Testing Okun's Law in South Africa

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Article's history:

Received 18th of February, 2022; *Received in revised form* 14th of March, 2022; *Accepted* 29th of April, 2022;
Published 30th of June, 2022.

Suggested citation:

Stungwa, S., Siphuxolo, T. 2022. Testing Okun's Law in South Africa. *Journal of Applied Economic Sciences*, Volume XVII, Summer, 2(76): 153 - 161.

Abstract:

The purpose of this study is to see whether Okun's coefficient exists in South Africa. The study analysed yearly data from 1995 to 2020. The study used an error correction model (ECM) to assess the short-run relationship between the variables under investigation. The granger causality test is also used to examine the variables' short-run causality. According to the study's results, there is a negative and significant relationship between unemployment and GDP in the short run. As a result, Okun's Law applies in South Africa. The Granger causality test findings reveal that GDP Granger causes unemployment in South Africa. As a result, the study recommends that policymakers prioritize balancing labour-intensive and capital-intensive jobs, as well as encouraging entrepreneurship and sufficient education and training.

Keywords: gross domestic product; unemployment rate; Okun's coefficient; South Africa.

JEL Classification: C1; F44; O4; J64.

Introduction

In any county, reducing unemployment should be the top priority. In a country with a low unemployment rate, labour resources are used effectively and efficiently. The goal of full employment should therefore be a macroeconomic priority for any government since it maximizes production. In the macroeconomic framework, Okun's Law says that the unemployment rate is negatively related to real GDP. This correlation was first proposed and estimated by Okun (1962) which is now commonly known as an Okun's law. The purpose of this study is to evaluate the existence of Okun's law in South Africa.

In the empirical literature, many studies supported the Okun's Law which states that there is a negative relationship between output and unemployment rate such as, Christopoulos (2004), Noor *et al.* (2007), Villaverde Castro and Maza Fernández (2007), Arshad and Erixon (2010), Hassan and Hossain (2013), Elshamy (2013), Karfakis *et al.* (2014), Dixon *et al.* (2017), Onakoya and Seyingbo (2020). The Okun's coefficient is mostly valid in developed and semi-developed countries, however according to Acaroğlu (2018) countries' Okun's coefficient differ depending on their development frameworks and output heterogeneities.

1. Unemployment Rate and Gross Domestic Product in South Africa from 1993 to 2019

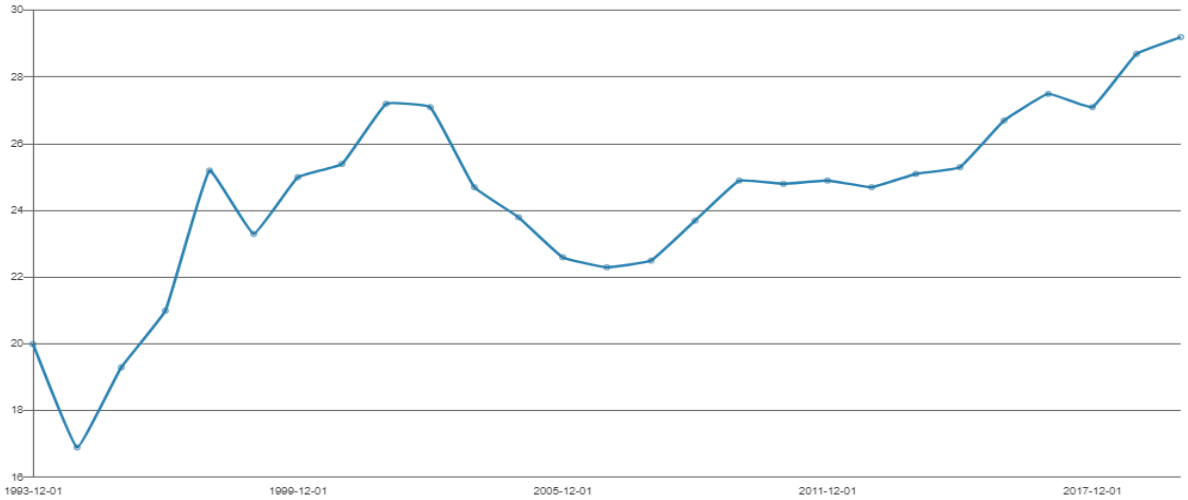
It is of paramount importance to look at unemployment rate and gross domestic product trends in South Africa in Figure 1 and Figure 2, respectively. Looking at the Figure 1 we clear see that there are stages that can be used for interpretation.

Stage 1 unemployment rate decreased from 1993 to 1994 with 20% to 16.9%. The reason for this decline of unemployment is that during that time before 1993 Black majority and Bantustans were not included in the labour force and it was the beginning of democracy which brought many investors in South Africa. *Second stage*, unemployment rate increased from 16.9% to 27.2% for the period ranging from 1994 to 2001. This was due to an increase in population growth and large net inflows in the labour market this period. The labour market stretched on average by 600 000 net new entrants each year (Altman 2001). *Third stage*, unemployment rate decreased from

2002 to 2006 by an average of 27.1% to 22.3% respectively. Looking at both Figure 1 and Figure 2 for the period ranging from 2002 to 2005, it is clear that an increase in economic growth increase was due low unemployment rate. *In the fourth stage,* unemployment rate increased from 2007 to 2019, while economic growth was decreasing in the same period. However, from 2007 to 2008 economic decrease severely from 3.2% to -1.5% and unemployment rate also increased in during this period, this was due to a global financial crisis hit during the period ranging 2007 to 2008.

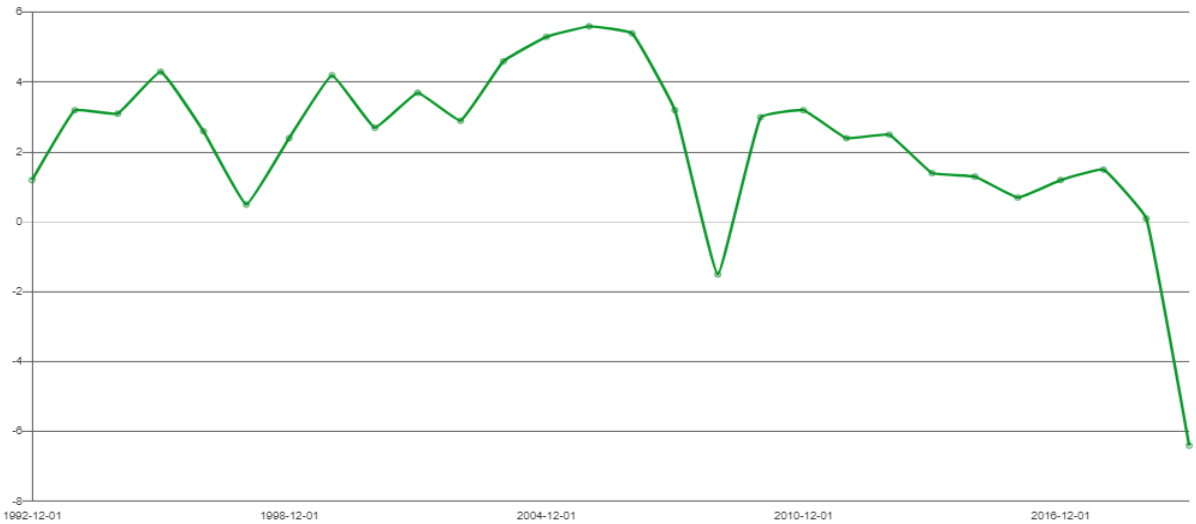
Furthermore, from 2008 to 2010 economic improved from -1.5% to 3.2% while unemployment rate showed a marginal decrease from 2009 to 2010 from 24.9% to 24.8%. The reason this is that South Africa was hosting FIFA world cup in 2010, so there was a need for the improvement of infrastructure in South Africa. In 2019 GDP showed the largest drop in 10 years period by 3.2% in the 1st quarter of 2019. The economist blamed a loadshedding as a course of this drop, and StatsSA says this dropped was also due to a drop in manufacturing (-18.8%), mining (-10.8%), and agriculture (-13.2%) (Mathe 2019). Nonetheless, according to the figure 1&2 we can see that unemployment has a negative relationship with gross domestic product in the South Africa over the period 1993 to 2019.

Figure 1. Unemployment rate in South Africa



Source: StatsSA (2020)

Figure 2. Gross Domestic Product in South Africa



*Source: SAR*B (2020)

In South Africa, there is only one study investigated the existence of Okun's law by Onakoya and SEYINGBO (2020) and two related studies in South Africa by Makaringe and Khobai (2018) and Mosikari (2013). The related studies only focused on investigating the relationship between Gross Domestic product and Unemployment in South Africa. To the best of our knowledge, there is no study in South Africa that strictly tested Okun's coefficient

using ARDL bound cointegration approach. Therefore, this study is conducted to close the gap and to also open a platform for continuous research. This paper is structured as follows: Section 1 concentrates of the review of literature review. Section 2 focuses on the research methodology. Section 3 focuses on the empirical results of the study. Last section presents the conclusion of the study.

Theoretical Literature

Just a few models in macroeconomics indicate a connection between unemployment and GDP growth. The empirical link between unemployment and GDP fluctuations was first noted by (Okun 1962). Okun's law is straightforward; companies adjust production plans when aggregate demand changes, which in turn changes labour demand, affecting unemployment rates as a consequence. Using the output gap approach, the Okun coefficient was estimated, whereas the second choice was to utilize GDP growth and a first difference measure of unemployment. The gap method is used to estimate unemployment in Okun's original work, as in Equation (1), which relates it to deviations of output from potential GDP.

$$\Delta U = a + b(gap) \quad (1)$$

The equation was modified further into:

$$\Delta U = a - b(\Delta Y/Y) \quad (2)$$

where: Y represents GDP (Gross Domestic Product), and U represents unemployment. Another option would be to use Okun's first difference method, as shown in equation (3), to see if output changes in response to changes in unemployment.

$$(\Delta Y/Y) = a - b\Delta U_t + \varepsilon_t \quad (3)$$

Or

$$\log Y_t = a - b\log U_t + \varepsilon_t \quad (4)$$

The Okun coefficient can be calculated from the estimation of *b*. According to equation (4), output growth and unemployment rate have a negative relationship, but it does not explain the causal connection between them. To determine whether this is the case, we need to use the Granger causality test.

Empirical Literature

According to Okun (1962) initial analysis, a one percent point drop in the unemployment rate would raise output by around 3%. As a result, in order to prevent the loss of unemployment, the economy must constantly expand. Christopoulos (2004) explored the geographical link between output and unemployment in Greece by the use of Okun's law. They used panel data settings to apply contemporary unit root test and cointegration methodologies. The empirical findings indicated that Okun's law can be substantiated in six of the thirteen regions investigated.

Noor *et al.* (2007) investigated whether the Malaysian economy has an Okun type correlation between output and unemployment. The empirical findings revealed that there is a negative link between output and unemployment. Okun's law was further examined by Villaverde Castro and Maza Fernández (2007) for Spain and its seventeen regions from 1980 to 2004. Based on its "gap" definition and two alternative detrending methodologies, the results demonstrate that an inverse link between unemployment and output existed for the majority of Spanish regions and the whole nation. Although the coefficients varied among provinces, they were lower than Okun's original coefficients.

In the Swedish economy, Arshad and Erixon (2010) investigated the link between unemployment and GDP. According to the study, the Okun's law existed in the Swedish economy from 1993 Q1 to 2009 Q2. This study also demonstrated that unemployment and GDP have a long-run and short-run connection. Lal *et al.* (2010) calculated the Okun's coefficient and examined the applicability of Okun's law in several Asian nations from 1980 to 2006. Engle Granger's (1987) co integration approach was utilized to determine the long run connection between variables, while the error correction mechanism (ECM) was used to determine the short run dynamic. Okun's law is not relevant, according to the empirical evidence.

For the period 1970-2008, Kreishan (2011) used simple regression to investigate the relationship between unemployment and economic growth in Jordan using Okun's law. The findings show that Okun's law cannot be applied in Jordan. As a result, it is possible to conclude that Jordan's unemployment problem is not due to a lack of economic growth. Nwakanma (2012) examined the association between output and unemployment using the

first difference and output-gab versions of Okun's regression equations. The study used a vector autoregressive (VAR) method to evaluate this link, and it was discovered that the Okun's coefficient is not significant in the Nigerian economy, but with a positive coefficient.

Hassan and Hossain (2013) investigated if there is an Okun type link between unemployment and real GDP in the Bangladesh economy from 1972/73 to 2009/10. the empirical findings revealed that there is a negative link between output and unemployment. Furthermore, they found out that there was no long-run association between economic growth and unemployment. Bankole and Fatai (2013) calculated the Okun's coefficient and examined the applicability of Okun's law in Nigeria from 1980 to 2008. The Engle granger cointegration test and the Fully Modified OLS were used. The empirical results revealed a positive coefficient in

The regression, showing that Okun's law interpretation is inapplicable to Nigeria. For the period 1970-2010, Elshamy (2013) used co-integration analysis to test the existence of Okun's coefficient in Egypt, both in the long run and in the short run, utilizing the Error Correction Mechanism (ECM). The coefficient proved be statically significant with the predicted sign when Okun's law was evaluated in Egypt in the long and short run. Mosikari (2013) examines the impact of unemployment on South Africa's gross domestic product using annual time series data for the estimating period 1980 - 2011. The variables were found to be one-order integrated. The presence of cointegrating vectors in the variables was determined using the Johansen cointegration test. The findings reveal that the rate of unemployment does not appear to "granger-cause" GDP growth.

Abdul-Khaliq *et al.* (2014) investigated the link between unemployment and GDP growth in Arab nations. Between 1994 and 2010, they looked at nine Arab countries. The Pooled EGLS (Cross-section SUR) model was used to evaluate the association. Economic growth has been demonstrated to have a negative and considerable impact on the unemployment rate. Considering Okun's law, Karfakis *et al.* (2014) examined the nexus between unemployment and output in Greece from 2000 to 2012. Granger causality studies show that real output is crucial for predicting future unemployment trends. During the 13-year period under study, Okun's ratio was determined to be 3:1, meaning that a 1% rise in unemployment was related with a 3% loss in real output.

Over the period 1985 – 2013, Dixon *et al.* (2017) reviewed the Okun correlation between observed unemployment rates and output gaps in OECD nations. The findings confirm that an increased economic growth will not only have the desirable effect of decreasing the aggregate unemployment rate, but it will also have the distributional effect of lowering youth unemployment. With time-series data from 1991 to 2014, Acaroğlu (2018) re-examines Okun's Law in G-20 countries. In most nations, the results reveal an inverse relationship between output and unemployment. However, China, Indonesia, Saudi Arabia, and Turkey do not satisfy the Okun's coefficient. It is acknowledged that the Okun's coefficients of the Group of G-20 countries differ depending on their development frameworks and output heterogeneities.

Using the ARDL model, Makaringe and Khobai (2018) study the influence of unemployment on economic growth in South Africa from 1994Q1 to 2016Q4. The ARDL model's findings imply that unemployment and economic growth have a long-term relationship. The empirical findings indicated that there is a long-term and short-term negative association between unemployment and economic growth. From 1980 to 2018, Onakoya and SEYINGBO (2020) used the Ordinary Least Squares method to investigate the existence of Okun's law in Nigeria, South Africa, and the United States of America. In all three nations, the dynamic version of the law was found to be relevant; however, in Nigeria, the difference version simply demonstrated a lack of relationship between economic growth and unemployment.

2. Data and Methodology

This study tests the Okun's law in South Africa for the period from 1995 to 2020. The study employs the Autoregressive Distributed Lag model (ARDL) Bonds cointegration tests proposed by Pesaran *et al.* (2001) to estimate the Okun's coefficient. Both variables are exposed to unit root tests utilizing Augmented Dickey-Fuller (ADF) test proposed by (Dickey and Fuller 1981), Philips Perron Test (PP) proposed by (Phillips and Perron 1988), and DF-GLS proposed by (Elliott *et al.* 1992). The diagnostic tests are performed to check for stability, serial correlation, heteroscedasticity, and normality using Jarque-Bera statistic.

Model Specification

The model specification to investigate the relationship between unemployment and gross domestic product in South Africa with the perspective of testing Okun' coefficient in the South African case is based on the simple bivariate framework where the relationship is presented as follows:

$$GDP_t = B_0 + B_1 UNEMP_t + \varepsilon_t$$

where: GDP_t is a gross domestic product of the country, $UNEMP_t$ is an unemployment rate of South Africa, and ε_t is an error term. All the under that study are already in percentages.

The model estimated in this study is from Lal *et al.* (2010), Makaringe and Khobai (2018), and Elshamy (2013).

Data Issue

This paper uses an annual time series data to investigate the Okun's coefficient in South Africa from 1995 to 2020. However, since the macroeconomic variables are more likely to carry a random walk, the variables are exposed to unit root tests. The data for the variables is collected from South African Reserve Bank. The Table 1 below shows the description of the variables, Table 2 presents descriptive statistics and Table 3 and Table 4 presents the unit root tests.

Table 1. Description of variables

Variables	Description	Source
$\mathrm{GDP_t}$	Gross domestic product	SARB
$\mathrm{UNEMP_t}$	Unemployment rate	SARB

Source: SARB

Table 2. Descriptive statistics

Variables South Africa	Mean $\pm$ SD	Jarque-Bera Statistic
$\mathrm{GDP_t}$	2.303846 $\pm$ 2.467465	30.45444***
$\mathrm{UNEMP_t}$	24.57308 $\pm$ 2.752099	3.887173

Source: Authors' computation: significant at (*), (**), (***) represent 10%, 5%, 1% respectively

Table 2 presents the descriptive statistics. The results shows that gross domestic product is not normally distributed, and unemployment is normally distributed based on the Jarque-Bera test (Jarque and Bera 1980). The null hypothesis of normality is not accepted at 1%, 5%, and 10% level of significant for gross domestic product and the null hypothesis of normality for unemployment is not rejected at 1%, 5%, and 10%. Nonetheless, the standard deviation obtained indicates robust evidence of high volatility of observations around the mean for unemployment and gross domestic product shows low volatility of observations around the estimated mean.

Unit Root Tests

The literature suggests that the unit root tests should be conducted first in order to determine the order of integration of the variables. This study employed three unit root tests such as Augmented Dickey-Fuller (ADF) (Dickey and Fuller 1981), Philips and Perron unit root test (Phillips and Perron 1988), and DF-GLS unit root test proposed by (Elliott *et al.* 1992). The ADF unit root test was criticised by Glynn *et al.* (2007) due to a failure to allow for an existing structural break leading to bias that decreases the ability to reject a false unit root null hypothesis. ADF and PP unit root tests are biased in favour of inferring that the null hypothesis for unit roots is true when there are structural breaks in the data, according to Perron (1989). In contrast with ADF and PP tests, (Elliott et al., 1992) argued the DF-GLS test is more powerful when a mean or trend is unknown. Further, the null hypothesis for all tests is that the series has a unit root which is evaluated against the alternative hypothesis of no unit root. The unit root tests are evaluated at constant, and constant and trend.

The results for unit root are presents in Table 3 and Table 4. The results for ADF and PP tests are presented in Table 2, and DF-GLS is presented by Table 4. Table 1 and Table 2 indicate that variables are all stationary at I(1), but PP test confirm that unemployment is also stationary at I(0) in presence of a constant only at 10% level of significance. Therefore, since that variables are integrated of the same order, then the ARDL bonds cointegration test introduced by Pesaran *et al.* (2001) is applicable and it selected to estimate Okun's coefficient in South Africa.

Table 3. Unit root tests by ADF, PP

Variables	ADF				PP			
	Constant		Constant & Trend		Constant		Constant & Trend	
	Level	Δ	Level	Δ	Level	Δ	Level	Δ
GDP	0.9443	-4.191***	-1.795	-4.303***	-0.753	-3.918***	-1.736	-4.030**
UNEMP	-2.091	-4.598***	-2.401	-4.482***	-2.638*	-4.598***	-2.790	-4.476***

Source: Authors' computation: significant at (*), (**), (***) represent 10%, 5%, 1% respectively

Table 4. Unit root tests by DF-GLS

Variables	DF-GLS			
	Constant		Constant & Trend	
	Level	Δ	Level	Δ
GDP	-1.236	-4.344***	-2.319	-4.395***
UNEMP	-1.145	-4.084***	-1.930	-4.539***

Source: Authors' computation: significant at (*), (**), (***) represent 10%, 5%, 1% respectively

3. Empirical Results

Table 5. Lag length

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-91.70601	NA	17.16890	8.518729	8.617914	8.542094
1	-76.69214	25.93305*	6.328940*	7.517468*	7.815025*	7.587563*
2	-74.18751	3.870799	7.343474	7.653410	8.149338	7.770236
3	-72.26505	2.621530	9.136593	7.842278	8.536577	8.005834
4	-70.82393	1.703152	12.19298	8.074902	8.967573	8.285189

Source: Authors' computation: significant at (*), (**), (***) represent 10%, 5%, 1% respectively

The Table 5 above presents optimal lag length criterion. The majority of the lag order selection criteria (LR, FPE, AIC, SC, and HQ select the 1st lag order, therefore, the study applied one lag when estimating ARDL model.

Table 5. Bounds test

Country	F-statistics	Critical values					
		1%		5%		10%	
South Africa	2.946380	I(0) 6.84	I(1) 7.84	I(0) 4.94	I(1) 5.73	I(0) 4.04	I(0) 4.78

Source: Authors' computation: significant at (*), (**), (***) represent 10%, 5%, 1% respectively

The study applied ARDL bound test to examine the long run relationship between the variables under the study which involves the estimation of Unrestricted Error Correction Model in the first difference. The results for ARDL bound test are shown in the Table 5. The calculated F-statistics for South Africa is less than the critical values at all levels of significant, therefore, the null hypothesis of no long run cannot be rejected. This implies that the long run ARDL model cannot estimated. Therefore, the estimation technique selected by study is Error Correction Model. These results are consistent to the results obtained by Lal *et al.* (2010), and Elshamy (2013).

Table 6. Error correction form and short run relationship, dependent variable: ΔGDP

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	12.43339	5.107715	2.434237	0.0239
D(UNEMP)	-0.848828	0.352712	-2.406576	0.0254
CointEq(-1)*	-0.601403	0.242050	-2.484626	0.0215

Source: Authors' computation: significant at (*), (**), (***) represent 10%, 5%, 1% respectively

The short run estimates are presented in the Table 6. Unemployment rate has a negative and significant relationship with gross domestic product in the short run in South Africa at 5% level of significant. Therefore, a 1% increase in unemployment rate will lead to 0.85% decrease in gross domestic product in the short run in South

Africa. These results are in line with the results obtained by Okun (1962), Elshamy (2013), although the coefficient is the less than the coefficient found by Okun. The coefficient of error correction term is negative and significant at 5% level. The error correction term suggests a faster adjustment to equilibrium for South Africa. 60% of the previous year's disequilibrium is corrected in the following year in South Africa.

Table 7. Granger causality test

Null hypothesis	Observations	F-Statistics	Prob
UNEMP does not granger cause GDP	24	1.226321	0.5416
GDP does not granger cause UNEMP	24	4.840757	0.0889

Source: Authors' computation: significant at (*), (**), (***) represent 10%, 5%, 1% respectively

According to equation 4 of Okun's regression above, there is a negative relationship between output growth and unemployment, however it does not explain the causality connection between them. Okun (1962) suggested that the variables should exposed to granger causality test that was proposed by Granger (1969) to determine if is there a causality exists in the regression equation. Based on the Table 7, the following conclusions can be made about the direction of the short-run causality between the variables under the study. Gross domestic product does granger cause Unemployment rate, unidirectionally and significantly at 10% level, meaning that the direction causality runs from gross domestic product to unemployment rate in South Africa. Therefore, the movements in GDP have a significant effect on the level of unemployment rate.

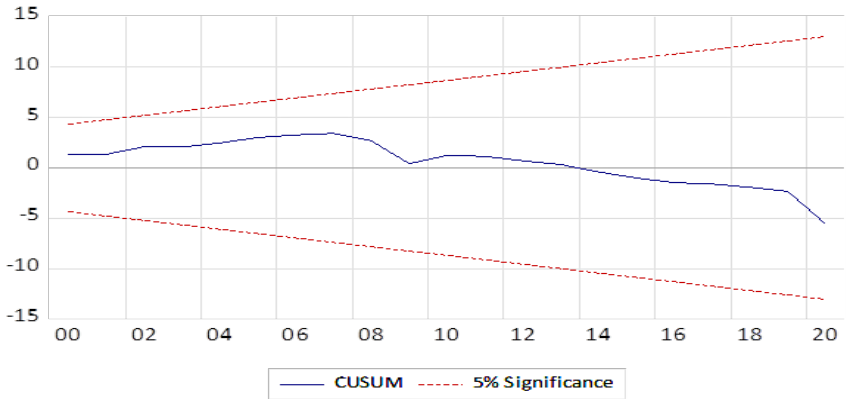
Further, unemployment does not granger cause gross domestic product in based on the finding of this study in South Africa, these results are consistent to the results obtained by Mosikari (2013) on the study investigating the effect of unemployment rate on gross domestic product in South Africa.

Table 8. Diagnostic tests

South Africa	Serial correlation	Heteroscedasticity	Ramsey's RESET test
Statistical test	0.079416	2.438221	0.776366
Probability value	0.778100	0.486600	0.388700

Source: Authors' computation: significant at (**), (***) represent 5%, 1% respectively

Figure 3. CUSUM Test



The variables are exposed to diagnostic tests for serial correlation, heteroscedasticity, model misspecification. The study recruits Breusch-Pagan LM test that was proposed autonomously by Breusch (1978) and Godfrey (1978). The null hypothesis of no serial correlation is tested against the alternative hypothesis of serial correlation. The presence of heteroscedasticity in this study is detected through Glejser (1969) test. The null hypothesis of homoscedasticity is tested against the alternative hypothesis of heteroscedasticity. To make sure that the model is correctly specified, the Ramsey (1969) test is employed by this study to investigate the model misspecification. The null hypothesis for Ramsey Test is that the model correctly specified, and the alternative hypothesis is that the model is not correctly specified. The results in Table 8 clearly show that there is robust evidence of no serial correlation, heteroscedasticity, and model misspecification since the null hypotheses are not rejected. Lastly, the study employed one coefficient stability test that is cumulative sum of recursive residuals (CUSUM) test proposed by (Brown *et al.* 1975). The graph for CUSUM test is shown in Figure 3. The Figure 3 for CUSUM indicates model stability as plots are within the 5% confident interval.

Conclusion

The existing literature gives convincing evidence that Okun's coefficient exists in most countries around the globe. To expand the literature, this study evaluates the Okun's coefficient in the case of South Africa using short run ARDL model which is also known as error correction model for the period from 1995 to 2020. The study used two variables such as unemployment rate as an independent variable and gross domestic product as a dependent variable.

The study has now reached a conclusion to say that Okun's law can be used to explain the South African situation. The results obtained by the study are inline to the results obtained by original analysis of Okun (1962), therefore, any attempt to decrease unemployment will lead to an increase in the output growth of the South African economy. This does not mean that increasing economic growth will absolutely eliminate the problem of unemployment in the South African economy, however, there will be a need to balance labour intensive and capital-intensive jobs. This would help unskilled people to stand a chance to get jobs.

Introducing youth to business and entrepreneurship at a young age might help South Africa overcome its high unemployment rate. This would teach them not to lose focus as they get older. This would teach them about business as they grow older. Furthermore, universities and colleges must provide entrepreneurial courses so that students do not rely solely on the government for employment. This will allow them to create their own businesses after graduation.

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*** SARB. 2020. Gross Domestic Product.

*** StatsSA. 2020. Unemployment rate