Does military spending nonlinearly affect economic growth in South Africa?

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ABSTRACT: Using annual data collected from 1988 to 2014, this study provides evidence of a nonlinear relationship between military spending, economic growth and other growth determinants for the South African economy. The empirical study is based on estimates of a logistic smooth transition regression (LSTR) model and our empirical results point to an inverted U-shaped relationship between military spending and economic growth for the data. Furthermore, our empirical results suggest that the current levels of military spending, as a component of total government expenditure, are too high in the South African economy and need to be transferred towards more productive non-military expenditure in order to improve the performance of economic growth and other growth determinants.

Keywords: Military expenditure; Non-military expenditure; Economic growth; Investment; Labour, Exports; South Africa; Sub-Saharan Africa; Developing country; Smooth transition regression (STR) model.

JEL Classification Code: C32; H56; O40.

1 INTRODUCTION

Following the seminal work of Benoit (1973, 1978), the effects of military expenditure on economic growth has been extensively investigated and the consensus drawn so far is that the precise relationship between the two variables is at best inconclusive. In differing from other forms of government expenditure, military spending presents quite an interesting case because such spending exerts both causes and consequences on the macroeconomy. One of the prevalent viewpoints in the academic literature is that military spending is helpful towards economic growth since it provides a variety of public infrastructures which aid an economy to enhance physical capital, human capital (such as education, nutrition, medical care and training) and domestic security (D'Agostino et. al., 2011). Contrariwise, a smaller portion of the literature contends that military spending may impede economic growth because it is an obstacle to the use of government spending for the civilian sector which is deemed to be more productive in stimulating economic growth (Ali and Dimitraki, 2014). In this later case, the transfer of resources from civilian to the military hampers economic growth through a crowding out effect of consumption and investment.

Up-to-date, most empirical studies have assumed linearity in analysing the military-growth relationship. And yet this assumption of linearity may be trivializing the whole issue since it has been previously documented that both the military expenditure and economic growth time series variables evolve nonlinearly over the steady state (see Fiaschi and Lavezzi [2007] and Lau et. al. [2015]). Stroup and Heckelman (2001) highlight that the introduction of nonlinearity in the military-growth nexus may serve to bridge two contrasting view-points by hypothesising a sign change of the relationship after crossing some optimal or threshold value. A theoretical rationale for the presence of nonlinearities is that the marginal effect of a change in military burden is not constant across different levels of the variable (Cuaresma and Reitsschuler, 2004). Moreover, over the last couple of decades or so, economies worldwide have been subject to a number of structural changes. Failure to empirically account for these structural changes may lead to the well-known problem of spurious regression estimates. Therefore, a shift from the conventional assumption of linearity to that of nonlinearity is quite significant in the development of empirical research regarding the military-growth relationship.

There have been a handful of empirical works which have investigated the relationship between military spending and economic growth for the South African economy and these studies generally advocate for a negative relationship between the two variables (Dunne and Vougas (1999), Dunne et. al. (2000), Batchelor et. al. (2000) and Aye et. al. (2014)). Notably, all of these studies assume a symmetric military-growth relationship for the South African economy. However, as noted by Aye et. al. (2014), ignoring nonlinearities in the military-growth relationship for the South African economy will likely result in misleading inference drawn from estimates obtained from a linear econometric model. Our study hereby contributes to the existing literature by investigating a possible nonlinear relationship between military growth and economic growth for South Africa. For empirical purposes we choose the smooth transition regression (STR) model. We favour this particular model on the basis of its superiority in comparison to other nonlinear econometric models like the TAR and the Markov Switching (MS) models which are considered deficient on account of assuming an abrupt transition within the model regimes. In addition, the STR framework allows the determination of the time series variable responsible for regime switching behaviour to be an inherent part of the modelling process.

Having provided the backdrop to our study, we structure the rest of the paper as follows. The next section of the paper provides a review of the associated literature. The third section presents the theoretical and empirical models used in the study whereas the testing and estimation of the LSTR model is done in the fourth section of the paper. The fifth section concludes the paper in the form of policy recommendations and also suggests avenues for future research.

2 LITERATURE REVIEW

As has been previously mentioned, academic researchers are increasingly contemplating on the idea of a nonlinear relationship between military spending and economic growth. For convenience sake, one can categorize these nonlinear studies into three broad strands of empirical research. The first group of these studies are those which used cross-sectional variations over panel data estimates and also over time periods to verify this notion of nonlinearity within the empirical data. A conspicuous example of such a study is that of Hooker and Knetter (1997) who investigate the impact of military spending on unemployment for panel data comprising of the 50 states in the US over data collected from 1963 to 1992. The authors are able to find that states with greater dependence on military spending have larger elasticities of unemployment with respect to military spending. In other words, decreases in military spending will lead to proportionately larger increases in unemployment rates in those states with a large share of military spending as opposed to those states with lower shares of military spending. Another study worth taking note of is that of Stroup and Heckelman (2001) which uses time variations in order establish nonlinearities in the military-growth relationship for 44 African and Latin American countries. Particularly the authors establish nonlinearities within the panel data by estimating military spending-economic growth regression across three separate growth periods namely, 1975-1989, 1980-1984 and 1984-1989. The findings of the study reveal that periods exhibiting low levels of military spending and labour use have a positive yet diminishing effect on economic growth. However, this positive influence turns negative during periods with higher levels of military spending and labour usage.

The second strand of nonlinear studies found in the literature are those which investigate the nonlinear relationship between military spending and growth using variants of the threshold autoregressive (TAR) models introduced by Tong and Kim (1981) and modified by Tsay (1998) and Hansen (2000). A popular citation amongst these studies is that of Cuaresma and Reitsschuler (2003) who use a two-regime TAR model to estimate the nonlinear military-growth relationship for the US economy using data collected from 1929-1999. The authors use two theoretical approaches in their empirical analysis; with the first approach being a growth equation framework and the second being a production function approach. In both approaches the level of total defence spending is chosen a-priori as the threshold variable. For the growth equation, the estimated threshold is estimated at defence spending level of $384.77 million, of which in the upper regime of the TAR model defence spending exerts an insignificant effect on economic growth and the relationship turns positive and significant in the lower regime. On the other hand, the empirical results associated with the production function produce a threshold estimate of $216.24, of which in the lower regime there is a positive and significant relationship between the two variables; whereas this relationship turns negative and significant in the lower regime. Similarly, Yang et. al. (2011) also make use of a two-regime TAR model to investigate the nonlinear relationship between military expenditure, threat and economic growth for a panel of 92 countries using data collected 1992 to 2003. The authors use initial income as the threshold variable in the regressions. The results show that there is a significant negative military-growth relationship for countries with initial incomes less than or equal to $475.93 whereas for the remaining countries with initial incomes greater than $475.93, the relationship turns insignificant.

Lai et. al. (2005) investigate the arms race between China and Taiwan using a multi-variate threshold vector autoregressive (MV-TVAR) model which is applied to two sets of military-growth data collected from two separate sources; namely, (1) the Chinese Statistics Yearbook (CSY) and (2) the Stockholm International Peace Research Institute (SIPRI) Yearbook. The authors include the rival's country's growth in military spending within the MV-TVAR specification and thereafter select this variable a-prior as the threshold variable for the estimated regressions. For the case of China, both datasets reveal a threshold of 5 percent of which Chinese military spending leads her economic growth albeit in the lower regime for CSY data and in the upper regime for SIPRI data. Furthermore, both datasets for China's case reveal that Chinese military spending leads Taiwan's military spending. Similarly for the case of Taiwan, a threshold of 5 percent is found for CSY data, of which feedback causality is found between Taiwanese military spending leads economic growth as well as between China's military spending and Taiwanese military spending in both regimes of the model. However, using SIPRI data, a threshold of 1.5 percent is found for the Taiwanese case in which causality running from military spending to economic growth is found in both regimes of the model and China's military spending being found to lead Taiwanese military spending.

And yet even the use of TAR models in the analysis of time series variables has faced severe criticism based upon its abrupt regime switching mechanism between regime coefficients (Phiri, 2015). Such criticisms laid the foundation for the next development in the empirical literature, which saw researchers turn their attention to the use of smooth transition regression (STR) models. What distinguishes this cluster of studies from earlier nonlinear studies is that the regime switching mechanism is conducted in a smooth manner as opposed to being abrupt, and, as previously mentioned, this is consistent with the stylized fact that economic entities who influence the variables do not behave simultaneously or in the same direction. One of the earliest studies to use such a framework is presented in Ocal (2002), who applies the STR model to investigate nonlinearities in the relationship between military spending in Turkey and military spending in Greece using data collected from 1956 to 1994. In similarity to Lai et. al. (2005), the authors include the rival country's military spending within the STR regressions and the linearity tests confirm that the best fitting model is one with Greece's military expenditure being the dependent variable and Turkey's military spending being the transition variable. The estimation results of this model indicate an optimal threshold value of 5.2 percent of which below this value the effects of Turkish military spending on Greek military spending is negative and this relationship turns positive above the threshold.

D'Agostino et. al. (2011) also apply the STR model the nonlinearities in the military growth relationship for the US using data collected from 1958 to 2005. In order to model these nonlinearities, the authors rely on endogenous growth models nested in Cobb-Douglas production functions and further use seven different specifications of government spending in which government spending is broken down into military and non-military spending and each of these two components of government spending are further decomposed into consumption and investment elements. The empirical exercise results show that aggregate government spending in the US has an inverted U-shape relationship with economic growth, that is, a positive relationship exists between the variables up to some optimal point, which turns negative thereafter. When government spending is decomposed into military and non-military components, only the former retains its nonlinear relationship with economic growth. Furthermore, both consumption and investment components of military spending are found to exhibit a nonlinear relationship with growth whereas only the investment component of non-military spending nonlinearly affects economic growth. Overall, the results show that military spending is productive for the US, while non-military spending does not significantly benefit economic growth unless it is through the channel of investment.

3 EMPIRICAL FRAMEWORK

In adhering to the developments found in the literature, our study also makes use of the STR model to investigate nonlinearities in the military-growth relationship for South Africa. Our baseline STR model takes the following functional form:

$$y_t = \beta_0' x_t + \beta_1' x_t \, G(z_t;\, \gamma, c) + \varepsilon_t \qquad (1)$$

Where y_t is a scalar; β_0' and β_1' are parameter vectors; x_t represents the vector of explanatory variables; and $\varepsilon_t \sim$ iid $N(0, h^2_t)$. The transition function $G(z_t; \gamma, c)$ is the transition function normalized and bound between 0 and 1. z_t is the transition or threshold variable whereas γ and c are the transition parameter and the threshold parameter, respectively. In further specifying the transition function $G(z_t; \gamma, c)$, we use the following logistic function:

$$G(z_t;\, \gamma, c) = [1 + \exp(-\gamma(z_t - c_k))]^{-1} \qquad (2)$$

Where $\gamma > 0$ and $c_1 \leq c_2 \leq \ldots \leq c_m$. For empirical purposes we restrict the STR model to the cases for k=1 and k=2. When k=1, the model parameters may change monotonically depending on the transition variable c, thus yielding the logistic STR (LSTR-1) model. When k=2, the parameters change depending upon whether the transition variable is below c_1 or above c_2, hence we refer to this regression specification as the logistic quadratic STR (LSTR-2) model. The initial specification stage of the modelling cycle consists of testing for linearity against the alternative of a LSTR model. Pragmatically, the LSTR model can be reduced to a linear model by imposing the constraint H_0: $\gamma = 0$ or H_0': $\beta_1 = 0$. However, the associated tests are nonstandard since the LSTR model contains unidentified nuisance parameters under the null hypothesis of linearity. To circumvent this identification problem we follow Luukkonen et.al. (1998) by replacing the transition function $G(z_t; \gamma, c)$ by its first order Taylor expansion around $\gamma = 0$, which results in the following auxiliary function:

$$y_t = \mu_t + \beta_0'^{*} x_t + \beta_1'^{*} x_t z_t + \beta_2'^{*} x_t z_t^2 + \beta_3'^{*} x_t z_t^3 + \varepsilon_t^* \tag{3}$$

Where the parameter vectors $\beta_1^*, \beta_2^*, \beta_3^*$ are multiples of γ and $\varepsilon_t^* = \varepsilon_t + R_3 \beta_1' x_t$, with R_3 being the remnant portion of the Taylor expansion. Hereafter, the null hypothesis of linearity may be tested by an LM test such that the Taylor series does not affect asymptotic distribution theory. By using auxiliary regression (3), we can test the null hypothesis of linearity as $H_0^*: \beta_3^* = \beta_2^* = \beta_1^* = 0$. If this is rejected, we then test $H_{03}^*: \beta_3^* = 0$, $H_{02}^*: \beta_2^* = 0 | \beta_3^* = 0$ and $H_{01}^*: \beta_1^* = 0 | \beta_3^* = \beta_2^* = 0$. The decision rule for selecting either a LSTR-1 or LSTR-2 model is thus as follows. Select a LSTR-2 specification if H_{02}^* has the strongest rejection, otherwise, we select the LSTR-1 specification.

In turning to our theoretical framework, we opt to model the military-growth relationship by incorporating a standard Cobb-Douglas production function within the neoclassical growth framework. Specifically, this involves specifying real output as a function of physical capital, human capital and technological progress i.e.

$$y_t = A_t K^{\theta_1} H^{\theta_2} \tag{4}$$

Where K_t is the level of aggregate capital, H_t is the level of aggregate labour and A_t is a measure of technology. A number of authors, inclusive of Cuaresma and Reitschuler (2004) as well as Dunne and Tian (2015), have hypothesized that both total government expenditure as well as the export sector are likely to have a technology augmenting effect on the economy and can thus should be included in the aggregate production function:

$$y_t = A_t K^{\theta_1} H^{\theta_2} G^{\theta_3} G^{\theta_4} XGS^{\theta_5} \tag{5}$$

Where G_t and XGS_t denote aggregate government spending and exports, respectively. Furthermore, Cuaresma and Reitsschuler (2006) as well as D'Agostino et. al. (2011) have also demonstrated on how aggregate government spending can be further divided between military (M_t) and non-military outlays (NM_t) such that $G_t = M_t + NM_t$. In referring to our STR regressions equations (1) through (3), we can transform the linear logarithmic form of the modified neoclassical growth equation (5) into the following STR empirical specification:

$$\begin{aligned} y_t = {} & \mu_t + \theta_1 K_t + \theta_2 H_t + \theta_3 M_t + \theta_4 NM_t + \theta_5 XGS_t + \\ & (\theta_1' K_t + \theta_2' H_t + \theta_3' M_t + \theta_4' NM_t + \theta_5' XGS_t) \times G(z_t; \gamma, c) \end{aligned} \tag{6}$$

From the above regression, the modelling and estimation process of the formulated STR regression can be outlined in the following steps:

I. Test linearity against the LSTR alternative by using each of the explanatory variables as a possible transition variable. Once linearity is rejected, use the decision criteria to choose between LSTR-1 and LSTR-2 specification and choose the model with the highest rejection.
II. For the chosen model, carry out a three-dimensional grid search over the values of z_t, y and c. The optimal values are the ones which minimize the residual sum of squares (RSS).
III. Estimate the chosen model using a Newton-Raphson algorithm to maximize the conditional maximum likelihood function.
IV. Perform diagnostic tests (i.e. ARCH effects, tests of no error autocorrelation and parameter consistency) on the estimated model.

4 EMPIRICAL ANALYSIS

4.1 Data and unit root tests

Our empirical analysis makes use of annual data collected from 1988 to 2015. The main sources of the data used in the study are (i) the Federal Reserve Economic Data (FRED) online database from which we obtain our labour force growth data (*lbr*); (ii) the Stockholm International Peace Research Institute (SIPRI) Yearbook from which we get our growth in military spending (*milex*) data; and (iii) the South African Reserve Bank (SARB) online database from which we get our gross domestic product (*gdp*) growth rate; our growth rate of non-military government expenditure (*non_milex*), our share of investment in GDP (*inv_gdp*) and the growth of exports of goods and services (*xgs*). It should be noted that the growth rate of non-military government expenditure (*non_milex*) variable is calculated as the percentage change in the difference between total government expenditure and military spending. Before making any attempts at estimating of our empirical model, it is necessary to examine the integration properties of the time series variables. Given the time period of the data used in the study, we find it best to account for structural breaks when testing for unit roots. To this end we use Zivot and Andrews (1992) structural break unit root tests. These unit root test are performed with i) an intercept and ii) a trend. The results of the unit root tests have been reported in Table 1 below.

Table 1: Zivot and Andrews (1992) unit root tests

time series	t-statistic		breakpoint(date)	
	Intercept	Trend	intercept	trend
gdp	-3.61 (-5.28)***	-4.49*** (-4.38)**	2008	2007
inv_gdp	-4.49 (-5.69)***	-3.59 (-4.59)**	2007	2001
lbr	-0.94 (-3.95)	-3.20 (-4.74)**	1995	1998
non_milex	2.61 (-4.12)	-3.19 (-4.50)**	1995	1995
milex	-3.99 (-6.59)***	-4.46** (-5.00)***	1994	2000
xgs	-3.32 (-4.34)	-3.99 (-4.13)*	2008	2009

Significance levels are given as follows: '***', '**' and '*' represent the 1 percent, 5percent and 10 percent significance levels respectively. The test statistics for first differences are reported in parentheses. The critical values for the Zivot and Andrews (1992) unit root tests inclusive of an intercept only are as follows: 1 percent: -5.34, 5 percent:-4.80 and 1 percent: -4.58; the critical values for the unit root test inclusive of a trend are as follows: 1 percent: -4.93, 5 percent: -4.42 and 1 percent: -4.11 whereas the critical values for the unit root test inclusive of a trend and intercept are as follows: 1 percent: -5.57, 5 percent: -5.08 and 1 percent: -4.82. The optimal lag which is used to facilitate these tests are determined by the AIC information criterion.

As is evident from Table 1, the empirical results of the performed unit root tests obtained for the time series are quite mixed. One on hand, economic growth (*gdp*), investment (*inv_gdp*) and military expenditure (*milex*) are I(1) processes when the unit root tests are performed with an intercept, and on the other hand, the labour force (*lbr*), non-military expenditure (*non_milex*) and exports (*xgs*) are I(1) process when the tests are performed with a trend. However, we consider these results to be satisfactory since all observed time series, whether inclusive of an intercept or a trend, fail to reject the null hypothesis of a unit root in their levels and only retain stationarity in their first differences. According to Engle and Granger (1987), this is sufficient evidence of an existing cointegration vector and we can thus proceed to estimate regressions formed from the time series without the fear of obtaining spurious results. Another thing worth noting from the results reported in Table 1 is that the various structural breaks detected in the time series correspond to the democratic shift of the South African economy in 1994, the monetary policy shift towards inflation targeting in 2001-2002 as well as the global financial crisis of 2007-2009 which lead to a period of worldwide depression.

4.2 STR Regression Estimates

Having confirmed first difference stationary in the time series, we proceed to estimate the STR regression model. However, prior to doing so, we must first select our transition variable, that is, the time series variable which is responsible for the regime switching behaviour in the estimated model. In order to do so, we carry out the linearity tests for a set of candidate transition variables and the variable which gives rise to the strongest rejection of linearity (i.e. the smallest p-value) is chosen as the transition variable. In addition to verifying the appropriate transition variable, these tests will also serve to determine whether a LSTR-1 or LSTR-2 model is an appropriate specification for the estimated regression associated with the selected transition variable. The decision rules for selecting the LSTR-1 and LSTR-2 models were discussed in the previous section of the paper. The results of the linearity tests are reported below in Table 2.

Table 2: Linearity tests

transition variable	tests statistics	decision

	F	F1	F2	F3	
inv_gdp	0.2213	0.3936	0.9349	0.0065	Linear
lbr	0.2489	0.6678	0.2479	0.4129	Linear
non_milex	0.0017	0.0935	0.0060	0.0042	LSTR-1#
milex	0.0098	0.40351	0.0003	0.2687	LSTR-2
xgs	0.1523	0.5469	0.0369	0.2144	Linear

Note: The F-tests for nonlinearity are performed for each possible candidate of the transition variable and the variable with the strongest test rejection (i.e. the smallest p-value) is tagged with symbol #.

Based on the results reported in Table 2, we observe that only two transition variable candidates reject the notion of linearity among the time series variables, those being, the military expenditure and the non-military government expenditure variables. However, of the two candidates for modelling nonlinearity, we further observe that non-military government expenditure is the more appropriate variable of the two transition candidates seeing that it displays lower p-values associated with the test statistics. Also given that the F3 statistic has the highest rejection associated with non-military government variable, we decide on fitting an LSTR-1 to the regression. As a compliment to the linearity tests, we also conduct tests of no remaining nonlinearity in the chosen transition variable. The results are reported in Table 3 below and show that there is no remaining nonlinearity for the chosen transition variable.

Table 3: Tests of no remaining nonlinearity

F-statistic	p-value
F	0.0305
F4	0.0639
F3	0.5218
F2	0.0103

Subsequent to performing our linearity tests as well as our tests for no remaining nonlinearity, we proceed to estimate the appropriate LSTR-1 regression model with the non-military government expenditure imposed as the transition variable and report the regression estimates in Table 3. Concerning our empirical estimates obtained from the estimation of the LSTR model, a number of interesting points can be highlighted. First of all, we obtain a significant threshold estimate of 11.65 for the transition variable of which there is substantial evidence of regime switching behaviour existing amongst a majority of the regression coefficient estimates. For instance, we find that the effects of both military and non-military spending switches from negative to positive when non-military expenditure exceeds an optimal threshold of 11.65. This result is particularly encouraging since it adheres to the theoretical intuition of an inverted U-shaped relationship between military spending and economic growth on one hand, as well as between non-military spending and economic growth, on the other hand. Notably, Cuaresma and Reitsschuler (2003) and D'Agostino et. al. (2011) find a similar inverted U-shape relationship between military spending and economic growth for the US economy, even though the authors are unable to establish one between non-military spending and growth.

Another finding worth taking note of is that the coefficients of the labour force and the exports variables all turn from positive to negative as one moves from the lower to the upper regime of the LSTR model. Again, this finding implies that the positive effects of these growth determinants on economic growth begin to emerge once the ratio of military spending to economic growth exceeds 11.65 and it is only in this upper regime whereby the coefficient signs on these growth determinants are in coherence with what is dictated in conventional growth theory. Another interesting finding is that the regression estimates point to a negative effect of investment on economic growth estimate across both regimes. This negative investment effect has also being found in the work of Batchelor et. al. (2000) for South Africa and this finding contradicts conventional growth theory which hypothesizes of a positive effect of investment on economic growth. Nevertheless, there exists two academic explanations for this finding. Firstly, as put forward by Fortainer (2007), a greater part of South Africa's investments are not 'Greenfield investments' but are rather mergers and acquisitions. The second reason is that the current high levels of public spending and budget deficits crowd out the positive effects of investment in the South African economy (Biza et. al., 2015).

Table 4: STR regression estimates

	linear part	nonlinear part
constant	-115.10	378.02
	(0.00)***	(0.01)**
inv_gdp	-0.91	-0.84
	(0.00)***	(0.31)
lbr	1.13	-3.44
	(0.02)**	(0.05)*
non_milex	0.61	-4.36
	(0.02)*	(0.00)***
milex	8.37	-30.99
	(0.00)***	(0.01)***
xgs	2.01	-2.60
	(0.00)***	(0.00)***
γ	11.65	
	(0.00)***	

c	9.61
	(0.00)***
R^2	0.95
diagnostic tests on residuals	
LM(4)	8.47
	(0.02)
ARCH(4)	4.02
	(0.86)
J-B	0.32
	(0.85)

t-statistics are reported in parentheses. Significance levels are given as follows: '***', '**' and '*' represent the 1 percent, 5percent and 10 percent significance levels respectively.

5 CONCLUSION

Thus far, the empirical investigation into the military-growth relationship in South Africa has been dominated by linear frameworks. However, it has recently come to attention that the assumption of a linear relationship between military spending and economic growth in South Africa may be incorrect. Using annual data collected from 1988 to 2014, this study becomes the first to examine a possible nonlinear relationship between military spending, economic growth and other growth determinants for the South African economy. This is an important contribution to the literature due to the scarcity of empirical evidence on the subject matter for the Sub-Saharan African (SSA) region as a whole. Our paper argues that such nonlinearities can be effectively captured by a STR model which is theoretically more appealing in comparison to other competing econometric models. Indeed, our empirical results are coherent with the dynamics of the endogenous model of D'Agostino et. al. (2011) by suggesting an inverted U-shaped relationship between military spending and economic growth. The regression estimates also show that other growth determinants such as non-military-to-GDP ratio, the labour force and the exports-to-GDP ratio also bear an inverted U-shaped relationship with economic growth. The empirical results also show that all regime switching behaviour is facilitated through the non-military-to-GDP ratio, of which below a rate of 11.65, the time series variables are positively correlated with economic growth whereas above this optimal rate the variables become negatively correlated with growth. The only exceptional case is with the investment variable, of which we find a negative effect on economic growth above and below the optimal threshold point.

Former studies have found a negative relationship between military growth and economic growth for the South African economy and have therefore implied that government should lower military spending in order to enhance the country's economic growth performance. However, due to the fact that our study finds regime switching behaviour between military spending and economic growth, a number of new policy inferences and possible future developments can be drawn from our overall empirical analysis. For instance, we find that the non-military-to-GDP ratio has been below its threshold level of 11.65 percent since 2000. In fact, the only periods which South African policymakers have managed to keep this ratio above 11.65 percent was between 1998 and 1999. This implies that the South African economy is currently hindered by its currently high levels of military spending and this will be the prevailing issue if government does not allocate more of it's total budget towards higher levels of non-military spending. And yet if government is to shift its resources from military spending to non-military spending, then which components of non-military spending would be more productive? Such questions can be addressed by decomposing the military and non-military spending components into their respective investment and consumption sub-components and therefore examining which of these sub-components is more productive. However, we leave such for future research endeavours and further suggest that the military-growth relationship be extended to other sub-Saharan African countries as a whole or as individual economies.

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