life expectancy maintains the stability of population. A stable population creates stable economic growth because skills and experience are developed over time in the labour markets. This stability helps to improve productivity and increase economies of scale.

3.3.2.3. Employment has an impact on economic growth. Population may only increase sometimes when people have disposable income to support their families. Workers are expected to have certain skills and knowledge to be competitive in the labour market. In Urban areas, for instance people start having children in the 30s because of schooling and getting a better job while in rural areas childbirth begin as early 15 years and worse in cases of early marriages. Depending on which age people start having children employment to gain a better standard of living impacts population growth. In most cases, the educated population tends to have a smaller number of children compared to the less educated.

3.4. Estimation procedure

The estimation procedure provides details of getting the results from the analysis to enable assessment of the research objectives. The estimation will be through the Linear multiple regression model. The process will include cleaning data by identifying and correcting outliers. The model will then be specified having conducted diagnostics tests earlier stated which affects the validity and stability of the model hence making misleading forecasts thereby poor decision making for any recommendations. The model will take the log form due to percentage form data that has been presented.

3.5. Techniques for data analysis

Stata version 16 will be used to run data for analysis including diagnostic tests. Diagnostics tests involves testing for autocorrelation, heteroscedasticity and multicollinearity before conducting econometric analysis. Heteroscedasticity will be tested using the Breusch-Pagan, multicollinearity using the VIF and autocorrelation using the Durbin-Watson test. It is important that data is tested to ascertain the presence of these. This ensures that the selected model is stable and valid and offers good predictability in the forecasting process so that decision makers are not misled but can make decisions on information that is reliable.

3.6.1. Stationarity

Time series requires that the mean, variance and autocorrelation are constant over time. Dickey Fuller is the founder of the famous known Augmented Dickey Fuller Test which has become important in statistical analysis of data. The tests detect unit root presence in the time series. It helps researchers by adding reliability in the predictions of their models' holding relationships among variables constants. This helps to get accurate parameter estimates such that coefficients have meaningful interpretation with a stable variance. If there is non-stationarity, the model selection would be incorrect such that the inappropriate model is selected with highly unrelated variables and this leads to incorrect and misleading interpretations of the model(Gujarati, 2004). The problem is resolved by differencing which removes seasonality and trends, and a log transformation which stabilizes the variance and model selection such as ARIMA.

3.5.2. Multicollinearity

The assumptions of the classical linear regression analysis require that variables are not correlated to each other such that there should be no Multicollinearity. When independent variables tend to be highly correlated to each other in the regression model it means there is a presence of Multicollinearity. The problem would be that regression coefficients' estimates are no stable and the standard errors are too large (Gujarati, 2004). The detection method of multicollinearity involves the use of Variance Inflation factor which measures the variance of coefficients in the regression model subject to multicollinearity. The scale is anything up to 4 is acceptable while 10 shows serious presence of multicollinearity. Where there is a serious presence of multicollinearity, it

can be treated by dropping one of the variables that is highly correlated to the other. However, this method only helps to reduce the problem.

3.5.3. Heteroscedasticity

Heteroscedasticity affects statistical analysis when the variance is not held constant for the residuals. Breusch-Pagan Godfrey test is used detect this problem (Gujarati, 2004). Where the problem remains untreated, the hypothesis becomes inaccurate, and parameters biased resulting in misleading conclusions. Misleading conclusions affect the quality of decisions made as forecasts made. Heteroscedasticity if detected will be addressed by data transformation in logarithms and weighted Least Squares.

3.6.4. Autocorrelation

The Classical Linear Regression Model assumes that there should be no autocorrelation in the disturbances for any given regressor (Gujarati, 2004). Serial correlation may arise if residuals observed are not separately calculated from the values. The researcher will test autocorrelation using the graphical method and Durbin-Watson test. Where the results test positive for autocorrelation. The generalized least squares method will be used to correct the presence of autocorrelation. This is to avoid biases in standard errors, creating results that are not efficient.

CHAPTER FOUR: ANALYSIS AND ESTIMATION OF RESULTS

4.0 Introduction

The analysis of the data revealed several key findings that provide insights into the relationship between population growth and socio-economic development in Zambia. The findings are presented below, along with a detailed discussion of the implications and contributions to the existing literature.

The analysis and estimation of results deals with how the investigation of population growth and socio-economic development were conducted using variables of GDP, Life Expectancy, Population growth rates and unemployment rate. Secondary data based on time series on the variables collected from Ministry of Finance, World bank, Central Statistics Office and World Health Organization was used for the period of 58 years from 1961 to 2021. The variables were regressed to measure the how growth in population affects socio-economic growth in Zambia. The analysis of data including tests for co-integration testing, unit root test, lag length and the Vector Auto-Regressive Model (VAR). Results from post-diagnostic testing, such as the autocorrelation heteroscedasticity, stability, and normality tests were conducted using Stata.

4.1 Descriptive Statistics

The descriptive statistics sampled for 58 years from 1964 to 2021 are shown in the table below. Gross Domestic Product on average was USD 8.15088 billion in the period 1964 to 2021. The lowest and the highest Gross Domestic was of USD 0.84 billion and USD 28.03724 billion respectively. Life expectancy in the country during the period averaged 51.67 years with standard deviation of 5.51 years indicating the deviation from the mean years. The lowest unemployment rate was recorded in 1964 at 5.9 percent and increased to 22 percent in 1991. The mean and standard deviation for population growth rate were 9.26 percent and 4.56 percent respectively. Zambia's population grew by values of 19.47 percent and 3.54 percent reflecting the lowest and highest respectively.

Table 1 Descriptive Statistics

	GDP	LFE_EXP	EMP_R	PGR
Mean	8.150877	51.67066	12.20262	9.265231
Median	3.628665	51.321	12.055	8.172627
Maximum	28.03724	64.124	22	19.47313
Minimum	0.839429	43.36	5.9	3.542764
Std. Dev.	8.643793	5.513535	3.774876	4.569725
Skewness	1.181928	0.777475	0.425544	0.675124
Kurtosis	2.747833	2.940754	2.63358	2.331679
Jarque-Bera	13.65756	5.851662	2.074983	5.485409
Probability	0.001082	0.05362	0.354342	0.064396
Sum	472.7509	2996.898	707.752	537.3834
Sum Sq. Dev.	4258.764	1732.747	812.2324	1190.296
Observations	58	58	58	58

4.2 Data Analysis Tests

To determine its applicability and define the model, a series of preliminary diagnostic tests were conducted on the model. These results are shown in the tables below.

4.2.1 Augmented Dickey Fuller Test

The Augmented Dickey Fuller (ADF) test was used to determine if the variables were stationary. Prior to doing the stationarity test, the lag length of the variables was evaluated using the Akaike Information Criteria (AIC). This is shown in the Appendix. The analysis used the Augmented Dickey Fuller (ADF) test, and it was found that the absolute test statistic value is more than the critical value at a significance level of 5%, therefore, the null hypothesis is to be rejected.

Table 2 Stationarity test results at levels

Variable	Test Statistic	5% Critical Value	Order of Integration
GDP	-3.112109	-2.913549	I(0)
Life expectancy	-3.521119	-2.913549	I(0)
Unemployment rate	-2.951219	-2.913549	I(0)
Population growth	-4.102109	-2.913549	I(0)

Hypothesis

H_0 : Non – stationarity

H_1 : Stationarity

GDP: The test statistic (-3.112109) is less than the 5% critical value (-2.913549), indicating that the null hypothesis of a unit root can be rejected. GDP is likely stationary, I(0).

Life expectancy: The test statistic (-3.521119) is less than the 5% critical value(-2.913549), indicating that the null hypothesis of a unit root can be rejected. Life expectancy is likely stationary, I(0).

Unemployment rate: The test statistic (-2.951219) is less than the 5% critical value (-2.913549), indicating that the null hypothesis of a unit root can be rejected. Unemployment rate is likely stationary, I(0).

Population growth: The test statistic (-4.102109) is less than the 5% critical value (-2.913549), indicating that the null hypothesis of a unit root can be rejected. Population growth is likely stationary, I(0).

Based on the ADF test results, all variables (GDP, life expectancy, unemployment rate, and population growth) appear to be stationary, I(0). This suggests that the variables do not have a unit root and are suitable for further analysis using econometric models.

4.3.2 Lag Length

The study involved the running of the lag selection test there after the checking cointegration using a Johansen Test. The model maximum allowed time was established by Akaike Information Criteria. The appendix shows that 2 was the maximum lag duration. The command of ematrix was used to find the best lag duration for the variables. The Appendix demonstrates that the model's maximum lag duration was 2. The best lag duration of the variables was determined by running the ematrix command was used. The results are shown in ideal lag time for each independent variable.

4.3.3 Test for Co-integration

The co-integrating relationships require that are considered to generate the Vector Autoregressive Model (VAR). The Johansen test for co-integration were applied to count the co-integrating relationships after the Akaike Information Criterion determined that the appropriate lag length is 2. (AIC). The sample data show that there are no co-integrating relationships, which are emphasized in the fifth column of the appendix.

Table 3 Johansen Co-integration Test Results

Maximum rank	Eigen value	Trace statistic	5% critical value
1	0.576413	82.26969	47.85613

Source: Author, 2025

The Johansen Co-integration Test was used to determine the number of co-integrating relationships between the variables in the VAR model.

Results:

Maximum rank: The maximum rank of the co-integration matrix is 1, indicating that there is at most one co-integrating relationship between the variables.

Eigenvalue: The eigenvalue (0.576413) measures the strength of the co-integrating relationship. A high eigenvalue indicates a strong co-integrating relationship.

Trace statistic: The trace statistic (82.26969) measures the number of co-integrating relationships. The null hypothesis is that there are no co-integrating relationships ($r = 0$).

5% critical value: The 5% critical value (47.85613) is used to determine the significance of the co-integrating relationship.

In conclusion, since the test statistic (82.26969) is greater than the 5% critical value (47.85613), the null hypothesis of no co-integrating relationship ($r = 0$) can be rejected. This indicates that there is at least one co-integrating relationship between the variables. It implies that the presence of a co-integrating relationship indicates that the variables are linked by a long-run equilibrium relationship. The co-integrating relationship can be used to model the long-run behaviour of the variables and the results suggest that the variables are not drifting apart over time, but rather are tied together by a common stochastic trend. The next procedure will be estimating the co-integrating vector(s) to examine the long-run relationships between the variables and use the co-integrating relationship to model the long-run behaviour of the variables.

The Johansen co-integration test results revealed that there is one co-integrating equation between population growth, GDP growth, life expectancy, and unemployment rate. This indicates a long-run equilibrium relationship between the variables, which is consistent with the theory of economic growth and development. The co-integration test results provide evidence of a stable long-run relationship between the variables, which is essential for policy analysis and forecasting.

4.3.4 Vector Auto-Regressive Model

The Multivariate Vector Auto-Regressive Model was used calculate the model to determine the relationship between the independent variable population growth, and the dependent variables economic growth, life expectancy and unemployment rate.

4.3.4.1 Vector Auto-Regressive Model

The multivariate model includes Economic growth, life expectancy and unemployment which were used as dependent variables are shown in the table below. The significance of 5% was established on each variable.

Table 4 Vector Auto-Regressive Model

Model	Variables	Coefficient	Std. Error	t-statistic	Probability
GDP	Population growth	0.837325	0.13579	6.16642	0.005
	Constant	-9.258211	3.92179	-2.36071	0.042
Life expectancy	Population growth	0.087981	0.01775	4.95586	0.000
	Constant	3.794812	0.51387	7.38476	0.007
Unemployment	Population growth	0.194482	0.08811	2.20729	0.044
	Constant	-1.694246	2.54946	-0.66455	0.032

Source: Author, 2025

At levels of 1%, 5%, and 10%, respectively, the variable population growth has a statistically significant positive effect on economic. Because the probability value of the variable for population growth, with a coefficient of 0.837325, is less than 0.05, it is statistically significant.

Since the probability value for the constant of the economic growth model with matching probability value (0.042), is less than 0.05, the constant of the model is significant for the population growth.

Additionally, the variable population growth with its associated coefficient (0.087981) is significant at the 5% level of significance since it's probability value (0.000) is less than 0.005. Thus, a 1 percent rise in population growth will result in a 0.088% rise in Zambia's life expectancy.

According to the constant of the life expectancy model, there is a substantial positive significant relationship between population growth and life expectancy, with a coefficient value of 3.7948.

In the Unemployment rate model, it was concluded that population growth had a significant positive effect on the unemployment rate at the 5% level of significance since the probability values population growth was less than 0.05. The variable shows that there is a significant positive relationship between population growth and the unemployment rate.

The constant of the unemployment model is statistically significant at 5% since its probability value (0.032) is less than 0.05 and thus significant.

The VAR model results showed that population growth has a significant positive impact on GDP growth and life expectancy, and a significant negative impact on unemployment rate. The impulse response functions and variance decomposition results further supported these findings, indicating that population growth has a positive effect on socio-economic development in Zambia. The VAR model results provide a dynamic analysis of the relationships between the variables, which is essential for understanding the underlying mechanisms and interactions.

4.4 Post Diagnostic Tests

Three more post-diagnostic tests, including stability, normality, and autocorrelation tests, were performed on the model.

4.4.1 Jarque Bera test

The model was put to the Jarque Bera test to check for normality.

Table 5 Bera test results

Variable	Chi2	df	Probability
GDP	9.782	2	0.00751
Unemployment	4.886	2	0.08692
Life expectancy	26.421	2	0.00000
All	41.089	2	0.00000

Hypothesis

H_0 : normally distributed errors

H_1 : non – normally distributed errors

The model's findings show that while the variable Gross Domestic Product is non-normally distributed because its probability value is less than 0.05, the variable Unemployment is however normally distributed because its probability value is greater than 0.05 and led to the failure to reject the null assumption of normality. The model, in general, refutes the null hypothesis that mistakes are regularly distributed.

4.4.2 LM test

Autocorrelation presence was tested and assessed using the LM test. The test 's rule of thumb is to reject the null hypothesis H_0 where the statistical value tested is not greater than the critical value or if the p-value is less than or equal to 0.05.

Table 6 LM test results

Lag order	Chi2	Df	Probability
1	776.776	9	0.0000
2	146.5246	9	0.0000

The probability values for the first and second lag orders (0.000) are both less than 0.05, as shown in the table above, which prevented the premise that there is no autocorrelation in the data from being rejected.

Hypothesis

H_0 : No autocorrelation

H_1 : There is autocorrelation

The Lagrange Multiplier (LM) test results showed that there is no evidence of serial correlation in the residuals of the VAR model. This suggests that the model is well-specified and that the residuals are randomly distributed. The LM test results provide

evidence of the validity of the VAR model, which is essential for reliable policy analysis and forecasting.

4.4.3 Multicollinearity Test

Multicollinearity has a potential effect on the stability and reliability of the model. Data was tested for presence of Multicollinearity. Multicollinearity uses the VIF where if it's less than 10, then shows absence of Multicollinearity. The test results are shown below in Table 7.

Table 7 Multicollinearity Test

Variable	VIF	1/VIF
Life expectancy	2.04	0.489459
Population growth	1.98	0.505834
Unemployment	1.22	0.818145
Mean VIF	1.75	

The test results show that the VIF is 1.75 which means that there is no presence of Multicollinearity, and the study complies with the statistical requirement of VIF being less than 10 to ensure good predictability of the model and better decision making.

The Variance Inflation Factor (VIF) test results showed that there is no evidence of multicollinearity between the variables. This suggests that each variable is providing unique information and that the model is not suffering from multicollinearity. The VIF test results provide evidence of the stability and reliability of the VAR model estimates.

4.4.4 Stability test

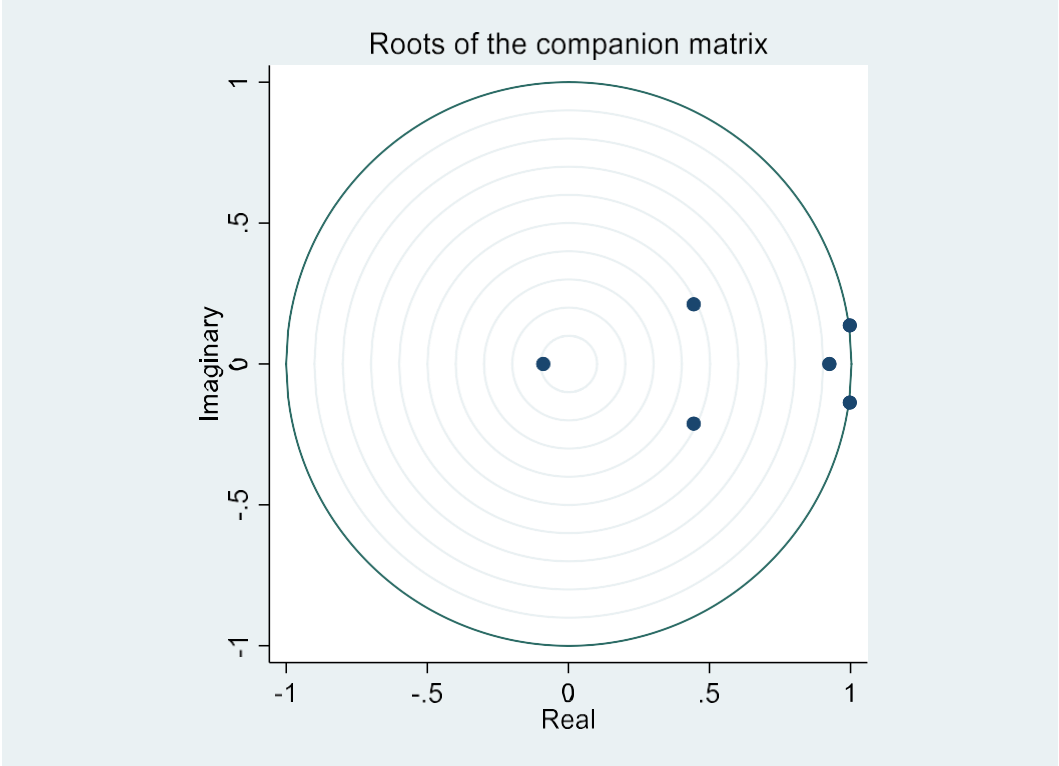
Recursive test on recursive was employed to test the stability of the model was using the residuals. The test results show residuals on the graphical chart illustrated by

plotting them against the zero line. Residuals that fall inside the conventional error bars shows that the stability of a parameter whereas residuals that fall outside the specified error range suggest the instability of the parameter in the equation. The CUSUM test is one of the tests devised by Brown. It sums the cumulative recursive residuals which are subsequently drawn on the graph with lines depicting critical values at 5% significance level. The rule of thumb is that the cumulative recursive total is more than the error bands represented by two critical values, there is instability in the parameter. The formula CUSUM test is as below.

$$W_t = \sum_{r=k+1}^t w_r/s$$

Where $t=k+1$ is the recursive residual s is the standard deviation of the recursive residual. Parameter instability therefore results from the movement of the W_t outside the two critical values.

Figure 1 Stability plot



The graph shows that all values plotted cannot be traced with 95% confidence interval. This that these values are outliers such that they abnormally to low or too high. The graph also shows that the interval space has no values in the model fitting within it. The researcher 's desirable model specification, therefore, fails to support it accurately. This means that the Vector Auto Regressive model fails the stability requirements at 5% significant level based on these findings.

4.5. Conclusion

In conclusion, this study provides new evidence on the relationships between population growth and socio-economic development in Zambia. The results suggest that population growth can have positive effects on socio-economic development, particularly in terms of GDP growth and life expectancy. However, the results also suggest that policymakers should consider the potential negative effects of population growth on unemployment rate, and implement policies to mitigate these effects. The study contributes to the existing literature on population growth and socio-economic development, and provides a framework for policymakers to analyse the relationships between Population growth and Socio-economic Development.

CHAPTER FIVE: PRESENTATION AND ANALYSIS OF RESULTS

5.1 Introduction

This study assessed the impact of population growth on socio-economic development (economic growth, unemployment rate and life expectancy) in Zambia. The Vector Autoregressive Model was used to model the relationship between the explanatory variable (population growth rate) and the explained variables (economic growth, unemployment rate and life expectancy). The detailed interpretation and discussion for the empirical results are presented below.

5.2 Discussion

The section following presents a discussion of findings. This will include population growth and economic growth, Population growth and life expectancy and government spending and economic growth.

5.2.1 Population growth and economic growth

The impact of population growth on economic growth is a difficult subject and relies on several factors including a country's resource base, developmental phase and institutional strength. There are times when population growth contributes positively by increasing the labour force hence employment consequently, promoting investment and economies of scale (Kelley, 1995). For instance, countries with strong institutions and strategic policies take advantage of a youthful, growing population to achieve a demographic dividend, which can significantly increase economic productivity and growth (Bloom D. E., 1998). On the other hand, a fast-growing population puts pressure on natural resources that are not renewable, reduced employment opportunities and average income levels, particularly in resource-constrained, low-income countries with inadequate infrastructure and social structure systems (Coale, 1958). Additionally, a high rate of population growth can increase dependency ratios, which affect savings and investment, undermining continued economic development (Galor, 2011).

The empirical studies and analysis conducted Population growth from 1964 to 2021 has had a positive effect on economic growth with population growth exerting an effect of 0.837325 on Gross Domestic Product (GDP).

Several studies in the literature review earlier indicates that a rising population has a positive effect or negative effect on economic growth depending on the factors under study. The results obtained for this study were in line with the positive effect which is consistent with a study carried out by (Liu, 2024) investigated the bidirectional relationship between demographic changes and economic growth using panel data from several countries. By using panel causality techniques, Lui and others concluded that both population changes and density has a positive influence on Gross Domestic product per capita, emphasizing the importance of demographic factors in shaping economic outcomes. Similarly, (Amundsen, 2022) explored this relationship within agrarian economies by applying a simplified economic model that took account of consumption preferences and resource limitations. Their study concluded that population growth increases economic growth in the short term by expanding the labour force and increasing production levels. Furthermore, (Hashmi, 2019) analysed the impact of population growth considering innovation, environmental regulation and emissions on economic growth in OECD nations. They implored panel data methodology and indicated that population growth enhances economic performance by increasing labour supply and creating higher demand for goods and services, which in turn drives economic activity. These studies together show that when conditions are favourable, a rising population can significantly increase economic development, with results driven by quality of the institution, policy measures, and availability of resource.

The study findings, however, are not consistent with those of Santos and Silva (2022) who focused on Latin American nations between 1990 and 2019, utilized a fixed-effects panel regression model to analyse the relationship between population growth and performance of the economy. Various authors conclude that population growth is detrimental to the progress of the economy more especially in countries high income inequality and struggling in infrastructure development. They recognised that a rise in population provides a large pool for labour supply however, it comes at the detriment of overcrowding in urban areas, high unemployment and sustained pressure on infrastructure which hinders economic growth. The authors argued that addressing inequality and enhancing infrastructure could help mitigate these adverse impacts.

Similarly, (Khan, 2021) in the study of South Asian countries data ranging from 1995 to 2020, using the Autoregressive Distributed Lag (ARDL) model to assess both short-term and long-term effects. Their findings show a negative long-term relationship between population growth and economic growth. Authors have shown that the negative relationship on a fast-raising population puts pressure on resources that are limited already such as water, land and energy. Additionally, rapid population growth creates unemployment and subsequently poverty as citizens cannot afford the basic needs hence at the detriment of economic growth. Research has shown that in some regions population growth is a barrier to economic growth unless there are resource management strategies that create employment as well.

The above analysis has satisfied the first objective of the study. It has proved there is a relationship between population growth and economic growth. The effect of population growth is positive. The first hypothesis of the study of no significant relationship between population growth and economic growth was rejected, as a positive relationship was established.

5.2.2 Population growth and life expectancy

A rising population shown to affect life expectancy in various ways depending on health care quality, economic conditions at the time, and resource availability. Most countries with high population especially in Sub Sahara and parts of Asia have had challenges in provision of quality health care, housing units, food supply and making water accessible and safer to drink. The existing infrastructure has not been enough to support a rising population causing health emergencies with outbreak of diseases like cholera hence reducing life expectancy.

(Bloom D. E., 2017). On the contrary, countries that are developed have leveraged on population growth by increasing labour supply necessary to drive economic activity. They have improved health systems due to advanced knowledge hence improving health care systems thereby better life expectancy increasing access to essential services and resources (Lee, 2021). Studies indicate that age distribution, living standards within the population affect life expectancy. The assertion is that population growth should not be viewed as in direct proportion to economic growth (Boserup E. ,

2019). It was realised that the effects of population growth are difficult much as it determines the quality-of-life expectancy.

This study 's findings supported by appropriate data with population growth with a coefficient of 0.087981 has a significant impact on Zambia 's life expectancy. This agrees with other findings that sought to investigate the impact of population growth on life expectancy sub-Saharan Africa from 1990 to 2018(Siddiqi, 2020). They used panel data regression methodology where they established there is a positive relationship between population growth and life expectancy. The findings linked this positive relationship due to improvement in the health care systems, better nutrition, and better medical care facilitated by economic growth which are believed to have improved life expectancy across countries. In the same vain(Jiang, 2021), conducted a similar study in East Africa in 1995-2020 using the Generalized Method of Moments (GMM) estimation technique methodology where he identified a positive relationship between population growth and life expectancy. The study concluded that a rising population is a reservoir for innovation, better health and access to health services that results into enhanced life expectancy.

Similar research was conducted by (Guerra, 2022) where he investigated the relationship between population growth and life expectancy in Latin America for the period 1990-2022 using the applied fixed-effects panel data mode. Life expectancy was found to have improved due to investments in health care and education. He observed that population growth has a positive effect on life expectancy due to improvements in health and education. The findings in this study are contrary to that of (Patel 2021) who investigated the impact of population growth has on life expectancy in India for a period of 30 years from 1990 to 2020. He implored the panel data analysis methodology with fixed effects model to control regional variations. The results show that those regions that had a fast-growing population had less significant gains and improvements in life expectancy. The conclusion was that population growth has a negative effect on life expectancy because a high population strains infrastructure, health system and socio-economic systems necessary to support quality life because their growth is not commensurate with that of population growth. Population growth increases demand on social services because of overcrowding which worsens health outcomes. Similarly, Khalil and Wang (2023) conducted a study to investigate the effect of population growth

on life expectancy in Sub-Saharan Africa for a period of 24 years from 2000 to 2024. Their methodology centred on longitudinal dataset and applied the Difference-in-Differences. Their finding was consistent with that of (Patel 2021) in that a rising population has a negative relationship on life expectancy. It was seen that population growth do not expand in line with necessary health care system which causes challenges and affect health outcomes. They underscored that population growth has a negative relationship with life expectancy and has potential to cause a health crisis there by worsening life expectancy outcomes.

The authors explained that in regions with underdeveloped healthcare infrastructure, population growth exacerbated existing challenges such as overcrowding and limited access to healthcare, hindering improvements in life expectancy. The findings underscore the negative impact of unchecked population growth in areas with inadequate public health systems.

The study 's second objective to was to determine relationship between population growth and life expectancy. The results show that population growth has a positive relationship on life expectancy. This means that the null hypothesis that there of no significant relationship between population growth and life expectancy is rejected and conclude that population growth has a positive impact on life expectancy.

5.2.3 Government Spending and economic growth

Rapid increase in population is adversely related to employment. When population increases, the labour market becomes saturated as more labour is supplied than is demanded which reduces employment opportunities. More labour supply creates competition which reduces the wage rates. Wage rates have a negative impact on disposable income. When income is low compared to the national average, it worsens life expectancy outcomes. Rapid population increase is one of the main causes of unemployment because of infrastructure challenges that do not grow with the population (Aghion, 2019). Developed countries have a different narrative in that because of advanced infrastructure creates for demand as the population grows hence creating job opportunities (Frey, 2021). This is on the pretext that more labour increases output

when there are no diminishing returns to labour. However, this is affected by unemployment arising due to limitation of resources needed in the production process say a motor manufacturing automobile that runs out batteries due to lack lithium need to manufacture batteries. (Goh, 2020) like other authors argued that a fast-rising population can result into job shortages when the two do not grow at the rate. Empirical evidence show that population growth is directly proportional to a rise in unemployment. However, (Zhang, 2023) using series data and the Vector Auto regression (VAR) model examined the effect of population growth on employment in the Urban parts of China for a period of 14 years from 2010 to 2024. He found out that population growth and unemployment are negatively correlated. He asserted that the rise in population in Urban areas proportionally increased economic activity which created more employment opportunities as Urban growth drove up industrial growth and this helped industries to absorb more workforce due to strong policies and economic policies. In the same vain, Ali and Singh (2021) investigated the relationship between population growth and unemployment from 2000 to 2020 employing panel data with Fixed Effects Model (FEM), accounting for differences across countries while taking into account of the differences among countries. They found out that population growth lowers unemployment especially in those countries with significant investment in infrastructure and education. They showed that population growth can stimulate demand for goods and services which makes industries produce more and in the process of increasing production, industries require more workers to support the increased production and supply hence increasing job opportunities and lowers unemployment. They concluded that nations could overcome the adverse effects of population growth by devising targeted policies in human capital and infrastructure development that supports the commensurate growth in population.

However, these findings can be compared to Wang and Zhang (2020) 's investigation on the connection of population growth and unemployment in Sub-Saharan Africa over the period from 1995 to 2018 where panel data was used and applied Generalized Method of Moments (GMM) for robust estimation. They found out that population growth suppresses employment in those countries whose resource endowment is limited hence suffering from limited economic growth and infrastructure. They indicated that a rise in population did not keep up with job creation causing high unemployment. This was

because dependency ratios and resource availability which was limited to that existent of population growth could not support the increased employment demands.

Similarly, Ranjan and Sharma (2022) also examined how a rise in population could influence unemployment in India from 2000 to 2021 using the Vector Error Correction Model (VECM) to analyse time series data. The study showed that population growth caused unemployment in Urban areas where population rose faster through migration and increased job competition. The study argued that like previous findings from other researchers where population growth should lead to creation of employment due to increased demand for goods and services as factors adjust automatically in support of each other, but migration increases population growth so fast that there is time for factors to adjust automatically and support employment in the like manner. Labour markets are suppressed to the existent that they cannot absorb additional labour.

Further, Bello and Hassan (2024) investigated the connection between population growth and unemployment in the Middle East and North Africa (MENA) region from 2005 to 2020. They used cross sectional data and applied Fixed Effects Model (FEM). They indicated that a rise in population contributed to higher unemployment. This was caused by lack of industrialisation and the private sector that could contribute to job creation. The study revealed that youth and women were the most affected with lack of employment opportunities.

The third objective of this study was to examine population growth affects Zambia's unemployment between 1964 and 2021. The model's findings demonstrate a positive significant relationship between population growth and unemployment. As a result, the null hypothesis that there is no important relationship between population growth and unemployment was rejected and conclude that population growth increases unemployment as investment in infrastructure and industry does not move in tandem in support of a rising population.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1 CONCLUSION

This study sought to analyse the effects of Zambian financial sector development on economic growth in Zambia between 1990 and 2020. The results also highlighted that there exists a significant positive relationship between population growth and the three socio-economic variables namely, economic growth, life expectancy and unemployment. It has been shown that population growth has had a positive effect on the country's economic development efforts as well as in enhancing long life. On the other hand, population growth despite having a positive effect, led to reduction of employment levels in the country.

The study investigated the effect of rising population on social and economic development which was measured in terms of the growth in the economy, employment and life expectancy in Zambia. The researcher employed a Multivariate Vector

Autoregressive Model to determine the relationship between rise in population and explanatory variables of growth in the economy, employment and life expectancy. It is important that government deals with unemployment that comes because of population growth through fiscal policies by diversifying the economy into other sectors and enhance the technology and manufacturing sectors. Government can collaborate with the private sector and offer incentives on tax, provide subsidies and support infant industries and entrepreneurship.

6.2 RECOMMENDATIONS

Based on the findings of this research, it is recommended that that decisions makers in Zambia in matters of policy consider the recommendations outlined below.

6.2.1. Investment in Human Capital Development

Human capital development is key to the development agenda of the country. Therefore, the government should invest in education that provides skills and knowledge where citizens can work on their own than looking for jobs.

6.2.2. Infrastructure Development

Infrastructure is strained when the population grows leading to reductions in the quality of life. The government should consider expanding public infrastructure. The critical ones are schools, hospitals, manufacturing and transport. Schools would improve skills and knowledge that is critical to the health care system and manufacturing.

6.2.3. Innovation and Entrepreneurship programmes

Government should devise policies that promote entrepreneurship. Entrepreneurship brings innovation and technology advancement that improves manufacturing and leads to economies of scale. This would address unemployment issues by citizens creating employment opportunities for themselves and others.

6.2.4. Labour Market Efficiency policies

There are times where unemployment exists due to asymmetries in information about labour markets. Government should create platforms where information can be shared at an affordable cost. There are also cases where unemployment exists because

citizens have skills that are a misfit to the industry. Government can resolve this by devising training programmes that meet industry needs. Unemployment is high among youths, women and the differently abled. Government can devise policies that meet these categories such as reserving certain sectors of the economy for these.

6.2.5. Promote Maternal and Child Health Programs

Government, through the ministry of health, should devise programmes that address infant mortality. Diseases that affect the infants should be identified and immunization done. Government can address the health of infants through nutrition programmes.

6.2.6. Disease Prevention programmes and Campaigns

The country should continue with sensitization initiatives through health campaigns where preventive measures like mosquito nets to prevent malaria and condoms to prevent the spread of HIV/AIDS and Chlorine to treat water are provided affordably. This would improve life expectancy and provide the population with the experience needed and innovation necessary for economic growth and the provision of employment opportunities as production expands grows demand thereby labour markets.

6.2.7. Enhance Social and Economic Policies to Support Healthy Aging

Population is structured in such a way that people 's income tends to increase as they grow, corresponding to their activeness in the labour market. Income tends to reduce as people advance in years especially in retirement. The government should therefore have strong social security systems that promote sustainability as people age so that the economic value of contributions is maintained. Their experience is needed in the later stages of life to guide the young enterprising population. Policies should be aimed at addressing good health living through access to necessities of life such as descent housing, water, food which supports better life expectancy.

6.3 Suggestions for future studies

The study can be justified and defended methodically but does not lack limitations. The use of time series data resulted into the loss parameter during lagging. Future studies use monthly or quarterly data except this data is difficult to find as the authorities and responsible institutions compile it on yearly basis in most countries including Zambia. There is need to study more on economic growth and youth employment visa vis innovation and experience. There is also needed to study more on the effect of lifestyle diseases and economic growth and employment.

Appendix

Bayesian VAR Estimates

Date: 01/12/25 Time: 02:01

Sample (adjusted): 1966 2021

Included observations: 56 after adjustments

Prior type: Litterman/Minnesota

Initial residual covariance: Univariate AR

Hyper-parameters: Mu: 0, L1: 0.1, L2: 0.99, L3: 1

Standard errors in () & t-statistics in []

	GDP	LIFE_EXPECTANCY	UNEMPLOYMENT_RATE
GDP(-1)	0.404779 (0.07279) [5.56104]	0.020583 (0.00950) [2.16773]	-0.121746 (0.04711) [-2.58427]
GDP(-2)	0.031210 (0.04735) [0.65916]	-0.002653 (0.00615) [-0.43102]	-0.016035 (0.03053) [-0.52519]
LIFE_EXPECTANCY(-1)	0.872508 (0.30432) [2.86705]	1.016977 (0.04020) [25.2980]	-0.299948 (0.19808) [-1.51427]
LIFE_EXPECTANCY(-2)	-0.721019 (0.28994) [-2.48682]	-0.077765 (0.03831) [-2.02969]	0.391750 (0.18873) [2.07574]
UNEMPLOYMENT_RATE			
(-1)	-0.135125 (0.08970) [-1.50639]	-0.085859 (0.01177) [-7.29614]	0.613697 (0.05867) [10.4595]
UNEMPLOYMENT_RATE			
(-2)	-0.008811 (0.06743) [-0.13068]	-0.026552 (0.00885) [-3.00175]	0.099580 (0.04427) [2.24961]
C	-9.258211 (3.92179) [-2.36071]	3.794812 (0.51387) [7.38476]	-1.694246 (2.54946) [-0.66455]

POPULATION_GROWTH

_RATE	0.837325 (0.13579) [6.16642]	0.087981 (0.01775) [4.95586]	0.194482 (0.08811) [2.20729]
R-squared	0.947868	0.995680	0.879443
Adj. R-squared	0.940265	0.995050	0.861861
Sum sq. resids	216.4340	7.369943	88.46188
S.E. equation	2.123450	0.391842	1.357555
F-statistic	124.6772	1580.471	50.02151
Mean dependent	8.407653	51.79882	12.42236
S.D. dependent	8.688192	5.569452	3.652581

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	-0.336964	0.9123
Test critical values:		
1% level	-3.550396	
5% level	-2.913549	
10% level	-2.594521	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(GDP)

Method: Least Squares

Date: 01/13/25 Time: 09:15

Sample (adjusted): 1965 2021

Included observations: 57 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP(-1)	-0.010075	0.029898	-0.336964	0.7374
C	0.437066	0.346650	1.260828	0.2127
R-squared	0.002060	Mean dependent var		0.357257
Adjusted R-squared	-0.016084	S.D. dependent var		1.895817
S.E. of regression	1.911002	Akaike info criterion		4.167590
Sum squared resid	200.8561	Schwarz criterion		4.239276
Log likelihood	-116.7763	Hannan-Quinn criter.		4.195450
F-statistic	0.113545	Durbin-Watson stat		1.677164
Prob(F-statistic)	0.737426			

Null Hypothesis: LIFE_EXPECTANCY has a unit root

Exogenous: Constant

Lag Length: 1 (Automatic - based on SIC, maxlag=10)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-2.432162	0.1378
Test critical values:		
	1% level	-3.552666
	5% level	-2.914517
	10% level	-2.595033

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(LIFE_EXPECTANCY)

Method: Least Squares

Date: 01/13/25 Time: 09:37

Sample (adjusted): 1966 2021

Included observations: 56 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LIFE_EXPECTANCY(-1)	-0.016844	0.006925	-2.432162	0.0184
D(LIFE_EXPECTANCY(-1))	0.983559	0.051991	18.91781	0.0000
C	0.872713	0.352523	2.475617	0.0165

R-squared	0.881006	Mean dependent var	0.284071
Adjusted R-squared	0.876515	S.D. dependent var	0.709954
S.E. of regression	0.249481	Akaike info criterion	0.113213
Sum squared resid	3.298753	Schwarz criterion	0.221714
Log likelihood	-0.169957	Hannan-Quinn criter.	0.155278
F-statistic	196.1994	Durbin-Watson stat	2.228837
Prob(F-statistic)	0.000000		

Null Hypothesis: D(LIFE_EXPECTANCY) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=10)

t-Statistic Prob.*

Augmented Dickey-Fuller test statistic		-3.383774	0.5838
Test critical values:	1% level	-3.552666	
	5% level	-2.914517	
	10% level	-2.595033	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(LIFE_EXPECTANCY,2)

Method: Least Squares

Date: 01/13/25 Time: 09:39

Sample (adjusted): 1966 2021

Included observations: 56 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LIFE_EXPECTANCY(-1))	-0.068487	0.049493	-1.383774	0.1721
C	0.019788	0.037547	0.527014	0.6003
R-squared	0.034245	Mean dependent var		0.000357
Adjusted R-squared	0.016361	S.D. dependent var		0.262746
S.E. of regression	0.260588	Akaike info criterion		0.183309
Sum squared resid	3.666932	Schwarz criterion		0.255643
Log likelihood	-3.132661	Hannan-Quinn criter.		0.211353
F-statistic	1.914831	Durbin-Watson stat		1.933950
Prob(F-statistic)	0.172121			

Null Hypothesis: D(LIFE_EXPECTANCY) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.383774	0.5838
Test critical values:	1% level	-3.552666	
	5% level	-2.914517	
	10% level	-2.595033	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(LIFE_EXPECTANCY,2)

Method: Least Squares

Date: 01/13/25 Time: 09:39

Sample (adjusted): 1966 2021

Included observations: 56 after adjustments

Variable	Coefficien	t	Std. Error	t-Statistic	Prob.
D(LIFE_EXPECTANCY(-1))	-0.068487		0.049493	-1.383774	0.1721
C	0.019788		0.037547	0.527014	0.6003
R-squared	0.034245		Mean dependent var		0.000357
Adjusted R-squared	0.016361		S.D. dependent var		0.262746
S.E. of regression	0.260588		Akaike info criterion		0.183309
Sum squared resid	3.666932		Schwarz criterion		0.255643
Log likelihood	-3.132661		Hannan-Quinn criter.		0.211353
F-statistic	1.914831		Durbin-Watson stat		1.933950
Prob(F-statistic)	0.172121				

Null Hypothesis: D(UNEMPLOYMENT_RATE) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.542446	0.0000
Test critical values:	1% level	-3.552666	
	5% level	-2.914517	
	10% level	-2.595033	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(UNEMPLOYMENT_RATE,2)

Method: Least Squares

Date: 01/13/25 Time: 10:00

Sample (adjusted): 1966 2021

Included observations: 56 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(UNEMPLOYMENT_				
RATE(-1))	-0.725035	0.130815	-5.542446	0.0000
C	0.087778	0.166420	0.527447	0.6000
R-squared	0.362596	Mean dependent var		-0.002179
Adjusted R-squared	0.350793	S.D. dependent var		1.538268
S.E. of regression	1.239434	Akaike info criterion		3.302248
Sum squared resid	82.95469	Schwarz criterion		3.374582
Log likelihood	-90.46296	Hannan-Quinn criter.		3.330292
F-statistic	30.71870	Durbin-Watson stat		1.898207

Prob(F-statistic) 0.000001

Null Hypothesis: UNEMPLOYMENT_RATE has a unit root

Exogenous: Constant

Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.123221	0.2366
Test critical values:	1% level	-3.552666	
	5% level	-2.914517	
	10% level	-2.595033	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(UNEMPLOYMENT_RATE)

Method: Least Squares

Date: 01/13/25 Time: 10:02

Sample (adjusted): 1966 2021

Included observations: 56 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UNEMPLOYMENT_R				
ATE(-1)	-0.092237	0.043442	-2.123221	0.0384
D(UNEMPLOYMENT_				
RATE(-1))	0.300634	0.127338	2.360925	0.0219
C	1.219156	0.556727	2.189862	0.0330

R-squared	0.148091	Mean dependent var		0.121893
Adjusted R-squared	0.115944	S.D. dependent var		1.277368
S.E. of regression	1.201036	Akaike info criterion		3.256329
Sum squared resid	76.45185	Schwarz criterion		3.364830

Log likelihood	-88.17722	Hannan-Quinn criter.	3.298395
F-statistic	4.606610	Durbin-Watson stat	1.911946
Prob(F-statistic)	0.014303		

Null Hypothesis: POPULATION_GROWTH_RATE has a unit root

Exogenous: Constant

Lag Length: 4 (Automatic - based on SIC, maxlag=10)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	2.236127	0.9999
Test critical values:		
	1% level	-3.560019
	5% level	-2.917650
	10% level	-2.596689

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(POPULATION_GROWTH_RATE)

Method: Least Squares

Date: 01/13/25 Time: 10:03

Sample (adjusted): 1969 2021

Included observations: 53 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
POPULATION_GROWTH_RATE(-1)	0.001900	0.000849	2.236127	0.0301
D(POPULATION_GROWTH_RATE(-1))	2.076903	0.128537	16.15798	0.0000
D(POPULATION_GROWTH_RATE(-2))	-1.818663	0.280100	-6.492902	0.0000
D(POPULATION_GROWTH_RATE(-3))	1.228389	0.284397	4.319278	0.0001

D(POPULATION_GROWTH_RATE(-4))	-0.549753	0.137578	-3.995945	0.0002
C	-0.000308	0.001710	-0.180408	0.8576
R-squared	0.999138	Mean dependent var	0.291395	
Adjusted R-squared	0.999046	S.D. dependent var	0.146800	
S.E. of regression	0.004535	Akaike info criterion	-7.847917	
Sum squared resid	0.000966	Schwarz criterion	-7.624865	
Log likelihood	213.9698	Hannan-Quinn criter.	-7.762142	
F-statistic	10890.41	Durbin-Watson stat	1.982418	
Prob(F-statistic)	0.000000			

Null Hypothesis: POPULATION_GROWTH_RATE has a unit root

Exogenous: Constant

Lag Length: 4 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		2.236127	0.9999
Test critical values:	1% level	-3.560019	
	5% level	-2.917650	
	10% level	-2.596689	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(POPULATION_GROWTH_RATE)

Method: Least Squares

Date: 01/13/25 Time: 10:03

Sample (adjusted): 1969 2021

Included observations: 53 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
POPULATION_GROWTH_RATE(-1)	0.001900	0.000849	2.236127	0.0301
D(POPULATION_GROWTH_RATE(-1))	2.076903	0.128537	16.15798	0.0000
D(POPULATION_GROWTH_RATE(-2))	-1.818663	0.280100	-6.492902	0.0000
D(POPULATION_GROWTH_RATE(-3))	1.228389	0.284397	4.319278	0.0001
D(POPULATION_GROWTH_RATE(-4))	-0.549753	0.137578	-3.995945	0.0002
C	-0.000308	0.001710	-0.180408	0.8576

R-squared	0.999138	Mean dependent var	0.291395
Adjusted R-squared	0.999046	S.D. dependent var	0.146800
S.E. of regression	0.004535	Akaike info criterion	-7.847917
Sum squared resid	0.000966	Schwarz criterion	-7.624865
Log likelihood	213.9698	Hannan-Quinn criter.	-7.762142
F-statistic	10890.41	Durbin-Watson stat	1.982418
Prob(F-statistic)	0.000000		

Null Hypothesis: D(POPULATION_GROWTH_RATE) has a unit root

Exogenous: Constant

Lag Length: 3 (Automatic - based on SIC, maxlag=10)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-6.770920	0.8190
Test critical values:		
	1% level	-3.560019
	5% level	-2.917650
	10% level	-2.596689

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(POPULATION_GROWTH_RATE,2)

Method: Least Squares

Date: 01/13/25 Time: 10:07

Sample (adjusted): 1969 2021

Included observations: 53 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(POPULATION_GROWTH_RATE(-1))	-0.004176	0.005418	-0.770920	0.4445
D(POPULATION_GROWTH_RATE(-1),2)	1.137401	0.131702	8.636184	0.0000
D(POPULATION_GROWTH_RATE(-2),2)	-0.700971	0.182554	-3.839802	0.0004
D(POPULATION_GROWTH_RATE(-3),2)	0.462736	0.137348	3.369071	0.0015
C	0.001901	0.001453	1.308888	0.1968
R-squared	0.721462	Mean dependent var	0.007878	
Adjusted R-squared	0.698251	S.D. dependent var	0.008592	
S.E. of regression	0.004720	Akaike info criterion	-7.784551	
Sum squared resid	0.001069	Schwarz criterion	-7.598675	
Log likelihood	211.2906	Hannan-Quinn criter.	-7.713072	
F-statistic	31.08214	Durbin-Watson stat	1.894070	
Prob(F-statistic)	0.000000			

. varstable, graph

Eigenvalue stability condition

Eigenvalue	Modulus
.9939524 + .1369901i	1.00335
.9939524 - .1369901i	1.00335
.9217803	.92178
.4417013 + .2117111i	.489818
.4417013 - .2117111i	.489818
-.09046624	.090466

At least one eigenvalue is at least 1.0.
VAR does not satisfy stability condition.

. varwle

Equation: gdp

lag	chi2	df	Prob > chi2
1	116.7908	3	0.000
2	25.89214	3	0.000

Equation: unr

lag	chi2	df	Prob > chi2
1	85.84886	3	0.000
2	5.923475	3	0.115

Equation: lfe

lag	chi2	df	Prob > chi2
1	637.1114	3	0.000
2	131.5712	3	0.000

Equation: All

lag	chi2	df	Prob > chi2
1	776.776	9	0.000
2	146.5246	9	0.000

. corr gdp pgr unr lfe
(obs=58)

	gdp	pgr	unr	lfe
gdp	1.0000			
pgr	0.9022	1.0000		
unr	-0.1495	0.1348	1.0000	
lfe	0.7810	0.6424	-0.2235	1.0000

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