

Long-run Nexus and Causality Tests Between Increased Military Expenditure, Employment, Technological Innovation and Economic Growth in Ghana

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Abstract

Peace and the long-run sustainable economic development processes are any government's prime twin goals and/or agendas. This study aimed to quantitatively investigate and analyse the long-run relationship and causality tests between increased defence and military expenditure, employment, technological innovation and economic growth and development in Ghana: 2013-2023. A multivariate regression model with the Keynesian growth model based on the augmented production function is used to achieve the goal and objectives of the study. The panel autoregressive distributed lag (ARDL) pooled mean group (PMG) technique is applied in addition to robust least squares, and fixed-effect estimates are implemented to ensure the robustness of the obtained results. The Levin-Lin-Chu unit root test, Im-Peseran-Shin unit root test, Breusch and Pagan Lagrangian Multiplier (BP LM) test, and the Hausman test, Pairwise Dumitrescu Hurlin panel test give evidence of a bi-directional causality between defence/military expenditure and economic growth and development. These related estimates strongly support that defence and military expenditure is beneficial to long-term employment creation and technological innovation relative to economic growth and development. The empirical findings of this study suggest that policymakers need to balance the design of defence and military expenditure within budgetary allocation to stimulate economic growth and development as part of the process of improving the socio-economic well-being of their respective citizens.

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1.0 Introduction

The end of the Cold War ushered in significant changes in worldwide military spending and its consequential effects on economic growth and development processes. Well-noted changes in international relations and the end of the Cold War, thus, continue to stimulate research and analysis on the determinants of defence expenditure, including the relationship between military spending and other public sector outlays such as technological innovation, employment and private consumption within the economy. There are schools of thought that have argued that the perceived and/or actual reductions in international tensions associated with the end of the Cold War have led to discussions relative to the magnitude of the “peace dividend” and its disbursement (Gleditsch et al., 1996; Clement, Gupta, & Schiff, 1997; Rockoff, 1998). The need for fiscal discipline and adjustments in many countries led to an emphasis on unproductive spending in general, including excessive military spending (Chua, 1993; International Monetary Fund, 1997). These investigations have identified the peace dividend as the observed reduction in military spending over time. This approach does not allow for the identification of defence and/or military spending attributable exclusively to reduced international tensions and/or increased regional (threat of terrorism) and international tensions, such as the Ukraine – Russian war, spark the potential threat of terrorist attacks, for instance within the West African sub-region.

Defence and/or military spending, equally known as a defence budget, is the quantum of financial resources dedicated by a state to raising and maintaining armed forces or any other methods essential for defence, security and military purposes. In essence, military budgets often reflect how strongly a country perceives the likelihood of threats against it or the amount of aggression it wishes to conjure. Moreover, it gives an idea of how much financing should be provided for the upcoming fiscal year; the size of the defence budget also reflects the country’s ability to fund military activities (Statista, 2024). Defence and military

expenditure reached 2443 billion United States dollars in 2023, an increase of 6.8% in real terms from 2022, projecting the steepest year-on-year increase since 2009. The ten largest militaries led by the United States of America (USA), China and Russia all increased their military spending according to new data on global military spending (SIPRI, 2024).

Defence and military expenditure as a share of Gross Domestic Product (GDP) provides an essential indicator of the proportion of a nation's resources used for military activities; it is an indicator of the economic burden of military expenditure. It is often referred to as "military burden" and/or "defence burden" as the most relevant measure of international comparison of military expenditure. Although military expenditure as a share of GDP may be a good measure of the military burden on the economy, it is not the priority given to the military sector over the use of available and given resources in decision-making. Henceforth, its alternative share of military expenditure is a good indicator of the relative relevance of the defence sector in each country (Kumar, 2017).

There exists a perception that military expenditure is mostly unproductive as it consumes more productive resources intended to expand the economy in meeting especially, for instance, the economic objectives as provided in Article 36 (1) of Ghana's Fourth Republican Constitution: "The State shall take all necessary action to ensure that the national economy is managed in such a manner as to maximise the rate of economic development and to secure the maximum welfare, freedom and happiness of every person in Ghana and to provide adequate means of livelihood and suitable employment and public assistance to the needy" (Ghana Publishing House, 2024, p.26).

Most critics of large defence budgets advocate for less spending on defence and expansion in military personnel worldwide, with little or no such spending levels by governments in the developing southern hemisphere. However, some contend that countries have legitimate defence goals and associated objectives, including increased military expenditure to create employment, technological innovation and economic growth and other less compelling defence and military needs and activities that require higher levels of expenditure than present in

meeting socio-economic and security objectives (Hemming & Hewitt, 1991).

The primary purpose of this study is to fill this gap in the literature by quantitatively assessing the long-run relationship and causality tests between increased military expenditure, employment, technological innovation and economic growth in Ghana: 2013–2023. This approach allows for identifying defence and/or military spending attributable to exclusively heightened international tensions (Russian – Ukraine War) and/or increased real or potential regional threat of terrorist attacks, for instance, within the West African sub-region. Within the same vein, the study model allows for the quantification of higher defence expenditure resulting from increased military and non-military spending within a specified time frame (Tamim, Hewitt, & Schiff, 1995).

The remainder of this study is structured as follows: Section two below contains and presents the literature review and body of theories applicable to this study. Section three dwells on the methodology, design, and data requirements; section four consists of the empirical results and analysis. Finally, section five concludes the study and provides recommendations.

2.0 Literature Review and Theoretical Framework

This section of the paper presents relevant literature and theoretical frameworks guiding the study under the following:

Historical Relationship Between Military Spending and Innovation

Among the first quantitative assessment of the relationship between military spending, measured as military expenditure divided by GDP, the innovative structure (the direction of technological change across economic sectors) in Europe in the 19th century; the nature of markets in war technology and war logistics suggests that the innovation response to national military expenditure may differ across war input (Danzer, Danzer, & Feuerbaum, 2023). The innovations reflect final products from a broad range of technologies: food processing (a proxy

for war logistics), machinery (a proxy for war technology, including the navy) and other technologies (including mining, chemicals, scientific and medical instruments; country characteristics related to economic development, access to the sea and geography. Employing multinomial logit regressions, Danzer, Danzer, and Feuerbaum (2023) assessed the prevalence of innovative activities in war logistics and war technology for countries featuring different levels of national military spending. The findings include a significant association between 19th-century national military spending and innovative activities in food processing and, to a lesser robust extent, in war technology. In addition, applying European Patent Office (EPO) data from 1990-2015 revealed that the military sector of the 19th century was not related to innovation patterns in the short run but possibly in the long run.

Exploiting historical data provides a glimpse of the roots of innovation processes and incentives that may no longer be self-evident. Nineteenth-century inventions in war logistics turned out to be relevant dual-use technologies with civilian applications in food preservation and transportation, for instance, the invention of food canning, dried foods, or margarine. Moreover, the military had an active role in private civic innovation long before the emergence of the military-industrial complex in the 20th century (Hughes, 2004).

Theoretical Literature on Defence/Military Spending and Economic Growth Relationship

It is documented that countries with an increased defence expenditure have the fastest growth rate compared to those with the lowest. Thus, defence programmes make tangible contributions to the economic growth in terms of civilian economies by (i) Feeding, clothing, and housing several people who would otherwise have to be fed, housed, and clothed by the civilian economy and, sometimes doing so, especially in less developed countries; (ii) Providing education and medical care as well as vocational and technical training; (iii) Engaging in a variety of public works - roads, dams, river improvements, airports, communication networks etc., that may in part serve civilian population; and (iv) Engaging in scientific and technical specialities

such as hydrographic studies, mapping, aerial surveys, dredging, meteorology, soil conservation, and forestry projects, as well as certain quasi-civilian activities such as coast guard, lighthouse operation, customs work, border guard, and disaster relief which would otherwise have to be performed by civilian personnel (Azam, 2020).

Subsequently, other schools of thought espouse that the direct and indirect contribution to the national income by defence and/or military spending is consistent with the Keynesian theory of consumption (Narayan & Singh, 2007). The Keynesian school of thought maintains that an increase in defence and/or military spending stimulates demand, boosting purchasing power and thus aggregate output and generating positive externalities (Solow, 1956; Azam, 2020). In contrast, others have argued that an upsurge in defence and military spending will likely impede economic growth by crowding out the private sector and civilian consumption (Deger & Smith, 1983; Deger, 1986). The theoretical prediction based on the Keynesian model is less evident as it is noted that there are no theoretical underpinnings to guide the experimental analysis (Dunne & Tian, 2016; Dunne, Nikolaidou, & Chiminya, 2019). In expounding the interpretation of the empirical results of any study, it is required to have a valid theory, even if it may not be provable by itself (Smith, 1977).

The empirical findings on the relationship between defence and military expenditure and its impact on economic growth are still inconclusive. The seminal work by Benoit (1978) argued that military spending and growth have a positive correlation; increased defence and military outlays lead to an increase in the rate of economic growth and development (Benoit, 1978).

Verified empirical studies buttress defence expenses as espoused by the Granger technique increase exports, and exports Granger causes national income, thus, revealing that defence spending indirectly buttress and leads to increased national income in the short-run for Fiji between 1970 -1. Furthermore, higher levels of defence and military spending are better prepared to stave off the harmful influences of an economic slump than nation-states with lower levels of defence expenditure of the 49 states in the United States of America (Borch

& Wallace, 2010). In Malizard's (2010) study, he observed a two-way causality between defence and military expenditure and economic growth in France during 1960-8. Additionally, other studies conclude that defence and/or military expenditure thus have a positive nexus with growth in sixty-seven developing economies between 2002 and 2010 respectively (Klein, 2004; Hou & Chen, 2013; Khalid & Noor, 2018).

However, earlier research revealed that increased defence expenditure burden is related to sluggish economic growth, as evidenced by 69 countries during 1952-70; an increase of 10% in defence spending leads to a decrease in annual economic growth of 0.13% (Faini, Annez, & Taylor, 1984). A panel study of the direct and indirect impact of defence expenditure of 50 developing economies between 1965 -73 concluded that increased military expenditure slows economic growth rate and actually impedes development (Deger & Smith, 1983; Deger, 1986). Likewise, defence expenditure tends to decrease productivity within an economy as more budgetary funds are diverted to military expansion, and layouts cause governments to either increase taxes or attract loans from foreign capital markets to balance developmental and re-current budgets. Such resource reallocation is harmful to economic progress as it increases the rate of interest, decreases investment and consumer demand, and drives economic growth sluggishly (Russet, 1969). Dunne (2000), in Azam (2020, p. 2), applying the Keynesian theoretical framework, espouses that defence spending does not influence growth at best but most probably has an inverse effect; obviously, there is no indication of a positive influence of military burden on economic growth. This implies that decreased military expenditure thus offers a prospect for augmented economic growth and development, especially in a less developed economy.

It is observed that in less secure regions of the world, each country allocates an uneven share of its meagre economic resources to unproductive military expenditure. Henceforth, in the absence of international collaboration to minimise political pressure, military expenditure can be escalated more and more across a region as each country goes beyond its neighbours to safeguard its security, raise the

level of regional military expenditure and bring a slight rise or even a decline in the security of all (Azam, 2020, p. 1).

Relationship Between Military Expenditure and Employment

In a study, Cheng-Tee (2022) constructs a theoretical model involving supply-side effect, demand-side effect, and security effect relative to defence spending to investigate the effects of military spending and foreign military threat on employment. The study reveals a nonlinear (reverse U shape) relationship between defence burden and employment. In the short run, a rise in foreign military threat is detrimental to the level of productivity in the economy, which in turn leads to a reduction in employment; an increase in the variance of the foreign military spending shocks, thus, raises the level of output and then leads to an increase in employment.

Similarly, an investigation of the impact of military expenditure on unemployment in Bangladesh, involving the application of Autoregressive Distributed Lag (ARDL) cointegration technique among unemployment, military expenditure, and foreign direct investment (FDI) variables relative to a time series annual data from the period of 1990-2018. The dependent variable is unemployment and military expenditure, and FDI is the independent variable that found a long-run relationship among the variables. In the short run, unemployment is significantly reduced as military expenditure increases; the higher the FDI, the higher the unemployment in the long run (Hanif, Uddin, Bakirtas, & Kader, 2023).

Employing the ARDL approach, a study of the nexus between defence and economic growth expenditure in South African countries suggested that military spending boosts employment in the manufacturing sector; thus, in the long run, defence spending has a direct influence on economic development (Batchelor, Dunne, & Saal, 2000). A mixed results is presented in the analysis of the association between military spending and economic growth in African countries from 1951 to 2010 via a bootstrap rolling window. The results suggested that military spending for the periods 1966-1972, 1973-1975, 1975-1977, and 1979-1984 directly influenced economic growth. However,

on the other hand, defence spending had an indirect relationship with economic growth and employment for the rest of the period (Aye, Balcilar, Dunne, Gupta, & Eyden, 2014). These findings are supported by Mosikari and Matlwa's (2014) research that employed the Johansen and Eagle cointegration technique and concluded that military expenditure directly influences economic growth processes. Using cointegration and causality tests on the panel data of three South Asian countries, Raju and Ahmed (2019) suggested a positive long-run relationship between defence expenditure and economic growth, leading to increased employment. The same study concludes that there is a unidirectional long-run causality among the variables in all three countries.

Among the studies that posit a positive relationship between increased defence spending and economic growth leading to increased employment levels are those of Kollias, Mylonidis, and Paleologou (2007) and Sezgin (2001). By contrast, research outputs that concluded a negative relationship between military spending and economic growth and, thus, low employment levels are those by Lebovic and Ishaq (1987) and Dunne and Tian (2013).

3.0 Methodology, Design and Data Requirements

Based on the existing literature on growth theories, the present study uses data accessed from the World Bank World Development Indicators (WDI), Ministry of Finance (Ghana); Ghana Statistical Service; CIA's World Factbook, International Labour Organisation (ILO); and the Stockholm International Peace Research Institute (SIPRI). Noted variables within the accessed datasets include the annual percentage growth rate of Gross Domestic Product (GDP), the percentage of the labour force, and the percentage of employment. The present study specified the growth equation introduced by Solow (1957) and applied in studies by Mankiw, Romer and Weil (1992), Barro et al. (1995), and Barro (2003) involving inputs both physical and human capital together produce aggregate production. The Solow (1957) model is underpinned by four inputs, namely, output (Y), capital (K),

labour (L), and knowledge and/or the effectiveness of labour (A) with t denoting time. As such, the economy as a whole produces output involving the combination of specific amounts of labour, capital, and knowledge and/or innovation. The model is written in mathematical form as follows:

$$Y = A(t)F(K, L) \dots\dots\dots(1)$$

The study specifies the empirical model by incorporating military spending in the growth equation following the existing literature, including those of Dunn and Tian (2015) and D'Agostino, Dunne and Pieroni (2017). A multivariate probabilistic model is applied based on the augmented production function to validate empirically the impact of military spending as a percentage of GDP with other control variables, including human capital, physical capital, employment, technological innovation and the level of development on economic growth as proxied by GDP per capita growth rate.

The adaptation of panel data regression, which, to a degree, differs from a regular time-series and cross-section regression with a double subscript relative to its variables:

$$y_{it} = \alpha + X_{it}'\beta + u_{it} \quad i = 1, \dots, N; t = 1, \dots, T \dots\dots\dots(2)$$

Where:

i = Denoting countries

t = Denoting time

α = Is a scalar

β = Is $K \times 1$

X_{it} = i th observation on K explanatory variable

Note: i denotes the cross-section dimension; t denotes the time-series dimension (Baltagi, 2005).

$$y_{i,t} = \rho y_{i,t-1} + x_{i,t}'\beta + n_i + e_{i,t}, \quad \rho \in (-1, 1) \dots\dots\dots(3)$$

Where:

η_i = Fixed effect

$X_{i,t}$ = Is a (K-1) x 1 vector of exogenous regressors

$\varepsilon_{i,t} \sim N(0, 0, \alpha_\varepsilon^2)$ = Random disturbance

Henceforth, the following is assumed:

$$\alpha_\varepsilon^2 > 0$$

$$E(\varepsilon_{i,t}, \varepsilon_{j,s}) \quad i \neq j \text{ or } t \neq s \dots\dots\dots (4)$$

$$E(\eta_i, \varepsilon_{j,t}) = 0 \quad \forall i, j, t$$

$$E(x_{i,t}, \varepsilon_{j,s}) = 0 \quad \forall i, j, t, s$$

By eliminating associated problems, the results of the

$$f \Delta ME = \beta_0 + \beta_1 \Delta GDP + \beta_2 + \Delta \Delta EM + \mu_1$$

(Korkmaz, 2015) of the article's model analysed with fixed effects is shown in Table 3.

4.0 Empirical Results and Analysis

This section presents the results and analysis of the long-run nexus and causality tests between increased military expenditure, employment, technological innovation and economic growth in Ghana.

Table 1 below presents the unit root tests conducted according to the Levin-Lin-Chu test to avoid misleading regression results and analyse whether the variables were stationary.

Table 1: Levin-Lin-Chu Unit Root Test

Variables	Intrinsic Correlation Delay	P value	Test Results (*)
ME	1	0.000	There is no unit root
EM	1	0.001	There is no unit root
GDP	1	0.000	There is no unit root

Source: Author's Compilation, (2024)

It should be noted that as a result of the Levin-Lin-Chu unit root test (Levin et al. year), the study espoused that there is a unit root when the p-value is above five per cent and, in another case, it is decided that there is no unit root. Therefore, the results in Table 1 reveal that defence and military expenditure, GDP and employment are stationary at the level. In addition to the Levin-Lin-Chu test, the Im-Peseran-Shin test (Pesaran & Smith, 1995; Peseran, 2007) is performed to verify if variables in the model had a unit root; the results are presented in Table 2 below.

Table 2: Im-Peseran-Shin Unit Root Test

Variables	Intrinsic Correlation Delay	P-value	Test Result (*)
ME	0	0.157	There is unit root
ΔME	0	0.008	There is no unit root
GDP	0	0.344	There is unit root
ΔGDP	0	0.003	There is no unit root
EM	0	0.998	There is unit root
ΔEM	0	0.466	There is unit root
ΔΔEM	0	0.022	There is no unit root

Source: Author's Compilation, (2024).

Relative to the Im-Peseran-Shin unit root test, it is decided that there was a unit root when the p-value is found to be above (5%) five per cent; in another case, it is decided that there is no unit root. Table 2 reveals that defence, military expenditure, and economic growth are stationary

in the first difference, and employment data become stationary in the second difference. The Breusch and Pagan Lagrangian Multiplier (BP LM) test is applied to verify if the model in the study is a pool or a random effect mode (Breusch & Pagan, 1979; Cook & Weisberg, 1983). The BP LM test revealed a probability (p) value of 0.042; the H_0 hypothesis is rejected as the 0.042 value is smaller than 5%. This clearly shows no random effects within the model as calibrated by the study. However, the model could have fixed effects; a dynamic fixed effects model of the form according to Judson and Owen (1999) as presented in equation 3: Methodology, design and data requirements. According to the conducted Hausman test (Mukherjee & Yu, 1997; Al-Sharkas, 2004), the alternative hypothesis, which indicates there are fixed effects, is accepted; the H_0 hypothesis reveals that there is autocorrelation, is accepted as the probability value is 0.122. According to Wooldridge autocorrelation test, the probability value is above 5% (Drukker, 2003; Gujarati & Porter, 2009). The heteroscedasticity test yielded a probability value of 0.000; this value is less than 5%, the H_0 hypothesis that brings to the fore no heteroscedasticity is rejected (Rao, 1973; Breusch & Pagan, 1979; Dumitrescu & Hurlin, 2012). The problem of heteroskedasticity is eliminated by conducting an ARI process, and a single lag Ordinary Least Square (OLS) residuals method is employed (Shirley, 1965; Granger & Newbold, 1974). The ARI process yielded a result of 0.561; the result is above 5%. Similarly, the Variance Inflation Factor (VIF) value of 1.31, less than 5%, means no problem with multiple correlations (Yang, Trumbull, Yang, & Huang, 2011).

Table 3 relates to the results of equation (4), which presents an analysis of fixed effects.

Table 3: Panel Results

Variables	Coefficient	P-value
Δ GDP	0.008	0.017
Δ ΔEM	0.012	0.103
Constant ©	-0.086	0.000

Source: Author's Compilation (2024).

The results in Table 3 show that the GDP and employment variables are statistically significant for Ghana. The expansion in defence and military expenditure positively affects economic growth and employment processes via expansion in defence/military personnel. As the country increases defence/military spending against possible terrorist threats from surrounding countries, there is an average growth in the economy, even during an economic downturn. Alptekin (2009), applying meta-fixed and random effects and regression analysis, revealed that military expenditure has a genuine net effect on economic growth and development processes. Although the magnitude is minimal, the combined net effect is positive. Thus, both Cappelen, Gleditsch, and Bjerkholt's (1984) and Alptekin's (2009) empirical findings and analysis support the current results presented in this study. The results in this study are buttressed by the Keynesian theory of consumption (Narayan & Singh, 2007). The Keynesian school of thought maintains that an increase in defence and military spending stimulates demand, boosting purchasing power and, thus, aggregate output and generating positive externalities.

In furtherance of the study's findings, an increase in defence and military expenditure in Ghana subsequently engaged in scientific and technical specialities such as hydrographic studies, mapping, aerial surveys (helicopter and drone surveillance), dredging, meteorology, soil conversation, and forestry projects as well as certain quasi-civilian activities such as coast guard, lighthouse operation, customs work, border guard, and disaster relief which would otherwise have to be performed by civilian personnel (Azam, 2020).

5.0 Conclusion and Recommendations

The main goal of this study is to empirically investigate and quantitatively analyse the impact and effects of the long-run relationship and causality tests between increased defence and military expenditure, technological innovation and economic growth in Ghana between 2013 - 2023.

The study's adopted approach allows for identifying defence and/or military spending attributable to exclusively heightened international tensions (Russian – Ukraine War) and/or increased actual or potential

regional threat of terrorist attacks within the West African sub-region. According to the literature, military spending positively affects the economic growth of certain countries; in this instance, it increases the rate of employment and economic growth via the multiple income effects espoused by the Keynesian (1936) theory of economic growth and development. Parts of the literature show that due to unrest faced in many parts of the world, the importance of security and, hence, the nexus between defence/military expenditure and economic growth and development within budgetary allocation has increased. This forces governments to separate and, thus, reduce resource investment in education, health, and infrastructure, which is the foundation of the increased economic growth and development rate, especially in the developing world and sub-Saharan Africa. This inefficient application of resources and production capacity established for the defence industry will lead to waste in economic terms.

As a result of increased military expenditure, advanced technology via innovation has a positive impact on production capacity as it requires intensive capital and a qualified labour force (Solow, 1957). It is noted that the distribution of scarce resources to defence and military spending depends on the conditions of the current economy; Keynes (1936) thus postulated that an increase in defence expenditure would spur total demand in the economy and, henceforth, contribute to economic growth and development. Consequently, to attenuate the gap in the literature and policy, the study contributes to the literature about the impact of defence/military expenditure on the processes of economic growth, especially for countries in sub-Saharan Africa.

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