HUMAN CAPITAL DEVELOPMENT AND ECONOMIC GROWTH IN RWANDA

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DECLARATION

I hereby declare that this project is my authentic and original work for the purpose of gaining masters' degree of science of economics, and it has not been presented for the purpose of attaining a degree in any other university or any other organization for award, I also declare that any secondary data used herein has been dully acknowledged.

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SIGNITURE ……

DATE ……..

APPROVAL

I, Dr GISANABAGABO SEBUHUZU certify that Miss IRENE UWANYIRIGIRA a candidate at MSCE/ULK has conducted research of HUMAN CAPITAL DEVELOPMENT AND ECONOMIC GROWTH IN RWANDA under my supervision.

Name: Dr GISANABAGABO SEBUHUZU

Signature: …….

Date: …….

DEDICATION

This work is dedicated to my loving family and friends for their continued contribution including but not limited to patience, financial and moral support during this period studying and carrying out this work. May Almighty God bless you all!

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First and foremost, I thank God for blessings and precious life to achieve this milestone, all glory and honor belong to him. I express my gratitude to family and friends, but most important I want to express my gratitude to MRS Ursula for her great contribution to my education growth. I express my gratitude to the founder and the whole management of KIGALI INDEPENDENT UNIVERSITY for great initiative they make towards education development for many Rwandans. My appreciation expressed to all lectures at MSCE for all assistance, knowledge rendered during this two years' program, without them I couldn't be to this level. As well as this dissertation is concerned, I want to express my sincerely gratitude to my supervisor Dr GISANABAGABO SEBUHUZU for his endless support, encouragement rendered during this period. Lastly, I thank my fellow classmates for their teamwork; support efforts and encouragement are highly appreciated.

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ABSTRACT

Rwanda's economic growth has been dramatically increased overtime since 2000, where there have been strategies settled to encourage economic growth and shape the brighter future for economic growth as well as development of Rwanda. Human capital development has been one of the primary elements that encourage growth in different ways as it is consensus that it contributes to economic growth, therefore this study analyzes this relationship between human capital development and economic growth in Rwanda by employing time series data from 2000 to 2022 based on endogenous growth theory. The model built for Gross domestic product considered as the proxy for economic growth whereas human capital explained by school enrollment for secondary and tertiary as the proxies for education sector then life expectancy from birth is the proxy for health sector in the model. Econometrics methods employed to analyze this economic relationship where ADF test conducted to check the stationarity of variables within the model, Johnsen cointegration test and Error correction model were employed to analyze short run and long run relationship of the variables in the model and other diagnostic tests also conducted. The study findings confirm that all variables used such as gross domestic product, gross capital formulation, labor force, life expectance, school enrollment(secondary and tertiary) have become stationary at their first difference which is in good line of Johnsen test results that the variables are cointegrated, the ECM revealed by findings that short run adjustment towards long run relationship at 38% of shocks should be adjusted within the short run, also diagnostic test results confirm the reliability of the estimated parameters in the model and their economic meaning. Drawing forward, this research therefore recommends the need to continue to strength human capital as one of the centers of future drivers of growth towards 2035 targets through its main primary element of education sectors like Improve innovative skills of university-educated from leaning by doing which is a hope to encourage positive returns from labor participation, to reduce the over-schooling gender gap and improvement in labor market outcomes for upper-secondary educated workers by providing more TVET opportunities and better computer skills and encourage studying in fields which showcase higher levels of demand. For health sector the study recommends the provision of more health care and health services.

Key words: Gross Domestic Product, Human Capital Development, Co-integration and Error Correction Model.

ABBREVIATIONS

EDPRS: Economic Development Poverty Reduction Strategy

SDGS: Sustainable Development Goals

ESSP: Education Sector Strategic Plan

PSD: Priority for Skills Development

RPHC 5:5th Rwanda Population and Housing Census

PRS-1: Poverty Reduction strategies (1)

NST1: National Strategy for Transformation

ADF: Augmented Dickey-Fuller Unit-Root test

CE: Cointegration Equation (s)

ECM: Error Correction Model

GDP: Gross Domestic Product

HCI: Human Capital Index

MINECOFIN: Ministry of Finance and Economic Planning

NISR: National Institute of Statistics of Rwanda

OLS: Ordinary Least Square

WB: The World Bank

WDI: World Development Indicators

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CHAPITER 1.

1.1. GENERAL INTRODUCTION

Economic growth has historically been a key topic of concern in both emerging and advanced nations. It has generated increased interest over the years, due to new economic growth theories that have mostly focused on the primary long-term drivers of economic development, resulting in demonstrated effects on the economic prosperity of nations. African nations, or developing countries, continue to experience poor pay, growing unemployment, high poverty, and high inflation (Veledinah, 2014)). According to development and growth theories, the main aspects influencing long-term economic growth and development are the accessibility of capital and work, in addition to productivity and mechanical innovation. This requests the increase in investment in productivity as well as capital production investment.

Economic growth and development depend strongly on human resource development (Hakooma, 2017). It starts from individual level, organization, and then the country as the world of work evolves, and when the pace of change is so rapid, then employee connection, engagement, wellbeing and organizational culture becomes even more important. Not only because of their impact on staff retention, attraction and development, but also as the critical foundations contributing to organizational stability, security and success.

According to the Swedish Agency for Development Evaluation (2007), the key inputs are labor and capital, which are usually considered in production models, but GDP is viewed as the final outcome in an economy's production process. Countries with high labor intensity appear to be among the least productive (Swedish Agency for Development Evaluation, 2007). Relatively capital-intensive nations are believed to employ resources more efficiently and to have higher development efficiency.

Since 1950s, many search has been conducted on existing relationship between economic growth and human capital and their recommendations has been implemented but there is still a gap that

Human capital is still low dues to low capacity of education and health sectors to added same value on outcomes of general economic productivity as well as growth.

1.2. BACKGROUND OF THE STUDY

Human capital encompasses qualities like education training, intelligence skill and health. It crucial for economic growth in global knowledge economy. Rwanda has made significant progress in improving its human capital through initiatives like vision 2020 and sustainable development goals after 1994 genocide where the country has been in general disorientation and confusion about the future. from 2000 the country's leadership gave a concrete solid direction and drive drawn from a clear vision of the future known as Vision 2020 where the main priorities were national security, economic reconstruction, food production, infrastructure construction including housing and roads, education and health care and ensuring justice was served for all Rwandans. Vision 2020 targets has been achieved including human resources which was improved in EDPS1(2008-12) where there was a significant progress particularly in health and education , so that Rwanda can become a knowledge-based economy as well as the GDP growth rate of 11.5% as target achievement of EDPRS 2(2013-18) The sustainable development goals(3 and 4) SDGS following the previous economic program achievements has emphasize the need of the government ensure a healthy existence and promote wellbeing for all ages of the Rwandans by ensuring inclusive quality and equitable education with life- long leaning opportunities for all stages. Education policies like Education Sector Strategic Plan (ESSP) and priority for skills development (PSD) has been implemented and modified for initiative of better lives and meeting the labor market demands of Rwandans of all ages.

PRS-1 acknowledged that education is more linkage to poverty in many different of ways , firstly lack of education is a defining character of under growing economy , since there is evidence that completion primary school can raise income by around 40% while also improving agriculture outputs and small business growth, secondary primary school has a positive return on health particularly on girl's education which has an impact on child mortality, mobility and fertility rate (Bigsten, 2005). The government of Rwanda is undergoing a shift from an economy based on subsistence-oriented agriculture to a modern service-oriented economy through investing in her people to overcome many developments constraints: poverty, land scarcity, high

fertility and low base of mineral resources among others (Nkurunziza, 2015).The current and upcoming industries that are major economic drivers and have the potential to significantly contribute to job creation and productive employment will be the focus of capacity development under NST1. Priority sectors include energy, agriculture; private sector development; environment and natural resources; urbanization; transport; tourism; manufacturing and ICT. (NST1, 2017) Through the difference policies Education and skills development policies have been implemented to enhance the wellbeing and employability of the Rwandan population. The recent Rwanda population and housing census (RPHC 5) highlight improvement in the health and education sector but also reveals the need for continued progress particularly in rural areas, The RPHC results show that 2,954,770 of the Rwanda resident population (about 22.3%) have never been to school. Urban areas had the lower proportion of individuals with no schooling (18%) as compared to rural areas 24% (RPHC5, 2022).

As an aspiration of Rwanda future growth to become middle income country by 2035, one of the main elements of growth strategy is highly developed of human capital which estimated as important positive factor of economic growth, where there are aspirations translate into double digit average annual growth rates that will make Rwanda to grow faster than any other country. Many reports have shown a great growth rapidly in economies have made great investments in education and health of the citizens. Thus, human capital includes the skills and knowledge of the citizens and its directly results of investment in health and education whereas human capital investment and economic growth are macroeconomic variables that are related in same direction, which means a greater human capital investment increases economic growth and greater economic growth finances great human capital development.

Basing on the published report of labor force survey published by NISR in 2022 it briefly highlights the share of labor force participation considering their education level.

1.2.1 LABOR FORCE PARTICIPATION BY EDUCATION LEVEL

From the analysis of labor force participation by education level it can be observed that the higher education level the more labor force participation increase, In February 2023(Q1), the labor force participation rate among youth aged 16 to 30 years (53.9 percent) increased by 4.4 percentage points compared to February 2022(Q1). For the age group 31-54 years old, the LFPR was 71.4 percent in February 2023, and it has not changed as compared to the same quarter one year back (February 2022). For the age group 55 years old and above, the labor force participation rate in February 2023(Q1) increased by 3.7 percentage points as compared to February 2022(Q1) (NISR, Labor force survey, 2023)

This shows a great contribution of education in labor participation differ to the education level thus an increase in education attendance in higher education level increase the labor force participation which is essential character for production in economy output.

In the health sector, having a healthy workforce is critical to the country's economic productivity; data indicate that a one-year increase in life expectancy at birth could raise GDP by up to 4%. (World Bank, 2018),The 5th population and housing census has revealed that the country's life expectancy from birth has increased from 51.2 years in 2002 to 69.6 years in 2022 which shows health sector improvement .

By considering all achievements of different strategies of sound economic growth, and Rwanda' growth aspiration of 2035, where highly human capital development has been and continue to be the main center of drivers of economic growth, it is in this line that the study want to analyze the relationship between human capital development and economic growth in Rwanda.

1.2.2 OVERVIEW OF ECONOMIC GROWTH OF RWANDA

Rwanda has been made a successful macroeconomic performance and example of success re construction country, following the past economic and social chocks that hind the development, Rwanda embarked an amazing economic reconstruction based on good and stable economic policies and development program such as EDPRS 1,2 VISION 2020,7YGP where the main objective is to build strong economy known as knowledge based economy , thus this has been an

attracting factor of the world to invest in Rwanda which has been a crucial effect on economic growth. Referring to the ambitious of Rwanda in NST 1 goals, Rwanda want to become middle-income country by 2035, however the challenges still remain, which include skills and knowledge, good health indicators where numbers of policies has been implemented but need to be evolved depending changing needs of the economy.

For the country to remain on its path of economic transformation, the macroeconomic framework for NST1 requires average GDP growth of 9.1% for the NST1 period. This will need significant efforts to increase both public and private investment financed by domestic savings and capital inflows; massive improvements in education; significant increases in land efficiency and innovative capacity; and sustained efforts to increase tradable goods and services production. At the same time, as Rwanda continues to benefit from a demographic dividend with a growing labor force, the expanding working-age percentage of the population should bring improvements in per capita income, incorporating to strong economic growth rates. ((NST1, 2017).

Referring to the report of MINECOFIN 2022, it clearly shows the significant economic transformation since 2000 and has made substantial progress in different aspects of the economy, where GDP has been increased on average more than 7% and in some years surpassed 10% except for some years(2003,2013,2017 and 2020) due to some global economic shocks the latter year Covid-19 putted Rwanda in recession like in many world country , recently the GDP grew by 9.2% in the first quarter 2023 and 6.3 in the second quarter following 8.2% growth in 2022 which is on the above graph . The economy of Rwanda has shown an ambitious increase for the past decades, where GDP has been growing by relation to the projections statistics, this was achieve due to the force that has been inverted in investment sector both private and public to support other economic activities.

The GDP performance has been supported by improvement in different aspects of the economy and one typical example is the Human Capital.

1.2.3 Human Capital Index (HCI)

The Human Capital Index (HCI) estimates how much human capital children born today may anticipate having by the age of 18. Both the World Bank and the World Economic Forum employ different methods to calculate the HCI, although they appear to utilize the same indicators in general.

Focusing on the World Economic Forum, the five main indicators being of the HCI are: child survival, school enrollment, quality learning, healthy growth, and adult survival. The HCI was constructed for 157 countries. According to the World Economic Forum, in 2015 Rwanda was at the 113th place, in 2016 it was at 118th, and in 2017, at 71st place. It is important to note that although Rwanda is among the lowest ranking countries, it has been improving overtime. According to the World Bank Report, Rwanda was 142 among 157 countries in the world.

1.2.3.1 World Bank Methodology

The World Bank Group first launched the Human Capital Index Project in October 2017 and the very first HCI report was release this October, in 2018. Their Index is made of the three components which are survival, Expected Learning Adjusted Years of School and Health There is no single broadly accepted, directly measured and widely available metric of health that is analogous to years of school as a standard metric of education attainment. In the absence of such measure, two proxies for the overall health environment are used to populate this component of the index: (i) adult survival rates, defined as the fraction of 15-year-old that survive until age 60, and (ii0 the rate of stunting for children aged 5.

1.2.3.2. World Economic Forum Methodology

The World Economic Forum Report's Global Human Capital Index strives to give an in-depth evaluation of a country's human capital across its population. It allows for accurate comparisons across geographies, generations, and economic levels.

An indicator must contain data for at least half (50%) of the sample nations to be included in the Index. The indicators' values are derived from publicly available data produced by international organizations such as the International Labor Organization (ILO) and the United Nations Educational, Scientific, and Cultural Organization (UNESCO). The Global Human Capital

Index's structure. Capacity, advancements, deployment, and know-how account for 25% of the overall index score. Capacity sub-index features the four common measure of formal education attainment which are Literacy and numeracy, Primary education attainment rate, Secondary education attainment rate and Tertiary education attainment rate.

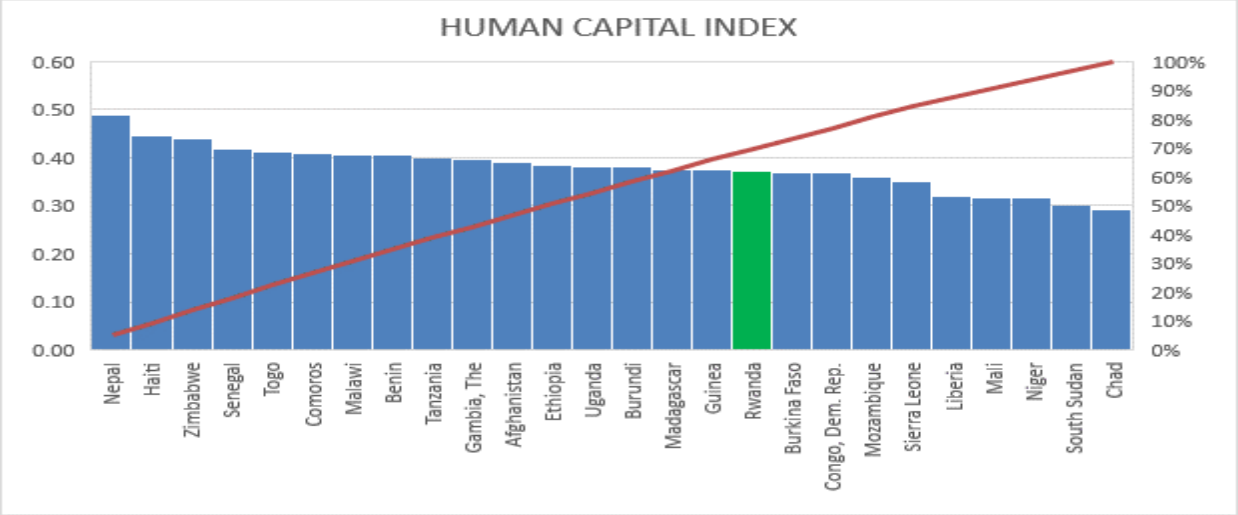
1.2.4. The state of the human capital in Rwanda

Human Capital Index- A child born in Rwanda today is on 37 percent as productive as he/she could be if he/she received an adequate education along with good health. However, this has been primarily challenged by the fact that there is a negative association between school completion, complete health, and age, indicating that the younger generations of children are at risk. University graduates are finding it increasingly difficult to obtain jobs that match their education, resulting in an impact on their health.

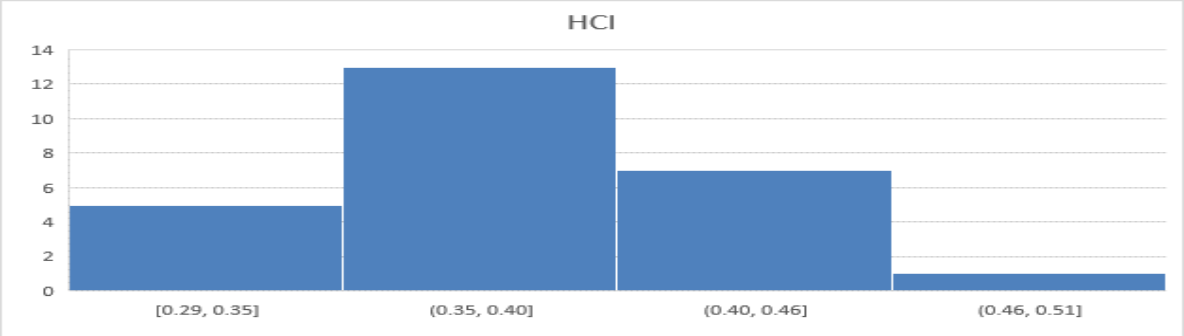
This is what has been seen in recent years, when Rwanda has witnessed a dramatic growth in higher school enrollment, resulting in an increase in the number of highly educated persons in the job market. As one of the six pillars of future growth, developing human capital should be viewed as a good development. However, if the rise in the number of university-educated workers is not matched by a corresponding rise in demand for highly trained individuals, there may be a mismatch between the supply and demand for tertiary schooled labor. Such a mismatch will make it difficult to obtain positions that meet their skill level, as well as the corresponding compensation expectations for those who have recently graduated. As the length of unemployment continues, workers' expectations will fall, and they may finally opt to choose a job that needs less education than tertiary degree (over-schooling). In contrast, excellent health is associated with a decent salary and a good employment.

HCI Rwanda rank among other low-income countries

Rwanda in Comparison to Countries with Similar Income:



0-1HUMAN CAPITAL INDEX COMPARISON



Source: *World Economic Forum0-2HUMAN CAPITAL INDEX OF RWANDA*

Rwanda ranks 17th among the 26 low-income nations, with an HCI of 0.37. Nepal has the greatest HCI in low-income nations, at 0.49, while Chad has the lowest, at 0.29.

Because the quantity of human capital that a kid born today may anticipate obtaining by the age of 18, which reflects the level of the Human Capital Index (HCI), is still an area of concern in Rwanda despite significant improvements achieved.

As reported by the World Bank, to encourage human capital creation, a comprehensive range of policies is required. Building human capital necessitates a wide range of interventions throughout the life cycle, beginning with investments in early childhood, such as prenatal and early child nutrition and cognitive stimulation, and continuing with high-quality basic education, higher education opportunities, and skills that individuals gain as adults, both through on-the-job training and adult education. Interventions also include health investments that go beyond early childhood nutrition, such as childhood vaccines and preventative and curative health care for children and adults. Finally, a healthy economy invests in innovation to keep creating new possibilities.

0-3DRIVESRS OF GROWTH

Source: world Bank, 2022

Building an innovation-led economy, as well as making the most of growing integration (particularly in services trade) and agglomeration, would necessitate significantly larger human capital investments. Such expenditures, particularly in the priority areas of lowering stunting and basic education, contribute to growth only after a long period of time, therefore moving on them early is critical for Rwanda's economic ambitions.

Building human capital necessitates a wide range of investments across the life cycle. Rwanda has made a strong effort the improvement of human capital as the major key to support social and economic transformation, where education and health as the important effects variables for human capital development has been given a concern as seen in different government development plans. Despite the better achievements in the education sectors, a report by the world bank on the future drivers of economic growth in Rwanda identified the development of world class human capital as the first reform priority with emphasis on quality of education which is a primary key for human capital development, put in consideration of health sector, a healthy labor force is an important for economic productivity of the country.

1.3. PROBLEM STATEMENT

Rwanda has ambitious target of becoming an upper middle-income country by 2035 and a high-income country by 2050.Notwithstanding for great effort made to the way of development, there is still a journey to go for Rwanda to achieve its 2035 and 2050 targets, because human capital that is to drive the economy has not increased sufficient in relation of Rwanda dreamed target of becoming an upper middle income country by 2035. Education and health sectors as the main principal components of human capital development as evidence from the World Bank report on Human development index, Rwanda has increased from 0.31score in 2001 to 0.53score in 2020 growing of an average annual rate of 2.24% (World Bank, 2020).

It is in this line that studying the effect of human capital development on economic growth is important for Rwanda to build a long-lasting solution for growth and development as well as the improvement of human capital development.

1.4. RESEARCH QUESTIONS/HYPOTHESES OF THE STUY

The following are the questions the findings of this research tried to address by finding their solutions.

- Is there a relationship between human capital development and economic growth in Rwanda?
- Is there a long run relationship between education and economic growth?

1.5 RESEARCH OBJECTIVES

1.5.1 GENERAL OBJECTIVE

The main objective of this study is to analyze the effects of human capital development and economic growth in Rwanda.

1.5.2. SPECIFIC OBJECTIVES

For the general objective to be achieved it must be supported by specific objectives

- Examine the role of education in economic growth.
- Find the role of health indicator on economic growth.
- To quantify the long run and short run relationship between chosen human capital proxies and economic growth in Rwanda.

1.6 SCOPE OF THE STUDY

1.6.1 DELIMITATION IN DOMAIN

The study is based on a macroeconomics assessment.

1.6.2 DELIMITATION IN SPACE

Regarding on delimitation of space, this study focuses on Rwanda

1.6.3 DELIMITATION IN TIME SCOPE

This study consists of the analysis of human capital development and economic growth in Rwanda for the period of 22 years from 2000 to 2022.

1.7 SIGNIFICANCE OF THE STUDY

This study is by the nature of endogenous growth theory of economic growth and human capital theory, much research has been conducted on the same topic over the past years, but they have not really show up and analyses the real effect of human capital development on economic growth. As the human capital development has a lot of effect to progress not only economic growth of a nation but also its economic development, it is in this view that the emphases analysis of direct effect of human capital development on economic growth of a country is a most important especially for Rwanda as a country that has aspiration to increase its knowledge based and technology in the progress economic growth of the country. On academic side the study findings will help the future student as a reference and knowledge addition for their research, The policy makers also will be based on the findings of this study to formulate policies, directives and regulations that will impact the economic growth.

1.8. LIMITATION OF THE STUDY

The study of Human capital development and economic growth in Rwanda using time series data for the last 22 years from 2000 to 2022 has the valuables insights for this macroeconomic analysis , but it is important to acknowledge the limitations of this study where one main limitation is data is that the student enrolment for both secondary and tertiary education data can't catch up well the learning outcomes from education sector , the second limitation is that data for the other variables that can be matched to measure human capital development are verry rare to find their data and it is not considered in this analysis .

1.9 DATA COLLECTION AND ANALYSIS THECHINICS

To examine the effects of human capital on economic growth, annual secondary data for variables that include GDP per capita, gross secondary school enrollment, gross tertiary school

enrollment, and health expenditure are used. The World Bank and NISR are the source of all the data, the data spans the years 2000 to 2022 and reflects fair time series data set.

EVIEWS 10 statistical software will processes the data and estimate econometric time series. The following econometrics tests will be specifically carried out to address methodological problems that might otherwise develop issues that could otherwise evolve. ADF for unit root test will be used to test the stationary of variables, it is important to see the stability of statistical parameters (mean and standard deviations) are not with the time change, this will guarantee the stability of data set and results for the best estimates. The Johansen cointegration test is going to be used to check that the variables will move closely together with no drift and their distance will be stationary over time, it is most important for testing the cointegration as the step to check the empirical meaningful relationship between the variables in model. The ECM will be employed in the model as the best standard of time series model to deal with non-stationary data series and separates the long run and short run, the model will be built in the way of limit the long run behavior of endogenous variables to meet their long run relationship, thus this all to adjust the model for dynamic in short run and show the stable long run relationship at equilibrium state.

1.10 STRUCTURE OF THE THESIS

The five chapters of this study are as follows: The study's introduction, problem statement, research objectives, and study scope will be all presented in the first chapter. The theory and empirical findings on education and health will be discussed in the second chapter. The methodology, model specification, data, sources, and estimation procedures will be displayed in the third chapter. The results are discussed in the fourth chapter in accordance with the study's objectives. The main findings, conclusion, and possible recommendations will be given in the final chapter.

CHAPITER 2: LITERATURE REVIEW

2.1 INTROCUTION.

Much research have been conducted both in developed as well as in developing country to study the relationship between two of the most important economic variables known as human capital development and economic growth, numerous empirical conclusion on their relations have been delivered from numerous studies that examined the relationship between human capital development and economic growth.

As a result, this section provides summaries of literature review focuses on the theoretical and empirical literature aspects of the subject, with a particular emphasis on education and health as the two most important components of human capital development and how they connect to economic growth.

2.2 **KEY CONCEPTS**

In this research, the definition of human capital development and economic growth are going to be defined deeply by referring to the related works being conducted with others.

2.2.1 HUMAN CAPITAL DEVELOPMENT.

Human capital recognizes as the intangible assets and qualities that improve worker performance and benefit the economy, it consists of the knowledge, skills and health that people accumulate throughout their lives, enabling them to realize their potential as productive members of the society (World Bank, 2018). Building human capital is going to be crucial in enabling people to generate a living and so contribute to economic growth and development as global economies keep progressing towards becoming more knowledge-based; the idea of human capital recognizes that all employment is not generated equal. Employers can, however, improve the quality of that capital by spending money on their employees through investing in knowledge, skills of people in the workforce which result to the winning of both employers and the economy in general all of this has immense economic worth.

Indeed, during the past two decades, a considerable number of researches have examined the beneficial relationship between human capital development and economic growth.

In a cross-sectional study of 106 nations, (Waheed, 2013) discovered a positive connection between human capital and economic growth. In a study conducted in Nigeria, (Jaiyeoba, 2015) revealed a favorable relationship between human capital and economic growth. (Pelinescu, 2014) ,on the other hand, argued that there is a positive and significant relationship between human capital and economic growth in European Union countries. (Queirós, 2016), for their part, examined the relationship between human capital and economic growth in Organization for Economic Cooperation and Development (OECD) nations, transition countries, and Mediterranean countries and results in positive relationship between human capital and economic growth.

*2.2.2. **ECONOMIC GROWTH***

Economic growth refers to the increase in general production level of goods and services compared to the previous period, economic growth is measured in nominal or real term, traditionally, aggregate economic growth is measured in terms of growth national product or gross domestic product even though it still sometimes used. The growth rate of real GDP is usually used as an indicator for the general health of the economy (IMF, 2019). Based on some theory, growth is commonly model as a function of physical capital, human capital, labor force and technology.

2.3 THEORITICAL REVIEW

The history of human capital has first made referred by Adam smith in his book "The Wealth of Nations" in 1776 where he mention a concept related to human capital, Although not employing the expression himself, Adam Smith paved the way for its investigation, he highlighted that a nation's wealth and economic progress primarily comes from the learned and applied skills of its citizens. Later in 1920, in his book Principles of Economics, Alfred Marshall addressed the long-term nature of investments in human capital and the part played by families in making them. Marshall additionally expands the scope of the concept of returns on human capital to include

other than financial elements. Marshall has been criticized for delaying the study of this idea, though, since he did not compare it to physical capital.

2.3.1 ECONOMIC GROWTH THEORY.

Economic growth has different theories; here are some details about two main theories of economics growth that this study is going to be based on.

2.3.2 CLASSICAL THEORY

These theories refer to set of economic ideas and principles that dominated economic thoughts during the 18th century and going in 19th century, where it laid on the foundation of modern economic theory and significant impact on development of capitalist economic system. one of their invented thoughts is labor theory of values where Adams smith and David Ricardo are the authors of the theory, this theory asserts that the value of goods or services is determined by the amount of labor required to produce it where the value of a product is proportional to the labor inputs used in the production process.

2.3.3 HARROD-DOMAR MODEL

The Harrod-Domar model explains the relationship between economic growth, capital accumulation, and savings. In the 1930s and 1940s, economists Roy Harrod and Evsey Domar developed this idea. The model argues that economic growth is determined by the amount of capital available for investment and that the rate of capital accumulation correlates to the rate of savings in closed economy with no global trade or outside investment.

The model mainly based on economic growth rate to stock of capital and stressed on the role of investments in capital that are fixed such as factories, machines as well as investment in human capital. The author believes that the economic growth through capital accumulation may be achieved by encouraging savings to assist in production of more returns for less capital thereby reducing capital output ratio as the productivity of investment in capital. The idea argues that the overall economic production output growth rate continues to rise if capital stock and labor has a relative growth rate to the output “Full capacity growth rate”. As the model assume closed

economy where normally saving equal to investment, in other words the production of output and saving rate equal to saving which also equal to investment at equilibrium, therefore the higher marginal propensity to save the higher rate of growth.

On the other hand, the capital-output ratio has an inverse relationship with output growth, meaning that countries with a high capital-output output ratio have a lower GDP level. As a result, depending to the model, the rate of economic growth has a direct correlation with savings and an inverse relationship with the capital-output ratio. Finally, the Harrod-Domar Model is only in equilibrium when both the capital stock and labor force are fully employed, which leads to incorrect long-term economic predictions.

2.3.4 **NEO CLASSICAL GROWTH THEORY**

The Neoclassical Theory of Growth is a model of growth that describes how the interactions of the three economic forces of labor, capital, and technology leads to a steady pace of economic growth. The Solow-Swan Growth Model is the most simple and well-liked variant of the Neoclassical Growth Model.

Back in 1956, Robert Solow was the first to advocate for it. The Solow model includes many assumptions that must be achieved by the Solow-Swan model, which is a neoclassical growth model (Sala-i-Martin, 2004). It advocates for domestic savings to be the only source of funding for domestic investment on the foundation significant returns to scale and the absence of private capital inflows.

The Solow Swam models provides insights into the long-term determinants of economic growth and focuses on factors like capital accumulation, technological progress, and the value of labor, it widely used in economic growth and understand the drivers of changes in living standards. it mainly based on the core of production function which describe how an economy transforms inputs (capital and labor) into output, the model normally known as Cobb Douglass production function.

According to the idea, the development of per-capita output is attributable to technological advancement and capital accumulation; such that once the economy reaches its peak,

technological progress may only be an exogenous element causing per-capita output growth. (Sala-i-Martin, 2004) confirm the influence of human capital identified through its effect on advancements in technology which in the model is "exogenous" In accordance with this hypothesis, as technology improves the efficiency, quality, and quantity of labor production rise dramatically. Thus, technological progress can be defined essentially as the evolution of machines and the use of computers in relation to increasing human capital through education and skill development (Solow, 1956).

The theory argues that different levels of labor and capital that are necessary for the production process led to short-term economic equilibrium, according to the theory, technological advancement has a big impact on the way an economy operates as a whole. Based on the three conditions established by neoclassical growth theory, an economy must grow. The theory, however, emphasizes the argument that transitory, or short-term, equilibrium is distinct from long-term equilibrium and does not need any of the three factors.

The production process under neoclassical growth theory claims the capital accumulation in an economy and the way peoples make use of that capital as the most way to determine economic growth simply the relationship between capital and labor in an economy determine its outputs and technology came in in the way of labor productivity as the increase of labor efficiency which results to an increase of general output “Y=AF(K,L)”.

The steady state equilibrium in Solow swam model is a long-term situation where the economy’s capital stock, output and consumption per labor remain constant over time. The model suggests that countries with lower initial level of capital experience higher growth rate until they catch up to the countries with higher initials capital level which known as conditional convergence and also the policies that promotes savings, investment in human capital and technology progress can speed long term economic growth.

2.3.5 AUGMENTED SOLOW MODEL

This model is extension of basic Solow growth model which was developed by Robert Solow in later 1950 as neoclassical economic model which attempt to explain long run economic growth

by focusing on accumulation of physical capital and technological progress, where the model suggest that economies converge to a steady state level of income per capital over time and incorporates additional factors and considerations to provide a more comprehensive explanation on economic growth. The inclusion of human capital in the model is explained by the fact that labor in the production process is not homogeneous within a nation or across various countries due to their differing degrees of education and abilities.

This alteration increases the model's adaptability and, as a result, adaption for the Ghanaian setting. The primary premise of this method is that improving worker quality via education boosts production. This lends credence to the human capital hypothesis, which holds that education improve outputs and the supports the human capital theory which postulates that education and healthcare of workers ensure greater productivity (Okemakinde, 2008).

2.3.6 ENDOUGENOUS GROWTH THEORY

The idea of endogenous growth defines economic growth as returns of forces in the production process, it has one explanatory variable as capital return rate on growth rate, as it believe in a system of internal processes that directly trigger economic growth to take place. More specifically, the idea argues that the development of new technologies and efficient, economical means of production will result from the improvement of a country's human capital, which will promote economic growth. In endogenous growth theory, it where economist Robert Lucas developed the model named the Lucas model of economic growth, the model introduced the idea that individuals accumulate human capital by passing through investment in education and leaning by doing, where the human capital in an economy directly influences its long-term growth rate.

Economist Paul Romer in endogenous technological change highlight the importance of knowledge creation and innovation in driving economic growth, the theory suggests that investment in research and development, education and knowledge accumulation leads to an increased productivity and technological progress.

Going back to the neoclassical growth theory and considering the results of slow swam economic growth model economic and assuming a standard neoclassical production function with decreasing returns to capital per capita can be traced to differing determinants of the steady state in the Solow growth model , accumulation of human and physical capital and population growth , Thus, the Solow model does not predict convergence it predicts only that income per capita in a given country converges to that country's steady-state value (Mankiw, 1992).

As a replacement for neoclassical growth theory, endogenous growth theory first appeared in the 1980s, it interested in argument on how wealth disparities could continue between rich and underdeveloped countries if investment in real assets like infrastructure are sensitive to diminishing returns. The major difference between neoclassical and endogenous growth models is based on assumption that if the return on capital does not decline below positive minimum bound, per capita production continue to rise that is endogenous growth model, whereas neoclassical economies theory believe that the returns on capital decline as more as capital acquired.

Endogenous growth theory was developed by economists David Romer, Gregory Mankiw, and David Weil applying the same fundamental structure as neo-classical theory in their paper titled "A Contribution to the Empirics of Economic Growth".

2.3.7 HUMAN CAPITAL THEORY

In 1960s , Gary Becker and Theodore social economists has developed Human capital theory focused on the significance of education on economic growth , they pointed out that education and trainings were investments that could add great contribution on productivity , they suggest that education should become most important part of workforce as the world accumulated more and more physical capital, the opportunity cost of going to school decline .They posits that investment in education, training and healthcare enhance an individual's productive capability which leading to an increase in income as well as economic growth at macroeconomic level, the theory give an image that human capital viewed as an essential form of capital alongside physical capital and emphasized on the crucial role of education in economic progress. It highlights education's importance in economic and socioeconomic development (Michaelowa, 2000). According to (Okemakinde, 2008), formal education significantly impacts productivity and enhances output quality and quantity. As a result, human capital theories hypothesize that a productive population is built on education since it promotes production efficiency by raising the degree of economic potential of human capital. Furthermore, education spending is justified by the theory that education creates skills, which in turn leads to higher levels of productivity among the educated population in both developing and developed countries (Saha, 1997) .

Other research, on the other hand, suggests higher levels of education within the labor force are likely to impact the process of expanding employment (Bowles et al., 1997). However, they claim that the tendency of society to perpetuate inequality is associated with education, which is viewed as an essential instrument for poverty reduction via the well-being of the poor through education. Yet pro-education poverty nexus activists such as OHare (1996) and Darby (1996) argue that greater education levels contribute not only increase income wages and production but also reduce income disparity. Thus, there is a considerable link between skill acquisition, educational attainment, job creation, and economic growth.

Education and skill-building among disadvantaged communities and families, according to human capital theory, are essential components of any effective poverty-reduction or poverty-fighting strategy and should be addressed. In both the rural and urban informal economies, Based on the theory, there is a clear relationship between education and paid labor in the formal sector,

as well as subsequent upward mobility when individuals obtain formal sector employment (Sulle, 2013)

2.4. EMPIRICAL REVIEW

2.4.1 HUMAN CAPITAL DEVELOPMENT AND ECONOMIC GROWTH

Over the past years across the globe, the issue of improve and maintain human capital gain remain contentious it way to achieve macroeconomics goals, many studies has been conducted to investigate the relationship between human capita and economics growths, many results have been founded that there are positively related. The first studies of these empirical started in neoclassical theories and much research conducted based on that theory where for instance the augmented Solow model take human capital as independent variable build in Cobb Douglas production function. That model can explain 80% ii developed and under developed countries (Mankiw,et al,1992).

The idea of study of Galbraith,1996 emphasize on human capital rather that capital investment where he suggested a way of promotion of investment in human capital through education, training, and healthcare, and suggest one's efficiency can be influenced by the rate of return on human capital. Human development has become one of the most important elements in stimulating economic growth through technological advances by reducing inequality and improving labor productivity as stated by Lucas (1990). Indeed, the development of human capital influences physical capital growth in the economy as investment in human development reduces income inequality in society (Jacobs, 2010) and promises a higher quality labor force for the long-term economic growth.

In the discussion of human capital and how it relates to economic growth, two basic approaches are used to analyze the relationship; one is based on the concept that economic growth is driven by accumulating the human capital which implies that growth rates in per capita income is due to the rate by which economies accumulate human capital while the second is in the recent Schumpeterian growth literature and argues that human capital determines the economy’s capacity for innovation, research and development (Benhabib, 2002)

Gokhan Umut (2010) has conducted a panel analysis techniques on impact of human development on economic growth in 14 countries both developing and under developing countries , the study used the data from world bank indicators for the period of 1999 to 2008 and the study used the model and theory that has been developed in endogenous economic growth by Lucas and Romer by inputting some modification on variables , the study results observed a positive relationship between public expenditure on education on economic growth , there is also a positive relationship between health expenditure and economic growth , furthermore the study authors advise the improve in education and health sector which returns positively on economic growth.

(Faisal Sultan Qadri, 2011) conducted a study on human capital and economic growth in Pakistan by employing OLS econometrics methods, the study used the data for the 1978 to 2010 where a health adjusted, education indicators for human capital are used in the standard cobb Douglas production function to analyze the situation and confirms the long-rung relationship between human capital and economic growth in Pakistan. Findings of the study confirm the expectation of the theory that there is a positive relationship between human capital economic growth in the long run, where the health adjusted education variable was found to be highly significant determinant of economic growth.

Human capital is seen as a driver of economic progress in developing countries. Considering the presence of human capital in the economic structure enhances economic growth (Jan Čadila, 2014). (Olaniyan, 2008)Olaniyan (2008) in their findings shows a positive relationship between education investment and growth and development in the economy. A high level of public investment in Bangladesh, together with advances in institutional environments, would be valuable for economic growth (Chowdhury, 2015). On the other hand, human capital development includes both qualitative and quantitative improvement and skill development in the labor force, which can be considered an important component that drives economic growth. Therefore, many African countries seeking productivity growth are likely to facilitate human capital development by attracting and promoting foreign capital inflows due to their limited budget for education, health, and social welfare, in the belief that productivity gains can be enhanced by developing their human capita. (Michael Asiamah, 2019)

Based on research conducted by Gebrehiwot (2014) on impact of human capital on economic growth in Ethiopia by integrating ADL approach to co integration in the analysis, where GDP per capita as proxy for economic growth and dependent variable in the model and health human capital, education human capital, as proxy for human capital development and labor force, gross capital formation, government spending and official development assistance are the independent variables in the model. The bound test was used to test the long run of the model and the results show a strong long run relationship between real GDP per capita, education human capita, health human capita, labor force, gross capital formation, government expenditure and official development assistance. In the short run, the coefficient of error correction term is -0.7366, implying a yearly adjustment of around 73.66 % towards a long-term equilibrium. This is just more confirmation that the variables have a long-term stable interaction. Based on the short-run model's estimated coefficients, education is the most major contributor to real GDP per capita change, followed by gross investment (one period lagged value) and government expenditure (one period lagged value). However, despite its long-run significance, health has no major short-run economic influence. Even a one-period lag has a large negative economic impact, therefore the results give incentives in policy implication where economic performance can be improved positively if the ration to public spending on health services to GDP increases as well as the improve in secondary school enrolment, such increase has great impact on human productivity which results to general increase in economic output.

Research conducted to investigate investment in human capital on economic growth in Singapore using Cobb-Douglass production function and Vector Error Correction approach. He final make a conclusion that investment in human capital does not give a contribution at initial periods but later contributes positively to economic growth (Maitra, 2016). Where GDP, education, and health spending annual data series from 1981-2010 were used.

In the research conducted by Mutabazi in 2019 on relationship between human capital and economic growth in Rwanda, the definite results of this study display that there is significant relationship between life expectancy and physical capital formation, and they influence positively economic growth whereas education was insignificant. (MUTABAZI, 2019)

Ali et al. (2018) conducted research on human capital, social capital, and economic development. The data for the research came from Penn World Tables, the World Bank's World Development Indicators (WDI), and the Fraser Institute's Economic Freedom Dataset, they applied descriptive statistics and correlation matrices. The findings delivered a set of elements that strongly and positively connected human capital to economic development. Using data from 132 countries gathered over a 15-year period, empirical findings revealed that human capital contributes positively to per capita GDP development only in the context of enhanced economic opportunities and high-quality legal systems. In real terms, economic possibilities strengthened the effect of human capital on economic growth: the easier it was to do business and trade locally or globally, the greater the influence of human capital on economic development.

On the other hand, the study conducted by M. Niaz et al, (2018) on the human capital development and economic growth in Bangladesh, the results shows that there no significant effect public education expenditure economic growth, primary and tertiary school enrolment coefficients are also positive whereas Tertiary education coefficient is strongly significant at 1% level but on secondary school enrollment is negative. The coefficient of primary and tertiary school enrolment is also positive but secondary school enrollment is negative. The results of study suggest a conclusion that the variations in tertiary school enrollment & primary school enrolment appeared to have a meaningful impact on the growth in Bangladesh economy (all, 2018). Assessed 35 nations in Sub-Saharan Africa (SSA) and found a positive and significant relationship between human capital and economic growth. Based on his analysis, he found that government spending had no significant impact on economic development in Ghana, as the variables did not maintain a uniform pattern over the study period due to a continuous random shock effect on the time series. He stated that the rate of government expenditure to real GDP has been increasing since the Structural Adjustment Program (SAP) without making a substantial contribution to Ghana's economic growth (Ogundari, 2018). This he assigned to a lack of government control of the capital project contracting process, inadequate deployment of government funds to productive activities, and a lack of openness and accountability on government expenditure.

There are two different channels by which human capital is expected to impact positively economic growth, as a result a better educated labor force appears to have positive and

significant on economic growth through factor accumulation as well as on the evolution of total productivity in economy (loaning,2002).

Johnson (2011) investigated the correlation between economic growth and HCD in Nigeria using OLS. In the study, total government spending, GDP (a proxy for economic development), and patterns of enrolment in elementary, secondary, and tertiary education (a proxy for human capital) were utilized. Data from secondary sources (1990-2009) were used. The results show that HCD has a significant impact on economic growth. Multiple proposals were offered. Stakeholders should establish more realistic methods for improving human capital abilities, as this is a crucial component impacting the country's economic progress.

In accordance with Mahmood and Alkahtani (2018), as a result of productivity gains, human capital (HC) is an essential element for assessing and driving economic development in the modern era. Obi, Atueyi, and Leonard (2022) investigated the impact of human capital development on Nigeria's economic growth from 1981 to 2020. The unit root test was used to assess the variables' stationarity, the co-integration approach to determine the variables' long-run equilibrium relationship, and the Error Correction Model (ECM) to quantify the rate of adjustment. The data was analyzed using the Ordinary Least Squares (OLS) method. Additional tests used in this study included the normality test, the stability test, and the serial correlation test. According to the concept, human capital development has had a significant positive impact on Nigerian economic growth, the research findings shows that government spending on health has a positive impact on the economy, while government expenditure on education has a negative and negligible impact on Nigeria's economic development. The report recommended that the government make an effort to resolve the problems of education personnel, which force them to go on strike on a regular basis.

Ali et al. (2018) studied human capital, social capacity, and economic development. The data for the analysis came from Penn World Tables, the World Bank's World Development Indicators (WDI), and the Fraser Institute's Economic Freedom Dataset. Descriptive statistics and correlation matrices were involved. The findings offered a set of characteristics that strongly and positively attached human capital to economic development. Using data from 132 countries gathered over a 15-year period, empirical findings demonstrated that human capital contributes positively to per capita GDP development only in the context of enhanced economic opportunities and high-quality legal systems.

In real life, economic opportunities increased the influence of human capital on economic development: the easier it was to do business and trade locally or globally, the greater the influence of human capital on economic development, data demonstrated that previous empirical research on human capital and development yielded unreliable results due to omitted variable bias, as these studies lacked variables associated with social abilities.

In accordance with David N. et al (2018), they have been conducted research on Human capital development and economic growth in Tanzania, their study employed Granger causality test to investigate the casual effect of estimated variables in the model by covering the period of 1970 t0 2017 in Tanzania. The bound test was used also to test for cointegration among the variables. The study results support the theory of endogenous that human capital is most important variable for economic growth for both short term and long-term dynamics, thus these results into policy implication that macroeconomics policy makers towards strong allocation of resources in investment in development in human capital to sustain economic growth.

Anaduaka and Eigbiremolen (2014) studied how HCD affects national output. The study employed the augmented Solow human-capital-growth model using secondary data time series data from 1999 to 2012. The data revealed that HCD had a significant impact on output level. This indicates that HCD cannot be neglected in the pursuit to achieve long-term economic growth in Nigeria, considering that an increase in HCD promotes economic performance. The results also show an inelastic connection between the HCD and output level. As a result, governments as well as other policymakers ought to put emphasis on proper educational financing to create and develop human ability at all levels, enabling for the economy's long-term development and growth.

2.4.2 EDUCATION, HEALTH, AND ECONOMIC GROWTH.

It is important to note that education and health indicators are primary variables to measure human development, and how efficient they are at forecasting human growth. For instance, education is considered an essential human right, and there is general agreement that better schooling improves people's well-being.

Majority of studies use education and health indicators as proxies for human capital development because they argue that output rises through various empirical channels and serve as precondition for the utilization of physical capital by attracting investment hence increase in output and growth (Abbas, 2000).

In the study conducted by Hannum and Buchmann (2005). Strong education promotes income, its significance as a criterion for calculating the human development is evident. They also stated that education quality influences personal income and consequently economic growth Hanushek and Wößmann (2007), Churchill et al. (2015), stated that education spending has a beneficial effect on the economy, education in particular, enhances personal and professional skills, which in turn boosts economic growth. In accordance with Ali and Jabeen (2015) for his study conducted in Pakistan, an increase in GDP in real terms correlates to enrollment in primary schools, suggesting that higher school enrollment rates have a significant effect on economic growth. Sims (2004) noticed that education boosts labor productivity simultaneously increasing firm profits.

Education affects human capital by increasing knowledge and skills which lead to more output and ultimately into better health". This is because education helps increase output steadily and simultaneously makes individuals aware of healthy living. Moreover, completion of primary school and joining secondary and vocational training has been linked with ability for people do not rely on subsistence agriculture but become engaged in other vibrant jobs (Bergheim, 2005).

Ndiyo (2002) modeled the "Paradox of Education and Economic Growth in Nigeria" for the contribution of education growth. He examined real GDP growth as a responder variable and explanatory factors such as gross fixed capital creation (GFCT), aggregate labor force (LAF), and real budget allocation to education (REDUB). He established the models in level and logarithmic forms, respectively. According to the two sources, the quantity of physical capital and labor inputs has a positive influence on the increase of real gross domestic product (RGDP) in all specifications, but only in the majority of circumstances. He noticed that, contrary to predictions, the estimate for the influence of educational capital increase on the growth of real GDP was consistently negative. That growth in educational capital outweighed GDP growth was

unexpected. Ndiyo, however, is not alone in this situation. This idea appears to be supported by Kyriacon (1980), Lan et al. (1991), and Dasgupta and Weale (1992).

Using panel data from African nations from 1990 to 2002, researchers looked at the impact of public spending on educational enrollment in Nigeria, South Africa, Algeria, Nigeria, and Egypt countries at the elementary and secondary school levels. The findings demonstrate that government education spending has a beneficial and considerable direct influence on primary and secondary school enrollment rates (Adeniyi,2004).

Baldacci et al. (2003) discovered that social expenditure is a key factor of educational performance using cross-sectional data from developing nations. According to this study, the influence of social expenditure on educational results is greater in cross-sectional samples than when the temporal dimension is included. They also discovered that education expenditure had a stronger impact on social indices than health spending. Empirical research undertaken in many industrialized and developing nations shows a substantial inverse relationship between a mother's education and fertility, as well as a positive relationship between a mother's education, her child's health, and her own health.

Yohana Maiga (2023) published research on impact of human capital index on economic growth in Africa by employing various statistical techniques, it explores the influence of the Human Capital Index (HCI) on economic growth especially in Ghana, Kenya, and Tanzania. In accordance with the findings, the link between Human capital index and Economic Growth is challenging and differs by nation. TZA has a positive coefficient, but GHA and KE have negative coefficients. These coefficients, however, are not statistically significant, and the aggregate coefficient for all nations is negative and non-significant. This implies that other variables like as infrastructure investment, education, and innovation may contribute to Economic growth, when developing strategies to promote economic growth in these nations, policymakers need to take into account a variety of issues other than Human capital index, the study end by emphases that more related studies are needed to discover possible predictors of Economic growth and investigate the interactions between these parameters.

Mtey and Sulle (2013) examined numerous studies on education and poverty in Tanzania. The study investigated the effect of education in poverty alleviation by a thorough evaluation of the

literature. The study emphasizes the role of education as an important means of poverty alleviation, thereby substantiating arguments drawn from appropriate empirical and theoretical literature, which shows a link 31 between poverty reduction and education established from household income levels that should be increased. According to the report, education is crucial and hence an important weapon in poverty alleviation and economic growth.

Self and Grabowski (2004) conducted research on the relationship between level of education and economic growth in India. Primary, secondary, and postsecondary educations were the three levels of education. The OLS model was used in the study to examine the relationship between education level and economic growth and the secondary data from previously published publications was applied. The findings revealed that basic education displayed a direct correlation between education level and a greater level of growth, although secondary education showed a small effect on income growth, indicating that an increase in earnings per capita corresponded with poverty reduction. (GRABOWSKI, 2004)

Odior (2011) used the Computable General Equilibrium (CGE) model adjusted using 2004 Nigerian Social Accounting Matrix (SAM) data to analyze the influence of government increases in education spending on economic development in Nigeria. Among other factors, the study found that reallocating resources to the education sector is important in explaining Nigeria's economic progress. Based on the study's findings, the author stated that education should be prioritized above all other public expenditures since it has the potential to contribute to significant economic development in the long term. Moving resources from unproductive endeavors to education, as is occasionally the case (due to rent-seeking, misallocation of cash, or diversion of public monies), surely would enhance the quality of education and alleviate poverty as investment in education is key to growth policies for promoting nation’s growth.

Adawo (2011) investigated the influence of education in the growth of the Nigerian economy using the OLS model. Primary education, secondary education, and higher education were the study variables. The proxy was 29 different levels of school enrollment. Furthermore, health expenditure and physical capital formation were also used. Primary school education, health spending, and physical capital construction all had a statistically significant effect on economic growth in Nigeria, according to the researcher's findings, which are consistent with previous

findings. Tertiary education, on the other hand, has had a negative effect on economic development, as has secondary education. Higher education is critical to Rwanda's economic progress. Higher education can spur economic growth through both private and public channels, resulting in higher individual earnings, employment opportunities, and investments in research and development. Recent empirical research indicates that education expenditure has an essential effect on growth (Bloom et al. 2014).

Rwigema (2020) conducted a study on effect of education on economic growth in Rwanda, the study was an attempt to investigate the extent to which the Rwandan government's spending on education level influences its economic growth and hence production level , the study adopted a Cobb-Douglas production function with a constant variable rate of returns in the human capital enhanced growth model and the data were extracted from the National Institute of Statistics Rwanda for the years 1999 through 2019 , the variables strongly fit the model, as seen by the R2 Adjusted - more than 55%, indicating strong goodness of fit in the short-run estimated model. As a result of the lack of multicollinearity, the goodness of fit is obtained. Findings summarize and recommended that education has a favorable impact on economic growth where it proved that human capital plays a crucial role in economic growth, primarily as a driver of production growth, implying that education is more than merely a tool for individuals to demonstrate their level of competence to employers and the Rwandan government should encourage citizens to become involved in education, the Rwandan government may accomplish this directly by supporting infrastructure, small farmers, and the construction of schools to address these issues, and foreign help has a substantial impact on economic growth. (RWIGEMA, 2020)

Education enrollment in Rwanda is low, but fast increasing. According to the most recent data from RPHC 5 reported that 8.2 million adult individuals aged 15years , among them 79% could read and write with understanding of in any language that are used here in Rwanda where gross attendance rate counted on 141.7% and 39.9 % for primary and secondary respectively and overall results highlight that about 22.3% of Rwandan resident population has never been to school which shows that there still a journey to go for well-known as in today's upper-middle-income countries. Furthermore, even with increased tertiary enrollments which have more than doubled in the last decade shifting the proportion of the population with tertiary education in the

workforce takes time because only a small part of the population has a tertiary education (NISR,2023)

Considering the results of different research on human capital and economic growth, many of them found a strong positive relation among them, for instance a study conducted on African countries has found a significant relationship between education and economic growth, where the author suggested that human capital investment captures the quality of human capital as a best driver of economic growth (Koenker, et al ,2018). Similarly, a study conducted in Tanzania on investment in human capital and economic growth, where HCI (human capital index) considered as measurement of human capital has found a positive relationship between human capital investment on economic growth (Yuan, et al,2018). A study by Owusu-Addo and Smith-Greenaway (2018) on Ghana found that maternal education has a positive impact on child health and survival.

Based on the study investigated the impact of education expenditure on economic growth between 1981 and 2012 through Johansen cointegration technique, the findings revealed that there is no long-run relationship between government spending and economic growth (Obi ZC, 2014).

Until the second part of the 1990s, the significance of human capital was primarily associated with schooling. Health is currently playing an essential part in improving worker productivity and general well-being yet additionally improving economic growth. Research studies examining the effect of health on growth employ a methodology that includes regressing the per capita GDP growth rate to the initial level of well-being and the variables that are intended to impact the equilibrium such as economic policy, institutional, educational, and other variables.

Few authors acknowledged the value of other factors, such as health and nutrition, that impact real per capita income. Some economists who studied the relationship between economic growth and health were (Fogel, 1994), (Barro & Sala, 2003), and this resulted in subsequent publications focused on the link between Health, Wealth, and Growth. Earning higher income will increase the consumption of health related good such as adequate food and medicine (Lopez, Rivera, & Currais, 2005).

Understanding the causal relationship between health and wealth is crucial for understanding how the two connect. The possibility of endogeneity between health and income challenges analysis. Although good health is an aspect of human capital that has an excellent effect on productivity, income also has a positive impact on health. There is also a positive spillover influence in the effort to fight against poverty. Advances in health and health variables in society will encourage people to invest more money by reducing mortality and increasing life expectancy. Productive workers are both mentally and physically more energetic, which makes them more effective in their duties. Because a bigger proportion of the workforce in nations that are developing is involved in manual labor than in industrial countries, the consequence of having a less productive workforce is stronger (Scheffler, 2004). Bloom et al. (2004b) came to the conclusion that good health has significant effects on aggregate output, suggesting that the life expectancy effect in growth correlations seems to be a real labor productivity effect.

Mandiefe and Tienguhong (2015) investigated the role of public health investments in Cameroon's economic growth. They used VECM as the econometric model in their estimations. they utilized annual time series data from 1988 to 2013. The estimates revealed that public health investments only contribute to Cameroon's economic growth in the long run. This means that public health investments improve economic growth in the long run by allocating resources efficiently. As a result of this, they recommended that the government increase its health investment to 10% or 15% of GDP, as recommended by the African Union and WHO, respectively; second, increase private sector provision of health care services; and third, improve the quality of health care services rendered by giving competitive awards to health units that render health care services with a good quality.

Serge and Julius (2017) have conducted research on health care expenditure on economic growth in central African countries known as CEMAC sub regional, the data for their study was extracted from world development indicators database the econometrics technics were panel OLS panel ordinary least square (OLS), fully modified ordinary least square (FMOLS) and dynamic ordinary least square (DOLS) used to analyze the outcomes. The study results found that health expenditure has a significant and positive effect on economic growth in all the sample used where a unit change in health expenditure can increase economic growth(measured by GDP per capital in the study)by 0.38 units and 0.3 units for the other five African countries that

achieve the settled targets, furthermore a long run relationship exist between health expenditure and economic growth for both the groups of countries , thus the study recommend that African countries should strongly build a health care system to support the social -economic growths of their nations.

Elmi and Sadeghi (2012) employed a panel co-integration causality vector error correction model (VECM) to validate this link using a sample of developing nations from 1990 to 2009. Their findings revealed a short-run linkage between GDP and health expenditure, as well as a long-run bi-directional relationship.

Bakare and Sanmi (2011) explored the relationship between health-care spending and Nigerian economic growth. They employed least squares multiple regression as their analysis strategy. Their findings indicated a significant and favorable relationship between healthcare spending and economic growth. They suggested that Nigerian policymakers boost the percentage of the budget spent on health services every year. Ogundipe and Lawal (2011) investigated the impact of health expenditure on Nigerian economic growth. They also used the standard least squares method, they found a negative influence of overall health expenditure on economic growth, which contradicts Bakare and Sanmi's (2011) findings.

Beylik, et al in 2022 the published a paper studies on relationship between health expenditure indicators and economic growth in OECD countries, the sampled 21 countries analyzed by panel data analysis where gross domestic product and income per capital were used as dependent variables and out pocket health spending ,ratio to drugs expenditure , per capital expenditure to gross domestic product and share of current expenditures in GDP were exploited as explanatory variables in model. The results of their study found that all health expenditure variable were positively correlated to economic growth said 1% increase in the share allocated to health services will increase the GDP by 0.09%, this shows that the increase in health services plays an important role the economic growth.

The improvement in the standard of living will have an indirect effect on workplace efficiency, the causal relationship of health and per capita income will bring biasedness and inconsistency when analyzing the estimates of the impact of health on economic growth. The positive impact of health on economic growth is identified either in exogenous growth models during the period

of steady-state transition or in endogenous growth models, each within the framework of inter-temporal optimization. As a result, it is helpful to fully investigate it impact on economic growth.

Lower levels of school involvement in underdeveloped nations are typically associated with disease, poor nutrition, and other family difficulties and problems (including circumstances that are more common in rural areas). Also, a decreased mortality rates and the prospect of a higher life expectancy will motivate people to invest in human capital.

Better health is said to influence education through several mechanisms, and education is agreed to have a favorable impact on the country's economic prosperity. A healthy child has higher school attendance and learning capacity, according to (Bloom, Canning, & Sevilla, 2004).

After reviewing all prior studies that has been used different types of data and time periods for both income and lower income countries, Various econometrics methods such as OLS, Cointegration Analysis and Two-stage Least Square(2SLS) were employed in above mentioned literature and most of them had mentioned a positive correlation between human capital development and economic growth where The majority of studies discovered that good health as well as education increases human capital as the two components of human capital. Health also has a substantial positive impact on economic growth. Furthermore, scholars have recognized that the causal relationship between health and per capita income must be explored to clearly discern their relationship.

On the side, quality of education has founded to increase the human capital which result on a positive direct impact on economic growth thus this gives an idea to undertake additional research on current relationship between human capital development and economic growth in Rwanda and incorporating different variables with a consideration of recommended diagnostic test. This will officially help in further understanding of the role of a positive increase in human capital respond to the economic productivity as well as economic growth and will also read to a provision ways for relevant policies to be implemented in order to sustain ways forward of human capital development that will enhance economic growth , then the study will be used by the authorities to examine the degree of responsiveness of change in GDP growth rate due to change in human capital invested in production process.

CHAPITER 3. RESEARCH METHODOLOGY.

3.1 INTROCUTION.

This chapter describes the strategy that was employed in accomplishing the study's objectives. The theoretical framework, empirical and model specifications, variable definitions, and measurement are all covered in this chapter. Finally, there are diagnostic tests, data kind and source, and data analysis to consider, it includes all the econometrics approaches used to estimate the model, analyze the model, and model interpretation.

The study employs time series yearly data from 2000 to 2022 where the statistics were gathered from an electronic database, such as the Rwanda National Institute of Statistics and the World Bank from World Bank indicators. However, several International Statistics Supplement Series Publications were useful in addition to the data especial for education indicators.

Initially, the sequence is changed as usual to induce stationary. The investigator would like to simultaneously apply the maximum probability estimate to a vector error correction model to evaluate the dependent variable's long-run and short-run effects on the independent variable in a model.

3.2 RESEARCH DESIGN.

The intention of this research is to look investigate the relationship between human capital development and economic growth in Rwanda. A research design covers the research problem successfully by interpreting the many components of the study in a coherent and logical manner (Labaree, 2009). Quantitative data was gathered to answer the study's questions. The correlation design was chosen in this examination because it is a non-experimental study. The researchers studied data from 2000 to 2022 for the criteria under consideration of time series data. The econometric relationship was assessed using the OLS estimation method, which was applied in this study.

The quantitative research design has been selected in the study because it requires systematic analytical analysis of quantifiable phenomena applying statistical or numerical data.

Generally, quantitative research design has three dimensions: descriptive research, which seeks to explain the current state of a variable or phenomenon, correlation design, which examines the relationship between variables using statistical analyses, and experimental design, involving the use of scientific methods to determine the relationship between cause and effect. Descriptive research is unique in terms of the number of factors at work. Descriptive research, like other types of study styles, can involve several variables for interpretation, but it only requires one variable, unlike other method examples (Borg & Gall, 1989) where descriptive studies are aimed at finding out "what is," so observational and survey methods are frequently used to collect descriptive data.

3.3 DATA SOURCE

This study makes use of annual time series secondary data. The use of time series data 2000-2022) was chosen because data is collected over time and can thus be utilized to better understand the relationship between human capital development and economic growth in Rwanda. The gross domestic product (GDP) is used as the dependent variable in the study as well as the proxy for economic development, with life expectancy from birth, and school enrollment rate taken as proxies of human capital development while capital formulation and labor force act as key explanatory variables.

The data required to accomplish this study are gained from World Bank known as world bank development indicators and NISR.

3.4 THEORETICAL FRAMEWORK

The Endogenous theoretical framework is used in this study. Where it represents a departure from traditional neoclassical growth theory in some key respects by introducing internal factors such as human capital, knowledge accumulation and innovation as endougenous drivers of economic growth , more to economic growth than the theories provided by classical economics, the idea in the theory clarifies growth by linking efficiency capital accumulation, work, and inventive progress. The theory emphasizes capital accumulation and the corresponding selection of reserve funds as an important component in the growth of the economy with adopted model of

Paul Romer, 1980 allows for an analysis of the influence of Human capital development on economic growth in Rwanda.

The model is widely used mathematical representation in economics that describe how inputs are combined to produce output in production process.

$$\mathbf{Y}t = A_t K_t^{\alpha} LBF_t^{\beta} Hc_t^{\lambda} \quad \text{.....(1)}$$

K_t represents the capital at time t LBF_t represent labor force at time t and HC_t represent human capital at time t

Under this model, human capital appears as non-homogeneous with labor in the creation process, either within an economy or among economies, due to their varied degrees of skills and education (Eigbiremolen & Anaduaka, 2014). This adjustment makes the model more appropriate for examining economic growth for Rwanda setting by forcing it to be acceptable in the context of the nation and therefore more applicable. According to the basic assumption, improving the quality and quantity of employees' output requires enhanced education, which in turn raises production.

In accordance with Mankiw et al. (1992), demonstrates how population growth, human and physical capital accumulation, and the rate of growth per capita influence the rate of growth per capita. Both physical and human capital have a positive impact on the rate of growth per capita, and human resource collection increases the effect of actual capital accumulation on the rate of growth per capita (Timakova,2011). To account for deviations in total factor productivity, the research used this theoretical framework and included several other factors from the literature, such as gross fixed capital formulation, thus this approach is relevant for this study because it analyzes output as a component of capital and labor all of which are associated with the variables under assessment. Thus, capital represented by a share of physical capital stock, whereas human capital development represented by school enrollment rates both secondary and tertiary level and health indicators.

3.5 SPECIFICATION OF THE MODEL

Human capital development is well known to enhance economic growth and development across economies, Many study has used endogenous economic growth model to demonstrate this relationship of human capital and economic growth, for this analysis, this study based on endogenous growth model Paul Romer in 1980 with some adjustment in explanatory variables to illustrate this relationship in Rwanda for the period of 2000 up to 2022 . It is in this line that function relationship is established.

Economic growth = f (Gross Capital formulation, Labor force, secondary school enrolment rate, tertiary school enrolment rate and Life expectancy).

The model of the study can be illustrated in below:

$$\text{Log } GDP_t=\alpha 1+\alpha 2\log GCF_t+\alpha 3\log LF_t+\alpha 4\log SEC_t+\alpha 5\log TER_t+\alpha 6\log LEXP_t+\mu_t \text{ ..... (2)}$$

The variables GDP, GCF, LB, SEC, TER, LEX represented as dependent variables in the model. $\alpha 0$ represent the constant term in the model, where $\alpha 1,\alpha 2,\alpha 3,\alpha 4,\alpha 5$ are the coefficients of independent variables in the model, ε_t represents econometric error term of the model, finally t represents the time periods of observation from 2000 to 2022.

Where **GDP** represent economic growth

GCF is gross fixed capital formation.

LB is the labor force.

SEC is the secondary school enrolment.

TER is the tertiary school enrolment.

LEX is the life expectancy.

3.6 DEFINITION OF MEASUREMENT VARIABLES

The parameters used in this study are laid out in the following table and the variables used as controls variable have been selected based on a review of both theoretical and empirical literature. Only those elements that scholars determined to be more important in promoting economic growth were considered. The decision regarding each of the control variables was also influenced by the availability of information.

Table 1: Variables definition and measurement

Table 1VARIABLES DEFINITION AND MEASUREMENT

VARIABLES	**DEFINITION**	**MEASUREMENT AND EXPECTED SING**
ECONOMIC GROWTH	Economic growth refers to the increase in country's production of goods and service over time.	Dependent variable in the model which measured by GDP growth rate.
CAPITAL	Increase in physical assets within an accounting period as a percentage of GDP.	Control variable in the model which measured by gross capital formulation, and it's expected to have a positive .
LABOR FORCE	Labor force is the total number of peoples who can produce goods and services during a specified period. It includes people who are currently employed and people who are unemployed but seeking work as well as	Control variables in the model which measured by the labor force, total from the age of 15years and older.

	first-time jobseekers	
SECONDARY SCHOOL ENROLMNENT (gross)	Gross secondary school enrollment ratio is the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown.	Proxy variable of education to human capital development and is expected to have a positive sign.
TERTIARY SCHOOL ENLONMENT (gross)	Gross tertiary school enrollment ratio is the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown.	Proxy variable of education to human capital development and is expected to have a positive sign.
LIFE EXPECTANCE	This refers to the number of years in average that a person can expect to live based on various health and demographic factors.	Proxy variable of health indicator to human capital development which measured at current mortality, the variable is expected to have a positive sign.

3.7 HANDELING ECONOMETRICS

Data is analyzed using the EVIEWS 10 statistical software suite and econometric time series estimation techniques. The following econometrics tests are specifically designed to address methodological difficulties that may otherwise arise.

The empirical model's formulation is based on economic theory and human capital development literature in general. Sunday (2021) created the human capital development variable through dividing school enrollment rates by the health representing variables. This may be a more accurate assessment because it considers both the education and health sectors. Education and health indicators are primarily used to track human capital development. A modified model was used in this investigation.

The technique known as Ordinary Least Squares (OLS) has been used hence we the study based on time series data, and as there is existence of the dependent variable, the hypothesis test evaluated these parameter values to establish the level of significance in the model. Since this is a time series study, the time series features of the variables to be modeled, stationary monitoring and variable co-integration were all analyzed.

3.8 DIAGNONISTIC TESTS

These are econometrics analysis tests used to evaluate the assumptions validity and robustness of economic model and empirical studies, they are most important to ensure the reliability and accuracy of analysis. For this study, empirical tests used which include stationarity tests known as unit root test, multicollinearity test, heteroscedasticity autocorrelation and robust test.

3.9 UNIT ROOT TEST

Unit root tests have been selected as a means of examining or identifying non-stationarity. This was done to avoid unit root-induced variations in estimates over time, which could lead to inaccurate conclusions. When the mean and variance of a stochastic process remain constant over the course of the process's duration, the process is said to be stationary distributed. A stable series can be observed when the mean and variance of the series are not influenced by changes in time. Non-stationary series are those in which the mean and variance of the series change over time. This subsection discusses several parametric and non-parametric pre-testing methodologies before demonstrating their benefits and drawbacks. Several ways can be used to examine the stationarity of time series results. However, the most frequently procedures are the Augmented Dickey-Fuller (ADF) test, the Phillips-Perron test (PP), and the Kwiatkowski, Phillips, Schmidt, and Shin (KPSS, 1992) test. We solely used the ADF test for stationarity of this study.

Unit root test for stationary is somehow difficult in practice as well as the selection of the best unit root test. Ender (1995) recommended applying the unit root test as a safe alternative to the Augmented Dickey-Fuller (ADF) (1981) test. The Augmented Dickey-Fuller (ADF) test is often used for unit root analysis. To verify stationarity, we are going to perform the commonly used unit root test, the ADF test, on the variables GDP, GCF, LB, SCE, TSE, LE for Rwanda. The unit root tests were conducted at the pattern, intercept term, and all difference levels. The optimal lag was chosen using the Akaike knowledge Criterion (AIC).

If the unit root test does not work at level, a differentiation is conducted to make a series stationary, and if the first difference of a non-stationary variable is made stationary, it is said to be integrated of I (1), and the Augmented Dickey Fuller test works in running a regression of a first differenced series I (1) of the variables in concern in a random walk.

Suppose that X_t is a random walk process, $X_t = X_{t-1} + \varepsilon_t$

The regression model became $X_{t-1} = \delta X_{t-1} + \varepsilon_t$

then subtract X_{t-1} on both side of the equation then, the model became.

$\Delta X_t = \pi X_{t-1} + \varepsilon_t$ where $\pi = (1 - \delta)$

HO: $\pi = 0[X_t \sim I(1)]$

H1: $\pi = 0[X_t \sim I(0)]$

3.10 MULTICOLLINEARITY TEST

When there is a perfect linear relationship among the independent variables in a research study, this is known as multicollinearity. As a result, the research study's findings are biased. When at least one set of factors is totally linked to another in terms of size or magnitude, and when the pairs of variables created by the correlation matrix are likewise completely connected to one another in terms of size or magnitude, a bias might occur. As a result of this approach, a set of Variance Inflation Factors (VIF) and correlation matrices were constructed and analyzed. The VIF test is required to discover how much the variance of an estimated coefficient increases. High multicollinearity can inflate the standard errors coefficients, making it difficult to determine which variable truly significant in demonstrating the dependent variable.

3.11 HETEROSCEDASTICITY

Heteroscedasticity is a common issue in analysis econometrics phenomenal where variance of error term in regression model is not constant across all levels of independent variables. When heteroscedasticity is present in variables, it can lead to biased and inefficient estimates and can affect the validity of hypothesis test and confidence intervals especial for OLS estimates.to detect this, the study used the Breusch-pagan test, and the null hypothesis had an assumption of homoscedasticity.

HO: There is heteroscedasticity in the series

3.12 AUTOCORRELATION TEST

The autocorrelation test also known as serial correlation test which is refers to the correlation between consecutive observations in time series econometrics, it simply indicates whether the residuals from regression model are correlated over time. The problem of autocorrelation is its violation of the assumptions of independent errors in the model, also lead to biased coefficient estimates incorrect standard errors and unreliable hypothesis tests and it is most important to test it as it gives concern to ensure validity of results. The study utilized Durbin Watson test to detect and address autocorrelation.

3.13 JOHANSEN COINTEGRATION TEST

Cointegration indicates that variables will move close together and will not get randomly over time and that the time between them will be stable. This idea reflects the long-run equilibrium relationship, in which variables converge with time (Johansen, 1991, 1995). Testing for cointegration is viewed as an essential step to figuring out if your model represents an experimentally valid relationship between variables. In most circumstances, if two I (1) variables are linearly combined, their combination will likewise be I (1). In general, if variables with different orders of integration are joined, the combination will have the biggest order of integration. If two processes, X_t and Y_t, are both integrated of order one, I (1) and $Y_t - \delta X_t = \varepsilon_t$ with t trend stationary, or simply I (0), then X_t and Y_t are Cointegrated.

Because it holds all desirable statistical characteristics, the Johansen Cointegration test is a suggested Cointegration test for more than one variable in an econometrical model. Johansen originally developed two tests, the λ- max (or maximal Eigen value test) and the Trace test.

The maximum Eigen Value is illustrated as below:

λ-max $[H_1(r-1) / H_1(r) = T \log(1 - \lambda_r)$ for r = 0,1,2 …….And the null hypothesis is that there exists r cointegrating vectors against the alternative of r+1 vectors.

3.14 ERROR CORRECTION MODEL (ECM)

Error correction model serves to estimate the dynamics of cointegration relationship of the variable, it helps to understand and analyze the relationship between the variables that are integrated in order one which normally called I (1) variables. ECM particularly dealing with the variables that have a long-term relationship, it links the current values of the differenced dependent variable and differences of independent variables as it captures the short run dynamics and how the variables adjust to deviations from the long term. The analysis of the short run model is based on error correction term in the ECM equation as a crucial element where it shows the speed of adjustment that they will correct from any short turn deviation.

The assumption of the model is.

All variables are no stationary in levels but are cointegrated.

$$GDP_t=\beta_0+\beta_1 GCF_t+ \beta_2 LF_t+ \beta_3 LEX_t+ \beta_4 SEC_t+ \beta_5 TER_t+\varepsilon_t \quad (1)$$

$$\varepsilon_{t-1}= GDP_{t-1}- \beta_0- \beta_1 GCF_{t-1}- \beta_2 LF_{t-1}-\beta_3 LEX_{t-1}-\beta_4 SEC_{t-1}- \beta_5 TER_{t-1} \quad (2)$$

Plug (1) in (2) to get the ECM.

$$\Delta GDP_t= \beta_0+ \Delta\beta_1 GCF_t+ \Delta\beta_2 LF_t + \Delta \beta_3 LEX_t + \Delta \beta_4 SEC_t + \Delta \beta_5 TER_t+\delta \varepsilon_{t-1}+\mu_t$$

Where $\delta \varepsilon_{t-1}$ is the error correction term and δ must be in the range of -1 and 0 and statistically significant.

The Error Correction model estimates involved values of GDP, Gross capital formation, labor force, secondary school enrolment, tertiary school enrolment life expectance in difference form and error correction term as parameters of the model.

CHAPTER 4: RESULTS PRESENTATION AND ECONOMETRICS ANALYSIS

This chapter provides and analyzes the study's results. GDP, gross capital formulation, labor force, secondary school enrollment, tertiary school enrolment and life expectancy examined in this study in line with research goals. The study intended to analyze the link between human capital development and economic growth in Rwanda from 2000 to 2022. For analyzing the relationship and influence of human capital on Rwanda's economic growth, the study apples Cobb-Douglass production function model, Ordinary regression model diagnostic tests and econometrics test for cointegration and error correction model.

4.1 DESCRIPTIVE STATISTICS

Table 2DESCRIPTIVE STATISTICS

	LOGGDP	LOGK	LOGLF	LOGLEX	LOGSEC	LOGTER
Mean	8.537247	6.860623	15.11039	4.108254	3.290644	1.554637
Median	8.577912	6.986566	15.13525	4.147269	3.571987	1.830241
Maximum	9.267949	7.848934	15.35329	4.234107	3.830519	2.036967
Minimum	7.713785	5.605802	14.81319	3.852889	2.43482	0.275652
Std. Dev.	0.477454	0.776564	0.166757	0.107127	0.487748	0.543921
Skewness	-0.16543	-0.428031	-0.244525	-1.075055	-0.562876	-1.00516
Kurtosis	1.793293	1.736028	1.862196	3.042495	1.739386	2.724757
Jarque-Bera	1.500377	2.233365	1.469861	4.432076	2.737444	3.945578
Probability	0.472278	0.327364	0.479539	0.10904	0.254432	0.139068
Sum	196.3567	157.7943	347.539	94.48985	75.68482	35.75666
Sum Sq. Dev.	5.015171	13.26713	0.611772	0.252474	5.233766	6.508703
Observations	23	23	23	23	23	23

From the table above of descriptive statistics shows the summary statistics for the whole selected sample used in the analysis of the study, it reveals that on average that the contribution of Gross capital formulation, labor force, life expectancy, secondary school enrolment and tertiary school enrolment on economic growth are 8.537247**,** 6.860623**,** 15.11039**,** 4.108254and 3.290644 respectively with the minimum of 7.713785**,** 5.605802**,** 14.81319**,** 3.852889**,** 2.43482**,** and maximum of 9.267949**,** 7.848934**,** 15.35329**,** 4.234107**,** 3.830519**,** 2.036967**.**

For distribution of data set,

HO: variables are normally distributed

H1: Variables are not normally distributed.

Null hypothesis is rejected with a confirmation result of probability of Jarque-Bera in the descriptive statistics results, therefore for this study, HO is accepted and confirm that the variables are normally distributed, for all other variables HO is accepted by checking the prob results which are greater than 0.05. The study dataset has 22 observations from 2000 to 2022.

4.2 CORRELATION ANALYSIS

Table 3CORRELATION ANALYSIS

Variables	LOGGDP	LOGK	LOGLF	LOGLEX	LOGSEC	LOGTER
LOGGDP	1	0.986335	0.984116	0.942138	0.960947	0.90724
LOGK	0.986335	1	0.98282	0.955689	0.978795	0.940702
LOGLF	0.984116	0.98282	1	0.948954	0.960744	0.93198
LOGLEX	0.942138	0.955689	0.948954	1	0.959455	0.979204
LOGSEC	0.960947	0.978795	0.960744	0.959455	1	0.967175
LOGTER	0.90724	0.940702	0.93198	0.979204	0.967175	1

This is used to determine if there is or not linear relationship between the two variables under consideration, From the results above shows that all variables have strong positive correlation with economic growth where the more positive connection among other variables in model of

this study appear on gross capital formulation with gross domestic product where the correlation coefficient is closer to one and is positive at 98%.

4.3 STATIONARITY TEST

The unit root test analyzes whether the variables integrated are in the same order. The Augmented Dickey-Fuller test was used to determine the stationarity level of the variables. It was determined that all variables had unit root, indicating that they were non-stationary at levels since their probability statistic (s) was more than 5% as the critical value testing level which resulting in the failure to reject the null hypothesis that there was no unit root. The below table is summary of stationarity values for all variables.

Table 4VARIABLE STATIONARITY LEVELS

VARIABLS	P-VALUES AT LEVELS	P-VLUES AT FIRST DIFFERENCE	INTEGRATION ORDER
GDP	0.0869>0.05	0.0001<0.05	I(1)
GCF	0.4855>0.05	0.0496<0.05	I(1)
LF	0.6486>0.05	0.0004<0.05	I(1)
LEX	0.9998>0.05	0.0000 <0.05	I(1)
SEC	0.2405>0.05	0.0246<0.05	I(1)
TER	0.8573>0.05	0.0008<0.05	I(1)

The result as given in table above, suggests that all variables integrated are of order 1, suggesting the presence of one unit root. As a result of this, the first differences of non-stationary variables conducted, and they became stationary.

4.4 MULTICOLLINEARITY TEST

Multicollinearity is a problem for OLS model, the problem must be detected and removed before results estimations, the VIF test conducted to determine if there is multicollinearity and detect which variables were causing high collinearity between the pairs of independents and dependent variables, the table below consist of VIF results.

To check for multicollinearity, centered VIF coefficients are the most concerns, they should be below 10 which confirm of absence of multicollinearity problem, ,then VIF test the results confirm absence of multicollinearity where all centered VIF coefficients which are (1.171606**,** 2.222621**,** 1.8988461.624622,3.661464**<10**).

Table 5MULTICOLLINEARITY RESULTS

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	0.000132	5.595492	NA
D(LOGK)	0.003117	2.414511	1.171606
D(LOGLF)	0.057119	3.677681	2.222621
D(LOGLEX)	0.235987	4.893711	1.898846
D(LOGSEC)	0.007274	2.738709	1.624622
D(LOGTER)	0.008211	5.618291	3.661464
RESID_ECM(-1)	0.022203	1.588647	1.588625

4.5 HETEROSKEDASTICITY TEST

Heteroskedasticity is necessary for deciding whether there is no variation between the error terms across observations or whether the study variables have a consistent variance across data. Breusch-Pagan test for heteroscedasticity were used for this analysis, the results are below, and the results follow the assumptions that.

HO: The series has heteroskedasticity

H1: The series has homoscedasticity.

Table 6 HETEROSKEDASTICITY TEST

Heteroskedasticity Test: Breusch-Pagan-Godfrey

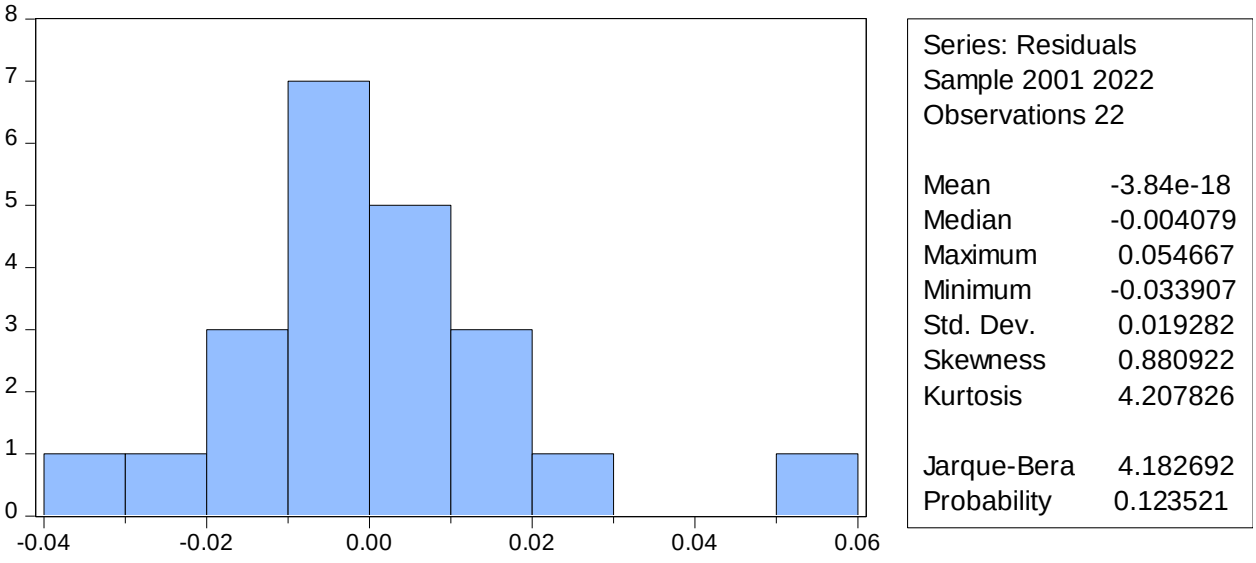
F-statistic	1.231874	Prob. F(6,15)	0.3444
Obs*R-squared	7.262095	Prob. Chi-Square(6)	0.2973
Scaled explained SS	5.414768	Prob. Chi-Square(6)	0.4918

From the results above driven to reject the null hypothesis and conclude that the series has homoscedasticity where **Prob. Chi-Square>0.005**.

4.6 NORMARITY DISTRIBUTION OF RESIDUALS

HO: Residuals are normally distributed

H1: Residuals are not normally distributed.



0-1NORMARITY TEST RESULTS

From the above figure, the test results confirm that the residuals are normally distributed hence the Jarque Bera probability is greater than 5% level of significant (0.12>0.05), thus this confirms the good quality of the model.

4.7 REGRESSION EQUATION

Dependent Variable: LOGGDP

Method: Least Squares

Date: 10/08/23 Time: 00:12

Sample: 2000 2022

Included observations: 23

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGK	0.196359	0.102006	1.924963	0.0311
LOGLF	1.332703	0.332037	4.013712	0.0009
LOGLEX	2.219792	0.561400	3.954032	0.0010
LOGSEC	0.419293	0.142179	2.949049	0.0090
LOGTER	-0.639886	0.117780	-5.432886	0.0000
C	-22.45198	4.808502	-4.669225	0.0002

R-squared	0.992572	Mean dependent var	8.537247
Adjusted R-squared	0.990387	S.D. dependent var	0.477454
S.E. of regression	0.046813	Akaike info criterion	-3.065872
Sum squared resid	0.037254	Schwarz criterion	-2.769656
Log likelihood	41.25753	Hannan-Quinn criter.	-2.991375
F-statistic	454.3106	Durbin-Watson stat	1.626688
Prob(F-statistic)	0.000000		

Table 7 REGRESSION EQUATION

The above equation shows the relationship and effect of independent variable to dependent variable where all independent variables are statistically significant relationship with GDP at 5%.

this indicates that 1% change increase in capital increase GDP by 0.19, 1% change in labor force increase GDP by 1.33 ,1% change increase in life expectance increase GDP by 2.21, 1% increase in secondary school enrollment increase GDP by 0.41 and 1% change increase in tertiary school enrollment decrease GDP 0.6 which was not expected.

R-squared in the model tell us the goodness of fit of independent variables to dependent variable as it shows the level of 99% goodness fit of the model.

The Durbin Watson results shows that the model is free from autocorrelation where it lays between 1.5 and 2.0.

4.8 JOHANSEN COINTEGRATION TEST RESULTS

The Johansen Cointegration test follows these hypotheses.

- H0 = No Cointegrating equation
- H1 = H0 is not true i.e. There is Cointegrating equation.

The HO rejected if the values of trace and maximum eigen statistics are greater than their critical values and the probabilities of cointegrated equations are less than 5% and the analysis of, therefore the results confirms that there are 4 cointegrated equations for the trace statistics and 4 cointegrated equations for maximum, the results are shown below.

Johansen Cointegration: Trace Test Results

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.943659	233.2069	95.75366	0.0000
At most 1 *	0.886443	146.9171	69.81889	0.0000
At most 2 *	0.782482	81.65368	47.85613	0.0000
At most 3 *	0.540522	35.88947	29.79707	0.0088
At most 4	0.339931	12.55955	15.49471	0.1320
At most 5	0.003235	0.097217	3.841466	0.7552

Table 8 COINTEGRATION TEST

Johansen Cointegration: Maximum-Eigen values results

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.943659	86.28976	40.07757	0.0000
At most 1 *	0.886443	65.26346	33.87687	0.0000
At most 2 *	0.782482	45.76422	27.58434	0.0001
At most 3 *	0.540522	23.32992	21.13162	0.0241
At most 4	0.339931	12.46234	14.26460	0.0945
At most 5	0.003235	0.097217	3.841466	0.7552

Table 9COINTERGRATION TEST: MAXIMUM EIGEN VALUES

The null hypothesis H0, i.e., no Cointegrating equation, is tested against the alternative hypothesis, i.e., the presence of a Cointegrating equation. The calculated Trace and Maximum

Eigen statistics exceed the critical value of 0.05, indicating that the null hypothesis of no Cointegrating equation in this model has been rejected because the model shows up to four Cointegrating equations for consideration of trace statistics and four cointegrating equations for consideration of max-eigenvalues statistics, confirming the existence of a long-run relationship in Rwanda.

4.9 ERROR CORRECTION MODEL RESULTS

The cointegration is determined, this means that there is existence of short run and long run linear relationship between the dependent and independent variables of the study, to estimate the short run, the Error Correction Term (ECT) is statistically significant and revealed that there is a short-run adjustment of the variables for maintaining the long-run equilibrium. the error correction model was performed, and the findings are shown below:

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.045953	0.011506	3.993864	0.0012
D(LOGK)	0.143049	0.055826	2.562416	0.0217
D(LOGLF)	-0.167353	0.238997	-0.700233	0.4945
D(LOGLEX)	1.324638	0.485785	2.726802	0.0156
D(LOGSEC)	0.119083	0.085290	1.396210	0.1830
D(LOGTER)	-0.201878	0.090614	-2.227891	0.0416
RESID_ECM(-1)	-0.388537	0.149008	-2.607492	0.0198

Table 10 ERROR CORRECTION MODEL

$GDP_t = 0.045953+0.143049K_t-0.167353LF_t+1.324638LEX_t+0.119083SEC_t-0.201878TER_t - 0.388537\varepsilon_{t-1}$

Since the error correction term is between -1 and 0 and statistically significant this shows the appropriate of short run model of the study and thus implies that there is a causal effect of human capital on economic growth in Rwanda. This ECM results suggesting that almost 38% of the discrepancy between the long run and the short run is corrected within a year also shows that capital and life expectance are the variables that have positive significant impact on economic growth in the short run.

CHAPITER 5 SUMMARY CONCLUSIONS AND POLICY RECOMMENDATIONS

5.1 Introduction

This chapter demonstrates an overview of the results of the study with a linkage to the goals, major indicators that was examined in the study as well as the related literature review. Furthermore, it shows the facts proven from the relationship between human capital development and economic growth in Rwanda which are detailed in the report, thus this resulted in the formulation of the required suggestions for policy recommendation and further research topics to be conducted to close the gaps found in the study.

5.2 SUMMARY OF STUDY FINDINGS

The main purpose of this study was to examine the relationship between human capital development and economic growth in Rwanda for the period of past three decades from 1990 to 2022 , these time series data were captured from world bank as development indicators and National Institute of statistics of Rwanda The findings were from the econometrics time series analysis by e view software and the model formulation is based on cobb Douglass production function theory where gross domestic product is used as dependent variable to measure economic growth, gross capital formulation ,labor force ,secondary school enrolment ,tertiary school enrolment ,and life expectance at birth as explanatory variable where from those explanatories variables three of them which are life expectance, secondary school enrolment and tertiary school enrolment are the proxies variables for human capital .

Diagnostic tests are performed before to see the characteristics and natural of the dataset. Descriptive statistics results showing the central tendency of the data by mean median and mode of data and other measurement of dispersion of the series in the sample taken, therefore the descriptive statistics results confirm that the study dataset is normally distributed by checking the probability of Jarque-Bera which is found to be greater than 0.05 for some variables in the model.

The stationarity tests is also performed by ADF unit roots test where all variables are found to not stationary at level but become stationary at first difference which indicate a long run

relationship between human capital development and economic growth in Rwanda thus the Johansen cointegration test applied to approve this existence long run relationship between human capital development and economic growth for at three first cointegrated equations on trace statistics and three first cointegrated equations on maximum eigen statistics .

The coefficient of error correction term which confirm the speed adjustment to long-run equilibrium was found to be negative less than one as the rule of thumb and it is statistically significant at 5% level thus this indicate that the shocks or previous deviation in human capital development must be corrected in the current period at 38% which will ensure stable long run relationship between these variables.

5.3LINK DISCUSSION WITH THE OTHER STUDY FINDINGS

In accordance with the previous research done for the case of Rwanda and around other developing countries, this study results have the same understanding of findings from the study conducted by RUDASINGWA Didace in 2022 where the results from the linear equation was supporting the evidence of positive the long run relationship in Rwanda and concluded that Gross capital formation efficiencies are positively statistically significant on economic growth , as a 1% rise in gross capital rise economic growth by 0.5% at lag one, 0.7 at lag two, 0.36% at lag three, 0.89% at lag four, and 0.64% at lag five , on the side of education as the proxy of human capital , theirs efficiencies gives the evidence of their relationship as they significant ,a 1% rise in secondary education influence economic growth by approximately 0.58% at lag two, - 0.72% at lag three, 0.67% at lag four, and 1.86% at lag five. Whereas a 1% increase in tertiary education affects economic growth by approximately 0.2% at lag one, 0.81% at lag two, 0.93% at lag three, and 0.96% at lag five, some important issues were ignored in this study such as health indicators which are important indicators of human capital. (Didace, 2022) and Sunday Anderu in 2021 for the case of Nigeria, the difference shown in study period of interest (2000-2022) and model specification where this study includes life expectancy as the measurement of health in human capital, but all the study's results revealed the great contribution of human capital development on economic growth.

5.4 RECOMMENDATIONS

In accordance with the study findings, there was a positive relationship between human capital development and economic growth in Rwanda. The findings correspond with many other past results with the same research intention that the government should place more emphasis on the development of the education sector, not only increasing the number of students enrolled in each school intake but also all other factors that affect learning outcomes as well as raising good health. The following should be taken account while developing human capital:

- Improve innovative skills of university-educated from leaning by doing which is a hope to encourage positive returns from labor participation.
- Improve the labor market outcomes for upper-secondary educated workers by providing more opportunities like better computer skills and other innovation skills , to reduce the number and consequent over-supply of university graduates.
- Encourage studying in fields which showcase higher levels of demand (health & welfare, science, and agriculture).

Furthermore, the findings direct to the need to have same strategies that would encourage the other key primary human capital factors, like behavioral patterns of employee that contribute to the work performance, more trainings provision, motivation toward labor productivity increase, health care and provision of more health services.

5.5 AREA OF FUTHER RESEARCH

This study was designed to examine the relationship between human capital development and Rwandan economic growth, specific objectives of the study included to examine the role of education and health indicator in economic growth and their long run relationship in Rwanda. The research based on two area that are said to be primary component of human capital development which are education sector that captured by school enrollment and health sector which captured by life expectance from birth though they didn't provide much information on those two sectors. Therefore, future studies must be based on the area that they must include other variables not only school enrollment but also a share of technology in education, leaning

outcomes, budget spending on education sector and as well as for health sector and other variables that might be better measurement of improved medical care and disease incidence.

As world bank reported that it might be not good to increase the number of school attendance which not necessarily resulting into better learning outcomes due to health issues and poor standard education thus this still affect the productivity as well as economic growth. (bank, 2019).

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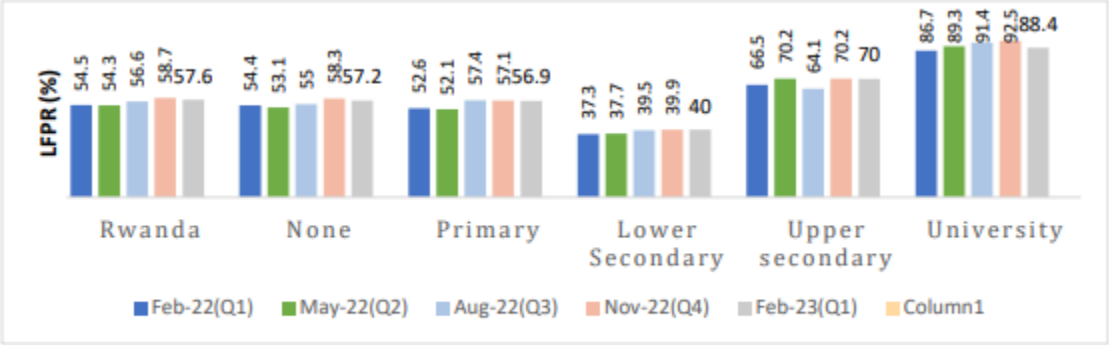
APPENDICES

DATA USED.

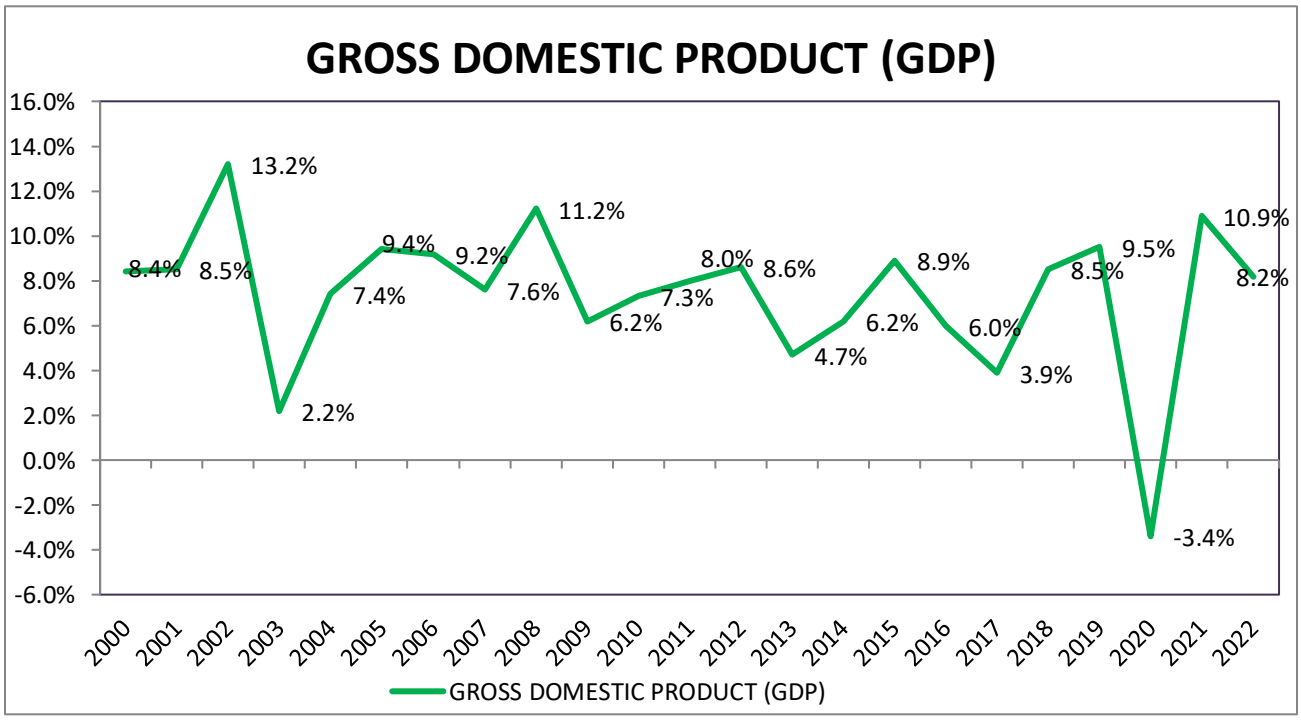
YEAR	Gross Domestic Product	Gross capital formulation	life expectancy	labor force, total	secondary school enrolnment,gross	tertiary school enrolnment,gross
2000	104,675	99	47	2,711,971	11.4	1.3
2001	110,253	111	49	2,797,990	11.7	1.7
2002	115,309	118	51	2,884,196	12.5	2.0
2003	138,434	151	53	2,974,186	14.0	2.4
2004	159,535	197	55	3,066,374	15.7	2.9
2005	185,909	248	57	3,156,917	16.7	3.0
2006	203,444	275	59	3,247,094	18.4	3.9
2007	241,848	374	60	3,338,604	20.4	4.1
2008	298,000	605	61	3,433,301	22.0	4.4
2009	332,268	678	62	3,532,102	26.1	5.3
2010	357,000	733	63	3,635,144	31.6	5.9
2011	405,000	864	63	3,742,460	35.6	7.0
2012	447,619	1,096	64	3,843,907	38.3	6.8
2013	472,336	1,235	64	3,940,991	40.7	7.3
2014	510,909	1,306	65	4,042,993	40.1	7.4
2015	543,982	1,491	65	4,152,626	37.9	7.6
2016	594,957	1,789	66	4,270,829	37.3	7.7
2017	652,034	1,834	66	4,399,260	38.9	7.4
2018	686,692	1,774	65	4,025,709	40.9	6.7
2019	752,585	2,183	66	4,085,693	44.3	6.2
2020	758,561	2,410	67	4,544,104	32.9	7.3
2021	844,610	2,856	69	4,588,673	46.1	7.3
2022	987,728	3,359	67	4,654,245	47.1	7.3

0-1LABOR FORCE PARTICIPATION BY EDUCATION LEVEL

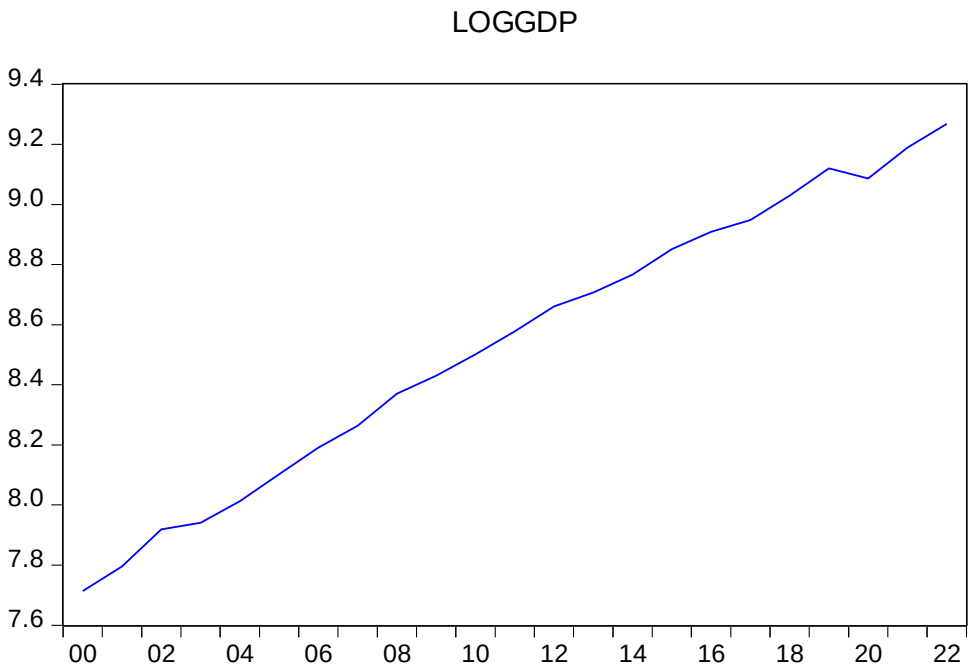


Source: National Institute of Statistics of Rwanda (NISR), Labour Force Survey (LFS)

0-2 GROSS DOMESTIC PRODUCTS GROWTH



Source: MINECOFIN,2022



0-3 GDP GRAPH

GDP STATIONARITY TEST AT I(0)

Null Hypothesis: LOGGDP has a unit root

Exogenous: Constant

Lag Length: 2 (Automatic - based on AIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.727895	0.0869
Test critical values:	1% level	-3.808546	
	5% level	-3.020686	
	10% level	-2.650413	

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

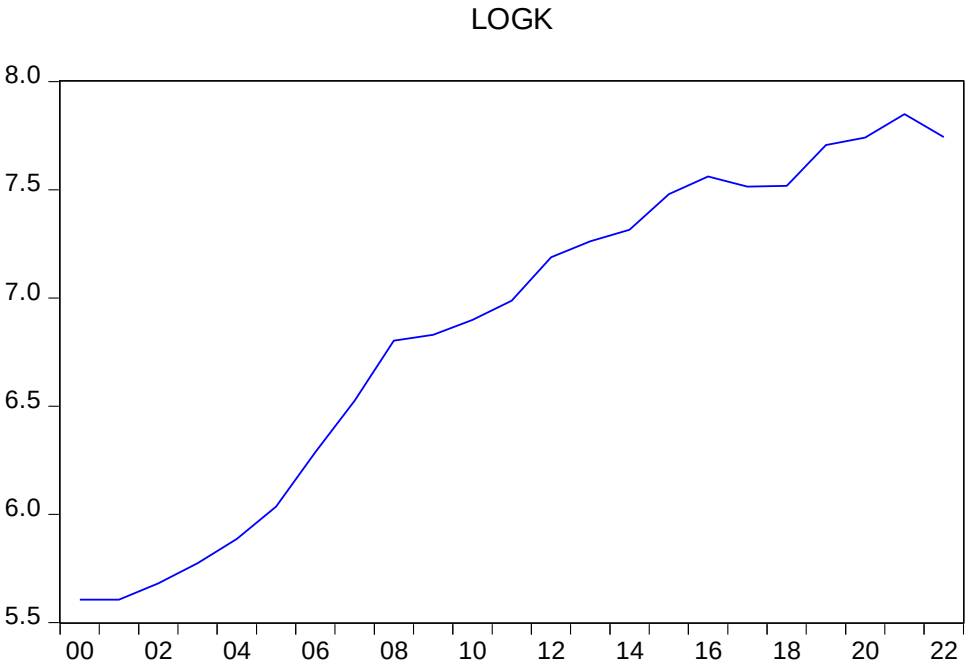
GDP STATIONARITY TEST AT I(1)

Exogenous: Constant, Linear Trend

Lag Length: 1 (Automatic - based on AIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.798129	0.0001
Test critical values:	1% level	-4.498307	
	5% level	-3.658446	
	10% level	-3.268973	

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



0-4 GRAPH OF CAPITAL

K STATIONARIRT TEST AT I(0)

Null Hypothesis: LOGK has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on AIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.559734	0.4855
Test critical values:	1% level	-3.769597	
	5% level	-3.004861	
	10% level	-2.642242	

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

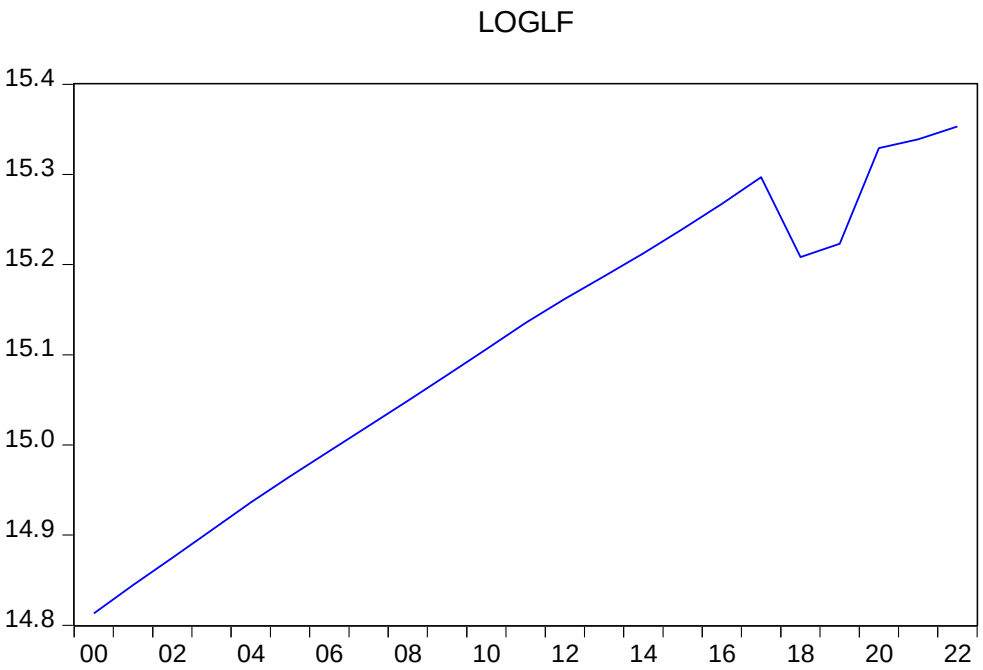
K STATIONARITY TEST AT I(1)

Null Hypothesis: D(LOGK) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on AIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.016837	0.0496
Test critical values:	1% level	-3.788030	
	5% level	-3.012363	
	10% level	-2.646119	



0-5GRAPH OF LABOR FORCE

LFSTATIONARIRT TEST AT I(0)

Null Hypothesis: LOGLF has a unit root

Exogenous: Constant

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

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.210442	0.6486
Test critical values:	1% level	-3.808546	
	5% level	-3.020686	
	10% level	-2.650413	

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

LF STATIONARITY TEST AT I(1)

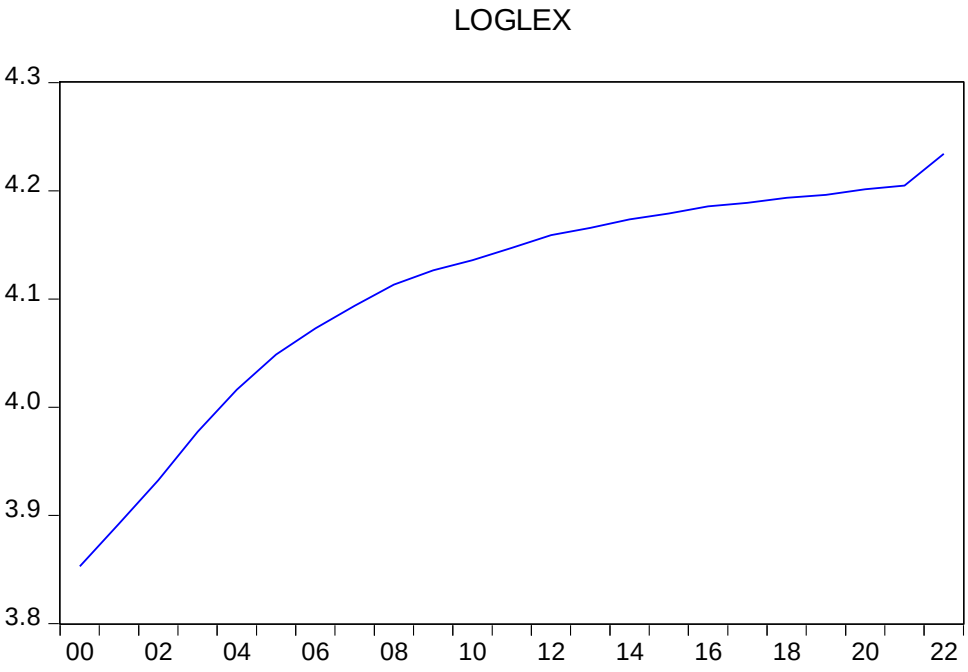
Null Hypothesis: D(LOGLF) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on AIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.259863	0.0004
Test critical values:	1% level	-3.808546	
	5% level	-3.020686	
	10% level	-2.650413	

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



0-6 GRAPH OF LIFE EXPECTANCE

LEX STATIONARIRT TEST AT I(0)

Null Hypothesis: LOGLEX has a unit root

Exogenous: Constant

Lag Length: 8 (Automatic - based on AIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		2.509375	0.9998
Test critical values:	1% level	-4.004425	
	5% level	-3.098896	
	10% level	-2.690439	

LEX STATIONARITY TEST AT I(1)

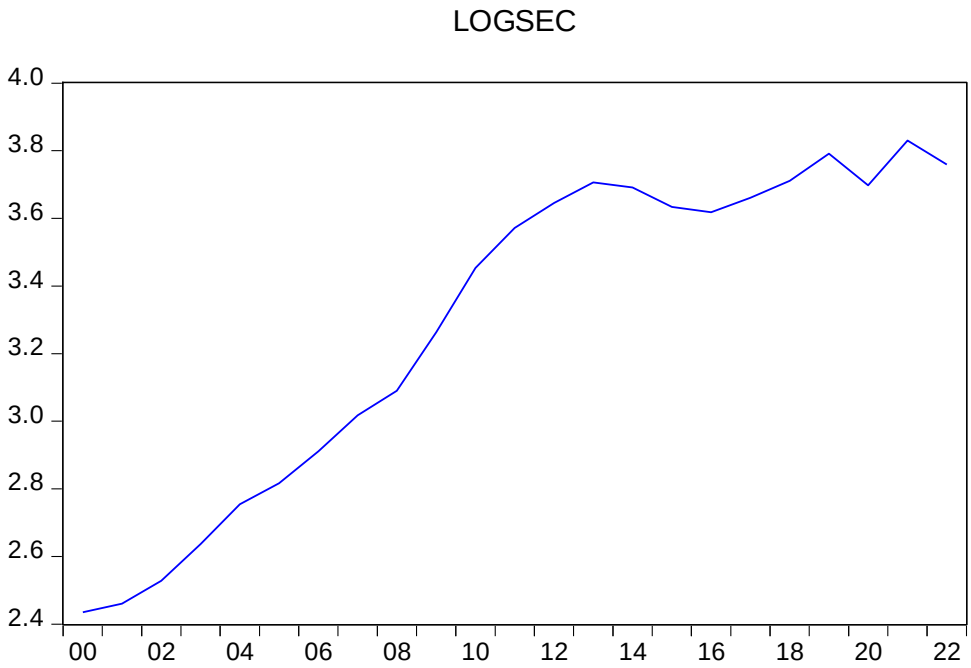
Null Hypothesis: D(LOGLEX) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on AIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.620773	0.0000
Test critical values:	1% level	-3.788030	
	5% level	-3.012363	
	10% level	-2.646119	

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



0-7 GRAP OF SECONDARY SCHOOL ENRLONMENT

SEC STATIONARITY TEST AT I(0)

Null Hypothesis: LOGSEC has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on AIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.116396	0.2405
Test critical values:	1% level	-3.769597	
	5% level	-3.004861	
	10% level	-2.642242	

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

SEC STATIONARITY TEST AT I(1)

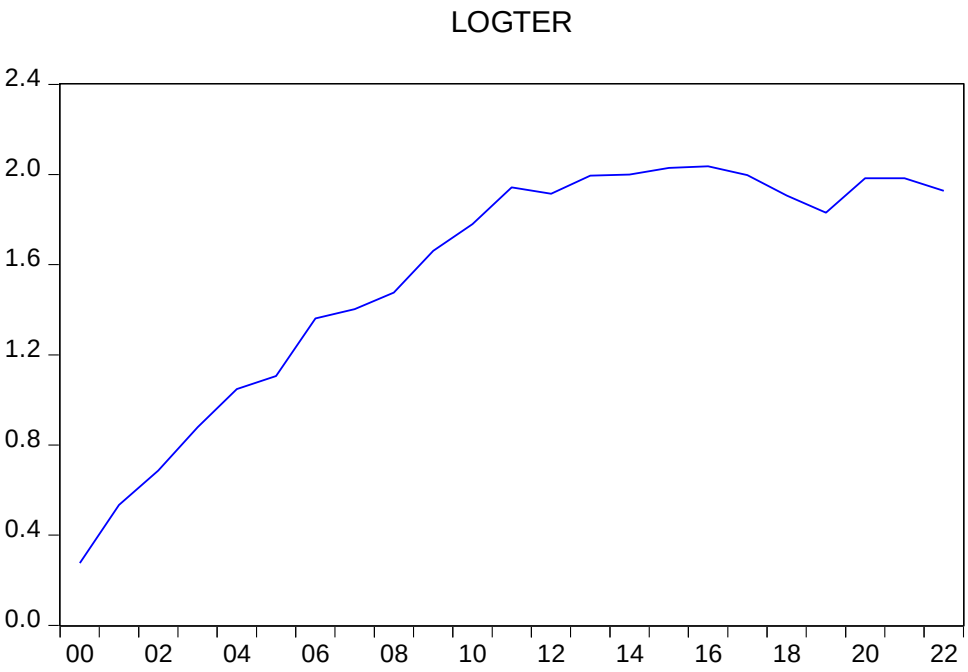
Null Hypothesis: D(LOGSEC) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on AIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.015087	0.0246
Test critical values:	1% level	-4.467895	
	5% level	-3.644963	
	10% level	-3.261452	

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



0-8GRAPH OF TERTIARY SCHOOL ENROLNMENT

TER STATIONARITY TEST AT I(0)

Null Hypothesis: LOGTER has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on AIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.313389	0.8573
Test critical values:	1% level	-4.440739	
	5% level	-3.632896	
	10% level	-3.254671	

TER STATIONARITY TEST AT I(1)

Null Hypothesis: D(LOGTER) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on AIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.909006	0.0008
Test critical values:	1% level	-3.769597	
	5% level	-3.004861	
	10% level	-2.642242	

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

REGRESSION EQUATION

Dependent Variable: LOGGDP

Method: Least Squares

Date: 10/08/23 Time: 00:12

Sample: 2000 2022

Included observations: 23

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGK	0.196359	0.102006	1.924963	0.0311
LOGLF	1.332703	0.332037	4.013712	0.0009
LOGLEX	2.219792	0.561400	3.954032	0.0010
LOGSEC	0.419293	0.142179	2.949049	0.0090
LOGTER	-0.639886	0.117780	-5.432886	0.0000
C	-22.45198	4.808502	-4.669225	0.0002

R-squared	0.992572	Mean dependent var	8.537247
Adjusted R-squared	0.990387	S.D. dependent var	0.477454
S.E. of regression	0.046813	Akaike info criterion	-3.065872
Sum squared resid	0.037254	Schwarz criterion	-2.769656
Log likelihood	41.25753	Hannan-Quinn criter.	-2.991375
F-statistic	454.3106	Durbin-Watson stat	1.626688
Prob(F-statistic)	0.000000		

JOHNSEN COINTEGRATION TEST

Date: 10/08/23 Time: 00:17

Sample (adjusted): 2000 2022

Included observations:21 after adjustments

Trend assumption: Linear deterministic trend

Series: LOGGDP LOGK LOGLF LOGLEX LOGSEC LOGTER

Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.943659	233.2069	95.75366	0.0000
At most 1 *	0.886443	146.9171	69.81889	0.0000
At most 2 *	0.782482	81.65368	47.85613	0.0000
At most 3 *	0.540522	35.88947	29.79707	0.0088
At most 4	0.339931	12.55955	15.49471	0.1320
At most 5	0.003235	0.097217	3.841466	0.7552

Trace test indicates 4 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.943659	86.28976	40.07757	0.0000
At most 1 *	0.886443	65.26346	33.87687	0.0000

At most 2 *	0.782482	45.76422	27.58434	0.0001
At most 3 *	0.540522	23.32992	21.13162	0.0241
At most 4	0.339931	12.46234	14.26460	0.0945
At most 5	0.003235	0.097217	3.841466	0.7552

Max-eigenvalue test indicates 4 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

LOGGDP	LOGK	LOGLF	LOGLEX	LOGSEC	LOGTER
12.35258	4.602273	-69.32525	9.021878	-4.588244	5.739726
13.68918	-3.479062	-64.17302	41.16347	2.313449	1.328522
-20.41357	16.39366	9.617868	-7.803189	-6.611404	-2.362282
10.10295	-7.743454	1.188757	8.748559	9.128514	-3.436193
-3.514292	-11.52841	36.78930	12.26980	7.006560	0.126242
-18.53100	10.38781	-8.165698	-1.531662	2.324677	1.085215

Unrestricted Adjustment Coefficients (alpha):

D(LOGGDP)	0.045181	-0.030311	-0.052666	-0.009281	0.002255
D(LOGK)	0.071804	-0.044417	-0.203550	-0.042197	0.002163
D(LOGLF)	0.007684	-0.004267	-0.024319	0.003515	-0.009843
D(LOGLEX)	0.044106	-0.062106	-0.116127	-0.028838	-0.012485
D(LOGSEC)	0.055759	0.025782	0.038009	-0.032087	0.007138
D(LOGTER)	-0.055910	-0.008853	-0.032262	-0.011052	-0.036343

1 Cointegrating Equation(s):	Log likelihood	309.4904

Normalized cointegrating coefficients (standard error in parentheses)

LOGGDP	LOGK	LOGLF	LOGLEX	LOGSEC	LOGTER
1.000000	0.372576	-5.612210	0.730364	-0.371440	0.464658
	(0.09233)	(0.42755)	(0.18421)	(0.06871)	(0.03417)

Adjustment coefficients (standard error in parentheses)

D(LOGGDP)	0.558102
	(0.22238)
D(LOGK)	0.886959
	(0.76620)
D(LOGLF)	0.094914
	(0.10189)
D(LOGLEX)	0.544825
	(0.48079)
D(LOGSEC)	0.688770
	(0.21617)
D(LOGTER)	-0.690635
	(0.27670)

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2 Cointegrating Equation(s):	Log likelihood	342.1221

Normalized cointegrating coefficients (standard error in parentheses)

LOGGDP	LOGK	LOGLF	LOGLEX	LOGSEC	LOGTER
1.000000	0.000000	-5.062702	2.083789	-0.050159	0.246121
		(0.21621)	(0.16262)	(0.03773)	(0.02710)
0.000000	1.000000	-1.474888	-3.632615	-0.862325	0.586558
		(0.64663)	(0.48637)	(0.11284)	(0.08106)

Adjustment coefficients (standard error in parentheses)

D(LOGGDP)	0.143176	0.313388
	(0.30111)	(0.09421)
D(LOGK)	0.278932	0.484988
	(1.12522)	(0.35208)
D(LOGLF)	0.036500	0.050209
	(0.15081)	(0.04719)
D(LOGLEX)	-0.305350	0.419058
	(0.65809)	(0.20591)
D(LOGSEC)	1.041700	0.166923
	(0.30000)	(0.09387)
D(LOGTER)	-0.811828	-0.226513
	(0.41101)	(0.12860)

3 Cointegrating Equation(s):	Log likelihood	365.0042

Normalized cointegrating coefficients (standard error in parentheses)

LOGGDP	LOGK	LOGLF	LOGLEX	LOGSEC	LOGTER
1.000000	0.000000	0.000000	-4.779410	-0.523398	0.752303
			(0.35252)	(0.14495)	(0.09919)
0.000000	1.000000	0.000000	-5.632032	-1.000191	0.734021
			(0.34384)	(0.14138)	(0.09675)
0.000000	0.000000	1.000000	-1.355640	-0.093476	0.099983
			(0.07823)	(0.03216)	(0.02201)

Adjustment coefficients (standard error in parentheses)

D(LOGGDP)	1.218276	-0.550000	-1.693603
	(0.26574)	(0.16789)	(0.91731)
D(LOGK)	4.434113	-2.851941	-4.085169
	(0.92657)	(0.58540)	(3.19848)

D(LOGLF)	0.532936	-0.348467	-0.492737	
	(0.15050)	(0.09508)	(0.51951)	
D(LOGLEX)	2.065212	-1.484686	-0.189059	
	(0.57109)	(0.36081)	(1.97137)	
D(LOGSEC)	0.265795	0.790035	-5.154443	
	(0.36330)	(0.22953)	(1.25408)	
D(LOGTER)	-0.153252	-0.755401	4.133836	
	(0.57163)	(0.36115)	(1.97323)	

4 Cointegrating Equation(s):	Log likelihood	376.6692

Normalized cointegrating coefficients (standard error in parentheses)

LOGGDP	LOGK	LOGLF	LOGLEX	LOGSEC	LOGTER
1.000000	0.000000	0.000000	0.000000	1.632706	-0.987082
				(0.56623)	(0.25747)
0.000000	1.000000	0.000000	0.000000	1.540551	-1.315661
				(0.68230)	(0.31025)
0.000000	0.000000	1.000000	0.000000	0.518085	-0.393379
				(0.16142)	(0.07340)
0.000000	0.000000	0.000000	1.000000	0.451124	-0.363933
				(0.12272)	(0.05580)

Adjustment coefficients (standard error in parentheses)

D(LOGGDP)	1.124510	-0.478133	-1.704636	-0.510301
	(0.27481)	(0.17842)	(0.89052)	(0.41018)
D(LOGK)	4.007802	-2.525193	-4.135331	0.038639
	(0.93743)	(0.60863)	(3.03781)	(1.39923)
D(LOGLF)	0.568447	-0.375685	-0.488559	0.114186
	(0.15825)	(0.10274)	(0.51280)	(0.23620)

D(LOGLEX)	1.773860	-1.261378	-0.223341	-1.504696	
	(0.57053)	(0.37042)	(1.84882)	(0.85158)	
D(LOGSEC)	-0.058381	1.038501	-5.192587	0.987007	
	(0.30745)	(0.19962)	(0.99632)	(0.45891)	
D(LOGTER)	-0.264909	-0.669820	4.120698	-0.713787	
	(0.60356)	(0.39186)	(1.95586)	(0.90088)	

5 Cointegrating Equation(s):	Log likelihood	382.9003

Normalized cointegrating coefficients (standard error in parentheses)

LOGGDP	LOGK	LOGLF	LOGLEX	LOGSEC	LOGTER
1.000000	0.000000	0.000000	0.000000	0.000000	-1.105170
					(0.13050)
0.000000	1.000000	0.000000	0.000000	0.000000	-1.427085
					(0.12158)
0.000000	0.000000	1.000000	0.000000	0.000000	-0.430851
					(0.04222)
0.000000	0.000000	0.000000	1.000000	0.000000	-0.396561
					(0.03840)
0.000000	0.000000	0.000000	0.000000	1.000000	0.072327
					(0.10662)

Adjustment coefficients (standard error in parentheses)

D(LOGGDP)	1.116587	-0.504124	-1.621694	-0.482638	0.001847
	(0.27627)	(0.20824)	(0.95329)	(0.42524)	(0.13322)
D(LOGK)	4.000202	-2.550123	-4.055773	0.065172	0.543502
	(0.94401)	(0.71154)	(3.25734)	(1.45303)	(0.45519)
D(LOGLF)	0.603037	-0.262215	-0.850663	-0.006582	0.078778
	(0.14187)	(0.10693)	(0.48953)	(0.21837)	(0.06841)

D(LOGLEX)	1.817737	-1.117444	-0.682658	-1.657885	0.070985
	(0.56718)	(0.42751)	(1.95707)	(0.87301)	(0.27349)
D(LOGSEC)	-0.083467	0.956210	-4.929980	1.074590	-0.690383
	(0.30514)	(0.23000)	(1.05291)	(0.46968)	(0.14714)
D(LOGTER)	-0.137189	-0.250841	2.783658	-1.159711	0.093815
	(0.54553)	(0.41119)	(1.88238)	(0.83969)	(0.26305)

UNIT ROOTS TEST OF THE RESIDUAL

Null Hypothesis: RESID_ECM has a unit root

Exogenous: None

Lag Length: 0 (Automatic - based on AIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.427464	0.0001
Test critical values:	1% level	-2.674290	
	5% level	-1.957204	
	10% level	-1.608175	

ERROR CORRECTION MODEL

Dependent Variable: D(LOGGDP)

Method: Least Squares

Date: 10/08/23 Time: 00:21

Sample (adjusted): 2001 2022

Included observations: 22 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.045953	0.011506	3.993864	0.0012
D(LOGK)	0.143049	0.055826	2.562416	0.0217
D(LOGLF)	-0.167353	0.238997	-0.700233	0.4945
D(LOGLEX)	1.324638	0.485785	2.726802	0.0156
D(LOGSEC)	0.119083	0.085290	1.396210	0.1830
D(LOGTER)	-0.201878	0.090614	-2.227891	0.0416
RESID_ECM(-1)	-0.388537	0.149008	-2.607492	0.0198

R-squared	0.649832	Mean dependent var	0.070644
Adjusted R-squared	0.509764	S.D. dependent var	0.032585
S.E. of regression	0.022815	Akaike info criterion	-4.469441
Sum squared resid	0.007808	Schwarz criterion	-4.122291
Log likelihood	56.16385	Hannan-Quinn criter.	-4.387663
F-statistic	4.639424	Durbin-Watson stat	2.455611
Prob(F-statistic)	0.007386		

HETEROSKEDASTICITY TEST

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.231874	Prob. F(6,15)	0.3444
Obs*R-squared	7.262095	Prob. Chi-Square(6)	0.2973
Scaled explained SS	5.414768	Prob. Chi-Square(6)	0.4918

CORRELATION LM TEST

HO: No serial correlation

H1: there is a serial correlation.

Hence the p>0.05, the null hypothesis of no serial correlation is accepted .

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.159196	Prob. F(2,13)	0.3441
Obs*R-squared	3.329634	Prob. Chi-Square(2)	0.1892

MULTICOLLINEARITY TEST

Variance Inflation Factors

Date: 10/08/23 Time: 00:26

Sample: 2000 2022

Included observations: 22

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	0.000132	5.595492	NA
D(LOGK)	0.003117	2.414511	1.171606
D(LOGLF)	0.057119	3.677681	2.222621
D(LOGLEX)	0.235987	4.893711	1.898846
D(LOGSEC)	0.007274	2.738709	1.624622
D(LOGTER)	0.008211	5.618291	3.661464
RESID_ECM (-1)	0.022203	1.588647	1.588625