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The Econometrics Evaluation Of The Causality Between The Economic Growth and Unemployment In The Gambia

Lamin Bittaye & Ms. Jarra Balajo

Department of Politic, Philosophy and Economics (PPE)
College of Management & Information Technology (CMIT)
American International University West Africa
The Gambia

Emails: lbittaye@aiu.edu.gm; lamin_1971@yahoo.com; Jarrabalajo@gmail.com

Phones: +2203666413; +2203073840

ABSTRACT

Even though the Gambian economy is growing; the Gambia is one of the poorest countries in the world. One of the major challenges of the Gambian economy is how to attain high and sustainable output growth with low levels and stable rates of unemployment. Access to full and productive employment and decent work for all is a fundamental development issue and a key determinant to promoting sustained, inclusive and sustainable economic growth, as identified in sustainable development Goal 8 of the 2030 Agenda for Sustainable Development. Unemployment is a major contributor to wide spread poverty and income inequality. Reducing unemployment is viewed as a significant instrument for improving Economic growth, reducing poverty and to help improve the living standards of people. Therefore, it is of utmost importance to understand the relationship between unemployment and economic growth in order to ensure the formulation of sound policies that will boost economic growth in the The Gambia. This is the focus of this paper.

Key words: Machine Learning, Enhanced Framework, HoneyPot, CAPTCHA Intrusion Detection

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1. INTRODUCTION AND BACKGROUND TO THE STUDY

The Gambia is a small, fragile country in West Africa. According to one of the Gambia Bureau of Statistics report, it has one of the fastest population growth rates in Sub-Saharan Africa, at 3.1 percent per annum. Even though the Gambian economy is growing; the Gambia is one of the poorest countries in the world. One of the major challenges of the Gambian economy is how to attain high and sustainable output growth with low levels and stable rates of unemployment. Access to full and productive employment and decent work for all is a fundamental development issue and a key determinant to promoting sustained, inclusive and sustainable economic growth, as identified in sustainable development Goal 8 of the 2030 Agenda for Sustainable Development.



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Unemployment is a major contributor to wide spread poverty and income inequality. Reducing unemployment is viewed as a significant instrument for improving Economic growth, reducing poverty and to help improve the living standards of people. Therefore, it is of utmost importance to understand the relationship between unemployment and economic growth in order to ensure the formulation of sound policies that will boost economic growth in the Gambia. In macroeconomics terminology this relationship is known as **Okun's Law**. The economic issues of unemployment are denying the nation of tax revenue in the form of income tax, wastage of productive hours and many others while the social issues of unemployment have to do with depression, lack of self-respect, and other vices such as robbery, theft and many others (Adarkwa, Donkor, &Kyei, 2017).

1.1 Problem Statement

Unemployment and low economic opportunities are one of the major issues that torment the lives of the Gambians especially the women and youths and this has poses a serious risk to the Gambian society. The Gambia is still positioned among the poorest nations on the planet with very high rate of unemployment. Hence, against this background, this paper seeks to examine the effect of unemployment on the economic growth of the Gambia. This paper is examined by applying the OLS regression technique using SPSS.

1.2 Objective:

The aim of the study is to investigate and evaluate the possible correlation and causalities between economic growth and unemployment in The Gambia. The accurate identification and interpretation of the possible relationships may provide effective tools for understanding our two fundamental problems thereby attaining high economic growth in the country. The objectives of the study are as follows:

1. To know what extent the unemployment reduction can contribute to economic growth in the Gambia.
2. To find out lessons learnt, specifically how the strategies can be implemented better, their impacts, or pros and cons.
3. To contribute to the study of unemployment and economic growth; the Gambia can use.

1.3 Organization of the Paper

The rest of the paper is organized as follows. The next chapter discussed the literature review on the relationship between the unemployment and economic growth and chapter three discusses the research methodology adopted and the econometric model and techniques used as well as the data source. Chapter four gives the presentation and analysis of the results, and conclusion and recommendation in chapter five. And Reference is given at the end of the last section of the paper with other appendixes.

2. LITERATURE REVIEW

2.1 Introduction

Five decades after independence, the Gambian economy is still in crises. The country still unable to transform the subsistence economies inherited or reverses their commodity trade asymmetries with the West. It was argued that poor grass-root involvement in the production activities because of the lack of capital, especially contributes enormously to its economic



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paralysis, low productivity and political disarray. African development requirements, especially the Gambia, at independence – conditions that for the most part remain unchanged until today – revolved around the discovery of basic forms of accelerating capital accumulation, for which grass-root capitalism, with all its shortcomings, remains the most suitable system. Against this background, it was argued that reducing unemployment will go a long way to improve the economic progress of the country. **Development**, defined as an incremental in the productive and consumptive capacity of a large segment of a society. This is unlikely to occur in the Gambia as long as the majority of productions are carried out by foreigners or non-grass rooted Gambians.

2.2 Economic Growth

The Gross Domestic Product (GDP) is the value of all final goods and services produced in the country within a given period of time, usually a year. Economic growth is the increase in the market value of the goods and services produced by an economy over time. It is conventionally measured as the percent rate of increase in real gross domestic product, or real GDP. Of more importance is the growth of the ratio of GDP to population (GDP per capita), which is also called per capita income. An increase in growth caused by more efficient use of inputs is referred to as intensive growth. GDP growth caused only by increases in inputs such as capital, population or territory is called extensive growth. Growth is usually calculated in real terms – i.e., inflation-adjusted terms – to eliminate the distorting effect of inflation on the price of goods produced. In economics, "economic growth" or "economic growth theory" typically refers to growth of potential output. It is however, influenced directly by labour (employment), natural resources and capital and influenced indirectly by collective demand, institutions, economic and fiscal policies, and efficiency of the government (Boldeanu & Constantinescu, 2005).

2.3 Unemployment

The phenomenon of unemployment has been expounded from diverse viewpoints in economic literature. The International Labour Organisation (ILO) defines unemployment based on three (3) important conditions which must be met simultaneously. These conditions are (i) without work (ii) available for work (iii) seeking work. Individuals are unemployed only if they are not working for pay at any job and are actively seeking work. The unemployment rate is defined as:

$$\text{Unemployment rate} = \frac{\# \text{ unemployed}}{\# \text{ in the labour force}} \dots\dots\dots(1.1)$$

The labor force consists of all non-institutionalized individuals aged 16 or above who are either working or actively seeking work. The Classical theory appraises that unemployment is a short term condition which the free market forces will automatically deal with and restore maximum occupation in the economy. The Keynesian theory on the other hand postulates that unemployment exists because of a deficient in aggregate demand for labour and that government should use an expansionary fiscal policy to help reduce unemployment in the economy (Banda, Ngirande, & Hogwe, 2016). Moreover, the Keynesian theory holds the view that unemployment is normally triggered by insufficiencies in total demand over specific periods within the labour market such that adequate jobs are created to accommodate people who want to work (Keynes, 1936).



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The unemployment rate generally rises during recessions and falls during periods of economic expansions. It is interesting to note, though, that when unemployed workers become discouraged and leave the labor force (these workers are called discouraged workers), the measured unemployment rate declines. Thus, the unemployment rate may decline when the number of discouraged workers rises. Similarly, the observed unemployment rate may increase when discouraged workers become more optimistic about the state of the economy and start looking for work.

2.4 Economic Growth and Unemployment trends in the Gambia

Gross Domestic Product is the most important measure of the output of the economy. According to the World Bank;

- Gambia GDP for 2021 was \$2.08 billion, a 13.53% increase from 2020.
- Gambia GDP for 2020 was \$1.83 billion, a 0.93% increase from 2019.
- Gambia GDP for 2019 was \$1.81 billion, a 8.56% increase from 2018.
- Gambia GDP for 2018 was \$1.67billion, a 11.01% increase from 2017.

The Gambia is facing a major problem of unemployment. The rate indicates the number of persons who are ready to participate in the production of goods and services. According to the World Bank they are;

- The Gambia unemployment rate for 2021 was 11.21%, a 0.13% increase from 2020.
- The Gambia unemployment rate for 2020 was 11.08%, a 1.58% increase from 2019.
- The Gambia unemployment rate for 2019 was 9.50%, a 0.02% increase from 2018.
- The Gambia unemployment rate for 2018 was 9.48%, a 0.01% decline from 2017.

This is worrying because research has showed that high unemployment is associated with suicides, crime, mental illness, heart attacks, and other maladies. Moreover, severe unemployment causes despair, family breakups, and political unrest.

2.5 Okun's Law

Macroeconomics theory provides a model that link the unemployment rate to GDP growth. The correlation between these two important economic variables is famously known as Okun's Law, discovered by Arthur Okun, the first economist to study the empirical relationship between unemployment and economic growth in 1962, hence the name. The empirical hypothesis of Okun suggested that a slowdown in economic growth is largely caused by rise in unemployment in the economy. In other words, it suggested that there is a negative relationship between unemployment and GDP. Okun's law states that a decrease in unemployment by 1%, will lead to an increase in the Gross Domestic Product by 3%. The Okun's law theory will be used in this study because it represents one of the most straightforward and convenient methods to investigate the relationship between unemployment and gross domestic product (GDP). Okun's law is based on different versions. All the versions of this law have different specifications and properties and consist of specific models that bear with it specific pros and cons. They have different ways to estimate coefficients of this law and have different interpretations.



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The following are the different versions of Okun's law:

- The Difference Version
- The Gap Version
- The Dynamic Version
- The Production Function Version

2.6 Criticisms of Okun's Law

One of the major criticisms of Okun's Law is that it is purely an empirical reliability and it lacks a theoretical framework. Even though a number of studies have attempted to provide theoretical foundations for Okun's Law, so far there is no consensus that the existing studies fully capture the nature of Okun's Law. To put it differently, these studies lack a clear analytical framework, that is, an explicit account of the transmission channels used by Arthur Okun.

The second criticism is related to the reliability of Okun's Law. A number of empirical studies have shed doubt on the stability of Okun's relationship in many industrialized countries including the United States (e.g., Altig, Fitzgerald, and Rupert, 1997; Kaufman, 1998; Lee, 2000); Moosa, 1997). Furthermore, several studies pointed out the role of institutional and related features on the labour market (e.g. employment practices of firms) and other good markets (e.g. the role of foreign competition) as potential reasons for the variation in Okun's coefficient across time and country. Another related issue to the above criticism is that Okun's Law is often treated as a behavioural rather than a reduced form relation and this, in turn, leads to misinterpretation of the Law.

Many economists also criticised Okun's original law, claiming that it omitted certain relationships such as the rate of technological innovation and investment activity on labour activity, which have an impact on unemployment and output (Khumalo, 2015).

2.6.1 Relevance of the Okun's Law

The Okun's law is an arithmetical relation not structural; therefore, it varies remarkably across countries depending on their economic structures. However, Okun's law is used as a benchmark by policy makers to measure the cost of higher unemployment and the benefits of lower unemployment in an economy given the inverse relationship with the output of the nation in question. It has also been used by policy makers during economic slowdowns to stimulate the economy.

2.7 Empirical Review

Numerous researches have been conducted to examine the relationship that exists between the rate of unemployment and the economic development rate of many countries. Nonetheless, contradicting findings have been established due to factors such as the jurisdiction of the study, the availability and source of data for the study, the econometrics technique applied and many others. Ellen and Wilson (2019) conducted a study on the impact of unemployment on economic growth in China using a time series data for the period 1991-2018. In conducting the econometric analysis of the study, both the Augmented Dickey-Fuller Test and Phillips Perron Test were employed to test for the short run and the long run co-integration of the variables of study since both variable were stationary at first difference.



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The finding of the study reveals that there are negative short run and long run relationship between unemployment and economic growth. However, Granger causality test also reveals that both unemployment and economic do not impact each other. Makaringe & Khobia (2018) investigated the trends and effect of unemployment on fiscal growth in South Africa using periodical data over the period 1994 first quarter to 2016 fourth quarter.

The outcomes of the test revealed that the variables of the study were not stationary at level but became stationary at first difference. They also used ARDL model to test the presence of a short term and a long term association between unemployment and fiscal growth of which the result of the test showed that there is an adverse short term and long term association among the variables of the study. The findings of the study confirm Okun's Law which states that there is an inverse relationship between unemployment and fiscal growth.

On the contrary, Ditimi and Ifeakachukwu (2013) conducted a study on the impact of unemployment rate on productivity growth in Nigeria using a time series data for the period 1986 to 2010. Productivity growth was used as a dependent variable while government spending, capital, labour, inflation and unemployment rates were independent variables. The results for both the long run and short run models revealed that unemployment rate has an insignificant influence on productivity growth. In other words, it suggested a positive impact of unemployment on economic growth.

Gachunga (2019) also conducted an analytical study of the impact of unemployment on economic growth in Kenya using Okun's law. The result indicated the existence of a long run relationship between unemployment and economic growth in Kenya. The finding shows that unemployment rate has a positive impact on the economic growth in both the short run and long run. The Granger causality test suggested the existence of an unidirectional causality running from unemployment to economic growth.

A review of the above studies on the relationship between economic growth and unemployment rate shows that there is no consensus regarding the direction of the relationship due to differences in econometric methods, variables, and the periods studied. Theoretical studies by Okun assert that there is an inverse relationship between unemployment and economic growth, whilst other empirical studies affirms Okun's Law only in the short term or in the long term or even in both the short term and the long term. However, some other empirical findings also discard Okun's law because the outcomes of their studies showed a positive relationship between unemployment and economic growth in either the short term or in the long term or even in both the short term and the long term. More so, other studies endorse the presence of no relationship between unemployment and economic growth in either the short term or long term or even in both the short term and the long term.



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3.0 METHODOLOGY

3.1 Data Source

The study employed a secondary macroeconomics annual time series data on The Gambia, which was downloaded from the World Development Indicator for the period 1991 to 2021. The World Development Indicator is known for presenting consistent and reliable data. The variables under study are GDP growth rate (annual %) and Unemployment, total (% of the total labour force).

3.2 Model Specification

The study used both descriptive and inferential statistical approaches. The statistical tool used to analyze data was the econometrics view. This study adopts the difference version model of Okun's Law due to its simplicity, accuracy and direct application to the data for getting results. Okun's Law studies the empirical relationship between unemployment and economic growth.

Our model was estimated using the Ordinary Least Square (OLS) method, since we are making use of annualized time-series data and the study covers a long sample period. This study adopted Okun's equation model in terms of the first difference and is specified as follows:

$$Y_t - Y_{t-1} = \alpha + \beta(U_t - U_{t-1}) + \varepsilon_t \quad (3.1)$$

where: Y_t = Real GDP; $Y_t - Y_{t-1}$ = First difference of real GDP; β = Okun's coefficient; α = Constant/intercept term; U_t = Unemployment rate; $U_t - U_{t-1}$ = First Difference of unemployment rate; ε_t = Error or stochastic disturbance term; and t = Time trend

3.3 Hypothesis to be Tested

The following hypotheses are formulated for estimation and testing.

- $H_0: \beta = 0$; The unemployment of The Gambia do not have a relationship with its gross domestic product.
- $H_1: \beta \neq 0$; The unemployment of The Gambia do have a relationship with its gross domestic product.

In order to apply the standard tests of significance, the standard error test and the 't' test are executed for judging the statistical reliabilities of the estimates using 5% significant level. Where, H_0 and H_1 are the null hypothesis and alternative hypothesis, respectively. In the case, answering this question requires three steps:

1. We will perform OLS.
2. Confront the theory with data to find out the presence of autocorrelation and heteroscedasticity.
3. Test the parameters estimated for validity and finally do prediction



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3.3.1 Autocorrelation

Autocorrelation refers to the correlation between successive values of the error term. This indicates that the regression results based on OLS estimates are less reliable and cannot be used for future predictions. This study employs Durbin Watson test for serial autocorrelation. Durbin and Watson suggested a test which is applicable to small samples. The Durbin Watson test has a value between 0 and 4. A value of 2 indicates no autocorrelation. A value of 0 to less than 2 indicates positive autocorrelation and values from 2 to 4 indicate negative autocorrelation. The test is applicable only for first order autoregressive scheme ($u_t = \rho u_t + v_t$).

The test may be outlined as follows:

- H_0 : the u's are not auto correlated with first order scheme.
- H_1 : β the u's are auto correlated with first order scheme.

3.3.2 Heteroscedasticity

Heteroscedasticity occurs when the variance of an unobservable error μ is not constant. The equality of error variances is the key assumption for validity of variance analysis. If the errors do not have equal variances, the regression results are less reliable. The study employs the Spearman rank correlation test for heteroscedasticity. A high rank correlation coefficient suggests the presence of heteroscedasticity.

4. DATA ANALYSIS AND PRESENTATION OF RESULTS

4.1 Estimation and Interpretation of Results

One of the major objectives of macroeconomic policies is to attain high and sustainable output growth with low levels and stable rates of unemployment. Economic growth and unemployment are two of the most important economic issues that policymakers should focus on because they are related to economic and social events and directly affect the welfare of the society. This study investigated the statistical causal relationship between the unemployment and economic growth in The Gambia. In other words, to know how much unemployment in the Gambia affects the Gambia's GDP growth rate. The relationship between economic growth rate and unemployment rate is expected to be inversed, that is, low unemployment rate would result into high economic growth rate and vice versa.

Figure 4.1 shows the unemployment and GDP growth movement of the Gambian economy over the period under review (i.e. 1991-2021). Unemployment rates increased in the years when economic growth slowed down. Unemployment in the Gambia is normally flat, while her GDP changes from period to period in all directions. The figure 4.1 shows that unemployment and GDP have a weak relationship according to the data from WDI and the period under review. However, the relationship is linear.



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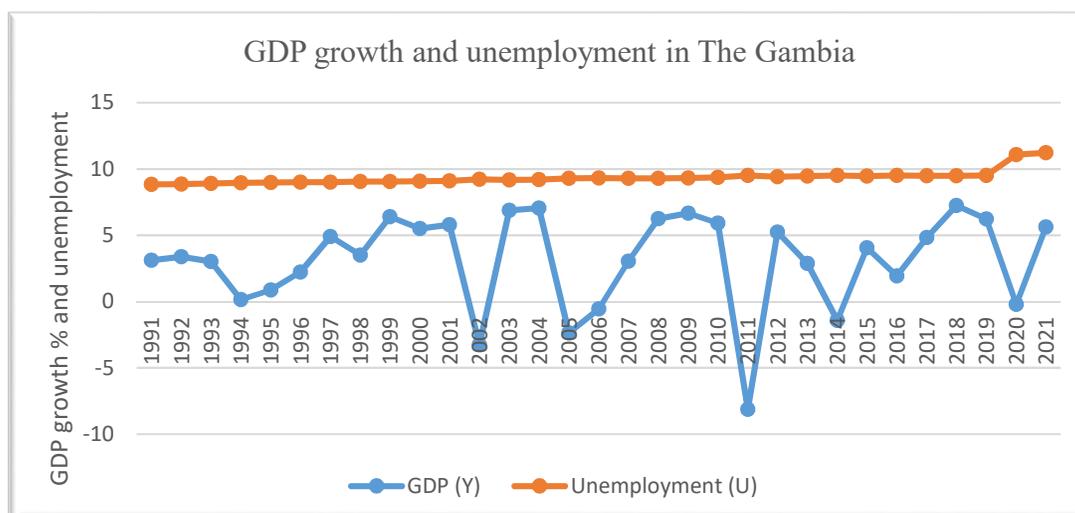


Figure 4.1: Unemployment and GDP growth trend in the Gambia
Source: Author's construction

4.1.1 Heteroscedasticity

The Spearman rank correlation test results reveals no presence of heteroscedasticity as the rank correlation coefficient is -0.02036. Hence the disturbance term (u_i) are homoscedastic.

4.1.2 Autocorrelation

Table 4.1: Model Summary

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson |
|-------|-------------------|----------|-------------------|----------------------------|---------------|
| 1 | .308 ^a | 0.095 | 0.064 | 5.160513638065530 | 2.684 |

a. Predicators: (Constant), $U_t - U_{t-1}$

b. Dependent Variable: $Y_t - Y_{t-1}$

Source: Author's Computation using SPSS

The value of the coefficient of determination (R^2) from the table above indicates that the growth of unemployment for the period under review is responsible for only 9.5% of the total variation in the GDP growth (annual %), while the remaining 90.5% variation in the GDP growth (annual %) is attributed to some other factors outside the model. The Durbin Watson statistics of 2.684 by 'rule of thumb' has not presented a serious suspicion of autocorrelation, hence we can proceed with the regression analysis without transformation.



4.2 Regression

Table 4.2: Coefficients

| Model | | Unstandardized | | Standardized | T | Sig. |
|-------|------------|----------------|------------|--------------|--------|-------|
| | | Coefficients | | Coefficients | | |
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | -0.627 | 0.978 | | -0.641 | 0.526 |
| | Ut-Ut-1 | -4.963 | 2.843 | -0.308 | -1.746 | 0.091 |

a. Dependent Variable: $Y_t - Y_{t-1}$

Source: Author's Computation using SPSS

The table 4.3 above shows the coefficient (β) of the independent variable ($U_t - U_{t-1}$) that was regressed on the dependent variables ($Y_t - Y_{t-1}$). The established regression equation is stated below:

$$(Y_t - Y_{t-1}) = -0.627 - 4.963(U_t - U_{t-1}) \quad (4.1)$$

(0.978) (2.843)

The negative coefficient value (-4.963) of the independent variables indicates that unemployment has a negative relationship with economic growth (GDP) which is compatible with the Okun's Theory. Taking the rate of change of equation (4.1) with respect to change in the unemployment, we have

$$\frac{\Delta(Y_t - Y_{t-1})}{\Delta(U_t - U_{t-1})} = -4.963$$

Or

$$\Delta(Y_t - Y_{t-1}) = -4.963(U_t - U_{t-1}) \quad (4.2)$$

Equation (4.2) indicates that the economic growth (GDP) of the Gambia will change by -4.963 of the change in unemployment. The t statistics value of -1.746 falls within the region of acceptance as it is more than the theoretical t value of -2.045 but less than 2.045, using 5% level of significance (i.e., $t^* > -2.045$ or $t^* < 2.045$), hence we accept the null hypothesis that the true value of $\beta = 0$ for the period under review. This means that unemployment has no effect on the economic growth of The Gambia, that is to say, unemployment is statistically insignificant to explain the economic performance of The Gambia.



Table 4.3: Analysis of Variance (ANOVA)

| Model | | Sum of Squares | Df | Mean Square | F | Sig. |
|-------|------------|----------------|----|-------------|-------|-------------------|
| 1 | Regression | 81.165 | 1 | 81.165 | 3.048 | .091 ^b |
| | Residual | 772.296 | 29 | 26.631 | | |
| | Total | 853.461 | 30 | | | |

a. Dependent Variable: $Y_t - Y_{t-1}$

b. Predicators: (Constant), $U_t - U_{t-1}$

Source: Author's Computation using SPSS

The F-statistics is used to check the overall significance of the model. From the table above, the F-statistics of our estimated model is 3.048 which is less than the theoretical F-statistics value of 7.60 (*i.e.* $3.048 < 7.60$) at 5% level of significance. This means that the model is not statistically significant, that is, reduction in unemployment is not a good reason to explain the increase in the economic performance of The Gambia over the period under consideration.

5. DISCUSSION OF FINDINGS

Since the discovery of Okun's law by Arthur Okun in 1962, numerous theoretical and empirical studies have been conducted on the relationship between unemployment and economic growth. The theoretical studies by Okun proposed a negative relationship between unemployment and economic growth. However contradicting findings have been established due to factors such as the jurisdiction of study, availability and source of data, the econometric technique applied and many others. Ellen and Wilson (2019) conducted a study on the impact of unemployment on economic growth in china using a time series data for the period 1991-2018. The findings of the study revealed that there is a negative short run and long run relationship between unemployment and economic growth. However the granger causality test reveals that both unemployment and economic growth do not impact each other.

On the contrary, Gachunga (2019) conducted an analytical study on the impact of unemployment on the economic growth of Kenya using Okun's law. The findings show that unemployment rate have a positive impact on economic growth in both the short run and long run. Kreishan (2011) also conducted a study on the connection between unemployment and economic growth in Jordan by the application of Okun's law. The answers of the study showed that economic progress does not influence unemployment and there is no connection between economic growth and unemployment in Jordan.

This study employed the difference version of Okun's Law to investigate the relationship between the unemployment and economic growth of The Gambia. The first practice was to get (Y_{t-1}) and (U_{t-1}) from the Y_t and U_t values. During this process one of the observations of (Y_{t-1}) and (U_{t-1}) got lost which were estimated using the formulae $(Y_t - \rho Y_{t-1})$ and $(U_t - \rho U_{t-1})$. The value of the coefficient of determination (R^2) which depicts the explanatory power showed that unemployment accounts for only 9.5% of the total variation in the GDP of The Gambia.



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The Durbin Watson statistics of 2.684 by 'rule of thumb' presented no serious suspicion of autocorrelation. The Okun's Coefficient (β) from ordinary least square regression is negative. The t statistics value indicated that unemployment is statistically insignificant to explain the economic performance of The Gambia. The value of the F-statistics also showed that reduction in unemployment is not a good reason to explain the increase in the economic performance of The Gambia over the period under consideration. Overall, the empirical results show the existence of a negative relationship between the unemployment and economic growth (GDP) of The Gambia for the period 1991 to 2021 which is consistent with the theory of Okun's Law.

6. CONCLUSION

Economists over the years had argued on the magnitude and direction of the effects that changes in the level of unemployment will have on the economic growth of an economy or vice versa. The correlation between GDP growth and unemployment is very important for policy makers in order to obtain a sustainable rise in living standards. Sustainable economic growth and unemployment have always been a major issue for many economies, and it becomes even a bigger problem in the time of recession. This study concentrated on the impact of unemployment on economic growth in the Gambia. Because of the weak relationship between unemployment and economic growth, policy makers in The Gambia should implement economic policies that promote both economic growth and employment. Concentrating the efforts on reducing unemployment may promote economic growth in The Gambia but such effect is expected to have very little impact.

7. RECOMMENDATIONS

The empirical results of this study provide policy makers with a better understanding of unemployment and economic growth linkage in The Gambia. The government has made various efforts to address the problem of unemployment and economic growth through various policy interventions, but this has not had the desired effect of significantly reducing unemployment and accelerating growth.

Economists and policymakers should promote the provision of investment opportunities to women and youths. The economy needs capital diversification and the empowerment of youths and women to become entrepreneurs and self-employed individuals. This will help solve the problem of income inequality, reduce unemployment and promote sustainable economic growth. The private sector has an essential role to play in creating new jobs in the economy through investing in new areas and the government should help the private sector especially in labour intensive projects through the implementation of proper monetary and fiscal policies such as offering loan incentives, increasing public expenses and reducing tax rates.



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Appendix: Data

| Year | GDP (y_t) | Unemployment (U_t) | Y_{t-1} | U_{t-1} | $y_t - y_{t-1}$ | $U_t - U_{t-1}$ |
|------|---------------|------------------------|--------------|-------------|-----------------|-----------------|
| 1991 | 3.107039224 | 8.833000183 | 3.378688791 | 8.86400032 | -0.27165 | -0.031 |
| 1992 | 3.378688791 | 8.86400032 | 3.012101374 | 8.899000168 | 0.366587 | -0.035 |
| 1993 | 3.012101374 | 8.899000168 | 0.15434596 | 8.951000214 | 2.857755 | -0.052 |
| 1994 | 0.15434596 | 8.951000214 | 0.881848241 | 8.973999977 | -0.7275 | -0.023 |
| 1995 | 0.881848241 | 8.973999977 | 2.223545638 | 8.991999626 | -1.3417 | -0.018 |
| 1996 | 2.223545638 | 8.991999626 | 4.89999911 | 8.998999596 | -2.67645 | -0.007 |
| 1997 | 4.89999911 | 8.998999596 | 3.499998702 | 9.039999962 | 1.4 | -0.041 |
| 1998 | 3.499998702 | 9.039999962 | 6.39999905 | 9.045000076 | -2.9 | -0.005 |
| 1999 | 6.39999905 | 9.045000076 | 5.500000216 | 9.083000183 | 0.899999 | -0.038 |
| 2000 | 5.500000216 | 9.083000183 | 5.800000243 | 9.109999657 | -0.3 | -0.027 |
| 2001 | 5.800000243 | 9.109999657 | -3.25000015 | 9.217000008 | 9.05 | -0.107 |
| 2002 | -3.25000015 | 9.217000008 | 6.869999622 | 9.161000252 | -10.12 | 0.056 |
| 2003 | 6.869999622 | 9.161000252 | 7.050000001 | 9.18599987 | -0.18 | -0.025 |
| 2004 | 7.050000001 | 9.18599987 | -2.351729362 | 9.293000221 | 9.401729 | -0.107 |
| 2005 | -2.351729362 | 9.293000221 | -0.555580977 | 9.303999901 | -1.79615 | -0.011 |
| 2006 | -0.555580977 | 9.303999901 | 3.043249508 | 9.300999641 | -3.59883 | 0.003 |
| 2007 | 3.043249508 | 9.300999641 | 6.255905534 | 9.300000191 | -3.21266 | 0.000999 |
| 2008 | 6.255905534 | 9.300000191 | 6.665724308 | 9.324000359 | -0.40982 | -0.024 |
| 2009 | 6.665724308 | 9.324000359 | 5.90833581 | 9.357999802 | 0.757388 | -0.034 |
| 2010 | 5.90833581 | 9.357999802 | -8.130444223 | 9.508999825 | 14.03878 | -0.151 |
| 2011 | -8.130444223 | 9.508999825 | 5.241569246 | 9.420000076 | -13.372 | 0.089 |
| 2012 | 5.241569246 | 9.420000076 | 2.87276879 | 9.453000069 | 2.3688 | -0.033 |
| 2013 | 2.87276879 | 9.453000069 | -1.407382495 | 9.503000259 | 4.280151 | -0.05 |
| 2014 | -1.407382495 | 9.503000259 | 4.058073804 | 9.467000008 | -5.46546 | 0.036 |
| 2015 | 4.058073804 | 9.467000008 | 1.943359655 | 9.498000145 | 2.114714 | -0.031 |
| 2016 | 1.943359655 | 9.498000145 | 4.822611249 | 9.484999657 | -2.87925 | 0.013 |
| 2017 | 4.822611249 | 9.484999657 | 7.234890333 | 9.475999832 | -2.41228 | 0.009 |
| 2018 | 7.234890333 | 9.475999832 | 6.22205316 | 9.498000145 | 1.012837 | -0.022 |
| 2019 | 6.22205316 | 9.498000145 | -0.201822911 | 11.08100033 | 6.423876 | -1.583 |
| 2020 | -0.201822911 | 11.08100033 | 5.626499143 | 11.21199989 | -5.82832 | -0.131 |
| 2021 | 5.626499143 | 11.21199989 | 5.607628701 | 12.24807342 | 0.01887 | -1.03607 |