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Military expenditure and economic growth: evidence from a heterogeneous panel of African countries

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ABSTRACT

This study investigates the causal relationship between military expenditure and economic growth by using a balanced panel of 35 African countries spanning 1990 to 2015. It uses the more recently developed bivariate heterogeneous panel causality, GMM and SGMM estimation techniques. The country-by-country causality results reveal:(i) no causal relationship between military expenditure and growth in seven countries; (ii) unidirectional causality from military expenditure to growth in two countries; (iii) unidirectional relationship from growth to military expenditure in fourteen countries; and (iv) bidirectional relationship in twelve countries. These findings imply: (i) that the seven African countries with no causality can pursue defence policy objectives independently from growth policy objectives; (ii) in the fourteen countries, the fact that growth causes military expenditure and not vice versa implies that, defence decisions are not made in a way as to relatively promote growth; (iii) two African countries effectively use military expenditure for growth aims, hence military expenditure causes growth; and (iv) the bidirectional causality in the 12 countries implies that both growth and defence policy objectives can be pursued together. The GMMs results show that military expenditure has a significant negative impact on growth in Africa.

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1. Introduction

The role of military expenditure (henceforth, MILEX) in economic growth has attracted research interest for some time now. Although attention has focussed more on other parts of the world (Desli, Gkoulgkoutsika, & Katrakilidis, 2017; Dolores Gadea, Pardos, & Pérez-Forniés, 2004; Dunne, Nikolaidou, & Vougas, 2001; Dunne & Tian, 2016; Kollias, Naxakis, & Zarangas, 2004; Krtalić & Major, 2010) and less on Africa.[1] When the issue of military spending in Africa ought to be given much attention not only for the academic needs but more so because of the surge of internal

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arm conflicts and intra-regional terrorist activities. Most part of Africa has become increasingly unstable due to violent socio-political unrest and internal and cross border terror activities. Some countries in Africa are either recent post conflict fragile states or in an active arm struggle of some sort. There are currently African countries in war or are experiencing post-war conflict and tension (for example in West Africa, the countries include Cote d'Ivoire, Guinea, Liberia, Nigeria, Sierra Leone and Togo. In East Africa, the countries include Eritrea, Ethiopia, Somalia, Sudan, Uganda, among others).

MILEX has been on the significant rise globally and in Africa also. The Stockholm International Peace Research Institute (SIPRI, 2015) shows that Africa's MILEX increased by 91 per cent from 2004 to 2014. Figure 1 represents Africa's average MILEX and real GDP (RGDP) from 1990 to 2015.

The possible motivation that could be behind increasingly military spending in Africa may be from the threat of insurgency and rebel groups (such as Al Shabaab, Seleka, M23, the White Army, anti-Balaka, Boko Haram, and the LRA, etc.), the rise of piracy, internal and border wars, emerging regional arms races and the desire of some authoritarian governments to secure their grip on power, etc. These insurgent groups cause conflicts which plays out differently on African countries, thereby exhibiting internal and cross-border dimensions. They depend on illicit trade, banditry, and international terrorist networks for funding and support. In some cases, the arms acquisitions could merely be a function of general economic growth of African countries. There are 54 countries in Africa and they all have different military and growth ambitions, objectives and policies. Africa's military expenditure has been rising over the last 10 years as it can be seen in figure one above. War and insecurity are some of the major obstacles to development (Dunne, Smith, & Willenbockel, 2005). In the absence of peace and tranquillity, undertaking productive investment and making returns on investment in a legal economy has a minimal likelihood.

The relationship between the two variables have been widely debated among researchers and yet without consensus. The positive impact of military expenditure on economic growth is said to include: provision of peaceful environment for investment and production activities to domestic and foreign investors; engaging resources particularly population in research and development activities; providing technical

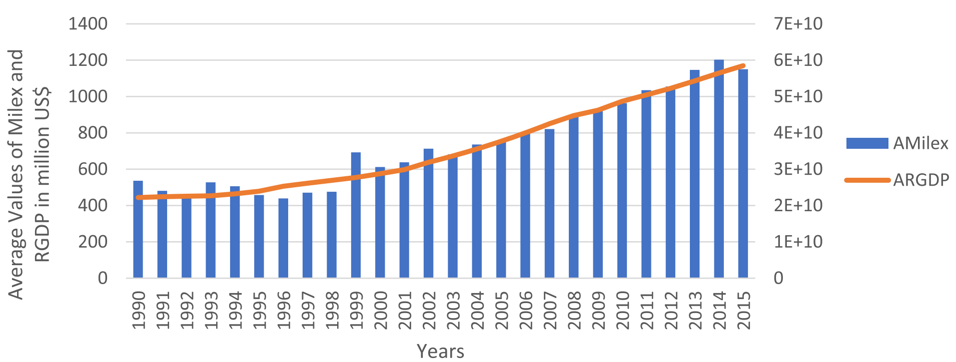

Figure 1. A graphical representation of Africa's average military expenditure and real GDP from 1990 to 2015. Source: Author's computation, 2019.

skills, educational training, etc (Ando, 2009; Benoit, 1978; Dunne, Nikolaidou, & Smith, 2002). On the contrary, some scholars have proven evidence of a negative impact of defence expenditure on the economy which can crowding-out private investment and adverse balance of payment and capital (physical and human) destruction (see Abu-Bader & Abu-Qarn, 2003; Dunne, Nikolaidou & Smith, 2002; Hou, 2010; Kentor & Kick, 2008; Shahbaz, Afza, & Shabbir, 2013, among others). There are also studies that reports that defence-growth nexus is negligible (see Huang & Mintz, 1990; Mintz & Stevenson, 1995). From the empirical literature, there is no specific prediction on the direction of causality between defence-growth nexus. Therefore, in terms of causal relationship between defence-growth nexus, some studies have reported causality running from defence spending to economic growth (*inter alia:* Dunne et al., 2002; Dunne et al., 2001; Dunne & Vougas, 1999; Özmucur, 1996; Saba & Ngepah, 2018; Sezgin, 2000). Studies that finds causality running from economic growth to military expenditure includes: Dritsakis (2004); Kalyoncu and Yucel (2006); Gokmenoglu, Taspinar, and Sadeghieh (2015); Korhan and Mohammadesmaeil (2015), among others. While others find evidence of bidirectional relationship between military spending and economic growth (see Cuaresma & Reitschuler, 2006; Joerding, 1986; Kollias, Mylonidis & Paleologou, 2007; Lee & Chen, 2007a,b). However, studies conducted by Görkem and Işık (2008), Hirnissa, Habibullah, and Baharom (2009) finds no evidence of causality between defence-growth nexus. Among these previous studies, none has exclusively focussed on Africa as a region to examine the causality between the defence-growth nexus except the one on South Africa by Dunne and Vougas (1999) which was country-specific. According to Smith (1994) and Mintz and Stevenson (1995), theoretical and methodological limitations are possible reasons for the failure to reach a consensus in the literature. Furthermore, the heterogeneity in the reported findings of empirical studies has often been associated with the use of different samples, different theoretical and econometric specification, and different time periods (Hou & Chen, 2014).

The rising trends of MILEX overtime alongside with economic growth triggers the interest of this study to empirically investigate the causal MILEX-growth nexus in Africa. Therefore, the purpose of this paper is to examine two important questions. First, what is the nature of causal relationship between MILEX and growth at Africa level? Second, what is direction of causality between MILEX and growth at country-by-country level? Smaldone (2006) in his review of Africa, considers military spending relationships to be heterogeneous, elusive and complex. Therefore, this study contributes to the existing literature by taking into account the heterogeneous nature of African countries in causality framework developed by Dumitrescu and Hurlin (2012). We used SIPRI's[2] new comprehensive post-cold war balanced panel data set for the period 1990 to 2015 for thirty-five (35) African countries (Perlo-Freeman & Sköns, 2016; Smith, 2017). We further utilise Generalised Method of Moments (GMM) estimation techniques. To the best of our knowledge, no study is yet to fill this gap in the literature. Hence, this study. The causality results suggest an overall two-way relationship between military expenditure and growth at Africa level with significant country-by-country level differences. The SGMM results show that military expenditure has a significant negative impact on growth in Africa.

The rest of this study is structured as follows: Section 2 briefly literature review. Section 3 presents the econometric methodology and data sources for the study. Section 4 presents the empirical findings. While Section 5 gives the conclusion and policy implications.

2. Literature review

Under this section, we review relevant theoretical and empirical literature related to our study.

2.1. Theoretical literature

Since MILEX comes with a developed finance and government fiscal policy, there is need to provide a brief theoretical discussion on the finance-led growth and fiscal policy-growth nexuses and how it relates to MILEX. The Wagner's and the Keynesian school of thought argued the possible direction of causal relationship that may exist between government expenditure and economic growth, that is, whether government expenditure is as a result of a growing economy or vice versa. In 1883, Wagner argued (known as Wagner's Law) that during the industrialisation process, as the per capita income of a country increases, the share of the government expenditures increases as well, implying that causality runs from economic growth to government expenditure. However, the Keynesians postulates that public expenditure is a component of fiscal policy and can be used as a policy instrument to promote growth. Hence, the causal relationship runs from public expenditure to growth. It is important to also note that MILEX is a component of government expenditure among other expenditures such as education, health, social and income security, administration and general government. In other words, government expenditures can be classified into two broad categories - defence and non-defence. Large body of literature have provided studies on the different components of government expenditure and it impact on growth; and finance-led growth relationship (*inter alia*: Abu-Bader & Abu-Qarn, 2003; Ahmad, Ali, & Iram, 2011; Katircioglu, 2010, 2012; Sodeyfi & Katircioglu, 2016; Soukhakian, 2007). For this study, we focused more on the defence-growth nexus considering the objective of this study. Theoretically, there is no consensus about the impact and causal relationship between MILEX and economic growth. Since there is no agreed theory among economists, various schools of thought have emerged to properly incorporate MILEX into economic growth (Dunne & Coulomb, 2008). These include the Neoclassical, Keynesian, Institutional, Marxist and international theories, which enables researchers to identify numerous channels linking MILEX to economic growth and help theorise its potential effects. These different channels can then be grouped into three major categories: demand, supply and security.

The first theoretical approach of neoclassical theory links military spending to economic development through the supply side channel. This theory considers the state as a rational actor that balances the security benefits and opportunity costs of MILEX in order to maximise national interest. In contrast, the Keynesian and Institutional theories are associated with both demand and supply side effects. These two approaches believe that the output is increased through a Keynesian multiplier effect when the state as a proactive entity utilises state funds on MILEX (Dunne & Uye, 2010). Marxist theory is of the view that by investing in the defence sector, countries delay the collapse of the capitalist mode of production thereby leading to capitalist development by escaping from the fall in the rate of profit (Coulomb & Bellais, 2008). While military spending has an inherently negative effect on the economy in a capitalist state that is often characterised as having over production and stagnation. Military spending contributes towards aggregate demand without adding to aggregate supply, thus allowing firms to reduce their surplus, sell the goods and realise profits (Gottheil, 1986; Riddle, 1986). The last theory comes from the international relations which says that in the absence of international cooperation to reduce political tensions, higher military spending can be used by a country to ensure its own security in the region.

2.2. Related empirical literature

Some empirical studies in literature have investigated the causal relationship between MILEX and economic growth since the seminal work of Benoit (1973, 1978). Studies from the empirical literature shows that there exist four different types of causal relationships between MILEX and economic growth: unidirectional causality from MILEX to economic growth which means MILEX influence economic growth; unidirectional causality from economic growth which means greater economic growth or high level of income could determine military expenditure; bi-directional causality between defence and growth; and no causal relationship. These causality relationships have been widely discussed in both cross-sectional and individual countries' studies with the use of different estimation techniques. For example, Kollias (1997) tests the Granger causality between growth rates in GDP and the share of MILEX in GDP for Turkey from 1954 to1993. The study uses two dummy variables due to Cyprus crisis in the mid-1970s. The conclusion of the study is that there is no causal relationship between MILEX and growth rates in GDP. Abu-Bader and Abu-Qarn (2003) study uses multivariate cointegration and variance decomposition techniques to investigate the causal relationship between government expenditures and economic growth for Egypt, Israel, and Syria. The sample includes the following countries for the specified periods: Egypt (1975–1998), Israel (1967–1998), and Syria (1973–1998). The empirical results for the bivariate system reveal a negative unidirectional causality running from military burden to economic growth in the three countries. While civilian government expenditure causes a positive economic growth in Israel and Egypt within a tri-variate system. Kollias, Manolas, and Paleologou (2004) also employs the Granger causality test incorporating cointegration technique to ascertain the causal relationship between defence spending and growth in Cyprus for the period 1964–1999. The study concludes by revealing a bidirectional causality between defence spending and economic growth.

Lai, Huang, and Yang (2005) investigates the causality between defence spending and economic growth for China and Taiwan for the period between 1953 and 2000.

The study uses VAR model and a multivariate threshold model. The empirical results of both models indicate that Chinese defence spending Granger causes economic growth and there are bidirectional causal relationships between Taiwan's defence spending and economic growth. Furthermore, Chinese defence spending growth Granger causes Taiwan's defence spending growth (one-way causality). Kalyoncu and Yucel (2006) study explores the effect of MILEX on growth for Turkey and Greece. The study also explores the direction of causality between growth of gross national product (GNP) and military expenditure. For the estimation technique, they use logarithmic form unit root test and Engel-Granger cointegration test on an annual data set that span between 1956 and 2003. The findings of the causality test show that there exists a unidirectional causality from growth to defence spending for Turkey. Lee and Chen (2007a,b) examines the long-run causality between defence spending and growth in a multivariate model. The study uses a panel data for 27 OECD and 62 non-OECD countries for the period 1988–2003. Their empirical results show that there is fairly a strong evidence to support the hypothesis of a long-run relationship between GDP and military expenditure.

Pradhan (2010) investigates the relationship between defence spending, public debt and economic growth in four Asian countries, namely China, India, Nepal and Pakistan from 1988 to 2007. The results of the panel Granger causality test revealed that there exists bidirectional causality between public debt and economic growth in the cases of China and India; unidirectional causality running from defence spending to economic growth in China and Nepal; unidirectional causality from public debt to defence spending in India. Tiwari and Shahbaz (2013) reinvestigates the effect of defence spending on economic growth using structural unit root tests and ARDL bounds testing approach to cointegration. The Granger causality analysis result shows bidirectional causal relationship between defence spending and economic growth as probed by variance decomposition approach.

Pan, Chang, and Wolde-Rufael (2015) investigates the causal relationship between per capita military spending and economic growth covering the period from 1988 to 2010 for 10 Middle Eastern countries. They use bootstrap panel causality test. The findings show that there is causal relationship running from per capita military spending to economic growth only in Turkey and Israel but found unidirectional Granger causality running from economic growth to military spending for Egypt, Kuwait, Lebanon, Israel and Syria. Phiri (2017) investigates the case study for South Africa and confirms that initially, MILEX supports to country's economic growth while at the later stages its largely decreases. Kollias and Paleologou (2019) employs a panel vector autoregression (PVAR) to investigate the nexus between MILEX, investment spending and growth rates with 65 countries covering the period 1971–2014. Findings from the study show that differences between the three income groups were unearthed by the empirical tests conducted. Zaman (2019) examines the nexus among military spending, business regulatory and growth. The results confirm the bidirectional causality between (i) income growth and military factors, and (ii) military growth and business factors. While it further validates the (i) business led MILEX, (ii) income led MILEX, and (iii) military led trade openness in a panel of G-7 countries.

Alptekin and Levine (2012) investigates the relationship between MILEX and growth by using a meta fixed and random effects regression analysis for 32 empirical studies with 169 estimates to find the combined overall effect of MILEX on growth. Their results show that there exists a 'genuine' net effect of MILEX on growth. The existing empirical literature tends to support the negative impact of MILEX on growth. This is because a survey of 168 studies by Dunne and Tian (2013) finds that increasing the sample size to include more recent studies provides an increasingly stronger evidence of a negative effect of MILEX on growth. While in a more recent survey, Churchill and Yew (2018) also examines the relationship between MILEX and economic growth using a sample of 272 meta observations of studies drawn from 48 primary studies. Their study finds that existing studies indicate growth-retarding effects of MILEX and that it is more pronounced in less developed countries than in developed countries. From the econometric perspective, this current study contributes to the existing literature by adopting a heterogeneous Granger panel causality test suggested by Dumitrescu and Hurlin (2012) which previous studies have failed to use. This is mainly because, Africa countries are heterogeneous in terms of their MILEX and socioeconomic condition. The causality test developed by Dumitrescu and Hurlin (2012) is used because it allows meaningful results to be interpreted, despite possible cross-sectional dependence.

3. Econometric methodology and data sources

This section gives a description of the methodology employed to achieve the objectives of this study. The section is subdivided into estimation strategy, panel Granger causality test, empirical model and dataset respectively.

3.1. Estimation strategy

This paper used the Modified Ordinary Least Square (FMOLS) (Phillipps and Hansen, 1990) estimators and Dynamic Ordinary Least Square (DOLS) (Stock & Watson, 1993) estimators to examine the panel long-run elasticity. We apply the heterogeneous panel causality test developed by Dumitrescu and Hurlin (2012)[3] to investigate the direction of causality between our variables of interest (i.e., MILEX and growth). We used this causality test because it takes into account the heterogeneous nature of the panel data. The causality test approach requires the selection of an appropriate lag[4] length. Therefore, the need to determine the optimum lag length for each country in the causality framework becomes a paramount issue. The three criteria and results for the optimal lag length are presented in Table A2 of the appendix. In this study, we used the AIC because it minimises maximum possible risk in finite sample sizes. This study further estimated generalised method of moments (GMM) and system generalised method of moments[5] (SGMM). We establish the dynamic relationship that exist between MILEX and growth in Africa through the estimation process of Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998) for GMMs. These dynamic models are employed to evaluate the distinct effect of the independent variables on growth while controlling for the potential bias due to the endogeneity of the regressors.

3.2. Panel Granger causality tests

In this stage, we perform a panel causality test suggested by Dumitrescu and Hurlin (2012). The Dumitrescu-Hurlin panel causality test is based on a bivariate model. The causality equations are as follows:

Equation (1) test the causality running from MILEX to economic growth:

$$lnRGDP_{i,t} = \varphi_{i,t} + \sum_{j=1}^{p} \beta_i^{(j)} lnRGDP_{i,t-j} + \sum_{j=1}^{p} \lambda_i^{(j)} lnMILEX_{i,t-j} + \mu_{1i,t} \quad (1)$$

Equation (2) test the causality running from economic growth to MILEX:

$$lnMILEX_{i,t} = \tau_{i,t} + \sum_{j=1}^{p} \beta_i^{(j)} lnMILEX_{i,t-j} + \sum_{j=1}^{p} \lambda_i^{(j)} lnRGDP_{i,t-j} + \mu_{2i,t} \quad (2)$$

Where, β and λ are the slope coefficients; i indicates each country under study ($i = 1, \dots,$ N); t indicates time period ($t = 1, \dots,$ T); p is the number of lag length; τ and φ are the intercepts; and $\mu_{1i,t}$ and $\mu_{2i,t}$ are the error terms. The findings from the panel causality tests are sensitive to the lag length. In this study, the maximum lag length is set to five. The heterogeneous panel causality test in this study was a modified version of the causality test suggested by Granger (1969). Further description for the variables can be found in Table 1.

3.3. Empirical model

Following previous studies, the basic theoretical model used to estimate the impact of MILEX on economic growth follows Dunne, Nikolaidou, et al. (2002) and Knight, Loayza, and Villanueva (1996) models. Our estimated model also includes other macroeconomic variables that determine growth. In examining the relationship between MILEX and economic growth in Africa, we estimate our empirical model as:

$$\begin{aligned} RGDP_{it} = \beta_0 + \beta_1 RGDP_{it-1} + \beta_2 MILEX_{it} + \beta_3 HC_{it} + \beta_4 GFCF_{it} \\ + \beta_5 POPR_{it} + \beta_6 IMGDP_{it} + \beta_7 EXGDP_{it} + \varepsilon_{it} \end{aligned} \quad (3)$$

Where: $\beta_1 \dots \beta_7$ are the coefficient parameters; ε_{it} is the error term; $i = 1, 2 \dots N; and\ t = 1, 2 \dots T$. The variables are in logarithm form. The description for the variables can be found in Table 1 below.

4. Empirical results and discussion

In this section, we present the econometric results and discuss the key findings emanating from the estimations of our variables of interest.

Table 1. Dataset.

Variables	Indicator/Description	Source
Dependent Variable		
RGDP	Real gross domestic product per capita (proxy for economic growth). Data is in constant 2010 U.S. dollars (GDP per capita (constant 2010 US$))	World Bank, 2015.
Independent variables		
MILEX	Military expenditure as a percentage share of GDP. Data in constant price (2014) US$ (millions)	SIPRI, 2017
HC	Human capital (enrolment in secondary general, both sexes (number) as a proxy for human capital. Data in millions)	World Bank, 2015.
GFCF	Gross fixed capital formation as a percentage share GDP (proxy for investment or physical capital). The data is in billion dollar, constant 2010 U.S. dollars.	World Bank, 2015.
POPR	Population growth rate	World Bank, 2015
IMGDP	Imports of goods and services as a percentage share of the GDP	World Bank, 2015.
EXGDP	Exports of goods and services as a percentage share of the GDP	World Bank, 2015.

Note: The paper considers a sample of 35 African countries (see Table A1 in the Appendix for the list of countries) over the period 1990–2015. Our choice of the sample size is solely determined by the availability of data for the main variables in some of the countries.

4.1. Panel FMOLS and DOLS test results

Table 2 reports the estimated long-run elasticities results. The FMOLS and DOLS estimated models gave different results. As the size of our sample is small in both dimensions of time and the number of countries, the DOLS results would not be robust. This is because it reduces the number of degrees of freedom by including leads and lags in the variables. The DOLS estimation method, however, allows us to confirm the general trend established by the FMOLS method. The panel long-run elasticity is −0.11 for MILEX in the growth model, which is statistically significant at 1 per cent level, and the effect is negative. This mean that 1 per cent increase in MILEX reduces growth by 11 per cent in the long-run. This implies that in the long-run, MILEX could be detrimental to growth in Africa. Therefore, policies that could help mitigate this negative effect in the long-run should be carefully formulated and implemented by African governments. While HC, GFCF, and EXGDP reveals a significant long-run positive impact on growth.

4.2. Panel causality tests results

The aim of this section is to present the findings on the direction of causality between military expenditure and economic growth in Africa. The results in Table 3 reveal a strong evidence of bidirectional (feedback) causality between MILEX and economic growth regardless of the number of lags included in the model at Africa level. The results in Table 3 shows that the null hypothesis of no causality is rejected across all the models because the panel test statistics at 1 per cent levels of significance are statistically significant. This implies that an increase (decrease) MILEX causes or predicts corresponding decrease (increase) in the level's economic growth in Africa. Equally, an increase (decrease) in the level of economic growth causes or predicts a decrease (increase) MILEX. These results reflect a significant dynamic

Table 2. Cointegrating regression (FMOLS and DOLS long-run elasticities).

Dep. Variable: GDPPC	DOLS	Std. Error	*p*-value	FMOLS	Std. Error	*p*-value
MILEX	−0.119	0.022	0.000***	−0.112	0.037	0.002***
HC	0.298	0.025	0.000***	0.316	0.034	0.000***
GFCF	0.125	0.024	0.000***	0.139	0.044	0.001***
POPR	−0.018	0.010	0.076*	0.008	0.027	0.762
IMGDP	−0.331	0.046	0.000***	−0.277	0.096	0.004***
EXGDP	0.263	0.030	0.000***	0.235	0.039	0.000***
R-squared	0.979			0.999		
Adj. R-squared	0.979			0.995		

Note: *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$ are significance level, respectively. Source: Author's computations, 2019.

Table 3. Summary of Dumitrescu and Hurlin (2012) Panel causality test.

Panel causality between military expenditure and economic growth

	Panel test statistics				
Lag length (k_i)	Wald test statistics	Z-statistics	Zbar tild statistic	Nature of direction	Panel direction
1	7.489	27.146***	22.696***	Rgdp → Milex	Bidirectional Causality
1	2.051	4.396***	3.392***	Milex →Rgdp	
2	8.395	37.832***	14.892***	Rgdp → Milex	Bidirectional Causality
2	3.212	7.169***	2.411**	Milex →Rgdp	
3	11.192	59.358***	14.671***	Rgdp → Milex	Bidirectional Causality
3	6.505	25.394***	5.898***	Milex →Rgdp	
4	14.478	87.663***	15.181***	Rgdp → Milex	Bidirectional Causality
4	9.277	44.147***	7.241***	Milex →Rgdp	
5	18.390	125.253***	15.997***	Rgdp → Milex	Bidirectional Causality
5	11.278	58.723***	6.982***	Milex →Rgdp	

Notes: *Rejection of the null hypothesis of no causal relationship between military expenditure and economic growth at least at the 10% level of significance of p-value. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Milex→Rgdp denote causality running from military expenditure to economic growth. Rgdp→Milex denote causality running from economic growth to military expenditure. Source: Author's computations, 2019.

feedback relationship that exist between the two variables. These results are consistent with the findings of Lai et al. (2005), Kollias, Manolas, et al. (2004), Tiwari and Shahbaz (2013) and Saba and Ngepah (2019).

For the country-by-country analysis, Table 4 shows that there is unidirectional causality running from MILEX to growth in two African countries.[6] This result is consistent with the findings of Sezgin (2000) and Dunne et al. (2001, 2002). While in the reverse direction, growth causes MILEX in 14 countries.[7] This finding is in line with the study of Kalyoncu and Yucel (2006), Gokmenoglu et al. (2015) and Korhan and Mohammadesmaeil (2015). The null hypothesis of no Granger causality is rejected for these countries in the opposite directions of causality. The individual Wald statistics at 10%, 5% and 1% levels of significance are statistically significant. This means that an increase (decrease) in MILEX causes (predicts or lead to) decrease (increase) in the levels of growth. While, an increase (decrease or fall) in the level of growth does not cause decrease (increase) in MILEX in these two countries. This means that for these countries to attain a significant level of growth, MILEX policies need to be pursued and given some level of attention. Causality running from MILEX to growth shows that growth policies could be partly dependent and integrated with MILEX policies. In this case, policy failure in the defence sector could possibly affect the level of economic growth of these two countries. The effective demand stimulative

Table 4. Summary of Dumitrescu and Hurlin (2012) Panel causality test.

Panel Causality between Military expenditure and Growth

		Individual Statistics			
Country	Optimal Lag (k_i)AIC	*Wald test statistic (W_i)*	*P-Value (p_i)*	Nature of Direction	*Direction of Causality*
Algeria	1	2.240	0.135	Rgdp → Milex	No causality
		0.045	0.832	Milex → Rgdp	
Angola	2	11.019**	0.004	Rgdp → Milex	Unidirectional
		2.597	0.273	Milex → Rgdp	
Benin	1	3.767*	0.052	Rgdp → Milex	Unidirectional
		0.476	0.490	Milex → Rgdp	
Botswana	5	19.373***	0.002	Rgdp → Milex	Unidirectional
		6.150	0.292	Milex → Rgdp	
Burkina Faso	5	40.379***	0.000	Rgdp → Milex	Unidirectional
		2.069	0.839	Milex → Rgdp	
Burundi	2	1.409	0.494	Rgdp → Milex	No causality
		0.969	0.616	Milex → Rgdp	
Cameroon	4	26.875***	0.000	Rgdp → Milex	Bidirectional
		9.586*	0.048	Milex → Rgdp	
Chad	5	19.897***	0.001	Rgdp → Milex	Unidirectional
		3.856	0.570	Milex → Rgdp	
Côte d'Ivoire	5	29.915***	0.000	Rgdp → Milex	Bidirectional
		14.651**	0.012	Milex → Rgdp	
Egypt	5	14.647**	0.012	Rgdp → Milex	Bidirectional
		15.107**	0.009	Milex → Rgdp	
Ethiopia	5	7.338	0.197	Rgdp → Milex	Unidirectional
		36.022***	0.000	Milex → Rgdp	
Gambia	4	36.052***	0.000	Rgdp → Milex	Bidirectional
		18.663***	0.000	Milex → Rgdp	
Ghana	5	74.661***	0.000	Rgdp → Milex	Bidirectional
		18.828***	0.002	Milex → Rgdp	
Kenya	1	45.310***	0.000	Rgdp → Milex	Unidirectional
		0.642	0.423	Milex → Rgdp	
Lesotho	1	3.577*	0.059	Rgdp → Milex	Unidirectional
		0.038	0.845	Milex → Rgdp	
Madagascar	3	3.069	0.381	Rgdp → Milex	No causality
		0.393	0.942	Milex → Rgdp	
Malawi	2	13.056**	0.002	Rgdp → Milex	Unidirectional
		1.327	0.515	Milex → Rgdp	
Mali	5	44.034***	0.000	Rgdp → Milex	Unidirectional
		7.002	0.221	Milex → Rgdp	
Mauritania	2	0.466	0.792	Rgdp → Milex	Unidirectional
		13.011***	0.002	Milex → Rgdp	
Mauritius	1	3.053*	0.081	Rgdp → Milex	Unidirectional
		0.314	0.575	Milex → Rgdp	
Morocco	5	26.276***	0.000	Rgdp → Milex	Bidirectional
		9.778*	0.082	Milex → Rgdp	
Mozambique	2	7.131**	0.028	Rgdp → Milex	Bidirectional
		15.828***	0.000	Milex → Rgdp	
Nigeria	5	14.729**	0.012	Rgdp → Milex	Bidirectional
		14.400**	0.013	Milex → Rgdp	
Rwanda	4	10.875	0.028	Rgdp → Milex	Bidirectional
		50.845***	0.000	Milex → Rgdp	
Senegal	1	12.645***	0.000	Rgdp → Milex	Unidirectional
		1.931	0.165	Milex → Rgdp	
Seychelles	1	0.229	0.632	Rgdp → Milex	No causality
		0.012	0.913	Milex → Rgdp	
Sierra Leone	2	0.312	0.856	Rgdp → Milex	No causality
		0.453	0.797	Milex → Rgdp	
South Africa	3	8.888**	0.030	Rgdp → Milex	Unidirectional
		4.661	0.198	Milex → Rgdp	
Sudan	3	7.974*	0.047	Rgdp → Milex	Bidirectional

(*continued*)

Table 4. Continued.

Panel Causality between Military expenditure and Growth

		Individual Statistics			
Country	Optimal Lag (k_i)AIC	*Wald test statistic (W_i)*	*P-Value (p_i)*	Nature of Direction	*Direction of Causality*
		6.467*	0.091	Milex → Rgdp	
Swaziland	1	3.007*	0.083	Rgdp → Milex	Unidirectional
		0.376	0.539	Milex → Rgdp	
Togo	2	9.666***	0.008	Rgdp → Milex	Unidirectional
		0.034	0.983	Milex → Rgdp	
Tunisia	1	0.906	0.341	Rgdp → Milex	No causality
		0.373	0.542	Milex → Rgdp	
Uganda	4	40.386***	0.000	Rgdp → Milex	Bidirectional
		11.342**	0.023	Milex → Rgdp	
Zambia	5	25.062***	0.000	Rgdp → Milex	Bidirectional
		40.369***	0.000	Milex → Rgdp	
Zimbabwe	1	1.810	0.179	Rgdp → Milex	No causality
		1.571	0.210	Milex → Rgdp	

Notes: *Rejection of the null hypothesis of no causal relationship between military expenditure and economic growth at least at the 10% level of significance of p-value. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Milex → Rgdp denote causality running from military expenditure to economic growth. Rgdp → Milex denote causality running from economic growth to military expenditure. Source: Author's computations, 2019.

effect channel from MILEX to the economy seems to be the case for these countries. The reverse case holds for when causality runs from growth to MILEX in the 14 countries. The null hypothesis of no Granger causality is rejected for the 14 countries. The individual Wald statistics at 10%, 5% and 1% levels of significance are statistically significant. This means that a rise (fall) in the level of growth causes (predicts) a fall (rise) in MILEX. This implies that governments of these countries fund military/defence activities from taxing production but with no positive returns on production. This further implies that growth of the economy allows more resources to be allocated to defence sector.

Bidirectional causality runs between MILEX and economic growth in 12 African countries.[8] This is consistent with previous investigations (Cuaresma & Reitschuler, 2006; Kollias et al. 2007; Lee & Chen, 2007a,b). This means that both MILEX and economic growth causes each other. A rise (fall) in MILEX causes a corresponding rise (fall) in the level of growth. For countries that falls under this category, the results suggest that MILEX and economic growth policies are formulated and pursued to complement each other. It also shows that they are dependent on each other, such that, a policy shift in one may have an impact on the other.

Furthermore, there is no causality between military expenditure and economic growth seven countries which means that the variables are independent of each other in these countries. This is consistent with previous studies (see Görkem & Işık, 2008; Hirnissa et al., 2009). The null hypothesis of no Granger causality is accepted for seven African countries.[9] The individual Wald statistics at 10%, 5% and 1% levels of significance are not statistically significant. This means that an increase (decrease) MILEX does not cause (predicts or lead to) a corresponding decrease (increase) in the levels of growth. This implies that for these countries to attain a significant level of growth, both MILEX and growth policies can be pursued separately.

Table 5. Two-step GMM and SGMM results.

Variables	(1) GMM	(2) SGMM
RGDP (−1)	0.890***	0.958***
	(0.021)	(0.018)
MILEX	−0.040***	−0.038***
	(0.003)	(0.003)
HC	0.057***	0.017
	(0.011)	(0.012)
GFCF	0.028***	0.035***
	(0.003)	(0.003)
POPR	−0.003***	−0.006***
	(0.001)	(0.001)
IMGDP	−0.055***	−0.039***
	(0.007)	(0.008)
EXGDP	0.045***	0.037***
	(0.005)	(0.006)
Constant	0.408***	0.026
	(0.127)	(0.116)
Observations	838	874
Number of Instruments	307	331
Wald χ^2	557.62***	6469.53***
Diagnostic test Results		
Sargan test	31.442	31.531
p-value	(1.000)	(1.000)
AR (2)	0.2709	0.151
p-value	(0.786)	(0.880)

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors in Parentheses. GMM: Arellano-Bond dynamic panel-data estimation. SGMM: Arellano-Bover/Blundell-Bond system dynamic panel-data estimation. Source: Author's computations, 2019.

4.3. Two-Step GMM and SGMM results

We proceeded with the estimations of two-step GMM and SGMM in order to overcome the problem of possible endogeneity issues in our model. Table 5 presents the results of the diagnostic tests for the models in order to establish the validity of the instruments for the estimated models. The dynamic panel models (GMM and SGMM) do not assume normality and allow for heteroscedasticity, which can be controlled through valid instrumentation (Baltagi, 2008). Columns 1 and 2 (see Sargan p-values), the Sargan Test for Over-identifying Restrictions confirmed the validity for two-step GMM and SGMM results for Africa. This implies that all our models are rightly specified and sufficient for policy-making. The models also passed the Arellano-Bond Test for Zero Autocorrelation. We estimated the GMM and SGMM to control for country fixed effect (heterogeneity), endogeneity, and mitigated the omitted variable bias problem. This study relied on the SGMM results because it takes into account these problems. In Column 2 of Table 5, the empirical results of the Two-step SGMM show that the lag of economic growth, MILEX, HC, GFCF, POPR, IMGDP and EXGDP are statistically significant at least at 1 per cent significance level. But HC is statistically insignificant to economic growth in Africa, at least at 10 per cent significance level. The overall joint significance of SGMM estimation, which is tested through the Wald chi-square, is 6469.53 with a probability value of 0.000. This implies that the lag of economic growth, and explanatory variables are jointly significant to economic growth in Africa. The lagged level value of real GDP per capita (RGDP) was negative and significant for Africa, which is known as conditional convergence. As expected, this is the standard result in the empirical growth literature. For our variable of interest, the GMM and SGMM results in column 1 and 2 show that MILEX has a significant negative effect on economic growth at Africa level. The MILEX result is consistent with Dunne et al. (2002), Abu-Bader and Abu-Qarn (2003), Kentor and Kick (2008), Shahbaz et al. (2013) and Dunne and Tian (2013) findings.

The 0.04 per cent negative impact of MILEX on growth implies that MILEX is detrimental to growth in Africa. This further shows that MILEX is not the best means to attain growth and development in Africa. This is because it has the tendencies of diverting resources from other productive sectors of the economy such as education, infrastructure or health etc. Mylonidis (2008) explain the fact that MILEX could crowding out public and private investment; contribute to adverse balance of payment within arms importing countries (of which is the case for most African countries); inefficient bureaucracies are just some of the possible opportunity costs associated with the negative impact of MILEX. Because resources are usually allocated to the defence sector in Africa, this could have probably contributed to the insignificant impact of human capital on growth given the opportunity cost associated with MILEX. The reason is that the resource that could have gone to the educational sector for human capital development is been diverted to the defence sector. The SGMM results of this study tend toward the neoclassical crowding-out effect of MILEX. The traditional growth variables such as investment (GFCF), population growth rate (POPR) are statistically significant and they have the expected signs, a finding that is in line with Mankiw, Romer, and Weil (1992)'s predictions. The investment variable is positive and significant, which implies that the higher the investment, the richer African countries become. The variable population growth rate (POPR) is negative and significant, which implies that higher rates of population growth have a negative impact on African countries economy.

Africa is a developing region when compared to the western world (i.e., developed region). Developed countries often have the capacity to allocate resources of their national budget to MILEX. While most less developed countries like African countries suffers from extreme levels of poverty and governments that continue to allocate a substantial portion of their resources to MILEX. Comparing the results of this study with the one conducted by Dunne and Tian (2015). We conclude that MILEX in the developing region like Africa does not promote growth when compared to the developed regions. Factors that are responsible for underdeveloped could possibly be the reason behind these differences.

5. Conclusion and policy implications

The MILEX impact on economic growth by African governments remain a big question that is yet to be answered in the empirical literature. Therefore, in this paper we contribute to the empirical literature by examining the relationship between MILEX and economic growth by using a causality and dynamic panel model approaches. We used a balanced panel of 35 African countries spanning 1990 to 2015. The estimation techniques used for this study include: cointegrating regression tests (FMOLS and DOLS long-run elasticities); heterogeneous panel Granger causality test suggested by Dumitrescu and Hurlin (2012); Two-step GMM and SGMM. The results from the FMOLS and DOLS long-run elasticities reveals that MILEX have a negative long-run impact on growth. From the heterogeneous panel causality test, the overall results of the panel model show that there is a bidirectional causality between MILEX and economic growth in Africa. However, country-by-country results reveal that: (1) no causal relationship for seven countries; (2) unidirectional causality from MILEX to growth in two countries; (4) unidirectional causality from growth to MILEX in fourteen countries; and (5) bidirectional causality between MILEX and growth in twelve countries. The results of this study enable us to conclude that the defence sector plays an important role in the economic growth of some African countries. And most especially, it could be among other factors that contribute towards the growth of some countries considering the channels by which it could impact on the economy. Furthermore, the SGMM results show that MILEX has a significant negative impact on Africa's growth.

Based on our empirical findings, we suggest four main policy implications. Firstly, the African countries with no causality can purse defence policy objectives independently from economic growth policy objectives. Secondly, in countries where unidirectional causality runs from military expenditure to economic growth, defence policy objective processes should be made and pursued seriously. Since the economic growth process partly depend on the defence sector. Thirdly, in countries where unidirectional causality runs from economic growth to military expenditure, military expenditure objectives and policies should be made and pursued based on the level of growth of the economy. Since the defence sector depend partly on the level of growth. Fourthly, the bidirectional causal relationship between military expenditure and economic growth also suggests a degree of interdependence between military expenditure policy objectives and economic growth policy objectives. Therefore, in such countries the implementation of economic growth policies should not be given more priority over the defence sector policies given the fragility of African countries insecurity. For this reason, an integration and creation of synergy should exist between defence and growth policies decisions when pursuing both defence and economic growth objectives across African countries. The results further suggest that the causal relationship between military expenditure and economic growth cannot be generalised across African countries. The reason is because the actual relationship may vary from one country to another due to the sample period, differences in the defence and growth policies, and the type of government in each of these countries. The negative impact of MILEX on growth suggest that policy makers should try as much as possible not to ultimately use MILEX to attain economic growth and development given the fact that Africa is still economically a developing region. But rather look forward to channelling these resources to other productive sectors such as education, healthcare, etc. This does not mean that African governments should completely leave out or exclude MILEX from their budget given the fact that it is needed to maintain a relative level of security (internal and external) necessary for economic and investment activities.

The empirical analysis on the relationship between MILEX and growth is a contentious theme that has over the years attracted attention and debate, and yet without consensus (Dunne & Tian, 2013, 2016). Therefore, future empirical studies may adopt the methodological approach of using the heterogeneous panel causality test developed by Dumitrescu and Hurlin (2012) to investigate the relationship between MILEX and other macroeconomic variables such as investment, debts burden, unemployment etc. Our study focuses on Africa and uses a panel data for MILEX and growth covering the period from 1990 to 2015. Future investigations using more extensive data by employing both linear and nonlinear tests would enhance the understanding between defence-growth causality nexus for Africa.

Notes

1. Apart from Dunne and Vougas (1999), Dunne (2010) and Aikaeli and Mlamka (2010) we could hardly find other papers on Africa.
2. Stockholm International Peace Research Institute.
3. Interested readers are referred to Dumitrescu and Hurlin (2012) methodological framework for more details.
4. It is important to make a little distinction between lag length for VAR (or VECM) and lag length for unit root test. The former is estimated so as to eliminate autocorrelation in the error term of the entire model while the latter is selected so as to eliminate autocorrelation in variable-specific error terms.
5. Interested readers are referred to Arellano and Bond (1991), Arellano and Bover, (1995) and Blundell and Bond (1998) for more details.
6. These countries include Ethiopia and Mauritania.
7. These countries include Angola, Benin, Botswana, Burkina Faso, Chad, Kenya, Lesotho, Malawi, Mali, Mauritius, Senegal, South Africa, Swaziland and Togo.
8. These countries include Cameroon, Côte d'Ivoire, Egypt, Gambia, Ghana, Morocco, Mozambique, Nigeria, Rwanda, Sudan, Uganda and Zambia.
9. These countries include Algeria, Burundi, Madagascar, Seychelles, Sierra Leone, Tunisia and Zimbabwe.

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Appendix

Table A1. List of selected African countries.

Countries						
Algeria	Burundi	Ethiopia	Madagascar	Morocco	Seychelles	Togo
Angola	Cameroon	Gambia	Malawi	Mozambique	Sierra Leone	Tunisia
Benin	Chad	Ghana	Mali	Nigeria	South Africa	Uganda
Botswana	Côte d'Ivoire	Kenya	Mauritania	Rwanda	Sudan	Zambia
Burkina Faso	Egypt	Lesotho	Mauritius	Senegal	Swaziland	Zimbabwe

Table A2. Optimum lag length selection.

	Selection of lag order for each country		
Country	AIC	HQIC	SBIC
Algeria	1	1	1
Angola	2	2	2
Benin	1	1	1
Botswana	5	5	1
Burkina Faso	5	5	3
Burundi	2	2	2
Cameroon	4	4	1
Chad	5	5	1
Côte d'Ivoire	5	5	2
Egypt	5	5	5
Ethiopia	5	5	2
Gambia	4	4	4
Ghana	5	5	5
Kenya	1	1	1
Lesotho	1	1	1
Madagascar	3	3	1
Malawi	2	2	2
Mali	5	5	5
Mauritania	2	2	1
Mauritius	1	1	1
Morocco	5	5	2
Mozambique	2	2	2
Nigeria	5	1	1
Rwanda	4	4	1
Senegal	1	1	1
Seychelles	1	1	1
Sierra Leone	2	2	2
South Africa	3	2	2
Sudan	3	2	1
Swaziland	1	1	1
Togo	2	2	1
Tunisia	1	1	1
Uganda	4	4	1
Zambia	5	5	5
Zimbabwe	1	1	1

Notes: The selection of lag order is based on Akaike's information criterion (AIC), Schwarz's Bayesian information criterion (SBIC), and the Hannan and Quinn information criterion (HQIC). The maximum lag is set to five. Source: Author's computations, 2019.