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Empirical Assessment of Unemployment and Economic Growth: Evidence from Sub-Saharan Africa

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Abstract

Unemployment is a social problem in the global space and adversely affects the economic growth of countries. It is a situation where individuals who are capable of working and are actively seeking work are unable to find job. The economies of sub-Saharan Africa are mostly affected by the scourge of unemployment as the region has the highest unemployment rate in the global space. This study examines the effects of unemployment on economic growth in sub-Saharan Africa. The study investigates the unemployment rate and economic growth rate of twenty (20) countries in the sub-region for the period of ten (11) years (2013 – 2023). Panel Generalized Method of Moment (GMM) techniques were used to analyze the data collected from the World Development Indicators (WDI). The study variables are GDP growth rate, unemployment rate, capital formation, education investment and exchange rate. The finding of the study demonstrates that the unemployment rate and exchange rate are negative and statistically significant on the economic growth rate, while capital formation and education indicate significant positive association in the region. Based on the finding the study recommends that the governments of the sub-region adhere strictly to the economic policies and intervention programmes that are capable of addressing the high rate of unemployment in the region, especially, by increasing the region's capital formation, committing more resources into the education sector to actualize high economic growth in the SSA region.

Keywords: *Unemployment, Economic Growth, Sub-Sahara Africa, Panel GMM, Education*

Background to the Study

The tactical effort of reducing unemployment and achieving growth stabilization is a global economic target. The economic policy of unemployment reduction and increasing growth is of high impetus in development actualization (Soylu, Cakmak and Okur, 2018). According to Ezebunwa, Ndukwe, and Njoku (2024), unemployment and economic growth have a strong negative correlation. The relationship between economic growth and unemployment is established in the neoclassical model, which posits that productivity growth is determined by the employment of labor and capital (Egbetunde and Adesina, 2022). Therefore, full employment of labor brings economic progress, whereas unemployment lowers growth. Unemployment is a pressing issue that extends beyond economic concerns, leading to social tension and unrest (Orji, 2023). It is defined as a situation where people who are willing and able to work at the prevailing wage rate cannot find befitting jobs (Orji, 2019). The International Labour Organization (ILO) has identified unemployment as one of the biggest social threats globally, estimating the global unemployment rate at 12.6% (ILO, 2022). However, the problem is more severe within the African continent. For instance, in 2010, South Africa's unemployment rate stood at 25.2%, Ghana's at about 14%, and Nigeria's at approximately 37% (ILO, 2022). The high unemployment rate in Sub-Saharan Africa (SSA) is a key factor contributing to the region's economic struggles (Correa, 2023). Economic welfare is often measured by Gross National Product (GNP) per capita, and SSA's low economic growth is largely attributed to its high unemployment rate (Nnachi and Ugochukwu, 2023).

Developed economies exhibit a better economic outlook due to their full employment levels and the adoption of advanced technologies in production (Hala, Mehdi, and Huseyin, 2021). The capital employed in these countries is labor-saving and enhances productivity, aligning with the endogenous growth theory, which states that economic growth results for technological progress, labor efficiency, and capital

stock (Lucas, 1988; Romar, 1986). In contrast, SSA countries struggle with technological backwardness and outdated capital in production (Ezenwa et al., 2024). Despite efforts to emulate industrialized economies, the SSA region has not achieved significant economic progress, partly due to a mismatch between advanced economies' policies and the realities of SSA's labor-abundant environment (Soylu et al., 2018). Trade liberalization policies have also adversely affected SSA economies, leading to the collapse of indigenous industries and rising unemployment as machines replace human labor (Egbetunde and Adesina, 2022). Additionally, the shift from agriculture historically the backbone of SSA's economy to industrial capitalist models has further exacerbated unemployment and food insecurity, leading to hunger, crises, terrorism, human trafficking, and war (Orji, 2023).

SSA countries continue to face the challenge of low economic growth, which is associated with several factors, including high unemployment, low capital formation, insufficient investment in education and research, trade imbalances, and currency fluctuations (Olayemi, Olukayode, and Oluwaseyi, 2023). Between 2022 and 2023, the economic growth rate in SSA declined from 3.65% to 2.95%, while unemployment slightly decreased from 6.08% to

5.97% (WDI, 2024). However, Egbetunde, et. al, (2022) add poverty, while, Egbenchong (2024), includes; economic freedom, and good governance to unemployment and economic growth. Correa (2023) used ARDL and ECM, on unemployment, inflation, FDI and economic growth. The present study adopts the Generalized Method of Moment (GMM) method of analysis, outside the pooled OLS, fixed and random effects used in the previous studies. The study variables are; unemployment rate, education, exchange rate and economic growth rate. The addition of education and exchange fill gap of literacy level in the sub-region. Therefore, this study seeks to investigate:

(1) The relationship between unemployment and economic growth in Sub-Saharan Africa.
(2) The availability of capital impacts economic growth in Sub-Saharan Africa.

Conceptual Review

Economic growth refers to the percentage increase in the total output of final goods and services produced in an economy over time. It is measured as the percentage increase in real gross domestic product (GDP), which represents the inflation-adjusted market value of goods and services produced in an economy (Falki, 2021). Economic growth occurs when a country expands its production possibilities, rising above its previous operating level (Eze, Atuma, and Egbeoma, 2016). It is a sustained rise in real per capita income and is associated with an increase in economic goods and services over time. Growth in the size of the working population, along with the full utilization of resources, enhances an economy's potential output (Akutson, Messiah, and Arf, 2018). It is typically calculated using data on GDP provided by national statistical agencies, using the income-output method: GDP = C + I + G + (X - M), where C represents consumption, I is investment, G is government spending, X is exports, and M is imports (Mankiw, 2009).

Sustainable economic growth ensures that the pursuit of increased output does not compromise the benefits available to future generations. This means preserving non-renewable resources and maintaining a clean environment. Rapid or persistent economic growth is associated with structural changes, such as the introduction of new products, production techniques, refined labor skills, capital goods, and economic institutions. However, failure to invest in human capital, real capital, and research and development (R and D) can reduce an economy's productive capacity. Over time, the productivity of real capital, such as machinery and equipment, declines due to depreciation, which can negatively impact labor productivity. The quality and productivity of labor depend on the continuous acquisition of new skills (Olayemi et al., 2023). Hence, economic growth is fundamentally a quantitative, sustained increase in a country's per capita output or income, accompanied by the expansion of its labor force, consumption, capital, and trade volume.

Unemployment, as a concept, has varying definitions across different international organizations and scholars. Orji (2023) defines unemployment as a situation where individuals are without work but are actively seeking employment. It is the proportion of a country's labor force that is jobless but available for work. According to the International Labour Organization (ILO, 2022), an unemployed person is defined as someone aged fifteen

years and above who has been without work for at least one week, is available for a job within two weeks, and has actively searched for work in the past four weeks. The ILO highlights unemployment as one of the major social threats worldwide, with the global unemployment rate estimated at 12.6% (ILO, 2022).

The unemployment situation in Nigeria is particularly severe compared to other African countries. For instance, in 2010, Nigeria's unemployment rate was approximately 37%, compared to South Africa's 25.2% and Ghana's 14% (ILO, 2022). The World Bank (2024) similarly defines an unemployed person as someone aged fifteen and above, who is not engaged in paid employment or self-employment, but is available, willing, and actively searching for a job. Unemployment is often expressed as a percentage of labour force. In addition, the International Monetary Fund (2012) viewed unemployment as the number of persons within the age bracket (18 – 64), who fulfill the following three conditions;

1. Did not have any work during the reference week;
2. Had been actively seeking a job during the last four weeks or who found a job to start within a specified period of, at most three months;
3. Was able to start work in the next two weeks.

However, according to these definitions, only those persons not at work for more than a specified minimum of time and who are able and willing to work, and also actively seeking work, are generally considered unemployed. Therefore, unemployment is not applied to everyone who is not employed but only to those of legal working age and others who are out of job and seeking work. Adebisi and Oluwakayode (2018) defined unemployment as a situation where a person is actively searching for a paid job but cannot find any work to do. Unemployment is the percentage of labour force that is without jobs but is able and willing to work, this is to say, unemployment includes ability and willingness to work. Also, unemployment could mean the presence of a workforce who is able and willing to work at the current wage and cannot find a job.

Indeed, unemployment is a situation where people within the working age have no benefiting job within a given time frame. It is a phenomenon whereby people who have the willingness and ability to work at a prevailing wage rate, could not find jobs (Ibrahim & Mahmoud, 2016). The term unemployment is described as a state of no job, job search and the need for a job. Muhammed, Khumum, Aneel and Nedim (2015) described unemployment as the involuntary idleness of a person willing to work at the prevailing rate of pay but unable to find a job. It implies that only those persons are regarded as unemployed, who are prepared to work at the prevailing rate of pay but they do not find work. Voluntarily unemployed persons who do not want to work like the idle rich are not considered unemployed.

Theoretical Review

Neoclassical Growth Theory

Neoclassical growth model as developed by Solow (1956). The theory assumes a production function of the type:

$$Y = Af(K, L) \quad (1)$$

Where *Y is* output, *A* is Total Factor Productivity (TFP), *K* is physical capital, and *L* is labour. Labour productivity is defined by *Y/L*. Changes in TFP (*A*) is called Hicks neutral technological change. Another widely used neoclassical production function takes the form:

$$Y=f(K,EL) \quad (2)$$

Where *E* is an efficiency index, for a given capital stock *K* and labour input *L*, changes in *E* lead to changes in labour productivity. Increases in *E* are thus referred to as labour-augmenting technological progress, also called Harrod-neutral technological change. Let *x* denote the rate of technological progress (either Hicks or Harrod neutral). Population growth increases the labour force at rate *n*. Long-run economic growth is equal to population growth and technological progress, *n+x*. As *n* and *x* are exogenously determined, it is referred to as exogenous growth. The short-run rate of economic growth can deviate from the balanced growth rate when the economy is adjusting towards a new equilibrium (transition dynamics).

Endogenous Growth Theory

Endogenous growth theory explains the long-run growth rate of an economy on the basis of endogenous factors as against the exogenous factors of the neoclassical growth theory. The theory was developed by Arrow (1962), Lucas (1988) and Romar (1986). The theory emphasizes technical progress resulting from the rate of investment, the size of the capital stock and the human capital as the major determinants of economic growth. Endogenous growth models are built on technical progress resulting from the rate of investment, the size of capital stock, and the stock of human capital. The endogenous theory assumes that there is (1) knowledge or technological advancement in non-rival good (2) there are increasing returns to a single factor, at least one. (3) Technological advancement comes from things people do. This implies that technological advancement is based on the people's innovations. The model for the theory arises from increasing returns to scale in the production that leads to economic growth. The model is in the form:

$$Y_i=\mathrm{A}(K)F(K_iL_i) \quad (3)$$

Where Y_i denotes the output of firm *i*, K_i denotes the firm capital stock, L_i denotes its labour stock, *K* denotes the aggregated stock of capital and *A* is the technology factor. For the output of an economy to grow, it involves that capital stock, skilled labour and technological advancement must be highly encouraged. Arrow introduced the concept of learning by doing in 1962; he regards learning as endogenous in the growth process. He assumes that new capital goods incorporate all the knowledge available based on experience and subsequent learning. Arrow's model is in the form:

$$Y_i=A(K)F(K_,L_i) \quad (4)$$

Where Y_i denotes the output of country *i*, K_i denotes the capital stock of country *i*, L_i denotes labour stock of country *i*, *K* without subscript denotes the aggregate stock of capital and *A* is the technology factor in country *i*. He showed that if the stock of labour is held constant, growth ultimately comes to a halt because socially very little is invested and produced. Romer

in 1986 presented a variant of Arrow's model which is known as learning by investment. He assumed that knowledge is a product of investment. Romer takes knowledge as factor input of the production function of the form;

$$Y = A(R)F(R_i, K_i, L_i) \quad (5)$$

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 expenditure on research and development of country i; and K_i *and* L_i are capital stock and labour stock of country i respectively. He assumed function F homogeneous of degree one in all inputs $R_i, K_i,$ *and* $L_i,$ *and treats* R_i as a rival good. According to Romer the spillover from research efforts of countries leads to the creation of new knowledge and that new knowledge is the ultimate determinant of long-run growth.

Lucas (1988) again developed an endogenous growth model based on investment in human capital. Lucas assumes that investment in education leads to the development of human capital which is crucial in the growth process. He distinguished between the external effects of human capital where workers undergoing training become more productive and external effects which spillover and increase the productivity of capital and of other workers in the economy. According to Lucas, it is an investment in human capital rather than physical that has spillover effects that increase the level of technology and output of a country.

Empirical Studies

Considering the regional studies; Egbenchong, (2024) estimated the impacts of unemployment on the economic growth of Sub-Saharan Africa. The study used a panel of 36 Sub-Saharan African countries for the period of (2007 – 2021). Pooled OLS, Fixed effects and random effect models were tested for suitable models to chosen for the analysis. The OLS result revealed that the unemployment rate has negative impact on economic growth. The result shows that combinations of economic freedom and good governance, along with fewer unemployed citizens, enhance a country's economic growth. Generating productive jobs is crucial for eliminating poverty. In a different technique, Correa, (2023) studied the influence of unemployment, inflation, and FDI on GDP growth from 1991 - 2021. The study used ARDL model to establish short-run and long-run equilibrium of the study variables. The Granger causality test, and the Error Correction Model (ECM) approach, was used in the analysis. The result revealed cointegration equilibrium of the model. The ECM demonstrates that unemployment and inflation have a decreasing function of the economic growth, while FDI is positive and significant.

Similarly, in the sub-Saharan region, Egbetunde, and Adesina, (2022) examined the effect of poverty and unemployment on economic growth in selected sub-Saharan Africa (SSA). The study covers the period 1991 to 2018. Panel OLS regression analysis technique was used with a fixed effect model to establish the impact of poverty and unemployment on the economic growth in SSA. The study found a significant positive effect of poverty on economic growth in the region while unemployment is negative and not significant on economic growth.

Soylu, Cakmak, and Okur (2018) studied the link between economic growth and unemployment in Eastern European countries. The study examines the relationship of unemployment and economic growth in the context of Okun's law. Pooled Panel OLS and Johansen Co-integration test were applied to the collected spanning 1992 – 2014. The result of the analysis demonstrates the negative relationship between unemployment and economic growth.

Studies on country bases, Ezebunwa, and Njoku, (2024) examined unemployment effects on the economic growth of Nigeria from (1990-2022). The statistical methods used for the analysis were f-test and t-test statistics. The major findings were that the unemployment rate hurts the gross domestic product in Nigeria, as well as gross capital formation. While in a different study, Eze, Atuma and Egbeoma (2016) assessed unemployment and economic growth in Nigeria, from (1980-2013). The study used the Vector Error Correction Model (VECM) technique and the Granger causality test for the analysis. The study result indicates long-run relationship among the variables studied. It also demonstrated a significant negative association between unemployment on real gross domestic product. There is a unidirectional link between unemployment and real gross domestic product.

Similarly, Nnachi, and Ugochukwu (2023) also took evaluation of unemployment and inflation on economic growth in Nigeria from (1981 - 2021). The study used autoregressive distributed lag model (ARDL) to assess the effect of inflation and unemployment on economic growth. The result indicates long-run association between inflation, unemployment and economic growth. In the study, unemployment has a decreasing function on economic growth, while inflation is positive. Similarly, Hala, Mehdi and Huseyin (2021) established a link between unemployment and economic growth in Jordan. The study period spanned from (1991 – 2019). Auto-regressive distributed lag (ARDL) model was used in ascertaining the relationship that exists between the variables. The empirical findings indicated the existence of a long-run equilibrium between unemployment, economic growth, education, the female population and the urban population of Jordan. It also revealed a negative association between economic growth and unemployment, while education, female population, and urban population and unemployment are positively related in Jordan. On related study, Olayemi, Olukayode, and Oluwaseyi. (2023) estimated unemployment impacts on economic growth in Nigeria, from (1980 – 2019). ARDL model were used for the analysis of the study. The study uncovered a significant negative association between unemployment on economic growth, in the short run and long run. Akutson, Messiah, and Araf, (2018) evaluated the link between unemployment and economic growth in Nigeria from 1986 to 2015. Data collected was analyzed using ARDL Bound Testing. The analysis demonstrated the absence of long-run equilibrium between unemployment and economic growth in Nigeria. The analysis further revealed statistically significant association between unemployment and economic growth in the country. The studies done in Europe and Asia, by Solylu, et al, (2018) and Khumum, et al, (2015) used pooled OLS, with fixed and random effect models in studying economic growth and unemployment. In the sub-Saharan Africa region, exploiting the same technique of analysis; Egbetunde, et. al, (2022) add poverty, while, Egbenchong (2024), includes; economic freedom, and good governance to

unemployment and economic growth. Correa (2023) used ARDL and ECM, on unemployment, inflation, FDI and economic growth. The present study adopts the Generalized Method of Moment (GMM) method of analysis, outside the pooled OLS, fixed and random effects used in the previous studies. The study variables are; unemployment rate, education, exchange rate and economic growth rate. The addition of education and exchange fill gap of literacy level in the sub-region.

Methodology

Theoretical Framework and Model Specification

This research study is the relationship between unemployment and economic growth in Sub-Sahara Africa. The study adopts Lucas (1986) endogenous growth model based on investment in human capital. Human capital investment increases the output of a country.
The model for sub-Saharan African economic growth is structurally specified as follows:

$$GDPR_{it} = \beta_0 + \beta_1 UNEMPR_{it} + \beta_{2AVC_{it}} + \beta_{3EDUI_{it}} + \beta_{4EXCHR_{it}} + u_{it} \quad (1)$$

β_0 = autonomous growth rate which is not influenced by the variables in the model, $\beta_1 - \beta_4$ = partial regression coefficients, U = the error component which captures other variables that could influence the dependent variable but are not included in the model. The a priori expectations for the explanatory variables in the study are as follows: $\beta_1 < 0,\ \beta_2 > 0,\ \beta_3 > 0, \beta_4 > 0$.

The study used panel data of sub-Saharan African economies covering the period from 2013 to 2023. The analysis covers 20 countries in sub-Saharan African region.

Table 1: Data Description and Sources

Variables	Measurement /unit	Variable description	Data source
GDPR	Annual % change in GDP	Gross Domestic Product Growth Rate	World Development Indicators
UNEMPR	% of total labor force	Unemployment rate	World Development Indicators
AVC	Gross capital formation (% of GDP or value)	Availability of Capital	World Development Indicators
EDUI	Government Expenditure	Education Investment	World Development Indicators
EXCHR	Percentage change of GDP	Exchange Rate	World Development Indicators

Source: Authors' compilation from World Development Indicator

Estimation procedure

Pre-Estimation Test

This study will conduct panel unit root tests by using Im-Pesaran-Shin (IPS) and Fisher ADF tests based on Schwarz Info Criterion (SIC). The reason for adopting IPS and Fisher ADF tests is that they rely on heterogeneity assumption among the observations (Baltagi & Kao, 2000). This assumption is imperative in this analysis because sub-Saharan African countries are by nature heterogeneous, therefore the application of IPS and Fisher ADF tests will guarantee reliable results.

The LM test helps us to decide between a random effect's regression and a simple panel OLS regression. The null hypothesis in the LM test is that variances across countries are zero. There is no significant difference across countries (i.e. no panel effect). If the mixed chi-square asymptotic critical value at a 5% level of significance is less than 0.05, we accept that variances across countries are zero and run simple panel OLS regression, but if the chi-square critical value is greater than 0.05, we run fixed effect and random effect regression.

Hausman test detects endogenous regressors in a regression model. This is very important for this study for the choice of technique for the estimation. The researcher will conduct an endogeneity test on the explanatory variables to determine whether there is endogeneity in our model. However, if endogeneity is detected in the model, the Generalized Method of Moment (GMM) is a good option, otherwise Fixed Effect and Random Effect is a good estimator. We reject the null hypothesis that there is no endogeneity between the explanatory variables and the error term if the Hausman Chi-square statistic P-value < 005.

Post Estimation Techniques

Fixed Effect and Random Effect

Fixed Effect (FE) explores the relationship between explanatory variables and explained variables within countries. Each country has its characteristics that may or may not influence the explanatory variables. FE assumes that individual effects bias explanatory variables or explained variables, which is the assumption of correlation between country's error term and explanatory variables. FE removes the effect of those time-invariant characteristics so we can assess the net effect of the explanatory variables on the explained variable. Each country is different therefore the country's error term and the constant should not be correlated with the others. If the error terms are correlated, then FE is not suitable since inferences may not be correct. Therefore, the need to model the relationship using random-effects which is the main rationale for the Hausman test to decide between fixed effect and random effect model for the analysis.

Fixed effect model: $y_{it} = \beta_i X_{it} + \alpha_i + U_{it}$

Where:

α_i $(i = 1. \ . \ .n)$ is the unknown intercept for each country (n country-specific intercepts).

y_{it} is the dependent variable (DV) where i = country and t = time.
X_{it} represents independent variables (IV),
β_1 $(i = 1. \ . \ .n)$ are the coefficient for the independent variables (IV),
U_{it} is the error term

Fixed effect model: $y_{it} = \beta_1 X_{it} + \alpha + U_{it} + \varepsilon_{it}$

Where:
U_{it} = Between − country's error and ε_{it} = Within − country's error

Panel General Method of Movement
Fixed and random effect models could satisfy the analysis of unemployment rate and economic growth, but the models exhibit methodological weaknesses as follows: fixed effects model relies on the assumption of different intercepts for different individual units (Gujarati and Porter 2005; Gopalan and Rajan 2016) employs Ordinary Least Squares (OLS) in its estimations. The applications of OLS may result in spurious estimates because it is unable to surmount the possible simultaneity relationship

(Himmelberg, Hubbard & Palia, 1999; Gopalan and Rajan, 2016) which may exist between economic growth rate and unemployment. If the simultaneity relationship between the unemployment rate and economic growth remains unsolved the results will be at risk of an endogeneity problem (Baltagi and Kao, 2005). Similarly, random effects model which relies on individuals' intercept and error term assumption employs the Generalized Least Squares (GLS) method in its estimations. GLS has also proved to experience inability to overcome the problem of endogeneity (Gujarati and Porter 2005). Therefore, premised on these methodological shortcomings, fixed and random effect models are unable to solve the problem of endogeneity (Han and Phillips, 2016). The most excellent solution to overcome the problem of endogeneity which guarantees consistent and efficient estimates is to deploy Generalized Methods of Moments (GMM), (Drukker, 2016).

Results
Data Analysis and Result
The data used for this study are analyzed using E-views. The summary and other preliminary tests are presented in tables below:

Table 2: Descriptive Statistics Results

Stat Tools	GDPR	UNEMPR	AVC	EDUI	EXCHR
Mean	3.771079	6.637915	24.07528	16.29295	1166.570
Median	3.970443	4.538000	22.44669	15.75600	565.5162
Maximum	17.43908	28.83800	76.78231	27.49724	9565.082
Minimum	-20.80528	0.524000	8.806016	6.555920	2.896575
Std. Dev.	4.020237	6.318725	8.803653	4.115683	2053.597
Skewness	-1.744317	1.838304	2.337741	0.187121	2.876726
Kurtosis	11.92167	5.602228	12.86291	2.330976	11.08133
Jarque-Bera	764.7223	169.0753	992.8087	4.897085	820.0842
Probability	0.0000	0.0000	0.0000	0.086419	0.0000
Observations	200	200	200	200	200

Source: Researcher's Compilation

In the descriptive statistic, there is a significant difference between the maximum and minimum values of the series. In the sub-region, the economic growth rate on average is 3.8%, while the unemployment rate is 6.6%. Capital formation is on average is 24.1% of GDP. The education investment on average is 16.3% of GDP. The average exchange rate of domestic currency is 1166.6 for US$1.

Table 3: Results for Panel Unit Root Tests

Variable	Im-Pesaran-Shin			Fisher ADF		
	Level	First Difference	Integration Order	Level	First Difference	Integration Order
GDPR	-0.76842 (0.2211)	-0.61951 (0.2678)	NIL	49.2834 (0.1491)	54.9737 (0.0477)	I(1)
UNEMPR	-1.1310 (0.1290)	-1.1310 (0.1290)	NIL	57.5747 (0.0354)	66.8900 (0.006)	I(0) & I(1)
AVC	-3.09752 (0.0010)	-3.24290 (0.0006)	I(0) & I(1)	96.5622 (0.0000)	109.675 (0.0000)	I(0) & I(1)
EDUI	-0.36552 (0.3574)	-2.11873 (0.0171)	I(1)	48.0976 (0.1263)	77.8688 (0.0001)	I(1)
EXCHR	-3.11158 (0.0009)	-2.39336 (0.0083)	I(0) & I(1)	72.9662 (0.0011)	74.1325 (0.0029)	I(0) & I(1)

Source: Researcher's Compilation

The results for panel unit root tests demonstrate that the variables are integrated at levels I(0) and first difference I(1) with Fisher ADF. Based on these findings, it is logical to conclude that

economic growth rate, unemployment rate, capital formation, education investment and exchange rate expenditure have both short-run and long-run stationarity in sub-Saharan Africa.

Breusch-Pagan Lagrange multiplier (LM) Test Results:
Breusch-Pagan LM test was conducted on the model used for this study. The LM mixed chi-square asymptotic critical value at a 5% level of significance is 4.321. The Breusch-Pagan statistic 27.60198 with probability 0.0000, which is less than 0.05; we reject the null hypothesis that variances across countries are zero; meaning that there is a significant difference across countries (i.e. there is a panel effect) in our model. Therefore, fixed effect and random effect regression is better than the OLS model. However, for the time-specific effect, the Breusch-Pagan time statistic 86.22647 indicates the presence of the time effect in the model.

Hausman Test for Endogeneity Result
Hausman endogeneity tests were conducted on the models posed for this study. The Hausman Chi-Sq Statistic is 9.8297286 is greater than the tabulated Chi-Square 9.48773 at a 5% level of significance, and the probability of the estimated Hausman Chi-Sq Statistic of 0.0481 < 0.05. Therefore, we reject the null hypothesis that there is no endogeneity between the explanatory variables and the error term and conclude that there are endogenous regressors in our model. Therefore, the Generalized Method of Moment (GMM) is a good option.

Table 4: Panel GMM Regression results for models

Variables	Coefficient	t-Statistic	Prob.
GDPR(-1)	-0.305916	-3.758199	0.0002
UNEMPR	-2.553259	-8.888166	0.0000
AVC	0.268882	4.705952	0.0000
EDUI	0.358591	4.295736	0.0000
EXCHR	-0.004590	-2.530457	0.0124

The results in Table 4 demonstrate that the first lag of GDP growth rate, unemployment rate, and exchange rate are significant and positively related to economic growth, while capital formation and education investment have a significant positive association with economic growth. The coefficient of lag dependent variable of -0.305916 revealed that all things being constant, the dependent variable of the model is affected by 30.6% of the previous year's economic growth. The coefficient of the explanatory variables on the dependent variable shows that a 1% decrease in unemployment increases economic growth by 25.5% in the sub-Saharan Africa. In the same vein, a 1% decrease in the exchange rate, increases the subregion's economic growth by 0.5%. On the other hand, 1% increases in capital formation, increase economic growth of the region by 26.9%, so, also a 1% increase in education investment increases the region's economic growth by 35.9% respectively.

Table 5: Serial correlation Test Result

Test Order	Test Statistic	Probability
AR(1)	-3.061925	0.0022
AR(2)	-1.252616	0.2103

Table 5, shows the results of the Arellano-Bond serial correlation test of the model. The result is significant in the first-order statistic, whereas the second-order statistic is not. Therefore; we reject that the dynamic estimator is appropriate for our model and accept that lag 2 is a good instrument.

Conclusion and Recommendation

Based on the empirical findings of this study, it could therefore be concluded that unemployment, capital formation, education investment and exchange rate are determinants of economic growth. The evidence is that the variables are statistically significant and conformed with the economic a priori of the study in the sub-region. The negative relationship of unemployment and exchange rate on economic growth shows that the growth and development in the sub-Sahara Africa are ill-functioning, because of the high rate of unemployment and exchange rate in the sub-region. The capital formation and education investment are very low that the investment in capital and education could not yield realize economic growth in the region.

The major focus of Sub-Sahara Africa has remained on how to sustain steady economic growth. To achieve sustainable economic growth in the sub-region policy measures must be put in place. Based on the findings the study recommends that:

i. Governments in the sub-region to adhere to intervention programmes to address the problem of the high rate of unemployment, to achieve maximum economic growth in the region.
ii. The capital formation of the sub-region should be improved upon by the government to minimize the challenges of capital deficiency in sub-Sahara Africa.
iii. The governments of the sub-Saharan African countries should ensure prompt investment in the education sector across all levels to skilled citizens to boost the total output of the sub-region.

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APPENDIX 1

List of Sub-Saharan African Countries Selected.

1. Burundi
2. Cameroon
3. Cape Verde
4. Congo, Democratic Republic
5. Cote D'Ivoire
6. Ethiopia
7. Gambia
8. Gabon
9. Ghana
10. Kenya
11. Madagascar
12. Malawi
13. Mauritius
14. Nigeria
15. Niger
16. Rwanda
17. Senegal
18. South Africa
19. Uganda
20. Guinea