EDWRG Working Paper Series
January 2022

UNIVERSITY OF JOHANNESBURG

ECONOMIC DEVELOPMENT AND WELL-BEING RESEARCH GROUP

Does military spending affect inequality in South Africa? A revisit

Working Paper Number 03-2022

Hinaunye Eita, Mduduzi Biyase, Thomas Udimal and Talent Zwane

Cite this paper: H. Eita, M. Biyase, T. Udimal, & T. Zwane (2022). Does military spending affect inequality in South Africa? A revisit. *EDWRG Working Paper Number 03-2022.*

Does military spending affect inequality in South Africa? A revisit

HINAUNYE EITA, MDUDUZI BIYASE, THOMAS UDIMAL AND TALENT ZWANE

Abstract

Previous investigations on military spending-inequality nexus (in South Africa) were underpinned by the assumption that military spending and inequality behaves in symmetric fashion and employed linear autoregressive distributed lag (ARDL) model in their analysis. This paper extends and improve upon prior studies by investigating the short-run and long-run asymmetric effect of military spending on South Africa's income inequality. Using annual data from 1980 to 2017 and asymmetric autoregressive distributed lag (NARDL) model by Shin et al. (2014), our paper revisits the military spending-income inequality nexus. We find evidence to suggest an asymmetric association between military and income inequality — income inequality responds differently to positive and negative shocks of military spending in the long- and short-run. Based on these findings, we are inclined to conclude that the NARDL model delivers more accurate estimates and provides nuanced insights that the traditional linear ARDL.

KEYWORDS: inequality; military spending; ARD; NARDL

JEL CLASSIFICATIONS: C22 H56

Introduction

The relationship between military expenditure and inequality has remained an area of research interest over the years. The relationship between military expenditure and inequality is a complex one. Government expenditures have different impact on the economic growth and inequality depending on the sector the expenditure is directed at. Government's spending through transfers and subsidies has direct impact on the beneficiary's income thereby raising household disposable income. Such expenditures, directly improves household nutrition, health and education status. Government's expenditures in sectors such as health, and education help improves quality of labour force and increase productivity of poor households (Heltberg, Simler, & Tarp, 2004).

However, there are other expenditures that have no direct linkage with the poor households, but are essential in the growth of economy. Military expenditure is in the category of expenditures that are not pro-poor in nature, but is essential as it guarantees law abiding citizens a peaceful environment for them to go about their economic activities. Despite the importance of military expenditure in every economy, the exact relationship between them (military expenditure and inequality) remains inconclusive.

There are two components of military expenditure; labour-intensive and capital-intensive expenditures (Kentor et al., 2012). Based on the Keynesian's perspective, military expenditure is expected to boost demand and employment, which will later translate into economic growth (Chester, 1978; Stevenson, 1974). Military expenditure is a component of government's consumption and is expected to stimulate economic growth through the creation of new demand for goods and services (Faini et al., 1984). An increase in military expenditure leads to the creation of new jobs, which invariably lead to an increase in demand and output growth. Improved human capital, stable political climate and social conditions of a country are some products of military expenditure. Improved military expenditure in targeted areas is supposed to improve the country's technological innovations and spin-offs in other sectors of the economy.

On the contrary, those who assess military expenditure from the political economy and dependency theories perspectives, see military expenditures as barriers to a country's economic growth. Military expenditure competes with other sectors of the economy for available resources, so there is an opportunity cost as funds and skilled workers are withdrawn from some sector to augment the military sector (Mylonidis, 2008; Russett, 1982). Increase in military expenditures lead to siphoning of funds from sectors that have the potential to stimulate the needed growth. Increase in military expenditure forces the government to either obtain capital from financial market or increase taxes to raise the needed funds to boost spending. This approach of raising money to fund economy often affects economy negatively as it decreases investment and consumer demand (Borch & Wallace, 2010). This approach of raising money by government often leads to the crowding out of private investors as interest rates become unbearable (Lipow & Antinori, 1995).

South Africa has high unemployment rates, inequality, and high poverty rates. Poverty and inequality in South Africa, even though statistics improved over the years; with the rate of 18.8% in 2015 down from an initial rate of 33.8% in 1996, (World Bank, 2018) classification still puts South Africa under countries under middle income and high rate of inequality.

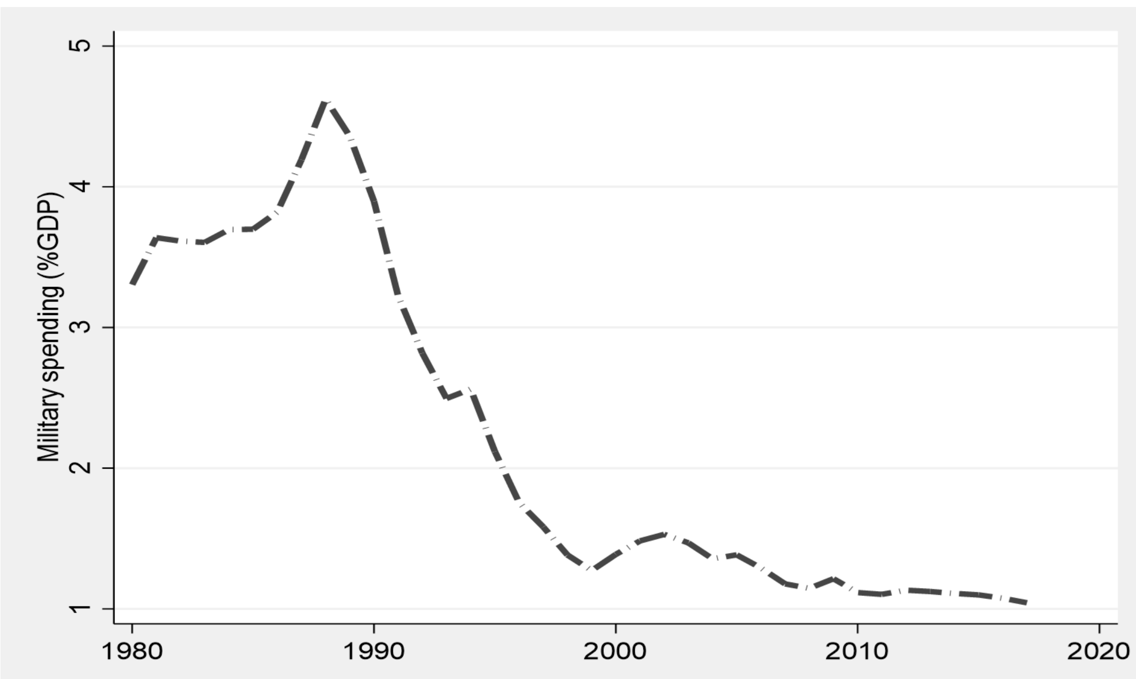
Inequality is a topical issue that has engaged the attention of both researchers and political leaders across South Africa. It was one of the major issues captured in ANC Party's Manifesto for 2009 general elections. Inequality and unemployment continue to be major challenges confronting South Africa's growth prospects (Roberts, 2014). Inequality and high unemployment rates in South Africa are as a result of the economy's inability to stimulate the needed growth to generate more jobs for teeming youth. It is also partly attributed to lack of government expenditures in pro-poor sectors of the economy (Ndlovu-Gatsheni, 2012; Roberts, 2014). By international standards, South Africa's New Growth Path (NGP) showed that inequality, unemployment, and poverty are still relatively high in South Africa (SA, 2017, SA, 2014). The National Development Plan (NDP) also made similar assertion. The National Development Plan was adopted by both the parliament and the cabinet of South Africa in 2013 as a working document to guide the country in its quest to eradicate poverty and inequality by 2030.

Despite the high inequality rate in South Africa, the impact of sectoral investment on income inequality has not received much attention in South Africa. A study by Biyase et al. (2021) through ARDL approach looked at the symmetric relationship between military sector's expenditure on income inequality in South Africa. The study concludes a positive relationship between military expenditure and income inequality in South Africa. As an extension of the study by Biyase et al. (2021), the current study seeks to examine whether there is an asymmetric relationship between military expenditure and income inequality, using NARDL approach.

South Africa has experienced a reduction in its military expenditure over the years as shown in figure 1. With this development, there is the need to explore both symmetric and asymmetric relationship between military expenditure and income inequality to guide in policy formulation. Military expenditures include “all current and capital expenditures on the armed forces, which includes peacekeeping forces; defence ministries and other government agencies engaged in defence projects; paramilitary forces, thus if they are trained and equipped for military operations; and military space activities” (South Africa World Development Indicators, 2020).

In as much as extant literature has dealt with this topic, evidence remains inconclusive and most of the studies only looked at their symmetric relationship. The current study extends the scope by looking at the asymmetric relationship between military expenditures and income inequality in South Africa.

FIGURE 1: MILITARY EXPENDITURE



Source: South Africa world development indicators.

Empirical Literature

The relationship between defence expenditure and economic growth has received a lot of attention since the seminal work of Benoit (1973, 1978), who found that defence spending has a direct effect on the economic growth of less developed countries. In his landmark statement, Benoit (1978) argued that defence spending promotes infrastructure development, employment creation and assist in economic development. However, there is still dearth of empirical literature in the field of defence expenditure and income inequality nexus in both developed and developing countries alike.

The limited studies conducted so far on the interactive association between defence expenditure and income inequality often follows three dominant hypothesis, which predict three conflicting predictions on the impact of defence spending on income distribution. The first is the *inequality-widening hypothesis*. The literature is full of evidence suggesting that since the defence industry mostly benefits the well-paid workforces comparative to other less-skilled workers in the non-defence industry, defence spending is capable of widening inter-sectoral wage gaps (Abell, 1994; Ali, 2007, 2012; Töngür & Elveren, 2012). According to the literature, the gap between the returns to skilled and unskilled workforce might be widened if the defence industry shifts production in favour of skilled over unskilled labour (Ali, 2007; Kentor et al., 2012; Wolde-Rufael, 2016b). Likewise, money assigned to military expenditure at the expense of other welfare boosting activities can limit the welfare state from redistributing income through transfer payments (Ali, 2011; Elveren 2012).

The second being the *inequality-narrowing hypothesis*, which assume that larger defence expenditure enhance aggregate demand thereby boosting employment creation in the economy (Hirnissa et al., 2009; Elveren 2012). The literature states that if the defence industry is labour intensive and if defence production is purely domestic, defence expenditure is likely to become a driver of economic growth thereby increasing income of the poorer population (Lin & Ali 2009; Elveren 2012). Nonetheless, this influence can be enlarged if a good share of defence expenditure is allocated mainly to wages and salaries of military personnel (Hirnissa et al., 2009).

Lastly, the *neutrality hypothesis* posits that the effect of military expenditure on income distribution can be insignificant as military spending could form a negligible portion of the overall government expenditure and if the work force in the military sector constitutes a minor share of the total labour force (Lin & Ali, 2009). Besides, if the government does not favour military expenditure at the expenses of welfare improving expenditures (education, health and social welfare), the effect of military expenditure on income inequality can as well be insignificant (Hirnissa et al., 2009; Meng et al., 2015).

Although these overriding hypothesis shed some light on the interactive relationship between defence spending and income inequality, still this is a topic that is comparatively underexplored in both developed and developing countries. More puzzling is the fact that even the few studies conducted so far does not appear to display any consensus with respect to the direction of the association between the two variables. The reason might be that scholars often adopt one of the above three central hypothesis as a yardstick.

Precisely, a large number of studies has unambiguously adopted the *inequality-widening* notion of a positive association between military spending and income inequality. The empirical evidence that supports the *inequality-widening* hypothesis comes from Abell (1994), Ali (2007, 2012), Töngür and Elveren (2012), Kentor et al. (2012), and Meng et al. (2015) where these authors revealed that increased defence expenditure leads to increased income inequality. In fact, Abell (1994) was the first scholar to examine the relationship between defence expenditure and income inequality using time series data covering the period 1972 to 1991 for the United States of America. In his seminal paper, Abell (1994) applied OLS regression and unveiled that increased defence expenditure widens the income gap between the different strata in society, after controlling for economic growth, taxes, interest rates, and inflation.

After the pioneer work of Abell (1994), a number of scholars began to examine this topic broadly, still supporting the *inequality-widening hypothesis.* In validating this hypothesis, a cross section of study by Vadlamannati (2008) examine the effect of defence spending and income inequality in South Asian countries. Thus, Pakistan, India, Sri Lanka and Bangladesh from the period of 1975 to 2004. The author used panel data analysis and reported that defence spending present a positive and significant effect on income equality. In their most recent publication, Biscionea and Caruso (2021) studied the association between defence expenditure and income inequality in a panel of 26 European transition countries over the period 1990 to 2015. Their paper exploit three different measures of military expenditures. Thus, military spending in absolute terms, military expenditures per capita, and military burden (see for example, Biscionea & Caruso, 2021). The results of the study showed that defence expenditure exacerbates income inequality captured by means of three different measures of inequality (Biscionea & Caruso, 2021).

For Taiwan, Wolde-Rufael (2016a) studies the association between military expenditure and income inequality using ARDL bounds test approach to cointegration and four long-run estimators for the period from 1976–2011. The authors uncovered a long-run association between different measures of inequality and military expenditure, where military spending had a positive and significant effect on income inequality in Taiwan (Wolde-Rufael, 2016a). The positive effect was also proven by Wolde-Rufael (2016b) for the case of South Korea. Wolde-Rufael (2016b) assessed the linkage between military expenditure and income distribution using time series covering the period 1965 to 2011 in South Korea. The authors used the bounds test approach to cointegration and reported that there is a long-run causal linkage between defence expenditure and the Gini coefficient with defence expenditure indicating a positive and significant impact on income inequality.

In support of the *inequality-widening hypothesis*, Töngür and Elveren (2015) utilised the GMM estimation technique to investigate the effect of military expenditure on pay and income inequality with respect to the welfare regime. Consistent with previous studies, Töngür and Elveren (2015) reported that military expenditure exacerbates income inequality. Ali and Galbraith (2003), studied the association between defence spending and income inequality by controlling the effects of size of armed forces, GDP growth and per capita income, supported the results. The study used the simultaneous regression model and the authors found that defence expenditure widen income inequality.

However, there are also few studies on the validity of the *inequality-narrowing hypothesis*. In fact, the work that corroborate *inequality-narrowing hypothesis* come from Ali (2012) who paid more attention on Middle East and North African countries over the period 1987–2005. The empirical work from this study showed that defence spending exerts a significant and negative impact on income inequality. The authors concluded that an increasing defence burden leads to a reduction in income inequality within these countries. These results were corroborate by Chletsos and

Roupakias (2018), who revealed that defence expenditure is capable of improving the income distribution, after addressing the problem of endogeneity using IV approach for a panel of 14 NATO countries for the period 1977–2007. In another study, Shahbaz et al. (2016) assessed the association between military expenditure and income inequality in Iran between 1969 and 2011. The authors used cointegration analysis and reported a negative association between military expenditure and income inequality. The authors concluded that military expenditure granger produces income inequality in Iran (Shahbaz et al., 2016).

There are also few empirical evidences that supports the *neutrality hypothesis* and comes from Hirnissa et al. (2009). In their work, Hirnissa et al. (2009) utilised ARDL technique to assess the link between defence spending and income inequality for a cluster of countries (such as, Malaysia, Indonesia, Singapore, the Philippines, South Korea and India). The reported results showed that countries such as Indonesia, Philippines, India and South Korea were characterised by no meaningful association between military expenditure and income distribution (Hirnissa et al., 2009). In support to the *neutrality hypothesis*, Lin and Ali (2009) studies the association between defence expenditure and inequality utilising BVC and SIPRI data across a cluster of 58 countries from 1987 to 1999. Making use of panel Granger non-causality tests, the authors found no significant evidence to support the relation in either direction between the two variables.

In South Africa, there is little empirical evidence that examines the interactive linkage between defence spending and income inequality. The only known study that has examined the interactive relationship between the two factors is that of Biyase et al. (2021) using annual data for the period 1990 to 2017. In this study, Biyase et al. (2021) examined the relationship between military spending and income inequality using ARDL bounds testing approach to cointegration. Their findings uncovered a long run association between military expenditure and income inequality in South Africa. The results showed that an increase in military expenditure result in high rate of inequality in the country. Given the dearth of literature for South Africa, this work builds on Biyase et al. (2021) work. Contrary to their paper that looked at the symmetric relationship between military sector's expenditure on income inequality, this paper seeks to examine whether there is an asymmetric relationship between military expenditure and income inequality, applying NARDL model by Shin et al. (2014). To the best of our knowledge, this is the first pioneer effort that studies the non-linear effect of defence expenditure on income inequality in case of South Africa. The NARDL decomposes computed parameter of a dependent variable into positive and negative components and then check the impact of these positive and negative components on independent variable (Shin et al., 2014; Ahad & Dar, 2017). The NARDL approach presents the coefficients of these positive and negative components individually and identify cointegration connection between estimated model (Ahad & Dar, 2017).

Methodology

Empirical model

After an extensive review of the theoretical and empirical literature, this study follows Biyase et al (2021) to specify the model that can be used to estimate the relationship between military expenditure and income inequality. This model is as follows in equation (1):

$$lnGINI_t = \beta_0 + \beta_1 lnME_t + \beta_2 lnEMP_t + \beta_3 lnPOP_t + \beta_4 lnGE_t + \beta_5 lnGDPCAP_t + \varepsilon_t \quad (1)$$

Where $lnGINI_t$, $lnME_t$, $lnEMP_t$, $lnPOP_t$, $lnGE_t$, $lnGDPCAP_t$, β and ε_t are income inequality, military expenditure or spending, employment, population, government expenditure, GDP per capita, long run coefficient and error term.

Estimation technique

To estimate the asymmetric relationship between military expenditure and come inequality, this study applies nonlinear autoregressive distributive lag (NARDL) for this purpose. It employs employ the NARDL model proposed by Shin et al. (2014) under the conditional error correction model as follows:

$$\begin{aligned} lnGINI_t = {} & \beta_0 + \beta_1 lnGINI_{t-1} + \beta_2^{+} lnME_{t-1}^{+} + \beta_3^{-} lnME_{t-1}^{-} + \beta_4^{+} lnEMP_{t-1}^{+} + \beta_5^{-} lnEMP_{t-1}^{-} \\ & + \beta_6^{+} lnPOP_{t-1}^{+} + \beta_7^{-} lnPOP_{t-1}^{-} + \beta_8^{+} lnGE_{t-1}^{+} + \beta_9^{-} lnGE_{t-1}^{-} + \beta_{10}^{+} lnGDPCAP_{t-1}^{+} \\ & + \beta_{11}^{-} lnGDPCAP_{t-1}^{-} + \varepsilon_t \end{aligned} \quad (2)$$

Equation (2) is re-specified in NARDL format as follows:

$$\begin{aligned} \Delta lnGINI_t = {} & \beta_0 + \sum_{i=1}^{p0} (\beta_{0,i} . \Delta lnGINI_{t-i}) + \sum_{j=0}^{p_1^{+}} (\beta_{1,j}^{+} \Delta lnME_{t-j}^{+}) + \sum_{j=0}^{p_1^{-}} (\beta_{1,j}^{-} \Delta lnME_{t-j}^{-}) \\ & + \sum_{k=0}^{p_2^{+}} (\beta_{2,k}^{+} \Delta lnEMP_{t-k}^{+}) + \sum_{k=0}^{p_2^{-}} (\beta_{2,k}^{-} \Delta lnEMP_{t-k}^{-}) + \sum_{l=0}^{p_3^{+}} (\beta_{3,k}^{+} \Delta lnPOP_{t-l}^{+}) \\ & + \sum_{l=0}^{p_3^{-}} (\beta_{3,k}^{-} \Delta lnPOP_{t-l}^{-}) + \sum_{m=0}^{p_4^{+}} (\beta_{4,m}^{+} \Delta lnGE_{t-m}^{+}) + \sum_{m=0}^{p_4^{-}} (\beta_{4,m}^{-} \Delta lnGE_{t-m}^{-}) \\ & + \sum_{m=0}^{p_5^{+}} (\beta_{5,m}^{+} \Delta lnGDPCAP_{t-m}^{+}) + \sum_{m=0}^{p_5^{-}} (\beta_{5,m}^{-} \Delta lnGDPCAP_{t-m}^{-}) + \gamma_0 lnGINI_{t-1} \\ & + \gamma_1^{+} lnME_{t-1}^{+} + \gamma_2^{-} lnME_{t-1}^{-} + \gamma_3^{+} lnEMP_{t-1}^{+} + \gamma_4^{-} lnEMP_{t-1}^{-} + \gamma_5^{+} lnPOP_{t-1}^{+} \\ & + \gamma_6^{-} lnPOP_{t-1}^{-} + \gamma_7^{+} lnGE_{t-1}^{+} + \gamma_8^{-} lnGE_{t-1}^{-} + \gamma_9^{+} lnGDPCAP_{t-1}^{+} + \gamma_{10}^{-} lnGDPCAP_{t-1}^{-} \\ & + \varepsilon_t \end{aligned} \quad (3)$$

Where p is the lag order. The long run coefficients are computed as $\beta_2 = \frac{\gamma_1^+}{\gamma_0}, \beta_3 = \frac{\gamma_2^-}{\gamma_0},\ \beta_4 = \frac{\gamma_3^+}{\gamma_0},\ \beta_5 = \frac{\gamma_4^-}{\gamma_0}, \beta_6 = \frac{\gamma_5^+}{\gamma_0},\ \beta_7 = \frac{\gamma_6^-}{\gamma_0},\ \beta_8 = \frac{\gamma_7^+}{\gamma_0},\ \beta_9 = \frac{\gamma_8^-}{\gamma_0}, \beta_{10} = \frac{\gamma_9^+}{\gamma_0}, \beta_{11} = \frac{\gamma_{10}}{\gamma_0}$.

(4)

The "+" and "-"notations for the explanatory variables in equation (3) are the partial sum of positive and negative changes or values. These partial positive and negative changes or values are expressed as follows:

$$lnME_t^+ = \sum_{i=1}^{t} \Delta lnME_i^+ = \sum_{i=1}^{t} \max(\Delta lnME_i , 0)$$

$$lnME_t^- = \sum_{i=1}^{t} \Delta lnME_i^- = \sum_{i=1}^{t} \min(\Delta lnME_i , 0)$$

$$lnEMP_t^+ = \sum_{i=1}^{t} \Delta lnEMP_i^+ = \sum_{i=1}^{t} \max(\Delta lnEMP_i , 0)$$

$$lnEMP_t^- = \sum_{i=1}^{t} \Delta lnEMP_i^- = \sum_{i=1}^{t} \min(\Delta lnEMP_i , 0)$$

$$lnPOP_t^+ = \sum_{i=1}^{t} \Delta lnPOP_i^+ = \sum_{i=1}^{t} \max(\Delta lnPOP_i , 0)$$

$$lnPOP_t^- = \sum_{i=1}^{t} \Delta lnPOP_i^- = \sum_{i=1}^{t} \min(\Delta lnPOP_i , 0)$$

$$lnGE_t^+ = \sum_{i=1}^{t} \Delta lnGE_i^+ = \sum_{i=1}^{t} \max(\Delta lnGE_i , 0)$$

$$lnGE_t^- = \sum_{i=1}^{t} \Delta lnGE_i^- = \sum_{i=1}^{t} \max(\Delta lnGE_i , 0)$$

$$lnGDPCAP_t^+ = \sum_{i=1}^{t} \Delta lnGDPCAP_i^+ = \sum_{i=1}^{t} \max(\Delta lnGDPCAP_i, 0)$$

$$lnGDPCAP_t^- = \sum_{i=1}^{t} \Delta lnGDPCAP_t^- = \sum_{i=1}^{t} \max(\Delta lnGDPCAP_i, 0)$$

(5)

According to Shin et al (2014), the bounds testing can be used to test for asymmetric cointegration between the variables. This is the same bounds test used linear autoregressive distributive lag (ARDL) technique. The null hypothesis is that the relationship between military expenditure and income inequality is symmetrical if:

$$\gamma_0 = \gamma_1^+ = \gamma_2^- = \gamma_3^+ = \gamma_4^- = \gamma_5^+ = \gamma_6^- = \gamma_7^+ = \gamma_8^- = \gamma_9^+ = \gamma_{10}^- = 0$$

$$\gamma_0 = \gamma_1^+ = \gamma_2^- = \gamma_3^+ = \gamma_4^- = \gamma_5^+ = \gamma_6^- = \gamma_7^+ = \gamma_8^- = \gamma_9^+ = \gamma_{10}^- = 0$$

The alternative hypothesis states that the relationship between military expenditure (and other variables) will be asymmetrical if:

$$\gamma_0 \neq \gamma_1^+ \neq \gamma_2^- \neq \gamma_3^+ \neq \gamma_4^- \neq \gamma_5^+ \neq \gamma_6^- \neq \gamma_7^+ \neq \gamma_8^- \neq \gamma_9^+ \neq \gamma_{10}^- \neq 0$$

Under the NARDL estimation technique, the F-statistic and critical values are used to make a decision on the hypotheses presented above. If the null hypothesis is rejected, it means that the relationship between military expenditure and income inequality is not symmetrical. It suggest that the relationship is asymmetrical. The results will have to go through diagnostic statistics in order to determine robustness of the results.

Data

To estimate the NARDL model as specified in equations (1-5), we use annual data for the years 1980–2017. This is based on consistent data availability. Directed by the existing studies, we use income inequality (GINI), the of ratio military spending to GDP (ME), employment (EMP), population (POP), general government spending (GE) and GDP per capita (GDPCAP). Three of these variables (the ratio military spending to GDP, GDP per capita and general government spending) are obtained from the World Development Indicators. The data for employment and population are sourced from Penn World Table (version 9.1). While the data for income inequality is obtained from Standardized World Income Inequality Database (SWIID). The data for these variables are transformed into logarithm to facilitate their interpretation. Table A2 in the appendix shows the descriptive stats for these variables. Considering the mean first, we observe that the means of LGE_R, LME, LPOP, LGPDPC, LEMP, LGINI are in the neighborhood of 26.68707, 0.654614, 3.763066, 10.76851, 2.530949, and 4.119527, respectively. Regarding the standard deviation we observe that there is a great deal of fluctuation and volatility in LGINI compared to the rest of the other series. There also appear to be a clear positive skewness of most variables LGE_R, LME, LGPD_PC and LGINI indicating that there are skewed to the right distribution, while LPOP and LEMP are skewed towards the left.

Empirical results

Unit root estimates

Before analyzing the short and long-run relationship between military spending and income inequality, we first look at the properties of the variables to be used in the analysis using the unit root tests of Phillips and Perron (1988), and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test (1992. The Phillips and Perron results show that the natural logarithmic values of most variables used: income inequality , the of ratio military spending to GDP, employment, population, general government spending and GDP per capita are all nonstationary in the level (except for population variable) but stationary in their first differences— they are I (1). Although the inequality variable was nonstationary at level and first difference in the Phillips and Perron results, it becomes stationary in the KPSS table at first difference. Specifically, variables such as income inequality, the of ratio military spending to GDP, employment, and GDP per capita are all I(1). Since all the variables in question are stationary at level and first difference (they are not I(2), the NARDL model would therefore yield superior results compared to other methods such as OLS.

TABLE 1: UNIT ROOT TEST TABLE, PHILLIPS PERRON (PP)

PANEL A	**AT LEVEL**						
		LGINI	LME	LEMP	LPOP	LGPD_PC	LGE_R
With Constant	t-Statistic	-1.4065	-0.5331	-0.9102	-7.0598	-0.5981	-0.4877
	Prob.	**0.5686**	**0.8732**	**0.7738**	**0.0000**	**0.8590**	**0.8824**
		n0	n0	n0	***	n0	n0
PANEL B	**AT FIRST DIFFERENCE**						
With Constant	t-Statistic	-0.8198	-3.6356	-6.1253	-1.3025	-3.7247	-4.6117
	Prob.	**0.8013**	**0.0098**	**0.0000**	**0.6178**	**0.0078**	**0.0007**
		n0	***	***	n0	***	***

Unit root test results table (KPSS)

Null Hypothesis: the variable is stationary

PANEL B: AT LEVEL		**LGINI**	**LME**	**LEMP**	**LPOP**	**LGPDPC**	**LGE_R**
With Constant	t-Statistic	0.6806	0.6636	0.7323	0.7395	0.4005	0.7188
	Prob.	**	**	**	***	*	**
AT FIRST DIFFERENCE							
With Constant	t-Statistic	0.2869	0.1264	0.1442	0.6385	0.3552	0.0948
	Prob.	n0	n0	n0	**	*	n0

Notes:

a: (*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1% and (no) Not Significant

b: Lag Length based on AIC

c: Probability based on Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

NARDL bounds test for co-integration estimates

Having confirmed the combination of stationarity and no-stationarity of variables to be used in our analysis, we proceed to check for the presence (if any) of the long-run co-integration between variables by employing the NARDL bounds test method. Table 2 displays the NARDL bounds test for co-integration estimates. The estimated F-statistic of 75.89335 which exceed both the lower and upper bound critical values at one percent significance level confirm the presence of a long-run association between the income inequality and the right hand side variables— our independent variable of interest plus the control variables in South Africa.

TABLE 2: NARDL BOUNDS TEST FOR CO-INTEGRATION ESTIMATES

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	75.89335	10%	2.12	3.23
		5%	2.45	3.61
		2.5%	2.75	3.99
		1%	3.15	4.43

NARDL estimates

The NARDL estimates displayed in Table 3. It is important to note that we only present the results of positive and negative values for the variable of interest (military expenditure). The results for negative and positive values of other variables can be obtained from the authors on request. The results in Table 3 show a good fit of the model, at an R-squared of 0.994228 and an Adjusted R-squared 0.988095—confirming that inequality is explained by the military spending, employment, population, general government spending and GDP per capita at 99%. Thus, the nonlinear influence of the military spending on the dependent variable of interest is confirmed. Given the paramount importance to choosing the optimum lags for our model (to obtain efficient estimates), we employed Akaike information criteria (AIC) and chose the NARDL (1, 3, 1, 3, 3, 3, 3) model specification. After choosing the optimal model, we launch into reporting the long-run and short-run estimates (see Table 4, and Table 5).

The NARDL estimates suggest an asymmetric association between military spending and income inequality responds differently to positive and negative shocks of military spending in the long-run. Specifically it shows that a 1 percent rise in military spending brings about an increase of income inequality of about 0.21 percent which is statistically significant at 1% level. The result obtained confirms the finding of Biyase et al (2021) who found a long-run association between military spending and the Gini coefficient, with military spending showing a positive and a statistically significant effect on income inequality. Similarly, our results resemble those of Töngür and Elveren (2015) who also reported a positive and significant impact of military expenditure on income inequality in a cross-country study. On the other hand, we found that a 1 percent reduction in military spending also increases income inequality by -0.05% also statistically significant at 1% level. This confirms our prior expectation that income inequality responds to military spending disproportionately in South Africa. A closer look at the results also shows that the positive shocks in military spending affect income inequality more than negative shocks. A quick takeaway from this key finding is that presuming a symmetric association between military expenditure and income inequality may lead to erroneous inferences and misinform policy makers regarding the appropriate policy responses to ameliorate inequality.

Consistent with existing studies, the estimated coefficients of the standards determinants of inequality (incorporated in our paper) mostly comply with our priori anticipations. The anticipation was that an increase in GDP per capita would reduce inequality and indeed we found that a unit increase in GDP per capita reduces income inequality by 0.081%. Our result are consistent with the work of Guzaa, Suryati, Banic , Madina and Dankumo (2020) who found that a rise in GDP per capita reduces income disparities in Nigeria. This finding is however not universal. Contrary to our study, Haffejee and Masih (2018) found evidence to suggest that in South Africa the estimated long-run effect of GDP per capita enters the model positively and significantly, suggesting that GDP per capita increases income inequality. Consistent with Biyase et al (2021), we found that employment variable with coefficient of 0.066600 enter the model positively and significantly, indicating that one percent increase in employment growth would increase income inequality 0.1 percent. A possible explanation for this finding is that there has been a significant shift in job creation from the primary sector to the tertiary sector, implying that highly skilled labour is likely to be absorbed into the labour market compared to their counterpart.

TABLE 3: LONG-RUN ESTIMATES OF NARDL MODEL

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LME^+	0.206653	0.037948	5.445696	0.0003
LME^-	-0.052368	0.005600	-9.350755	0.0000
LEMP	0.066600	0.013630	4.886418	0.0006
LPOP	-0.702576	0.075008	-9.366664	0.0000
LNGPDCAP	-0.080665	0.008569	-9.413155	0.0000
LGE_R	0.102332	0.009124	11.21606	0.0000

The short-run NARDL estimates are displayed in Table 4 below. The asymmetric short-run effects denoted by ΔLME+ and ΔLME- of the military spending and their lagged terms are on the whole found to be significant on income inequality and consistent with the long-run estimates. The ECM coefficient gives an indication of how swiftly it takes for the variables to gravitate back to equilibrium point. The estimated coefficient in Table 4 enters the model significantly with the expected negative sign. More precisely, ECM coefficient (ECM(−1)) is -0.443432 for the short-run model, implying that deviations from the long-term income gap are adjusted by about 44% per year. Testing for robustness check also revealed that NARDL model does not suffer from serial correlation and heteroscedasticity. The Jarque–Bera normality test also confirm that the errors were normally distributed. We used the Wald test statistics to check for existence of any asymmetries between the dependent and independent variable of interest (military expenditure). The Wald test estimates indicates a clear difference between positive and negative of military spending coefficients leading to a rejection of the null hypothesis of symmetric relationship.

TABLE 4: SHORT RUN ESTIMATES OF NARDL

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.101167	0.072217	29.09516	0.0000
ΔLME$^+$	0.034476	0.002418	14.25877	0.0000
Δ LME$^+$_1	-0.028262	0.002191	-12.89933	0.0000
Δ LME$^+$_2	-0.017324	0.002254	-7.687232	0.0000
Δ LNME$^-$)	-0.010969	0.001356	-8.091750	0.0000
ΔLNEMP	0.016071	0.002390	6.725376	0.0001
ΔLNEMP_1	-0.010673	0.002317	-4.606546	0.0010
ΔLNEMP_2	0.006567	0.002403	2.733093	0.0211
ΔLNPOP	-10.34886	0.326224	-31.72319	0.0000
ΔLNPOP_1	14.06680	0.463654	30.33901	0.0000
ΔLNPOP_2	-7.187396	0.247430	-29.04818	0.0000
ΔLNGPDCAP	-0.045958	0.003853	-11.92706	0.0000
ΔLNGPDCAP_1	-0.003360	0.003245	-1.035485	0.3248
ΔLNGPDCAP_2	0.014168	0.003384	4.186048	0.0019
ΔLNGE_R)	0.001259	0.002864	0.439742	0.6695
ΔLNGE_R(-1))	-0.059986	0.003450	-17.38720	0.0000
ΔLNGE_R(-2))	-0.041492	0.002716	-15.27817	0.0000
ECM(-1)*	-0.443432	0.015210	-29.15485	0.0000

R-squared	0.994228	Mean dependent var	0.001299
Adjusted R-squared	0.988095	S.D. dependent var	0.002224
S.E. of regression	0.000243	Akaike info criterion	-13.50459
Sum squared resid	9.42E-07	Schwarz criterion	-12.69652
Log likelihood	247.5780	Hannan-Quinn criter.	-13.22902
F-statistic	162.1130	Durbin-Watson stat	3.245040
Prob(F-statistic)	0.000000		

Cumulative sum (CUSUM) and CUSUM square test

We also undertaken the Cumulative sum (CUSUM) and CUSUM square test (within the NARDL framework) to ensure that our model is not unstable. Figure 2 and figure 3 show that the plots of the CUSUM and CUSUMSQ statistics are not outside the 95% confidence bands, leading us to conclude that the estimated coefficients of the model are stable.

FIGURE 2: CUSUM STABILITY TEST

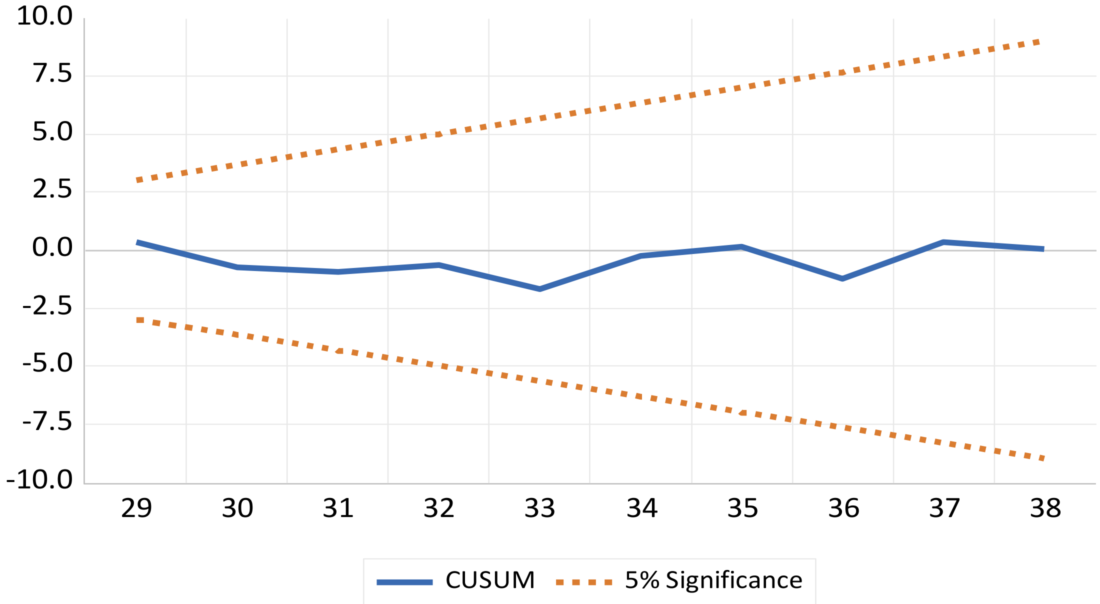
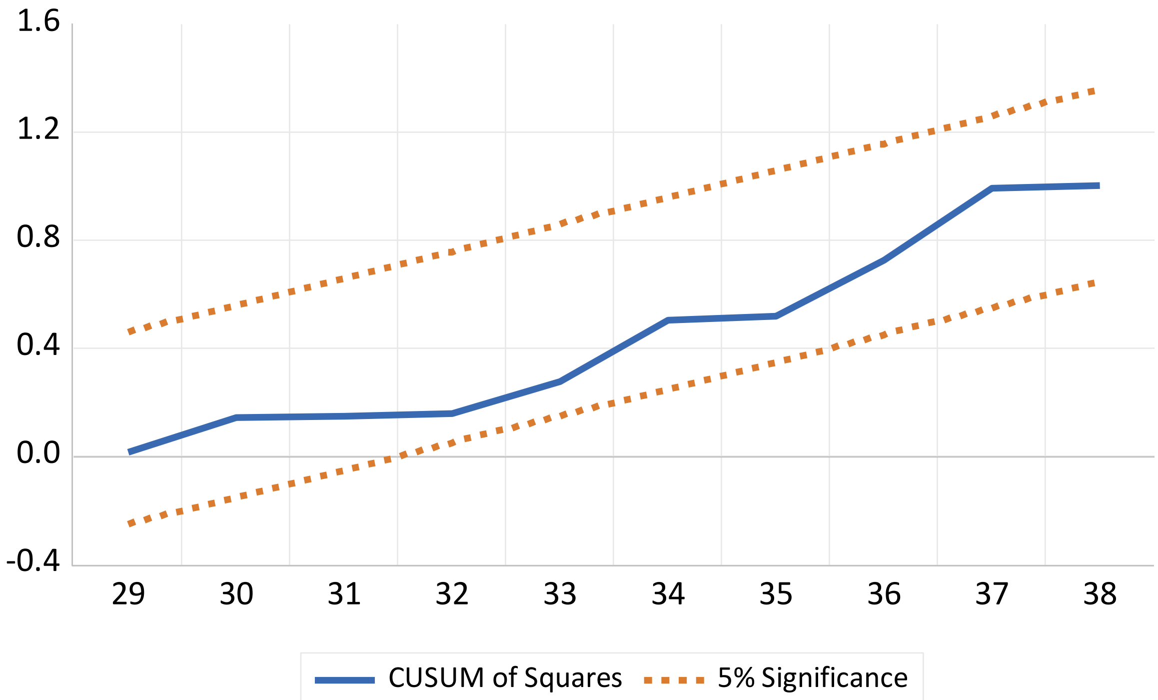
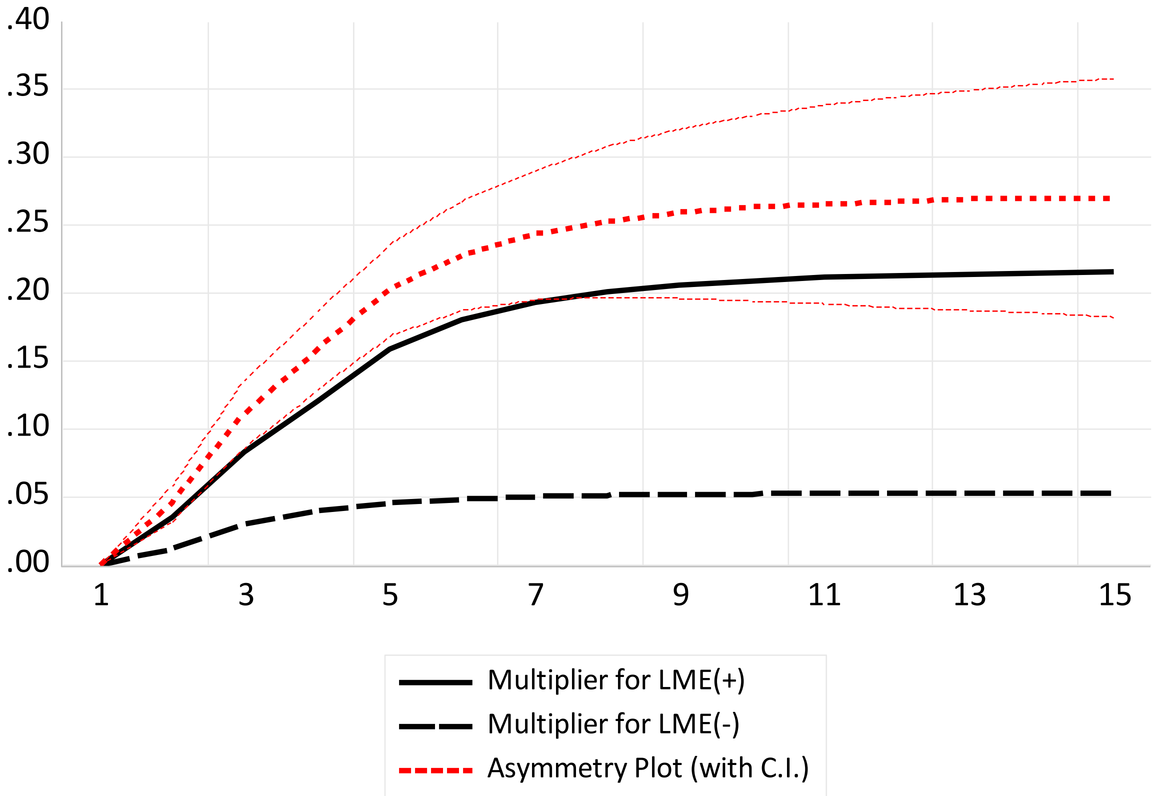


FIGURE 3: CUSUM SQUARES STABILITY TEST



The long-run and short-run estimates of the asymmetric effect of military spending on income inequality are further confirmed by dynamic multipliers. Figure 4 plots the dynamic multiplier effect of military spending on inequality and shows that there are a positive and a negative changes of military spending on the income inequality. What stands out from the figure is that the gap between the influence of positive and negative influence in military spending in period 1, 2 and 3 is relatively small and tends to expand overtime, especially from period 5 to 15. What we also observe is that from period 5 onwards the effect of positive influence appears to be substantially greater than negative influence. By and large, we can conclude based on the military spending—inequality dynamic multiplier (Long-run and Short -run asymmetries) that, the dynamic effects of the independent variable of interest collaborate the nonlinear result obtained in the study.

FIGURE 4: DYNAMIC MULTIPLIERS



Conclusion

The study applies NADRL approach to assess long run and short run effect of military expenditures on inequality in South Africa. The dataset spanned from 1980 to 2017. The study is an extension of a previous study which assumed a symmetric relationship between military expenditure and income inequality using ARDL approach in South Africa. NARDL approach is adopted in the current study to examine asymmetric relationship between military expenditure and income inequality. The study established an asymmetric relationship between military expenditure and income inequality in South Africa. Income inequality in South Africa, responds differently to positive and negative shocks of military spending in the long- and short-run. The reaction of income inequality to positive shocks in military expenditure is however greater than the negative shocks in military expenditure. The NARDL approach provides more understanding on the relationship between military expenditure and income inequality compared with the traditional linear ARDL approach.

Based on this study outcome, we recommend for policy makers to be mindful of the impacts of both negative shock and positive shock in military expenditures on income inequality since income inequality reacts to both shocks. Military expenditure in South Africa requires a fair balance to reduce its negative and positive shocks on income inequality.

Reference

Abell, J.D. (1994). Military spending and income inequality. Journal of Peace Research, 31(1): 35–43.

Ahad, M. and Dar, A. (2017). Modelling the asymmetric impact of defence spending on economic growth: An evidence from non-linear ARDL and multipliers. Journal of Economic and Administrative Sciences, 33 (2): 131-149.

Ali, H. E. and Galbraith, J. (2003). Military expenditures and inequality: Empirical evidence from global data. The University of Texas at Austin UTIP Working Paper No. 24.

Ali, H.E. (2007). Military expenditures and inequality: Empirical evidence from global data. Defence and Peace Economics, 18(6): 519-535.

Ali, H.E. (2012). Military expenditure and inequality in the Middle East and North Africa: A panel analysis. Defence and Peace Economics. 23(6): 575-589.

Benoit, E. (1973). Defence and economic growth in developing countries. Boston, MA: Lexington Books.

Benoit, E. (1978). Growth and defence in developing countries. Economic Development and Cultural Change, 26(2): 271–280.

Biscione, A. and Caruso, R. (2021). Military expenditures and income inequality: Evidence from a panel of transition countries (1990-2015). Defence and Peace Economics, 32(1): 46-67.

Biscione, A. and Caruso, R. (2021). Military expenditures and income inequality: Evidence from a panel of transition countries (1990-2015). Defence and Peace Economics, 32(1): 46-67.

Biyase, M. Eita, J. Udimal, T. and Zwane, T. (2021). Military spending and inequality in South Africa: An ARDL Bounds testing approach to cointegration. Unpublished working paper.

Borch, C., and Wallace, M. (2010). Military spending and economic well-being in the American states: the post-Vietnam war era. Social forces, 88(4): 1727-1752.

Chester, E. (1978). Military spending and capitalist stability. Cambridge Journal of Economics, 2(3): 293-298.

Chletsos, M. and Roupakias. S. (2018). The Effect of Military Spending on Income Inequality: Evidence from NATO Countries. Empirical Economics. https://doi.org/10.1007/s00181-018-1576-7.

Elveren, A.Y. (2012). Military spending and income inequality: Evidence on cointegration and causality for Turkey, 1963–2007. Defence and Peace Economics, 23(3): 289–301.

Faini, R. Annez, P. and Taylor, L. (1984). Defence spending, economic structure, and growth: Evidence among countries and over time. Economic development and cultural change, 32(3): 487-498.

Haffejee, M. I. and Masih, M. (2018). Is the relationship between financial development and income inequality symmetric or asymmetric? New evidence from South Africa based on NARDL. MPRA Paper 87574, University Library of Munich, Germany.

Heltberg, R. Simler, K. and Tarp, F. (2004). Public spending and poverty in Mozambique. In Debt relief for poor countries (pp. 209-240): Springer.

Heltberg, R. Simler, K. and Tarp, F. (2004). Public spending and poverty in Mozambique. In Debt relief for poor countries (pp. 209-240): Springer.

Hirnissa, M.T. Habibullah, M.S. Baharom, A.H. (2009). Defence spending and income inequality: Evidence from selected Asian countries. Modern Applied Science, 3(5): 96–111.

Kentor, J. Jorgenson, A. K. and Kick, E. (2012). The “new” military and income inequality: A cross-national analysis. Social Science Research, 41(3): 514-526.

Lin, E. and Ali, H. (2009). Military spending and inequality: panel Granger causality test. Journal of Peace Research 46(5): 671–685.

Lipow, J. and Antinori, C. M. (1995). External security threats, defence expenditures, and the economic growth of less-developed countries. Journal of policy modeling, 17(6): 579-595.

Meng, B. Lucyshyn, W. and Li, X. (2015). Defence expenditure and income inequality: evidence on co-integration and causality for China. Defence and Peace Economics, 26(3): 327-339.

Mylonidis, N. (2008). Revisiting the nexus between military spending and growth in the European Union. Defence and Peace Economics, 19(4): 265-272.

Ndlovu-Gatsheni, S. (2012). Beyond the equator there are no sins. Coloniality and violence in Africa. Los Angeles: SAGE Publications.

Robert, B.J. (2014). Your place or mine? Beliefs about inequality and redress preferences in South Africa. Soc Indic Res, 118: 1167-1190.

Russett, B. (1982). Defence expenditures and national well-being. The American Political Science Review, 767-777.

Shahbaz, M. Sherafatian-Jahromi, R. Malik, M.N. Shabbir, M.S. and Jam, F.A. (2016). Linkages between defence spending and income inequality in Iran. Quality and Quantity, 50(3): 1317–1332.

Stevenson, P. (1974). A defence of Baran and Sweezy. In: University of Chicago Press.

Töngür, U., and A. Elveren, A.J. (2015). Military expenditures, inequality, and welfare and political Regimes: A dynamic panel data analysis." Defence and Peace Economics 26 (1): 49–74.

Vadlamannati, K. C. (2008). Exploring the Relationship between Military Spending and Income Inequality in South Asia. William Davidson Institute Working Paper No. 918. Ann Arbor, Michigan.

Wolde-Rufael, Y. (2016a). Defence spending and income inequality in Taiwan. Defence and Peace Economics, 27(6): 871-884.

Wolde-Rufael, Y. (2016b). Military expenditure and income distribution in South Korea. Defence and Peace Economics, 27(4):571-581.

Appendix 1A

Table A1: Wald test estimates
Wald Test:
Equation: NARDL

Test Statistic	Value	df	Probability
t-statistic	4.339658	10	0.0015
F-statistic	18.83263	(1, 10)	0.0015
Chi-square	18.83263	1	0.0000

Null Hypothesis: C(1)=C(2)

Normalized Restriction (= 0)	Value	Std. Err.
C(1) - C(2)	0.522092	0.120307

Restrictions are linear in coefficients.

Table A2: Descriptive stats

	LGE_R	LME	LPOP	LGPDPC	LEMP	LGINI
Mean	26.68707	0.654614	3.763066	10.76851	2.530949	4.119527
Median	26.58504	0.409496	3.800289	10.74409	2.578780	4.117409
Maximum	27.16853	1.531208	4.038077	10.92443	2.894759	4.151040
Minimum	26.19099	0.042391	3.393181	10.60646	2.122440	4.085976
Std. Dev.	0.295860	0.524297	0.190653	0.106209	0.227728	0.022095
Skewness	0.274178	0.373253	-0.381316	0.137949	-0.329432	0.004364
Kurtosis	1.927197	1.465631	1.944660	1.636292	2.008793	1.482927
Observations	38	38	38	38	38	38