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The effect of military spending on economic growth in MENA: evidence from method of moments quantile regression

Isiaka Akande Raifu* and Alarudeen Aminu

Abstract

This study adopted a novel quantile regression via moments to explore the effects of military spending on the distribution of economic growth of 14 MENA countries over the period from 1981 to 2019. The method, apart from enabling us to investigate the effects of military spending on the distribution of economic growth at different quantiles, also helps to address issues of heterogeneity and endogeneity characterising the panel studies. Our results showed that irrespective of measures of military spending and economic growth, an upsurge in military spending leads to a positive effect on economic growth at different quantiles, suggesting that military spending is productive and growth-enhancing in the MENA countries.

Keywords Military spending, Economic growth, Quantile regression via moments

JEL Classification O40, H56, C23, C33

Introduction

MENA region had the highest military spending in 2019 among the regions in the world (see Fig. 13 in the appendix).[1] Although military spending has declined across the regions since the end of the cold war [28, 33], there was an increase in military spending in MENA from 2011 to 2015.[2] Such an increase in military spending during the periods has been associated with the Arab Spring that began on 17 December 2010. It could be recalled that the self-immolation of Mohamed Bouazizi triggered riots in Tunisia on January 4th, 2011. As a result of his single action, the protest spread to other Arab countries such as Libya, Egypt, Yemen, Syria, Bahrain, Morocco, Iraq, Algeria, Iran, Kuwait, Jordan and Oman. To ensure that these internal threats are put under control, the governments of the region increased the military budget for the procurement of more arms and ammunition to build up security. Wezeman [79] noted that the MENA region accounted for 34% of arms imports globally between 2012 and 2016. Thus, the procurement of arms and ammunition increased by 20.47% within the same period. However, Khan [51] argued that solving the political problem through military action had a grave consequence on the economy of the region. Devarajan and Mottaghi [24] noted that an increase in military spending slowed down economic growth and raised fiscal deficits in the region. As observed in Fig. 15 (Appendix), the economic growth rate dropped from 3.891% in 2012 to 2.431% in 2015.

Defence economists have shown a keen interest in quantifying the effects of military spending on economic growth for a very long time. The pioneering study of Emile Benoit in 1978 for 44 less developing countries between 1950 and 1965 led to a plethora of other studies (see review by [3, 28]). Despite the large number of studies published in different research

[1] Refer Table 10 in appendix for full meaning of abbreviated words.

[2] See Fig. 14 in appendix for the decline in military spending across the world in recent times.

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outlets, there appears to be no consensus about the effects of military spending on economic growth. The initial argument is that most of the pioneering studies are based on cross-sectional studies or panel studies; hence, it may be practically impossible to get full information about the relationship between military spending and economic growth for a particular country. The proponents of this argument, therefore, suggested that there is a need to conduct a country-specific study [31, 33]. With no consensus emanating as well from the country-specific studies, several other plausible explanations were put forward. According to Dunne and Tian [28], the inconclusive relationship between military spending and economic growth comes from different theoretical models, different empirical approaches, different countries, different periods considered and different sources of data. All of these might have fuelled the continuing evaluation of the relationship between military spending and economic growth as there are new approaches that offer new insights into the nexus between the two variables.

Based on this, this study is conducted to re-examine the relationship between military spending and economic growth in MENA. In specific terms, we are interested in examining how military expenditure affects the distribution of economic growth at different quantiles taking into consideration the issue of heterogeneity and endogeneity characterising *the panel studies*. Previous studies that examined the relationship between military spending and economic growth adopted or used a plethora of estimation methods that focused on the conditional mean effect of military spending on economic growth. However, econometricians and applied econometricians believe that such an approach cannot offer a true picture of the relationship between the variables. In fact, Binder and Coad [11] argued that using estimation techniques that estimate conditional mean effect may underestimate or overestimate the relationship between two economic or non-economic variables. Kollias, Paleologou and Tzeremes [53] based their argument on the adoption of quantile regression on the fact that economic theory on the effects of government expenditure on unemployment does not give any precise guidance as regards the parts of the distribution of unemployment where the effects of government expenditure (either military expenditure or non-military expenditure) are likely to take place. Hence, it is important to investigate how military expenditure affects economic growth at different points of the distribution, that is, at different quantiles. To examine this, the quantile regression method becomes an appropriate estimation tool. The quantile regression is useful for estimating the effects of military spending on economic growth at different quantiles. It offers more useful policy implications than considering the conditional mean effect of military spending on economic growth.

In this study, we employ a unique quantile regression known as quantile regression via moment (also known as method of moments quantile regression–MM–QR) developed by Machado and Silver [57] to explore the effect of military spending on the distribution of economic growth at different quantiles in the MENA region. Unlike the original quantile regression developed by Koenker and Basset [52] which can only be used to estimate the effect of the independent variable(s) or dependent variable at different quantiles, Machado and Silva's quantile regression can combine the estimation of conditional mean effects (scale and location effects) and distributional effect of the independent variable(s) on the distribution of the dependent variable. Apart from this, Koenker and Basset's quantile regression cannot handle heterogeneity and endogeneity in the panel study. However, Machado and Silva's quantile regression can handle issues of fixed effects, heterogeneity and endogeneity (endogeneity via the instrumental variable approach).

In panel data analysis, issues of heterogeneity and endogeneity are so central that they cannot be neglected. In the case of the relationship between military expenditure and economic growth, Smaldone [74], in his review, concluded that the relationship between the two variables in Africa was heterogeneous. Consequently, studies by Dunne and Tian [28, 29] and Saba and Ngepah [69] investigated the heterogeneity between military spending and economic growth by employing different methodologies. While Dunne and Tian [28, 29] explored heterogeneity in the relationship between military spending and economic growth by considering factors such as levels of income, conflict experience, natural resources endowment, openness and foreign aid or assistance, Saba and Ngepah [69] employed Demitrescu-Hurlin [26] panel causality to examine the heterogeneity in the relationship between military spending and economic growth.

In economic parlance, heterogeneity arises because countries put together for analysis have different characteristics even though they may belong to the same region. For example, the dynamics of economic growth and military spending are not the same across the MENA region. While some countries like Saudi Arabia, Turkey, Israel and Algeria appear to be big spenders as regards acquisition of military weapons, countries like Tunisia, Jordan and Lebanon are small spenders. Besides, each of these countries differs in terms of their institutional structures, budgetary planning and execution and political configurations. Concerning the endogeneity issue, apart from the fact that both military spending and economic growth can influence each other, a common factor such as security threats can drive both military spending and

economic growth in the same or different directions. Thus, a negative nexus can exist between military spending and economic growth when the security threat is high and conversely when the security is low [22].

The rest of the study is structured as follows. "Review of literature" section summarises the existing studies. "Methodology, data sources and stylised facts" section presents the methodology, data sources and some stylised facts. While "Empirical findings and discussions" section presents empirical findings, "Conclusion and policy implications" section concludes with policy implications.

Review of literature

Extensive studies have been conducted on the effects of military spending on economic growth and other macroeconomic indicators ([18, 28, 30, 66–68, 74], [66]; Raifu [65]). Despite the huge number of studies, the empirical evidence has not been concretised. This offers an opportunity to further explore the relationship between military spending and economic growth including other macroeconomic variables whenever there is a new development in terms of data availability and estimation techniques. Consequently, existing studies are briefly discussed under theoretical and empirical reviews.

Theoretical review

Existing economic theories on government expenditure and economic growth do not provide any link between military spending and economic growth. However, some defence economists have sort of adopted and adapted some theories to explain some links between military spending and economic growth. Precisely, the literature has identified four theories that provide explanations for the relationship between the two variables. These theories include neoclassical theory, Keynesian theory, Marxist theory and institutionalist theory.

From a neoclassical perspective, military spending is perceived as a public good. To maximise societal welfare, government acts as a rational agent to balance the opportunity costs and benefits of spending more on the military. Thus, the impact of military expenditure on economic growth is seen as a trade-off between military spending and civilian spending (d'Agostino, Dunne and Pieroni [21]; [28]). In the case of Keynesian, especially in the period of falling aggregate demand, military spending is considered a fiscal policy tool used by the government to stimulate the economy through the multiplier effect. According to Faini, Annez and Taylor [36], military spending can assist in building up capacity utilisation, boost profits of firms as well as bolster overall economic growth. However, the Keynesian approach to military spending is criticised because of its focus on the demand side alone without considering the supply side of military spending [37].

The Marxist theory perceives military spending as a tool used for the development of the military–industrial complex (MIC) that generates class struggle among the powerful elites and capitalists [28]. Under the Marxist theory, Baran and Sweezy [9] explain how military spending can help to resolve the problem of under-consumption created by capitalists. It is believed that the mode of production of capitalists would eventually lead to its downfall because of two main factors, namely *the realisation problem and a fall in the rate of profits.* According to Smith [75], the realisation problem arises because capitalist produces more than what the households can effectively demand. Consequently, capitalists would try to put pressure on wages to limit the excess output. This action by capitalists would lead to the stagnation of the economy and due to ineffective demand the profit would fall. Thus, military spending can be used to rescue the capitalists from their self-destruction. The institutionalist approach to military spending supports Keynesian theory, but adds that military spending can be used to satisfy the interest of some groups [28]. In other words, military spending would lead to the preservation of some powerful groups' interests known as the Military–industrial complex. The organisations achieved this by putting pressure on the government so that an increase in military spending can be tilted towards their benefits.

Empirical review

A large number of empirical studies have been conducted since Benoit [10] establishes a positive relationship between military spending and economic growth in developing countries. These sundries of studies have used different models such as the Feder–Ram model, augmented Solow growth model and Barro model (see [34]). Apart from this, several estimation techniques which range from time series estimation methods to panel estimation methods have been deployed. Studies have also been conducted on country-specific, cross-sectional and panel bases. Several issues such as causality, cointegration, endogeneity and heterogeneity have been examined. These approaches have yielded mixed empirical results. In light of this, we review the existing studies focusing on country-specific and panel studies while taking into account the issues they addressed.

The country-specific studies on the relationship between military spending and economic growth are broad and they cover a wide range of issues such as causality test, cointegration test and impact analysis of military spending on economic growth. The empirical findings vary across the studies. Beginning with causality tests, the following studies examine the direction

of causality between military spending and economic growth ([72] India and Pakistan, [47] Turkey and Greece, [49] Turkey, [40] Turkey, [80] China, [76] China). As regards their findings, Shah, et al. [72] report no causality between military spending and economic growth in Pakistan, while military spending Granger causes economic growth in India. Kalyoncu and Yucel [47] find evidence in support of unidirectional causality which runs from economic growth to military spending in Turkey and Greece. The same unidirectional causality is reported by Zhao, et al. [80] and Su, et al. [76] for China. A study by Gokmenoglu, et al. [40] shows a bidirectional causality between military spending and economic growth in Turkey while Karagianni and Pempetzoglu [49] establish the existence of both linear and nonlinear causality between military spending and economic growth in Turkey.

On the effects of military spending on economic growth, the negative effect appears to dominate the positive effect, especially for the studies that use military expenditure expressed as a percentage of GDP (military burden) as a measure of military spending. For instance, the following studies find a negative effect of military spending on economic growth in different countries (Shabbaz, Afza and Shabbir, [73] Pakistan; [35] Turkey, Mcmillan, 1992, [31] and Batchelor, Dunne and Saal, 2000-South Africa).

However, some studies establish mixed findings when a comparative analysis between two or more countries is examined. For example, Shah, et al. [72] who study the effect of military spending on economic growth in India and Pakistan reveal that military spending has a positive effect on economic growth in India but a negative effect in Pakistan. Dunne, Nikolaidou and Vougas [33] establish the same finding for Greece and Turkey. Specifically, they find the positive and negative effects of military spending on economic growth in Greece and Turkey, respectively. Some have argued that the effect of military spending on economic growth in the short run might be different from the long run. Hence, some studies have distinguished the effect of military spending on economic growth in the short run from the one in the long run using either an error correction method (ECM) or a novel autoregressive distributed lag method (ARDL). Apanisile and Okunola [6, 7], while using an ARDL, find that military spending has a negative effect on economic growth in Nigeria in the short run, but the effect turns positive in the long run. However, Ajefu [2] using an ECM submits that military spending has a negative effect on economic growth in Nigeria in the short run and the long run. While the study by Huang and Minzt [44] for the US does not find a significant relationship between the two variables, Sezgin [71], however, shows that military spending has a positive effect on economic growth in Turkey. It is also possible that the effect of military spending on economic growth may depend on the state of the economy. This is demonstrated by the study conducted on the Chinese economy by Menla Ali and Dimitraki [58]. Using Markov switching method, they show that the effect of military spending on economic growth is negative when the economy is slowing down and positive when the economy is growing.

We would now review the panel studies. Like country-specific studies, panel studies can also be grouped broadly into two, namely the studies that examine causality tests between military spending and economic growth, and those that investigate the impact of military spending on economic growth. Empirical findings from panel studies are also found to be mixed [16]. Ortiz, Alvarado and Salinas [60] examine the effect of military spending on output between countries with low income, middle income and higher income. Their results reveal a unidirectional causality that runs from output to military spending in higher-income countries, unidirectional causality that runs from military spending to output in middle-income countries and no causality between the two variables in low-income countries. Saba and Ngepah [69] also document varying causality results among the 35 African countries they studied. Their findings reveal that no causality exists in seven countries, unidirectional causality that runs from military spending to economic growth exists in two countries, and unidirectional causality runs from economic growth to military spending exists in 14 countries. Other studies that report mixed causality results include Dicle and Dicle [25], Chang, Lee and Chu [14], Pan, Chang and Wolde-Rufael, [61] and Desli, Gkoulgkoutsika and Katrakilidis [81]. The studies by Destek [23] and Saba and Ngepah [69] establish a bidirectional causality between military spending and economic growth, especially in advanced and newly industrialised countries.

On the impact of military spending on economic growth, the findings are also mixed. Some studies exclusively find a negative effect of military spending on economic growth [1, 27, 32, 69]. However, some studies show that countries that spend more on military spending do have economic growth and vice versa for the countries with low military spending [10, 19, 78]. Consequently, Churchill and Yew [17] synthesise some empirical findings from the existing studies and find that military spending has a positive effect on economic growth in developed countries and a negative effect in developing countries. Similar findings are documented by Lee and Chen [55] who find a positive effect of military spending on economic growth in OECD countries while obtaining a negative effect in non-OECD countries. However, Frederiksen and Looney [37] show that the effect of military

spending could vary from negative to positive effect even in developing countries.

From the studies reviewed, it is clear that the relationship between military spending and economic growth is far from being perfectly settled. This offers the opportunity for researchers to further explore the relationship between the two variables. Hence, in this study, we explore the relationship between military spending and economic growth in MENA using a newly developed panel quantile via moments by Machado and Silva [57]. The method enables us to examine the effect of military spending on the distribution of economic growth at different quantiles while taking into consideration the issues of heterogeneity and endogeneity characterising the panel studies.

Methodology, data sources and stylised facts

Methodology

Our primary aim is to apply quantile regression via moments developed by Machado and Silva [57] to obtain more information on how military spending affects economic growth in MENA at different quantiles while accounting for heterogeneity and endogeneity issues. Real GDP and real GDP per capita are used to proxy economic growth. Military spending in absolute value (USD) and military spending as a percentage of GDP are also used. We simply call military spending in absolute value "military expenditure" and military spending as a percentage of GDP "military burden". In the baseline model, we estimate the quantile regression of real GDP on military expenditure and military burden (separately) as well as other control variables. For robustness, real GDP per capita is regressed on military expenditure, military burden and other control variables.

Before we discuss and specify Machado and Silva's quantile regression model, it is important to mention that we conduct some preliminary tests that provide insights into the characteristics of variables of interest. These preliminary tests include a correlation test, unit root test, cross-sectional dependence test, causality test and cointegration test. Correlation analysis is usually conducted to show the strength of the relationship between two or more variables and to determine whether multicollinearity is present among the independent variables. Six unit root tests are conducted to test the stationarity properties of our variables. These unit roots tests include Im–Pesaran–Shin [46], Levin–Lin–Chu [56], Breitung [12], Hadri [41], Fisher-type [15] and Harris–Tzavalis [43] unit root tests. All the unit root tests except Hadri [41] assume that the panels contain a unit root, that is, the series is not stationary at level. Pedroni [62] and Kao [48] cointegration methods are used for the cointegration test. Both methods assume that there is no cointegration among the variables. This is tested against the alternative which suggests that the variables are cointegrated. For the cross-sectional dependence test, we adopt three methods which include Frees [38], Friedman [39] and Pesaran [63] cross-sectional dependence tests. All these tests have the same null hypothesis which states that no cross-sectional dependence in the panel of countries under investigation. This is tested against the alternative hypothesis which stipulates the existence of cross-sectional dependence in the panel. We use a panel VAR Granger causality test and Dumitrescu and Hurlin [26] Granger non-causality test to examine the direction of causality between military expenditure and economic growth on the one hand and military burden and economic growth on the other.

The specification of the Machado and Silva [57] quantile regression begins by assuming that Y_{it} denotes economic growth (real GDP and real GDP per capita). The distribution Y_{it} is conditional on the set of a vector of some variables such as military spending (military expenditure and military burden), the number of persons employed (employment hereafter), capital stock, population growth, foreign direct investment and trade openness denoted together as X_{it} with location–scale variants. The inclusion of control variables is guided by the modified augmented Solow growth model advocated for by Dunne, Smith and Willenbockel [34] and used by Dunne [27]. The quantile regression for this relationship is specified as follows:

$$Y_{it} = \alpha_i + X_{it}^{'}\beta + (\delta_i + Z_{it}^{'}\gamma)U_{it} \tag{1}$$

where $(\alpha, \beta, \delta, \gamma)^{'} \in R^{2(k+1)}$ are the unknown parameters to be estimated as the conditional probability. We denote the individual fixed effects as $(\alpha_i, \delta_i), i = 1, ..., n$, Z. The k-vector components of X_{it} are transformed by differentiating the element l given as $Z_i = Z_i(X), l = 1, ..., k$. The transformed X_{it} follows the assumption of normality which is independently and identically distributed for a fixed, i and also independent across time, t. U_{it} consists of three unique characteristics. First, it follows a standard normal distribution assumption across individuals, i and time, t. Second, it is orthogonal to X_{it}, that is, it is uncorrelated with X_{it}. Third, it satisfies moment conditions after being normalised. Equation 1 can be expressed in the form of quantile regression as follows:

$$Q_Y(\tau \Big/ X_{it}) = (\alpha_i + \delta_i q(\tau) + X_{it}^{'}\beta + Z_{it}^{'}\gamma q(\tau) \tag{2}$$

From Eq. 2, $Q_Y(\tau \Big/ X_{it})$ shows the quantile distribution of economic growth which depends on the location regressors X_{it}. $\alpha_i(\tau) \equiv \alpha_i + \delta_i q(\tau)$ is referred to as the scalar

coefficient indicating the quantile, τ fixed effects of an individual country, i. The individual fixed effects are time-invariant parameters whose homogenous impacts are allowed to differ across the quantiles of conditional distributions of the endogenous variable, Y. $q(\tau)$ is the $\tau - th$ sample quantile estimated by solving the following optimisation problem given as:

$$\min_{q} \sum_{i} \sum_{t} \rho_i(R_{it} - (\delta_i + Z_{it}^{'}\gamma)q) \tag{3}$$

where $\rho_\tau(A) = (\tau - 1)AI\{A \leq 0\} + TAI\{A > 0\}$ which denotes the check function. We estimated the quantile regression via an instrumental variable (moments) for different quantiles, 0.05th, 0.1th, 0.25th, 0.50th, 0.75th and 0.90th quantiles. In most cases, the lags of both dependent and independent variables are used as instruments.

Data sources and some stylised facts

This study uses the data of 14 MENA countries which covers the period from 1981 to 2019. The MENA countries were selected based on the availability of both dependent and independent variables. The main dependent variable is economic growth measured by real GDP and real GDP per capita. The main independent variables include military expenditure (absolute term) and military burden (percentage of GDP). We include other variables such as employment, capital stock, population growth, foreign direct investment and trade openness. As regards a priori expectations, both military expenditure and military burden could have positive or negative effects on economic growth based on theoretical arguments and findings from existing studies [28]. Employment and capital stock should have a positive effect on economic growth. Population growth, FDI and trade openness could have a positive or negative effect on economic growth. The sources and measurements of the variables are presented in Table 1.

Stylised facts

We present stylised facts about the variables of interest in this section. We compute the average of the variables for each country and plot bar charts. Figure 1 shows the average military expenditure (USD) for 14 MENA countries. Figure 2 denotes the average military burden. Figures 3 and 4 show average real GDP and real GDP per

Table 1 Variables, units of measurement and sources *Source*: Compiled by the authors

Variables	Units of measurement	Sources
Real GDP	Billion USD	WDI (2020)
Real GDP per capita	1′000 USD	WDI (2020)
Military expenditure	Million USD	SIPRI
Military burden	Percentage of GDP	SIPRI
Employment	Million	Penn World Table 10
Capital stock	Million USD	Penn World Table 10
Population growth	Percentage	WDI (2020)
Foreign direct investment	Percentage of GDP	WDI (2020)
Trade openness	Percentage of GDP	WDI (2020) version

SIPRI Stockholm International Peace Research Institute. *WDI* World development Indicators

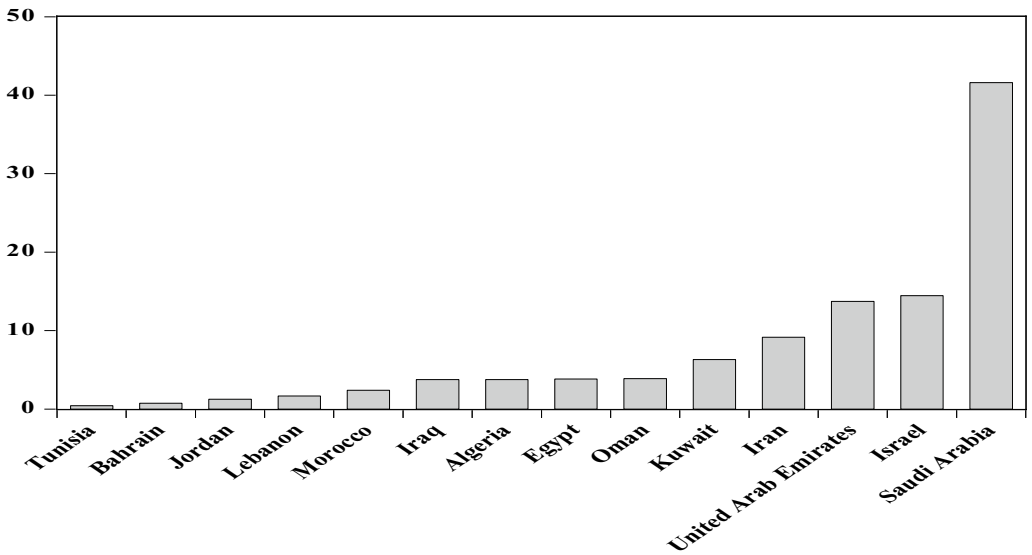

Fig. 1 Military spending in selected MENA countries (B'USD)

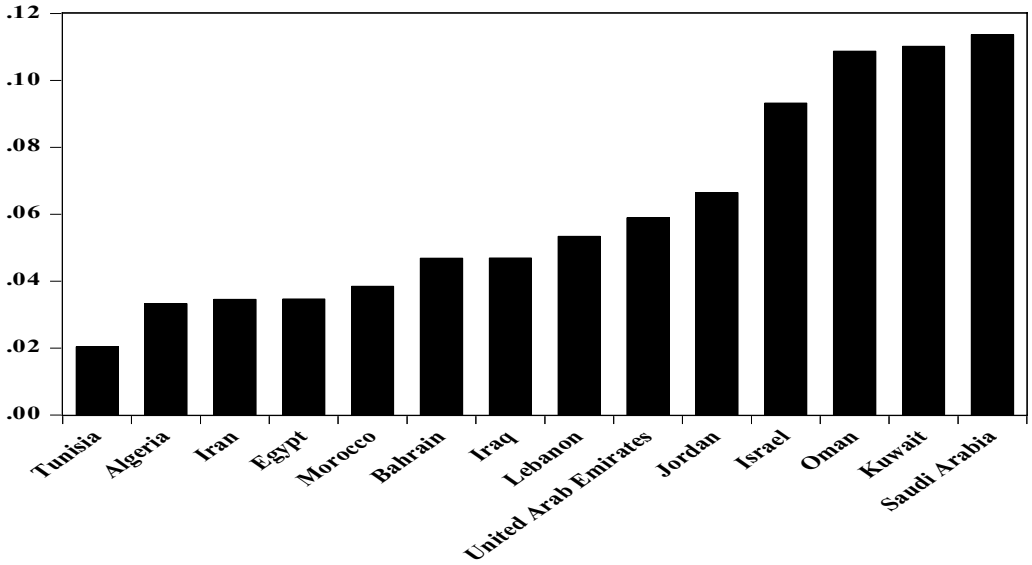

Fig. 2 Military spending in selected MENA countries (% of GDP)

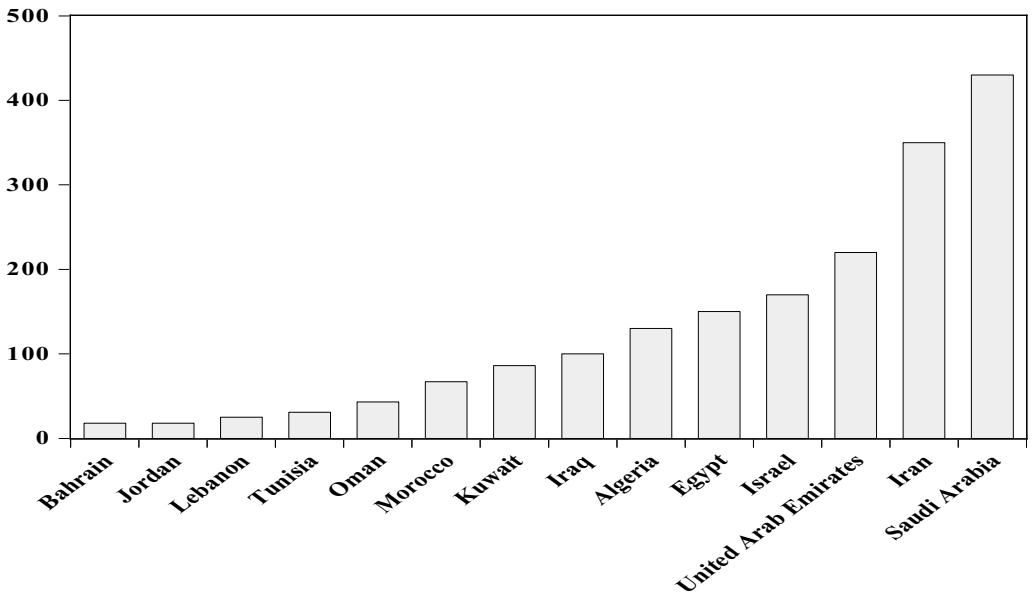

Fig. 3 Real GDP in selected MENA countries (B'USD)

capita, respectively. As shown in Fig. 1, Saudi Arabia is the highest military spender among the 14 MENA countries. Israel is the second-highest military spender, followed by United Arab Emirates (UAE), Iran, Kuwait, Oman, Egypt, Algeria, Iraq, Morocco, Lebanon, Jordan, Bahrain and Tunisia, respectively. In terms of military burden as shown in Fig. 2, Kuwait has the second military burden after Saudi Arabia. Oman occupies the third position while Israel takes the fourth position. Jordan, UAE, Lebanon, Iraq, Bahrain and Morocco are fifth, sixth, seventh, eighth, ninth and tenth, respectively. Tunisia has the least military burden.

As shown in Fig. 3, Saudi Arabia, on average, is the largest economy among the selected MENA countries, followed by Iran, UAE, Israel, Egypt, Algeria, Iraq, Kuwait, Morocco and Oman in succession. Bahrain is the lowest economy. UAE has the highest per capita income, followed by Kuwait, Israel, Bahrain, Saudi Arabia, Oman and Lebanon in succession. Among the countries, Egypt has the least per capita income (see Fig. 4).

Figure 5 shows the scatter plot of military expenditure (USD) and real GDP. Figure 6 depicts the scatter plot of military burden and real GDP. Figure 7 shows the scatter plot of military expenditure and real GDP per capita. Figure 8 describes the relationship between military burden and real GDP per capita. As shown from all the figures, there is a positive relationship between military spending and economic growth, albeit the degree of the relationship varies across the countries.

Empirical findings and discussions

This section presents the empirical findings. The findings are divided into two, namely the preliminary findings and the main findings. The preliminary findings consist of descriptive statistics, correlation analysis, unit root tests, causality tests as well as cross-sectional dependence tests. The main findings are the results of quantile regression which show the effect of military spending on the distribution of economic growth at different quantiles. The results are presented one after the other.

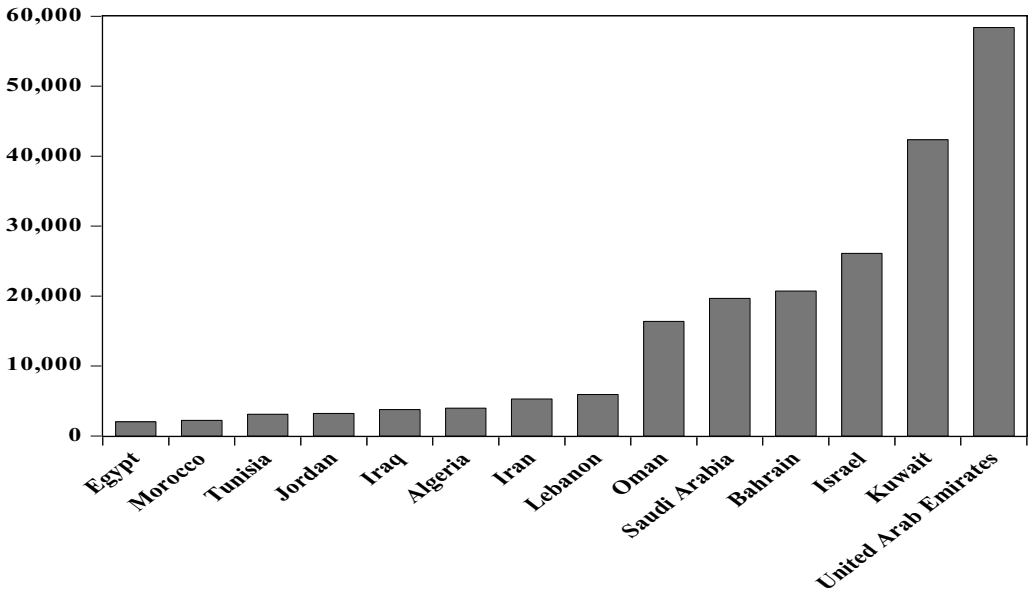

Fig. 4 Real GDP per capita in selected MENA countries (USD)

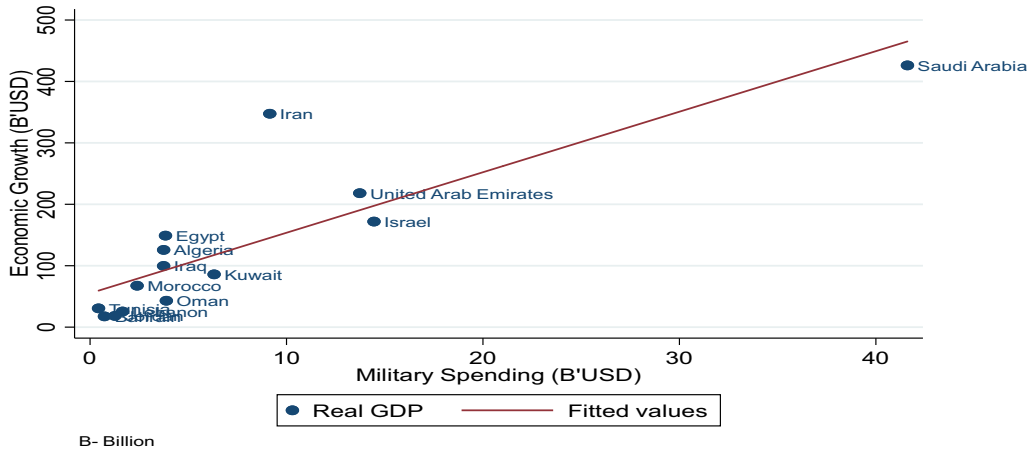

Fig. 5 Real GDP and military spending in selected MENA countries

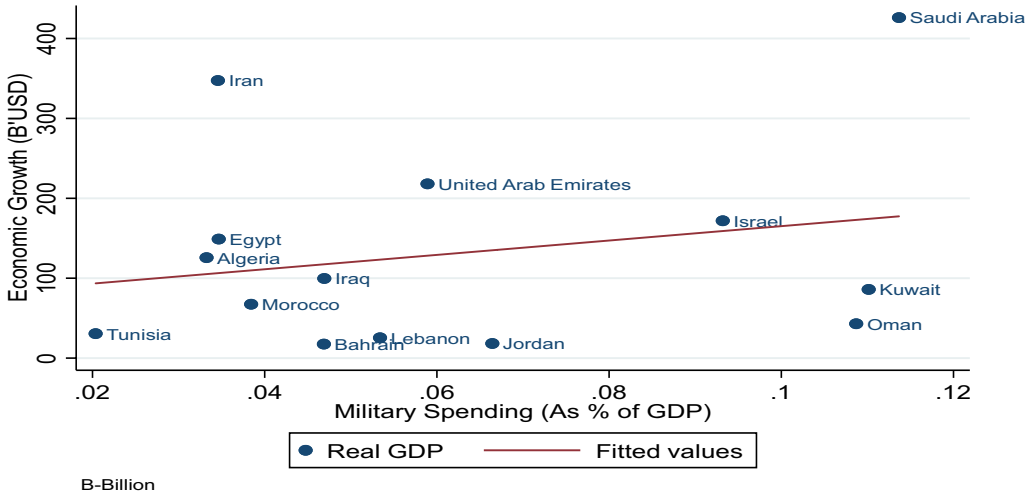

Fig. 6 Real GDP and military burden in selected MENA countries

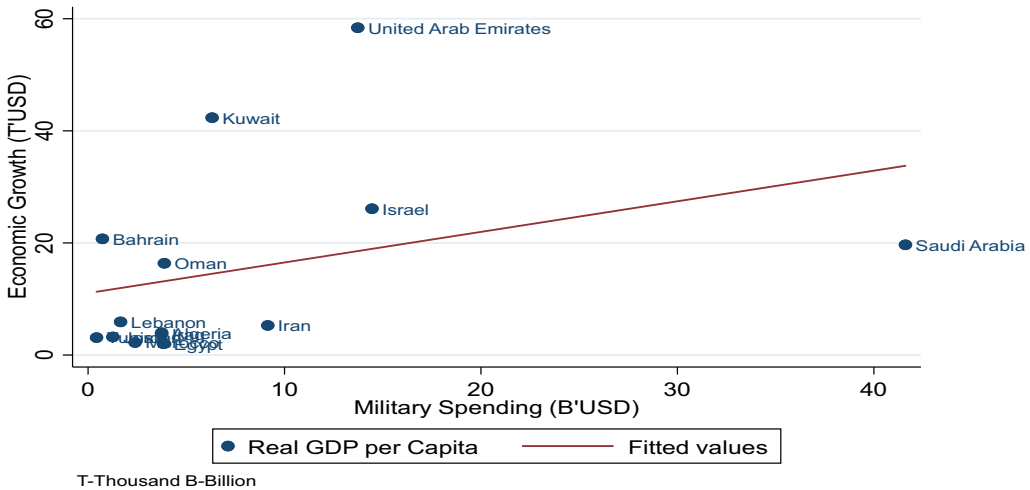

Fig. 7 Real GDP per capita and military spending in selected MENA countries

Preliminary results

Descriptive statistics

As shown in Table 2, the selected MENA countries have an average real GDP of 130.00 billion USD with minimum and maximum values of real GDP of 6.70 billion USD and 700.00 billion USD, respectively. Real GDP per capita, on average, stands at 15,222.54 USD. This shows that some of the MENA countries are among the countries with high income per capita. However, some MENA countries still fall among the low-income countries as shown by the minimum value of real GDP per capita which stands at 1,154.740 USD. The highest income per capita in the selected MENA countries stands at 113,095.00 USD. The average real military expenditure in the region is 7,638.92 USD. The average military burden, however, is 0.06% which ranges from 0.01% to 1.173%. The average employment is 5.5 million. However, the maximum employment is 27 million. Real capital stock employed, on average, is 1.14 million USD. Population grows at an average of 2.88% per annum, a kind of moderate population growth. The average FDI per GDP received during the period under consideration is 2.13% while the maximum FDI per GDP received is 15.18%, signifying that MENA countries are among the recipients of FDI in the world. MENA countries are relatively small open economies with an average trade openness of 82.93%. Most of the variables are moderately dispersed from their means as shown by standard deviation results. All the variables are positively skewed. As regards the kurtosis, all the variables are more heavily tailed than a normal distribution.

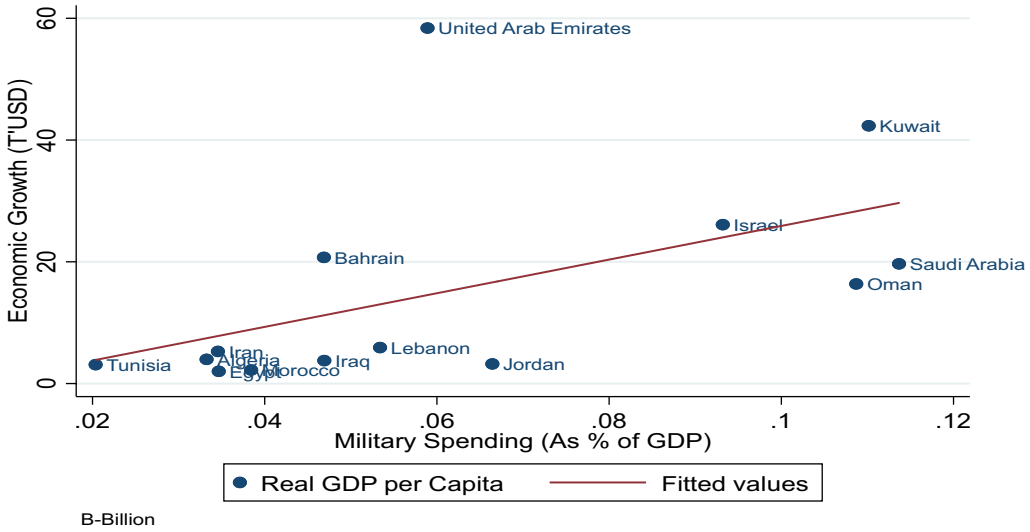

Fig. 8 Real GDP per capita and military burden in selected MENA countries

Table 2 Descriptive statistics results

Variables	Obs.	Mean	Std. dev	Min.	Max.	p1	p99	Skew	Kurt
RGDP	546	130.445	139.027	6.700	700.000	7.200	650.000	1.734	5.927
RGDPPCP	546	15,222.54	17,435.490	1154.740	113,095	1363.27	68,780.600	1.882	7.155
MIL	546	7638.915	11,956.14	192.024	90,409.2	252.536	64,698.3	3.495	17.956
MIL_GDP	546	0.061	0.064	0.011	1.173	0.013	0.184	10.658	176.072
EMPL	546	5.462	5.980	0.127	26.795	0.150	24.648	1.586	4.942
POPGR	546	2.880	1.974	−3.365	15.177	0.093	9.174	1.667	10.202
CAPSTK	546	1,140,000	1,440,000	54,696.2	7,100,000	71,012.8	6,700,000	2.166	7.513
FDI	546	2.131	3.389	−5.288	33.566	−2.574	15.325	3.299	21.775
FROPEN	546	82.928	37.609	0.021	251.139	3.791	190.33	0.933	4.364

RGDP, RGDPPCP, MIL, MIL_GDP, EMPL, POPGR, CAPSTK, FDI and TROPEN denote real gross domestic product (M'USD), real gross domestic product per capita (M'USD), military expenditure (M'USD), military burden, employment (M), population growth (%), capital stock at a constant price, 2017 (M'USD), foreign direct investment (%) and trade openness (%), respectively

Correlation analysis

Table 3 presents the results of the correlation analysis. Correlation analysis is conducted for two main cogent reasons. First, it is to know the strength of the relationship between or among the variables of interest. Second, it is to detect the presence of multicollinearity among the regressors. Our results show that military expenditure is positively and significantly correlated with real GDP. However, the military burden is negatively correlated with real GDP, albeit the negative correlation is not statistically significant. Both military expenditure and military burden are positively and significantly correlated with real GDP per capita. Employment is positively correlated with real GDP; however, it is negatively correlated with real GDP per capita. On the other hand, capital stock is positively and significantly correlated with real GDP and real GDP per capita. Population growth is negatively correlated with real GDP but positively correlated with real GDP per capita. Trade openness and FDI follow the same pattern of correlation with real GDP and real GDP per capita. Among the regressors, the correlations are moderate, implying that there is no problem of multicollinearity.

Unit root tests

Table 4 displays the results of the unit root tests. As shown in the table, irrespective of the unit root method deployed, there is a mixture of integration of orders 0 and 1. To be precise, military burden (MIL_GDP), FDI, POPGR and TROPEN are stationary at level. In other words, these variables are integrated of order 0. However, real GDP, real GDP per capita, military expenditure and capital stock are stationary after the first difference which implies that these

Table 3 Correlation analysis results

Variables	RGDP	RGDPPCP	MIL	MIL_GDP	EMPL	POPGR	CAPSTK	FDI	TROPEN
RGDP	1								
RGDPPCP	0.243*	1							
MIL	0.840*	0.467*	1						
MIL_GDP	−0.041	0.468*	0.458*	1					
EMPL	0.734*	−0.461*	0.433*	−0.382*	1				
POPGR	−0.047	0.378*	0.076	0.170*	−0.309*	1			
CAPSTK	0.924*	0.159*	0.727*	−0.128*	0.720*	−0.038	1		
FDI	−0.205*	0.003	−0.167*	−0.059	−0.175*	0.048	−0.173*	1	
TROPEN	−0.215*	0.251*	−0.137*	0.071	−0.343*	0.104*	−0.239*	0.224*	1

*Shows significance at the 0.05 level

RGDP, RGDPPCP, MIL, MIL_GDP, EMPL, POPGR, CAPSTK, FDI and TROPEN denote real gross domestic product (M'USD), real gross domestic product per capita (M'USD), military expenditure (M'USD), military burden, employment (M), population growth (%), capital stock at a constant price, 2017 (M'USD), foreign direct investment (%) and trade openness (%), respectively

variables are integrated of order one. Thus, we have a mixture of integration of orders 0 and 1.

Cointegration test

The results of the cointegration test are presented in Table 5. It is obvious that of all three t-tests presented by the Pedroni cointegration test, only modified Phillips–Perron t is statistically significant across the models. Phillips–Perron t is only significant at 5% and 10% in Model 1 and Model 3, respectively. ADF t shows that there is no cointegration. However, all of the t-tests of Kao's cointegration test based on Dickey–Fuller reveal that all the variables in all the models are cointegrated. This connotes that all the variables have a long-run relationship in all the models.

Cross-sectional dependence test results

It is not uncommon in the panel analysis to see that countries that share similar characteristics or belong to the same regional block respond similarly to common shocks. In this case, we say that the countries are cross-sectional dependent. Modelling economic relations in panel data without examining whether the countries exhibit this characteristic could result in underestimation of the panel coefficients [64]. The results of the three tests are presented in Table 6. As shown in the table, we reject the null hypothesis of no cross-sectional dependence based on Frees and Friedman cross-sectional dependence tests in all of the models. However, based on Pesaran cross-sectional dependence test, we can only reject the null hypothesis of cross-sectional independence only in Model 4.

Causality test

To obtain more information about the relation between military spending and economic growth, we conduct a bivariate causality test using two methods, namely the panel VAR Granger causality and Dumitrescu and Hurlin [26] Granger non-causality test. Before we perform the panel VAR Granger causality test, it is important to know the optimal lag order for the models. In other words, it is important to select an appropriate optimal lag length for the estimation of panel VAR Granger causality. We select the lag order based on the moment and model selection criteria (MMSC) developed by Andrew and Lu [4]. Three statistic criteria are provided by Andrew and Lu (AL), and they include modified Bayesian information criterion (MBIC), modified Akaike information criterion (MAIC) and modified Quinn information criterion (MQIC). However, the AL criteria are based on Hansen [42] J-statistical test for over-identifying restrictions. Based on the coefficient of determination, the optimal lag length that minimises the three aforementioned criteria is the right lag length to be used for conducting the panel VAR Granger causality test. We conduct the lag order selection test; however, its results are not presented here. It must, however, be stated that the optimal lag lengths we select vary across our four models. Specifically, the selected optimal lag lengths range from 1 to 2. These same optimal lag lengths are used for the estimation of the Dumitrescu and Hurlin Granger (DH) non-causality test. The p-value of the DH test is computed using 500 bootstrap replications. Although both causality estimation methods assume the absence of causality between two or more variables, they are quite different in some aspects. Panel VAR causality just establishes the direction of causality between two variables without taking into consideration the heterogeneous characteristics of and cross-sectional dependence among the panel of countries. The DH causality test captures both heterogeneity and cross-sectional dependence among the panel data.

The results of the two causality tests are presented in Table 7. The results appear to be mixed but related in some ways. For instance, both estimation methods established a unidirectional causality that runs from economic

Table 4 Unit root test results

	IPS		LLC		BREITUNG		FISHER		HADRI		HT	
Variables	**Level**	**1st Diff**	**Level**	**1st Diff**	**Level**	**1st Diff**	**Level**	**1st Diff**	**Level**	**1st Diff**	**Level**	**1st Diff**
RGDP	−0.828	−5.786***	−2.066**	−7.692***	11.413	−5.445***	3.414	−11.532***	87.737***	−0.456	2.765	−47.822***
RGDPPCP	−1.709	−5.517***	−1.045	−7.002***	5.890	−5.650***	−0.060	−10.603***	68.289***	−0.1700	−0.735	−47.179***
MIL	−0.772	−5.973***	1.250	−11.320***	2.649	−8.995***	2.684	−14.057***	67.496***	−1.291	1.144	−41.405***
MIL_GDP	−1.826*	−6.253***	−3.100***	−11.229***	1.216	−9.269***	−2.394***	−13.789***	46.877***	−1.686	−3.230***	−41.829***
EMPL	−0.940	−3.667***	−3.576***	−5.617***	14.610	−7.481***	1.651	−7.180***	89.082***	3.889***	3.301	−18.697***
POPGR	−1.798	−2.091**	−13.222***	−15.086***	2.704	−2.903***	−16.774***	−16.283***	13.261***	0.768	−0.499	−14.163***
CAPSTK	−0.207	−2.840***	2.918	−3.349***	17.522	−0.928	7.170	−5.764***	87.773***	18.176***	3.579	−10.230***
FDI	−2.998***	−7.938***	−4.259***	−11.551***	−6.625***	−12.335***	−4.561***	−15.484***	19.446***	−3.329	−17.733***	−56.767***
TROPEN	−2.502***	−5.358***	−3.480***	−11.034***	0.913	−6.943***	−3.425***	−13.273***	18.329***	−2.047	−5.552***	−36.105***

***, ** and * represent 1%, 5% and 10%, respectively

RGDP, RGDPPCP, MIL, MIL_GDP, EMPL, POPGR, CAPSTK, FDI and TROPEN denote real gross domestic product (M'USD), real gross domestic product per capita (M'USD), military expenditure (M'USD), military burden, employment (M), population growth (%), capital stock at a constant price, 2017 (M'USD), foreign direct investment (%) and trade openness (%), respectively

Table 5 Cointegration test

Test	Statistics	Model 1	Model 2	Model 3	Model 4
Pedroni cointegration test	Modified Phillips–Perron t	2.395*** (0.008)	3.013*** (0.001)	2.354*** (0.009)	2.796*** (0.003)
	Phillips–Perron t	− 1.884** (0.030)	− 1.084 (0.139)	− 1.564* (0.059)	− 1.131 (0.1291)
	Augmented Dickey–Fuller t	− 0.340 (0.367)	0.834 (0.202)	0.0014 (0.500)	0.739 (0.300)
Kao cointegration test	Modified Dickey–Fuller t	− 4.484*** (0.000)	− 4.668*** (0.000)	− 5.581*** (0.000)	− 4.287*** (0.000)
	Dickey–Fuller t	− 3.215*** (0.001)	− 3.240*** (0.001)	− 4.051*** (0.000)	− 3.306*** (0.001)
	Augmented Dickey–Fuller t	− 1.896** (0.029)	− 2.194** (0.014)	− 2.377*** (0.009)	− 2.069 *** (0.019)
	Unadjusted modified Dickey–Fuller t	− 4.229*** (0.000)	− 4.308*** (0.000)	− 5.122*** (0.000)	− 3.765*** (0.000)
	Unadjusted Dickey–Fuller t	− 3.133*** (0.001)	− 3.127*** (0.000)	− 3.926 *** (0.000)	− 3.137*** (0.001)

***, ** and * represent 1%, 5% and 10%, respectively. Model 1: effect of military expenditure (in absolute value) on real GDP. Model 2: effect of military burden (% of GDP) on real GDP. Model 3: effect of military expenditure (in absolute value) on real GDP per capita. Model 4: effect of military burden (% of GDP) on real GDP per capita

Table 6 Cross-sectional dependence test

Test	Model 1	Model 2	Model 3	Model 4
Frees	2.104*** (0.000)	2.645*** (0.000)	2.244*** (0.000)	3.225*** (0.000)
Friedman	42.221*** (0.000)	50.492*** (0.000)	53.804*** (0.000)	53.156*** (0.000)
Pesaran	0.401 (0.688)	1.570 (0.116)	1.334 (0.182)	2.453** (0.014)

***, ** and * represent 1%, 5% and 10%, respectively

Table 7 Causality test

Variable	Panel VAR Granger causality test	Dumitrescu & Hurlin [26] Granger non-causality test
MIL versus RGDP	1.726 (0.422)	3.946* (0.096)
RGDP versus MIL	11.631*** (0.003)	12.823*** (0.000)
MIL_GDP versus RGDP	4.035** (0.045)	0.622 (0.644)
RGDP versus MIL_GDP	0.167 (0.683)	2.104 (0.536)
MIL versus RGDPPCP	3.583 (0.167)	4.296 (0.108)
RGDPPCP versus MIL	13.197*** (0.001)	7.292 ** (0.020)
MIL_GDP versus RGDPPCP	1.702 (0.192)	5.948** (0.016)
RGDPPCP versus MIL_GDP	0.099 (0.753)	1.629 (0.592)

***, ** and * represent 1%, 5% and 10%, respectively. Note: RGDP, RGDPPCP, MIL and MIL_GDP denote real gross domestic product (M'USD), real gross domestic product per capita (M'USD), military expenditure (M'USD) and military burden, respectively

growth to military expenditure. This implies that military expenditure is dependent on economic growth. In other words, economic growth predicts military spending in MENA. However, in the case of causality between military burden and economic growth, only panel VAR Granger causality establishes a bivariate unidirectional causality that runs from military burden to economic growth. Thus, the military burden is detected to be exogenous to (or determining) economic growth. We conduct a robust analysis by using real GDP per capita as a measure of economic growth. Specifically, we find a unidirectional nexus that runs from GDP per capita to military expenditure in both causality test methods. In the case of military burden, only DH causality test results show a unidirectional causality that runs from military burden to GDP per capita. Our findings, therefore, confirm the fact in the extant studies that the causal effect of military spending depends on the measure of military spending and the causality estimation method deployed [14, 23], Ortiz, Alvardo and Salinas [60].

Main findings

The results of quantile regression are presented in this section. Two results are presented, namely the baseline results in which the effects of military expenditure and military burden on real GDP are examined. In the robustness, we investigate the influence of military expenditure and military burden on real GDP

per capita. We control for variables such as employment, capital stock, population growth, foreign direct investment and trade openness. Table 8 reports the quantile baseline results which show both conditional mean and distributional effects of military spending on economic growth captured by real GDP. Table 9 reports the results of robustness analysis which focuses on the conditional mean and distributional effects of military spending on economic growth captured by real GDP per capita.

Table 8 Method of moments quantile regression baseline results dependent variable: real gdp (rgdp)

Model 1	Location	Scale	Quantiles					
			0.05	0.10	0.25	0.50	0.75	0.90
MIL	0.296***	0.040**	0.217	0.255***	0.290***	0.318***	0.338***	0.355***
EMPL	0.367***	−0.008	0.382*	0.375***	0.368***	0.363***	0.359***	0.355***
CAPSTK	0.313***	−0.107***	0.524***	0.421***	0.331***	0.255***	0.203***	0.158**
POPGR	−0.028	0.081***	−0.189**	−0.111*	−0.041	0.016	0.056***	0.090***
FDI	−0.223***	0.094***	−0.408***	−0.318***	−0.239***	−0.173***	−0.127***	−0.087***
TROPEN	0.048	0.061**	−0.073	−0.014	0.038*	0.081***	0.111***	0.137***
CONS			16.048***	17.015***	17.873***	18.582***	19.077***	19.503***
Model 2								
MIL_GDP	0.407***	0.082**	0.259***	0.284***	0.325***	0.405***	0.468***	0.551***
EMPL	0.386***	0.073***	0.254***	0.276***	0.313***	0.384***	0.440***	0.514***
CAPSTK	0.572***	−0.124***	0.795***	0.757***	0.695***	0.576***	0.481***	0.355***
POPGR	0.037***	0.005	0.027	0.029	0.032**	0.037***	0.041***	0.046***
FDI	−0.024***	−0.013***	−0.001	−0.005	−0.011	−0.024***	−0.033***	−0.046***
TROPEN	0.032	0.017	0.002	0.007	0.015	0.031	0.045	0.062
CONS			14.350***	14.980***	16.018***	18.029***	19.620***	21.730***

***, ** and * represent 1%, 5% and 10%, respectively

RGDP, MIL, MIL_GDP, EMPL, POPGR, CAPSTK, FDI and TROPEN denote real gross domestic product (M'USD), military expenditure (M'USD), military burden, employment (M), population growth (%), capital stock at a constant price, 2017 (M'USD), foreign direct investment (%) and trade openness (%), respectively

Table 9 Method of moments quantile regression robustness results dependent variable: real GDP per capita (RGDPPCP)

Model 3	Location	Scale	Quantiles					
			0.05	0.10	0.25	0.50	0.75	0.90
MIL	0.467***	0.136***	0.234***	0.292***	0.349***	0.464***	0.558***	0.653***
EMPL	−0.997***	0.099***	−1.166***	−1.124***	−1.082***	−0.999***	−0.930***	−0.861***
CAPSTK	0.558***	−0.347***	1.151***	1.005***	0.858***	0.566***	0.326***	0.085
POPGR	0.029***	0.003*	0.024***	0.025***	0.027***	0.029***	0.031***	0.033***
FDI	−0.019***	−0.007**	−0.008	−0.011	−0.014	−0.019	−0.024*	−0.028*
TROPEN	0.257***	−0.139***	0.494***	0.435***	0.377***	0.260***	0.164**	0.068
CONS			−9.887***	−8.006***	−6.134***	−2.391***	0.687	3.769***
Model 4								
MIL_GDP	0.342******	−0.019	0.372***	0.367***	0.359***	0.343***	0.327***	0.307**
EMPL	−0.878***	−0.052	−0.793**	−0.807***	−0.828***	−0.873***	−0.918***	−0.972***
CAPSTK	0.909***	−0.063*	1.012***	0.996***	0.969***	0.915***	0.860***	0.793***
POPGR	0.039***	−0.014**	0.062	0.058	0.052	0.041*	0.029**	0.014
FDI	−0.024***	−0.020***	0.009	0.004	−0.004	−0.022**	−0.039***	−0.061***
TROPEN	0.252***	−0.106**	0.426	0.398*	0.353*	0.263**	0.170**	0.059
CONS			−5.238	−4.762	−4.008*	−2.446**	−0.861	1.064

***, ** and * represent 1%, 5% and 10%, respectively. Note: RGDPPCP, MIL, MIL_GDP, EMPL, POPGR, CAPSTK, FDI, TROPEN and CONS denote real gross domestic product per capita (M'USD), military expenditure (M'USD), military burden, employment (M), population growth (%), capital stock at a constant price, 2017 (M'USD), foreign direct investment (%), trade openness (%) and constant, respectively

Baseline results

As reported in Table 8, the first two rows show the location and scale effects' results which show the conditional mean positive effects of military expenditure and military burden on economic growth (Models 1 and 2). This means an increase in military expenditure and military burden by 1% would raise economic growth (real GDP) by 0.040% and 0.082%, respectively (scale effect). This implies that an upsurge in military spending leads to economic growth in MENA. Even though the literature is dominated by the negative impact of military spending on economic growth [28], some studies have documented some positive effects of military spending on economic growth ([71] Turkey, Lee and Chan, 2007-OECD and [72] India). Empirical findings from existing studies on the effects of military spending on economic growth in MENA appear to be mixed. For instance, recent studies by Ortiz, Alvarado and Ali [59] and Khalid and Razaq [50] find a positive effect of military spending on economic growth in MENA. However, Çetin and Güzel [13] established a negative relationship between military spending and economic growth in MENA. Thus, the findings obtained here are consistent with the findings of Ortiz, Alvarado and Ali [59] and Khalid and Razaq [50]. Apart from this, our findings are consistent with the Keynesian theory which sees military spending as a policy tool to stimulate the economy. Thus, according to military Keynesianism, the government raises military spending to boost the economy, especially during the period of economic crisis [20].

The next six rows show the quantile regression estimates via instrumental variable. In most cases, the lags of dependent and independent variables are used as instruments. Military expenditure enters with a positive effect on economic growth at a lower quantile of 0.05th. The positive effect is not statistically significant. From 0.10th quantile onwards, military expenditure has a positive and significant effect on economic growth, implying that there will be an increase in economic growth as a result of an increase in military spending. In specific terms, as the military spending increases, economic growth increases by 0.255%, 0.290%, 0.318%, 0.338% and 0.355%% at 0.10th quantile, 0.25th quantile, 0.50th quantile, 0.75th quantile and 0.90th quantile, respectively. The result remains unchanged when the effect of a military burden on economic growth is examined (Model 2). This suggests that irrespective of the measures of military spending employed (military spending in absolute dollar value or as a percentage of GDP), military spending is growth-enhancing in MENA. Thus, it implies that military spending is productive spending in MENA and not wasteful as argued in some studies such as Ortiz, Alvarado and Ali [59] and Khalid and Razaq [50].

Our findings could be justified on the ground of the sociopolitical situation in MENA. The region appears to be one of the most volatile regions in the world. It can be described as the hotspot of the world. Besides, most MENA countries are resource-endowed countries that often engage in sociopolitical and economic conflicts and sometimes in armed conflicts. The conflicts, in most cases, spring up from within the region and sometimes from outside the region. Several studies have associated arm conflicts with resource endowment (see [54] for a review of literature along this line). It is believed that conflicts arise, most of the time, because of the struggle over resources among the political gladiators or aggrieved factions. Thus, the increase in military spending to build up capability may be aimed to put internal conflict under control or ward off aggressive neighbouring countries in the same region. Apart from this, some MENA countries spend more on arms and ammunition to combat terrorism within their territories [59, 77]. Above all, most of the MENA countries increase military spending to douse internal tensions to create a conducive environment to lure investors into their respective countries. This is because internal crises and terrorism activities have detrimental effects on the economy of the region. Thus, military spending can be used to build up security to douse the tension and stimulate the economy. This is consistent with the Keynesian theory as previously mentioned.

Robustness results

We conduct a robustness analysis by using real GDP per capita as a measure of economic growth and then examine its response to a change in military spending over different quantiles. The results are reported in Table 9. The results obtained are robust to the baseline results in that military expenditure and military burden have conditional mean and distributional positive effects on real GDP per capita as shown by location effect, scale effect and quantile results, respectively. However, it can be observed that in the case of military burden, the positive effect reaches the maximum point at 0.50th quantile before the effect declines afterwards even though it is still positive and statistically significant (see Fig. 12). This means that irrespective of measures of economic growth and military spending, the relationship between military spending and economy is ditto, suggesting the importance of military spending to the economy of the region.

Interpretation of other control variables

Apart from military spending, we used control variables such as employment, capital stock, population growth, foreign direct investment and trade openness. Table 8 shows that employment, capital stock and trade openness have significant positive effects on economic growth. However, the positive effect of trade openness is not statistically significant. Precisely, an increase in employment and capital

stock by 1% would lead to an increase in economic growth by 0.367% and 0.313%, respectively. Population growth and foreign direct investment negatively influence economic growth but only the foreign direct investment is significant. Therefore, an increase in FDI by 1% can result in a decline in economic growth by 0.223% (location effect).

As regards the quantile regression results of control variables as reported in Table 8 (Model 1), we find that both employment and capital stock enter with positive and significant effects on economic growth at a lower quantile (0.05th) reaching the maximum at 0.10th quantile before it declines afterwards. However, the positive effects continue to the upper quantiles. Population growth has a negative significant effect on economic growth at lower quantiles (0.05th and 0.10th) with the negative effects fading away at the middle quantile and then turning to a significant positive effect at the upper quantiles (0.75th and 0.90th). FDI exhibits a significant negative effect on economic growth throughout the quantiles. Trade openness, on the other hand, enters with an insignificant negative impact on economic growth at a lower quantile (0.05th and 0.10th). However, it begins to have a positive effect on economic growth at 0.25th quantile and the positive effect continues throughout the rest of the quantiles. The centrality of the message here is that some sort of additional information that is useful to the policymakers can be obtained from economic relations when quantile regression is used for conducting research. For instance, population growth can be detrimental to economic growth in the short run, but it can be growth-enhancing in the long run if properly harnessed.

Discussion of the results

This study's focus is on the effect of military spending on the distribution of economic growth in MENA at different quantiles. While existing studies on MENA have focused on the estimation of conditional mean effect of military spending on economic growth using different estimation techniques, none of them has examined how military spending affects the distribution of economic growth over time ([13, 50], Ortiz, Alvarado and Ali [59]). The outcomes of such studies may have little input into policy formulation or planning as regards military spending and how it affects the economy over time. Thus, to capture how military spending affects the distribution of economic growth at different quantiles, we employ a novel quantile regression developed by Machado and Silver in [57]. The quantile regression is called a quantile regression via moments. The difference between Machado and Silva's quantile regression from the existing quantile regressions is that it captures both the conditional mean effect of military spending on economic growth through the fixed effects and distributional effects. The method also captures both heterogeneity and endogeneity characterising panel studies. Thus, the findings from using this quantile regression can provide some critical input into the formulation and implementation of policies regarding the expenditure on military ammunition and welfare and the extent to which such expenditure affects the economy. To estimate, we take the natural logarithm of most of our variables except population growth which is already expressed in growth rate form. As the instruments, we use the lags of dependent variables and independent variables. These instruments prove to be efficient because we do not have the problem of over-identification [5].

Using this method, we find some interesting results irrespective of the measures of military spending and economic growth. Our results show that military expenditure is a productive expenditure in MENA as it leads to increased economic growth over time. In other words, both at the lower and upper quantiles, military spending has a positive effect on economic growth in the region. The continuous positive effect of military spending on the economy of MENA countries may be contrary to some empirical findings in other studies. In the literature review by Dune and Tian [28], it is evident that the negative effect of military spending on economic growth is more prominent in the literature than the positive effect. The results, particularly of the negative effect of military spending, are usually rationalised by the fact that an increase in military spending symbolises a diversion of government expenditure away from investment in other aspects of the economy such as education and health that can have direct impacts on the economy. Hence, military spending may have a long-term unfavourable effect on the economy ([70]; [8]). This, notwithstanding, the effect of military spending on the economy can depend on the political or economic situation of a particular country or region. Some authors have argued that during political or economic crises such as recession and war military spending could have a positive effect on the economy because it can be used as an economic or political stabiliser [45]. This is even evident in the case of MENA countries characterised by political upheavals. The region of MENA is one of the most volatile regions in the world. Apart from this, most MENA countries are blessed with mineral resources. Who then controls these mineral resources, in most cases, often leads to sociopolitical conflict, economic conflict as well as armed conflicts. The conflict may originate from within the region or engineered by outsiders. Hence, some studies have associated armed conflicts with resource endowment in several countries including MENA countries (see [54] for a review of literature in this regard). Thus, the governments of the countries in the region may increase their military spending to build

up arm capability aimed at putting internal conflict under control or warding off aggressive neighbouring countries. Aside from this, some MENA countries spend more on arms and ammunition to combat terrorism within their territories [59, 77]. Above all, most of the MENA countries increase military spending to douse internal tensions to create a conducive environment to lure investors into their respective countries. This could guarantee a continuous investment that could boost economic growth in the region. Consequently, most of the studies on MENA found a positive effect on economic growth in MENA irrespective of the methodological approaches adopted by the researchers (see Ortiz, Alvarado and Ali [59] and [50]). Within these studies, our empirical finding is situated even though we use different estimation techniques.

Despite this, our study is limited in terms of the scope it covers. We literarily cover the effect of military spending on the distribution of economic growth at different quantiles. We do not, therefore, examine the factors, particularly the institutional factors (formal and informal) that could affect the distributional effect of military spending on the economy of MENA. Hence, future studies should consider these factors as they have a long way in determining the relationship between military spending and economic growth over time.

Conclusion and policy implications

This study explores the effect of military spending on the distribution of economic growth in 14 MENA countries using a newly developed quantile regression via moments by Machado and Silva [57]. We measure military spending using military expenditure in dollar value and as a percentage of GDP. Economic growth is proxied by real GPD and real GDP per capita. Based on augmented Solow growth model applied by Dunne [27], we control for other variables such as employment, capital stock, population growth, FDI and trade openness. A series of preliminary tests are also carried out which include a correlation test, unit root tests, cross-sectional dependence test, cointegration test and causality test.

Our results show some degrees of cross-sectional dependence exist among MENA countries. This show that events, either political, social or economic events, that break out in one of the countries can affect or spill over to other countries in the region. Or rather an external shock that hits one of the countries in the region can spread to the others. We also find that the variables are cointegrated which suggests the existence of a long-run relationship among the variables. In the case of causality test results, our findings reveal that even though, in most cases, there is a unidirectional causality that runs from economic growth to military spending, the overall direction of causality still depends on the measures of military spending and economic growth as well as estimation techniques employed. For the main finding, it is evident that military spending does not only have a conditional mean effect on economic growth but also a conditional distribution effect at all quantiles irrespective of the measures of military spending and economic growth. The effect is progressive in the sense that, it is low at lower quantiles and increases progressively towards the upper quantiles (see Figs. 9, 10, 11, 12). This shows that military spending is productive and growth-enhancing in MENA.

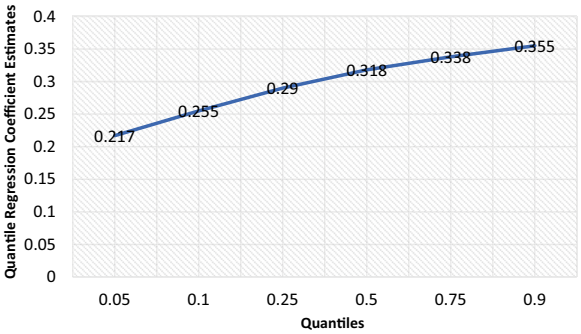

Fig. 9 Plot of coefficients of quantile regression for MIL and RGDP nexus

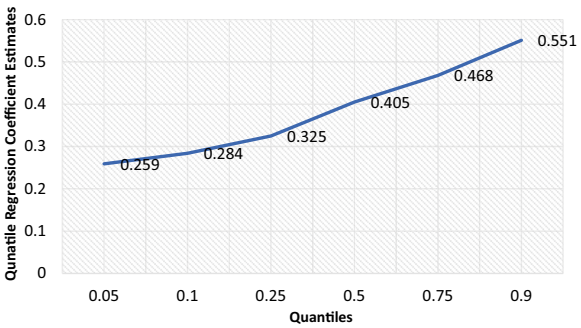

Fig. 10 Plot of coefficients of quantile regression for MIL_GDP and RGDP nexus

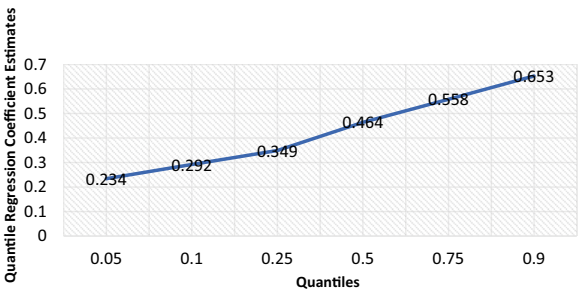

Fig. 11 Plot of coefficients of quantile regression for MIL and RGDPPCP nexus

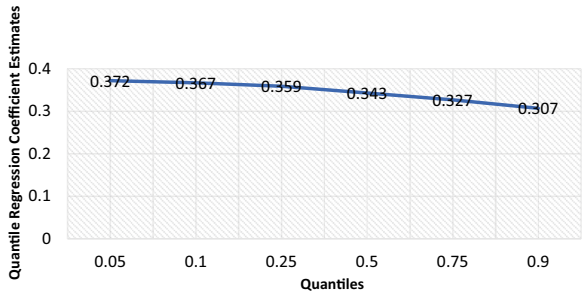

Fig. 12 Plot of coefficients of quantile regression for MIL_GDP and RGDPPCP nexus

Given our findings, the policy implication of our study is that spending more on the military is helpful to the economy of the region considering its volatility in terms of security. Since a peaceful environment is a prerequisite for investment and growth, increasing military spending to secure the region remains an invaluable option.

Appendix

The selected MENA countries include Algeria, Bahrain, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Morocco, Oman, Saudi Arabia, Tunisia and United Arab Emirates

See Table 10 and Figs.13, 14, 15.

Table 10 Full meaning of abbreviated world *Source*: Compiled by the Authors

Abbreviation	Full meaning
ARDL	Autoregressive distributed lag method
ECM	Error correction method
FDI	Foreign direct investment
GDP	Gross domestic product
MAIC	Modified Akaike information criterion
MBIC	Modified Bayesian information criterion
MENA	Middle East and North Africa
MM-QR	Method of moments quantile regression
MQIC	Modified Quinn information criterion
VAR	Vector autoregressive
UAE	United Arab Emirates

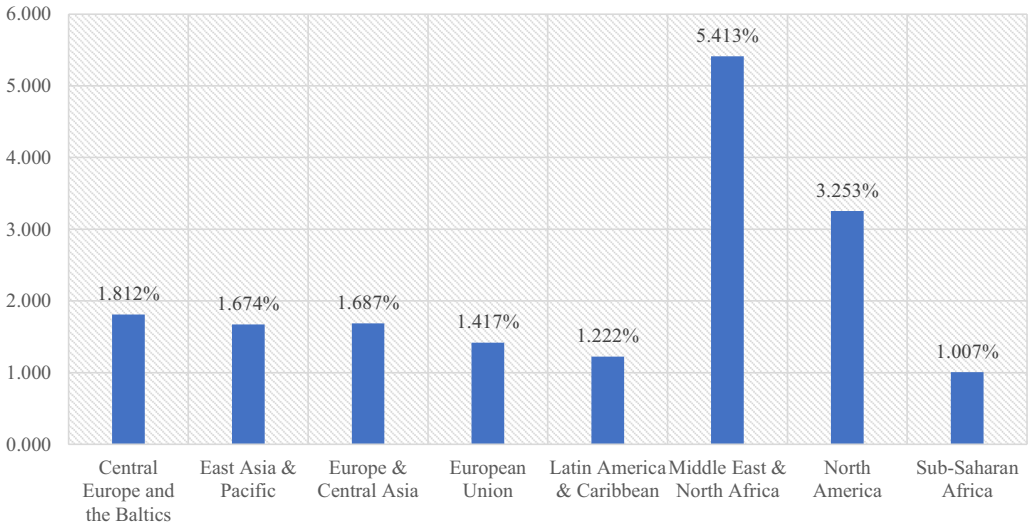

Fig. 13 Military expenditure as a percentage of GDP (%)

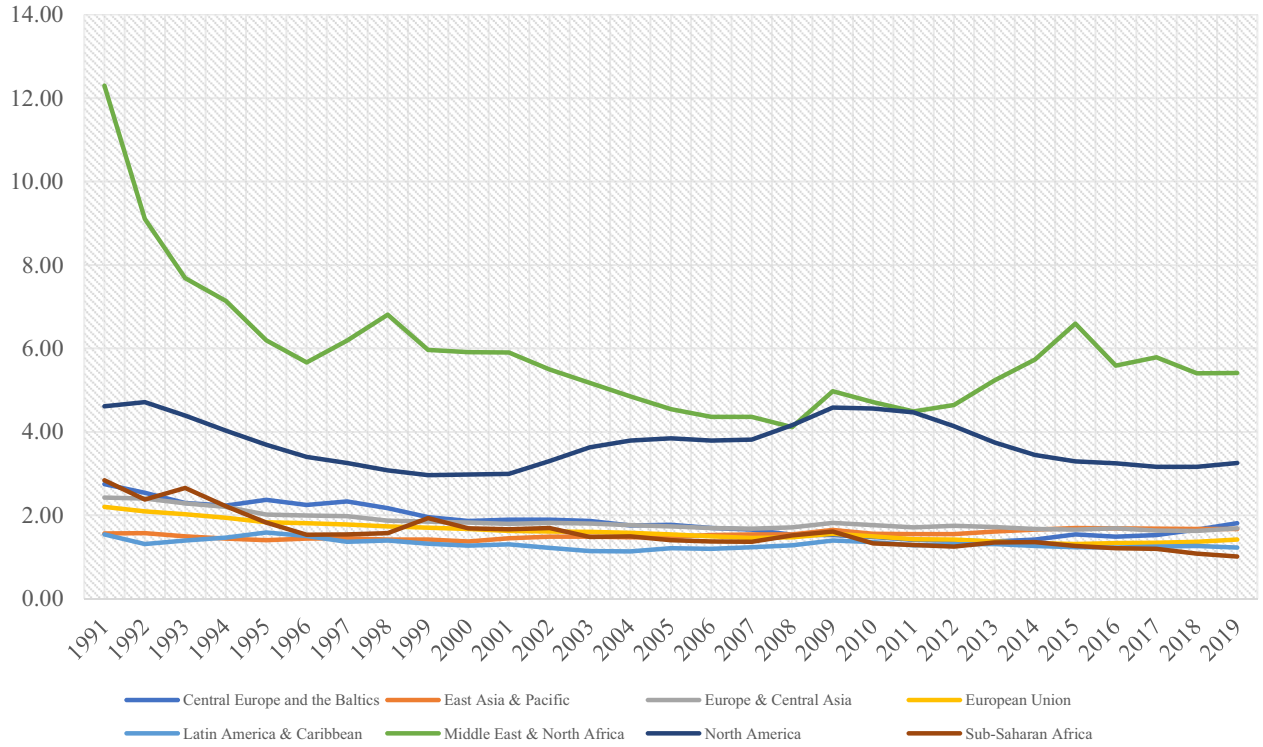

Fig. 14 Trend of regional military expenditure (1991–2019)

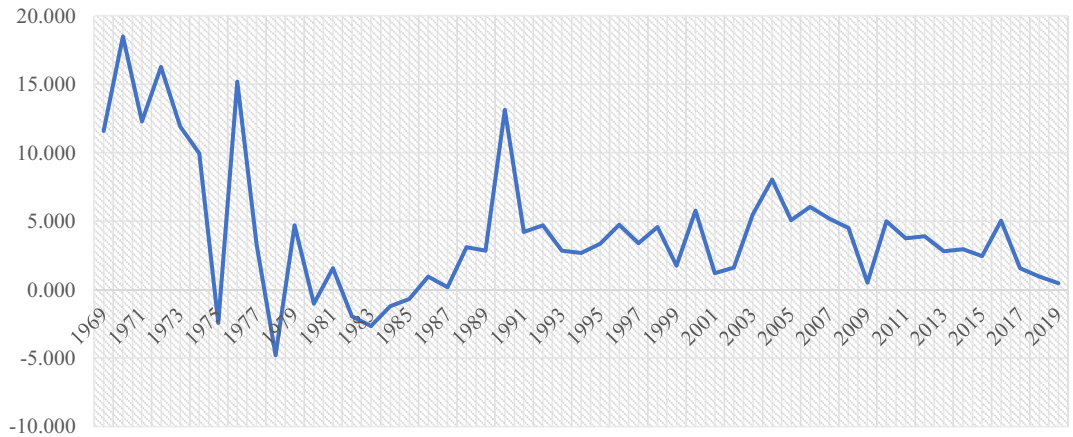

Fig. 15 Trend of GDP growth rate in MENA (%)

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Author contributions
IAR conceptualised the idea and contributed significantly the writing. AA made significant improvement to the writing through reading and editing. Both authors read and approved the final manuscript.

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Availability of data and materials
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Declarations

Ethics approval and consent to participate
All authors agreed to participate.

Consent for publication
All authors consented to the publication of this manuscript.

Competing interests
There is no conflict of interest.

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