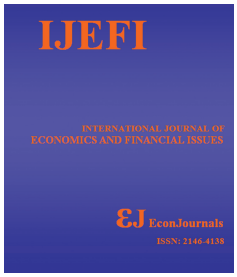

International Journal of Economics and Financial Issues

ISSN: 2146-4138

available at http: www.econjournals.com

International Journal of Economics and Financial Issues, 2017, 7(5), 169-177.

Causality between Defence Spending and Economic Growth in Sub-Saharan Africa: Evidence on a Controversial Empirical Issue

Zahra N. Masih*

United States Metric Association, Windsor CO 80550, USA. *Email: zahramasih1@gmail.com

ABSTRACT

Identifying the proper links toward stimulating economic growth has been a debate among economists for years. To analyse potential variables, this paper utilizes the Granger causality test between economic growth and defense spending. Unlike previous studies, this paper illustrates the relationship by finding cointegration between the variables (i.e., long-term equilibrium relationship). We test for cointegration between defense spending and real income in a sample of Sub-Saharan African nations. By using a dynamic vector error-correction model, we analyse the direction of Granger-causation and hence the within-sample Granger-exogeneity or endogeneity of each of the variables. The relative strength of the causality is gauged (through the dynamic variance decomposition technique) by decomposing the total impact of an unanticipated shock to each of the variables beyond the sample period, into proportions attributable to shocks in the other variables including its own, in the bivariate system. Results based on these tools of methodology, broadly tend to indicate that, defence spending and economic growth did share a common trend over the sample period under analysis, but it was the former which stimulated the latter. Our study found Kenya and Niger as subject to defense spending, and Sudan, Mali and Tanzania experiencing predicted bidirectionality. It is defence spending that has a much more pronounced and permanent effect on economic growth, giving rise to implications: Although expenditure on defence may have been politically motivated, over the long-run this spending did play a significant role in enhancing impact on a closed-door economy.

Keywords: Defence-growth Causality, Cointegration, Vector Error-correction Model, Granger Error-correction Causation
JEL Classifications: O11, C22, C32, C52

1. INTRODUCTION

The ideal of economic growth poses itself as a stimulant to the thought process of economists worldwide. Almost continuously, multiple factors are being analyzed for correlation, in hopes that the given history of the nation will develop a trend line to help shape future policies and positively induce economic prosperity. Recent undertakings in research have illuminated the engenderment and behavior of economic growth, specifically noted toward a nation's military expenditure. Though mutually agreed upon as a factor to national finance, much controversy exists on the validity of addressing military spending as a key element in impacting economic growth.

The origin to such controversy is exhibited in claims made by Benoit (1978): A positive causation exists between military expenditure and economic growth. This research challenges the viewpoints of numerous economists, in which conflicting results have emerged from testing and approving Benoit's claims. Currently, military expenditure and economic growth is characterized under two different perspectives. Under the positive portrayal, more investment toward military needs increases national security and allows the population to focus more on domestic affairs. This may promote confident international trade, by means of acknowledging internal security. Also, a greater focus on areas with more expense create jobs for the public, a higher standard of living, and aid for technological advancement within the defense sector (Pradhan, 2010). However, critiques argue that increased military expenditure is unnecessary, where such finances may be taken away from other economic interests and resources. This may lead to higher taxation in terms of national financing. Also, an influx of technologically advanced military equipment may label a nation as intimidating and increase foreign threat, similar to that experienced during the 1945 Arms Race (Datta and Mukhopadhyay, 2011). This prompts the need for further investigation, in which a continuous debate persists on validating such viewpoints.

Aside from divergent perspectives, further debate prevails regarding the employment of methodology and statistical data. Benoit's findings were employed utilizing the Granger causality test, a statistical method that determines the practicality of stating the effects of time series data on two or more variables. Given that there exists a correlation between defense spending and economic growth at a macroeconomic dimension, researchers debate upon the directionality of causation. Identifying directionality is of extreme importance, in which it determines which factors in the relationship are responsible for impact. If economic growth Granger causes defense spending, a nation will experience a generalized surplus of goods and a stable economy. Therefore, defense spending improves merely because the nation can afford to invest money into the area, as it may do with any other interest. Conversely, should defense spending Granger cause economic growth, a nation's investment into the defense sector stimulates jobs through developing equipment, advertising, etc. Therefore, the increase in jobs raises the standard of societal living, and economic growth is enhanced. Following Benoit's work, many researchers utilized the Granger causality test to implement their work, and the variation in results further contributes additional debate on the means of error, the time period data was taken from, nations of interest, etc.

It is of critical importance that issues regarding causation be thoroughly investigated, where findings may contribute to shifts in policy. Research in this field acts in interest to a wide range of countries, including those of all developmental positions. Policy makers can depend on such work to help formulate new distributions in economic spending depending on the severity of national conflict and the needs of society. Toward a grander scale, investigating the possible relationship between military expenditure and economic growth may provide insight into realigning national wartime policies, and may encourage peace both domestically and internationally (Datta and Mukhopadhyay, 2011). Finally, such research will contribute to the developing variety of data available for establishing a consensus upon the prolonged debate.

A variety of countries that have utilized the Granger causality test to explore this issue empirically maintain a dynamic economic setting, such as China (Khalid and Mustapha, 2014), Latin America (Kung and Min, 2013), Turkey and Greece (Dunne et al., 1998). Therefore, such countries are often subject to analysis. However, countries in Africa are not as comparatively tested for (Mohammed, 1992). Not only are they in the process of development, but such regions have also undergone many transitional shifts in power. Sub-Saharan countries in particular have gained their independence during the 1950's and '60s making them prime candidates for new and influential policy changes. Data analysis regarding economic prediction may act in benefit to the respective policymakers and economists. The following research will utilize a Granger causality test between two variables, defense spending and economic growth, in various African countries. The goals are to analyze in-sample and out-of sample data for short run and long run causal relationships.

Research conducted within this paper contributes to a wide range understanding of defence behaviour in reference to defence spending. Such contirbutions specifically include: (1) Research with African economies is severely limited, and a handful of such countries are struggling to thrive in a gloabal cutthroat economy. This research will shed light upon such issues. (2) This research elaborates on half a century's worth of data to provide both historical relevance and accurate data sets on a selected group of countries. (3) This analysis employs the most powerful time series methods to unveil the direction of causation and uses it as a template towards broader policy prescriptions. (4) Further, we provide prescriptions delineating across time windows of short and longer term relationships and underline the nuances this brings within a practical policy settings that such countries often overlook.

The remainder of the paper is formatted as follows: Section 2 provides a brief synopsis of the Granger causality test in reference to various papers, demonstrating the unique variability of results. Section 3 presents methodology applied for empirical analysis. Section 4 discusses the results paired with possible explanations for the direction of country-specific causality. Section 5 will summarize the paper and provide insight into further implications.

2. REVIEW OF LITERATURE

Aside from Benoit (1973), multiple papers have addressed the underlying reasons for causation through a variety of research, many of which have profusely contributed to the controversy of the topic. Pradhan (2010) describes national security as an imperative necessity for the wellbeing of its citizens. A greater focus on defense spending will strengthen national defense in benefit of growth. The findings in the research were inconclusive for five ASEAN countries, in which the unidirectional causality from economic growth to defense spending was severely contradicted from previous studies, dependent on the country being analyzed. Whereas, Korkmaz (2015) claims that a significantly larger amount of the economic budget is spent on defense materials in comparison to other facilities, such as education and infrastructure. This empowers the need to re-access policy via historical data to determine if needs are still being met in a society. This research finds that a unidirectional, negative relationship exists from military spending to economic growth, which supported the Keynesian economic theory.

Variables affecting the outcome of results also differ. Each nation experiences a form of political, economic, and environmental challenges that make it unique to its counterparts. Take, for example, China, whose rising military and economic status over the past decade have made it a considerable candidate for Granger causality. As according to Menla and Dimitraki (2013), China exhibits dynamic interplay between economic growth and defense spending, in which areas of high variance have lower economic output and vice versa. Given China's significantly high position in economic and militaristic affairs, it is evident that its Granger causality results will also differ from Greece and Turkey, where defense spending is frequently exercised to develop foreign (NATO) and domestic prosperity.

Controversy still exists in methodology and time periods data is taken from. Alluding to the Greece and Turkey example,

Manamperi (2016) found a strong, unidirectional causality from defense spending to economic growth. This research connects findings to geographic and governmental distribution of funds. Due to Greece and Turkey residing in an area of continuous unrest, both are pressured to strengthen national security, which actually result in the deterring of economic growth. In contrast, Gokmenoglu et al. (2015) find Turkey to exhibit a unidirectional causality from economic growth to military expenditure under the explanation that Turkey is a developing country with limited resources. The contradictory findings demonstrated here are just one of the many cases that contribute to the lack of consensus. This prompts the need for further investigation, particularly in nations that have not been as studied.

Countries in Africa are sparse in economic research, which positions it as a prime candidate for study. As according to van Hilten (2015), African countries have been continuously labeled as developing nations, which plead the need for economic research. Most recently, African countries have linked education as an economic growth factor, in which the need for human capital ensures higher income and economic success. Despite these findings, it is imperative that more research be added to the collections of data present for such nations. Identifying potential links between defense spending and economic growth may inspire new policy changes or reaffirm that such countries are funding sectors properly.

3. ECONOMETRIC METHODOLOGY

3.1. Vector Error-Correction Modelling (VECM) and Exogeneity

Engle and Granger (1987) demonstrated that once a number of variables (say, x_t and y_t) are found to be cointegrated, there always exists a corresponding error-correction representation which implies that changes in the dependent variable are a function of the level of disequilibrium in the cointegrating relationship (captured by the error-correction term [ECT]) as well as changes in other explanatory variable(s). If we exploit the idea that there may exist co-movements between defence burdens and real incomes of less developed countries and possibilities that they will trend together in finding a long-run stable equilibrium, by the Granger representation theorem we may posit the following testing relationships which constitutes our VECM:

$$\begin{pmatrix}\Delta x_t\\ \Delta y_t\end{pmatrix}=\begin{pmatrix}d_{11}(L) & d_{12}(L)\\ d_{21}(L) & d_{22}(L)\end{pmatrix}\begin{pmatrix}\Delta x_t\\ \Delta y_t\end{pmatrix}+\begin{pmatrix}\delta ECT_{t-1}\\ dECT_{t-1}\end{pmatrix}+\begin{pmatrix}c_1\\ c_2\end{pmatrix}+\begin{pmatrix}v_{1t}\\ v_{2t}\end{pmatrix}$$

Where Δ is a difference operator, ECT refers to the error-correction term derived from long-run cointegrating relationship via the Johansen method, c_1 and c_2 are constants, and v_1 and v_2 are serially-uncorrelated random error terms with mean zero.

A consequence of relationships described by (1) and (2) is that either Δx_t or Δy_t or both must be caused by ECT_{t-1} which is itself a function of x_{t-1}, y_{t-1}. Intuitively, if *yt* and *xt* have a common trend, then the current change in x_t (say, the dependent variable) is partly the result of x_t moving into alignment with the trend value of y_t (say, the independent variable). Through the ECT, the VECM opens up an additional channel for Granger-causality (ignored by the standard Granger and Sims tests) to emerge. The Granger-causality (or endogeneity of the dependent variable) can be exposed either through the statistical significance of: (i) The lagged ECTs (δ and d) by a t-test; (ii) a joint test applied to the significance of the sum of the lags of each explanatory variable ($d_{12}(L)$ and $d_{21}(L)$) by a joint F- or Wald χ^2 test; or (iii) a joint test of all the set of terms described in (i) and (ii) by a F- or Wald χ^2 test, i.e., the $d_{12}(L)$ and δ in (1) and $d_{21}(L)$ and d in (2). The non-significance of both the t- and F- or Wald tests in the VECM indicates econometric exogeneity of the dependent variable.[1]

3.2. Generalized Variance Decompositions (GVDCs) and Causal Relativities

The VECM can only indicate the presence of Granger-causality of the dependent variable within the sample period but cannot provide the relative contributions of the explanatory variables in explaining the variation in the dependent variable beyond the sample period. The generalized VDCs, by partitioning the variance of the forecast error of a certain variable into proportions attributable to innovations (or shocks) in each variable in the system including its own, can provide an indication of relative causal strength. We adopt the partitioning of the variance attributable to a shock in each variable according to the methodology outlined in Lanne and Nyberg (2016), who propose a new generalized forecast error variance decomposition with the property that the proportions of the impact accounted for by innovations in each variable sum to unity. Their decomposition methodology is based on the well-established concept of the generalized impulse response function.

4. DISCUSSION AND ESTIMATION RESULTS

Our data set describing defence burden (defence expenditure) and real economic growth (real gross domestic product [GDP]) covers eight Sub-Saharan countries, namely: Central African Republic (CAR), Ethiopia, Kenya, Mali, Tanzania, Niger, Somalia and Sudan. These countries were chosen directly as a function of geography and data availability. All data are annual and cover the period 1961-2015, uniformly across all countries in our sample. All data are for "defence burden" sourced from SIPRI Military Expenditure Database (https://www.sipri.org/databases/milex) and observed as a percentage of GDP. All data for real economic growth are sourced from World Bank: World Development Indicators (http://data.worldbank.org/data-catalog/world-development-indicators). Annual percentage growth rate of GDP at market prices based on constant local currency; aggregates are based on constant 2015 US dollars.

1 Defining the source of causation is still a controversial area particularly when it comes to discerning whether (i) and (ii) constitute long and short-run sources. While lagged changes may be intuitively classified as short-run influences, the ECT involves a constant reconciliation between short-run departures from the long run information channel. This question has been taken up theoretically by Granger (1988).

Table 1: Summary of stationarity properties (1961-2015)

Country	Real GDP (y)	Defence burden (db)
CAR	I (1)	I (1)
Ethiopia	I (1)	I (1)
Kenya	I (1)	I (1)
Mali	I (1)	I (1)
Tanzania	I (1)	I (1)
Niger	I (1)	I (1)
Somalia	I (1)	I (1)
Sudan	I (1)	I (1)

Using the appropriate notation, a series χ_t is said to be integrated of order d, if it has an invertible ARMA representation after being differenced d times. For example, a stationary series is indicated by $I(0)$, whereas a non-stationary series in levels, but stationary in first differences is indicated by $I(1)$. Data observed annually from 1961 to 2015 inclusive for all countries. GDP: Gross domestic product, CAR: Central African Republic

Prior to testing for cointegration, we investigated the integrational properties of each of the variables by applying a battery of unit-root testing procedures. Based on augmented Dickey–Fuller and Phillips–Perron tests which are presented in Appendix Table A1 (Dickey and Fuller, 1979; Perron, 1988; Phillips and Perron, 1988), we could not find any significant evidence that both ds_t, and y_t were not integrated of order one or $I(1)$[2]. These results are not surprising given Nelson and Plosser's (1982) findings that most macroeconomic aggregates are difference stationary processes. Given the common integrational properties of these variables, we next proceeded to test for the presence of cointegration in the vector (db_t, y_t). Results of Johansen's *LR* and trace tests are presented in Appendix Table 2, and indicate that there exists at most one cointegrating realtionship since $r = 0$ is clearly rejected in favour of $r = 1$; but $r \leq 1$ cannot be rejected by the 95% critical values. Given that there exists $(n-r)$ common trends within the system, we can conclude that there exists a single common trend within the vector.

Temporal test estimates of Granger causality provided by the VECM which is described by equations (1) and (2) are summarised in Table 2. It is fairly self-explanatory to note that none of the channels of Granger causality appear to be significant in the case of real economic growth having any significant impact on defence spending. In sharp contrast however, all three channels are significant when we test equation (2) with Δyt as the dependent variable indicating that there exists Granger causation only in one direction from defence spending to economic growth. In addition the interpretation of the d parameter being significant implies that when there is a deviation from the equilibrium cointegrating relationship as measured by the ECT ($\varepsilon_t = y_t - c - db_t$), it is y_t that adjusts to restore equilibrium, implying that defence expenditures lead economic growth. Furtheremore, the novelty of these results is the finding that changes in defence spending positively affects economic growth as indicated by the positive coefficients on Δdb_t.

2 Using the appropriate notation, a series x_t is said to be integrated of order d, if it has an invertible ARMA representation after being differenced d times. For example, a stationary series is indicated by $I(0)$, whereas a non-stationary series in levels, but stationary in first differences is indicated by $I(1)$.

Since the VECM was estimated by ordinary least square and our test statistics may be prone to inconsistencies due to non-spherical disturbances, a battery of diagnostic tests were applied for each equation and appear in summarised form in Appendix Table 3. In summary, across all these tests, given the power for which they are designed over the sample, we could not find any significant evidence of departures from standard assumptions.

In the following, we discuss these results in reference to the econometric interdependence between economic growth and defense spending in the following African countries: CAR, Ethiopia, Kenya, Mali, Tanzania, Niger, Somalia and Sudan. As according to Appendix Table 2, we characterize Tanzania, CAR and Ethiopia enduring unidirectional Granger causality from economic growth to defense expenditure. These results imply said countries may have experienced economic growth due to another factor, and the mere surplus of budget allows the government to fund toward defense spending accordingly (Were, 2015). For example, Ethiopia heavily exported coffee to foreign interests ever since World War II (Schwarz, 1969), and this continued as a trend throughout the late twentieth century. Ethiopia's dependence on coffee as a major export implies the majority of potential growth and investment is focused upon trade. Therefore, a stimulated economy from such trade exports may provide surplus for investment in other areas, such as military expenditure.

It is interesting to note that the majority of the African countries tested received their independence around the same decade (1960s), and yet each pursued a different style of power and influence to shape their policies. Differences in policy may contribute to the variability in results. For example, both Kenya and Niger experience unidirectional Granger causality running from defense spending to economic growth. Kenya initially thrived with a continuously increasing GDP rate as due to agriculture Economic History of Kenya, (2017). However, major shifts in agricultural, industrial and foreign policy during the 1970's made Kenya weaker in internal production, in which the country became a main source of import rather than export Sitko et al., (2017. This weakening, coupled with gradual inflation, may have paved a platform for defense spending to act as a stimulant to economic growth.

Conversely, countries such as Mali, Somalia and Sudan are characterized as having no relationship. Possible explanations of this are also explained by policy changes and the effect of a fluctuating world economy. Sudan, for example, upon independence in the mid-1950s, experienced internal warfare and political power shifts. This could have contributed to an overall unstable economy, in which governmental investment was not strategized effectively Sudan Economic Development, 1991. The civil war occurring during the 1980's also contributed to lack of proper financing, resulting in a fluctuating economic environment (see references). In reference to the results, it is evident that Sudan, and perhaps other nations attached in this category, experienced no Granger-caused relationship between economic growth and defense spending due to outside factors and interests engaged by the respective governments.

Upon recognition of analysis originating from in-sample data, we also investigated other insights this relationship may possess

Table 2: Results of tests for temporal error-correction causality between economic growth and defence burden

Country	Source of causation					
	Does economic growth cause defence burden?			Does defence burden cause economic growth?		
	ECT	Short-run Δ*y*	Joint: (ECT and Δ*y*)	ECT	Short-run Δ*db*	Joint: (ECT and Δ*db*)
CAR	−1.83*	0.95	0.168	−1.06	0.01	0.001
Ethiopia	2.67**	0.01	0.004	−0.34	0.64	0.774
Kenya	1.35	0.30	0.175	1.61*	0.16	0.200
Mali	-	0.07	-	-	0.83	-
Niger	−0.28	0.28	0.371	−4.24***	0.16	0.007
Somalia	-	0.61	-	-	0.37	-
Sudan	−3.11	0.20	0.07	1.14	0.10	0.153
Tanzania	−3.23***	0.31	0.044	−0.54	0.10	0.091

Figures beneath the column labeled "ECT" refers to t-statistics testing the null that the error-correction term (derived from Johansen tests conducted in Appendix Table 2) is equivalent to zero; "short-run" column refers to significance levels associated with F-statistics testing the null that lags of the variable indicated are jointly equivalent to zero; "joint" refers to significance levels associated with a joint F-test of the ECT and all lags of the variable indicated, being equivalent to zero. A full summary of diagnostic tests conducted for each of these equations appear in Appendix Table 3. ***. **indicates statistical significance at the 1%, 5% levels. CAR: Central African Republic

Table 3: GVDC from bivariate models of economic growth and defence burden

Country	Years	Percentage of forecast variance explained by innovations in:			
		Relative variance of: Defence burden (Δ*db*)		Relative variance of: Economic growth (Δ*y*)	
		Δ*db*	Δ*y*	Δ*db*	Δ*y*
CAR	1	100.00 (98.86)	0.00 (1.14)	20.94 (0.00)	79.06 (100.00)
	2	99.99 (96.12)	0.01 (3.88)	20.18 (0.13)	79.82 (99.86)
	5	99.37 (85.88)	0.63 (14.12)	46.29 (32.40)	53.71 (67.35)
	10	99.31 (87.26)	0.69 (12.74)	50.28 (36.34)	49.72 (63.66)
Ethiopia	1	100.00 (79.06)	0.00 (20.94)	1.13 (0.00)	98.86 (100.00)
	2	93.67 (78.82)	6.33 (21.18)	1.70 (0.13)	98.30 (99.86)
	5	83.74 (77.10)	16.26 (22.38)	3.17 (1.78)	96.83 (98.22)
	10	85.98 (77.00)	14.02 (23.00)	3.95 (2.64)	96.05 (97.36)
Kenya	1	100.00 (98.99)	0.00 (1.01)	1.01 (0.00)	98.99 (100.00)
	2	96.67 (94.39)	3.32 (5.61)	6.70 (6.49)	93.31 (93.51)
	5	96.58 (94.15)	3.43 (5.85)	7.21 (6.91)	92.79 (93.09)
	10	96.57 (94.15)	3.43 (5.85)	7.21 (6.92)	92.79 (93.08)
Mali	1	100.00 (78.17)	0.00 (21.17)	21.17 (0.00)	78.17 (100.00)
	2	87.26 (67.97)	12.74 (32.03)	22.78 (0.17)	77.22 (99.83)
	5	87.00 (67.58)	13.00 (32.42)	22.83 (0.17)	77.17 (99.83)
	10	87.00 (67.58)	13.00 (32.42)	22.83 (0.17)	77.17 (99.83)
Niger	1	100.00 (94.07)	0.00 (5.93)	5.93 (0.00)	94.07 (100.00)
	2	99.86 (93.51)	0.14 (6.49)	9.33 (3.58)	90.67 (96.42)
	5	95.78 (90.84)	4.22 (9.16)	31.48 (24.10)	68.52 (75.90)
	10	95.52 (90.41)	4.48 (9.59)	32.19 (25.21)	67.81 (74.79)
Somalia	1	100.00 (98.12)	0.00 (1.88)	1.88 (0.00)	98.12 (100.00)
	2	99.05 (3.07)	0.95 (3.07)	6.22 (3.06)	93.78 (96.94)
	5	98.90 (3.26)	1.10 (3.26)	6.84 (3.50)	93.16 (96.50)
	10	98.89 (3.26)	1.11 (3.26)	6.84 (3.50)	93.16 (3.50)
Sudan	1	100.00 (97.69)	0.00 (2.31)	2.31 (0.00)	97.69 (100.00)
	2	96.58 (92.00)	3.42 (8.00)	23.56 (24.05)	76.44 (75.95)
	5	75.78 (67.23)	24.22 (32.77)	33.88 (25.48)	66.12 (74.52)
	10	75.81 (67.16)	24.19 (32.84)	34.20 (26.28)	65.80 (73.72)
Tanzania	1	100.00 (99.76)	0.00 (0.24)	0.23 (0.00)	99.76 (100.00)
	2	99.23 (98.75)	0.77 (1.25)	1.95 (1.89)	98.05 (98.11)
	5	91.44 (90.05)	8.56 (9.95)	21.36 (21.00)	78.64 (79.00)
	10	89.81 (87.87)	10.19 (12.13)	30.13 (29.26)	69.87 (70.74)

Decompositions based on an alternative ordering for the bivariate relationship with Δ***y*** preceding Δ*db* appear in parentheses. All figures are estimates rounded to two decimal places —. rounding errors may prevent a perfect percentage decomposition in some cases. GVDC: Generalized variance decompositions

out of-sample. As presented in Appendix Table 3, the respective African countries were analyzed in both predicted short run and long run scenarios. There is insight explaining the variance of relative defense burden as a result of economic growth in the following countries: Sudan, followed by Ethiopia and slightly in Mali and Tanzania. In terms of explaining the relative economic growth as a result of defense spending, Sudan, Mali, along with Niger and Tanzania (in the long run) serve as candidates. It is interesting to note Sudan's varying results. In-sample data describes no relationship between variables, whereas out-of-sample predicts an evident relationship from economic growth to defense burden. Sudan also appears to have a bidirectional causality between the two variables from predicted outcome. Similar fluctuations in directionality are seen in Mali and Tanzania.

5. CONCLUSIONS AND POLICY IMPLICATIONS

Overall, the goal of this study was to analyze causal relationships between military expenditure and economic growth within African countries. This study was done in an effort to shed light upon growth patterns in young, developing countries, that have not been heavily tested for. Also, this study was conducted in an effort to provide more data toward an ongoing economic debate as to how economic growth is stimulated and pushed forward. In terms of the flexibility of the Granger causality test, our results deem parallel to the review of literature, in which results can vary greatly depending on the demographics, industry and political structure of the country.

Our results showed diversity in all three forms of directionality. Particular areas of interest include Kenya and Niger, which have unidirectional Granger causality from defense spending to economic growth with in-sample data. A unidirectional relationship from defense spending and economic growth has a more pronounced effect in comparison to its counterpart. The effects of this may be permanent, in which policy implications can influence the state of the country strategically. Also, in predicted estimations, we see multiple countries, particularly Tanzania, Mali and Sudan, experiencing significant bidirectionality. Since Mali, Somalia and Sudan showed no relationship with in-sample data, other variables should be looked at to determine the stimulant to their economic growth. A deeper analysis allowing for data observed at a higher frequency could be performed for each country before their independence, to see if transitions instrumented by individual governments influenced economic growth and global demand.

Though empirical research on these economies is encouraged, our findings based on our application may be instrumental in aiding African policymakers with the appropriate guidelines for stimulating their country's economic growth, or harnessing their defence spending within their aggregate fiscal policy. Future analysis involves looking at other countries within the African continent, including those that have not failed to record significant economic growth due to their burgeoning export sectors. The subject matters of this study were based in the Sub-Saharan region. Considering that other regions, such as South Africa, have experienced a greater amount of modernization and global demand, analysis of their spending is also recommended to compare between and across geographic regions over time.

6. ACKNOWLEDGMENTS

The author would like to acknowledge the support of Professor Mansur Masih for his encouragement and very valuable comments on an earlier draft of this paper. The views expressed in this paper are of the author alone and not necessarily shared or advocated by NRHS.

REFERENCES

Benoit, E. (1973), Defense and Economic Growth in Developing Countries, D.C. Boston, MA: Health & Co., Lexington Books.

Benoit, E. (1978), Growth and defense spending in developing countries. Economic Development and Cultural Change, 26, 271-280.

Datta, K., Mukhopadhyay, C.K. (2011), Defense expenditure and economic growth: Time series evidence of causality in India. International Journal of Economic Issues, 4, 241-255.

Dickey, D.A., Fuller, W.A. (1979), Distribution of the estimators for autoregressive time-series with a unit root. Journal of the American Statistical Association, 74, 427-431.

Dickey, D.A., Fuller, W.A. (1981), Likelihood ratio statistics for autoregressive time series with a unit root. Econometrica, 49, 1057-1072.

Dunne, P., Eftychia, N., Dimitrios, V. (1998), Defence Spending and Economic Growth: A Causal Analysis for Greece and Turkey. Ankara: Diss. Middlesex U Business School.

Economic History of Kenya. (2017), Available from: http://www.Softkenya.com. [Last accessed on 2017 Mar 28; 2017 Jul 30].

Engle, R.F., Granger, C.W.J. (1987), Cointegration and error correction: Representation, estimation, and testing. Econometrica, 55, 251-276.

Gokmenoglu, K.K., Taspinar, N., Sadeghieh, M. (2015), Military expenditure and economic growth: The case of Turkey. Procedia Economics and Finance, 25, 455-462.

Granger, C.W.J. (1981), Some properties of time series data and their use in econometric model specification. Journal of Econometrics, 16, 121-130.

Granger, C.W.J. (1986), Developments in the study of cointegrated economic variables. Oxford Bulletin of Economics and Statistics, 48, 213-228.

Granger, C.W.J. (1988), Some recent developments in a concept of causality. Journal of Econometrics, 39, 199-211.

Johansen, S. (1988), Statistical analysis of cointegration vectors. Journal of Economic Dynamics and Control, 12, 231-254.

Khalid, M.A., Mustapha, A.B. (2014), Military expenditure and economic growth in the case of China: Using ardl approach. International Journal of Development and Emerging Economics, 2(1), 27-36.

Korkmaz, S. (2015), The effect of economic growth on military spending and unemployment in Mediterranean countries. International Journal of Economics and Financial Issues, 5, 273-280.

Kung, Hsien-Hung, Jennifer C.H., Min. Military Spending And Economic Growth Nexus In Sixteen Latin And South American Countries: A Bootstrap Panel Causality Test. Romanian Journal of Economic Forcasting, 2013.

Lanne, M., Nyberg, H. (2016), Generalised forecast error variance decomposition for linear and nonlinear multivariate models. Oxford Bulletin of Economics and Statistics, 78, 595-603.

Manamperi, N. (2016) Does military expenditure hinder economic growth? Evidence from Greece and Turkey. Journal of Policy Modeling, 38(6), 1171-1193.

Menla, A.F., Dimitraki, O. (2013), Military Spending and Economic Growth in China: A Regime-Switching Analysis. China: Diss. Department of Economics and Finance, Brunel UN.

Mohammed, N.A.L. (1992), Economic growth and defense spending in Sub-Saharan Africa: Benoit and Joerding revisited. Journal of African Economies, 2, 145-156.

Nelson, C.R., Plosser, C. (1982), Trends and random walks in macroeconomic time series. Journal of Monetary Economics, 10, 129-162.

Perron, P. (1988), Trends and random walks in macroeconomic time series. Journal of Economic Dynamics and Control, 12, 297-332.

Phillips, P.C.B., Perron, P. (1988), Testing for a unit root in time series regression. Biometrika, 75, 335-346.

Pradhan, R.P. (2010), Modelling the nexus between defense spending and economic growth in Asean-5: Evidence from cointegrated panel analysis. African Journal of Political Science and International Relations, 4(8), 297-307.

Schwarz, W.L.K. (1969), Ethiopia's Export Trade in Major Agricultural Commodities. 6th ed. Menlo Park: Stanford Research Institute.

Sims, C. (1982), Policy analysis with econometric models. Brookings Papers on Economic Activity, 1, 107-152.

Sitko, N.J., Jordan, C., Benedito, C., Milu, M., Julius, M. (2017), A comparative political economic analysis of maize sector policies in eastern and southern Africa. Food Policy, 69, 243-255.

Sudan Economic Development. (1991), Sudan Economic Development-Flags, Maps, Economy, History, Climate, Natural Resources, Current Issues, International Agreements, Population, Social Statistics, Political System, The Library of Congress Studies.

Van Hilten, L.G. (2015), Higher Education is Key to Economic Development, But It's Not as Simple as You Think. International Journal of Educational Development: Elsevier.

Were, M. (2015), Differential effects of trade on economic growth and investment: A cross-country empirical investigation. Journal of African Trade, 2, 71-85.

APPENDIX

Appendix Table 1: Tests of the unit root hypothesis

Country	Augmented Dickey–Fuller				Phillips–Perron				
	τ_μ	τ_τ	$Z(\alpha)$	$Z(t_\alpha)$	$Z(\Phi_1)$	$Z(\alpha)^*$	$Z(t_\alpha^*)$	$Z(\Phi_2)$	$Z(\Phi_3)$
Levels									
Defence burden (Δdb)									
CAR	−3.03	−2.54	−7.23	−3.11	7.07***	−6.04	−2.56	5.00*	6.53*
Ethiopia	−1.26	−2.45	−1.05	−0.68	1.81	−5.48	−1.64	1.98	1.38
Kenya	−1.79	−2.56	−5.01	−1.69	1.53	−14.07**	−2.15	2.63	3.84
Mali	−1.33	−1.94	−7.04	−1.90	1.83	−8.34	−2.23	1.68	2.51
Niger	−1.71	−1.90	−5.62	−1.84	1.74	−5.81	−1.98	1.83	2.71
Somalia	−1.43	−2.05	−3.83	−1.42	1.01	−4.89	−2.02	2.57	3.86
Sudan	−1.85	−2.40	−6.86	−1.97	1.97	−8.20	−2.44	2.46	3.68
Tanzania	−1.61	−1.53	−2.46	−1.61	2.96	−5.26	−1.54	2.17	1.69
Real GDP (y)									
CAR	−1.93	−2.25	−2.95	−2.02	4.46*	−7.55	−2.12	3.42	2.95
Ethiopia	−0.21	−2.47	−0.12	−0.15	11.38***	−22.65***	−2.06	12.64***	8.25**
Kenya	−0.39	−2.59	−0.25	−0.35	10.09***	−10.57*	−2.35	10.48***	3.87
Mali	−1.45	−1.98	−5.44	−1.64	1.38	−6.47	−2.06	2.10	3.15
Niger	−2.07	−1.52	−3.48	−2.09	3.54	−4.32	−1.49	2.29	2.15
Somalia	−0.94	−2.44	−1.26	−0.82	1.82	−18.65***	−2.45	4.93*	5.95*
Sudan	−0.71	−2.03	−1.35	−0.79	1.10	−9.37	−2.21	2.22	2.49
Tanzania	−0.26	−2.49	−0.18	−0.13	2.54	−9.84	−2.46	3.78	3.17
First differences (Δ)									
Defence burden (Δdb)									
CAR	−1.36	−1.38	−35.81	−6.07	18.53	−34.97	−7.36	17.89	26.82
Ethiopia	−2.80	−2.71	−15.08	−2.91	4.30	−15.04	−2.84	2.80	4.17
Kenya	−3.00	−3.06	−33.31	−6.80	23.04	−33.06	−6.70	14.86	22.28
Mali	−3.62	−3.55	−24.78	−4.52	10.21	−24.89	−4.45	6.59	9.90
Niger	−3.93	−4.01	−20.54	−3.92	7.69	−22.04	−4.01	5.37	8.05
Somalia	−1.82	−2.13	−30.83	−5.63	15.87	−31.64	−6.25	12.91	19.36
Sudan	−2.92	−2.89	−22.38	−4.38	9.55	−23.34	−4.47	6.61	9.90
Tanzania	−5.82	−6.64	−29.22	−5.74	16.60	−29.37	−6.59	15.38	22.99
Real GDP (Δy)									
CAR	−2.07	−2.64	−32.64	−7.18	25.57	−30.00	−8.82	24.91	37.36
Ethiopia	−4.03	−3.94	−35.40	−8.88	39.00	−35.41	−8.67	24.72	37.07
Kenya	−4.92	−4.42	−24.73	−4.71	11.03	−25.29	−4.74	7.46	11.19
Mali	−8.09	−6.27	−18.34	−3.78	7.06	−18.22	−3.93	4.97	7.46
Niger	−3.21	−4.39	−29.20	−5.27	13.88	−30.74	−5.57	10.34	15.50
Somalia	−4.40	−4.32	−36.39	−7.13	25.41	−36.32	−7.00	16.37	24.56
Sudan	−4.12	−4.04	−23.08	−4.14	8.62	−23.09	−4.06	5.53	8.28
Tanzania	−2.55	−2.51	−33.48	−6.54	21.39	−33.60	−6.41	13.74	20.58

The sample consists of logged-annual time-series observations (1961-2015). The optimal lag used for conducting the augmented Dickey-Fuller test statistic was selected based on an optimal criteria (Akaike's final prediction error), using a range of lags. The truncation lag parameter I used for the Phillips-Perron tests was selected using a window choice of $w(s, I)=1-[s/(I+1)]$ where the order is the highest significant lag from either the autocorrelation or partial autocorrelation function of the first differenced series. Relevant test equations and related technical descriptions for all unit root testing procedures appear in Appendix Table 1. Presented for levels tests only: ***.** and *indicate significance at the 1%, 5% and 10% levels respectively. GDP: Gross domestic product, CAR: Central African Republic

Appendix Table 2: Bivariate Johansen tests for cointegrating relationships between economic growth and defence burden

Country	H_0 and H_1	Optimal lag used in VAR	Test statistic		χ^2 test of restriction
			Max Eigen value	Trace	
CAR	$r=0$; $r>0$	2	15.64**	20.37**	14.27†
	$r\leq1$; $r=2$		3.01	3.01	
Ethiopia	$r=0$; $r>0$	3	16.60**	16.85**	16.18†
	$r\leq1$; $r=2$		0.25	0.25	
Kenya	$r=0$; $r>0$	1	14.47**	14.48**	6.55†
	$r\leq1$; $r=2$		0.03	0.03	
Mali	$r=0$; $r>0$	2	8.61	13.84	-
	$r\leq1$; $r=2$		5.24	5.24	
Niger	$r=0$; $r>0$	3	29.45**	32.92**	25.79†
	$r\leq1$; $r=2$		3.47	3.47	
Somalia	$r=0$; $r>0$	2	6.97	7.98	-
	$r\leq1$; $r=2$		1.01	1.01	
Sudan	$r=0$; $r>0$	4	16.02**	17.91**	5.53‡
	$r\leq1$; $r=2$		2.88	2.88	
Tanzania	$r=0$; $r>0$	2	20.47**	23.99**	14.01†
	$r\leq1$; $r=2$		3.52	3.52	

r indicates the number of cointegrating relationships. The optimal lag structure for the VAR was selected by minimising the Akaike's FPE criteria. All estimated coefficients of the cointegrating vectors are available on request. Critical values are sourced from Johansen and Juselius (1990). **Indicates rejection at the 95% critical values. † and ‡indicate significance at the 1% and 5% levels, associated with a Chi-square statistic testing the restriction that *db* in the cointegrating vector [*y*, *db*] is equivalent to zero statistically. VAR: Vector auto regression, CAR: Central African Republic

Appendix Table 3: Summary of diagnostic tests for equations used in causality tests

Country	Equation	Serial correlation		Heteroskedasticity		Function form	Normality
		LM (1)	LM (4)	Het	ARCH	RESET	JB
CAR	Δy	0.03	2.50	0.12	0.33	2.41 (2,15)	2.36
	Δdb	3.28	1.29	0.10	0.55	0.15 (2,15)	0.41
Ethiopia	Δy	1.05	1.81	0.18	0.06	5.72 (3,12)	0.98
	Δdb	1.88	2.12	0.47	0.96	4.67 (3,12)	0.37
Kenya	Δy	0.22	0.72	3.83	0.34	8.10 (2,21)	2.11
	Δdb	3.46	0.81	3.34	3.51	10.15 (2,21)	0.78
Mali	Δy	1.18	1.20	0.004	0.35	0.67 (2,24)	172.88
	Δdb	0.13	0.48	0.01	0.12	5.50 (2,24)	132.29
Niger	Δy	0.26	1.68	0.83	0.83	3.87 (2,15)	2.08
	Δdb	1.18	1.31	0.16	0.003	0.15 (2,15)	9.17
Somalia	Δy	0.26	1.68	0.83	0.83	3.87 (2,15)	2.08
	Δdb	1.18	1.31	0.16	0.003	0.15 (2,15)	9.17
Sudan	Δy	0.76	0.86	0.63	0.64	0.61 (2,12)	0.005
	Δdb	1.97	0.38	0.01	0.002	0.83 (2,12)	9.75
Tanzania	Δy	2.67	0.85	0.43	0.04	4.26 (2,17)	0.18
	Δdb	0.09	1.24	0.12	0.08	3.89 (2,17)	3.15

Distributional properties of diagnostics are respectively: LM(1) and LM(4) as $\chi^2(1)$ and $\chi^2(4)$ testing for the null of no first and no fourth order serial correlation amongst the residuals; Het: A $\chi^2(1)$ test based on regression of squared residuals on a constant and squares of the fitted values; A $\chi^2(1)$ test for first-order ARCH effects; Ramsey's regression specification error (F) test with (*n, m*) degrees of freedom; and the Jarque-Bera $\chi^2(2)$ LM test for normality of residuals. ARCH: Autoregressive conditional heteroskedasticity