University of Venda

GOVERNMENT EXPENDITURE ON EDUCATION AND ECONOMIC GROWTH IN SOUTH AFRICA

By

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DECLARATION

I, Ronewa Sadiki, hereby declare that this research thesis for the Degree of Master of Commerce in Economics submitted to the Department of Economics at the University of Venda has not been submitted previously for any degree at this or another university. It is original in design and in execution, and all reference material contained therein has been duly acknowledged.

Student……………………………… Date……………………….……

CERTIFICATION

It is hereby certified that this research was written by Sadiki Ronewa Candy and the supervisor was Dr. A.I Nemushungwa, and Co-supervisor was Dr. M.A Dagume, submitted to the Department of Economics, Faculty of Management, Commerce, and Law at the University of Venda.

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ABSTRACT

Education is one of the most important factors influencing a country's progress, welfare, and level of economic and social development. Therefore, this study aims to empirically investigate the relationship between government expenditure on education and economic growth in South Africa. The study employed annual time series data spanning from 2000 to 2021. The data was analysed by means of the Autoregressive distributive lag technique and Granger causality analysis. The findings revealed that government spending on education and economic growth are positively related in South Africa. Furthermore, the findings revealed that government expenditure on education granger causes economic growth, implying that in the long run, government educational expenditure, through its impact on human capital, positively influences economic growth. The results also revealed that reveal that in the short run, education expenditure and gross fixed capital formation have a positive impact on economic growth. This demonstrates that any investment (spending) on education is a critical factor in significantly promoting economic growth, especially in the long-term. Another implication is that, as the government invests more funds in education, this tends to boost human capital, which in turn, is translated into economic growth in the long run.

Keywords: Education expenditure, Economic growth, cointegration analysis, Causality test, South Africa

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My salutations to the following pillars:

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DEDICATION

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ACRONYMS

GDP - Gross Domestic Product

USAID - United States Agency for International Development

GEXPE - Government Expenditure on Education

GFCF - Gross Fixed Capital Formation

ARDL - Autoregressive Distributed Lag

STATSA - Statistic South Africa

SARB - South African Reserve Bank

TFP - Total Factor Productivity

ADF - Augmented Dickey-Fuller

OECD - Organisation for Economic Corporation and Development

VAR - Vector Autoregressive

PVECM - Panel Vector Error Correction Model

BRICS - Brazil, Russia, India, China, and South Africa

ARMA - Autoregressive Moving Average

AIC - Akaike Information Criteria

SBIC - Schwarz's Bayesian Information Criteria

HQIC - Hanna-Quinn Information Criteria

ECM - Error Correlation Model

LM - Lagrange Multiplier

OLS - Ordinary Least Square

CUSUM - Cumulative Sum

CUSUMQ - Cumulative Sum of Square

ECT - Error Correction Term

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CHAPTER 1: INTRODUCTION

1.1 Background of the Study

Since the democratic elections of 1994, the South African government has been preoccupied with addressing the social imbalances inherited from the former apartheid system. One of the pillars of the government's strategy has been to increase public expenditure on education. However, one of the biggest challenges to South Africa's education system was creating an environment that favours inclusive education as most people in South Africa were racially marginalised due to years of neglect and inequality that the country had experienced (De Wet and Wolhuter, 2009; Malangeni and Phiri, 2018).

The South African government considers education as its highest priority. For instance, nearly 20 percent of total government expenditure in South Africa is allocated towards education (United States Agency for International Development, 2021). As a ratio of the GDP, total government expenditure on education stood at 19.75 % in 2022 (World Bank, 2022). During the 2021 budget speech, Finance minister Tito Mboweni announced that the government would cut expenditure on education in the next three years. Despite this, government expenditure of education continues to increase (National Treasury, 2021). In the 2021/2022 budget, about R408.2 billion was allocated to education.

1.2 Problem Statement

Many countries have paid attention to education as one of the leading sectors for economic growth. Countries invest in education to elevate their human resources, which in turn stimulate growth (Suwandaru et al., 2021). Currently, each of the world's economies relies heavily on knowledge for long-term growth. As market economies develop, education and investment in human resources have become priorities for national strategies (Zoran, 2015). Likewise, the South African government considers education as its highest domestic priority and the single greatest long-term challenge facing the country. Education receives the greatest share of government spending (5% of GDP), with 21% of non-interest allocations set aside for basic and higher education (United States Agency for International Development, 2021).

Education is important for a country's economic growth. Besides, public expenditure on education is important for improving the education system. Therefore, public expenditure on education will influence economic growth in a country. However, it is also possible that when the economy grows, there may be more public expenditure on education as a result of the government improving education. Thus, the relationship between public expenditure on education and economic growth needs to be thoroughly examined (Hua, 2016).

Education is an important weapon that many believe affects the productivity of the country and is considered one of the necessary conditions to achieve better outcomes on social welfare. A study by the World Economic Forum (2016) proposes three ways education can affect a country's production. Firstly, it increases the cooperative ability of the workforce. Secondly, it makes it possible to transfer knowledge about new information, products, and technologies created by others. Thirdly, it increases creativity and boots a country's ability to develop new products, knowledge, and technologies. The quality of human capital as a productive source has been consistently improving due to improvements in education and skills, and as a result, a positive impact on economic growth is expected. Mitra (2017) shows that individuals who graduate and have access to quality education throughout primary and secondary school are more likely to find gainful employment, which will significantly increase tax revenue and in turn result in a greater benefit to the government. Also, educated individuals are less likely to commit crimes nor enrol for welfare assistance programs.

Education is one of the important components of human resource development in a country (Bhattacharyya, 2019). The South African government has spent tremendous amounts investing in education for its people. Several changes in the educational system have been made, which were to improve the quality of education to develop the economy and its people. However, South Africa has been performing poorly compared to Brazil, Russia, India, and China, especially with the effects of the covid-19 pandemic. South Africa's average annual growth rate between 2010 and 2020 is 0.68% compared to China (7.2%) and India (5.3%) (Stats SA, 2021). The relationship between the cost of education and economic growth is among the studies attracting interest in economic literature (Gheraia et al., 2021). There is a wealth of literature on this topic, showing the long-held expectation that human capital formation (a population's education and health status) plays a significant role in a country's economic development (IIASA 2008; Grant, 2017). However, despite the vast literature on this topic, the results are contradictory (Suwandaru et al., 2021). Churchill (2017) also shows that the effect of government education expenditure on growth is positive for developed countries. However, for less developed countries (LDCs), the association is statistically insignificant.

Lupidio and Mariani (2019) proposed that the study should be extended to the Southern African region as the topic has seldom been explored. Therefore, given the gap in literature, this study aims to add to the body of knowledge by exploring the study in the South African context. Besides, the relationship between public spending on education and economic growth has been examined in other countries extensively. However, there is scantiness of literature that analyse the relationship between public spending on education and economic growth for South Africa. The study by Odhiambo (2020), is among those few studies. This necessitates the need for a study on this topic in South Africa.

1.3 Research Objectives

1.3.1 Purpose of the Study

The primary objective of the study is to empirically investigate the relationship between government expenditure on education and economic growth in South Africa.

1.3.2 Specific Objectives

The specific objectives can be stated as follows:

1. To determine the existence of the long-run relationship between government education expenditure and economic growth.
2. To determine the existence of short-run dynamics among the variables under study.
3. To determine the existence and direction of causality between the variables under study.
4. To develop policy recommendations based on the conclusion drawn.

1.4 Research Hypothesis

The hypothesis which the proposed study aims to test are as follows:

Hypothesis 1: To determine the existence of the long-run relationship between education expenditure and economic growth.

H_0= A long-run relationship does not exist between education expenditure and economic growth.

H_1= A long-run relationship exists between education expenditure and economic growth.

Hypothesis 2: To determine the existence of short-run dynamics among the variables under study.

H_0= Short-run dynamics do not exist among the variables under the study.

H_1= Short-run dynamics exist among the variables under the study.

Hypothesis 3: To determine the existence and direction of causality between the variables under study.

H_0= Education expenditure does not granger cause economic growth.

H_1= Education expenditure granger causes economic growth.

1.5 Significance of the study

There is a wealth of literature on the proposed topic, showing the long-held expectation that human capital formation plays a significant role in a country's economic development. Better education leads not only to higher individual income, but it is also a necessary (although not always sufficient) precondition for long-term economic growth (IIASA 2008; Grant, 2017). The present study is therefore expected to contribute to the body of knowledge in microeconomics and public economics. Moreover, to provide knowledge and policy recommendations in the South African development community. The study will also benefit the South African government on budget allocations by shedding some light on the policy measures appropriate for dealing with budget allocations.

1.6 Delimitations of the Study

A review article was written by Theofanidis and Fountouki (2018) that elaborate on the difference between limitation and delimitation. The article shows that delimitation is the limitations consciously set by the authors themselves as the boundaries or limits of their work so that the study's aims and objectives do not become impossible to achieve. The current study analyses the relationship between spending by the government on education and economic growth in South Africa.

1.7 Organization of the study

This study is divided into six chapters.

Chapter 1 comprises the introduction of the study, problem statement, research objectives, significance as well as the delimitation of the study. A concise literature review is presented and the research methodology.

Chapter 2 focuses on literature review, the theoretical framework, and available studies examining the link between education and economic growth.

Chapter 3 focuses on the data, research design, and study's methodology.

Chapter 4 covers the results and findings of the study and gives an interpretation of the results.

Chapter 5 provides the conclusion and findings of the study and makes recommendations for possible interventions.

1.8 Theoretical consideration

This study will acknowledge all sources used, and plagiarism will not be conducted. The information from acknowledged sources will be presented with honesty, integrity, and credibility.

1.9 Summary

1.9.1 Introduction

Investment in education is critical for society's economic growth and social cohesiveness. In the 2019/2020 financial year, South Africa spent 14.4% of total government resources on basic education programs and about 1.4% on higher education. However, the funding has not translated into skills needed by the economy, especially for graduates coming from Universities. Despite Finance Minister Tito

Mboweni's announcement to cut expenditure on education over the next three years, government allocations towards the education sector have been on the rise.

Many countries worldwide have paid attention to education as one of the leading sectors for economic growth. Countries invest in education to elevate their human resources, which will increase growth. Likewise, the South African government considers education as its highest domestic priority and the single greatest long-term challenge facing the country. The relationship between the cost of education and economic growth is among the studies attracting interest in economic literature. However, despite the vast literature on this topic, the results are contradictory. Besides, though the relationship has been examined in other countries extensively, there seems to be scantiness of literature in South Africa. This necessitates the need for a study on this topic for South Africa.

Against this background, this study aims to analyse the nexus between education expenditure and economic growth in South Africa. Furthermore, the study aims to determine the existence of the long-run relationship between public spending on education and economic growth, the existence of short-run dynamics among the variables under study, as well as the existence and direction of causality between the variables under study.

1.9.2 Theoretical Literature Review

1.9.2.1 Neo-classical approach

Neoclassical growth theory is an economic theory that outlines how a steady economic growth rate results from a combination of three driving forces namely, labour, capital, and technology. The National Bureau of Economic Research names the Robert Solow and Trevor Swan as having the credit for developing and introducing the model of long-run economic growth in 1956. The model first considered exogenous population increases to set the growth rate but, in 1957, Solow incorporated technological change into the model (Will, 2022).

Neoclassical economics is primarily concerned with the efficient allocation of limited productive resources. It also considers the growth of resources in the long term, which will allow for expanding the production of goods and services. Neo-classical integrates the cost of production theory from classical economics with the concepts of utility maximization and marginalism. Classical economics states that the cost of production drives the value of a good or service. Neoclassical economics emphasizes demand as a key driver of the value of a product or service.

1.9.2.2 Endogenous growth theory

This economic theory argues that economic growth is generated from within a system as a direct result of internal processes. The theory notes that the enhancement of a nation's human capital will lead to economic growth by means of the development of new forms of technology and efficient and effective means of production. According to Tomic (2015) investment in education by the state, is an investment in human capital which is a factor in the production function, therefore participating in the creation of an adequate educational program is a key factor in improving human capital, which leads to increased productivity and getting the necessary technological innovation to further economic growth.

The endogenous growth model (Cozzi 2017; Gualdi and Mandel 2019) holds that economic growth is influenced by public capital investment. Consequently, public capital investment will be the major component in shaping economic growth. Public expenditure on education is a part of public capital investment, so the increased allocation for the education sector will impact economic growth.

1.9.3 Empirical Literature Review

Despite the vast of literature conducted on the relationship between public spending on education and economic growth, the results are inconclusive. This is because researchers have used different types of research methods and studies were conducted on developed countries while others on developing countries. This led to different outcomes that are contradictory. For example, a study by Lupido and Mariani's (2019) and Amaghionyeodiwe (2019) revealed that there is no relationship between government expenditure on education and economic growth, whereas a study by Kouton(2019) and Iwegbunam and Robison (2017) showed a negative relationship between the variables.

Bexheti and Mustafi (2015) investigated the relationship between public spending on education and economic growth in Macedonia using the logarithmic Multiple Regression Model. A similar study was done by Nworji, et al (2012) assessing the effects of government expenditure on economic growth in Nigeria using a disaggregated analysis of data spanning from 1970 to 2008. This study was motivated by the rationale that rising government expenditure has not translated to meaningful development as Nigeria still ranks among the world's poorest countries. Both studies have revealed that government spending on education has a negative effect on economic growth.

1.9.4 Research Methodology

1.9.4.1 Theoretical Framework

The Cobb–Douglas production function with constant return technology forms the basis of the empirical model that will be used in this study. This function measures the magnitude of several input variables' relationships to the number of production factors (Dritsaki and Stamatiou, 2018). We assumed that increasing human capital positively influences a country's economic growth (Suwandaru, 2021).

1.9.4.2 Model specification

The study follows Mallick, Das and Pradhan (2016) and Ahamefule (2018) by modifying the neoclassical production function to investigate the effect of expenditure on economic growth. This is expressed as follows:

$Y = f(L, K)$ ……………………………………………………………..(1)

Where L is the amount of labour and K is the amount of capital needed to produce 'Y' level of output in the economy. For the impact of education on economic growth, we can include the government expenditure on education as an indispensable variable in the production function. This is in-line with Mallick, et al. (2016). Thus:

$GDP = f(GEXPE, L, K, P)$ ………………………………………………… (2)

Where, GDP represents economic growth and GEXPE refers to government (public) expenditures on education. The expenditure on education, which is a measure of education quantity, presents human capital formation which can make skilled labour force. This skilled labour force can enhance the productivity of physical and human capital and in turn, have a positive impact on economic growth. It should be noted that various studies measured education quantity using various proxies. L represent

Labour, which is measured by total labour force, K is capital, which is proxied by Gross Fixed Capital Formation and P is Poverty.

1.9.4.3 Estimation Techniques

To answer the research questions of this study, a quantitative approach will be used to explore the relationship between government spending on education and economic growth. Econometric tools that will be used include the Cointegration analysis (Cointegration test and Error Correction Model) as well as the Causality test. In a case where the series will be arbitrarily integrated, the autoregressive distributed lag (ARDL) approach will be employed. This study will employ annual time series data for the period spanning from 2000 to 2021, sourced from the South African National Treasury, National Department of Education, and the World Development Bank Indicators.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Various macroeconomic factors including economic growth have long attracted the interest of economists and policymakers, leading to many research papers investigating how public education funding affects economic growth in developed and emergent countries. However, South Africa has a dearth of research on this topic. Prior studies have found varying results depending on the research area and the methods used to examine the relationship. An analysis of previous literature will be conducted to identify research gaps and conflicts in previous studies and improve understanding of the relationship between government spending on education and economic growth.

The chapter is organized as follows: section 2.2 presents theoretical literature, where theoretical growth models are discussed. In section 2.3, an empirical literature review is presented. Section 2.4 summarizes the chapter.

2.2 Theoretical Literature Review

This section provides a discussion on theoretical growth models.

2.2.1 Neo-classical growth theory

Sometimes referred to as the Solow-Swan model, the theory was first introduced by Solow and Swan (1956). According to this theory, economic growth is the result of three factors - labour, capital, and technology. While an economy has limited resources in terms of capital and labour, the contribution from technology to growth is boundless. The theory states that short-term equilibrium results from varying amounts of labour and capital in the production function. The theory also argues that technological change has a major influence on an economy, and economic growth cannot continue without technological advances.

This growth theory posits that the accumulation of capital within an economy, and how people use that capital, is important for economic growth. Further, the relationship between the capital and labour of an economy determines its output.

Finally, technology is thought to augment labour productivity and increase the output capabilities of labour.

The production function for estimating neoclassical growth theory is stated as follows:

$Y = Af(K, L)$ ………………………………………………….. (2.1)

Where, Y represents the country's GDP. K is the proxy for share of capital. L is the level unskilled labour in an economy and, A represents the level of technology. According to this theory, despite the fact that the capital accrued by a country is important to economic growth, the integration of technology as well as labour productivity are also crucial to achieving a stable rate of growth (Gordon, 2022).

2.2.2 Endogenous growth theory

This is an economic theory that argues that economic growth is generated from within a system as a direct result of internal processes. The theory notes that the enhancement of a nation's human capital will lead to economic growth by means of the development of new forms of technology and efficient and effective means of production. Endogenous growth theory emerged as an extension of neoclassical growth theory in the 1980s. Endogenous growth theory was developed by economists Gregory Mankiw David Romer, and David Weil in their 1992 paper, "*A Contribution to the Empirics of Economic Growth*," using the same basic framework as neoclassical theory.

According to Tomic (2015) investment in education by the state, is an investment in human capital which is a factor in the production function. Therefore, participating in the creation of an adequate educational program is a key factor in improving human capital, which leads to increased productivity and getting the necessary technological innovation to further economic growth. The endogenous growth model holds that economic growth is influenced by public capital investment (Cozzi 2017; Gualdi and Mandel 2019). Consequently, public capital investment will be the major component in shaping economic growth. Public expenditure on education is a part of public capital investment, so the increased allocation for the education sector will impact economic growth.

An example of endogenous model is the Romer model, which considers technological changes to be endogenous. Thus, technological advancements lead to economic gains. Furthermore, the model assumes that innovative ideas are a critical component of economic growth. Combining improvements in human capital with existing knowledge can generate innovative ideas to boost economic output.

Romer in his first paper on endogenous growth in 1986 presented a variant on Arrow's model which is known as learning by investment. He assumes the creation of knowledge as a side product of investment. Romer takes knowledge as an input in the production function of the following form:

$Y = A(R)f(R_i, K_i, L_i)$ ………………………………………….. (2.2)

Where Y is aggregate output, A is the public stock of knowledge from research and development R, R_i is the stock of results from firm i's research and development expenditure, and K_i and L are firm i's capital and labour stocks, respectively. He considers R_i to be a rival good and assumes the function (f) homogeneous of degree one in all its inputs R_i, K_i, and L_i.

Romer used three key elements in his model: externalities, increasing returns on output, and diminishing returns on new knowledge. According to Romer, spill overs from a firm's research efforts result in the creation of new knowledge by other firms. In other words, new research technology developed by a company has an immediate impact on the entire economy.

2.2.3 The Keynesian Theory

Keynesian economics is a macroeconomic theory of total spending in the economy and its effects on output, employment, and inflation. Keynesian economics was developed by the British economist John Maynard Keynes during the 1930s. Keynes was one of the most well-known economists who discussed the relationship between government spending and economic growth, despite his seemingly opposing viewpoint. Public expenditures, according to Keynes, are an exogenous factor that can be used as a policy tool to promote economic growth. Public expenditure can positively contribute to economic growth. The increase in government spending is likely to lead to increased employment, profitability, and investment through multiple effects on aggregate demand. Thus, government spending increases aggregate demand, which causes increased production depending on the expenditure multiplier (Tomic, 2015). The Multiplier Effect is a key component of Keynesian economics. The multiplier effect is a theory that states that a change in input (for example, spending more money) causes a more significant increase in output and customer demand. According to Keynes' theory, fiscal stimulus y, increases outputs and income, which positively affects an economy's gross domestic product (GDP). That is,

$$Y = C+I+G+E-mY \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2.3)$$

Where,

Y= Income
C = Marginal propensity to consume
I = Investment
G = Government expenditure
E= Exports
mY =Marginal propensity to impose

According to the Keynesian multiplier effect, spending from one consumer serves as income for another worker, who then spends his income, and the cycle continues. Therefore, one dollar spent generates more than one dollar of growth. The Keynesian fiscal multiplier, on the other hand, sparked considerable debate among economists such as Milton Friedman and Murray Rothbard.

2.2.4 Cobb-Douglas Production Function

In 1928, Charles Cobb and Paul Douglas presented the view that production output is the result of the amount of labour and physical capital invested. This analysis produced a calculation that is still in use today, largely due to its accuracy. The Cobb-Douglas production function reflects the relationships between inputs (physical capital and labour) and the amount of output produced. It is a means for calculating the impact of changes in the inputs, the relevant efficiencies, and the yields of production activity. Education is a form of national investment to improve the quality of human resources needed in a modem economy (as input). Educational investment is expected to generate an increase in prosperity and wider opportunity in real life (Wulan, 2013). The basic form of the Cobb-Douglas production function is stated as follows:

$$Q(L,K) = A^{*}L^{\beta *}K^{\alpha} \ldots \quad (2.4)$$

In this formula, *Q* is the quantity produced from the inputs *L* and *K. L* is the amount of labour expended, which is typically expressed in hours. *K* represents the amount of physical capital input, such as the number of hours for a particular machine, operation, or perhaps factory. *A,* which appears as a lowercase *b* in some versions of this formula, represents the total factor productivity (TFP) that measures the change in output that isn't the result of the inputs. Typically, this change in TFP is the result of an improvement in efficiency or technology. The Greek characters, alpha (α) and beta (β) reflect the output elasticity of the inputs, that is, the change in the output that results from a change in either labour or physical capital.

2.2.5 Musgrave Theory of public expenditure

The theory was formulated by Musgrave (1961). It is based on the explanations of increasing public expenditure on the need to provide social amenities for growth and development (Edame and Fonta, 2014). They further asserted that at the development stage of an economy, some capital projects are needed to accelerate the growth and development of the country, such as the establishment of hospital, good road networks and schools inter alia. Musgrave's formula was formulated from Wagner's hypothesis. That is,

$$G/GDP = f\,(GDP_R/N) \ldots \quad (2.5)$$

where G is nominal total government expenditure, GDP is nominal Gross Domestic Product, GDP_R is real Gross Domestic Product, N is the total population size, and C is government consumption expenditure. Musgrave proposed this theory after discovering changes in the income elasticity of demand for public services across three levels of per capita income. Musgrave contends that at low levels of per capita income, demand for public services is very low as such income is devoted to satisfying primary needs and that as per capita income rises above these low levels, demand for public-sector services such as health, education, and transportation rises, forcing the government to increase spending on them. In addition, Musgrave observes that when per capita income is high in developed economies, the rate of public sector growth tends to slow (Otiwu et al., 2018).

2.6.1 Wagners's Law

The first model of public spending in the history of public finance is Wagner's Law. According to Wagner (1883), the proportion of public spending to national revenue tends to increase as the economy develops. Many economists found an interest in studying and testing the Wagner's Law, and some are discussed below.

2.6.1.1. Peacock and Wiseman (1961)

The Peacock and Wiseman interpretation of the Wagner Hypothesis assumes that changes in the demand for public services are related to increases in public spending, and it anticipates that public spending should grow steadily and smoothly at a rate higher than the rate of increase in national income. These shifts in demand are mostly brought on by population and per capita income increase. According to Wagner, there will be more government activity because of other causes including a constantly growing division of labour, advances in technology and science, as well as the complexity of transportation and communications. According to the Peacock and Wiseman view, the amount of government spending depends on national revenue and can be reflected in the general relationship shown in equation (2.6).

GE=F(GNP) ………………………………………………………. *(2.6)*

where GE represents total government expenditure and GNP represents Gross National Product.

2.6.1.2. Gupta (1969)

Gupta interpreted the Wagner's law by considering the relationship between state activity and national income where government expenditure must increase at a rate faster than that of the national income (Gupta, 1969). Gupta measured the size of government by GE per capita, and economic development by GNP per capita, as shown in the general relationship depicted in equation (2.7):

GE/P=F(GNP/P) ………………………………………………………. (2.7)

where P represents population, GE represents total government expenditure and GNP represents Gross National Product.

2.6.1.3 Pryor (1968)

Pryor analysed the growth of public expenditure in market and centrally planned economies. Unlike Gupta and Peacock and Wiseman, Pryor (1968) interpreted the Wagner's Hypothesis so that in growing economies, public consumption expenditure becomes an increasingly larger component of the national income. Pryor narrowed the definition of government expenditure to include only government consumption expenditure. Pryor's general relationship of the Wanger's Hypothesis is depicted in equation (2.8)

$$GC/GNP = F(\frac{GNP}{P}) \quad \ldots \ldots \ldots \ldots \ldots \ldots \quad (2.8)$$

where GC denotes government consumption expenditure, GNP represents Gross National Product and P represents population.

2.3 Empirical Literature review

2.3.1 The nature of transitional economies

Many studies have examined the relationship between education expenditure and economic growth in developing countries, but their results are contradictory. A study by Ayeni and Omobude (2018) empirically investigate educational expenditure and economic growth nexus in Nigeria using secondary and time series data from 1987 to 2016. The random characteristics of the variables were tested using the Augmented Dickey-Fuller (ADF) technique. The findings showed that educational expenditure was inconsistent with education sectoral output, while recurrent educational expenditure exhibited a significant relationship with the real gross domestic product (economic growth); in contrast, capital expenditure on education was insignificant. Generally, the study concluded that the impact of educational expenditure on real GDP is mainly a function of the expenditure type in Nigeria. The notion is that education expenditure will have different impacts, depending on the typed used.

Another study by Madaka (2017) investigate the relationship between investment in education and economic growth in Nigeria using annual time series data from 1980-2015. It was found that investment in education is positively related to economic growth and also statistically significant, which shows that if Nigeria is to increase its economic growth, investment in education needs to be increased.

However, a study by Devine (2018), which inspects the connection between the educational expenditure and economic growth in Nigeria utilizing time series and secondary data from 1981 to 2018, has contrasting results as the study reveals that educational expenditure has no causal connection with economic growth. The outcome additionally demonstrated that educational expenditure has a negative and insignificant relationship with economic growth. Devine (2018) used an Ordinary Least Square analysis and Granger Causality test to test the relationship between the variables, which might have caused the difference in the results between these two studies (Madaka, 2017; Divine, 2018). The idea behind this is that education expenditure can portray different results during different periods. As Devine's study was extended to cover the period 2016 to 2018, there might have been economic dynamics that can be attributed to this.

Ahmodu et al., (2022) examine educational budget allocation and economic growth in Nigeria, using descriptive and regression statistics and secondary data spanning from 2011 to 2022. A causal comparative type of quantitative research design was used with the annual budget of education in Nigeria. The findings reveal that the government capital expenditure (with the coefficient and probability value of $r = 0.019$; $p = 0.440 > 0.05$) has optimistic weight on economic growth; and the government recurrent expenditure (with the coefficient and probability value of $r = 2.860$; $p = 0.033 < 0.05$) have low significant association with economic growth in Nigeria. It also revealed that human capital development (with the coefficient and probability value of $r = 0.253$; $p = 0.025 < 0.05$) has a weak significant correlation with the growth of the economy. This can also speak to the dynamics during this period. One can therefore conclude that the Nigerian economy was no longer driven by education expenditure, Therefore, a large budget allocation on education can be seen as a way of draining funds from the fiscus, as it is not translated into growth.

A study by Kouton (2018) investigates the relationship between government education expenditure and economic growth for Côte d'Ivoire from 1970 to 2015, applying the Pesaran et al. (2001) bounds testing approach and the Toda and Yamamoto (1995) causality test. The findings suggest a negative and significant long-run link between government education expenditure and economic growth for the above-mentioned period. Additionally, an insignificant positive effect of government education expenditure on economic growth in the short run. The results show a unidirectional causality relationship between the two variables, running from education expenditure to economic growth.

Literature reveals the positive response of some developing countries' economic growth to educational investment (Randolph, 2020; Almajdob and Marikan, 2019). In a study by Mercan and Sezer (2014), a positive relationship between education expenses and economic growth was found in the Turkish economy for the period 1970 to 2012. Consistent with Mercan and Sezer (2014), Hua (2016) analyses the relationship between public expenditure on education and economic growth in China, using the linear regression model and Granger causality. The results show that the influence of public expenditure on education on GDP is relatively less than the influence of capital stock on GDP, but however, concludes that public expenditure on education plays an important role in economic growth.

Studies by Mercan and Sezer (2014) and Hua (2016) are corroborated by Mekdad et al (2014)'s study, which investigates the relationship between education and economic growth in Algeria over the period 1974-2012. In the study, multiple dimensions of information relating to education and economic growth on theoretical and empirical backgrounds were used. The empirical results concluded that public spending on education positively affects economic growth.

Suwandaru, et al. (2021) investigating the relationship between public expenditure in the educational sector and economic growth in Indonesia, using time series data from 1988 to 2018 and the Cobb–Douglas production function as an economic theory for measurement. In the methodology, they employed Autoregressive Distributed Lag bound tests to find the relationship between variables. The results show that public expenditure on education has an insignificant relationship in the long- and short-term estimation which has different directions, which is a positive relationship in the long-term and a negative relationship in short-term estimation.

Randolph (2020) study selected Five Asian developing countries to study the impact of their public education expenditure on economic growth. The cointegration test results show that education expenditure has a long-run equilibrium relationship with growth. The Random Effect Model used for the panel regression suggested a positive and significant relationship between education expenditure and GDP per capita. The result implies that to achieve a sustainable growth plan; countries should invest more in public education. In this way, they will be able to reduce unemployment, increase the standard of living, and eradicate poverty.

2.3.2 Literature for Developed countries

Studies conducted for advance economies on education expenditure and economic growth also portray mixed results.

Coman et al (2022) investigate the impact of education spending on economic growth in Eastern European countries for the period was 1990-2020, using ARDL with structural break. The results obtained reveal that, for six Eastern European states (Bulgaria, Croatia, Czech Republic, Estonia, Hungary, and Latvia), a long-term relationship between education spending and GDP exists. In contrast, in the other five countries (Lithuania, Poland, Romania, Slovakia, and Slovenia), there is no long-term relationship, meaning there is no cointegration between the analysed variables.

Conversely, Karacor et al. (2017) study the relationship between educational expenditures and economic growth for selected 19 the Organisation for Economic Co-operation and Development (OECD) countries using the panel data method and found that education expenditure has no effect on economic growth. This result difference might have been basically caused by the development differences of countries which are based on analysis. Especially examined in terms of OECD countries, it has been observed that the income of investments is low.

Le and Tran (2021) employ the Vector autoregressive (VAR) and Granger causal models to determine the government expenditure on education-economic growth link in Vietnam for the period 2006 to 2019. The research results show a two-way nexus between economic growth and government spending on education with a lag of about two years. The results of statistical data analysis show that the level of expenditure between education expenditure and GDP growth in Vietnam has a positive relationship and influence each other. The results of the cointegration analysis for the period 2006–

2019 show a long-term relationship between economic growth and government spending on education.

The first response function analysis results implied that when the growth rate of education expenditure increases by 1%, the GDP increases by 63.7% at the end of the 10th year. This implies that the investment in education is bringing quality and effective results in terms of producing the right labour required in the development process. The most significant advantage of developed countries is their ability to produce well-educated and qualified labour while keeping up with rapid changes in manufacturing processes and producing high technology, which then results in a positive relationship between education expenditure and economic growth.

2.3.3 The nature of both developed and developing economies

Comparative studies for both developed and developing economies also produce conflicting results. Frank (2018) conducts a comparative study between developed and developing economies, using a long-run accounting model and 179 countries for the period spanning from 1970 to 2014. The findings reveal positive results for developing countries and insignificant results for developed countries when testing the existence of causality between the two variables. The study by Frank (2018) confirms the views that in low-income countries, dependence on government is high, and in high-income countries, dependence on government is low.

Overall, the results indicate that education expenditure positively affects growth. However, when the sample is split into different criteria based on the economic prosperity of the countries in question, the results change. In non-oil countries, education expenditure increases economic growth; in developing countries, education expenditure has a negative impact, and in OECD countries, the impact is non-significant.

Conversely, Mallick et al., (2016) study results revealed a positive and statistically significant impact of education expenditure on the economic development of all the 14 Asian countries (Bangladesh, China, Hong Kong, India, Japan, Nepal, Pakistan, Malaysia, The Philippines, Saudi Arabia, Singapore, Sri Lanka, Thailand, and Turkey). Further, the panel vector error correction model (PVECM) presents unidirectional

Granger causality running from economic growth to expenditure on education both in the short- as well as in the long run. However, expenditure on education only Granger causes economic growth in the long run in all the countries.

Tomic (2015) verifies the findings from Mallick et al (2016) study by empirically analysing the impact of public education expenditure on the economic growth of the European Union and Brazil, Russia, India, China, and South Africa (BRICS). The study presented a comparative analysis of investment funds in education systems, and it resulted in a positive correlation between public expenditure on education and the value of the GDP of the country.

2.3.4 Studies conducted for South Africa

Despite the vast literature for developing economies, there seems to be a dearth in literature on the nexus between government expenditure on education and growth in South Africa. The study by Luthuli (2017) focuses on the impact of education expenditure on education attainment and not economic growth. The study evaluates the effect of the amount spent by the government on human capital development. Conversely, the study by Nkomo (2016) assessed the impact of education and health public spending on economic growth, not solely education spending.

These studies are not zoned in the education expenditure and economic growth only since they include other variables, and this shows the scantiness of the literature on this topic for South Africa and necessitates the need for this study to be conducted. The present study will focus on analysing the impact of education, and health and any other social spending will not be treated as controlled variables.

As the results for both advanced and transitional economies are inconclusive, the topic is still a debatable issue. Depending on the method used, the results vary. The present study will also help contribute to this ongoing debate, thereby filling the gap that exists in South Africa on this topic. Consistent with majority of studies, the study will apply the autoregressive distributed lag approach and causality test to determine the long and short-run relationship between these variables, as well as the causal effect of education on economic growth.

2.4 Summary

Most of the studies adapted Musgrave's theory of public expenditure growth which attempts to relate the demand for public services to the stage of economic development of a country. At a high level of per capita income which is a characteristic of advanced economies, the rate of public sector growth tends to fall as more basic needs are satisfied by the citizens. Many studies supported that education is imperative for economic growth of a country or region as an input. Neo-classical, Endogenous, and Cobb-Douglas theories have almost similar production functions, literature proved that capital and Labour in a form of government expenditure on education has a positive impact on economic growth. However, both neo-classical and endogenous theories are criticized for having theories that are impossible to validate with empirical evidence. The theory has been accused of being based on assumptions that cannot be accurately measured.

The abundance of literature reviewed has explored the possible relationship between education expenditure and economic growth. The studies have all made use of different forms of econometric models. However, the studies have resulted in many conflicting results, which may be influenced by the study area (developed or developing countries), or the method used. Many studies on developing countries showed a positive relationship when testing the relationship between education and economic growth as well as confirming a causality by education expenditure on economic growth. However, few studies had negative results, while other shows insignificant results.

In South Africa, two studies have been reviewed, of which conflicting conclusions were arrived at. Furthermore, in the two studies that were reviewed, the studies are not specifically zoned on education expenditure alone but focus either on health or human capital as important dependent variables. As it seems that there is no study that particularly focuses on the relationship between education expenditure and economic growth, there is, therefore, a need for such study in South Africa.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the research methodology. The chapter aims to build a model that will serve as a cornerstone for empirical analysis of the research problem. The chapter is structured as follows: Section 3.2 presents the theoretical framework (the theoretical model that forms the basis of the empirical model. In section 3.3, the empirical model is specified. Sections 3.4 and 3.5 discuss econometric tools used to estimate the model as well as diagnostic models. In section 3.6, a summary of the chapter is presented.

3.2 Theoretical framework

The neo-classical production function forms the basis of the model employed in this study. The model by Mallick et al. (2016) is one of the earlier theories which employs a modified version of the Cobb-Douglas production function to examine the link between government expenditure on education and economic growth. According to Mallick et al. (2016). The growth education expenditure model is expressed as follows:

$$GDP = f(GEXPE.L, K)\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.1)$$

Where, GDP represents the total economic growth; and $GEXPE$ represents government (public) expenditures on education. The government expenditure on education (which is a measure of education quantity) represents human capital formation which can make a skilled labour force.

3.3 The Empirical Model

The present study is a modified version of Malick et al. (2016) and Amaghionyeodiwe (2018) in employing the modified Cobb-Douglas function. The model is specified as follows:

$$GDP_t = f(K, L, EDEXP, Poverty)\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.2)$$

The equation can be rewritten as follows:

$$L\_GDP_t = \beta_0 + \beta_1 L\_GFCF_t + \beta_2 L\_Labour_t + \beta_3 L\_EduExp_t + \beta_4 L\_Poverty_{t} + \varepsilon_t \ldots\ldots \quad (3.3)$$

Where, GDP_t represents GDP economic growth, $GFCFt$ is gross fixed capital formation, which represents capital. $Labour$ is the workfoce, measured by labour force, and $Poverty_t$ $is\ the$ rate of poverty (all for period t).

A Priori Assumption

$\beta_1, \beta_{2,}$ $\beta_{3,}$and $\beta_4 > 0$, implying that GDP positively correlates to government fixed capital expenditure, labour, government education expenditure, and poverty rate, positively.

3.4 Estimation Techniques

3.4.1 Introduction

This study utilizes the autoregressive distributed lag (ARDL) bounds cointegration technique to determine the long-run relationships and short-run dynamics between government expenditure on education and economic growth. Before the ARDL tests are conducted, stationarity tests are conducted to check the presence of unit roots in the series. Subsection 4.4.2, therefore, presents a discussion on stationarity tests.

3.4.2 Stationarity (unit root) testing

The first step in conducting co-integration analysis is testing each of the time-series to determine their order of integration, using the stationarity test. The theory behind autoregressive moving average (ARMA) estimation is based on stationary time series. A series is said to be stationary if the mean and auto-covariance of the series do not depend on time.

A common example of a non-stationary series is the *random walk*:

y_t=y_{t-1}+ε_t…………………………………………………………………….. (3.4)

Where, ε_t is a stationary random disturbance term, The series y has a constant forecast value, conditional on t, and the variance is increasing over time. The random walk is a differenced stationary series since the first difference of y is stationary:

y_t-y_{t-1}=$(1 = L)_{yt}$=ε_t………………………………………………………… (3.5)

A difference stationary series is said to be *integrated* and is denoted as I (d) where d is the order of integration. The order of integration is the number of unit roots contained in the series, or the number of differencing operations it takes to make the series stationary. For the random walk above, there is one unit root, so it is $I(1)$ series. Similarly, a stationary series is $I(0)$. Standard inference procedures do not apply to regressions which contain an integrated dependent variable or integrated regressors. Therefore, it is important to check whether a series is stationary or not before using it in a regression. The formal method to test the stationarity of a series is the unit root test.

There is a variety of tests used to test for the presence of unit root. Amongst them are the Augmented Dickey-Fuller (1979) and Phillips-Perron (1988), the GLS-detrended Dickey-Fuller (Elliot, Rothenberg, and Stock, 1996), Kwiatkowski, Phillips, Schmidt, and Shin (KPSS, 1992), Elliott, Rothenberg, and Stock Point Optimal (1996), and Ng and Perron (NP, 2001) unit root tests. This study uses the Augmented Dickey-Fuller (ADF) and Phillips-Perron tests. The augmented Dickey–Fuller (ADF) test is a popular approach used for testing the unit root null hypothesis (Guney and Komba, 2016).

3.4.2.1 The Augmented Dickey-Fuller (ADF) Test

The ADF technique was developed by David Dickey and Wayne Fuller in the year 1979. It is a regression technique of the first difference of a variable on its lagged level together with additional lags of the first difference (Gujarati and Porter, 2009). On ADF technique, the null hypothesis shows that the time series contains a unit root and therefore further differentiation will be required to bring stationarity to the series. On the other hand, a one-sided alternative hypothesis represents a stationary series thus, no further differentiation will be needed.

The standard Dickey Fuller test is carried out by estimating the following equation:

$$\Delta Y_t = \propto Y_{t-1} + X_t'\delta + e_t \qquad (3.6)$$

Where,

$\propto = p - 1$

The null and alternative hypotheses may be written as,

$H_0 : \propto = 0$ (null hypothesis) ………………………………………………… (3.7)

$H_1 = \propto = 1$ (alternative hypothesis) .... (3.8)

The simple Dickey-Fuller unit root test described above is valid only if the series is an AR (1) process. If the series is correlated at higher order lags, the assumption of white noise disturbances ε_t is violated. The Augmented Dickey-Fuller (ADF) test therefore constructs a parametric correction for higher-order correlation by assuming that the y series follows an AR (p) process and adding p lagged difference terms of the dependent variable y to the right-hand side of the test regression. This is presented as follows:

$\Delta y_t = \propto y_{t-1} + x_t'\delta + \beta\Delta y_{t-1} + \beta_1\Delta y_{t-1} + \beta_2\Delta y_{t-2} + \beta_p\Delta y_{t-p} + V_t$.................. 3.9)

There are two practical issues in performing an ADF test. Firstly, one should choose whether to include exogenous variables in the test regression. Therefore, one has the choice of including a constant, a constant and a linear time trend, or neither in the test regression. One approach would be to run the test with both a constant and a linear trend since the other two cases are just special cases of this more general specification. However, including irrelevant regressors in the regression will reduce the power of the test to reject the null of a unit root.

Secondly, one should specify the number of lagged difference terms (the lag length) to be added to the test regression (0 yields the standard DF test, whereas integers greater than 0 correspond to ADF tests). The usual (though not particularly useful) advice is to include several lags sufficient to remove serial correlation in the residuals.

3.4.3 Selection of lag-length criteria

The next step is determining the appropriate maximum lag length for the variables in the VAR. According to Brooks (2002), financial theory has little to say on what an appropriate lag length used for a VAR model should be and how long changes in the variables should persist to work through the system. However, the optimal lag length selected should produce the number and form of co-integration relations that conform to all the *a priori* knowledge associated with economic theory (Seddighi *et al*., 2000). The three most popular information criteria used to determine optimal lag length are the Akaike (1974) information criterion (AIC), Schwarz's (1978) Bayesian information criterion (SBIC) and the Hannan-Quinn information criterion (HQIC). However, these information criteria sometimes produce conflicting vector autoregressive (VAR) order selections.

The VAR model is illustrated in the following manner:

y_t=β_0+$\beta_1 t^1$+…..$\beta_q t^q$ +η^q………………………………………… (3.10)

Where {η_t} sequence is a vector autoregression with k lag length and it can be presented as:

η_t=$J_1\eta_{t-1}$+…..$J_k\eta_{t-k}$+ε_t…………………………………………… (3.11)

It is assumed that k is the optimal lag length and ε_t is random vector.
Accordingly, the null hypothesis is to jointly test vector J:

H_0: J_1=J_2=…. J_k=0………………………………………………… (3.12)

3.4.4 Autoregressive distributed lag (ARDL) Bounds Test Approach

The ARDL cointegration approach was developed by Pesaran et al. (1999) and Pesaran et al. (2001). It has three advantages in comparison with other previous and traditional cointegration methods. Firstly, the ARDL does not need that all the variables under study to be integrated of the same order and it can be applied when the under-lying variables are integrated of order one, order zero or fractionally integrated. Secondly, the ARDL test is relatively more efficient in the case of small and finite sample data sizes. Lastly, by applying the ARDL technique, we obtain unbiased estimates of the long-run model (Harris and Sollis, 2003).

The procedures to carry out the ARDL approach to the cointegration technique include determining the Bounds F-Test and estimating the coefficients of the long and short-run relationships by using the OLS method and error correction model.

3.4.4.1 Estimating long-run relationship-ARDL Bounds F-test approach

To implement the bound test procedure, equation (4) is modelled as a conditional ARDL error correction model (ECM) as follows:

$$\Delta X_t = \delta_0 + \sum_{i=1}^{m}\theta_i \Delta X_{t-i} + \sum_{j=1}^{n}\lambda_j \Delta Y_{t-j} + \sum_{k=1}^{p}\gamma_k \Delta REER_{t-k} + \sum_{l=1}^{q}\alpha_l \Delta V_{t-l} + \beta_1 X_{t-l} + \beta_2 Y_{t-1} + \beta_3 REER_{t-1} + \beta_4 V_{t-1} + \varepsilon_t \quad \text{……………………………… (3.13)}$$

The short run dynamics are captured by the terms with the summation signs whereas the other terms represent the long run relationship. The bounds testing method is based on the F-statistics. The F-test is conducted to test the null hypothesis that β_1=β_2 =$\beta_3 = \beta_4$ =0. The F-statistics computed are then compared to the critical F-values of Pesaran et al (2001), which follows an asymptotic non-standard distribution. If the computed statistics fall in the upper bound, it means there is long run relationship. If the computed F-statistics fall in the lower bounds, then there is no cointegration. If the F-statistics lies within the bounds, the test is inconclusive.

3.4.4.2 Estimating short-run dynamics- ARDL-ECM

After cointegration is found, the long run estimates of the ARDL model can be obtained. Furthermore, the existence of the cointegration property indicates the presence of an error correction term in the model, which shows the speed of adjustment back to the long run equilibrium because of a short-term shock. Therefore, an error correction model (ECM) is estimated.

The ECM is expressed as follows:

$$\Delta X_t = \delta_0 + \sum_{i=1}^{m} \theta_i \Delta X_{t-i} + \sum_{j=1}^{n} \lambda_j \Delta Y_{t-j} + \sum_{k=1}^{p} \gamma_k \Delta REER_{t-k} + \sum_{l=1}^{q} \alpha_l \Delta V_{t-l} + \beta_1 X_{t-1} + \alpha ECM_{t-1} + \mu_1 \ldots\ldots (3.14)$$

Where:

α = the speed of adjustment parameter and

θ_i,λ_j, $Y_k \alpha_l$ are the coefficients, which represent the degree of changes in explanatory variables.

ECM = the lag residuals that are found from the estimated cointegration model.

If π is negatively significant, then the variables tend to converge to their long run equilibrium.

3.4.5.3 Testing for Causality

- **Granger Causality Test**

One of the main objectives of empirical econometrics is to study the causal relationships among economic variables (Jung, 1986). As Jung (1986) mentioned, Granger causality's predictability and exogeneity are quite useful in empirical work. The Granger causality measures if a certain event happens before another, and helps to predict that event (Sorenson, 2005). According to Stern (2011), variables are said to Granger-cause one another if the past values of a certain variable assist in prediction of current level of another variable given the applicable information. The purpose of the causality test is to check how the variables react to each other, and it determines whether the paired time series data has a correlation (Shaari, et al. 2012). In addition to Granger causality test, Wald test is the complementary test of causality particularly developed to check for short run causality among the variables.

According to the normal hypothesis rule, a variable is significant based on the probability that is below less than 1%, 5% and 10%. The Granger Causality Test is used to determine the significant causal relationship between the variables. The Null hypothesis presents that one of the variables in question does not causally affect the other variable in the linear analysis. If both variables do Granger cause (affect) one another, then this is bidirectional causality and if it is only one variable that Granger cause (affect) another, then this is considered as unidirectional causality.

3.4.5 Diagnostic tests

The purpose of a diagnostic test is to classify or predict the presence or absence of normal series hence the best fit of the model (Caspi et al., 2017). To verify that there are no problems with the residuals, the study will conduct diagnostic tests. This is to check whether the model is proficient or not. This study will test for heteroskedasticity, autocorrelation, and misspecification of the functional form.

3.4.5.1 Misspecification test

Model misspecification occurs when the model made with regression analysis is in error. Models that are mis-specified can have biased coefficients and error terms, and tend to have biased parameter estimations. Three tests will be used to test for misspecification in the model, namely, serial (auto) correlation test, heteroscedasticity test and normally test.

- **Testing for serial correlation**

Testing for serial correlation helps to identify any relationships that may exist between the present values of the regression residuals (μt) and any of its lagged values. Such tests can be done via graphical exploration or by using formal statistical tests such as the Durbin-Watson test or the Lagrange Multiplier (LM) test (Brooks, 2002). In this study, the LM test is used to investigate residual serial correlation. According to Harris (1995), the lag order for the LM test should be the same as lag order chosen for the VAR. The null hypothesis of the LM test is that the residuals are not serially correlated, while the alternative is that the residuals are serially correlated.

- **Testing for Heteroscedasticity**

According to Brooks (2002), heteroscedasticity describes a scenario where the variance of the errors in a model is not constant. Thus, a problem arises when errors are heteroscedastic, but are assumed to be homoscedastic (constant variance). The result of such an assumption would be that the standard error estimates might be wrong (Brooks, 2002). In this study, the test for heteroscedasticity will be done using an extension of White's (1980) test to systems of equations.

The null hypothesis of the test is that the errors are homoscedastic and independent of the regressors and that there is no problem of misspecification. In performing the test, each of the cross products of the residuals is regressed on the cross products of the regressors, testing for the joint significance of the regression. If the test statistic produced from this process is significant, the null hypothesis of homoscedasticity (no heteroscedasticity) and no misspecification will be rejected.

- **Testing for Normality**

One of the assumptions of the classical linear regression model is that residuals must be normally distributed with zero mean and a standard deviation of 1. Violating the assumption results in erroneous confidence intervals as well as hypothesis testing. The Jarque-Bera test, conducted at 5% significance level, is employed to assess departures from this assumption with a null hypothesis that residuals are normally distributed. When the probability value is below 0.05, H_0 is rejected.

3.4.5.2 Misspecification of the functional form (testing for stability)

If the population regression function is nonlinear, but the regression function is linear, the functional form of the regression model is mis-specified. This leads to a bias of the ordinary least square (OLS) estimator. A misspecification test can detect a range of alternatives and indicate that something is wrong under the null, without giving clear guidance on what alternative hypothesis is appropriate. A regression suffers from misspecification of the functional form when the functional form of the estimated regression model differs from the functional form of the population regression function. Functional form misspecification leads to biased and inconsistent coefficient estimators. A way to detect functional form misspecification is to plot the estimated regression function and the data. This may also be helpful in choosing the correct functional form.

- **Ramsey's RESET (regression specification error test)**

A useful approach to a general test for functional form misspecification is Ramsey's RESET (regression specification error test). The idea behind RESET is that if we have properly specified the model, no nonlinear functions of the independent variables should be significant when added to our estimated equation. As the estimated model's fitted or predicted values (y hat) are linear in the independent variables, we may consider the powers of the predicted values as additional regressors.

The Ramsey RESET test is based on the regression:

y_i=$x_i b + z_i t + \mu_i$... (3.15)

where:

z_i = ($\hat{y}^2, \hat{y}^3, \hat{y}^4$).

The predicted y value is normalized between 0 and 1 before the powers are calculated. If the regression is properly specified, the coefficients on all powers of the predicted y should be jointly insignificant.

3.4.5.3 Testing for Structural Breaks

- **Cumulative Sum of Residuals (CUSUM) test and Cumulative Sum of Squares (CUSUMQ) test**

The results of the Cumulative Sum (CUSUM) and Cumulative Sum of Squares (CUSUM of Squares) depend on the nature of the structural change taking place. If the break is in the intercept of the regression equation, then the CUSUM test has higher power. However, if the structural change involves a slope coefficient or the variance of the error term, then the CUSUMSQ test has higher power. This may help to explain why the two tests often produce contradictory findings. There is a possibility that the model may be unstable, and for that reason, the CUSUM and CUSUM of Squares will be conducted to test for the stability of the model. CUSUM of Squares is used as a recursive structural stability test, which is usually applied to observations that run forward from start to finish of a given time interval (Pesaran et al, 2002).

- **Chow Breakpoint Test**

The Chow test, proposed by econometrician Gregory Chow in 1960, is a test of whether the true coefficients in two linear regressions on different data sets are equal. In econometrics, it is most commonly used in time series analysis to test for the presence of a structural break at a period that can be assumed to be known *a priori* (for instance, a major historical event such as a war). In program evaluation, the Chow test is often used to determine whether the independent variables have different impacts on different subgroups of the population. The null hypothesis for the test is that there is no breakpoint (i.e., the data set can be represented with a single regression line).

3.5 Data Issues

A quantitative approach will be used to explore the relationship between government spending on education and economic growth. This study will employ annual time series data for the period spanning from 2000 to 2021, sourced from the South African Reserve Bank, International Monetary fund, and the World Development Bank Indicators. From the listed variables, government expenditure on education will be sourced from South African Reserve Bank, while the rest of the variables are sourced from World Development Bank Indicators and the International Monetary Fund websites. The study will use EViews software for analysing the data as it is a good tool for time series analysis.

3.6 Summary of the chapter

The purpose of this chapter was to introduce the methods that will be used to achieve the study's objectives. Before the methods were introduced, the theoretical model underpinning the model to be used as well as the empirical model, were presented. The various methods that will be adopted were discussed. These techniques include stationarity and cointegration tests. This study will utilize the autoregressive distributed lag (ARDL) bounds cointegration technique to determine the long-run relationships and short-run dynamics between government expenditure on education and economic growth. Before the ARDL tests are conducted, stationarity tests will be conducted to check the presence of unit roots in the series. To verify that there are no problems with the residuals, the study will conduct diagnostic tests. The results of the techniques discussed above will be presented in the following chapter.

CHAPTER 4: RESULTS AND DISCUSSION

4.1 Introduction

The aim of this study is to empirically investigate the relationship between government education expenditure and economic growth in South Africa using econometric tools. The findings of econometric estimations of the empirical model used in the study as well as diagnostic tests that were used to test the validity of the model are presented in this chapter. The chapter is organized as follows: Section 4.2 presents the stationarity tests results. Section 4.3 presents autoregressive distributed lag approach results, which will be utilized to determine the existence of a long-run relationship between the explanatory variables and the outcome variable, short-run dynamics among the variables under review, and the causal effect of the variables on each other. The results for diagnostic tests used to check for the goodness fit of the model, are presented in section 4.5. Finally, Section 4.6 summarizes the chapter.

4.2 Stationarity test results

The unit root test is applied to ensure that variables are integrated in the same order. It is an important phenomenon for a series to be tested for stationarity since this can influence its behaviour (Ruiters and Charteris, 2020). For this reason, variables are tested for unit root to avoid spurious results and to ensure that no second difference variables exist in the model, as this would violate the ARDL estimator. An augmented Dickey-Fuller test (ADF) is used to test the null hypothesis that a unit root exists in a time series sample. The assumption used in the test for stationarity is that the null hypothesis states that there is a unit root at any given level of confidence. As such, Table 5.1 presents ADF results at levels after 1st difference and 2nd difference under the assumption of intercept (constant) only.

The findings of the Augmented Dickey-Fuller (ADF) test are shown in Table 4.1 below. The ADF test was conducted under the null hypothesis (H_0) that the series has a unit root (non-stationary) versus the alternative hypothesis (H_1) that the series is stationary. The ADF test statistics were compared with critical values at the 5% level of significance. Accordingly, if the calculated ADF statistic is greater than the critical value at 5%, the null hypothesis that the series has a unit root is rejected, and we conclude that the series has no root test; therefore, it is stationary, and vice versa.

Table 4.1: Stationarity Test

		Augmented Dickey-Fuller test			Philips-Perron test		
Order of integration	**Variable**	**Test statistic**	**P-value**	**Implication**	**Test statistic**	**P-value**	**Implication**
Level	L_GDP	-2.96074	0.521	Non-Stationary	-4.55595	0.0013	Stationary
1st difference	L_GDP	-4.93146	0.0027	Stationary	-4.93671	0.0027	Stationary
Level	L_EDEXP	-2.02327	0.2757	Non-Stationary	-2.39999	0.1511	Non-Stationary
1st difference	L_EDEXP	-4.05052	0.0045	Stationary	-4.04142	0.0046	Stationary
Level	L_LABOUR	-2.03796	0.2699	Non-Stationary	-1.91106	0.3225	Non-Stationary
1st difference	L_LABOUR	-6.23395	0.0000	Stationary	-6.33023	0.0000	Stationary
Level	L_GFCF	-2.26051	0.1912	Non-Stationary	-2.26051	0.1912	Non-Stationary
1st difference	L_GFCF	-5.84495	0.0001	Stationary	-6.03149	0.0000	Stationary
Level	L_POVERTY	-2.84443	0.0684	Non-Stationary	-1.16406	0.6747	Non-Stationary
1st difference	L_POVERTY	-2.81687	0.0697	Stationary	-2.83406	0.0673	Stationary

Sources: EViews and Author's compilation

The results presented in table 4.1 above reveal that all the variables are non-stationary at level for Augmented Dickey-Fuller (ADF), as the calculated t-statistics in absolute terms are less than the critical values at the 5% level of significance, respectively. However, all variables become stationary after 1st differencing under Augmented Dickey-Fuller (ADF) test, and as a result, the Auto regressive distributive lag (ARDL) model will be employed. The results also reveal that GDP is stationary at level under the Philip-Perron unit root test, while all other variables become stationary after the 1st differencing under Philip-Perron test.

4.3 Autoregressive Distributed lag (ARDL) Bounds test Approach Results

4.3.1 Order selection criterion

Identifying the long-run structure and formulating a long-run analysis requires a lag order selection with the ARDL method. Table 4.2 presents the requisite lag order selection criterion conforming to the selected method applicable to this discipline. According to the results presented in Table 4.2, by considering the lowest value with an asterisk (*), it is evident that the Akaike Information Criterion value of -19.44198* is less than -17.73147* of the Schwarz Information Criterion and -18.955517* of Hannan-Quinn Criterion. Therefore, this value indicates the best optimal lag for the model as lag 2. A chosen criterion should minimize the asterisk figure to determine the best optimal lag.

Table 4.2: Leg length Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	195.4936	NA	2.61e-12	-15.31949	-15.12447	-15.26540
1	253.8321	93.34154	9.02e-14	-18.70657	-17.73147*	-18.43612
2	279.0247	32.24656*	4.84e-14*	**-19.44198***	-17.68680	-18.95517*

Source: Eviews and Author's compilation

4.3.2 Autoregressive Distributed lag (ARDL) Bounds test Approach Results

Table 4.3: Long-run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0,930271	0,261619	3,555825	0,0019
L_GDP(-1)*	-0,036102	0,009915	-3,641009	0,0015
L_EDEXP**	-0,374882	0,111536	-3,361083	0,0030
L_LABOUR**	-0,005345	0,070386	-0,075937	0,9402
L_GFCF**	-0,215359	0,124718	-1,726775	0,0989
L_POVERTY**	0,004547	0,026492	0,171633	0,8654

Source: Eviews and Author's compilation

Table 4.4: ARDL Bound Test

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Significance	I(0)	I(1)
F-statistic	8,454950	10%	2,45	3,52
k	4	5%	2,86	4,01
		2,5%	3,25	4,49
		1%	3,74	5,06
Actual Sample Size	27	Finite Sample: n=35		
		10%	2,696	3,898
		5%	3,276	4,63
		1%	4,59	6,368

Source: Eviews and Author's own work

The rule states that if the calculated F-statistic is lower than the critical value for the lower bound I (0), we fail to reject the null hypothesis that there is no long run relationship and conclude that there is no cointegration. However, if the F-statistic is greater than the critical value for the upper bound I (1), we reject the null hypothesis that there is no long-run relationship between the dependent variable and its explanatory variables and conclude that there is cointegration. The F-statistic value

(8,454950) is clearly greater than the I (1) critical value bound (4.01). Consequently, we reject the null hypothesis that there is no equilibrating (long run) relationship and conclude that there is long run relationship between the dependent variable and the explanatory variables under review.

In interpreting the ARDL long run results, the signs of the coefficients are reversed, and they explain short run causal effects. As the p-value of education expenditure (0.0030) is less than 0.05 at the 5% level of significance and gross fixed capital formation (0,0989) is less than 0.10 at the 10% level of significance, we, therefore, conclude that education expenditure and gross fixed capital formation have a short-run causal effect on economic growth as measured by the gross domestic product. However, there is no causal effect running from the labour force and poverty to economic growth in the short run. We can therefore conclude that, in the short-run, education expenditure and fixed capital formation have positive impact on economic growth.

4.3.3 ARDL Error Correction Form

TABLE 4.5: ARDL Error Correction Regression

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	8,454950	10%	2.45	3,52
k	4	5%	2.86	4,01
		2.5%	3.25	4,49
		1%	3.74	5,06

Source: Eviews and Author's compilation

As expected, the ARDL error correction regression results reveal that the error correction term (ECT), here represented as CointEq (-1), has a correct negative sign with an associated coefficient estimate of −0.036102. This implies that about 4% (3.6%) of any movements into disequilibrium are corrected for within a year. The p-value of 0.0000, which implies perfect significance, also supports that there is a high significant long-run causal relationship between the regressand and its regressors.

4.4 Granger Causality Test

The purpose of the causality test is to determine how the variables react to each other and the direction of causality between them (Waseem, 2015). Table 4.6 provides findings from the causality test between the dependent variable and independent variables.

Table 4.6: Granger causality tests

Null Hypothesis:	Obs	F-Statistic	Prob.
L_EDEXP does not Granger Cause L_GDP	26	4,58890	0,0222
L_GDP does not Granger Cause L_EDEXP		0,80533	0,4603
L_LABOUR does not Granger Cause L_GDP	26	0,15910	0,8539
L_GDP does not Granger Cause L_LABOUR		12,1917	0,0003
L_GFCF does not Granger Cause L_GDP	26	0,64793	0,5333
L_GDP does not Granger Cause L_GFCF		1,69566	0,2076
L_POVERTY does not Granger Cause L_GDP	26	3,06233	0,0681
L_GDP does not Granger Cause L_POVERTY		1,55443	0,2347
L_LABOUR does not Granger Cause L_EDEXP	26	0,11909	0,8883
L_EDEXP does not Granger Cause L_LABOUR		3,81246	0,0387
L_GFCF does not Granger Cause L_EDEXP	26	0,03749	0,9633
L_EDEXP does not Granger Cause L_GFCF		0,49553	0,6162
L_POVERTY does not Granger Cause L_EDEXP	26	0,61569	0,5497
L_EDEXP does not Granger Cause L_POVERTY		0,55186	0,5840
L_GFCF does not Granger Cause L_LABOUR	26	2,16953	0,1392
L_LABOUR does not Granger Cause L_GFCF		0,55148	0,5842
L_POVERTY does not Granger Cause L_LABOUR	26	2,11368	0,1458
L_LABOUR does not Granger Cause L_POVERTY		0,65754	0,5285
L_POVERTY does not Granger Cause L_GFCF	26	0,09169	0,9128
L_GFCF does not Granger Cause L_POVERTY		0,45363	0,6414

Source: Eviews and Author's compilation

The Granger Causality test results reveal that education expenditure has a causal effect on economic growth (GDP) as depicted by the p-value of 0.0222, which is less than 0.05 at the 5% level of significance. Thus, we reject the null hypothesis that education does not granger cause economic growth. However, GDP does not lead to education expenditure. In the case of GDP and labour, causality runs from GDP to labour and not the other way round. This is depicted by the p-value (0.8539) which is not significant, implying that labour force does not granger cause GDP, but it is economic (GDP) growth which granger cause labour force. In respect of the gross fixed capital formation and poverty, neither gross fixed capital formation nor poverty granger causes GDP.

4.4 Diagnostic tests

4.4.1 Misspecification Tests

- **Serial (auto) Correlation Test**

Table 4.7: Serial Correlation Test

Breusch-Godfrey Serial Correlation LM Test: Null hypothesis: No serial correlation at up to 8 lags			
F-statistic	2,19127	Prob. F(8,13)	0,1005
Obs*R-squared	15,50317	Prob. Chi-Square(8)	0,0501

Source: Eviews and Author's compilation

The F-statistic p-value of 0.1005, which is greater than 0.05 implies failure to reject the null hypothesis of no serial correlation. We therefore conclude that there is no serial autocorrelation.

- **Heteroscedasticity Test**

Table 4.8: Heteroscedasticity Test: Breusch-Pagan-Godfrey

Heteroskedasticity Test: Breusch-Pagan-Godfrey Null hypothesis: Homoskedasticity			
F-statistic	1,939502	Prob. F(5,21)	0,1303
Obs*R-squared	8,529447	Prob. Chi-Square(5)	0,1294
Scaled explained SS	8,434828	Prob. Chi-Square(5)	0,1338

Source: Eviews and Author's compilation

The Breusch-Pagan LM test provides a formal test for heteroscedasticity, which test for the violation of assumption 5, which indicates that the error term should have a constant variance. The above table indicates that the null hypothesis that there is no evidence of heteroscedasticity cannot be rejected because nR squared (Obs*R-squared) is greater than the Chi-Square values. Thus, it can be said that there is significant evidence of homoscedasticity. Since the p-value of the F-statistic (0.1303) is greater than 0.05 at the 5% level of significance, we therefore fail to reject the null hypothesis of homoscedasticity (no heteroscedasticity). Thus, we conclude that the residuals are homoscedastic at the 5% significance level.

- **Residual Normality Test**

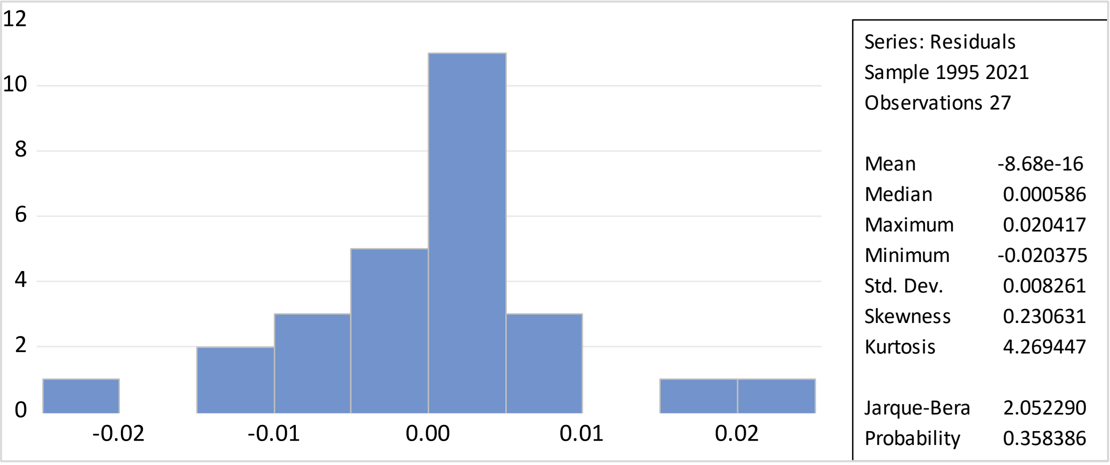


Figure 4.1 Residual Normality Test

Source: EViews and Author's compilation

The Jarque-Bera test is used to ascertain the normality of residuals within a model. Regarding the results, the probability value of the Jarque-Bera is 0.358386 and is non-significant at the 5% level of significance. Therefore, we fail to reject the null hypothesis of normal distribution and conclude that the residuals are normally distributed.

4.4.2 Stability test

- **Ramsey RESET Test**

Table 4.9: Ramsey Reset Test

Ramsey RESET Test Equation: UNTITLED Omitted Variables: Squares of fitted values Specification: L_GDAP L_GDP(-1) L_EDEXP L_LABOUR L_GFCF L_POVERTY C			
	Value	df	Probability
t-statistic	0,645302	20	0,5261
F-statistic	0,416415	(1, 20)	0,5261
Likelihood ratio	0,556388	1	0,4557

Source: Eviews and Author's compilation

The p-value for the F-statistic is 0.5261, which is greater than 0,05 at the 5% level of significance. We therefore fail to reject the null hypothesis that the model does not suffer from omitted variables and conclude that the model is correctly specified.

4.4.3 Testing for Structural Breaks

- **Cumulative Sum of Residuals (CUSUM) test and Cumulative Sum of Squares (CUSUMQ) test**

Finally, the CUSUM and CUSUMSQ plots were used to determine the stability of the long-run parameters and the short-run movements for the ARDL-Error Correction Model. The findings are given in Figures 4.2 and 4.3, respectively. If the plots of the CUSUM and CUSUMSQ statistics stay within the critical bounds at the five percent level of significance, the null hypothesis that all coefficients in the given regression are stable cannot be rejected. Examination of plots in Figures 4.2 and 4.3 shows that CUSUM and CUSUMSQ statistics are well within the 5% critical bounds, implying that short-run and long-run coefficients in the ARDL-Error Correction Model are stable or the residual variance is stable.

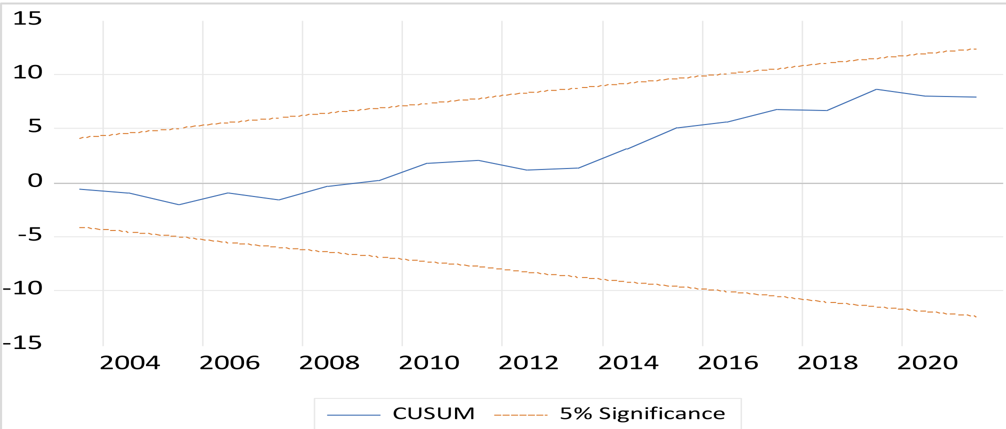


Figure 4.2 CUSUM test of stability
Source: EViews and Author's compilation

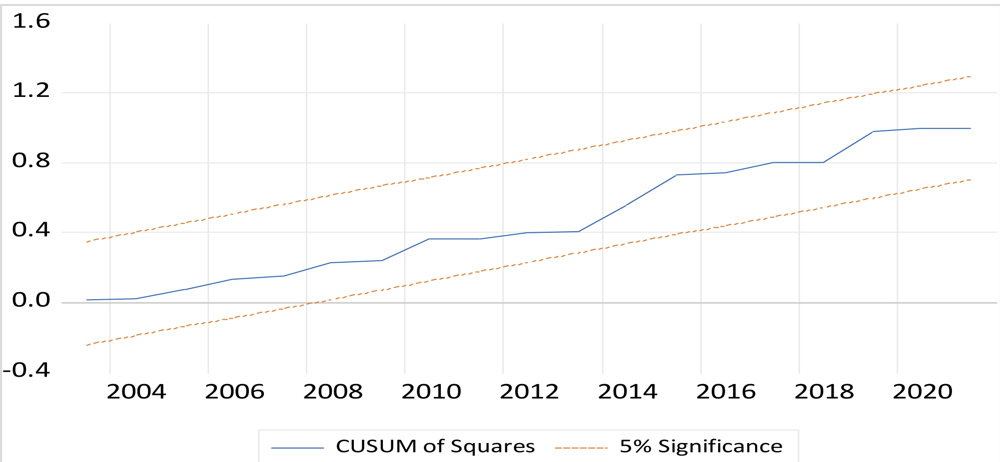


Figure 4.3: CUSUMQ test of stability
Source: EViews and Author's compilation

- **Chow Breakpoint Test**

Table 4.10: Chow Breakpoint Test

Chow Breakpoint Test: 2015 Null Hypothesis: No breaks at specified breakpoints Varying regressors: All equation variables Equation Sample: 1994 2021			
F-statistic	2.203077	Prob. F (7,14)	0.0988
Log Likelihood ratio	20.79475	Prob. Chi-Square (7)	0.0041
Wald Test	15.42154	Prob. Chi-Square (7)	0.0310

Source: EViews and Author's compilation

The rule of chow breakpoint states that, if the value of the F-statistic is greater than 0.05 at the 5% level of significance, we fail to reject the null hypothesis of no break. In table 4.12, it is evident that the F-statistic is (0.0988), which is insignificant at the 5% level of significance. We therefore fail to reject the null hypothesis, implying that there is no structural break at the chosen period. This is supported by the results of CUSUMQ test, which reveal that the model coefficients are stable, or the residual variance is stable.

4.5 Summary of the chapter

The study aimed to analyse the relationship between government expenditure on education and economic growth in South Africa, with the aid of the autoregressive distributed lag (ARDL) model. The chapter therefore presented the results of the ARDL model. Before the ARDL model was conducted, the variables were tested for stationarity. The ADF test was used in this regard. As the ADF test results portrayed that the variables were arbitrarily integrated, the ARDL test was conducted.

The long run and bounds test results revealed that there is a long run relationship between the dependent variable and its explanatory variables, as depicted by the F-statistic (8,454950), which is greater than the I (1) critical value bound (4.01). The long-run coefficients results, which show short-run causal effect among the variables under study, reveal that in the short-run, education expenditure and gross fixed capital formation have positive impact on economic growth. The error correction form model results show that there is a long-run causal relationship between the regressand and its regressors. This is also depicted by the error correction term (ECT) with a probability value of 0.0000, which implies perfect significance. The coefficient of the ECT -0. 036102, implies that about 4% of disequilibrium in the economy is corrected within a year. The diagnostic misspecification test results showed that the model is well-specified, as the p-value for all tests (autocorrelation, heteroscedasticity and normal tests) are all insignificant at the 5% level of significance. The Ramsey RESET, CUSUM, CUSUMQ and Chow breakpoint tests also confirmed that the functional form is correct and that our model does not suffer from omitted variables.

CHAPTER 5: SUMMARY, CONCLUSION, AND POLICY IMPLICATIONS

5.1 Introduction

The aim of this study was to analyse the relationship between government expenditure on education and economic growth in South Africa for the period 1994 to 2021. The current chapter therefore presents a summary of the study, conclusion, and policy implications on the relationship between government education expenditure and economic growth in South Africa. The chapter is divided into subsections.

5.2 Summary of findings

The abundance of literature reviewed has explored the possible relationship between government education expenditure and economic growth. The studies made use of different econometric models. However, the studies have resulted in many conflicting results, which may be influenced by the study area (developed or developing countries) and the method used. Many studies on developing countries showed a positive relationship between education spending and economic growth. However, few studies had negative results, while others showed insignificant results.

This study employed the auto-regressive distributed lag (ARDL) approach to analyse the relationship between government expenditure on education and economic growth in South Africa. Secondary time series data was collected from the South African Reserve Bank, International Monetary Fund, and the World Bank. The data was annual in frequency, and the complete data set consisted of 28 observations. The Eviews 12 software package was employed to conduct stationarity (unit root) tests, optimal lag length criterion, ARDL test and diagnostic tests.

The stationarity test results revealed that at the 5% level of significance, all the variables are non-stationary at level except for GDP, as the calculated t-statistics in absolute terms are less than the critical values at the 5% level of significance, respectively. These variables only became stationary after 1st differencing under the Augmented Dickey-Fuller (ADF), implying that they are arbitrarily integrated. The Autoregressive distributive lag (ARDL) model was then employed as the appropriate model. The ARDL results showed that there is a long-run relationship between the variables under review which include economic growth, education expenditure, gross fixed capital formation, poverty, and total labour force. This was evidenced by the F-statistic value of 8,454950 which is greater than the I(1) critical value bound. The results also indicated that education expenditure and gross fixed capital formation have a short-run causal effect on economic growth as measured by the gross domestic product. However, there is no causal effect running from the labour force and poverty to economic growth in the short run.

The diagnostic test results indicated that there is no serial correlation among the variables since the F-statistic p-value of 0.1005 is greater than 0.05. The results also showed that the residuals are homoscedastic at the 5% significance given the F-statistic p-value of 0.1303 which is greater than 0.05. However, the normality test results showed a normal distribution of variables since the p-value of the Jarque-Bera test statistic (0.358386) is greater than 0.05. The stability test results revealed that the model's functional form is correct and does not suffer from omitted variables since the F-stat value of 0.5261 is greater than 0,05 at a 5% significance level. The results also revealed that there are no structural breaks during the chosen period. This is supported by the results of the Chow breakpoint test and CUSUMQ test, which revealed that the model coefficients are stable, or the residual variance is stable.

5.3 Conclusion

Consistent with Amaghionyeodiwe (2019), the study's findings revealed that government spending on education and economic growth in South Africa are positively and significantly related. Long-term Granger causality exists between government expenditure on education and economic growth, indicating that in the long run, government educational expenditure through its impact on human capital, significantly and positively influences economic growth. This demonstrates that any investment (spending) on education is a critical factor in significantly promoting economic growth, especially in the long-term. The results are logical and agree with the Keynesian theory, which postulates that government spending has a positive effect on economic growth. These results are, however, inconsistent with some previous empirical results. For example, Vijesandran and Vinayagathasan (2014) found a negative long-run association between education expenditure and economic growth in Sri Lanka. Kouton

(2018) also found a negative link between education spending and economic growth in Côte d'Ivoire.

5.4 Policy Implications

The causal relationship from education expenditure to economic growth implies that in the short run, education expenditure granger causes economic growth. This is consistent with Yahya et al., (2012) findings. The inference is that policies aiming to invest more in education are important for more production.

Another implication is that, as the government invests more funds in education, this tends to boost human capital, which in turn, is translated into economic growth in the long run. The policy suggestion is that government education expenditure should increase. However, this expenditure must be of quality, so that it may result in inclusive growth. In other words, the rate of pupils enrolled in primary education should be high, so that not only a high economic trajectory will be improved, but also results in more inclusive growth. As argued by Kouton (2018) ''what is also important is the efficiency with which education expenditure is translated in education outcomes through better ratios of education'.

Finally, policies on education expenditure should be reviewed and updated, which will be advantageous for wealth creation. This would mean that the role of the government would no longer be to invest massively in education only, but to set up the economic environment to increase the benefits of education for economic development.

5.5 Areas of Further Research

The researcher aims to make improvement and explore other avenues in future by analysing the effects of other macroeconomic variables on economic growth in South Africa. It is recommended that the connection between education levels and economic growth, with the inclusion of other variables, is tested and generalized. The study could be extended to include quality of education variable to assess how this measure has influenced the labour force and thereby its impact on economic development in South Africa. Furthermore, future study could assess which specific level or levels of education (primary, secondary, or tertiary education) contributes mostly to South Africa's economic growth. This will enable policymakers to direct resources towards the level of education which contributes less to the economic development of South Africa, to boost it.

References

- Ahamefule, L. (2018). Government Spending on Education and Economic Growth: A Case Study of West African Countries.
- Ahmodu, A. O., Egbewole, I. K. & Salam, S. I. (2022) Educational budget allocation and economic growth in Nigeria. *Fuoye Journal of Management, Innovation and Entrepreneurship*, Vol.1, No. (1), pp.8 – 17.
- Akaike, H. (1974). A new look at the statistical model identification. *IEEE transactions on automatic control*, Vol. 19, No. (6), pp.716-723.
- Almajdob, M. S., & Marikan, D. A. A. (2019). Effect of Education Sector Expenditure on Economic Growth in Arab Spring Countries: A Panel Data Analysis*. International Journal of Academic Research in Business and Social Sciences*, Vol. 9, No. (9)
- Amaghionyeodiwe, L. A. (2019). Government spending on education and economic growth: a case study of West African countries. working paper, City University of New York, Jamaica, NY, available at: file:///C:/Users/tzeng/Downloads/GovernmentSpendingOnEducationAndEco_ previe% 20 (2). pdf (accessed July 24, 2019).
- Ayeni, A. O., & Omobude, O. F. (2018). Educational expenditure and economic growth nexus in Nigeria (1987-2016). *Journal for the Advancement of Developing Economies*, Vol. 7, NO.(1), pp.59 – 77.
- Bhattacharyya, P. (2019). Public expenditure on education and economic growth: A state-level analysis in India. *Humanities & Social Sciences Reviews*, Vol. 7, No. (6), pp.533-539.
- Brooks, C. (2019). EViews guide for introductory econometrics for finance. Cambridge University Press.
- Brooks, G. A. (2002). Lactate shuttle–between but not within cells? *The Journal of physiology*, 541(Pt 2), 333.
- Brown, K.E. (2021) African Center for Economic Transformation: Education must be a crisis priority, not an afterthought. https://acetforafrica.org/media/opinion/education-must-be-a-crisis-priority-not-an-afterthought/

- Caspi, O., Habib, M., Cohen, Y., Kerner, A., Roguin, A., Abergel, E., ... & Aronson, D. (2017). Acute kidney injury after primary angioplasty: is contrast-induced nephropathy the culprit? *Journal of the American Heart Association*, Vol. 6, No. (6), e005715.
- Churchill, S. A., Ugur, M., & Yew, S. L. (2017). Government education expenditures and economic growth: a meta-analysis. *The BE Journal of Macroeconomics*, Vol. 17, No. (2)
- Coman, A. C., Lupu, D., & Nuţă, F. M. (2022). The impact of public education spending on economic growth in Central and Eastern Europe. An ARDL approach with structural break. Economic Research-Ekonomska Istraživanja, 1-18.
- Cozzi, G. (2017). Endogenous growth, semi-endogenous growth... or both? A simple hybrid model. *Economics Letters*, Vol. 154, pp.28-30.
- De Wet, C., & Wolhuter, C. (2009). A transitiological study of some South African educational issues. *South African Journal of Education*, Vol. 29, No.(3)
- Di Lupidio, V. and Mariani, F. (2019). "How does government expenditure on education and specific reforms in education affect economic growth? Evidence from OECD countries and policy implications.
- Dickey, D. A., & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American statistical association*, Vol. 74(366a), pp.427-431.
- Divine, N. N. (2018). impact of educational expenditure on economic growth in nigeria(Doctoral dissertation, Baze University).
- Edame, G. E., & Fonta, W. M. (2014). The impact of government expenditure on infrastructure in Nigeria: A co- integration & error correction specification. *International Journal of African and Asian Studies*, Vol. 3, pp.50–63.
- Elliot, G., Rothenberg, T., & Stock, J. (1996). Public investment in infrastructure in a simple growth model. *Journal of Economic Dynamics and Control*, Vol.18
- Frank, N. (2018). Making the grade: The contribution of education expenditure to economic growth. *Undergraduate Economic Review*, Vol. 14, No. (1),
- Gheraia, Z., Benmeriem, M., Abdelli, H. A., & Saadaoui, S. (2021). The Effect of Education Expenditure on Economic Growth: The Case of the Kingdom of Saudi Arabia. *Humanities and Social Sciences Letters*, Vol. 9, No. (1), pp.14-23.

- Goczek, Ł., Witkowska, E., & Witkowski, B. (2021). How does education quality affect economic growth? *Sustainability*, Vol. 13, No. (11), 6437.
- Gordon, J. (2002).Neoclassical Growth Theory – Explained Economics, Finance and Analytics- Economic Analysis and Monetary policy
- Grant, C. (2017). The contribution of education to economic growth.
- Gualdi, S., & Mandel, A. (2019). Endogenous growth in production networks. *Journal of Evolutionary Economics*, Vol. 29, No. (1), pp.91-117.
- Gujarati, D. N., & Porter, D. (2009). Basic Econometrics Mc Graw-Hill International Edition.
- Guney, Y., & Komba, G. (2016). Testing for the Weak-Form Market Efficiency of the Dar es Salaam Stock Exchange. In Handbook of Frontier Markets (pp. 3-26). Academic Press.
- Gupta, S. P. (1969). Public expenditure and economic development–a cross-section analysis. *Finanzarchiv/Public Finance Analysis*, (H. 1), 26-41.
- Harris, J. R. (1995). Where is the child's environment? A group socialization theory of development. *Psychological Review*, Vol. 102, No. (3), pp.458.
- Harris, R., & Sollis, R. (2003). Applied time series modelling and forecasting. Wiley.
- Hua, Y. (2016). The relationship between public expenditure on education and economic growth: Evidence from China.
- IIASA (2008) Economic Growth in Developing Countries: Education Proves Key, Policy Brief http://www.iiasa.ac.at/web/home/resources/publications/IIASAPolicyBriefs/pb03-web.pdf
- Iwegbunam, I. A., & Robinson, Z. (2017, November). Government Expenditure and Economic Growth in South Africa: Causality and Cointegration Nexus. In Biennial Economic Society of South Africa Conference, Rhodes University, Grahamstown, Eastern Cape, South Africa.
- Jahan, S., Mahmud, A. S., & Papageorgiou, C. (2014). What is Keynesian economics. *International Monetary Fund*, Vol. 51, No. (3), pp.53-54.
- Karaçor, Z., Güvenek, B., Ekinci, E., & Konya, S. (2017, October). Relationship with education expenditure and economic growth in OECD countries: A panel data analysis. In DIEM: *Dubrovnik International Economic Meeting*, Vol. 3, No. 1, pp. 255-269. Sveučilište u Dubrovniku.

- Klona, M. (2021). The Days After COVID-19: A Meta-Analysis on the Impact of Epidemics and Pandemics on Long-Term Macro-Economic Performance. *American Business Review*, Vol. 24, No. (1), 10.
- Kouton, J. (2018). Education expenditure and economic growth: Some empirical evidence from Côte d'Ivoire.
- Kwiatkowski, D., Phillips, P. C., Schmidt, P., & Shin, Y. (1992). Testing the null hypothesis of stationarity against the alternative of a unit root: How sure are we that economic time series have a unit root? *Journal of econometrics*, Vol. 54, No. 1, 159-178.
- Le, M. P., & Tran, T. M. (2021). Government Education Expenditure and Economic Growth Nexus: Empirical Evidence from Vietnam. *The Journal of Asian Finance, Economics and Business*, Vol. 8, No. (7), pp.413-421.
- Luthuli, L. G. (2017). Investigating the link between government expenditure on education and education attainment (Doctoral dissertation).
- Madaka, F. A. (2017). Relationship between Education and Economic Growth: A Case Study of Nigeria (Master's thesis, Eastern Mediterranean University (EMU)-Doğu Akdeniz Üniversitesi (DAÜ)).
- Malangeni, L. M. (2021). Effects of different levels of education and government spending on economic growth.
- Mallick, L., Das, P. K., & Pradhan, K. C. (2016). Impact of educational expenditure on economic growth in major Asian countries: Evidence from econometric analysis. *Theoretical & Applied Economics*, Vol. 23, No. (2)
- Mankiw, N. G., Romer, D., & Weil, D. N. (1992). A contribution to the empirics of economic growth. *The quarterly journal of economics*, Vol. 107, No. (2), pp. 407-437
- Mekdad, Y., Dahmani, A., & Louaj, M. (2014). Public spending on education and economic growth in Algeria: Causality test. *International Journal of Business and Management*, Vol. 2, No. (3), pp.55.
- Mercan, M., & Sezer, S. (2014). The effect of education expenditure on economic growth: The case of Turkey. *Procedia-Social and Behavioral Sciences*, Vol. 109, pp.925-930.
- Mitra, D. (2011). The social and economic benefits of public education. Pennsylvania State University.

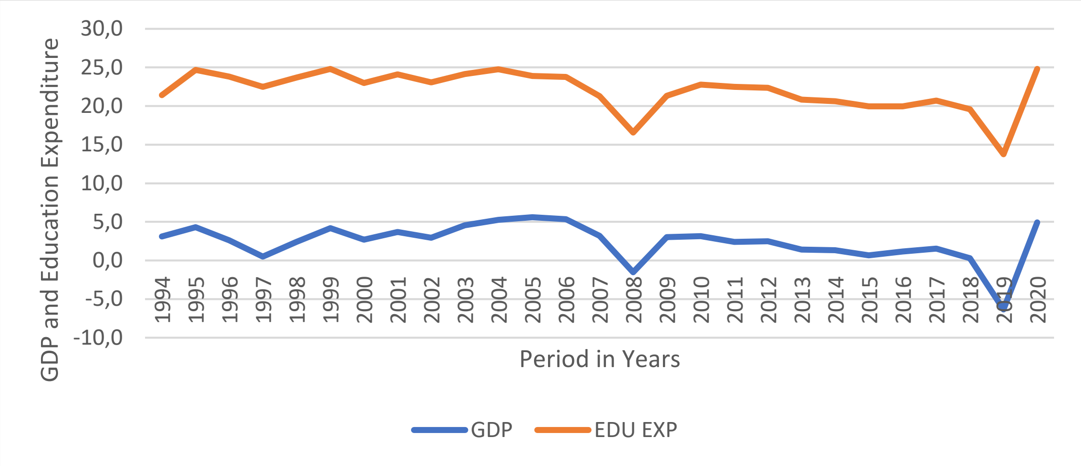
- Musgrave, R. A. (1961). Approaches to a fiscal theory of political federalism. In Public finances: Needs, sources, and utilization (pp. 97-134). Princeton University Press.
- National Treasury (2021), Budget expenditure, Department of national treasury. www.nationaltreasury.gov.za
- Ng, S., & Perron, P. (2001). Lag length selection and the construction of unit root tests with good size and power. *Econometrica*, Vl. 69, No. (6), 1519-1554.
- Nkomo, S. (2016). A Study on the impact of government expenditure (health and education) on economic growth(Doctoral dissertation, KDI School).
- Odhiambo, N. M. (2012). Economic growth and carbon emissions in South Africa: An empirical investigation. *Journal of Applied Business Research*, Vol. 28, No. (1), pp.37-46.
- Otiwu, K., Okere, P. A., & Uzowuru, L. N. (2018). Determinants of Private Domestic Savings in Nigeria (1981-2015). *International Journal for Innovation Education and Research,* Vol. 6, No. (2), pp.21-40.
- Peacock, A. T., & Wiseman, J. (1961). Front matter, the growth of public expenditure in the United Kingdom. In The growth of public expenditure in the United Kingdom (pp. 32-0). Princeton University Press.
- Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of applied econometrics*, Vol. 16, No. (3), pp.289-326.
- Pesaran, M. H., Shin, Y., & Smith, R. P. (1999). Pooled mean group estimation of dynamic heterogeneous panels. *Journal of the American statistical Association*, Vol. 94, No. (446), pp.621-634.
- PRYOR, F. L. (1968): Public Expenditures in Communist and Capitalist Nations. London: George Allen & Unwin Ltd.
- Randolph, R. (2020). Does education expenditure have a positive impact on economic growth? A panel data estimation of five developing countries.
- Ruiters, M., & Charteris, A. (2020). Gender equality in labour force participation, economic growth and development in South Africa. *Development Southern Africa*, Vol. 37, No. (6), pp. 997-1011.

- Schwarz, A. S. (1978). The partition function of degenerate quadratic functional and Ray-Singer invariants. *Letters in Mathematical Physics*, Vol. 2, No. (3), pp. 247-252.
- Seddighi, H., Lawler, K. A., Lawler, K., & Katos, A. V. (2000). Econometrics: A practical approach. Psychology Press.
- Solow, R. M. (1955). The production function and the theory of capital. *The Review of Economic Studies*, Vol. 23, No. (2), pp.101-108.
- Statistics South Africa, 2021. www.statsa.gov.za
- Suwandaru, A., Alghamdi, T. and Nurwanto, N., (2021). Empirical Analysis on Public Expenditure for Education and Economic Growth: Evidence from Indonesia. *Economies*, Vol. 9, No. (4), p.146.
- _The World Bank. Education in developing countries (education newsletter). Availablefromworldbank https://www.worldbank.org/en/topic/education/overview#1
- The World Economic Forum. (2016).The Future of Jobs Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution.
- Theofanidis, D., & Fountouki, A. (2018). Limitations and delimitations in the research process. Perioperative Nursing-Quarterly scientific, online official journal of GORNA, 7(3 September-December 2018), 155-163.
- Toda, H. Y., & Yamamoto, T. (1995). Statistical inference in vector autoregressions with possibly integrated processes. Journal of econometrics, 66(1-2), 225-250.
- Tomić, Z. (2015). Analysis of the impact of public education expenditure on economic growth of European Union and BRICS. *Economic analysis*, Vol. 48, No. (1-2), pp. 19-38.
- United Nations Children's Fund (UNICEF) (2019), Education budget brief, South Africa
- Vijesandiran, S., & Vinayagathasan, T. (2015). Dynamic relationship between human capital and economic growth in Sri Lanka: A co-integration analysis. *Asian Online Journal*, Vol. 2, No. (2), pp. 20-29.
- Wagner, A. (1883). Finanzwissenschaft...: th. Einleitung, ordnung der finanzwirthschaft, finanzbedarf, privaterwerb. 3 (Vol. 4). CF Winter.

- Waseem, M. (2015). Gender Inequalities in Education in India: Issues and Challenges. *CLEAR International Journal of Research in Commerce & Management*, Vol. 6, No.(2)
- Will, K. (2012)[The Investopedia team] https://www.investopedia.com/terms/n/neoclassical.asp]
- Wulan, E. R. (2013). The Utilization of the Cobb-Douglas Production Function for analysing Indonesia's and Malaysia's Economic Growth. *International Journal of Nusantara Islam*, Vol. 1, No. (2), pp.38-44.
- Wycliffe, N. O., & Muriu, P. (2014). The Impact of Macroeconomic Variables on Stock Returns in Kenya. *International Journal of Business and Commerce*, Vol. 3, No. 11
- Yahya, Mohd & Muhammad, Fidlizan & Abu-Hussin, Mohd Fauzi & Razak, Azila. (2012). Education Expenditure and Economic Growth: A Causal Analysis for Malaysia. *Journal of Economics and Sustainable Development*, Vol. 3, No. 7

Appendices

GDP and Government Expenditure on Education



Source: Author's calculation based on SARB and IMF data (2022)

Unit Root Test: Augmented Dickey-Fuller

Level (L_GDP)

Null Hypothesis: L_GDP has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.960749	0.0521
Test critical values:	1% level	-3.711457	
	5% level	-2.981038	
	10% level	-2.629906	

Null Hypothesis: L_GDP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.952701	0.9997
Test critical values:	1% level	-4.356068	
	5% level	-3.595026	
	10% level	-3.233456	

Null Hypothesis: L_GDP has a unit root
Exogenous: None
Lag Length: 2 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.966108	0.9063
Test critical values:	1% level	-2.660720	
	5% level	-1.955020	
	10% level	-1.609070	

1'st Difference (L_GDP)

Null Hypothesis: D(L_GDP) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.626796	0.4546
Test critical values:	1% level	-3.724070	
	5% level	-2.986225	
	10% level	-2.632604	

Null Hypothesis: D(L_GDP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.931468	0.0027
Test critical values:	1% level	-4.356068	
	5% level	-3.595026	
	10% level	-3.233456	

Null Hypothesis: D(L_GDP) has a unit root
Exogenous: None
Lag Length: 1 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.228633	0.1951
Test critical values:	1% level	-2.660720	
	5% level	-1.955020	
	10% level	-1.609070	

Level (L_EDEXP)

Null Hypothesis: L_EDEXP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.023272	0.2757
Test critical values:	1% level	-3.699871	
	5% level	-2.976263	
	10% level	-2.627420	

Null Hypothesis: L_EDEXP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.808758	0.2063
Test critical values:	1% level	-4.339330	
	5% level	-3.587527	
	10% level	-3.229230	

Null Hypothesis: L_EDEXP has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.000556	0.6741
Test critical values:	1% level	-2.653401	
	5% level	-1.953858	
	10% level	-1.609571	

1'st Difference (L_EDEXP)

Null Hypothesis: D(L_EDEXP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.050524	0.0045
Test critical values:	1% level	-3.711457	
	5% level	-2.981038	
	10% level	-2.629906	

Null Hypothesis: D(L_EDEXP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.950965	0.0241
Test critical values:	1% level	-4.356068	
	5% level	-3.595026	
	10% level	-3.233456	

Null Hypothesis: D(L_EDEXP) has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.172191	0.0002
Test critical values:	1% level	-2.656915	
	5% level	-1.954414	
	10% level	-1.609329	

Level(L_LABOUR)

Null Hypothesis: L_LABOUR has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.037960	0.2699
Test critical values:	1% level	-3.699871	
	5% level	-2.976263	
	10% level	-2.627420	

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

Null Hypothesis: L_LABOUR has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.347208	0.0801
Test critical values:	1% level	-4.339330	
	5% level	-3.587527	
	10% level	-3.229230	

Null Hypothesis: L_LABOUR has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.380016	0.7869
Test critical values:	1% level	-2.653401	
	5% level	-1.953858	
	10% level	-1.609571	

1’st Difference (L_LABOUR)

Null Hypothesis: D(L_LABOUR) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.233955	0.0000
Test critical values:	1% level	-3.711457	
	5% level	-2.981038	
	10% level	-2.629906	

Null Hypothesis: D(L_LABOUR) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.098719	0.0002
Test critical values:	1% level	-4.356068	
	5% level	-3.595026	
	10% level	-3.233456	

Null Hypothesis: D(L_LABOUR) has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.366348	0.0000
Test critical values:	1% level	-2.656915	
	5% level	-1.954414	
	10% level	-1.609329	

Level (L_GFCF)

Null Hypothesis: L_GFCF has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.260518	0.1912
Test critical values:	1% level	-3.699871	
	5% level	-2.976263	
	10% level	-2.627420	

Null Hypothesis: L_GFCF has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.197470	0.1060
Test critical values:	1% level	-4.339330	
	5% level	-3.587527	
	10% level	-3.229230	

Null Hypothesis: L_GFCF has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.473632	0.8106
Test critical values:	1% level	-2.653401	
	5% level	-1.953858	
	10% level	-1.609571	

1'st Difference (L_GFCF)

Null Hypothesis: D(L_GFCF) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.844957	0.0001
Test critical values:	1% level	-3.711457	
	5% level	-2.981038	
	10% level	-2.629906	

Null Hypothesis: D(L_GFCF) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.739409	0.0004
Test critical values:	1% level	-4.356068	
	5% level	-3.595026	
	10% level	-3.233456	

Null Hypothesis: D(L_GFCF) has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.862041	0.0000
Test critical values:	1% level	-2.656915	
	5% level	-1.954414	
	10% level	-1.609329	

Level_(L_POVERTY)

Null Hypothesis: L_POVERTY has a unit root
Exogenous: Constant
Lag Length: 5 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.844434	0.0684
Test critical values:	1% level	-3.769597	
	5% level	-3.004861	
	10% level	-2.642242	

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

Null Hypothesis: L_POVERTY has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 5 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.915321	0.6127
Test critical values:	1% level	-4.440739	
	5% level	-3.632896	
	10% level	-3.254671	

*MacKinnon (1996) one-sided p-values.
Null Hypothesis: L_POVERTY has a unit root
Exogenous: None
Lag Length: 1 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.139422	0.6260
Test critical values:	1% level	-2.656915	
	5% level	-1.954414	
	10% level	-1.609329	

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

1'ST Difference (L_POVERTY)

Null Hypothesis: D(L_POVERTY) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.816870	0.0697
Test critical values:	1% level	-3.711457	
	5% level	-2.981038	
	10% level	-2.629906	

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

Null Hypothesis: D(L_POVERTY) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.229195	0.1008
Test critical values:	1% level	-4.356068	
	5% level	-3.595026	
	10% level	-3.233456	

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

Null Hypothesis: D(L_POVERTY) has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.883977	0.0057
Test critical values:	1% level	-2.656915	
	5% level	-1.954414	
	10% level	-1.609329	

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

Unit Root Test: Phillips-Perron

Level (L_GDP)

Null Hypothesis: L_GDP has a unit root
Exogenous: Constant
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.555950	0.0013
Test critical values:	1% level	-3.699871	
	5% level	-2.976263	
	10% level	-2.627420	

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

Null Hypothesis: L_GDP has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		0.370672	0.9980
Test critical values:	1% level	-4.339330	
	5% level	-3.587527	
	10% level	-3.229230	

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

Null Hypothesis: L_GDP has a unit root
Exogenous: None
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		7.302549	1.0000
Test critical values:	1% level	-2.653401	
	5% level	-1.953858	
	10% level	-1.609571	

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

1'st Difference (L_GDP)

Null Hypothesis: D(L_GDP) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.936712	0.0027
Test critical values:	1% level	-4.356068	
	5% level	-3.595026	
	10% level	-3.233456	

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

Level (L_EDEXP)

Null Hypothesis: L_EDEXP has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.399992	0.1511
Test critical values:	1% level	-3.699871	
	5% level	-2.976263	
	10% level	-2.627420	

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

Null Hypothesis: L_EDEXP has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.068098	0.1337
Test critical values:	1% level	-4.339330	
	5% level	-3.587527	
	10% level	-3.229230	

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

Null Hypothesis: L_EDEXP has a unit root
Exogenous: None
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.006504	0.6717
Test critical values:	1% level	-2.653401	
	5% level	-1.953858	
	10% level	-1.609571	

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

1'st Difference (L_EDEXP)

Null Hypothesis: D(L_EDEXP) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.041426	0.0046
Test critical values:	1% level	-3.711457	
	5% level	-2.981038	
	10% level	-2.629906	

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

Null Hypothesis: D(L_EDEXP) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.935325	0.0249
Test critical values:	1% level	-4.356068	
	5% level	-3.595026	
	10% level	-3.233456	

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

Null Hypothesis: D(L_EDEXP) has a unit root
Exogenous: None
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.170460	0.0002
Test critical values:	1% level	-2.656915	
	5% level	-1.954414	
	10% level	-1.609329	

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

Level(L_LABOUR)

Null Hypothesis: L_LABOUR has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.911063	0.3225
Test critical values:	1% level	-3.699871	
	5% level	-2.976263	
	10% level	-2.627420	

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

Null Hypothesis: L_LABOUR has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.215420	0.1026
Test critical values:	1% level	-4.339330	
	5% level	-3.587527	
	10% level	-3.229230	

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

Null Hypothesis: L_LABOUR has a unit root
Exogenous: None
Bandwidth: 18 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		1.207714	0.9376
Test critical values:	1% level	-2.653401	
	5% level	-1.953858	
	10% level	-1.609571	

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

1'st Difference (L_LABOUR)

Null Hypothesis: D(L_LABOUR) has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.330234	0.0000
Test critical values:	1% level	-3.711457	
	5% level	-2.981038	
	10% level	-2.629906	

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

Null Hypothesis: D(L_LABOUR) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.164577	0.0002
Test critical values:	1% level	-4.356068	
	5% level	-3.595026	
	10% level	-3.233456	

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

Null Hypothesis: D(L_LABOUR) has a unit root
Exogenous: None
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.455493	0.0000
Test critical values:	1% level	-2.656915	
	5% level	-1.954414	
	10% level	-1.609329	

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

Level (L_GFCF)

Null Hypothesis: L_GFCF has a unit root
Exogenous: Constant
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.260518	0.1912
Test critical values:	1% level	-3.699871	
	5% level	-2.976263	
	10% level	-2.627420	

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

Null Hypothesis: L_GFCF has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.197470	0.1060
Test critical values:	1% level	-4.339330	
	5% level	-3.587527	
	10% level	-3.229230	

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

Null Hypothesis: L_GFCF has a unit root
Exogenous: None
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		0.783644	0.8766
Test critical values:	1% level	-2.653401	
	5% level	-1.953858	
	10% level	-1.609571	

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

1’st Difference (L_GFCF)

Null Hypothesis: D(L_GFCF) has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.031491	0.0000
Test critical values:	1% level	-3.711457	
	5% level	-2.981038	
	10% level	-2.629906	

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

Null Hypothesis: D(L_GFCF) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.919982	0.0003
Test critical values:	1% level	-4.356068	
	5% level	-3.595026	
	10% level	-3.233456	

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

Null Hypothesis: D(L_GFCF) has a unit root
Exogenous: None
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.906895	0.0000
Test critical values:	1% level	-2.656915	
	5% level	-1.954414	
	10% level	-1.609329	

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

Level (L_POVERTY)

Null Hypothesis: L_POVERTY has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.164064	0.6747
Test critical values:	1% level	-3.699871	
	5% level	-2.976263	
	10% level	-2.627420	

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

Null Hypothesis: L_POVERTY has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.632097	0.9684
Test critical values:	1% level	-4.339330	
	5% level	-3.587527	
	10% level	-3.229230	

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

Null Hypothesis: L_POVERTY has a unit root
Exogenous: None
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		0.196540	0.7355
Test critical values:	1% level	-2.653401	
	5% level	-1.953858	
	10% level	-1.609571	

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

1'st Difference (L_POVERTY)

Null Hypothesis: D(L_POVERTY) has a unit root
Exogenous: Constant
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.834064	0.0673
Test critical values:	1% level	-3.711457	
	5% level	-2.981038	
	10% level	-2.629906	

Null Hypothesis: D(L_POVERTY) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.219461	0.1026
Test critical values:	1% level	-4.356068	
	5% level	-3.595026	
	10% level	-3.233456	

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

Null Hypothesis: D(L_POVERTY) has a unit root
Exogenous: None
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.900758	0.0054
Test critical values:	1% level	-2.656915	
	5% level	-1.954414	
	10% level	-1.609329	

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

Long Run Coefficients

Dependent Variable: L_GDAP
Method: ARDL
Date: 01/21/23 Time: 17:06
Sample (adjusted): 1995 2021
Included observations: 27 after adjustments
Maximum dependent lags: 1 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (1 lag, automatic): L_EDEXP L_LABOUR L_GFCF
L_POVERTY
Fixed regressors: C
Number of models evaluated: 16
Selected Model: ARDL(1, 0, 0, 0, 0)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
L_GDAP(-1)	0.963898	0.009915	97.21234	0.0000
L_EDEXP	-0.374882	0.111536	-3.361083	0.0030
L_LABOUR	-0.005345	0.070386	-0.075937	0.9402
L_GFCF	-0.215359	0.124718	-1.726775	0.0989
L_POVERTY	0.004547	0.026492	0.171633	0.8654
C	0.930271	0.261619	3.555825	0.0019

R-squared	0.999316	Mean dependent var	3.357680
Adjusted R-squared	0.999153	S.D. dependent var	0.315848
S.E. of regression	0.009192	Akaike info criterion	-6.347899
Sum squared resid	0.001774	Schwarz criterion	-6.059935
Log likelihood	91.69663	Hannan-Quinn criter.	-6.262272
F-statistic	6135.764	Durbin-Watson stat	2.660633
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model selection.

ARDL Bound Test

ARDL Error Correction Regression
Dependent Variable: D(L_GDAP)
Selected Model: ARDL(1, 0, 0, 0, 0)
Case 3: Unrestricted Constant and No Trend
Date: 01/21/23 Time: 17:08
Sample: 1994 2021
Included observations: 27

ECM Regression
Case 3: Unrestricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.930271	0.125633	7.404703	0.0000
CointEq(-1)*	-0.036102	0.005089	-7.094159	0.0000

R-squared	0.668114	Mean dependent var	0.039089
Adjusted R-squared	0.654839	S.D. dependent var	0.014339
S.E. of regression	0.008424	Akaike info criterion	-6.644195
Sum squared resid	0.001774	Schwarz criterion	-6.548207
Log likelihood	91.69663	Hannan-Quinn criter.	-6.615653
F-statistic	50.32709	Durbin-Watson stat	2.660633
Prob(F-statistic)	0.000000		

* p-value incompatible with t-Bounds distribution.

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	8.454950	10%	2.45	3.52
k	4	5%	2.86	4.01
		2.5%	3.25	4.49
		1%	3.74	5.06

t-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
t-statistic	-7.094159	10%	-2.57	-3.66
		5%	-2.86	-3.99
		2.5%	-3.13	-4.26
		1%	-3.43	-4.6

Ramsey Reset

Ramsey RESET Test
Equation: UNTITLED
Omitted Variables: Squares of fitted values
Specification: L_GDAP L_GDAP(-1) L_EDEXP L_LABOUR L_GFCF L_POVERTY C

	Value	df	Probability
t-statistic	0.645302	20	0.5261
F-statistic	0.416415	(1, 20)	0.5261
Likelihood ratio	0.556388	1	0.4557

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	3.62E-05	1	3.62E-05
Restricted SSR	0.001774	21	8.45E-05
Unrestricted SSR	0.001738	20	8.69E-05

LR test summary:

	Value
Restricted LogL	91.69663
Unrestricted LogL	91.97483

Unrestricted Test Equation:
Dependent Variable: L_GDAP
Method: Least Squares
Date: 01/21/23 Time: 17:14
Sample: 1995 2021
Included observations: 27

Variable	Coefficient	Std. Error	t-Statistic	Prob.
L_GDAP(-1)	0.794593	0.262558	3.026349	0.0067
L_EDEXP	-0.362355	0.114773	-3.157146	0.0050
L_LABOUR	-0.026242	0.078387	-0.334780	0.7413
L_GFCF	-0.210251	0.126735	-1.658981	0.1127
L_POVERTY	-0.010523	0.035599	-0.295595	0.7706
C	1.228735	0.533219	2.304370	0.0321
FITTED^2	0.026520	0.041097	0.645302	0.5261

R-squared	0.999330	Mean dependent var	3.357680
Adjusted R-squared	0.999129	S.D. dependent var	0.315848
S.E. of regression	0.009322	Akaike info criterion	-6.294432
Sum squared resid	0.001738	Schwarz criterion	-5.958474
Log likelihood	91.97483	Hannan-Quinn criter.	-6.194534
F-statistic	4971.113	Durbin-Watson stat	2.720620
Prob(F-statistic)	0.000000		

Heteroskedasticity Test

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

F-statistic	1.939502	Prob. F(5,21)	0.1303
Obs*R-squared	8.529447	Prob. Chi-Square(5)	0.1294
Scaled explained SS	8.434828	Prob. Chi-Square(5)	0.1338

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 01/21/23 Time: 17:12
Sample: 1995 2021
Included observations: 27

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000217	0.003172	0.068304	0.9462
L_GDAP(-1)	0.000163	0.000120	1.355128	0.1898
L_EDEXP	-0.001031	0.001352	-0.762136	0.4545
L_LABOUR	-0.000828	0.000853	-0.970469	0.3429
L_GFCF	0.000635	0.001512	0.419703	0.6790
L_POVERTY	0.000735	0.000321	2.287235	0.0327

R-squared	0.315905	Mean dependent var	6.57E-05
Adjusted R-squared	0.153026	S.D. dependent var	0.000121
S.E. of regression	0.000111	Akaike info criterion	-15.17316
Sum squared resid	2.61E-07	Schwarz criterion	-14.88519
Log likelihood	210.8376	Hannan-Quinn criter.	-15.08753
F-statistic	1.939502	Durbin-Watson stat	1.323651
Prob(F-statistic)	0.130298		