Does military spending stifle economic growth? The empirical evidence from non-OECD countries

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ABSTRACT

Undeniably, peace and long-term sustainable economic development are the prime agenda of all countries. This study aims to empirically evaluate the impact of military spending on economic growth for a panel of 35 non-OECD countries over 1988–2019. A multivariate regression model based on the augmented production function is used to achieve the objective of the study. The panel autoregressive distributed lag (ARDL)/pooled mean group (PMG) technique is employed, while, in addition the robust least squares and fixed-effect estimators are implemented for the robustness of the results. This study found a clear negative effect of military spending on economic growth. The pairwise Dumitrescu Hurlin panel causality test results exhibit bi-directional causality between military expenses and economic growth. Overall, these estimates provide strong support that military expenditure is not beneficial rather detrimental to economic growth. The empirical findings of this study suggest that policymakers need to redesign the military budget to stimulate economic growth and improve social welfare.

1. Introduction

The assessment of the economic and social effects of military expenditure remains an interesting desirable area of research. The ultimate objectives of underdeveloped and developed countries are to achieve sustainable economic growth and prosperity in the long-run. There is a substantial volume of literature about the economic consequences of military expenditure; however, no consensus has been developed, whether military spending is beneficial or detrimental to economic growth. Military spending according to the Keynesian approach is a component of government consumption, which stimulates economic growth by expanding demand for goods and services. Military spending affects economic growth through many channels. When aggregate demand is lower relative to prospective supply, rises in military spending tend to enlarge capacity utilization, raise profits, and consequently, enhance investment and aggregate output (Faini et al., 1984). Several prior studies have drawn findings that support the Keynesian military view of the positive influence of military expenditure on national output (Benoit, 1978; Khalid and Noor, 2018; Raju and Ahmed, 2019). In a study conducted by Lobont et al. (2019), it is ascertained that military spending has several positive effects on capital, labor, growth, and the effectual use of available resources in the economy as a whole.

The focus of academicians, researchers, and developmental economists for peace economics are useable as military spending is one of the main concerns of countries, regardless of their development status. According to conventional logic, the military formulation is an economic encumbrance. While comparatively more resources are devoted to military formulations, and lesser proportion is left for investment in the education and technology sectors, which play a vital role in the economic growth process and provide a broader base for socio-economic development. Generally, it is believed that in the insecure region, each country deliberately allocates an uneven share of its meager economic resources to “unproductive” military expenditure. In the absenteeism of international collaboration to minimize political pressure, military expenditures can be driven more and more across a region as each country goes beyond its neighbors to safeguard its security, raise the level of regional military expenditure and bring little rise or even a decline in the security of all. However, there are two direct and interconnected ways by which higher military expenditure may unfavorably affect long-run economic growth. First, military spending upsurge may diminish the total accumulation of existing resources available for other domestic

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1 Looney and Frederiksen (1986).  

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usages such as investment in prolific capital, education, and market-oriented technological enhancement. Second, high military expenditure can intensify misrepresentations that condense the efficiency of resource distribution, thereby diminishing the total yield factor.

Military expenditure tends to attenuate productivity because more funds diversion to military expenditure causes the government to either increase taxes or get loans from the foreign capital market to balance its budget. The second alternative is therefore primarily harmful to economic prosperity, since it escalates the rate of interest, decreases investment and consumer demand, and drives economic growth sluggish (Russett, 1969; Borch and Wallace, 2010). In a similar vein, some other studies including Lim (1983) noted that military expenses are harmful to the growth of any economy. Even, a study by Dunne (2000) focusing on the Keynesian framework reveals that military spending has no influence on 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 disarmament certainly offers a prospect for augmented economic performance.

Figure 1 shows the trend analysis of Latin American and Caribbean; lower middle income, low & middle income, and world military expenditure in billion US$. The trend analysis reveals that defense spending has grown from 1980 to 2019. The motivation of this study is based on the growing global military burden–worldwide military spending as a share of global GDP–in 2019 it was estimated at 2.2%, a minor upsurge from 2018. Military expenditure per head increased from USD243 in 2018 to USD249 in 2019. In 2019, non-OECD countries’ China and India were the 2nd and 3rd largest military payers in the world respectively. Likewise, the statistics reveal that military expenditures have been increasing in many non-OECD countries which are not a good symptom for national economic development and the desired level of social welfare. Moreover, there are still very limited empirical studies on non-OECD countries except Lee and Chen’s (2007) study, where the authors evaluate the long-run causality between defense expenditure and national income using panel data for 62 non-OECD countries from 1988–2003.

The main objective of this study is to explore empirically the impact of military expenditure on growth in the context of 35 non-OECD (Organization of Economic Cooperation & Development) countries from 1988 to 2019. The panel of countries is considered based on balanced and consistent data availability. I assume that all sample countries have similar characteristics. This study contributes to the growing literature on the effects of defense expenditures on growth in four novel ways. Firstly, this study analyzes the effect of defense spending on a panel of 35 non-OECD countries, where military spending has been increased substantially during the investigated period. To the best of our knowledge, none of the existing studies covers this large panel of non-OECD countries. Secondly, unlike the erstwhile studies, I employed the Panel ARDL/PMG approach, and the methods of Robust Least-Squares, and Fixed-Effect for the robustness of results. Additionally, the commonly used heterogeneous panel Granger causality test by Dumitrescu and Hurlin (2012) is employed to find the causal linkages between the variables. Thirdly, I used a different portfolio of regressors to avoid any misspecification of the growth equation. Finally, I have articulated several prior studies to comprehend the problem in depth. Consequently, to mitigate the gap in the literature, this study contributes to the literature about the impact of military spending on economic growth for less developed countries.

The remainder of this study is structured as follows. Section 2 contains the literature review. Section 3 deals with the empirical methodology and data. Section 4 consists of empirical results and discussion. Finally, section 5 concludes the study.

2. Literature review

2.1. The theoretical literature on defense spending and economic growth relationship

Benoit (1978) documented that countries with substantial defense expenditure mostly had the quickest rate of growth compared to those with the lowermost defense expenditures which tended to exhibit the lowermost growth rates. On the positive contribution of defense spending in economic growth Benoit (1978) noted that “Defense programs of most countries make tangible contributions to the civilian economies by (i) feeding, clothing, and housing a number of people who would otherwise have to be fed, housed, and clothed by the civilian economy—and sometimes doing so, especially in less developed countries, in ways that involve sharply raising their nutritional and other consumption standards and expectations; (ii) providing education and medical care as well as vocational and technical training (e.g., in the operation and repair of cars, planes, and radios; in hygiene and medical care; in construction methods) that may have high civilian utility; (iii) engaging in a variety of public works-roads, dams, river improvements, airports, communication networks, etc.-that may in part serve civilian uses; and (iv) engaging in scientific and technical specialties 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. Military forces also engage in certain R & D …… which might not be economically produced solely for civilian demand.” (p. 277).

A study conducted by Narayan and Singh (2007) claim that the direct and indirect contribution to the national income by defense spending is consistent with the Keynesian theory of consumption. On the other hand, Smith (1977) expounded that in interpreting the empirical results of any study, it is required to have a valid theory, even if it may not by itself be provable. Unfortunately, there is no economic theory to this date covering the economic impact of defense expenditure. Deger and Smith (1983) noted that the classical school of thought argues that an upsurge in defense spending is likely to impede economic growth. This argument is based on the principle that greater defense expenditure indicates a lower level of private investment, savings, and consumption due to small aggregate demand. In other words, increased military spending contributes to a rise in the interest rate, which subsequently overwhelms private investment. The Keynesian school of thought argues that a rise in the defense expenses stimulates demand, boosting purchasing power and aggregate output, and generating positive externalities. In their study Dunne and Tian (2016), it was noted that there was no theoretical basis to guide the experimental analysis. Though, the Keynesian consumption theory reveals that defense spending may stimulate growth through positive spill-over effects. However, such kind of theoretical prediction based on the Keynesian model is less clear.

2.2. Empirical studies on the impact of military spending on economic growth

Despite the voluminous empirical studies on the military-growth connection, the empirical findings are still inconclusive. The
discussion in the present literature on the influence of military spending opened with the seminal work of Benoit (1976) which opined that military spending and growth have a positive correlation. Afterward, many studies are continuously performed to empirically verify the relationship between these variables by using different models, estimation techniques, set of countries, and data period. Several other studies support the positive effect of defense spending including Atesoglu (2002), who observed that there exists a significantly positive association in military outlays and aggregate output in the case of the United States from 1947:2–2000:2. The empirical analysis of the study by Yildirim et al. (2005) found that military spending boosts national income in the Middle Eastern countries and Turkey over 1989–99. Narayan and Singh (2007) empirically verified that defense expenses Granger causes exports, and exports Granger causes national income (GDP), indicating that defense spending indirectly Granger causes national income in the short-run for Fiji over 1970–01. According to Borch and Wallace (2010), higher levels of military expenditure are better prepared to stave off the harmful influences of an economic slump than states with lower levels of military spending in the 49 U.S. states during 1977–04. Malizard (2010) observed two-way causality between military spending and growth in France during 1960–08. Findings of Farzanegan (2014) study supported the positive impact of the military outlay on growth in Iran during 1959–07. Khalid and Noor (2018) concluded that military spending has a positive relationship with growth in sixty-seven developing economies during 2002–10.

On the other hand, some prior studies, for example, Faini et al. (1984) detected that a greater military burden is related to sluggish growth for 69 countries during 1952–70, whereas a rise of 10% military spending leads to a decrease of annual economic growth by 0.13%. Deger (1986) revealed that overall the direct and indirect effects of military expenditure will dampen growth rate and impede development in a panel of 50 developing economies during 1965–73. The author suggested that empirical indication goes against the conclusions of Benoit and others about the positive impact of military outlay on growth in less-developed economies. Abu-Bader and Abu-Qarn (2003) found that military expenditure hampers economic growth, but civilian expenses have a positive impact on growth for Egypt, Israel, and Syria (1975–98), (1967–98), and (1973–98) respectively. The empirical findings of Klein (2004) reveal that overall the military outlay has a negative influence on the growth rate of Peru over 1970–96. Chang et al. (2011) found that military expenditure leads to deleterious growth for low-income countries in the whole sample of 90 countries during 1992–06. D’Agostino et al. (2017) observed a significantly negative effect of military spending on growth in 83 countries from OECD over 1970–14. Saba and Ngepah (2019) examined the causal link between military spending and economic growth for 35 African countries over 1990–15. The authors found that (i) no causal link in seven countries; (ii) one-way causality from military spending to growth in two countries; (iii) one-way link from growth one-way in 14 countries; and (iv) two-ways link in 12 countries. Overall, the GMM estimates reveal that military spending has a significant negative effect on economic growth in Africa.

Similarly, other studies provide evidence of mixed results on the economic effects of military expenses on growth, for example, the study of Frederiksen and Looney (1982) divided the economies into financial resource restrained and unrestrained groups over 1960–78. The findings revealed that enhanced military expenditures promoted growth in the unrestrained group, but a small visible impact was found in resource-constrained countries. In a study on three North American countries namely Canada, Mexico, and the U.S. during 1963–05, Bremmer and Kesselering (2007) found that enhanced military expenditure promotes nominal GDP in Canada and Mexico, while it declines the growth in nominal GDP in the U.S. Aye et al. (2014) observed no Granger causal association between military outlay and growth for South Africa during 1951–10. However, by using the bootstrap rolling window estimation approach, the study finds two ways Granger causality in different subsamples. The results of Chang et al. (2014) supported the neutrality hypothesis for France, Germany, and Italy, while, the military expenditure–growth hampering hypothesis for Canada and the UK, and unidirectional Granger causality running from national income to military outlay for China. Moreover, the results supported the feedback between military spending and national income in the case of Japan and the U.S. over 1988–10. Using the “Hendry General-to-Specific modeling” methodology, the study of Abdel-Khalek et al. (2019) fails to find any causal linkages between military spending and economic growth in India over 1980–16. Some more related empirical studies are given in Table 1.

The existing empirical studies have shown that, although it is a subject of concentration for many researchers, economists, and policymakers, there is still no harmony in the literature on the economic impact of military spending on economic growth.

3. Empirical methodology
3.1. Model specification

Based on the existing literature on the growth theories, the present study specified a growth equation introduced by Solow (1956; 1957), also used by Mankiw et al. (1992), Barro et al. (1995), and Barro (2003) where inputs namely physical and human capital together produce aggregate production. The Solow model encompasses four inputs, namely, output (Y), capital (K), labor (L), and “knowledge” or the

It means two-way Granger causal connection between military expenditure and economic growth.

For China and Pakistan (1989–17), for India (1980–17).

Austria, Belgium, Cyprus, Denmark, Finland, Greece, Germany, Italy, Luxembourg, Portugal, Turkey, Spain, Sweden the Netherlands and UK.

The results confirm the hypothesized positive relationship between defense and growth in the unconstrained group, but was not confirmed for the constrained group, where the study hypothesize that a negative relationship will exist between defense and economic growth in countries which are financially resource constrained, and a positive relationship will exist in countries which are relatively resource unconstrained.
effectiveness of labor” (A), and \( t \) denotes time. The economy produces output with a combination of certain amounts of labor, capital, and knowledge. The model can be written in mathematical form as follows:

\[
Y = A(t)F(K, L) 
\]  

I specify the empirical model by incorporating military spending in the growth equation following the existing literature including (Dunne and Tian, 2015; D’Agostino 2017, see for details on the empirical model). Thus, in this study, a multivariate probabilistic model, based on the augmented production function is used to validate empirically the impact of military spending as a percentage of GDP along with some other control variables, including human capital, physical capital, foreign remittances, and the level of development on economic growth proxied by GDP per capita growth rate. Similar growth models encompass military spending is also frequently used in erstwhile research studies, for instance by Antonakis (1997), Dunne and Nikolaidou (2012), Hou and Chen (2013), Lobont et al. (2019), Mohanty et al. (2020). The multivariate regression equation used in this study can be expressed symbolically as follows;

\[
G_{it} = \alpha_0 + \alpha_1 MS_{it} + \alpha_2 I_{it} + \alpha_3 RM_{it} + \alpha_4 HK_{it} + \alpha_5 PCI_{it} + \epsilon_{it} 
\]  

In Eq. (2) \( \alpha_0, \alpha_1, \alpha_2, \alpha_3, \alpha_4, \) and \( \alpha_5 \) symbolizes the estimated coefficients, \( i \) and \( t \) indicates the \( i^{th} \) country and the \( t^{th} \) time period, respectively (\( i = 1, 2, \ldots, N = 35; t = 1, 2, \ldots, T = 32 \)). Where \( G \) is the GDP per capita growth rate, \( MS \) represents military spending, \( I \) is an investment by gross capital formation, \( RM \) is personal remittances received, \( HK \) is human capital by total life expectancy at birth in years, \( PCI \) is GDP per capita at level represents the level of development, and \( \epsilon \) is an error term, which shows effects of other variables not included in the model. It is assumed that the error term \( (\epsilon_{it}) \) is to be independently and identically distributed

\[
\text{\( \epsilon \sim iid (0, \sigma^2) \).}
\]

I hypothesized that in Eq. (2), the impact of human capital, physical capital, and workers’ remittances have a positive relationship with economic growth, and initial per capita income hurts economic growth, while the impact of military spending is determined in this study.

The unrestricted error correction for the ARDL model (p, q, q….q) model by Pesaran et al. (1999: 623–24) is used as per the order of integration of the data and can be expressed symbolically as follows:

\[
G_{it} = \sum_{j=1}^{p} \lambda_{j} G_{i,j-1} + \sum_{j=0}^{q} \delta_{j} X_{i,j} + \mu_{i} + \epsilon_{it} 
\]  

In Eq. (3), the subscripts \( i \) and \( t \) show group (country) and period, respectively. So, the periods \( t = 1, 2, \ldots, T \) (i.e., 1988–2019) and the groups (countries) \( i = 1, 2, \ldots, N \) (in this case \( N = 35 \)). \( G_{it} \) is the growth rate of GDP per capita (regressand); \( X_{i}(k \times 1) \) is the vector of explanatory variables (regressors), including military spending, investment, human capital, workers remittances, and initial per capita income, \( \mu_{i} \).

Table 1. Selected prior studies on the association between Milex and aggregate output.

| Author(s) | Period, country(s), methodology used | Regressand | Regressor(s) | Findings |
|-----------|--------------------------------------|------------|-------------|----------|
| Mohanty et al. (2020) | 1970–71 to 2015–16, India ARDL, Toda-Yamamoto Granger Causality | GDP per capita | Capital Milex, labour force, gross domestic capital formation, per capita revenue Milex, and trade openness | Capital Milex has significantly positive effect on economic growth |
| Raju and Ahmed (2019) | India, Pakistan, China9 Ganger Causality | GDP growth | Milex | Significantly positive long-run link and long-run causality from Milex to growth |
| Lobont et al. (2019) | 1991–16 Romania, Granger causality test | GDP | Milex | Two-ways link between Milex and growth |
| Ajmair et al. (2018) | 1990–15 Pakistan ARDL | GDP | Milex, and total arm force | Impact of Milex on growth found positive but insignificant |
| Arshad et al. (2017) | 1988–15 61 countries, fixed effect, LSDV | Real GDP per capita | Milex, FDI, general government consumption spending population, school enrollment rate, and trade openness | Milex has negative impact on growth |
| Sheikh et al. (2017) | 1972–16 Pakistan GMM | GDP per capita | Milex, inequality, saving, investment | Milex has positive impact on growth |
| Hou and Chen (2013) | 1975–99 35 Developing countries GMM | Per capita income growth rate | Milex, initial income per capita, investment and human capital | Milex has negative impact on growth |
| Dunne and Nikolaidou (2012) | 1961–07 EU 15 Fixed-effect and Random-effect | GDP per capita | Miles, labor force growth rate, and gross investment | Miles has negative impact on growth |
| Feridun et al. (2011) | 1977–07 North Cyprus Granger causality, ARDL | GDP | Miles | Miles has positive impact on growth |
| Antonakis (1997) | 1960–90 Greece, ARDL, OLS, 3SLS | Real GDP growth rate | Miles, saving, population growth, and inflation | Combined effect of Milex on the output is negative |
| Knight et al. (1996) | 1971–85, 79 countries Fixed-effect | Output per capita | Miles, labor force, War, investment, international trade, and human capital | Miles has negative impact on growth |
| Frederiksen (1989) | 1964–85 Indonesia, Granger causality | Real GDP growth rate | Miles | Found feedback link between Miles and growth |
| Looney and Frederiksen (1986) | 1970–82 61 countries, Panel regression | Real GDP growth | Miles, investment, external debt | Mixed results on Milex (1) and growth |

Source: Author’s compilation. Military expenditures (Milex)
denote the fixed effects; $\delta_j$ represents the coefficient of the lagged regressand; $\delta_0$ are $k \times 1$ coefficient vectors (representing the coefficient of the lagged explanatory variables); and $\varepsilon$ is an error term. $\mu_j$ needs to be suitably large such that the model for each group (country) can be estimated separately.

Eq. (3) in reparameterized form can be used to accomplish the objectives of the study:

$$\Delta G_{it} = \phi_t G_{it-1} + \beta X_{it} + \sum_{j=1}^{p-1} \lambda_j \Delta G_{ijt-1} + \sum_{j=1}^{q-1} \delta_j \Delta X_{ijt-j} + \mu_i + \varepsilon_{it}$$

where, $\phi_t = -1 - \sum_{j=1}^{p-1} \lambda_j$, $\beta_t = \sum_{j=1}^{p-1} \delta_j$.

$$\lambda_0 = -\sum_{j=1}^{p-1} \lambda_j, \quad j = 1, 2, \ldots, p - 1,$n and

$$\delta_0 = -\sum_{j=1}^{q-1} \delta_j, \quad j = 1, 2, \ldots, q - 1.$$n

In Eq. (4), $\phi$ is the coefficient of the speed of adjustment in the long-run equilibrium.

### 3.2. Data and it sources

Annual cross-sectional balanced panel data from 1988 to 2019 is used. Though we intend to use longer period data, consistent balanced data were available for only 32 years. The growth rate of GDP per capita is used as regressand, and the regressors are military expenditure as % of GDP, worker remittances are personal remittances, received (current US$), GDP per capita (current US$), gross capital formation, and total life expectancy at birth (years). The data initially were in US$ and converted to GDP ratio except for GDP per capita. Data on all variables are extracted from the World Development Indicators (WDI, 2020), the World Bank.

### 3.3. Estimation strategy

#### 3.3.1. Panel unit root tests (PURTs)

Before the formal empirical exploration of the panel data, it is essential to have an understanding of the integrating properties of the data. Therefore, this research work employed PURTs i.e., Levin et al. (2002) (LLC), Fisher-ADF, and Fisher-PP tests by Maddala and Wu (1999) and Choi (2001); and Im et al. (2003) (IPS).

#### 3.3.2. The autoregressive distributed lag (ARDL)/pooled mean group (P.M.G.)

Pesaran and Shin (1999) introduced the Autoregressive Distributed lag (ARDL) model in error correction form as a comparatively innovative cointegration test. Pesaran and Shin (1999) claim that the panel ARDL can be employed for variables even with dissimilar order of integration i.e. either in case of I(0) or I(1). The ARDL model, in particular, the P.M.G. provides reliable coefficients despite the potential existence of endogeneity, as it comprises lags of regressand and regressors (Pesaran et al., 1999). This study, therefore, uses the panel ARDL approach to explore the long-run equilibrium association of the elemental variables and the P.M.G. model to assess the impact of defense spending on economic growth. The error correction model provides information regarding the long-run equilibrium of the parameters of the model. This approach has the advantage that it uses a single condensed form equation, compared with the other cointegration approach, so that endogeneity is not a major problem as it is free from the residual relationship. Likewise, the ARDL neglects the specification of the exogenous and endogenous variables required to be incorporated into the model. It also uses optimal lags for the elemental variables that cannot be used in standard cointegration tests (Ouel, 2019). This method is also employed by D’Agostino et al. (2017) for investigating the long-run equilibrium linkage between military expenditure and growth in 83 OECD countries.

#### 3.3.3. The robust least squares (RLS), fixed-effect and Dumitrescu and Hurlin

The robust least squares estimators are applied because the outliers in the data can have a severe effect on regression results. Usually, the most commonly used method, including the traditional least squares method (OLS) for data analysis, overlooks the issue of outliers (Barnett and Lewis 1978; Belsley et al., 1980). Robust regression is an alternate solution to overcome this problem, which provides robust results (Huber, 1973). M-estimation is a broadly used method for robust statistical results. The setting of M-estimation is logically advantageous to penalization to standardize parameters, and it is generally employed to perform robust estimation and variable selection (Owen, 2007). Many prior studies such as Wilcox and Keselman (2012), and Pitselis (2013) documented that the M-estimation of R.L.S. method gives large advantages over the least-squares method.

This study also employed the fixed-effect estimator suggests by the Hausman (1978) test over the random-effect as the p-value (0.0279) is statistically significant (see Table 6). To deal with endogeneity bias is offered by the fixed-effect analytic approach, which necessitates multilevel data/p panel data (Allison, 2009). The method of fixed-effect is a very flexible approach to adjusting for endogeneity originating from omitted variable bias. The predominant purpose of the fixed-effect model is to eliminate all bias that is due to the association of encompassed variables with omitted time-invariant variables (Wooldridge, 2009; Stone and Rose, 2011). The fixed-effect estimator is also implemented by Knight et al. (1996) Dunne and Nikolaidou (2012), Azam and Feng (2017), and Dunne et al. (2019) in related studies. Also, the commonly used heterogeneity test by Dumitrescu and Hurlin (2012) which is a simple non-causality test in heterogeneous panel data models developed by Granger (1969) is employed to find the direction of causality between the variables.

### 4. Results and discussions

Table 2 provides a summary of the descriptive statistics of balanced panel data set containing 35 non-OECD countries over the period of 1988–19. The results of the pair-wise correlation between the series are also given in Table 2. These results reveal that all the variables are normally distributed whereas the error term is having zero mean and finite variance indicated by Jarque-Bera’s statistic. The pair-wise correlation results expose that military spending and per capita income is negatively correlated with economic growth, while a positive correlation exists between physical capital and economic growth, and the same is true for human capital and foreign remittances. The correlation analysis suggests no evidence of multicollinearity between the series.

Before checking stationarity properties of selected variables namely military spending, physical capital, human capital, per capita income, foreign remittances, and economic growth, this study first implements Pesaran’s (2004) tests to check the cross-sectional dependence in panel data. To avoid the problem of cross-sectional dependence may lead to partial results. The cross-sectional dependence test results are reported in Table 3. These results reveal solid evidence to discard the null hypothesis of cross-sectional dependence as the relevant p-values are statistically significant. These results endorse the existence of cross-sectional dependence for military spending, physical capital, human capital, per capita income, foreign remittances, and economic growth.

A summary of the results of PURTs is given in Table 4. The panel unit root results demonstrate that the growth rate of GDP per capita, military spending, human capital, investment, and workers remittances are stationary at the level, while PCI proxied by GDP per capita are found non-stationary at the level and became stationary after its first difference with individual constant and trend in a panel. PURTs results suggest that all variables used in the study are mixed in order of integration i.e. integrated at I(0) and I(1) in each panel. Thus, I implement the ARDL/P.M.G. methods for empirical estimation purposes. For the sake of robustness, this study also employed the methods of robust least squares and fixed-effect.
Based on the PURTs results, this study first implements the pooled mean group technique for exploring the long-run equilibrium association between variables. Empirical estimations of both the long-run and short-run parameters that link military spending, human capital, remittances, the initial level of development, and national income (economic growth) by employing the PMG method are reported in Table 5. It is evident from Table 5 that all empirically evaluated explanatory variables have considerable effects on the economic growth of the 35 non-OECD economies. The P.M.G. results reveal that all regressors are statistically significant individually, thus, validating and signifying that the estimated

| Statistics/variables | $G_t$ | $MS_t$ | $I_t$ | $HK_t$ | $PCI_t$ | $RM_t$ |
|----------------------|-------|--------|-------|--------|---------|--------|
| Mean                 | 2.4135| 2.0421 | 21.9897| 64.1024| 2035.705| 5.9982 |
| Median               | 2.2847| 1.6501 | 21.6250| 66.5750| 1391.708| 2.8833 |
| Maximum              | 37.5355| 10.2766| 53.1866| 76.5510| 13245.62| 184.8444|
| Minimum              | -47.5033| 0.2715| 0.0000 | 27.6100| 111.9272| 0.0049 |
| Std. Dev.            | 3.9936| 1.4062 | 8.7326 | 8.7624 | 7.6586| 2.563 |
| Kurtosis             | 31.4445| 8.8577| 4.3668 | 3.3188| 7.6486| 84.2010 |
| Jarque-Bera          | 36867.27| 2264.901| 84.7874| 139.0325| 1590.844| 310412.7 |
| p-value              | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

Note: p-values are in ( ).

| Table 3. Results of CD cross-sectional dependence tests. |
|--------------------------------------------------------|
| Tests                                                  | $G_t$ | $MS_t$ | $I_t$ | $HK_t$ | $PCI_t$ | $RM_t$ |
| Breusch-Pagan LM                                      | 1183.274 | (0.0000) | 4817.421 | (0.0000) | 3490.282 | (0.0000) |
| Pesaran scaled LM                                     | 16.0386 | (0.0000) | 121.3873 | (0.0000) | 82.9154 | (0.0000) |
| Bias-corrected scaled LM                              | 15.4552 | (0.0000) | 120.8039 | (0.0000) | 82.3321 | (0.0000) |
| Pesaran CD                                            | 8.17779 | (0.0000) | 33.6431 | (0.0000) | 3.83925 | (0.0001) |

Note: Null hypothesis: No cross-section dependence. d.f. = 595. All tests shows that all included variables are significant at the 1% level of significance.

| Table 4. Summary of PURTs results. |
|------------------------------------|
| Tests                              | Variables | Level | 1st Difference | Decision |
| Levin Lin & Chu (LLC)              | $G_t$     | -8.429a | -7.396a | - Stationary |
|                                   | $MS_t$   | -14.752a | -11.651a | - Stationary |
|                                   | $RM_t$   | -5.184a | -2.263a | - Stationary |
|                                   | $I_t$    | -7.605a | -2.413a | - Stationary |
|                                   | $HK_t$   | -14.823a | -7.783a | - Stationary |
|                                   | $PCI_t$  | -10.174 | 2.060 | -15.527a | -15.582a | Stationary |
| Im, Pesaran and Shin W-stat (IPS)  | $G_t$     | -10.950a | -9.447a | - Stationary |
|                                   | $MS_t$   | -7.245a | -5.341a | - Stationary |
|                                   | $RM_t$   | -2.148a | -1.529b | - Stationary |
|                                   | $I_t$    | -3.467a | -3.926a | - Stationary |
|                                   | $HK_t$   | -12.582a | 8.373a | - Stationary |
|                                   | $PCI_t$  | 13.845 | 3.969 | -16.298a | -15.778a | Stationary |

Note: The unit root tests are carried out with a specification of constant and time trend. Where, asterisk indicates statistical significant at the 1% level of significance. C shows Constant, and T show Trend.
model is theoretically and statistically acceptable. All the regressors carry the probable coefficient signs. Results given in Table 5 reveal that military spending (MS) has an inverse effect on the national income (G) in the long-run. I obtained impartially robust empirical results on the negative impact of defense spending and economic growth in the long-run. Results favor the likely adverse effect of military spending on growth. In the long-run, the estimated coefficient of -0.3223 is estimated for the military spending variable, which is significant statistically at the 1% level. Empirical results indicating that a 1% upsurge in military expenditure will dampen economic growth by 0.3223%. Similar results are also obtained by Dunne and Nikolaidou (2012) using panel data for 15 countries from the EU over 1961–07. The findings of this study are consistent with the study carried out by Knight et al. (1996), Hou and Chen (2013), and D’Agostino et al. (2017), and Saba and Ngepah (2019). While, our results are in contrast with the findings of Narayan and Singh (2007), Feridun et al. (2011), Farzanegan (2014), Sheikh et al. (2017), and Lobont et al. (2019), as these studies yield positive relationship between military expenditures and economic growth, also quite consistent with the illustration of the Keynesian school of thought. Mostly military expenditure is unproductive in developing countries. Developing countries face multiple challenges and need to focus on promoting economic growth and thereby social welfares. After achieving the desired level of economic growth, these countries may opt for military spending. Countries spending on the military are in loss unless they export armaments to other countries and increase their foreign exchange.

Table 5. Pooled Mean Group results.

| Variable  | Coefficient [Std. Error] | p-values |
|-----------|---------------------------|----------|
| **Long Run Equation** | | |
| MS<sub>i</sub> | -0.3222<sup>a</sup> [0.1166] | 0.0059 |
| I<sub>i</sub> | 0.1195<sup>a</sup> [0.0212] | 0.0000 |
| HK<sub>i</sub> | 0.0283<sup>a</sup> [0.0101] | 0.0054 |
| PCE<sub>i</sub> | -0.0005<sup>a</sup> [0.00007] | 0.0000 |
| RM<sub>i</sub> | 0.0916<sup>a</sup> [0.0292] | 0.0000 |
| **Short Run Equation** | | |
| ECM<sub>i</sub> | -0.7184 [0.0753] | 0.0000 |
| Δ(G<sub>i</sub> (−1)) | -0.0658 [0.0403] | 0.1030 |
| Δ(MS<sub>i</sub> (−1)) | 0.1657 [0.5812] | 0.7756 |
| Δ(I<sub>i</sub>) | 0.2019 [0.0822] | 0.0143 |
| Δ(L<sub>i</sub> (−1)) | 0.0667 [0.0535] | 0.2127 |
| Δ(HK<sub>i</sub>) | -1.9648 [1.4658] | 0.1806 |
| Δ(RM<sub>i</sub> (−1)) | 0.6298 [1.6028] | 0.6945 |
| Δ(PCE<sub>i</sub>) | 0.0117 [0.0032] | 0.0004 |
| Δ(PCE<sub>i</sub> (−1)) | -0.0029 [0.0031] | 0.3347 |
| Δ(RM<sub>i</sub>) | 1.0525 [0.7498] | 0.1609 |
| Δ(RM<sub>i</sub> (−1)) | -0.2244 [0.3364] | 0.5050 |

Note: Regressor is GDP per capita growth rate.
Asterisk<sup>a</sup> denotes 1% level of significance.

ECM = Error correction coefficient. Model selection method: AIC.

Table 6. Robust least squares, and fixed-effect estimates.

| Variables  | Coefficient [Std. Error] | P value | Fixed-effect | Coefficient [Std. Error] | P value |
|------------|---------------------------|---------|--------------|---------------------------|---------|
| **R.L.S.** | | | **Fixed-effect** | | |
| MS<sub>i</sub> | -0.1733<sup>a</sup> [0.0624] | 0.0055 | -0.2358<sup>b</sup> [0.1207] | 0.0512 |
| I<sub>i</sub> | 0.1492<sup>a</sup> [0.0108] | 0.0000 | 0.1109<sup>a</sup> [0.0169] | 0.0000 |
| HK<sub>i</sub> | 0.0207<sup>a</sup> [0.0123] | 0.0907 | 0.1045<sup>a</sup> [0.0307] | 0.0007 |
| PCE<sub>i</sub> | -0.0002<sup>b</sup> [0.00005] | 0.0054 | -0.0002<sup>b</sup> [0.00007] | 0.0118 |
| RM<sub>i</sub> | 0.0286<sup>a</sup> [0.0063] | 0.0000 | 0.0201<sup>b</sup> [0.0083] | 0.0161 |
| **Constant** | -1.7479 [0.7189] | 0.0151 | -5.9881<sup>a</sup> [1.8879] | 0.0016 |

Robust Statistics
R<sup>2</sup> 0.091459 0.3389
Rw<sup>2</sup> 0.199625
adj. R<sup>2</sup> 0.087248 0.3142
Adj. Rw<sup>2</sup> 0.199625

Correlated random effects - Hausman test 10.8818 0.0279

Method: M-estimation M settings: weight = Bisquare, tuning = 4.685, scale = MAD (median centered).
Huber Type I Standard Errors & Covariance.
Note: a, b, and c denotes 1%, 5%, and 10% level of significance respectively.
economic growth. The positive and statistically significant correlation between remittances and growth was also acquired by Azam (2015; 2016).

Investment (I) represented by gross capital formation is included in the regression model, which is one of the fundamental inputs for production. Table 5 indicates that the investment variable is positively associated with economic growth in the long run. The estimated coefficient value is 0.1195 and significant at the 1% level in the long-run. This result infers that an upsurge of 1% in investment leads to an enlargement in the national growth rate by 0.1195% in the long-run. This finding is consistent with the results obtained by Azam (2016), and Mohanty et al. (2020).

Human capital (HK) is a key element of the production function; so, human capital by total life expectancy in a year is included in the regression model. The P.M.G. results exhibit that human capital has a positive impact on economic growth in the long-run. The estimated coefficient for human capital found is 0.0283 and significant at the 1% level in the long-run. Empirical estimates exhibit that one unit change in the human capital will promote economic growth by 0.0283%. The results of these two variables can be measured exogenous. These results are also explored by Hou and Chen (2013).

Initial GDP per capita represents the level of development that has a negative association with the growth and significant statistically at the 1 percent level. The estimated coefficient for the initial level of development is -0.0005 in the long-run. The negative result of the coefficient on the initial level of development variable, the GDP per capita at the start of each year, shows the conditional convergence effect. The estimated speed of conditional convergence is around 0.0005% per year. The significantly negative impact on initial GDP per capita on the growth was also explored by Hou and Chen (2013).

The robust least squares and fixed-effect estimators’ results are given in Table 6 confirms that military spending has a detrimental impact on the growth in 35 non-OECD countries. Whereas workers’ remittances, physical and human capital have a positive effect on national income, and initial GDP per capita harms growth. There is no indication of any positive impact of military spending on economic growth. All estimated coefficients are statistically significant and strongly support the empirical results of the P.M.G. approach. Non-OECD countries are mostly developing countries if compared to developed countries. The developed world often can allocate resources of their national budget to military spending. Whereas most developing economies including non-OECD countries suffer from high levels of poverty, and allocation of their resources to military spending may further contribute to poverty. Comparing the empirical results of this study with many including Saba et al. (2019), I conclude that military expenditure in non-OECD does not stimulate economic growth.

Moreover, the commonly used heterogeneous test by Dumitrescu and Hurlin (2012) is used to explore the causal linkages between the variables. The Dumitrescu and Hurlin test allows for heterogeneity through cross-sections, and the results are presented in Table 7. The results reveal that there exists a statistically significant bidirectional causality between military spending and economic growth. It is evident from Table 7 that most of the results show the existence of causality between variables which are also statistically significant. The Dumitrescu – Hurlin Granger causality results suggest a feedback link between military spending and growth. The empirical finding of a feedback link indicates that neither of these two variables can be measured exogenous. These results are consistent with the findings accrued by Frederiksen (1989), and Lobont et al. (2019), while inconsistent with the findings of Abdel-Khalek et al. (2019).

Thus, overall, the PMG, RLS, fixed-effect, and Dumitrescu-Hurlin panel causality tests results reveal that military spending does not have any positive impact on military spending in non-OECD countries, while it has a significant negative effect on the economies. These theoretically, technically, and statistically sound empirical results are plausible for policy formation.

5. Concluding remarks

Several empirical studies are available on the relationship between military spending and economic growth, but their empirical findings are yet inconclusive. Undeniably, the economic effect of military expenditure is an essential issue for the developing world. Therefore, this research work aims to determine empirically the impact of military expenditure along with some other control variables on the growth, for a set of thirty-five countries from non-OECD over 1988–19. According to the nature of the data, the widely used panel unit tests are employed to check the order of integration of each variable. The results are found mixed (i.e., I(0), and I(1)) based on stationarity, and thus, the panel ARDL/PMG approach is applied. Afterward, the panel robust least squares and fixed-effect
estimators are also employed as analytical techniques for parameters’ estimation to affirm the results, and the Dumitrescu–Hurlin Granger causality test is employed to find the direction of causality between the variables.

The empirical results of all the methods suggest that military spending and economic growth have a strong inverse relationship, suggesting that encouraging military expenditure is not a good option because it discourages economic growth. Moreover, the Dumitrescu–Hurlin Granger causality test exposes bidirectional causal nexus between military expenses and economic growth in the sample countries. The bidirectional causal linkage between military spending and growth though exhibits a degree of interdependence between military spending and economic growth policy objectives. Thus, the execution of economic growth policies should not be given more primacy over the military burden while other than military expenditure factors shall be considered.

Overall, the empirical results validated that military spending is undesirable for national economic development. The results of the significantly negative effect of military spending on national income go against the results obtained by Benoit (1978), and others who claim that military expenditure positively contributes to the aggregate output, while, significantly negative effect of military spending on national income go against the economies. Therefore, military expenditures need to be reduced while expenditures on other developmental sectors including health and education sectors to be increased.

From these findings, the unequivocal negative effect of military spending on economic growth indicates that non-OECD countries are developing countries with scarce resources, and these economies can't afford military spending, while when these economies grow, governments can contemplate rising its military spending to strengthen its military power. Enlarged military spending can't be used to boost economic growth in the non-OECD countries, since any positive impacts it would have on the economic growth through augmented demand, modernization, and resource outset, would have overwhelmed by the damaging effects on economic growth through reduced investment. Policymakers should thus leave military spending for security objectives only and restructuring public resources from the military sector toward civilian objectives11. Likewise, policymakers should focus on rationalizing their budget spending more on improving social welfare. Furthermore, incremental efforts are required to adopt an effective and prudent policy to further encourage growth, while shrinkage in military spending can largely benefit the economies. Therefore, military expenditures need to be reduced while expenditures on other developmental sectors including health and education sectors to be increased.

The limitation of this study is that it deals only with a panel of 35 non-OECD countries over the period of 1988–19, as consistent and balanced data were only available on this period on selected variables.

It is suggested for future research to divide the non-OECD countries based on the levels of military spending, re-run regression on non-OECD and OECD countries separately, and compare their empirical findings which will certainly help the management authorities. Moreover, the turning point/threshold effect of military spending shall be empirically evaluated. Perhaps, it will need advanced econometric techniques to come up with a meaningful investigation.

Declarations

Author contribution statement

Muhammad Azam: Conceived and designed the analysis; Analyzed and interpreted the data; Contributed analysis tools or data; Wrote the paper.

11 See Antonakis (1997).

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Additional information

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