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Military Expenditure and Unemployment in South Africa: Evidence from Linear and Nonlinear ARDL with and without Structural Break

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Abstract

This study examined the symmetric and asymmetric effects of military expenditure on the unemployment rate in South Africa using quarterly data from 1994Q1 and 2019Q4. The study adopted the autoregressive distributed lag (ARDL) and nonlinear autoregressive distributed lag (NARDL) frameworks and accounted for structural breaks in the military expenditure-unemployment nexus. The ARDL results revealed that military spending reduces unemployment in the long run for models with and without structural break but aggravates it in the short-run without a structural break. For the nonlinear ARDL results, irrespective of whether we account for a structural break or not, a positive change in military spending increases unemployment while a negative change in military spending reduces unemployment, especially in the long run. This implies that an increase in military spending is detrimental to unemployment reduction, whereas a reduction in military spending would reduce unemployment. Thus, the policy implication of the study is that the government need to prioritise other forms of spending over military spending in its drive to abate unemployment.

Keywords: Military Spending, Unemployment, Linear and Nonlinear ARDL, Structural Break

JEL: E24; E62; O43

1.0. Introduction

The nexus between military spending and unemployment has enjoyed an intensive and extensive study, especially in developed countries as well as some developing and emerging countries (Abell 1990; Dunne and Smith, 1990; Chan and Davis, 1991; Paul, 1996; Dunne and Watson, 2000; Yildirim and Sezgin, 2003; Tang, Lai and Lin, 2009; Malizard, 2014; Zong et al., 2015; Korkmaz, 2015; Becker, 2015; Sanso-Navarro and Vera-Cabello, 2015; Azam et

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al., 2016; Michael and Stelios, 2017; Anoruo, Akpom and Nwoye, 2018; Kollias, Paleologou and Zeremes, 2020; Afolabi, Raifu and Aminu, 2022). Despite this, empirical findings are far from reaching a concrete consensus. Three opposing findings have dominated the literature. One strand of studies shows that military expenditure promotes employment or reduces unemployment (Malizard, 2014-France, Azam, et al. 2015-India, Nepal, Pakistan and Sri Lanka). The other strand of studies reveals that military expenditure is detrimental to employment or worsens unemployment (Dunne and Watson, 2000-South Africa; Yildirim and Sezgin, 2003-Turkey; Kollias, Paleologou and Zeremes, 2020- USA; Raifu, Afolabi and Oguntimehin Jr, 2022-Nigeria). The third strand of studies does not find support for any significant nexus between military spending and unemployment (Smith, 1978; Dunne and Smith, 1990 OECD). The divergence in empirical findings could possibly stem from dichotomised theoretical arguments, the country/countries of study, the measures or transformation of military expenditure, the stage of development of the economy under consideration and the deployed estimation methods (Abell, 1990).

South Africa (hereafter, SA) is one of the countries with the highest unemployment rate in Sub-Saharan Africa. As revealed in Table 1A (Appendix 1), among the top ten economies in Africa, SA has the second-highest unemployment rate after Nigeria, which has an unemployment rate of 33.3% in the fourth quarter of 2020. In specific terms, the unemployment rate in SA stood at 32.5% in the fourth quarter of 2020 (STATS SA, 2020). The level of unemployment among the youth is even more worrisome for they are the most vulnerable to joblessness among the categories of unemployed persons. In the fourth quarter of 2020, the youth unemployment rate for age brackets of 15-25 years and 25-34 years stood at 63.2% and 41.2% respectively.[1] These figures reveal a high level of underutilisation of the capacity of the young population in the country. Apart from the fact that the unemployment is gender-sensitive as male and female unemployment stood at 31.0% and 34.3% respectively, it also varied across the race. Black SA populations are more unemployed than the rest of the race - Coloured, White and Indian/Asia. Black SA population unemployment rate stood at 36.3%. The Coloured SA population recorded the second-highest rate of unemployment which stood at 25.7%, the Indian/Asian followed in the third position with an unemployment rate of 11.8% and the least unemployment among the race is the White with an unemployment rate of 8.8%. Overall, unemployment in SA is precarious (see Figure 2A).

Several studies have attributed the rising rate of unemployment in SA to several factors. Altman (2003) traced the root causes of unemployment in SA to lopsided policies pursued by the Apartheid regime, which promoted a segregated development agenda, especially policies relating to education and the labour market. The employment policy promulgated and backed up by strict labour market requirements and legal restrictions favoured the White population to the detriment of the Black population. After the Apartheid regime, Banerjee et al. (2008) found that the high rate of unemployment is orchestrated by the influx of African women into the labour market, women who lack the requisite skills demanded by the labour market. Also, due

[1] http://www.statssa.gov.za/publications/P0211/Presentation%20QLFS%20Q4_2020.pdf

to the shrinking of some sectors, there is a mismatch between demand for labour (which fell) and the supply of labour, which rose persistently. The increase in women participation in the labour force, according to Casale and Posel (2002), can be attributed to higher levels of education attained by women, a reduction in the percentage of married women and a rising number of single women, who have to feed themselves and their children. For an extensive discussion on the factors responsible for youth unemployment in SA see Cassim and Oosthulzen (2014) and Maskaeva and Msafiri (2021). Summarily, a high rate of youth unemployment is associated with a low level of education among the youth, lack of work experience, skills (both numeracy and communication skills), lack of strong network and social capital and lack of effective policy that would address the youth unemployment (Rankin and Roberts, 2011; Raifu and Afolabi, 2022; Afolabi, 2023).

Table 1A reveals the military expenditure in absolute terms and as a percentage of GDP among the top ten economies in Africa.[2] In 2019, SA's military expenditure expressed as a percentage of GDP stood at 0.98. This means SA spends less than 1% of its GDP on military activities - military personnel and arms and ammunition procurement. This ranks the country number 6 among the top ten economies in Africa whereas Algeria ranked first, followed by Morocco and Angola. However, in absolute terms, SA spent $3.47 billion in 2019 and was ranked the fourth largest military spender among the top ten economies in Africa after Algeria, Egypt and Morocco, which occupied the first, second and third place, respectively. The historical trend of military spending as shown in Figure 1A shows military spending has been on a decline over time. The decline in military spending started toward the end of the Apartheid regime. The decline began around the 1980s and further declined towards the years 2000s. Although the absolute value of military expenditure increased between 2002 and 2012, the military expenditure as a percentage of GDP continued to decline since its first decline in 1988. Many scholars have attributed the decline in military spending to many factors among which is fear of militarisation of the South African political and economic environment; the end of the liberalisation struggle; the end of the Namibian War of Independence; disarming and establishment of civilian control in the SA society after the Apartheid era; and the worst economic experience during the period between the 1980s and 1990s (see Husseini, 2019). The decline in military spending could lead to a drastic reduction in the employment of highly skilled workers, dominated mainly by White workers in the defence industry (Dunne and Smith, 2000).

Based on the above argument, the current study examines the symmetric and asymmetric relationship between military spending and unemployment in SA. Most of the studies regarding the military expenditure and the economy of SA are dominated by studies that examined either causality between military spending and economic growth or the impact of military spending on economic growth (Dunne and Vougas, 1999; Batchelor, Dunne and Saal, 2000; Mosikari and Matlwa, 2014; Aye et al., 2014; Phiri, 2019; Saba and Ngepah, 2019). One notable study that examined the nexus between military spending and employment is conducted by Dunne and

[2] See the bottom of Table 1 for sources of data

Watson (2000). However, the authors only focused on the linear relationship between military spending and employment. The trend of military spending and unemployment in SA over time appears nonlinear. Dr Tian observed that the military spending since 1998 has followed a U-shaped pattern, suggesting that military spending has been experiencing ups and downs since the aforementioned date.[3] Also, the unemployment rate has not followed a linear trend in SA over time. The two variables, like many other macroeconomic variables, might have experienced structural change over time. Hence, modelling the two variables linearly would result in spurious regression (Phiri, 2019). In fact, Hooker and Knetter (1994) previously submitted that the relationship between military spending and unemployment is not linear as the periods of larger spending on procurement of ammunition may elicit larger unemployment responses due to the multiplier effect of military spending. Thus, we contribute to existing studies by examining whether the period of increase in military spending in SA is associated with a decline in unemployment and vice versa for the periods of decline in military spending.

Our contributions are in two folds. First, we examine the issue of structural stability by testing for the existence of a structural break in the relationship between military spending and unemployment including other control variables included in the estimation. Aye et al. (2014) explained the possibilities of a structural break in the nexus between military spending and economic growth in SA. According to them, the position of SA in sub-Saharan Africa, the military build-up during the apartheid regime and its decline post-apartheid regime were the major factors responsible for the structural break. To test for a structural break, we use a novel Gregory-Hansen co-integration structural break approach. Second, we account for a structural break in both the estimation of a linear and nonlinear effect of military spending and unemployment based on the year the structural break occurred.

The rest of the study is structured as follows. In section 2, we briefly review existing studies and presented the methodology and data sources in Section 3. In section 4, empirical findings are presented while section 5 concludes with policy implications.

2.0. Literature Review

The literature is replete with studies on the theoretical and empirical nexus between military expenditure and unemployment. However, no consensus has been reached on this relationship. Various schools of thought (such as the Keynesian, Neo-classical and Marxist schools) have emerged to appropriately situate the theoretical link between military expenditure and unemployment within the context of existing theories such as Wagner's Law and Keynesian theory, among others. Wagner's law posits that an increase in the per capita income of a country is often associated with an increase in the share of government expenditure, indicating that causality runs from economic growth to government expenditure. Conversely, the Keynesians posit that government expenditure, a component of fiscal policy, can serve as a policy tool for stimulating economic growth, indicating that causality runs from government expenditure to economic growth.

In the context of this study, however, Wagner's law suggests causality running

[3] https://www.army-technology.com/features/south-african-military-spending/

from unemployment to military expenditure while the Keynesians' theory suggests the converse. The basic idea behind the Keynesian school of thought is that as government raises its expenditure, household disposable income would also increase as well as the firms' investment, which would generate employment. Consequently, as disposable income rises, households' demand (consumption) will also increase and prompt firms to increase their production level to meet the increasing demands of consumers. As the production level rises, more labour would be required in the production process and this will ultimately reduce the unemployment rate.

On the other hand, the neoclassical theorists argued that the state is rational thus, it weighs the costs and benefits of military expenditure for the purpose of maximizing national interests. Intuitively, the state will increase military expenditure if and only if the benefit of doing so outweighs the cost and vice versa. However, the Keynesian and institutional theories postulate that the effective utilization of military expenditure would have a multiplier effect on output and employment, by extension (Dunne and Uye, 2010). The Marxists argued that investment in the defense sector helps countries preserve the capitalist mode of production and its level of profitability (Coulomb and Bellais, 2008). Whereas military expenditure negatively affects capitalist economies, it increases aggregate demand without affecting aggregate supply thereby, raising product prices and firms' profitability (Riddle, 1986).

Another school of thought identified four main channels through which military expenditure affects unemployment: the socio-political structure, organization of production, resource allocation and mobilization, and international relations. It argued that the short-run impact of increased military spending is to stimulate growth and reduce unemployment (via its demand expansion effects) while its long-run impact is to stifle growth and worsen unemployment (through its supply-side effects on the change in production and investment). However, the magnitude of the impact depends on whether the country is demand- or supply-constrained, the prevailing political economy in the country, forms of organizations in the firms, and the needs the military expenditure meet, among others (Smith and Georgiou, 1983).

With regards to empirical evidence on the military expenditure-unemployment nexus, there is overwhelming evidence that military spending aggravates unemployment (Abell, 1990; Paul, 1996; Azam et al., 2015; Korkmaz, 2015; Michael and Stelios, 2017; Ahmad and Khan, 2018; Saba and Ngepah, 2019; Kollias et al., 2020; Oji and Afolabi, 2022) although some studies found no significant relationship between the two macroeconomic variables (Dunne and Smith, 1990; Yildirim and Sezgin, 2003). Smith and Georgiou (1983) argued that the transmission mechanism through which military spending affects unemployment is the investment channel because military spending crowds out investment and, in turn, aggravates unemployment due to the limited technological spin-offs it generates. However, a few studies have shown that the military expenditure-unemployment nexus depends largely on the nature of the spending, existing government policies and predominant circumstances as well as on whether the type of technology deployed in military operations is labour intensive or otherwise, as the acquisition of high-technology labour-saving weapons could worsen unemployment (Smith and Georgiou, 1983; Yildirim and Sezgin, 2003; Afolabi, 2023).

Moreover, Anoruo et al. (2018) and Gül and Torusdağ (2020) found that the effect of military expenditure on unemployment is sensitive to the prevailing inflation regimes in each country as military expenditure was found to be employment-enhancing during low inflation regimes but unemployment-worsening during high inflationary periods. Similarly, Abouelfarag and Qutb (2020) found that both non-discretionary and discretionary government expenditure have a positive relationship with unemployment with the employment-inhibiting effect of discretionary government expenditure being largely explained by the volume of government subsidies and workers' wages and salaries. This suggests the need for government intervention in abating unemployment as it could lead to a surge in social vices. As such, Bagchi and Paul (2017), Oji and Afolabi (2022) and Raifu et al. (2022) attributed the increased domestic and transnational terrorism to the increase in youth employment, which is partly caused by increased military spending.

Nonetheless, some studies showed that military spending has a greater impact on unemployment than non-military spending (Malizard, 2014; Khan et al., 2015; Qionga and Junhua, 2015; Michael and Stelios, 2017). The observed difference in the impact of military and non-military spending on unemployment is explained by the fact that most countries designate their defense budget to ensure increased personnel welfare, enhanced military training conditions, improved investment in ammunitions and enhanced support for military reforms, all of which have implications for unemployment (Yildirim and Sezgin, 2003; Qionga and Junhua, 2015). On the other hand, most developed countries devote a large proportion of their defense budget to the acquisition of modern military weaponry and equipment to fortify their army and foster national security (Abell, 1990; Oji and Afolabi, 2022; Raifu et al., 2022).

With regards to the causality between military spending and unemployment, a number of studies documented unidirectional causality (Tai et al., 2009; Zhong et al, 2015), causal dependence (Zhong et al., 2015) and causal independence (Chan and Davis, 1991; Payne and Ross, 1992). Paul (1996) attributed the mixed findings across countries to the differences in the fiscal structure, economic policies, historical factors and state capacity in each country. For the United States, Paul (1996) explained that the US spends about 13 percent of its defense budget on protecting the US borders while the rest is spent on containing communism and protecting the economic interests of the country. Thus, a change in defense expenditure is unlikely to affect employment in the country. The same is true for other countries with similar features to the US. On the other hand, Sanso-Navarroa and Cabello (2015) argued that the causality between military expenditure and unemployment is significant in countries where a large proportion of their defense budget is devoted to personnel. Overall, Dunne and Smith (1990) warned against the superfluity of the dystopian fear that lower military spending will raise the average unemployment rate.

3.0. Methodology and Data Sources

3.1. Methodology

To model the linear and nonlinear effect of military expenditure on unemployment with and without a structural break in South Africa, we employ a series of preliminary tests and estimation techniques. The preliminary tests include descriptive statistics, a correlation test, unit root tests (Augmented Dickey-Fuller

test, Phillips-Perron test and Zivot-Andrew test,) Gregory-Hansen co-integration test and BDS nonlinearity test. We do not present the econometric frameworks of some of these tests, we only present ARDL and NARDL estimation frameworks.

3.1.1. ARDL and NARDL Frameworks

To model the linear and nonlinear effect of military spending on unemployment in South Africa, we follow the theoretical exposition of Dunne and Smith (1990), Dunne and Watson (2000) and a host of other studies such as Abell (1992), Hooker and Kneller (1994), Paul (1996), Yildirim and Sezgin (2003), Malizard (2014) and Azam et al. (2016) to specify the baseline model which depicts unemployment as a function of military expenditure, real GDP, consumer price index (inflation rate) and real wage as follows:

$$UN = f\,(ME, RGDP, CPI, WG) \quad (1)$$

Where UN is the unemployment rate measured in percentage; ME denotes military expenditure measured in US$; RGDP is the real gross domestic product capturing the performance of economic activities and it is measured in US$; CPI represents consumer price index, which is used to capture inflation rate; and WG is the real wage measured in US$. On the a priori ground, military expenditure can have a mixed effect on unemployment. As argued by Dunne and Watson (2020), increase in military spending can have a crowding-out effect. Thus, military spending can worsen the unemployment situation (Zhong et al., 2015). The possibility still exists that an increase in military spending can ginger investment, growth and employment. In this regard, an increase in military spending can aid the procurement of arms and ammunition that foster the security of the society, where investors can have the confidence to invest. When investment increases, economic activities would soar and lead to employment creation. Thus, an increase in military expenditure can reduce unemployment (Dunne, 1996). In the case of RGDP, based on the famous Okun's law, we expect economic growth to have a negative effect on unemployment. Phillips curve hypothesis shows an inverse relationship between inflation and unemployment. Thus, we expect inflation rate to have a negative effect on unemployment. With regards to real wage, its effect could be positive or negative depending on the economic school of thought one considers. In line with the classical theory of wages and employment, a wage increase would worsen unemployment because it raises the cost of production, lowers the firm's output and eventually employment. Thus, wage reduction stimulates employment. Conversely, the Keynesian theory of wages and employment posits that a wage increase stimulates employment and reduces unemployment provided the general price level increases, making the real wages remain constant (see Raifu, 2017; Ogunjimi, 2021).

The equation can be transformed into an econometric model as follows:

$$UN_t = \alpha_0 + \alpha_1 ME_t + \alpha_2 RGDP_t + \alpha_3 CPI_t + \alpha_4 WG + \varepsilon_t \quad (2)$$

Where α_0 is a constant term while α_1, α_2, α_3 and α_4 are estimated parameters showing the long-run effect of military expenditure, real GDP, consumer price index and real wage rate on unemployment, respectively. ε is the error term assumed to be normally distributed.

Following the theoretical econometric developed by Pesaran, Shin and Smith (2001)

and other empirical studies that had applied the Autoregressive Distributed Lag Model such as Dunne (2000), Raifu and Raheem, (2018); Aminu and Raifu (2019); Aminu and Ogunjimi (2019); Ogunjimi and Amune (2019); Ogunjimi (2019); Raifu and Aminu (2020); Raifu, Aminu and Folawewo (2020); Ogunjimi (2020a, 2020b) and Raifu (2021), we incorporate the short-run dynamic model into the long-run model of equation 2 to form the ARDL model specified as follows:

$$\begin{aligned}\Delta UN_t = {} & \alpha_0 + \alpha_1 UN_{t-1} + \alpha_2 ME_{t-1} + \alpha_3 RGDP_{t-1} \\ & + \alpha_4 CPI_{t-1} + \alpha_5 WG_{t-1} + \sum_{i=1}^{l} \theta_1 UN_{t-1} \\ & + \sum_{i=0}^{n1} \theta_2 \Delta ME_{t-1} + \sum_{i=0}^{n2} \theta_3 \Delta RGDP_{t-1} \\ & + \sum_{i=0}^{n3} \theta_4 \Delta CPI_{t-1} + \sum_{i=0}^{n4} \theta_5 \Delta WG_{t-1} + \varepsilon_t \end{aligned} \quad (3)$$

Equation 3 is replicated but now we account for the structural break as follows:

$$\begin{aligned}\Delta UN_t = {} & \alpha_0 + \alpha_1 UN_{t-1} + \alpha_2 ME_{t-1} \\ & + \alpha_3 RGDP_{t-1} + \alpha_4 CPI_{t-1} \\ & + \alpha_5 WG_{t-1} + \varphi D + \sum_{i=1}^{l} \theta_1 UN_{t-1} \\ & + \sum_{i=0}^{n1} \theta_2 \Delta ME_{t-1} + \sum_{i=0}^{n2} \theta_3 \Delta RGDP_{t-1} \\ & + \sum_{i=0}^{n3} \theta_4 \Delta CPI_{t-1} + \sum_{i=0}^{n4} \theta_5 \Delta WG_{t-1} + \varepsilon_t \end{aligned} \quad (4)$$

Where Δ is the first difference operator, α_0 is a constant known as the drift component of the model. α_1 to α_5 denote the long-run coefficient parameters, which show the effect of lags of unemployment, military expenditure, real GDP, inflation rate and real wage on the unemployment rate, ϕ is a coefficient parameter of a dummy variable that capture structural break, D is the dummy variable which takes the value 0 before the break occurs and 1 thereafter. and θ_1 to θ_5 captures the short-run coefficient parameters of all independent variables on the dependent variable.

The above ARDL specification shows the symmetric effect of military spending on unemployment in the short- and long-run but, fails to capture the unemployment effect of an increase/decrease in military spending. Given this drawback, Shin, Yu and Greenwood-Nimmo (2014) developed a nonlinear ARDL to capture the asymmetric effect of the independent variable(s) on the dependent variable. The specification of the nonlinear ARDL long-run model is as follows:

$$\begin{aligned}UN_t = {} & \alpha_0 + \alpha_1 ME_t^+ + \alpha_2 ME_t^- + \alpha_3 RGDP_t \\ & + \alpha_4 CPI_t + \alpha_5 WG + \varepsilon_t \end{aligned} \quad (8)$$

Where α_0 to α_5 are vectors of estimated long-run coefficients. ME_t^+ and ME_t^- are positive and negative changes in military expenditure, respectively. Military expenditure is decomposed into positive and negative components as follows:

$$\begin{aligned} ME_t^+ &= \sum_{j=1}^{t} \Delta ME_j^+ = \sum_{j=1}^{t} \max(\Delta ME_j, 0) \\ ME_t^- &= \sum_{j=1}^{t} \Delta ME_j^- = \sum_{j=1}^{t} \min(\Delta ME_j, 0) \end{aligned} \quad (9)$$

Equation 8 can be presented in NARDL form as follows:

$$\begin{aligned}\Delta UN_t = {} & \alpha_0 + \alpha_1 UN_{t-1} + \alpha_2^+ ME_{t-1}^+ + \alpha_3^- ME_{t-1}^- \\ & + \alpha_4 RGDP_{t-1} + \alpha_5 CPI_{t-1} + \alpha_5 WG_{t-1} \\ & + \sum_{i=1}^{l} \theta_1 \Delta UN_{t-1} + \sum_{i=0}^{n1} \theta_2^+ \Delta ME_{t-1}^+ \\ & + \sum_{i=0}^{n2} \theta_3^- \Delta ME_{t-1}^- + \sum_{i=0}^{n3} \theta_4 \Delta RGDP_{t-1} \\ & + \sum_{i=0}^{n4} \theta_5 \Delta CPI_{t-1} + \sum_{i=0}^{n5} \theta_6 \Delta WG_{t-1} + \varepsilon_t \end{aligned} \quad (10)$$

The NARDL with structural break is specified as follows:

$$\Delta UN_t = \alpha_0 + \alpha_1 UN_{t-1} + \alpha_2^+ ME_{t-1}^+ + \alpha_3^- ME_{t-1}^- + \alpha_4 RGDP_{t-1} + \alpha_5 CPI_{t-1} + \alpha_5 WG_{t-1} + \varphi D + \sum_{i=1}^{l} \theta_1 \Delta UN_{t-1} + \sum_{i=0}^{n1} \theta_2^+ \Delta ME_{t-1}^+ + \sum_{i=0}^{n2} \theta_3^- \Delta ME_{t-1}^- + \sum_{i=0}^{n3} \theta_4 \Delta RGDP_{t-1} + \sum_{i=0}^{n4} \theta_5 \Delta CPI_{t-1} + \sum_{i=0}^{n5} \theta_6 \Delta WG_{t-1} + \varepsilon_t \quad (11)$$

Where α_0 is a constant, l and $n's$ are lag operators, α_2^+ and α_2^- are the long-run parameter coefficients which capture the impact of increase and decrease in military spending on unemployment in the long run, respectively. $\sum_{i=0}^{n2} \theta_2^+$ and $\sum_{i=0}^{n2} \theta_2^-$ are the short-run coefficient parameters, which depict the effect of increase and decrease in military expenditure on unemployment, respectively. $\beta^+ = \frac{\alpha_2^+}{\rho}$ and $\beta^- = \frac{\alpha_3^-}{\rho}$ capture the asymmetric effect of military expenditure on unemployment in the long run. The null hypothesis of the long-run asymmetric test can be stated as: $\rho = \alpha^+ = \alpha^- = 0$. The null hypothesis is tested against the alternative hypothesis stated as: $\rho = \alpha^+ \neq \alpha^- \neq 0$. If the null hypothesis is rejected based on the F-test probability value from the Wald test, then there is a long-run asymmetric nexus between military spending and unemployment, otherwise, there is no asymmetric effect between the two variables. Similarly, we check for the short-run asymmetry between the two variables by testing the null hypothesis specified as: $\rho = \theta^+ = \theta^- = 0$ against the alternative hypothesis $\rho \neq \theta^+ \neq \theta^- \neq 0$. The lag length is selected using the Akaike Information Criterion (AIC)

3.2. Data Sources

The primary aim of this study is to explore the linear and nonlinear effects of military spending on unemployment in South Africa, taking into consideration the issue of a structural break in the data generating process. We used quarterly data that covers the period from 1994Q1 to 2019Q4. This period was chosen based on the availability of relevant data. The variables used include: military spending in absolute value (US$), unemployment rate (%), real gross domestic product (US$), consumer price index (%) and wage rate (US$). As regards the sources of data, military spending (US$) is extracted from the Stockholm International Peace Research Institute (SIPRI), unemployment rate, real GDP, consumer price index and wage are sourced from the South African Reserve Bank database under the section of Economic and Financial Statistics for South Africa.[4] It is important to mention that while we have a series such as unemployment rate, real GDP and real wage on a quarterly basis, the military spending is an annual series. Consequently, we converted the annual series of military spending to quarterly series using a quadratic match average. Quadratic match average entails performing a local proprietary quadratic interpolation of the low-frequency data to fill in the high observations (Raifu et al., 2020). Also, the consumer price index is converted from monthly data to quarterly data using an average of first-fourth quarter data.

4.0 Empirical Findings

4.1. Summary Statistics

The statistical properties of the variables of interest in this study are shown in Table

[4] https://www.resbank.co.za/en/home/what-we-do/statistics/releases/economic-and-financial-data-for-south-africa#footnote

1. It shows that the unemployment rate is relatively high, ranging between 16.9 and 29.3 percent with an average of 24.3 percent. The high unemployment rate in South Africa could be explained by strict labour laws, apartheid-era spatial planning and the weak educational system, which fails to empower graduates with requisite labour market skills. Similarly, the consumer price index (CPI) ranged between 25.5 and 113.6, indicating the prevalence of a high inflation rate, which lowers the purchasing power of consumers as well as the value of real money balances in South Africa. In addition, wages ranged from US$3.85 million to US$15.5 million, denoting a huge income gap among the residents of South Africa. The real GDP, a measure of economic performance, averaged US$321 trillion, positioning South Africa as the second-largest economy in Africa, after Nigeria, in terms of GDP. Nonetheless, South Africa spends an average of US$3.2 million annually on its military. This relatively low military expenditure could be attributed to the relative peace South Africa has experienced in recent decades post-apartheid.

Table 1. Descriptive Statistics

Variables	Obs	Mean	Std.Dev.	Min	Max	p1	p99	Skew.	Kurt.
Unemployment Rate (%)	104	24.288	2.859	16.900	29.300	16.900	29.300	-0.617	3.151
Military Spending (USD)	104	3.183	0.840	1.650	4.630	1.690	4.630	-0.389	2.192
Real GDP (USD)	104	321000	77580.750	178000	476000	193000	475000	0.139	2.138
Consumer Price Index	104	62.227	25.912	25.540	113.570	25.990	113.100	0.427	1.956
Wage (USD)	104	9.260	3.200	3.850	15.509	4.264	15.207	0.097	1.705

Source: Computed by the authors

4.2. Correlation Matrix

Correlation indicates the direction and degree of relationship between variables and also signals the possibility of multicollinearity. The correlation result is shown in Table 2, which reveals a weak negative relationship between unemployment and military expenditure but a strong negative relationship between unemployment and real GDP. This indicates that an expansionary fiscal policy in favour of military expenditure or a positive economic growth not only equips the military to combat insecurity but also pulls out the populace from the unemployment pool. However, unemployment has a statistically significant positive association with consumer price index and wage in South Africa. It is noteworthy that military expenditure has a significantly strong positive association consumer price index and wage but a weak positive association with real GDP in South Africa. Overall, the correlation result suggests the possibility of not encountering a multicollinearity problem since most of the variables are moderately correlated.

Table 2. Correlation Matrix

Pairwise correlations					
Variables	**UNP**	**MIL**	**RGDP**	**CPI**	**WAGE**
Unemployment Rate (%)	1.000				
Military Spending (USD)	-0.031	1.000			
Real GDP (USD)	-0.753*	0.267*	1.000		
Consumer Price Index	0.649*	0.584*	-0.562*	1.000	
Wage (USD)	0.313*	0.874*	-0.018	0.834*	1.000
* shows significance at the 0.05 level; Note: UNP, MIL, MIL_GDP, RGDP CPI and WAGE are unemployment rate, military spending in dollar value, military spending as a percentage of GDP, real GDP, consumer price index and real wage respectively					

Source: Computed by the authors

4.3. Unit Root Tests

Unit root tests are conducted to check the stationarity properties of variables of interest to avoid spurious results. Accordingly, this study conducted unit root tests using the Augmented Dickey-Fuller (ADF) and Philip Perron (PP) approaches and their results are presented in Table 3A. The Zivot-Andrew unit root test was also conducted to account for structural breaks in the series and its results are presented in Table 3B. From the PP results in Table 3A, all the variables contain unit root but became stationary after first difference. However, the ADF results show that only consumer price index (CPI) is stationary at level while unemployment, military expenditure, wage and real GDP are stationary at first difference. This mixed order of integration justifies the use of the ARDL and NARDL frameworks.

The results of the Zivot-Andrew unit root tests with structural breaks, reported in Table 3B, show that only unemployment rate is stationary at level while all other variables are stationary at first difference. This finding gives credence to the earlier result showing a mixed order of integration and the absence of an I(2) series. However, with regards to structural breaks, all the variables have a varying period of break across intercept, trend and both. But for our variables of interest (unemployment and military expenditure), breaks in the first quarter of 2004 and the second quarter of 2002 are common. The events leading to these breaks are diverse. For unemployment whose break was in the first quarter of 2004, the unemployment rate plummeted to 24.7 percent as South Africa was ranked among the top ten countries with the highest unemployment rate in the world. The high unemployment in South Africa was attributed to the legacy of apartheid-era distortions, high population growth rate and growing market rigidities (Klasen and Woolard, 2008). On the other hand, the structural breaks in military expenditure (US$) in the second quarter of 2002 is explained by the fear of militarisation of the South African political and economic environment and the signing of the Strategic Defence Acquisition with the African National Congress by the South African Department of Defence in which military equipment and weapons worth R$30 billion were procured (Husseini, 2019).

Table 3A. Unit Root Test Results

	Level			First Difference			Decision
	WC	WC&T	WDC&T	WC	WC&T	WDC&T	
Augmented Dickey-Fuller Unit Root Test							
Unemployment Rate	-2.124	-2.732	0.640	-11.137***	-11.082***	-11.129***	I(1)
Military Spending	-1.796	-2.650	-0.470	-2.778*	-2.741	-2.793***	I(1)
Real GDP	-1.708	-2.014	-1.207	-8.046***	-8.005***	-8.007***	I(1)
Consumer Price Index	-1.644	-3.272*	4.750	-6.190***	-6.392***	-2.915***	I(0)
Wage	-1.105	-1.591	0.946	-8.453***	-8.417***	-8.401***	I(1)
Phillips-Perron Unit Root Test							
Unemployment Rate	-2.061	-2.556	0.824	-11.423***	-11.358***	-11.221***	I(1)
Military Spending	-1.352	-2.021	-0.383	-4.267***	-4.266***	-4.286***	I(1)
Real GDP	-1.720	-1.995	-1.036	-8.016***	-7.975***	-7.978***	I(1)
Consumer Price Index	-1.915	-2.803	10.727	-6.264***	-6.392***	-2.479**	I(1)
Wage	-1.221	-1.943	0.784	-8.455***	-8.420***	-8.389***	I(1)

Notes: (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1%. and (no) Not Significant *MacKinnon (1996) one-sided p-values. Note: WC, WC&T and WDC&T denote with constant, with constant & trend, and without constant & trend respectively

Table 3B. Unit Root with Structural Break Results (Zivot-Andrew)

	Break (Intercept)		Break (Trend)		Break (Both)	
Variable	Level	First Difference	Level	First Difference	Level	First Difference
UNP	-4.005 (2004q3)	-11.436*** (2003q3)	-3.902 (1998q2)	-11.115*** (1998q1)	-5.625** (2004q1)	-11.826*** (1998q3)
MIL	-4.324 (2002q2)	-5.512*** (2002q2)	-3.143 (2011q2)	-5.178*** (2003q2)	-4.572 (2002q2)	-5.696*** (2002q2)
RGDP	-3.661 (2003q1)	-9.107*** (2002q2)	-2.430 (2011q1)	-8.159*** (2004q1)	-4.523 (2003q1)	-9.158*** (2002q2)
CPI	-3.814 (2008q1)	-6.921*** (2006q2)	-3.674 (2015q3)	-6.517*** (1999q3)	-4.053 (2008q1)	-6.959*** (2006q2)
WAGE	-3.508 (2003q1)	-9.484*** (2002q2)	-2.275 (2011q)	-8.529*** (2004q1)	-3.947 (2003q1)	-9.572*** (2002q2)

Note: *, ** and *** represent 1%, 5% and 10% level of significance respectively. UNP, MIL, RGDP, CPI and WAGE are unemployment rate, military expenditure, real GDP, consumer price index and wage respectively

4.4. Gregory Hansen Co-integration Test

The Gregory-Hansen co-integration test was carried out to determine the long-run relationship among the variables of this study and its result is reported in Table 4. The results of the ADF and Zt tests for both models confirm the existence of co-integration among the variables, indicating that the variables converge in the long run

albeit with structural breaks. The ADF and Zt tests show breaks in the second quarter of 2002 and the first quarter of 2004 for level and regime respectively for the military spending-unemployment model. Thus, dummy variables are generated using the first quarter of 2002 and thereafter incorporated into the ARDL and NARDL models.

Table 4. Gregory-Hansen Co-integration

	Military Spending and Unemployment		
	Break k(Level)	**Break (Trend)**	**Break (Regime)**
ADF	-5.750** (2002q2)	-5.880** (2007q4)	-6.620** (2004q1)
Zt	-6.130*** (2002q2)	-6.230** (2007q4)	-6.660** (2004q1)
Za	-52.430(2002q2)	52.840 (2007q4)	-59.830 (2004q1)

Note: *, ** and *** represent 1%, 5% and 10% level of significance respectively.

4.5. Brock-Dechert-Scheinkman (BDS) Test

The BDS test is used to test whether the variable is linear and nonlinear in order to choose the right model for estimation. Basically, the BDS test tests the null hypothesis which states that the series is linearly dependent against the null hypothesis, which states that the series is non-linearly dependent. The null hypothesis will be rejected if the probability value of the Wald statistics of the variables is less than 5 percent but accepted if otherwise. Accordingly, the BDS test result in Table 5 shows that the probability values of all the variables are less than 5 percent, thus, the null hypothesis is rejected. This implies that all the variables are non-linearly dependent. This justifies the estimation of the NARDL model.

Table 5. BDS Test Result

Length of SD (σ^2)	Embedding Dimension (m)	Wald Statistics of the Variables					
		UNP	MIL	RGDP	CPI	WAGE	U1
0.5	2	26.580***	44.103***	59.415***	350.162***	151.165***	34.535***
0.5	3	37.173***	72.852***	95.327***	711.553***	257.005***	53.225***
0.5	4	55.145***	129.263***	161.738***	1606.871***	472.925***	88.507***
0.5	5	87.302***	247.240***	302.729***	3985.668***	941.949***	154.630***

Note: *, ** and *** represent 1%, 5% and 10% level of significance respectively. In U1, unemployment rate is regressed on independent variables and the residual is obtained. The linear dependence test is conducted on the residual using BDS test.

4.6. ARDL and NARDL Estimation Results

The estimation results of the ARDL and NARDL models (with and without structural breaks) on the military expenditure-unemployment nexus in South Africa are presented in Table 6. Given that we account for structural breaks in this study in both the ARDL and NARDL models, a total of four models were estimated. First, the Bounds test results corroborate the Gregory-Hansen co-integration test results, which showed a long-run relationship among all the variables across all models irrespective of the

presence/absence of a structural break. This indicates that military expenditure indicators, unemployment, real GDP, wage and consumer price index do not diverge in the long run. However, the speed of adjustment from a shock to unemployment in each model, measured by their respective error correction terms, is moderate across the models but higher in the models with structural breaks. This indicates that accounting for structural breaks in the determination of the military expenditure-unemployment nexus in South Africa aids the speed at which variables converge to the long-run equilibrium after a short-term shock.

For the short-run analysis, the ARDL model results show that military expenditure has an insignificant positive relation with unemployment in the model without a structural break but a significant inverse relation with unemployment in the model with a structural break. However, the relationship became significantly positive for both models when the first period lag of military expenditure was accounted for such that an increase in military expenditure by US$1 in the immediate past period will lead, on the average, to about 0.3 percent increase in unemployment rate in the current period. The finding parallels the findings of Yildirim and Sezgin (2003) for Turkey, Malizard (2014) for France, and Qionga and Junhua (2015) for China. This positive relationship between unemployment and military expenditure signals the unemployment-worsening effect of military expenditure in South Africa. Put differently, rather than reduce the unemployment rate, an increase in military expenditure worsens it in South Africa.

With regards to the NARDL model, which decomposed military expenditure into positive and negative sums, positive changes in military expenditure has a positive and significant impact on unemployment for both the models with and without a structural break while negative changes in military expenditure have an inverse and significant effect on unemployment for both models. This indicates that military expenditure and unemployment move in the same direction in South Africa such that when military expenditure increases, unemployment rises and vice versa. It is important to note that the magnitudes of the impact of positive and negative changes in military expenditure of models with a structural break exceeds the magnitudes in models without a structural break. This corroborates the findings of the ARDL models even though the NARDL estimates have higher coefficients than the ARDL models'.

Worthy of mention is the Wald test results, which indicate the existence of short-run and long-run asymmetries in the models with structural breaks and only one of the models without a structural break. This shows that positive and negative changes in military expenditure have different effects on the unemployment rate in South Africa. Moreover, in accounting for structural breaks, we generated dummy variables to depict the periods of break and estimated them in the ARDL and NARDL models. The coefficients of the dummy variables are not statistically significant but its third period lag was significant for only the ARDL model, signalling the importance of accounting for a structural break in the short-run linear analysis of the military expenditure-unemployment nexus.

With regards to other explanatory variables, their results are mixed across the models. For example, the statistically significant negative coefficients of real GDP, in line with Okun's law, indicate an inverse relationship between real GDP and unemployment with the coefficients being close to unity, implying that unemployment responds sharply to a change in real GDP. In addition, the positive coefficients of the consumer price index (CPI) imply that unemployment worsens as inflation rises. This finding corroborates the postulation of the Phillips curve, suggesting the validity of the Phillips curve in South Africa. However, lagged values of CPI showed an inverse relationship between unemployment and CPI, indicating a trade-off between past inflation rates and present unemployment rate. More so, the results show that wage has a significant positive relationship with unemployment in South Africa. This result is plausible because an increase in the wage rate will lead to an increased supply of labour as against the demand for labour (excess supply of labour), which ultimately leads to increased unemployment given the limited capacity of employers to absorb more labour. It is noteworthy that the magnitude of the impact of wage on unemployment is higher in the model with a structural break.

For the long run results, military expenditure has a significant inverse relationship with unemployment both for the models with and without a structural break. Similarly, when military expenditure is decomposed into positive and negative sums, both the positive and negative changes in military expenditure have inverse relationship with unemployment although the relationship of the positive change in military expenditure is insignificant for the model with a structural break. However, the long-run coefficient of the dummy variable is statistically significant for the NARDL model, indicating the importance of accounting for a structural break in the non-linear long-run analysis of military expenditure-unemployment. The results further showed that all the models have high predictive power although the models with structural breaks have slightly higher predictive power than the models without a structural break. More so, the probability values of the F-Statistic show that all the explanatory variables jointly influence unemployment.

We conducted diagnostic tests to validate the reliability of the findings. The results of the normality test show the normal distribution across all estimated models while the serial correlation results together with the Durbin Watson results show the absence of serial correlation in the estimated models. The results of the heteroscedasticity tests show that the errors are homoscedastic while the results of the Ramsey Reset tests show correct specification across all the estimated models. These results are desirable as they confirm the reliability of the findings for policy formulation and implementation. The CUSUM test results show model stability across all the models while the CUSUM square test results show model stability for only one of the four estimated models. Interestingly, this does not in any way undermine the validity and reliability of our findings.

Table 6. ARDL and NARDL Model Estimation Results

	ESTIMATES WITHOUT STRUCTURAL BREAK		ESTIMATES WITH STRUCTURAL BREAK	
Parsimonious Lag Length	**ARDL(1, 2, 1, 3, 1)**	**NARDL(1, 1, 1, 0, 2, 0)**	**ARDL(1, 2, 1, 3, 1, 4)**	**NARDL(1, 2, 1, 0, 2, 0, 1)**
SHORT-RUN				
Constant	9.094 (0.1176)	14.628*** (0.0088)	7.796 (0.1884)	13.014**(0.0111)
D(MIL)	0.002 (0.9892)		-0.325** (0.0497)	
D(MIL(-1))	0.266* (0.0939)		0.346** (0.0299)	
D(MIL_POS)		0.838*** (0.0000)		0.993*** (0.0000)
D(MIL_POS(-1))				0.294 (0.1607)
D(MIL_NEG)		-0.898*** (0.0000)		-1.072*** (0.0000)
D(RGDP)	-0.737** (0.0125)		-0.868** (0.0029)	
D(CPI)	0.981* (0.0567)	0.795* (0.0821)	0.785 (0.1096)	0.503 (0.2785)
D(CPI(-1))	-1.327** (0.0349)	-0.968** (0.0255)	-1.726*** (0.0046)	-0.515 (0.2381)
D(CPI(-2))	-1.058** (0.0447)		-1.227** (0.0163)	
D(WAGE)	0.817** (0.0041)		0.934*** (0.0009)	
D(DUM)			0.040 (0.3707)	0.017 (0.6475)
D(DUM(-1))			0.009 (0.8254)	
D(DUM(-2))			0.044 (0.2883)	
D(DUM(-3))			0.173*** (0.0003)	
ECT(-1)	-0.482*** (0.0000)	-0.413*** (0.0000)	-0.515*** (0.0000)	-0.459*** (0.0000)
LONG-RUN				
MIL	-0.323*** (0.0012)		-0.432*** (0.0000)	
MIL_POS		-0.251* (0.0586)		-0.022 (0.9064)
MIL_NEG		-0.371*** (0.0019)		-0.500*** (0.0001)
RGDP	-0.462 (0.2441)	-0.853** (0.0229)	-0.368 (0.3611)	-0.686*** (0.0473)
CPI	-0.182 (0.6503)	-0.702* (0.0820)	-0.139 (0.7318)	-0.776** (0.0394)
WAGE	0.486 (0.1930)	0.916*** (0.0096)	0.506 (0.1622)	0.719** (0.0279)
DUM			0.0427 (0.3730)	-0.126** (0.0111)
Bounds Testing	6.539***	6.774***	6.573***	6.168***
Wald Test (SRA)		17.165*** (0.0000)		18.092*** (0.0000)
Wald Test (LRA)		5.663*** (0.0048)		8.113*** (0.0006)
R-Squares	0.8964	0.9164	0.9127	0.9215
Adjusted R-Squares	0.8822	0.9072	0.8946	0.9098
F-Stat	63.437 (0.0000)	99.806 (0.0000)	50.437 (0.0000)	78.586 (0.0000)
Durbin-Watson	1.885	2.015	1.918	1.968
DIAGNOSTIC TESTS				
Jarque–Bera	2.352 (0.3085)	4.491 (0.1059)	1.3617 (0.5062)	3.989 (0.1360)
B-G serial corr. LM test	0.1918 (0.8258)	0.332 (0.7178)	0.141 (0.8690)	0.058 (0.9433)
Het. LM test	0.1035 (0.7483)	0.344 (0.5590)	0.002 (0.9632)	0.230 (0.6325)
Ramsey-reset test	1.1190 (0.2662)	1.332 (0.1862)	1.225 (0.2243)	1.570 (0.1200)
CUSUM test	Stable	Stable	Stable	Stable
CUSUM square test	Unstable	Unstable	Unstable	Stable

Note: *, ** and *** represent 1%, 5% and 10% level of significance respectively. UNP, MIL, RGDP CPI and WAGE are unemployment rate, military spending in dollar value, real GDP, consumer price index and real wage respectively

5.0. Conclusion and Policy Implications

The primary focus of this study is the evaluation of the symmetric and asymmetric effects of military expenditure on the unemployment rate in South Africa. Accordingly, the autoregressive distributed lag (ARDL) and nonlinear autoregressive distributed lag (NARDL) frameworks were used to analyse quarterly data of variables of interest spanning the period between 1994Q1 and 2019Q4. The study also accounted for structural breaks in the military expenditure-unemployment nexus in South Africa. The results of the structural break tests showed that the model of unemployment and military expenditure had structural breaks in the second quarter of 2002, first quarter of 2004 and fourth quarter of 2007 in level, trend and regime respectively. The Gregory-Hansen co-integration test and Bounds test results confirmed the existence of a long-run relationship with structural breaks among unemployment, military expenditure, real GDP, consumer price index and wage. The ARDL model results show that military expenditure has an insignificant positive relation with unemployment in the model without a structural break but a significant inverse relation with unemployment in the model with a structural break. However, the relationship became significantly positive for both models when we accounted for the first period lag of military expenditure.

On the other hand, the NARDL model results exposed that positive changes in military expenditure have a positive and significant impact on unemployment for both the models with and without a structural break while negative changes in military expenditure have an inverse and significant effect on unemployment for both models. The results also confirmed the existence of short-run and long-run asymmetries in the models with structural breaks and only one of the models without a structural break. Overall, the findings indicate that the choice of estimation technique as well as accounting for structural breaks matters in the analysis of the military expenditure-unemployment nexus in South Africa. The implication of the unemployment-worsening effect of military expenditure in South Africa is that the South African government needs to prioritise non-military spending over military spending in its drive to tackle the unemployment conundrum. Moreover, the government and other stakeholders need to develop strategies to maintain the peace and tranquillity the country enjoys since the end of apartheid in a bid to lower the cost militarization in the country. Finally, policymakers need to take cognizance of the nature of military expenditure and other macroeconomic fundamentals in designing and formulating strategies for tackling unemployment in South Africa.

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Appendix

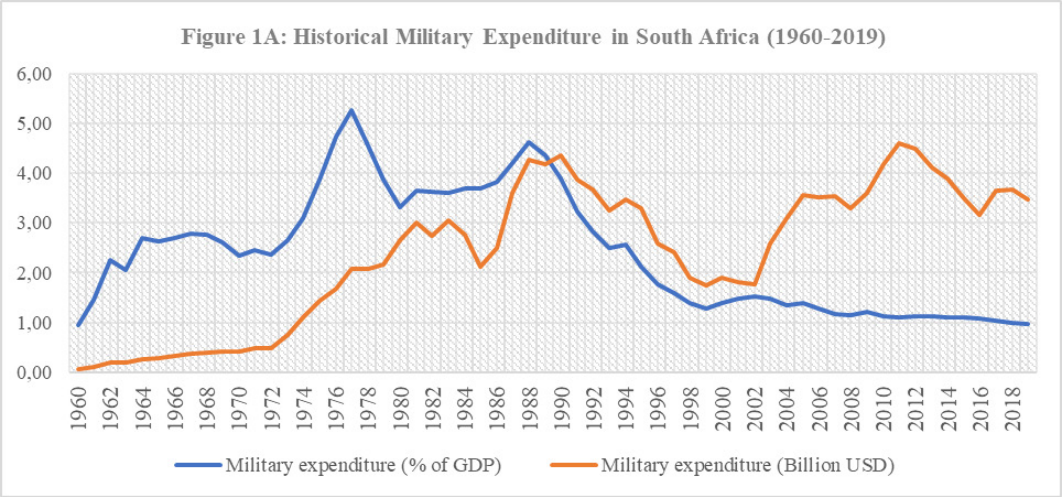
Figure 1A: Historical Military Expenditure in South Africa (1960-2019)
6,00
5,00
4,00
3,00
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1960 1962 1964 1966 1968 1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Military expenditure (% of GDP)
Military expenditure (Billion USD)

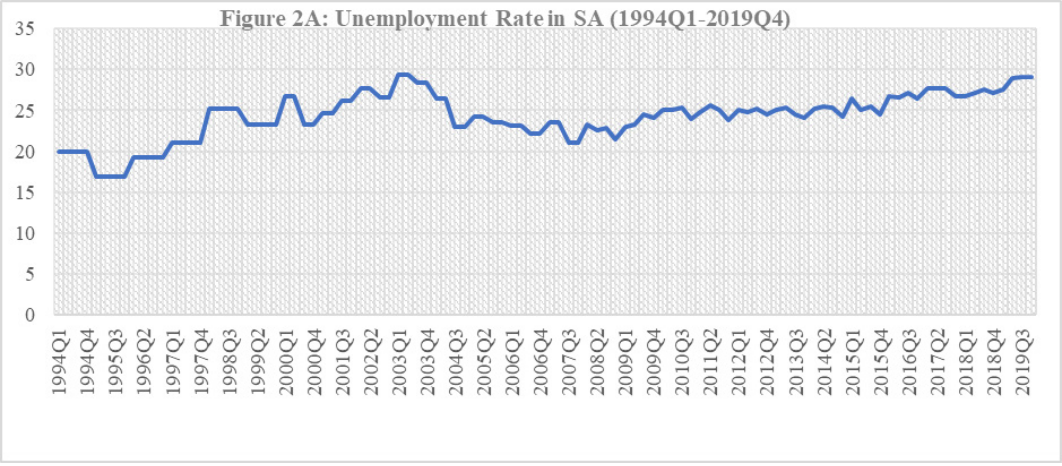
Figure 2A: Unemployment Rate in SA (1994Q1-2019Q4)
35
30
25
20
15
10
5
0
1994Q1 1994Q4 1995Q3 1996Q2 1997Q1 1997Q4 1998Q3 1999Q2 2000Q1 2000Q4 2001Q3 2002Q2 2003Q1 2003Q4 2004Q3 2005Q2 2006Q1 2006Q4 2007Q3 2008Q2 2009Q1 2009Q4 2010Q3 2011Q2 2012Q1 2012Q4 2013Q3 2014Q2 2015Q1 2015Q4 2016Q3 2017Q2 2018Q1 2018Q4 2019Q3

Table 1A. Military Expenditure (2019 estimate) and Unemployment Rate (estimate 2020) Among Top Ten Economies in Africa

S/N	Country	GDP	Military Expenditure per GDP	Military Expenditure (US$ Billion)	Unemployment rate (2020)
1	Nigeria	442.98	0.46	1.86	33.3
2	Egypt	361.88	1.18	3.74	7.4
3	South Africa	282.59	0.98	3.47	32.5
4	Algeria	147.32	6.01	10.30	11.4
5	Morocco	112.22	3.09	3.72	12.5
6	Kenya	101.05	1.16	1.15	7.2
7	Ethiopia	95.589	0.60	0.54	19.1
8	Ghana	67.34	0.44	0.23	4.5
9	Tanzania	64.12	1.32	0.80	9.6
10	Angola	62.724	1.64	1.47	30.5

Note: Author's Compilation. GDP data comes from Statistica (https://www.statista.com/statistics/1120999/gdp-of-african-countries-by-country/). Military data comes from World Development Indicators. Unemployment rate comes from trading economics (https://tradingeconomics.com/country-list/unemployment-rate?continent=africa)

Conflict of Interest /Ethical Statement

The authors declare that there is no conflict of interest.