Journal of Infrastructure, Policy and Development 2024, 8(8), 5130.
https://doi.org/10.24294/jipd.v8i8.5130

Article

Effect of socio-economic variables on unemployment in South Africa: A Vector Error Correction Model

Wandile Vilakati, Phetole Semosa, Kanayo Ogujiuba*

School of Development Studies, University of Mpumalanga, Nelspruit 1200, South Africa
*** Corresponding author:** Kanayo Ogujiuba, Kanayo.Ogujiuba@ump.ac.za

CITATION

Vilakati W, Semosa P, Ogujiuba K. (2024). Effect of socio-economic variables on unemployment in South Africa: A Vector Error Correction Model. Journal of Infrastructure, Policy and Development. 8(8): 5130. https://doi.org/10.24294/jipd.v8i8.5130

ARTICLE INFO

Received: 10 March 2024
Accepted: 9 April 2024
Available online: 13 August 2024

Abstract: Using time series data covering the years 1980 to 2020, this study examines the effects of government spending, population growth, and economic expansion on unemployment in the context of South Africa. The study's variables include government spending, population growth, and economic growth as independent factors, and unemployment as the dependent variable. To ascertain the study's outcomes, basic descriptive statistics, the Vector Error Correction Model (VECM), the Johansen Cointegration Procedures, the Augmented Dicky-Fuller Test (ADF), and diagnostic tests were used. Since all the variables are stationary at the first difference, the ADF results show that there isn't a unit root issue. According to the Johansen cointegration estimation, there is a long-term relationship amongst the variables. Hence the choice of VECM to estimate the outcomes. Our results suggests that a rise in government spending will result in a rise in South Africa's unemployment rate. The findings also suggest that there is a negative correlation between unemployment and population growth. This implies that as the overall population grows, unemployment will decline. Additionally, the findings suggest that unemployment and economic growth in South Africa are positively correlated. This contradicts a number of economic theories, including Keynesian and Okuns Law, which hold that unemployment and economic growth are inversely correlated.

Keywords: economic; growth; government; unemployment

1. Introduction

Despite many tactics implemented by global, national, and local policy makers to combat poverty. Poverty is still a reality for a large number of people globally and has not decreased. In 2020, about 1.3 billion people were estimated to be living in many forms of poverty (Chen et al., 2021). Africa's rural areas are mostly to blame for this poverty. Extreme poverty affects 80% of people on Earth, and it is most prevalent in Africa's rural areas. According to Beegle and Christiaensen (2019), 40% of the same population is impoverished temporarily, and 60% of them are impoverished permanently, particularly in rural areas. South Africa is Africa's economic engine and a key symbol of hope for Sub-Saharan Africa's (SSA) sustainable development. Regretfully, data from Langalanga (2019) indicates that over 18.2 million South Africans are living in severe poverty. Many reasons drive immigrants, including education, political stability, job opportunities, and economic shifts, despite the fact that the majority originate from the same continent and Asia (mainly from Zimbabwe, Mozambique, Nigeria, Malawi, Lesotho, Eswatini, Pakistan, India, and China) (Redders, 2021). But high unemployment rates, limited development, poverty, and inequality are inevitable realities of life, especially in very rural areas. Between 1990 and 2015, the number of impoverished people on the

African continent rose by 135 million (Chen et al., 2021).

South Africa is often regarded as Africa's economic development leader, and in order to overcome the cruel legacy of an Apartheid dictatorship, the post-apartheid administration dedicated itself to developing programs that will combat unemployment (Mbekeni and Phiri, 2020). One measurable issue that has persisted since the onset of democracy in South Africa is unemployment, which has not decreased despite national efforts. But in the wake of the sluggish growth, institutions are giving close attention to resolving unemployment. The South Africa NDP has set a goal to lower unemployment to 6% by 2030 as a result. Nevertheless, South Africa is presently one of the world's countries with the highest jobless rates and people between the ages of 15 and 64. South Africa's official unemployment rate increased from 32.5 percent to 32.6 percent in the first quarter of 2021. It was the highest unemployment rate since similar data was first collected in 2008. (StatsSA, 2021).

South Africa is currently experiencing a high level of unemployment. Unemployment is a macroeconomic issue that affects the population in diverse ways. The increase in the rate of unemployment means reduced standard of living and psychological stress (Mosikari, 2013). However, because of its consequences on social variability, economic welfare, crime, and the creation of products and services, unemployment is a problem in South Africa. According to some, the biggest threat to the South African economy and its administration is the rate of unemployment and its increase. To report the estimates of unemployment in the nation, Statistics South Africa (Stats SA) utilizes two definitions of unemployment: the official, stringent definition and the expanded, board definition.

People who did not look for work during a four-week period are included in the broad definition since they can report when a job becomes available, they could work, and they stated they would accept if a suitable position was offered. A person who is employable and actively looking for work but is unable to find employment is considered unemployed under the strict definition. Since the International Labor Organization uses this definition, the official unemployment estimate is considered. South Africa's unemployment rate dropped from a record high of 30.1% in the first quarter of 2020 to 23.3% in the second quarter. The COVID-19 pandemic, which afflicted many individuals, contributed to the gap by increasing unemployment and poverty. Because lockdown limitations were loosened, the official unemployment rate rose to 30.8% in the third quarter of 2020—above its pre-COVID level. The higher unemployment rate, which takes into account both recent graduates and people who gave up looking for job Conversely, surged from 39.7% in 2020's first quarter to 42.0% in the second, signifying the elevated rate of joblessness during that period.

In the third quarter of 2020, the expanded unemployment rate rose even more, reaching a new high of 43.1% (South African Reserve Bank, 2020). According to StatsSA (2020), there was a temporary glitch in the official unemployment rate decrease during the second quarter. This was due to the implementation of a national lockdown, which made it difficult for people to actively search for work. Additionally, Statistics South Africa encountered several challenges related to classification and measurement. Following the easing of lockdown limitations and

the restoration of survey gathering procedures, the official jobless rate increased significantly. (Bank of South Africa, 2020).

The issue is characterized by its effects on the economy, society, and politics because of South Africa's high unemployment rate. Unemployment in South Africa has reached frightening proportions, with university graduates, unskilled laborers, and children from basic and secondary schools making up the bulk of the unemployed. The issue has been made more difficult by the recent rise in the unemployment of experts, including bankers, engineers, accountants, and others. Additionally, the working population of South Africa has the greatest mortality toll (Kameta, 2016). Bello (2003) from the old days, states that unemployment has always been an issue that gives economists hard time working on it. The Government implemented policies that could help in reducing the issue but still there is no change in the rate of unemployment. Oluwajodu et al. (2015) believed the fact that poorly educated people, who make up the vast bulk of the labor supply, are unable to find job in to South Africa. Since unemployment, with its economic and social consequences, is one of the most compelling issues challenging South African policymakers. Kreishan (2011) finds that high unemployment rates indicate a labor market shortage, rising rate of poverty, and widespread immoral living standards.

High levels of unemployment in South Africa have exacerbated social tensions and contributed to social unrest. This scenario has affected the country's international competitiveness by influencing factors such as labor costs, productivity, and skills availability and leading to high levels of poverty and income inequality. Researching the socio-economic determinants of unemployment can provide insights into strategies for poverty alleviation and social welfare improvement. By tackling the root causes of unemployment, such as inadequate education or limited access to economic opportunities, policymakers in South Africa can work towards reducing poverty levels. Furthermore, understanding how socio-economic factors influence unemployment rates helps policymakers formulate targeted interventions and policies to address unemployment effectively. Existing literature is sparse as per identifying which variables have the most significant impact on unemployment, Thus, policymakers struggle with the design of programmes aimed at improving education, skills development, access to credit, and labor market flexibility. This research is value added to previous studies because it sheds light on the dynamics of the labor market in South Africa, which is valuable for employers, job seekers, and labor market intermediaries in making informed decisions about hiring, skills development, and workforce participation. Overall, studying the effect of socio-economic variables on unemployment in South Africa is essential for addressing the country's pressing socio-economic challenges, promoting inclusive growth and development, and building a more prosperous and equitable society.

There are many factors that affects unemployment level in South Africa. However, this study will focus on the impact of government expenditure, population growth and economic growth in country. This article delves deeply into potential steps to reduce unemployment in South Africa, with an emphasis on how government spending, population growth, and economic growth affect it. Because unemployment affects so many facets of South Africa's economy, society, and general development, research on the topic is essential. In conclusion, researching

unemployment in South Africa is critical to advancing social cohesion, decreasing poverty and inequality, accelerating economic progress, and creating a wealthy and inclusive society. A thorough knowledge of unemployment's sources, effects, and ramifications for the economy and society is necessary for the development of effective measures to solve it.

Theoretical framework

Okun's Law is one of the oldest theories linking unemployment with economic activity. It was presented by the American economist Arthur Okun in 1962. It presupposes a negative relationship between unemployment and economic output, where there is a negative association between changes in unemployment rates around the normal rates and changes in real GDP around the potential average (Alamro and Al-dalaien, 2014). This relationship has gained a great deal of realistic support in developed economies such as the OECD countries, however, in the South African economy, it has gotten very little empirical backing (Mbekeni and Phiri, 2020). Most studies were done to test whether Okun`s law is valid (Khobai and Makaringe, 2018). This theory states that if economic growth increases, unemployment will eventually decrease.

On the other hand, the relationship between government size, population growth and unemployment is an important topic of study in economics. According to Keynesian theory, large government spending has been blamed for producing increased unemployment, despite the idea that it would help to reduce unemployment (Jaman et al., 2021). Two basic arguments and strands of literature have historically dominated employment theory. This hypothesis was based on the classical and Keynesian theories of employment. Both assumed that in order for an economy to function at its greatest capacity, labour must be fully employed (and near full potential) (Onodugo et al., 2017). In the near run, economic growth through full employment is substantially impacted by total expenditure in the economy, according to the Keynesian theory of employment (Onuoha and Agbede, 2019). According to this theory, energetic management engagement in a marketplace through government spending is the single way to ensure high employment by assuring productivity in resource allocation and market regulation (Sangkuhl, 2015). The theory emphasizes the significance of lowering population growth for a thriving economy, as well as effective strategies to do so (Ali et al., 2021).

2. Literature review

Most research in the literature has demonstrated the efficacy of economic expansion in lowering poverty. Meanwhile, as we get closer to 2030, the NDP predicts that economic growth would likely average about 5%. Afzal and Malik (2012), Ebunoluwa and Yusuf (2018), Garza-Rodriguez (2018), and other research have all highlighted the significance of economic growth in reducing poverty. Some of them (Sissons, 2016; Suryahadi et al., 2021; Skare and Druzeta, 2016) have upheld the legitimacy of growth while also pointing out that it is insufficient to address poverty. Nonetheless, certain research has indicated that growth has no discernible effect on the decrease of poverty (Ilemobayo et al., 2013).

2.1. Government expenditure on unemployment

Government spending has taken on a tactical role in numerous economies around the world, and it is an important tool in government policy. Without government spending for the welfare of its population and to generate economic activity, no economy can exist. Public spending has remained a critical issue in Sub-Saharan Africa's less developed countries, in numerous dimensions (Selase, 2019). Both development and non-development spending have been shown to raise both categories of unemployment, though the impact of such is greater (Jaman et al., 2021). According to a study by Choga et al. (2013), fiscal policy has an impact on unemployment in South Africa. The impacts of fiscal policy aggregates on unemployment were estimated using a Vector Error Correction Model. As per the findings, government consumption expenditure and taxes have a favourable impact on employment. Government investment expenditure, on the other hand, has a negative impact on unemployment in South Africa, according to Abouelfarag and Qutb (2021).

Nonetheless, Nwosa (2014) investigated the impact of government spending on unemployment and poverty rates in Nigeria. He discovered that government expenditure increases unemployment while lowering poverty rates using the OLS estimating approach. Selase (2019), conducted a study using panel data from 2000 to 2017 to investigate the impact of gross public expenditure on unemployment rates in selected African nations. In some African countries, the results showed that gross fixed capital formation and education spending have an inverse association with unemployment rates. The research used a dynamic panel. Two-step system approach Techniques for empirical analysis using the Generalized Method of Moments (GMM). Since scarce resources are used for excess job creation rather than constructive expenditures, a larger government might generate unemployment in emerging countries. According to Nepram et al. (2021), cases of blotted civil service have been frequently recorded in various nations, particularly in Africa and South Asia.

2.2. Economic growth on unemployment

A simple regression was performed to estimate the relationship between economic growth and unemployment. Significant results were found and it came out that a high rate in GDP can cause a decrease in the rate of unemployment and the study supported the theory of Okuns Law (Rukhsana, 2003). Phiri (2014) undertook an examination of asymmetric co-integration adjustment in Okun's law for South Africa between the period of 2000 and 2013, the study's goal was to demonstrate that long-term unemployment did not lead to economic growth. The momentum threshold autoregressive (MTAR) econometric model was used to attain the goal. The findings had major implications for South Africa's policymaking. They highlighted the importance of labor market policies in improving economic growth. Geldenhuys and Marinkov (2007) calculated Okun's coefficient for the South African economy using annual data from 1970 to 2005, the variables utilized were economic growth and unemployment, which were decomposed into trend and cyclical components using a variety of de-trending methods. The presence of

structural breakdowns in Okun's relationship was discovered, as well as the use of co-integration analysis. Both symmetric and asymmetric models revealed evidence of a statistically significant link between output and unemployment. Yamamoto causality test found no feedback correlations between unemployment and GDP in South Africa, according to Leballo and Mello (2014), who considered a South African perspective and analyzed data from 1990 quarter 1 to 2013 quarter 1. Evidence suggests that Okun's law is inapplicable to South Africa, based on positive coefficients. Banda (2016) estimated the rate of unemployment and population ratio in some of the world's most developed countries using a modified version of Okun's law. His findings revealed that the evolution of the unemployment rate since the early 1970s may be anticipated with high precision.

Khobai and Makaringe (2018) examined the trends and influence of unemployment on economic growth in South Africa. The auto regressive distribution limits (ARDL) method was used to determine the long-term relationship between unemployment and economic growth. The ARDL model's findings revealed that there is a positive relationship between unemployment and economic growth in the long-term. The empirical findings indicated that unemployment and economic growth had a negative relationship across long and short periods of time. Between 1994 and 2012, Banda (2016) investigated the relationship between unemployment and the economy in South Africa. The results of Johansen's co-integration revealed that the variables have a long-term relationship. The findings also revealed that in South Africa, there is a significant relation between GDP and unemployment.

Based on linear evidence from Mbongeni et al. (2023), economic growth reduces poverty in the long-run, while unemployment inflates poverty in the long-run. The asymmetric evidence in their study confirmed that although negative shocks of economic growth reduce the poverty rate, the positive shocks of the former reduce the poverty rate. On the other hand, poverty rates rise concurrently as a result of both positive and negative shocks of unemployment rates.

Khumalo and Madito (2014), adjustment of mistakes was made to determine the rate at which South Africa's Gross Domestic Product growth is adequate to jobs in employment or unemployment. The data quality attributes revealed that there are no correlations in the data, hence the variables are zero-order integrated. The model identification found that the South African growth model may be uniquely recognized using the Johansen co-integration test, which revealed four co-integration vectors. The estimated coefficients have been constrained as a result of this. To test the dynamics of Breterun, the method of correction of vector errors (VECM) was applied, and the findings showed that roughly 62 percent of economic growth is correct each quarter. These general findings revealed a negative relationship between economic growth and labour productivity, as demonstrated by Johansen Co-integration, which shows a stable and one significant long run relationship between unemployment and the explanatory variables of economic growth, budget deficit, real effective exchange rate, and labour productivity. Economic development has a negative long-run influence on unemployment but a positive impact on the other variables, according to the VECM, which was conducted between 1994 and 2012. (Banda and Choga, 2015).

2.3. Population growth on unemployment

According to Rukhsana (2003), there is a strong positive correlation between unemployment and population. GDP is believed to have a negative relationship with unemployment for a 13-year period, which spans 1986 to 1999. To obtain the results, a simple regression was used. The results were really substantial. According to the findings, population pressure can spill over into job chances, and a high GDP growth rate can lead to a fall in the jobless rate. They may have taken two measures with an intention to reduce the problem of unemployment. First, a strict population policy can be implemented.

From 1981 to 2016, Njoku and Ihugba (2011) investigated the link between population growth and unemployment in Nigeria. In their research, they used a multiple regression model based on the OLS approach. They discovered that in most developing countries, population growth has a positive substantial effect on unemployment, according to their findings.

Nyoni (2018), employed the Ordinary Least Squares (OLS) estimate method. Diagnostic tests were performed to ensure that the calculated model was statistically suitable. The study discovered, among other things, that a 1% increase in contraceptive prevalence will result in a 3.53 percent drop in population growth in Pakistan. Malika et al. (2017) used quarterly data from 1992 to 2015 to investigate the impact of population growth and foreign direct investment on unemployment in Russia. Johansen co-integration was employed to investigate the long-term relationship between the estimated variables of population and unemployment. In the framework of VECM, long-run elasticity and Granger causality were examined. The final results of the study revealed that population expansion has a positive and statistically significant impact on unemployment.

3. Data and methods

The Augmented Dickey-Fuller (ADF) is used to determine if the unit root for time series data is stationary or not. This article used the Johansen cointegration test and Vector Error Correction Model (VECM). The main purpose of error-correction models is to capture the time-series properties of variables, through the complex lag-structures allowed, while at the same time incorporating an economic theory of an equilibrium type.

Diagnostic tests are performed to determine whether the model is properly specified. All tests were estimated using the statistical package known as E-views.

3.1. Data

This article used secondary data. The data for unemployment is sourced from the World Bank Statistics and the indicator presented as the total unemployment rate (percentage of total labor force). Data for Population Growth is also sourced from the World Bank Statistics and the indicator measured as total Annual Population Growth (percentage change). The data for economic growth is drawn from the International Monetary Fund (IMF) and the indicator is presented as the GDP per capita growth (Annual %). Lastly, data for government expenditure is derived from the International Monetary Fund (IMF). The data spans from the years 1980 to 2020.

3.2. Model specification

The model of the study consists of four variables, unemployment, government expenditure, population growth and economic growth (See **Table 1** below). In the model, unemployment is the dependent variable while government expenditure, population growth and economic growth are the independent variables and their functional form of relationship is expressed as follows:

$$\text{UNEMPL} = f(\text{GOV\_EX, GDP, POPUL}) \quad (1)$$

Table 1. Expected signs and relationships.

Variables	Expected relationship with unemployment
Government expenditure (GovEx)	(Negative)
Economic growth (GDP)	(Negative)
Population growth	(Positive)

Then as a linear equation,

$$\text{UNEMPL} = \beta_0 + \beta_1 \text{GOV\_EX}_t + \beta_2 \text{GDP}_t + \beta_3 \text{POPUL}_t + \varepsilon_t \quad (2)$$

where,

UNEMPL = Unemployment rate

β_0 = Constant

GOVEX = Government expenditure

GDP as a proxy for economic growth

POPUL = Population growth

ε = Error term

In this article, the VECM Model is used to estimate t the relationship between the variables. The VECM were used because of the results of the Johansen cointegration test, which indicated a cointegration in the long run.

Model specification,

$$\Delta X_1 = \beta_{x0} + \beta_{xx1}\Delta_{t-1} + \beta_{x11}\Delta P^1{}_{t-1} + \beta_{x21}\Delta P^2{}_{t-1} + v^x t \quad (3)$$

$$\Delta P^1 t = \beta_{10} + \beta_{1x1}\Delta_{t-1} + \beta_{111}\Delta P^1{}_{t-1} + \beta_{121}\Delta P^2{}_{t-1} + v^1 \quad (4)$$

$$\Delta P^2 t = \beta_{20} + \beta_{2x1}\Delta_{t-1} + \beta_{211}\Delta P^1{}_{t-1} + \beta_{221}\Delta P^2{}_{t-1} + v^2 \quad (5)$$

where: X represent the unemployment variable, β_1 represent the economic growth, and β_2 represent the β_3 population growth variable.

3.3. Preliminary testing

Unit root test: When applied to stationary data, time series models produce accurate findings. Granger and Newbold (1974) define spurious regression as a regression of non-stationary variables. They go on to say that non-stationary series, as defined by a high R squared value combined with a low (Durbin-Watson statistic), indicate a misleading association. The Augmented Dickey-Fuller was utilized to test for stationarity of time series data variables in this study.

Johansen's cointegration method: Johansen cointegration makes it possible to estimate all co-integrating vectors when there are more than two variables. If there are three variables each with unit roots, there are at most two cointegrating vectors. More generally, if there are n variables which all have unit roots, there are at most $n - 1$ cointegrating vectors. The Johansen test provides estimates of all cointegrating

vectors. Just as for the Dickey-Fuller test, the existence of unit roots implies that standard asymptotic distributions do not apply. When there are more than two variables, cointegration allows you to estimate all cointegrating vectors.

3.4. Hypothesis

H_0: There is no significant impact of economic growth, population growth and government expenditure on unemployment in South Africa.

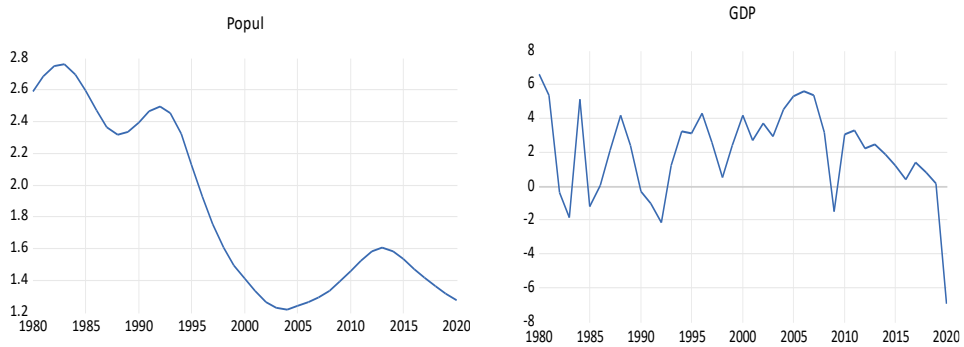
H_1: There is a significant impact of economic growth rate, population growth and government expenditure rate on unemployment in South Africa.

4. Findings and discussion

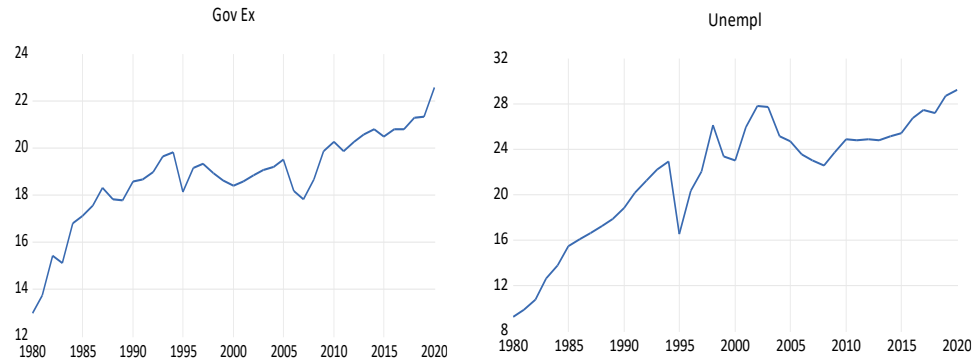
The section is as follows: stationary tests whereby the Augmented Dickey-Fuller (ADF) is used to determine the unit root test for time series data, the unit test root is used to test if the variables are stationary or non-stationary. The study employed the Johansen cointegration test and Vector Error Correction Model (VECM) to capture the relationship or correlation between the variables. The diagnostic tests The Breauch-Godfrey LM test is used to test for serial correlation amongst the variables. Since the problem with heteroscedasticity is that ordinary least squares (OLS) regression assumes that all residuals are drawn from a population with a constant variance, the Breauch-Pegan Godfrey method is used to determine the existence of heteroscedasticity among the variables where heteroscedasticity should be tested.

4.1. Visual inspection

Figure 1 below shows the variables that are employed for visual inspection are the unemployment, government expenditure, economic growth and population growth denoted as UNEMPL, GOV_EX, GDP and POPUL respectively. If it could be found that the variable in question contain unit root (non-stationary) in levels, the variable is then differenced, and unit root tests performed again. The illustrations are portrayed below are the visual and informal impression of stationarity.



(a) **(b)**



(c) **(d)**

Figure 1. Variables trajectory; **(a)** POPUL; **(b)** GDP; **(c)** GOV_EX; **(d)** UNEMPL.

From the above graphical illustration of the variables employed in the study it can be articulated that all variables are stationary at first difference. The trend on the graphs shows upwards and downwards trending around the mean, in this case the mean and variance are fair constant overtime. However, it is not sufficient to draw conclusion based on the informal graphical illustration, so the formal tests of stationarity were performed. This is to avoid spurious results. We thus, used the first difference of data before estimation of the results.

4.2. Descriptive statistics

The dependent (unemployment) and independent variables are described in the table above with descriptive statistics (economic growth, population growth and government spending). There are 41 observations in this investigation. It demonstrates that there is a gap between the minimum and greatest levels of unemployment during the study period, indicating that unemployment in South Africa is steady and less volatile. In South Africa, the variance and gap between the minimum and greatest values of economic growth is determined to be relatively small. Government spending has a considerable disparity between its minimum and greatest values throughout this time period, indicating that government spending is insecure. There is some variety and a gap in the economy. **Table 2** below shows that the difference between the minimum and greatest population growth figures, while a variable and big gap, reflects a very inconsistent economic growth in South Africa.

Table 2. Descriptive statistics results.

Variable	Obs	Mean	Std. dev	Min	Max
UNEMPL	41	21.671	5.335	29.175	9.241
GOVEX	41	18.751	1.9522	12.951	22.565
GDP	41	2.005	2.651	−6.959	6.620
POPUL	41	1.845	0.549	1.217	2.759

4.3. Augmented Dickey-Fuller test at 1st difference

This estimating technique is used to establish the non-stationarity assumptions as well as to ensure that incorrect results, autocorrelation difficulties, and heteroscedasticity concerns are avoided (Dickey and Fuller, 1979). The probability

values, critical values, and *t*-statistics values is the focus.

The null hypothesis is not rejected if the critical values are greater than the *t*-statistics values at various levels of significance.

H_0 = The time series is non-stationary

H_1 = The time series is stationary

Table 3. Unit root test.

Variables	*P*-value: Level test statistic	*P*-value: First difference test statistic	*T*-statistics @ Level	*T*-statistics first difference	Critical values			Order of integration
					1%	5%	10%	
UNEMPL	0.6643	0.0000	−1.2143	−6.7435	−5.3256	−3.6524	−3.3812	Non-Stationery *I*(0) at level but stationary at first difference *I*(1) form
GDP	0.5145	0.0000	−2.4182	−6.5348	−4.2465	−3.8562	−3.3263	Non-Stationery *I*(0) at level but stationary at first difference *I*(1) form
GOV EXP	0.7621	0.0000	−1.1463	−6.4843	−4.6751	−3.4879	−3.1137	Non-Stationery *I*(0) at level but stationary at first difference *I*(1) form
POPUL	0.4837	0.0364	0.1234	−2.0632	−4.3878	−3.4638	−3.3265	Non-Stationery *I*(0) at level but stationary at first difference *I*(1) form
			0.1177					

Table 3 above states that all the variables are non-stationary at level form with the trend and intercept model. Applying the ADF test variables at 1st difference under the model of trend and intercept tends to be stationary at 1%, 5% and 10% level of significance. Then the above results conclude that the variables are stationary at 1st difference, the study can reject the null hypothesis of non-stationary and accept.

4.4. Johansen cointegration

Rank test (trace):

H_0: There is no cointegration in the model

H_1: There is cointegration in the model

The decision criteria for the JCT test is that, if the value of trace and max statistics is greater than the 5% critical value, the null is rejected, meaning that the series are cointegrated. Details are shown in **Table 4** below.

Table 4. Trace cointegration results.

Hypothesized No. of CE(s)	Eigenvalue	Trace statistic	0.05 Critical value	Prob.**
None *	0.531683	58.73124	49.63613	0.00438
At most 1*	0.423529	28.68365	24.84707	0.0151
At most 2*	0.668854	20.752119	15.53471	0.03241
At most 3*	0.351084	12.041211	4.7211465	0.014391

Note: Trace test indicates 1 cointegrating eqn(s) at the 0.05 level.

Since the assumption states that the trace value should be greater than its critical

value that means we reject the null hypothesis that states that there is no co-integration @ None. However, according to the above results at most 1, 2 and 3 we reject the null hypothesis and concludes that there is long-term equilibrium relationship between the variables in the model.

Table 5 showing the Rank test (maximum eigenvalue) is presented below:

Table 5. Rank test cointegration results.

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical value	Prob.**
None *	0.678683	38.2472	26.43764	0.0012
At most 1*	0.532429	25.93153	20.5421	0.0421
At most 2*	0.76214	23.78213	14.45632	0.0438
At most 3*	0.7632	14.3512	8.79376	0.02361

Note: Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level.

Since the assumption states that the trace value should be greater than its critical value that means we reject the null hypothesis that states that there is no co-integration @ None. However, we reject the null hypothesis for at most 1, 2 and 3 which means there is a long-term equilibrium relationship between the variables in the model.

4.5. Lag criteria

The test for lag criteria was done and a lag of two was chosen as shown in **Table 6**. The lag on two was selected according to LR, FPE, AIC, SC and HQ it was used throughout the study. It is important to conduct lag length selection to observe how it takes for independent variables to take an effect on unemployment in the economy of South Africa. In addition, **Table 7** below shows the normalized cointegration results from the model.

Table 6. Lag criteria results.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	55.31118	-	1.63×10^{-7}	−4.275932	−4.079590	−4.223842
1	118.3102	99.74850	3.33×10^{-9}	−8.192520	−7.210808	−7.932071
2	155.3814	46.33899*	6.55×10^{-10}*	−9.948452*	−8.181372*	−9.479645*

4.6. Normalized cointegrating equation: Long-run model

Table 7. Normalized cointegration results.

Co integrating Eq	CointEq1
CONSTANT	3.283
LUNEMP(−1)	1.000
LPOPUL(−1)	0.637
LGOV(−1)	−2.247
LGDP(−1)	−0.073

R squared 0.7894.

4.7. VECM

Table 8 below shows the short-run impact of GDP, GOV_EX, and POPUL on Unemployment.

$$UNEMPL = 0.6131 + 1.2008GOV\_EX_t + 0.0249GDP_t + 4.4951POPUL_t \quad (6)$$

Table 8. Error correction model results.

Variable	Coefficient	Std. error	*t*-statistic	Prob.
D(GDP)	−0.029404	0.080633	−0.364668	0.7175
D(GOV_EX)	1.200786	0.303258	3.959623	0.0003
D(POPUL)	4.495128	2.519126	1.784400	0.0828
Constant	0.613108	0.155536	3.941902	0.0004
CointEQ(−1)*	−0.382008	0.142332	−8.6839	0.0000

R-squared 0.757446.

The above equation states that there is a positive relationship between UNEMPL and GOV_EX in South Africa. The implication if this relationship is that a 1% increase in Government expenditure implies that Unemployment would increase with 1.2008 units in South Africa.

Table 8 above, also indicates that the error correction term is negative and significant, with a probability value of 0.000 and a coefficient of 0.382, which is an indication of the speed of adjustment from a period of disequilibrium to a period of disequilibrium to a of equilibrium. Furthermore, this implies that the speed of adjustment towards the long run equilibrium is 38% or system corrects its previous period disequilibrium at a speed of 38% within one period. As a result, this shows that there was no evidence of short run relationship for the variables. The findings demonstrated a positive and statistically significant association between government spending and unemployment. It claims that South Africa's unemployment rate rises in tandem with increases in government spending. However, using yearly time series data for the years 1980 to 2010, Choga et al. (2013) findings are at odds with ours because they found an influence of fiscal policy on unemployment in South Africa. Furthermore, the results of the study by Abouelfarag and Qutb (2021) demonstrate that government investment spending has a negative impact on unemployment in South Africa.

Government spending and unemployment have a complicated connection that can vary depending on a number of variables, including the health of the economy, the makeup of government spending, and the success of government initiatives. According to our findings, there's a chance that a temporary increase in unemployment might emerge from more government spending. As per the Keynesian viewpoint, an augmentation in government spending, namely on public services, social welfare initiatives, and infrastructure projects, might in the short term enhance economic activity and raise aggregate demand. As firms hire more workers to match the increasing demand for products and services, this rise in demand may result in an increase in employment. But rather than significantly lowering unemployment, as is the case in South Africa, this boost in demand might result in inflationary pressures if the economy is running near to full employment capacity.

Furthermore, the marginal propensity to consume, the effectiveness of government spending, and the investment's responsiveness to variations in demand in the South African economy are probably the main reasons why the fiscal multiplier size is negligible.

Furthermore, our findings could be the consequence of crowding-out effects brought on by increases in government spending that are funded by borrowing. Interest rates rise in this scenario, which may discourage investment from the private sector and counteract the employment-boosting benefits of government expenditure. If the decrease in private sector investment exceeds the impacts of government expenditure on job creation, the overall effect on unemployment may be negligible or even negative in certain situations. However, the nature of government spending is also important. While spending on transfer payments or subsidies may not have as much of an immediate impact on job creation, investments in infrastructure, technology, and education can have a favorable long-term influence on productivity and employment. Furthermore, the crowding-out effects resulting from increases in government spending funded by borrowing may account for our findings. As a result of this scenario's rising interest rates, private sector investment may decline and the employment-boosting benefits of government expenditure may be neutralized. In these situations, the overall effect on unemployment can be negligible or even negative if the decrease in private sector investment surpasses the impacts of government expenditure on job creation. Still, the nature of government spending matters as well. The generation of jobs can be indirectly impacted by spending on transfer payments or subsidies, but employment and productivity can benefit over the long run from investments in infrastructure, technology, and education.

Nonetheless, there is a weak and negative correlation between GDP and UNEMPL; in South Africa, a 1% increase in GDP would cause a 0.0294-unit decrease in UNEMPL. When Geldenhuys and Marinkov (2007) computed Okun's coefficient for the South African economy using annual data from 1970 to 2005, they found a significant relationship between unemployment and economic growth. In the short run, Okuns Law was supported by the evidence showing a negative relationship between unemployment and economic growth. Conventional economic theory states that there is often a correlation between economic growth and GDP, with the former being associated with a decrease in unemployment and the latter with an increase.

Then lastly the results states that there is a positive relationship between POPUL and UNEMPL in South Africa, it is found that a 1% increase in POPUL would increase UNEMPL by 4.4951 units in the short run. Moreover, population increase had a negative or negligible correlation with unemployment. Increases in population can translate into higher unemployment rates. It shows that there is a positive correlation with unemployment in the near term. There is a long-term correlation between unemployment and population increase, according to research by Njoku and Ihugba (2011). In most emerging nations, there is a positive and strong correlation between population growth and unemployment. The rate of unemployment may rise or fall proportionally, or vice versa. It's important to note that the relationship between population growth and unemployment is not deterministic, and other factors such as economic growth, technological

advancements, government policies, and demographic characteristics can influence labor market outcomes. Moreover, population growth can also have positive effects on economic growth and development, such as increasing consumer demand, expanding the tax base, and fostering innovation and entrepreneurship. Therefore, the impact of population growth on unemployment depends on the interplay of various economic, social, and policy factors within a specific context.

4.8. Diagnostic and stability testing

Table 9 below shows the Breusch-Pagan test. The hypothesis is as follows:

H_0: the residuals of the model are homoscedastic

H_1: The residuals of the model are heteroskedastic

Heteroskedasticity test: Breusch-Pagan-Godfrey:

Table 9. Breusch-Pagan test results.

***F*-statistic**	0.306999	Prob. *F*(3.37)	0.8202
Obs**R*-squared**	0.995777	Prob. Chi-Square(3)	0.8023
Scaled explained SS	0.755415	Prob. Chi-Square(3)	0.8601

If the model is heteroskedastic, it means that it does not have a constant variance and observing from the results above, the above results shows that the model is homoscedastic which means the variance is constant. The probability of Chi-squared is 0.8023 which is above the 5% critical value and as a result the study fails to reject the null hypothesis of homoscedasticity. That means the model estimated is homoscedastic.

Breusch-Godfrey serial correlation LM test:

When dealing with a time series data, serial correlation is found to be a challenge on most occasion and it can portray as results that are underestimated of probability, thereafter, causing p-values to be overestimated. The hypothesis of the LM test is as following:

H_0: The is no serial correlation in the model

H_1: The is a serial correlation in the model

Breusch-Godfrey serial correlation LM test:

Table 10. Breusch-Godfrey serial correlation LM test result.

***F*-statistic**	0.245020	Prob. F(2.33)	0.7841
Obs**R*-squared**	0.585297	Prob. Chi-Square(2)	0.7463

The results in **Table 10** above are evident that the model developed is not affected by serial correlation with the probability value of 0.7463 above the 5% level of significance of the probability Chi-Squared. Therefore, the study accepts the null hypothesis of serial correlation and conclude that there is no serial correlation in the model.

Jarque-Bera test of Normality test:

The Jarque is performed to ensure that the estimated residuals are normally distributed. **Figure 2** below shows the details. If the residuals are not normally

distributed it can produce misleading results in the model estimated. Below is the hypothesis: if the probability test is above the level of 0.5% significance that means we can accept the null hypothesis.

H_0: Residuals are multivariate normal

H_1: Residuals are not multivariate normal

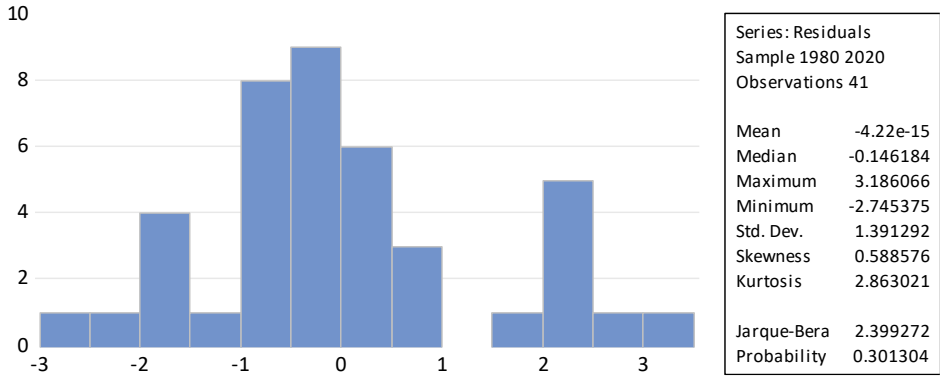


Figure 2. Normality test.

Referring to the above results, it is evident that the model estimated was normally distributed with a probability of 0.301304. This concludes that the study accepts the null hypothesis of residuals are multivariate normal. The residuals of the estimated model were normally distributed.

5. Summary and conclusion

To achieve the study objectives, time series data for the period of 1980 to 2020 were used. Unit root tests were conducted to test the stationarity level of the data thereby determining the order of integration. The unit root test results indicated that government expenditure, population growth economic growth and unemployment are *I*(1). Nonetheless, the study revealed a non-existence of co-integrating relationships amongst the variables used. Thus, the vector autoregressive estimation was used to estimate the dynamic relationship between the variables. The study discovered a long-term positive significant relationship between unemployment and economic growth, which is unfavorable in South Africa. Despite a steady increase in economic expansion, unemployment sems to be unabated.

Policies and recommendations

Addressing unemployment and weak economic growth requires a comprehensive set of policies that target both short-term job creation and long-term structural reforms to enhance productivity and competitiveness. Implementing a combination of the policies below, tailored to the specific context of South Africa can help address unemployment and stimulate economic growth, laying the foundation for sustainable and inclusive development.

- As a result, the South African government should adopt a policy that allows economic growth to impact the unemployment rate. Policy interventions to address the high rate of unemployment in South Africa should focus on the youth, as they are most of the unemployed people. The government over the

years has continued to priorities on spending on education and implemented the unemployment relief fund and it seems like it worsens the unemployment rate. Therefore, a need to increase spending on training schemes to provide the required or demanding skills to the unemployed people in the country but also needs to decrease spending on the relief fund.

- The study emphasizes that the government should invest in small business that most people get employed and efforts should be made towards corresponding labor-intensive projects in agriculture so that unskilled and semi-skilled people can have work. The South African government should refocus its investment on programmes that directly and indirectly encourage job development and good employment. All of this will aid in the absorption of huge numbers of unemployed workers and the reduction of unemployment. To address the requirements of an expanding population, the government should encourage companies that promote labour-intensive production.
- Policymakers should implement fiscal stimulus measures such as increased government spending on infrastructure projects, education, and healthcare. These investments not only create immediate job opportunities but also lay the foundation for long-term economic growth. Furthermore, the Reserve Bank should use monetary policy tools such as interest rate cuts or quantitative easing to stimulate economic activity and encourage investment. Lower interest rates can make borrowing cheaper for businesses, leading to increased investment and job creation.
- Government should introduce labor market reforms to improve flexibility and reduce barriers to employment. This may include measures to streamline hiring and firing processes, reforming unemployment benefits systems to incentivize job search and retraining, and promoting wage flexibility.
- The government should provide targeted support for SMEs, which are often major contributors to job creation and economic growth. This can include access to finance, business development services, and assistance with regulatory compliance. By creating an enabling environment for innovation and entrepreneurship, this will lead to reduction in bureaucratic hurdles, research and development, and fostering collaboration between universities, research institutions, and the private sector.
- Investments in education and skills development programmes have become imperative to ensure that the workforce has the necessary skills to meet the demands of a modern economy. This can involve expanding vocational training programs, promoting lifelong learning initiatives, and strengthening ties between educational institutions and employers.
- Government needs to pursue policies that attract foreign investment and promote export-oriented industries, which can create jobs and stimulate economic growth. This may involve negotiating trade agreements, providing incentives for foreign direct investment, and improving infrastructure to facilitate trade. Furthermore, the strengthening of social safety nets to protect vulnerable groups affected by unemployment, such as providing unemployment benefits, job training programs, and support for reintegration into the labor

market is important in this context.

- Summarily, policymakers need to tackle structural barriers to economic growth, such as corruption, inefficient bureaucracy, and regulatory burdens. Streamlining administrative procedures, improving governance, and enhancing the business environment can foster entrepreneurship, investment, and job creation. Additionally, coordination among various government agencies, stakeholders, and international partners is essential to maximize the effectiveness of these policies.

Author contributions: Conceptualization, WV and PS; methodology, WV, PS and KO; validation, KO; formal analysis, WV; data curation, PS; writing—original draft preparation, WV and PS; writing—review and editing, KO and PS; visualization, KO; supervision, KO. All authors have read and agreed to the published version of the manuscript.

Acknowledgments: The article APC was supported by the University of Mpumalanga and therefore, the authors are grateful to the authority of the university.

Conflict of interest: The authors declare no conflict of interest.

References

Abouelfarag, H. A., & Qutb, R. (2021). Does government expenditure reduce unemployment in Egypt? Journal of Economic and Administrative Sciences, 37(3), 355–374. https://doi.org/10.1108/jeas-01-2020-0011

Afzal, M., & Malik, M. E. (2012). Relationship among Education, Poverty and Economic Growth in Pakistan: An Econometric Analysis, 22(1), 23–45.

Alamro, H., & Al-dalaien, Q. (2014). Modeling the Relationship between GDP and Unemployment for Okun's Law Specific to Jordan. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.2440674

Ali, O., Omar, M., & Yusuf, S. (2021). Population Growth and Unemployment in Zanzibar. International Journal of Sciences: Basic and Applied Research (IJSBAR), 59(2), 36–47.

Banda, H., & Choga, I. (2015). The Impact of Economic Growth on Unemployment in South Africa. Corporate Ownership & Control, 12(4), 699–707. https://doi.org/10.22495/cocv12i4c7p1

Banda, H. (2016). The impact of economic growth on unemployment in South Africa. Investment Management and Financial Innovations, 13(2), 246–255.

Bello, L. (2003). Factors Affecting Entrepreneurship Decision in Los Banos, Laguna, Philippines. Journal of Economics, Management & Agricultural Development, 2(1), 89–106.

Choga, I., Maredza, A., & Mavetera, N. (2013). Fiscal Policy and Unemployment in South Africa: 1980–2010. Mediterranean Journal of Social Sciences, 4(6), 579.

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, 74, 427–431. https://doi.org/10.1080/01621459.1979.10482531

Ebunoluwa, O. O., & Yusuf, W. A. (2018). Effects of Economic Growth on Poverty Reduction in Nigeria. 9(5), 25–29. https://doi.org/10.9790/5933-0905012529

Garza-Rodriguez, J. (2018). Poverty and Economic Growth in Mexico. Social Sciences, 7(10), 183. https://doi.org/10.3390/socsci7100183

Geldenhuys, J. P., & Marinkov, M. (2007). Cyclical Unemployment and Cyclical Output: An Estimation of Okun's Coefficient for South Africa. South African Journal of Economics, 75(3), 373–390.

Granger, C. W. J., Newbold, P. (1974). Spurious Regressions in Econometrics. Journal of Econometrics, 2(111), 20.

Ilemobayo, S., Adewale, B., & Simoen, A. (2013). Does Economic Growth Reduce Poverty in Nigeria. Developing Country Studies, 3(9), 62–69.

Khobai, H., & Makaringe, C. S. (2018). The effect of unemployment on economic growth in South Africa (1994-2016), Munich

Personal RePEc Archive.

Khumalo, J., & Mosiane, O. (2014). FDI - Employment Short-Run Dynamics in South Africa: VECM Approach. Mediterranean Journal of Social Sciences. https://doi.org/10.5901/mjss.2014.v5n20p522

Kreishan. (2011). Economic Growth and Unemployment: An Empirical Analysis. Journal of Social Sciences, 7(2), 228–231. https://doi.org/10.3844/jssp.2011.228.231

Leballo, G. P., & Mello, D. M. (2014). An Empirical Robustness of Okun's Law in South Africa: An Error Correction Modelling approach. Mediterranean Journal of Social Sciences, 5(23), 435.

Malika, S., Faisal, F., & Resatoglu, N. G. (2017). Influence of energy use, foreign direct investment and population growth on unemployment for Russian Federation. Procedia Computer Science, 120, 706–711. https://doi.org/10.1016/j.procs.2017.11.299

Mbongeni, Z. N., Siyabonga, M., & Irshaad, K. (2023). Economic growth, unemployment and poverty: Linear and non-linear evidence from South Africa. Heliyon, 9, 10. https://doi.org/10.1016/j.heliyon.2023.e20267

Mbekeni, L., & Phiri, A. (2020). South African Unemployment in the Post-Financial Crisis Era: What are the Determinants? Folia Oeconomica Stetinensia, 20(2), 230–248. https://doi.org/10.2478/foli-2020-0046

Mosikari, T. J. (2013). The Effect of Unemployment Rate on Gross Domestic Product: Case of South Africa. Mediterranean Journal of Social Sciences. https://doi.org/10.5901/mjss.2013.v4n6p429

Nepram, D., Jaman, S., Singh, S. P. (2021). The Effect of Government Expenditure on Unemployment in India: A State Level Analysis. Journal of Asian Finance, Economics and Business, 8(3), 0763–0769.

Njoku, A., & Ihugba, A. (2011). Unemployment and Economic Growth in Nigeria: An Empirical Investigation between 1985-2009. In: Proceedings of the International Conference. Nigeria.

Nwosa, P. I. (2014). Government Expenditure, Unemployment and Poverty Rates in Nigeria. Journal Research in National Development, 12(1), 77–84.

Nyoni, T. (2018). Determinants of population growth: empirical evidence from Pakistan (1960-2017). Harare: Munich Personal RePEc Archive.

Oluwajodu, F., Blaauw, D., Greyling, L., et al. (2015). Graduate unemployment in South Africa: Perspectives from the banking sector. SA Journal of Human Resource Management, 13(1). https://doi.org/10.4102/sajhrm.v13i1.656

Onodugo, V. A., Obi, K. O., Anowor, O. F., et al. (2017). Does public spending affect unemployment in an emerging market? Risk Governance and Control: Financial Markets and Institutions, 7(1), 32–40. https://doi.org/10.22495/rgcv7i1art4

Onuoha, F. C., & Agbede, M. O. (2019). Impact of Disaggregated Public Expenditure on Unemployment Rate of Selected African Countries: A Panel Dynamic Analysis. Journal of Economics, Management and Trade, 24(5), 30–175.

Phiri, A. (2014). Re-evaluating Okun's law in South Africa: A nonlinear co-integration approach, North West: Munich Personal RePEc Archive.

Rukhsana, K. (2003). Population and Unemployment: A Dilemma to Resolve. The IUP Journal of Applied Economics, 0(3), 7–15.

Sangkuhl, E. (2015). How the Macroeconomic Theories of Keynes influenced the Development of Government Economic Finance Policy after the Great Depression of the 1930's: Using Australia as the Example. Athens Journal of Law, 1(1), 33–52. https://doi.org/10.30958/ajl.1.1.3

Selase, A. E. (2019). Impact of Disaggregated Public Expenditure on Unemployment Rate of Selected African Countries: A Panel Dynamic Analysis Approach. American International Journal of Humanities, Arts and Social Sciences, 1(2), 47–57. CLOCKSS. https://doi.org/10.46545/aijhass.v1i2.101

Sissons, P. (2016). Inclusive Growth? The Relationship between Economic Growth and Poverty in British Cities. 2016.

Suryahadi, A., Hadiwidjaja, G., & Sumarto, S. (2021). Economic Growth and Poverty Reduction in Indonesia before and after the Asian Financial Crisis.

Skare, M., & Druˇzeta, R. P. (2016). Poverty and Economic Growth: Rev. 22(1), 156–175. https://doi.org/10.3846/20294913.2015.1125965

South African Reserve Bank. (2020). December 2020—Why did South Africa's unemployment rate decline sharply in the second quarter of 2020. Quarterly Bulletins > Boxes.

StatsSA. (2020). Quarterly Labour Force Survey, Pretoria: s.n.

StatsSA. (2021). Quarterly Labour Force Survey, Pretoria: s.n.