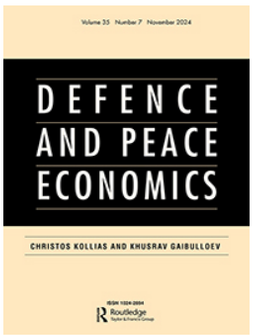

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Redefining the Nexus of Military Spending Among Southeast Mediterranean Countries in the Presence of Nonlinearities

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ABSTRACT

The paper presents evidence on the relationship concerning military spending among Southeast Mediterranean countries (Greece – Turkey, Israel – Egypt, Israel – Turkey) over the period 1962–2020. We account for the presence of nonlinearities in the bilateral relationships of defence spending by applying Threshold Autoregressive methodologies and utilize kink regression analysis to detect the existence of a country's military spending threshold that signals a threat to another country of the region. Our empirical results show: First, there is a nonlinear strategic interaction between the countries examined, in the sense that their defence spending policy is cointegrated. Second, there is no arms race among the countries examined, but only unilateral effects. Third, there is consistent evidence of a possible military spending equilibrium, in the absence of friction between the countries involved (peace threshold). Our findings have important policy implications as they indicate, first, that each country in the region should not determine its level of military spending considering only operational factors, but also considering the signaling of its military spending on its neighboring countries and, second, that there is space for peaceful solutions regarding disputes in the Southeast Mediterranean region.

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Introduction

Over the last years, many events have prompted increased military spending (Yalta and Tüzün 2021) and as a result, there is increased interest in examining the military expenditures nexus among countries. Military spending is an important factor that affects the security of a country's stance at the international level, its growth path as it secures economic stability, whereas at the same time may explain an arms race between neighboring countries. Further, military expenditure is import demanding implying increasing borrowing from the international markets (Stavrinos and Zombanakis 1998) and it interacts with growth (Emmanouilidis and Karpetis 2020), thus affecting the foundations of each economy.

In such a framework, various studies have examined the nexus between defence spending and economic growth (e.g. Bragoudakis and Zombanakis 2017; Chen, Lee, and Chiu 2014; DeRouen 2000; Dunne, Nikolaiodu, and Voguas 2001; Karagol and Palaz 2004; Sezgin 2001; Yildirim and Sezgin 2002; Yildirim, Sezgin, and Öcal 2005; Zhong et al. 2017), military spending (MS) among countries to estimate the existence of an arms race between countries and regions (e.g. Amir-Ud-Din, Waqi Sajjad,

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*The views expressed are those of the authors and not those of their respective institutions.

and Aziz 2020; Andreou and Zombanakis 2011; Brauer 2002; Choulis, Mehrl, and Ifantis 2021; Kollias and Paleologou 2002; Yalta and Tüzün 2021) and the demand for military spending (e.g. Kollias, Paleologou, and Stergiou 2016). Recent research has focused attention on the nexus between defence spending and geopolitical risk and claims strong interrelation of defence spending with geopolitical tensions (e.g. Khan, Su, and Rizvi 2022).

Recently, Saba (2021) suggests that the defence spending of G7, OECD and NATO is characterized by major differences and the members of the three organizations are found to engage in military races. Tan (2013) states that the arms race in the region of Asia can be distinguished into three main categories, namely external factors (e.g. power rivalries, territorial disputes), internal factors (e.g. domestic politics, economic factors) and the technological imperative. The structural changes in the balance of power in the Eastern Mediterranean can be attributed to a combination of these three factors. Bastian (2022) argues that the region has been dominated, until recently, by Europe, Russia, and the United States. However, China is recently proved to be the fourth key player in the region as it is attracted by the advantages of the geographical location of Greece, seen as a gateway to Europe, the innovation of Israel's economy and Turkey. This approach is in line with Axt (2022) who states that the initiated withdrawal of the US from the region has created a gap that will eventually allow Russia and China to increase their influence in the region (Egypt, Greece, Israel, Turkey). Bardakçı (2022) suggests that the Turkish foreign policy tries to deepen its relationships with the new geopolitical player of the region, along with Russia, to counterbalance the relationship between Greece, EU and US, despite the fact that the war against Ukraine has reshuffled the cards in the region, thus strengthening the unity of the West (Axt 2022).

Following these recent developments and the fact that conflicts of interest in the Eastern Mediterranean have a strong historical background, it becomes clear that the international relations in the region are characterized by a high degree of fragmentation, therefore laying the ground for intense competition among countries. In such a context, countries seek for sources of power, especially for military power, which increases the possibility of arms races. However, although the implications of identifying the causes or direction of causation of defence spending is of vital importance, the empirical evidence is vague. For example, the studies of Avramides (1997) and Kollias and Paleologou (2002) find empirical evidence in favor of a bidirectional causality between Greece's and Turkey's military spending, while Georgiou (1990), Stavrinos (1992) and Georgiou, Kapopoulos, and Lazaretou (1996) do not confirm the previous evidence. The conflicting findings are attributed to different methodologies applied to study the underlined relationships, the implementation of various time horizons and the use of different samples. In this context, the literature rarely discusses the presence of asymmetries in the nexus among variables in the short- and long-term. Furthermore, the presence of thresholds, that is the presence of certain level of military spending to ensure its security, is scarcely introduced.

We contribute to the nexus of military spending among neighboring countries in four ways. First, we analyze the bilateral relationships between the military spending of neighboring countries, namely Egypt, Greece, Israel and Turkey during the period 1962–2020. We examine the pairwise relationships (Greece–Turkey, Israel–Egypt, Israel–Turkey),[1] as these four countries are in the same geographical area and their military expenditures are interrelated. Such an analysis allows the perception of a more holistic view of the underlying relationships. Second, we account for the presence of asymmetries in the bilateral relationships of spending by examining for the existence of a long-run asymmetric cointegrating relationships, applying the Enders and Siklos (2001) methodology. Third, we identify the causal asymmetric bilateral relationships between the military spending of the neighboring countries in the short run utilizing Sun's (2011) methodology. Finally, employing the Hansen's (2017) kink regression analysis, we detect the existence of a threshold in the military spending of one country that differentiates the direction and the magnitude of the other country's military spending.

Our findings – that to best of our knowledge, are reported for the first time in the related literature – suggest the following: (a) In the long run the pairwise relationships of military spending

among the neighboring countries examined are cointegrated. Further, the findings suggest that the adjustment process between the variables is nonlinear, with positive and negative shocks leading to different adjustment speeds or to a unilateral adjustment process towards the new equilibrium point, (b) in the short run, we confirm the existence of asymmetries, and find indications in favor of the absence of a bilateral causality effect, namely we conclude there are no arms races between the examined countries, (c) having empirically detected the direction of causality we apply Hansen's (2017) kink regression analysis to search for the existence of a possible threshold above which the military spending of the country that is the driving force of the spending could be perceived as a threat to the other countries of the region. Our results suggest that the reaction of one country's military spending becomes more intense and/or statistically significant, after a certain level of the other's country military spending, namely after a certain threshold, defined as security threshold. Consequently, each country should determine its level of military spending accounting not only for operational factors but also for the signaling of its military spending on its neighboring countries. The only exception concerns the relationship between the military expenditures of Turkey and Israel which, despite the presence of cointegration, appears to be weak.

The rest of the paper is organized as follows: Section 2 offers a review of the literature. Section 3 presents the data and the econometric methodology. In section 4 the results are discussed. Section 5 concludes the study.

Theoretical and Empirical Evidence

As outlined by Yalta and Tüzün (2021) there are four underlined approaches in modelling the demand for military spending, (i) the arms and race approach (Richardson 1960); (ii) the theory of alliances (Olson and Zeckhauser 1966); (iii) the concept of security web (Rosh 1988) and (iv) the neoclassical model (Smith 1989). The main idea of the arms and race approach is that the attainment of arms by two or more antagonistic countries could lead to a competitive race and could explain increases in military expenditures (Richardson 1960). Further, he analyzed the prevalence of specific conditions under which such a race could become unstable and tentatively end in war (Smith 2020). The third strand of literature analyzes the concept of security wed, a country's external environment, that affects the country's defence spending as a response to a potential threat emerging from surrounding or regional countries (Rosh 1988). The final approach to modelling military expenditures is based on the notion that a country tries to maximize society's social welfare that consists of security, consumption and other macroeconomic factors and is subject to budgetary constraints (Smith 1989).

The core of the above theoretical approaches is the assumption that military spending is a crucial factor that determines the power and consequently the position of each country in the international power hierarchy. Participation in a political and/or military alliance is also a critical determinant of power. Karbuz (2018) states that Greece and Turkey are key members of NATO alliance, Israel is a key ally of US and Egypt is a key regional player, which implies that western countries have a strong interest to constrain the increasing impact of Russia and China on Turkey and the Eastern Mediterranean. Further, as Tanchum (2021) suggests, the geopolitical tensions in Eastern Mediterranean have increased because of the competition between EU, US and China to maintain and expand their commercial presence in Egypt, Israel and Greece and the efforts of Greece and Turkey to take advantage of their own potential gas resources. The disputes in the region related to hydrocarbon resources have existent for a long time. However recently, the finding of hydrocarbon resources in the Egyptian offshore, the discoveries of the Gaza Marine field in the Palestinian off shore and the Mari-B field in the off shore of Israel are some of the most important examples that have gradually strengthened the dependence of the EU energy strategy on these countries (Dorsman, Ediger, and Karan 2018). As a result, the tensions among these players in the region (Egypt, Greece, Israel, Turkey) were amplified, increasing the possibility of an arms race in an attempt to secure the strategic interests of the participants involved.

According to Kollias and Paleologou (2002), Brauer (2002) and Öcal and Yildirim (2009), the existence of an arms race could be empirically verified by the presence of bidirectional causality between the time series employed. However, the determinants of military expenditure could not be fully explained by the presence of a bilateral relationship between two countries. Instead, a researcher should apply a more holistic approach to include the impact of the broader economic, political and historical environment. For example, a determinant of military expenditure could imply the political will to boost economic growth. Öcal (2002) examines the existence of nonlinearities in the military expenditure between Greece and Turkey, using data for the period 1956–1994. He finds strong evidence that changes in the Turkish military expenditure led to asymmetric effects on Greece's military expenditure. Kollias and Paleologou (2002) find empirical evidence in favor of a bidirectional causality between Greece's and Turkey's military spending, during the period 1950–1999. They also find that the size of Greece's military spending depends more on Turkey's military spending than the reverse. These findings are in line with Avramides (1997), Kollias and Makrydakis (1997) who support the existence of an arms race between the two NATO allies. Kollias and Makrydakis (1997), using cointegration and causality test find empirical support in favor a systematic armaments competition between the two countries, contrary to the results of Georgiou (1990), Stavrinos (1992) and Georgiou, Kapopoulos, and Lazaretou (1996). Andreou and Zombanakis (2000, 2011) also do not confirm the existence of an arms race between Greece and Turkey as they show that there is no bilateral relationship between the military spending of the two countries. However, they documented that the Turkish military expenditure is the driving force in their relationship with the Greek military expenditure, while the opposite does not hold. Öcal and Yildirim (2009) using data for the period 1956-2003 do not find evidence in favor of an arms race between Greece and Turkey, but they show that the military expenditure of Greece is the driving force of the Turkish military expenditure. Further, they show that the relationship between Greece's and Turkey's military expenditure is asymmetric as it is characterized by a threshold cointegration towards the long-run equilibrium.

Further, Öcal and Yildirim (2009), using data for the period 1956-2003 confirm that the relationship between Greece's and Turkey's military expenditure is characterized by a threshold cointegration towards the long-run equilibrium. They do not find a bidirectional causality, implying that there is no indication for an arms race and they conclude that Turkish military expenditure adjusts to discrepancies from the long-run equilibrium, whereas Greek military expenditure does not. On the opposite, Andreou and Zombanakis (2011), in line with Andreou and Zombanakis (2000), find that the Turkish military expenditure is the driving force in their relationship with the Greek military expenditure, while the opposite does not hold.

Amir-Ud-Din, Waqi Sajjad, and Aziz (2020) examine empirically the possible arms race, namely the existence of a bidirectional causality in the military expenditure, between India and Pakistan for the period 1960–2016. They find that only the military expenditure of India causes the military expenditure of Pakistan. Therefore, despite the non-existence of an arms race between the two countries, India's military expenditure is the exogenous variable in its relationship with Pakistan's military expenditure.

On the other hand, the nexus of military spending among countries has been examined accounting for other factors, such as economic and security changes. Kollias, Paleologou, and Stergiou (2016) examine the factors that affect military spending in Greece and Turkey, taking into account the political, economic and security changes that have taken place during the period 1990–2014. They find empirical evidence that upward and downward trends in Greek military spending are not mainly driven by changes in the relations of the country with Turkey, but by Greece's ability to finance its military expenditures. Therefore, the driving force for Greece's declining military expenditure in the late 2000s is the debt crisis and the recession of the economy, rather than the evolution of the Greek-Turkey security state. Prontera and Ruszel (2017) argue that the new gas resources discovered in the Eastern Mediterranean Sea have important implications concerning energy security in the area, as they have increased complexity

and have contributed to the formation of a trilateral cooperation between Israel, Greece and Cyprus. However, government capacities to use energy resources to achieve their foreign policy targets are constrained by economic and security concerns. Kollias, Paleologou, and Zouboulakis (2021), using ARDL methodology for a unique data set covering the period 1848–2018, find, unlike the previous studies, that there is no statistically significant effect of Greece's defence expenditure on public debt. Choulis, Mehrl, and Ifantis (2021) support the view that the gas discoveries, the Libyan Turkish maritime agreement and the territorial demarcations between Greece and Egypt have increased the Greek-Turkish tensions over the control of the Aegean Sea and the broader eastern Mediterranean. They use the number of violations of the Greek claimed airspace by the Turkish air force, during the period 1985–2020, to capture the extent of the intensity with which Turkey pursues the conflict between the two countries. They find empirical evidence that changes in military expenditure can interpret the rising number of airspace violations, which in turn is an effective tool to challenge the existing status-quo.

At an aggregate panel-data level Cavatorta and Smith (2017) using the SIPRI data over the 1965–2014 period, unlike the standard fixed effect panel estimation approach, estimate dynamic heterogeneous models of military expenditures with cross-sectional dependence in errors employing principal components (PC) and common correlated effect (CCE) estimation techniques that account for the presence of cross-sectional dependence. They account for strategic interactions between countries, such as arms races among countries, burden sharing within country-affiliations and economic and political disturbances that effect the military responses of different countries. Recently, Isomitdinov, Lee, and Payne (2021) examine the trend and comovements of military expenditures using a sample of 70 countries from 1967 to 2018. They underline the importance of regional- and country-specific factors in the military spending of the countries and find that the importance of country-specific and global factors is more crucial in explaining the military spending behavior than regional factors. Finally, Yalta and Tüzün (2021) using a sample of 70 countries over the period 1967 to 2018 and a dynamic factor model show a significant variation in military spending across countries and report significant country and regional factors explaining military spending.

The impact of military spending on the economy is also in the epicenter of the military defence literature as it indicates the ability of a country to sustain a level of defence spending and, therefore, its ability to finance a potential arms race. Pan, Chang, and Wolde-Rufael (2015) examine the causal relationship between military spending and economic growth for 10 Middle East countries, among them Egypt, Israel and Turkey, for the period 1988–2010, concluding that there is not consistent evidence when it comes to the relationship between military spending and economic growth. Yolcu Karadam, Yildirim, and Öcal (2017) find empirical evidence, for the period 1988–2012, according to which for low level of military expenditures the effects on economic growth are positive, while for higher the effects become negative. Recently, Maher and Zhao (2022) find empirical support, using data covering the period 1982–2018, that in the short-run military expenditures have a negative effect on the growth of Egypt, while, in the long run, the relationship is statistical insignificant, in line with Kuimova (2020).

In summary, there is a growing amount of research concerning the interactions and the effects of military spending on critical economic and political variables. However, the empirical evidence on the relationship remains unclear. This indicates that there is room to apply recent econometric methodologies that would provide a more comprehensive view on the interrelationships between military spending among neighboring countries and account for the presence of non-linear relationships. Further, the possible presence of a threshold in the relationship is important, as the existence of a military spending equilibrium, for which the countries are safe, without threatening each other, is vital for securing peaceful solutions to regional East Mediterranean disputes. The selection of the four neighboring countries (Egypt, Greece, Israel, and Turkey), serves as an example and the conclusions drawn from the analysis could be applied to other countries sharing similar characteristics.

Data and Methodology

Analysis of Data

The empirical investigation of the bilateral relationship between the military spending of the neighboring countries is carried out using yearly data for military expenditure expressed as a percentage of GDP for Egypt (Eg), Greece (Gr), Israel (Isr) and Turkey (Tr) over the period 1962–2020. Our analysis focuses on the military expenditures as a share of GDP, in line with Amir-Ud-Din, Waqi Sajjad, and Aziz (2020), as this variable shows the importance of military expenditure in the government's decision making. Therefore, the advantage of the military expenditures as a share of GDP is that it embodies the vast number of (observed and unobserved) political and remaining factors. Further, accounting for the importance of military spending not in absolute terms but in relation to GDP accounts for comparable variables across the countries examined. The series are obtained from SIPRI Military Expenditure Database.[2] The normality properties of the series are examined applying conventional normality tests (Table 1), such as Jarque and Bera (1980), Sapiro and Francia (1970)), Sapiro and Wilk (1965)) and Kolmogorov-Smirnov (KS).[3] The tests provide strong evidence of non-normal distribution for Greece, Egypt, and Israel series, with the exception of the military spending of Turkey where the results are mixed. The Pearson correlation coefficients show the existence of statistically significant correlation between all the pairwise relationships of the variables. Further, the nonlinearities in the distribution of the variables suggests that the linear econometric techniques to estimate the pairwise relationships between our variables would be inappropriate, as in Francis, Mougoue, and Panchenko (2010)and Nusair and Olson (2019). Figure 1 displays scatterplot matrices (left part), Pearson correlation coefficients (right part) and variables distribution (diagonal). Overall, the graphical representation of the variables distribution confirms the findings of a non-normal distribution for all the variables, with the exception of Turkey, where the results are mixed.

Table 1. Summary statistics and conventional tests of normality.

Variable	Obs	Mean	median	standard deviation	JB	SF	SW	KS
Gr	59	3.74 %	3.57 %	0.01	4.304*	0.942***	0.933***	0.121**
Eg	59	6.06 %	3.47%	0.05	8.756**	0.863***	0.855***	0.225***
Isr	59	12.43 %	9.44%	0.07	7.574**	0.867***	0.859***	0.174***
Tr	59	3.27%	3.36%	0.01	0.543	0.969	0.965*	0.112**

Notes: *, **, *** denote significance at 10%, 5%, and 1% level respectively.

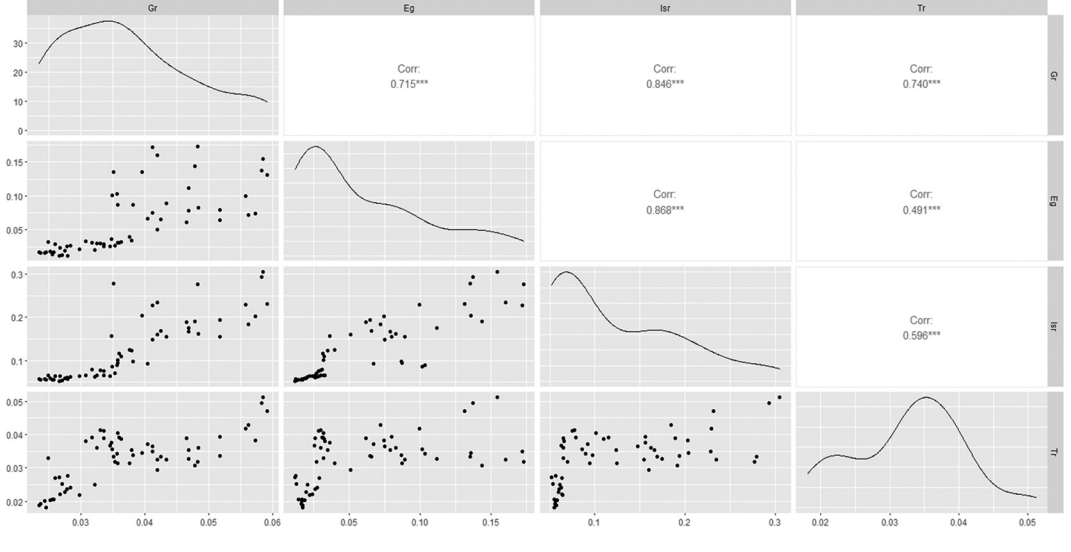

Figure 1. Scatterplot matrices, Pearson correlation coefficients and variables distribution.

Econometric Methodology

To examine the bilateral relationships of military expenditures among neighboring countries, allowing for the existence of possible asymmetric dynamics, we apply the following steps in our analysis: First, we verify the order of integration of the variables by performing both conventional and unit root tests that allow for the presence of breaks. Second, having verified that the variables are integrated of order one I(1), we proceed by investigating the long- and short-term relationships among the variables in a pairwise framework. In particular, we examine the presence of asymmetric long-run cointegration, the direction of causality between the military spending and the existence of an arms race, if a bidirectional causality is detected, by applying threshold cointegration techniques (Threshold Autoregressive Model – TAR and Momentum Autoregression Model – MTAR), developed by Enders and Siklos (2001) and Sun (2011).[4] Third, we apply Hansen's (2017) kink regression analysis to detect the existence of a possible threshold in the military spending of one country (assignment variable) that differentiates the direction and the magnitude of the other country's military spending (outcome variable). Specifically, we apply the kink regression methodology, which is a continuous threshold model, introduced by Chan and Tsay (1998) and further developed by Hansen (2017). This methodology allows searching for an induced kink in depicting the relationship between the dependent and the independent variable. Following Hansen (2017), recent econometric literature focuses on the discontinuous threshold model, which implies that the regression model is split into groups, depending on a threshold parameter. The main advantage of the kink regression model is that there is no need to expect a discontinuous response at the threshold point.

The regression kink models, one for each bilateral relationship of military spending, are as follows:

$$lnG_{it} = \beta_{1i}\left(lnG_{jt} - \gamma\right)_{-} + \beta_{2i}\left(lnG_{jt} - \gamma\right)_{+} + \beta_{3i}' z_{it} + e_{it} \tag{1}$$

where,lnG_{it},lnG_{jt}, are scalars denoting observable variables corresponding to the natural logarithm of military spending for countries i, j, respectively. e_t is also a scalar denoting the error term, while the observable variable $z_t$is an $l-$vector that includes an intercept. It holds that $z_t = (lnG_{it}1)'$ for the error term to be serially uncorrelated. $\beta_1, \beta_2, \beta_3$ are the regression slopes denoting coefficients to be estimated and γ is the unknown threshold parameter known as 'kink point'. We use $\left(lnG_{jt} - \gamma\right)_{-} = \min\left[lnG_{jt} - \gamma, 0\right]$ and $\left(lnG_{jt} - \gamma\right)_{+} = \max\left[lnG_{jt} - \gamma, 0\right]$ to signify the negative and positive part of the respective difference, where G_{jt} denotes the military spending variable for each of the j countries, respectively.

To determine the threshold for each of country's military spending, the least square criterion is applied:

$$S_n(\beta, \gamma)\frac{1}{n}\sum_{t=1}^{n}\left[lnG_{it} - \beta' lnG_{jt}(\gamma)\right]^2 \tag{2}$$

The corresponding least square estimator $\left(\hat{\beta}, \hat{\gamma}\right)$ is the joint minimizer of $S_n(\beta, \gamma)$. It holds that: $\left(\hat{\beta}, \hat{\gamma}\right) = \underset{\beta \varepsilon R^{k-1}, \gamma \varepsilon \Gamma}{\arg\min}\, S_n(\beta, \gamma)$ where, $S_n(\beta, \gamma)$ is quadratic in β but nonconvex in γ. Therefore, we have:

$$\hat{\gamma} = \underset{\gamma \varepsilon \Gamma}{\arg\min}\, \underset{\beta \varepsilon R^{k-1}}{\min}\, S_n(\beta, \gamma) = \underset{\gamma \varepsilon \Gamma}{\arg\min}\, S_n^*(\beta, \gamma)$$

As a result, the least square criterion can be expressed as the concentrated sum-of-squared errors, as:

$$S_n^*(\gamma) = S_n\left[\hat{\beta}(\gamma), \gamma\right] = \frac{1}{n}\sum_{t=1}^{n}\left(lnG_{it} - \hat{\beta}(\gamma)' lnG_{jt}(\gamma)]\right)^2 \tag{3}$$

where, $\hat{\beta}(\gamma)$ are the least square coefficients from standard regression of lnG_{it} on each of the threshold variables $lnG_{jt}(\gamma)$ and, $lnG_{jt}(\gamma)=\begin{pmatrix}(lnG_{jt}-\gamma)_{-}\\(lnG_{jt}-\gamma)_{+}\\z_{j,t}\end{pmatrix}$, where j denotes each country. To determine the value of the threshold,γ, for the military spending of each country, we apply a grid search. Then we estimate the least square coefficients, at each of the grid points, and compute the least square criterion $S_n^*(\gamma)$. The value that minimizes the least square criterion is chosen as threshold $\hat{\gamma}$. Finally, we apply standard regression of lnG_{it} on each of the threshold variables $lnG_{jt}(\hat{\gamma})$, which leads us to estimate the least square coefficients.

Empirical Results

The empirical analysis is executed in the following steps. Initially, having verified that the variables are integrated of order 1, I(1), in section 4.1, we examine the existence of a long-run asymmetric cointegrating relationship, by applying the threshold autoregressive approach of Enders and Siklos (2001). Next, we estimate an asymmetric error-correction model to examine the causal bilateral relationships between the military spending of the neighboring countries, applying Sun's (2011) methodology. Finally, in section 4.2, we apply Hansen's (2017) kink regression analysis to detect the existence of a possible threshold in the military spending of one country that differentiates the direction and the magnitude of the other country's military spending.

Threshold Cointegration Analysis

Unit Root Tests

Initially, the stationarity properties of the series employed are examined. We perform two standard unit root tests, namely the augmented (Dickey and Fuller 1979) and the Kwiatkowski, Phillips, Schmidt and Shin (KPSS, Kwiatkowski et al. 1992). To account for the presence of possible asymmetries that could lead to spurious results, we utilize the Zivot and Andrews (1992) and the Lagrange Multiplier (LM) unit root test by Lee and Strazicich (2013) that allow for possible structural breaks in the series. The results, presented in Table 2, show that the variables are integrated of order one I(1). Therefore, we can proceed to cointegration analysis.

Long-Run Asymmetric Dynamics

Having established that the variables are integrated of order one I(1), we proceed by investigating their short- and long-run interactions, following Enders and Siklos (2001). The main advantage of the TAR model is that it captures deep movements in the residuals, while the MTAR deals with steep variations in the residuals. Further, according to Enders and Siklos (2001) this methodology demonstrates satisfying power and size properties, when there are asymmetric departures form the equilibrium. In addition, it enables to examine the existence of non-parametric effects, the presence and the direction of a causal equilibrium relationship between the variables.

Initially, we estimate the following long-run equilibrium relationship:

$$lnG_{it} = a_0 + a_i lnG_{jt} + \varepsilon_t \tag{4}$$

$$\Delta\widehat{\varepsilon_t} = \rho_1 I_t \widehat{\varepsilon_{t-1}} + \rho_2 (1 - I_t)\widehat{\varepsilon_{t-1}} + \sum_{i-1}^{\rho} \varphi_i \Delta\widehat{\varepsilon_{t-1}} + \mu_t \tag{5}$$

$$I_t = 1, \widehat{\varepsilon_{t-1}} \geq \tau, 0 \; otherwise \tag{6}$$

Table 2. Unit root tests.

	Greece		*Egypt*		*Israel*		*Turkey*	
Variable	Level	First difference	Level	First difference	Level	First difference	Level	First Difference
Part i: Unit root test not allowing for structural breaks								
ADF	−1.266 [1]	−5.577 [1] ***	−0.081 [2]	−3.888 [3] ***	−1.097 [3]	−2.803 [2] *	−1.554 [1]	−5.351 [1] ***
KPSS	0.217 [3]***	0.074 [3]	0.114 [3] *	0.113 [3]	0.198 [3] **	0.079 [3]	0.238 [3] ***	0.073 [3]
Part ii: Unit root test allowing for structural break								
Zivot-Andrews	−4.231 [3]	−6.440 [3] ***	−3.633 [2]	−4.839 [2] ***	−4.068 [3]	−6.413 [3] ***	−4.137 [1]	−6.232 [1] ***
Breakpoint	1973	1976	1966	1973	1991	1974	2002	2014
Lee and Strazicich	−3.811 [1]	−7.136 [1] ***	−3.447 [3]	−6.290 [1]***	−3.659 [3]	−7.112 [1]***	−3.563 [1]	−8.621 [1]***
Breakpoint	1980	1975	1968	1973	1981	1977	2002	2002

Note: The number in the bracket are lags used in the test. The lag order is in accordance with the AIC lag length for the ADF, KPSS and Zivot-Andrews tests and in accordance with 'general to specific' method, as in Lee and Strazicich (2013).
*, **, *** Denotes significance at 10%, 5% and 1% level, respectively.

$$I_t = 1, \Delta\widehat{\varepsilon_{t-1}} \geq \tau, 0 \; otherwise \tag{7}$$

where a_i are the coefficients of the long-run relationship between the military spending lnG_{it},lnG_{jt}, for countries i, j and ε_t is the error-term. Further, $\widehat{\varepsilon_t}$ are the estimated residuals from the long-run equilibrium relationship, $\rho_1, \rho_2, \varphi_i$ are coefficients to be estimated, p is the number of lags, $\mu_t \approx iid\left(0, \sigma_\varepsilon^2\right)$. The lag selection of p is specified using AIC and BIC values. I_t is the Heaviside indicator, where τ, is the value of threshold, which can be endogenously determined using Chan's (1993) methodology. Following Sun (2011) we present four models for each of the three pairwise relationships (Greece – Turkey, Israel – Egypt, Israel – Turkey) (Table 3).

In the pairwise relationship between military spending in Greece (G_{Gr}) and Turkey (G_{Tr}) the cMTAR model has the lowest AIC and BIC statistics and it is chosen as the best model for the development of the error-correction model (ECM) estimation. The Φ-statistic ($H_0 : \rho_1 = \rho_2 = 0$) for the cMTAR model is statistically significant, revealing that the null hypothesis of no threshold cointegration is rejected, which supports the hypothesis that the military spending between the two countries is cointegrated. Further, according to the F-statistic the adjustment process is asymmetric. We find for the adjustment process is statistically significant only for positive shocks (−0.439), implying that, in the long run, the adjustment process of the military spending of Greece and Turkey occurs only for positive deviations, namely after positive shocks.

In the pairwise relationship between military spending in Israel (G_{Isr}) and Egypt (G_{Eg}) the cMTAR model has the lowest AIC and BIC statistics and an asymmetric long-run equilibrium exists, whereas the adjustment process takes place after positive shocks. In the pairwise relationship between military spending in Israel (G_{Isr}) and Turkey (G_{Tr}) the cMTAR model has the lowest AIC and BIC statistics and we obtain an asymmetric cointegrating relationship, while the adjustment process arises only after positive shocks.

Overall, from a technical perspective, the findings suggest that the pairwise relationships of military spending of the examined countries are cointegrated and the adjustment processes are asymmetric, with positive and negative shocks leading to different adjustment speeds or to unilateral adjustment processes towards the new equilibrium point. From a policy perspective, these asymmetric strategic interactions, revealed by the cointegration analysis, imply that there is a long-run association between the military spending of the countries, independent of the existence or not of a bilateral causality effect, namely of an arms race. Consequently, each country could determine its level of military spending accounting not only for operational factors but also for the signaling of its military spending on its neighboring countries.

Short-Run Asymmetric Dynamics: Error-Correction with Threshold Cointegration

As a next step, we follow Sun (2011) to study the direction of causality in the bilateral relationship of the countries' military spending, namely which country's military spending is the driving force (exogenous) and which country adjusts the level of its military spending as a percentage of GDP (endogenous). Further, we examine whether the short-run relationship between the variables is characterized by asymmetry. The selected model for the analysis of the pairwise relationships is the cMTAR model, as suggested above.

We develop the following error-correction models using Eqs. (5) and (6).

$$\Delta G_{i,t} = \theta_{G_{i,t}} + \delta^{+}_{G_{i,t}} \mathrm{E}^{+}_{t-1} + \delta^{-}_{G_{i,t}} \mathrm{E}^{-}_{t-1} + \sum_{K=1}^{k} a^{+}_{G_{i,t}} \Delta G^{+}_{i,t-k} + \sum_{K=1}^{k} a^{-}_{G_{i,t}} \Delta G^{-}_{i,t-k} + \sum_{K=1}^{k} \beta^{+}_{G_{i,t}} \Delta G^{+}_{j,t-k} + \sum_{K=1}^{k} \beta^{-}_{G_{i,t}} \Delta G^{-}_{j,t-k} + u_{G_{i,t}} \tag{8}$$

Table 3. Results of threshold cointegration estimations.

	Greece-Turkey				Israel – Egypt				Israel-Turkey			
Equation	TAR	TAR	TAR	TAR	TAR	MTAR	cTAR	cMTAR	TAR	MTAR	cTAR	cMTAR
Threshold value	0.000	0.000	0.129	0.074	0.000	0.000	−0.234	−0.078	0.000	0.000	0.382	−0.060
ρ_1	−0.257**	−0.329***	−0.314**	−0.439***	−0.184*	−0.328***	−0.175**	−0.310***	−0.122	−0.150*	−0.151*	−0.170**
	(−2.127)	(−2.750)	(−2.491)	(−2.699)	(−1.962)	(−3.622)	(−2.053)	(−4.374)	(−1.456)	(−1.907)	(−1.700)	(−2.287)
ρ_2	−0.180	−0.109	−0.141	−0.138	−0.369***	−0.179	−0.437***	0.376	−0.083	−0.024	−0.063	0.027
	(−1.522)	(−0.920	(−1.256)	(−1.419)	(−3.616)	(−1.607)	(−3.847)	(1.217)	(−0.964)	(−0.264)	(−0.785)	(0.283)
φ_1	-	-	-	-	0.020	0.082	0.018	0.167	-	-	-	-
					(0.160)	(0.650)	(0.147)	(1.286)				
φ_2	-	-	-	-	−0.036	−0.056	−0.016	−0.112	-	-	-	-
					(−0.300)	(−0.465)	(−0.134)	(−0.924)				
φ_3	-	-	-	-	0.296**	0.297**	0.326***	0.292**	-	-	-	-
					(2.495)	(2.485)	(2.761)	(2.522)				
Diagnostics												
AIC	−88.243	−87.185	−89.107	−89.982	−75.956	−75.163	−77.665	−78.816	−22.005	−22.176	−22.454	−23.712
BIC	−82.062	−81.056	−82.926	−83.853	−63.912	−63.119	−65.621	−66.772	−15.824	−16.047	−16.273	−17.583
Hypotheses												
$\Phi(\rho_1 = \rho_2 = 0)$	3.420**	4.204**	3.892**	4.651***	8.295***	7.819***	9.346***	10.073***	1.524	1.852	1.753	2.654*
$F(\rho_1 = \rho_2)$	0.212	1.723	1.056	3.522**	1.820	1.078	3.456*	4.586**	0.106	1.072	0.541	2.604*

$$\Delta G_{j,t} = \theta_{G_{j,t}} + \delta^{+}_{G_{j,t}} E^{+}_{t-1} + \delta^{-}_{G_{j,t}} E^{-}_{t-1} + \sum_{K=1}^{k} a^{+}_{G_{j,t}} \Delta G^{+}_{j,t-k} + \sum_{K=1}^{k} a^{-}_{G_{j,t}} \Delta G^{-}_{j,t-k} + \sum_{K=1}^{k} \beta^{+}_{G_{j,t}} \Delta G^{+}_{i,t-k} + \sum_{K=1}^{k} \beta^{-}_{G_{j,t}} \Delta G^{-}_{i,t-k} + u_{G_{j,t}} \quad (9)$$

where$\Delta G_{i,t}$ is the first difference of *i* country's military spending and $\Delta G_{j,t}$ is the first difference of *j* country's military spending. θ is a constant, a_j, β_j are the coefficients of the lagged first differences, j represents the number of lags, which is chosen taking into account AIC and BIC statistics, ensuring that the residuals have no serial correlation, u is the error term and *E* are the error-correction terms. $E^{+}_{t-1}=I_t\widehat{\varepsilon_{t-1}}$ and $E^{-}_{t-1}=(1-I_t)\widehat{\varepsilon_{t-1}}$ are constructed from the threshold cointegration regressions in equations (5), (6.2) and account for the asymmetric level of military spending, as a percentage of GDP, variable in response to positive and negative shocks to the deviations from long-run equilibrium and consider the impact of threshold cointegration through the construction of Heaviside indicator. $\Delta G_{i,t-k}$, $\Delta G_{j,t-k}$, are the lagged variables in first difference. Based on AIC and BIC statistics, a lag of one is selected in all cases, except for the bilateral relationship between Israel-Egypt, where a lag of two is selected. In total, six asymmetric error-correction representations are developed, specifically, two models for each of the three pairwise relationships (Greece – Turkey, Israel – Egypt, Israel – Turkey). The results of the asymmetric error-correction models are reported in Table 4.

The point estimates for the pairwise relationship of the military spending between Greece and Turkey show that the only statistically significant coefficient is that of Turkey (−0.384), after a positive shock, suggesting that the adjustment process occurs through the level of Turkey's military spending, whereas the military spending of Greece is the driving force (exogenous variable). This evidence is further reinforced by the lower values of the AIC and BIC statistics for Turkey's military spending

Table 4. Results of asymmetric (TAR, MTAR) error-correction models.

ECM Equation	Greece	Turkey	Israel	Egypt	Israel	Turkey
Threshold value	0.074		−0.078		−0.060	
δ^{+}	−0.221	−0.384**	−0.442 ***	−.107(−1.379)	−0.026	0.133***
	(−1.318)	(−2.042)	(−5.497)	(−1.379)	(−0.440)	(2.737)
δ^{-}	−0.083	0.025	0.008	−.084(−.539)	0.050	0.016
	(−0.988)	(0.264)	(0.046)	(−0.539)	(0.689)	(0.276)
a_1^{+}	0.728 ***	0.565*	0.260	.362*(1.978)	0.115	−0.182
	(2.810)	(1.945)	(1.369)	(1.978)	(0.479)	(−0.932)
a_1^{-}	−0.469*	0.155	−0.072	−.042(−.197)	−0.062	−0.002
	(−1.722)	(0.507)	(−0.325)	(−0.197)	(−0.244)	(−0.007)
β_1^{+}	−0.179	−0.147	0.540 *	.194(.637)	−0.086	−0.022
	(−1.026)	(−0.749)	(1.706)	(0.637)	(−0.340)	(−0.105)
β_1^{-}	0.128	−0.010	−0.436 **	.562***(2.773)	0.052	−0.067
	(0.592)	(−0.042)	(−2.076)	(2.773)	(0.157)	(−0.247)
a_2^{+}	-	-	0.000	.180(.829)	-	-
			(0.001)	(0.829)		
a_2^{-}	-	-	−0.369 *	.007(.036)	-	-
			(−1.715)	(0.036)		
β_2^{+}	-	-	0.054	.052(.219)	-	-
			(0.219)	(0.219)		
β_2^{-}	-	-	−0.382*	−.683***(−3.082)	-	-
			(−1.661)	(−3.082)		
Intercept	−0.030	−0.017	−0.110***	−.075**(−2.301)	−0.008	−0.006
	(−1.414)	(−0.705)	(−3.247)	(−2.301)	(−0.227)	(−0.225)
Diagnostics						
AIC	−91.596	−104.774	−80.369	−76.203	−55.940	−79.587
BIC	−75.252	−88.430	−56.065	−51.899	−39.595	−63.242
Hypothesis						
$H_0: \delta^{+}=\delta^{-}$	0.553	2.964*	6.629**	.018	0.659	2.330

Notes: *, **, *** denote significance at 10%, 5% and 1% level respectively.

equation compared to that of Greece's equation, suggesting that the model has a better fit on Turkey's ECM and the adjustment process takes place through Turkey's spending. Consequently, it is confirmed that Greece's spending is evolving more independently, representing the exogenous variable.

Moreover, the empirical evidence presented in Table 4 suggests the following: (a) in the relationship of the military spending between Egypt and Israel the military spending of Egypt is the exogenous variable, and (b) for the pairwise relationship of the military spending between Israel and Turkey the military spending of Israel is the exogenous variable.

Overall, two conclusions can be drawn from the short-run analysis: First, the presence of asymmetries is confirmed, as in the long run. Second, the absence of a bilateral causality effect is indicated. According to Kollias and Paleologou (2002), Brauer (2002) and Öcal and Yildirim (2009), the existence of an arms race could be empirically verified by the presence of bidirectional causality between the time series employed. Therefore, a possible positive or direct relationship between the military spending of two countries is not a sufficient condition for the presence of an arms race. As there is no bilateral causality effect, the presence of arms races between the examined countries is not confirmed, in line with Öcal and Yildirim (2009) and Amir-Ud-Din, Waqi Sajjad, and Aziz (2020). This finding may indicate that military expenditures among countries that do not point to an arms race, as in our case, may reflect the ability of a country to devote scarce resources to national defence (Kollias, Paleologou, and Stergiou 2016) or domestic political factors (Kollias and Paleologou 2002). Moreover, the findings suggest that each of the examined countries tries to ensure its security without necessarily threatening the security of the other country.

Kink Regression Analysis

Having considered the direction of causality, we proceed by developing the pairwise Hansen's (2017) kink regression model analysis. Kink regression analysis allows testing for the presence of a spending threshold above which the military spending of a country could be perceived as a threat to the other countries of the region, thus differentiating the long-run bilateral relationship among the countries.

Before presenting the empirical findings, two points are outlined. First, similar to Hansen (2017), we indicate two important coefficients: β_2, where high values of it indicate the intensity and direction of each country's military spending reaction with respect to the other's country military spending, and the threshold parameter,γ. This choice, in line with Hansen (2017) is justified by the fact that sharp fluctuations at a high level of military spending are more likely to exhibit important policy implications. Second, a direct relationship between the military spending of two countries does not necessarily imply an arms race between these countries. Allies mutually increase their military spending driven by external security concerns. Therefore, a direct coefficient in two countries' military spending could be interpreted as a signal of commitment to an alliance, too.

We compute the 90% confidence intervals by applying Hansen's (2017) symmetric percentile bootstrap methodology for the slope coefficients. Using 10.000 bootstrap replications we compute the threshold parameters performing the test inversion confidence intervals method. Table 5 reports the results and the corresponding threshold value, with the lowest least square criterion, for each kink regression model (first row).

Specifically, the threshold parameter that minimizes the least square criterion $S_n^*(\gamma)$ of the kink model referring to the relationship between the military spending of Turkey (G_{Tr}) and Greece (G_{Gr}) is $\hat{\gamma}_{Tr,Gr} = -3.342(3.5\%ofGDP)$. The corresponding slope of the military spending of the two countries equals 0.571 for values of military spending of Greece less than the estimated threshold value and equals 0.630 for values greater than the threshold value, implying that the relationship between the military spending of the two countries is direct and asymmetric exhibiting a regression kink effect. Therefore, higher military spending in Greece induces a more intense reaction of Turkey's military spending.

Table 5. Coefficient estimates and bootstrap 90% confidence interval.

	Turkey-Greece		Israel-Egypt		Turkey-Israel	
	Estimate	Interval	Estimate	Interval	Estimate	Interval
β_1	0.571	[0.17, 0.97]	−0.053	[−0.26, 0.16]	−1.110	[−2.2, 0.00]
	(0.222)		(0.079)		(1.144)	
β_2	0.630	[0.46, 0.80]	0.787	[0.64, 0.93]	0.810	[0.00, 1.62]
	(0.109)		(0.095)		(0.090)	
lnx_{t-1}	0.068	[−1.06, 1.20]	0.178	[−0.67, 1.02]	0.085	[0.00, 0.17]
	(0.117)		(0.079)		(0.049)	
intercept	−1.235	[−1.86, −0.61]	−0.635	[−1.11, −0.16]	−0.719	[−1.4, 0.00]
	(0.372)		(0.268)		(0.333)	
γ	−3.342 (3.5% of GDP)	[−3.68, −2.91]	−3.867	[−4.06, −1.87]	−2.869	[−3.0, −1.19]
	(0.088)		(2.09% of GDP)		(5.7% of GDP)	
			(0.125)		(0.066)	

Further, the kink model referring to the relationship between the military spending of Israel (G_{Isr}) and Egypt (G_{Eg}) shows that the threshold parameter equals $\hat{\gamma}_{Tr,Gr} = -3.867(2.09\%ofGDP)$. The corresponding slope of the military spending of the two countries equals −0.053 for values of military spending of Egypt less than the estimated threshold value and equals 0.787 for values greater than the threshold value, implying that the relationship between the military spending of the two countries is asymmetric, exhibiting a regression kink effect. Specifically, higher values of Egypt's military spending cause Israel's military spending to increase too, while lower values lead to a decrease.

Finally, the kink model referring to the relationship between the military spending of Turkey (G_{Tr}) and Israel (G_{Isr}) reveals a threshold parameter of $\hat{\gamma}_{Tr,Gr} = -2.869(5.7\%ofGDP)$. The corresponding slope of the military spending of the two countries equals −1.110 for values of military spending of Israel less than the estimated threshold value and 0.810 for values greater than the threshold value, implying that the relationship between the military spending of the two countries is asymmetric, However, this relationship is weak as both the slope parameters below and above the threshold are statistically insignificant.

Overall, the above estimates suggest that all bilateral relationships of the military spending are asymmetric, in line with our findings from TAR and MTAR methodology. The results also imply a far more intense reaction in the military spending of one country for higher levels of the other country's spending except for the case of Greece and Turkey, where the slope coefficient shows a moderate change in the effect for Greece's spending above the threshold. The results also show that the bivariate relationships between the military spending of Turkey and Israel are asymmetric but weak, due to the statistically insignificance of the slope coefficients. Therefore, there are indications that the relationships in the military expenditures between Turkey and Israel may not necessarily be symptomatic of a military escalation on behalf of one country, but they may be due to domestic political factors (Kollias and Paleologou 2002) or the state of the economy (Kollias, Paleologou, and Stergiou 2016), namely the ability of the economy to allocate resources to national defence. On this issue, Abu-Qarn and Abu-Bader (2003) find evidence that military burdens in Middle Eastern countries are not determined by economic factors but rather by the geopolitical situation in the area.

In addition, the analysis suggests that, in most bivariate relationships, the reaction of one country becomes statistically significant after a certain level of the other country's military spending, namely after a threshold defined as security threshold. Military spending under this threshold is not perceived as a threat to security by the other country. This result, in line with Khan, Su, and Rizvi (2022), suggests that there is room for peaceful solutions in regional disputes. Further, in line with Öcal and Yildirim (2009), Özer (2017) and Amir-Ud-Din, Waqi Sajjad, and Aziz (2020), the analysis reveals that examining the impact of military expenditure fits better to threshold models than to linear models.

Conclusions

In the present study, we analyze the bilateral relationships between the military spending of neighboring countries (Greece – Turkey, Israel – Egypt, Israel – Turkey), during the period 1962–2020. We contribute to the literature on the interactions between the military spending among neighboring countries by applying different empirical methodologies that account for the presence of asymmetries in the bilateral relationships of defence spending. We examine the existence of a long-run asymmetric cointegrating relationship, by utilizing the threshold autoregressive approach of Enders and Siklos (2001). Next, we examine the causal bilateral relationships between the military spending of the neighboring countries, applying Sun's (2011) methodology and finally, we detect the existence of threshold in the military spending of one country that differentiates the direction and the magnitude of the other country's military spending by applying Hansen's (2017) kink regression analysis.

The main findings of our analysis can be summarized as follows. First, the pairwise relationships of military spending among the neighbouring countries examined are cointegrated, with the presence of long-run equilibrium relationships. Further, the findings suggest that the adjustment process between the variables is asymmetric, with positive and negative shocks leading to different adjustment speeds or to unilateral adjustment process towards the new equilibrium point. Second, the results reveal the presence of asymmetries in the short run and identify the direction of causality in the bilateral relationships. Another important finding of short-run empirical analysis is the absence of a bilateral causality effect, which implies the non-existence of an arms race between the countries. Third, the results of the kink regression methodology show a far more intense reaction in the military spending of one country to higher levels of the other's country's spending, as a percentage of GDP, after a certain threshold (security threshold). Military spending under this threshold is not considered as a threat to security by the other countries. The only exception is found for the bivariate relationship between Greece and Turkey where the slope coefficient shows a moderate effect for Greece's spending above the threshold. Further, there are indications that the pairwise relationships in the military expenditures of Greece and Turkey as well as the pairwise relationships in the military expenditures of Turkey and Israel may not necessarily be symptomatic of a military escalation on behalf of one country, but they may be due to other factors (political, economic).

The results presented have strong policy implications. First, there is an asymmetric strategic interaction between the countries examined, as revealed by the cointegration analysis. This implies that there is a long-run association between the military spending of the countries, independent of the existence or not of a bilateral causality effect, namely of an arms race. Consequently, each country should determine its level of military spending accounting not only for operational factors but also for the signaling of its military spending on its neighboring countries. Further, the fact that this strategic interaction is asymmetric implies that the intensity and the direction of this relationship may change after a specific level of military spending, making the determination of the appropriate level of military spending a complex military and political decision. Second, despite the existence of asymmetric cointegration, there is no indication of arms races among the neighboring countries. Third, the increase in the military spending of one country does not cause the reaction of the other country under a security threshold. This finding is of vital importance as it implies that each country has a certain margin of military spending to ensure its security, without threatening the security of the other countries. Consequently, there is room for a military spending equilibrium, where all countries are safe without threatening the others (peace margin), which increases the possibility for peaceful solutions in the disputes of Southeast Mediterranean region.

Overall, our analysis has established a more solid understanding of the linkages between the military spending of neighboring countries and has contributed towards a profounder understanding of the conditions under which peace can prevail in the Mediterranean region.

Notes

1. The results concerning the pairwise relationships between Greece-Israel, Egypt–Greece and Egypt–Turkey are also available upon request.
2. Data are acquired from https://www.sipri.org/databases/milex.
3. We have performed quantile-mean covariance normality tests that provide evidence of non-normal distribution of the variables under consideration. The results are available from the authors upon request.
4. Sun (2011) extended only the second of part of Enders and Siklos'(2001) methodology, namely the short run analysis, by splitting the lagged variables of the error correction model into positive and negative changes. Therefore, the long-run asymmetric cointegrating relationship is performed according to Enders and Siklos (2001) while the short run analysis, which includes the examination of the causal bilateral analysis, is performed according to Sun (2011).

Disclosure statement

No potential conflict of interest was reported by the authors.

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References

Abu-Qarn, A. S., and S. Abu-Bader. 2003. "Government Expenditures, Military Spending and Economic Growth: Causality Evidence from Egypt, Israel and Syria." *Journal of Policy Modelling* 25 (6–7): 567–583. https://doi.org/10.1016/S0161-8938(03)00057-7.

Amir-Ud-Din, R., F. Waqi Sajjad, and S. Aziz. 2020. "Revisiting Arms Race Between India and Pakistan: A Case of Asymmetric Causal Relationship of Military Expenditures." *Defence and Peace Economics* 31 (6): 721–741. https://doi.org/10.1080/10242694.2019.1624334.

Andreou, A. S., and G. A. Zombanakis. 2000. "Financial versus Human Resources in the Greek-Turkish Arms Race: A Forecasting Investigation Using Artificial Neural Networks." *Defence and Peace Economics* 11 (2): 403–426. https://doi.org/10.1080/10430710008404956.

Andreou, A. S., and G. A. Zombanakis. 2011. "Financial versus Human Resources in the Greek-Turkish Arms Race 10 Years On: A Forecasting Investigation Using Artificial Neural Networks." *Defence and Peace Economics* 22 (4): 459–469. https://doi.org/10.1080/10242694.2010.539858.

Avramides, C. A. 1997. "Alternative Models of Greek Defence Expenditures." *Defence and Peace Economics* 8 (2): 145–187. https://doi.org/10.1080/10430719708404874.

Axt, H. J. 2022. "Conflicts and Global Powers in the Eastern Mediterranean. An Introduction." *Comparative Southeast European Studies* 70 (3): 393–413. https://doi.org/10.1515/soeu-2022-0052.

Bardakçı, M. 2022. "Turkey and the Major Powers in the Eastern Mediterranean Crisis from the 2010s to the 2020s." *Comparative Southeast European Studies* 70 (3): 516–539. https://doi.org/10.1515/soeu-2021-0071.

Bastian, J. 2022. "The Dragon Reaches the Eastern Mediterranean: Why the Region Matters to China." *Comparative Southeast European Studies* 70 (3): 486–515. https://doi.org/10.1515/soeu-2021-0079.

Bragoudakis, Z., and G. Zombanakis. 2017. "Earning a Peace Dividend in a Crisis Environment: The Greek Case." *Peace Economics Peace Science and Public Policy* 23 (3): 20160040. https://doi.org/10.1515/peps-2016-0040.

Brauer, J. 2002. "Survey and Review of the Defence Economics Literature on Greece and Turkey: What Have We Learned?" *Defence and Peace Economics* 13 (2): 85–107. https://doi.org/10.1080/10242690210969.

Cavatorta, E., and R. P. Smith. 2017. "Factor Models in Panels with Cross-Sectional Dependence: An Application to the Extended SIPRI Military Expenditure Data." *Defence and Peace Economics* 28 (4): 437–456. https://doi.org/10.1080/10242694.2016.1261428.

Chan, K. S. 1993. "Consistency and Limiting Distribution of the Least Squares Estimator of a Threshold Autoregressive Model." *The Annals of Statistics* 21 (1): 520–533. https://doi.org/10.1214/aos/1176349040.

Chan, K. S., and R. S. Tsay. 1998. "Limiting Properties of the Least Squares Estimator of a Continuous Threshold Autoregressive Model." *Biometrika* 85 (2): 413–426. https://doi.org/10.1093/biomet/85.2.413.

Chen, P. F., C. C. Lee, and Y. B. Chiu. 2014. "The Nexus Between Defence Expenditure and Economic Growth: New Global Evidence." *Economic Modelling* 36:474–483. https://doi.org/10.1016/j.econmod.2013.10.019 .

Choulis, I., M. Mehrl, and K. Ifantis. 2021. "Arms Racing, Military Build-Ups and Dispute Intensity: Evidence from the Greek-Turkish Rivalry, 1985-2020." *Defence and Peace Economics* 33 (7): 1–26. https://doi.org/10.1080/10242694.2021.1933312.

DeRouen, K., Jr. 2000. "The Guns–Growth Relationship in Israel." *Journal of Peace Research* 37 (1): 69–83. https://doi.org/10.1177/0022343300037001004.

Dickey, A. D., and A. W. Fuller. 1979. "Distribution of the Estimators for Autoregressive Time Series with a Unit Root." *Journal of the American Statistical Association* 74 (366): 427–431. https://doi.org/10.1080/01621459.1979.10482531 .

Dorsman, A. B., V. Ş. Ediger, and M. B. Karan, Eds. 2018. *Energy Economy, Finance and Geostrategy*. Springer International Publishing. https://doi.org/10.1007/978-3-319-76867-0 .

Dunne, J. P., E. Nikolaiodu, and D. Voguas. 2001. "Defence Spending and Economic Growth: A Causal Analysis for Greece and Turkey." *Defence and Peace Economics Special Issue* 12 (1): 5–26. https://doi.org/10.1080/10430710108404974.

Emmanouilidis, K., and C. Karpetis. 2020. "The Defence-Growth Nexus: A Review of Time Series Methods and Empirical Results." *Defence and Peace Economics* 31 (1): 86–104. https://doi.org/10.1080/10242694.2018.1428261.

Enders, W., and P. L. Siklos. 2001. "Cointegration and Threshold Adjustment." *Journal of Business and Economic Statistics* 19 (2): 166–176. https://doi.org/10.1198/073500101316970395.

Francis, B. B., M. Mougoue, and V. Panchenko. 2010. "Is There a Symmetric Nonlinear Causal Relationship Between Large and Small Firms?" *Journal of Empirical Finance* 17 (1): 23–38. https://doi.org/10.1016/j.jempfin.2009.08.003.

Georgiou, G. 1990. "Is There an Arms Race Between Greece and Turkey? Some Preliminary Econometric Results." *Cyprus Journal of Economics* 3 (1): 58–73.

Georgiou, G. M., P. T. Kapopoulos, and S. Lazaretou. 1996. "Modelling Greek-Turkish Rivalry: An Empirical Investigation of Defence Spending Dynamics." *Journal of Peace Research* 33 (2): 229–239. https://doi.org/10.1177/0022343396033002008.

Hansen, B. E. 2017. "Regression Kink with an Unknown Threshold." *Journal of Business and Economic Statistics* 35 (2): 228–240. https://doi.org/10.1080/07350015.2015.1073595.

Isomitdinov, H., J. Lee, and J. E. Payne. 2021. "Comovements in Military Spending: Evidence from a Dynamic Factor Model with Time-Varying Stochastic Volatility." *Defence and Peace Economics* 34 (1): 1–23. https://doi.org/10.1080/10242694.2021.1952503.

Jarque, C. M., and A. K. Bera. 1980. "Efficient Tests for Normality, Homoscedasticity and Serial Independence of Regression Residuals." *Economics Letters* 6 (3): 255–259. https://doi.org/10.1016/0165-1765(80)90024-5.

Karagol, E., and S. Palaz. 2004. "Does Defence Expenditure Deter Economic Growth in Turkey? A Cointegration Analysis." *Defence and Peace Economics* 15 (3): 289–298. https://doi.org/10.1080/10242690320001608908.

Karbuz, S. 2018. "Geostrategic Importance of East Mediterranean Gas Resources." In *Energy Economy, Finance and Geostrategy*, Edited by A. Dorsman, V. Ediger, and M. Karan. Cham, Switzerland: Springer.

Khan, K., C. W. Su, and S. K. A. Rizvi. 2022. "Guns and Blood: A Review of Geopolitical Risk and Defence Expenditures." *Defence and Peace Economics* 33 (1): 42–58. https://doi.org/10.1080/10242694.2020.1802836.

Kollias, C., and S. Makrydakis. 1997. "Is There a Greek-Turkish Arms Race?: Evidence from Cointegration and Causality Tests." *Defence and Peace Economics* 8 (4): 355–379. https://doi.org/10.1080/10430719708404886.

Kollias, C., and S. Paleologou. 2002. "Is There a Greek-Turkish Arms Race? Some Further Empirical Results from Causality Tests." *Defence and Peace Economics* 13 (4): 321–328. https://doi.org/10.1080/10242690212357.

Kollias, C., S. Paleologou, and A. Stergiou. 2016. "Military Expenditure in Greece: Security Challenges and Economic Constraints." *The Economics of Peace & Security Journal* 11 (1): 28–34. https://doi.org/10.15355/epsj.11.1.28 .

Kollias, C., S. Paleologou, and M. Zouboulakis. 2021. "Defence Spending and Sovereign Debt in Greece: A Long-Term Historical Perspective." *Peace Economics Peace Science and Public Policy* 27 (4): 531–548. https://doi.org/10.1515/peps-2021-0020.

Kuimova, A. 2020. "Understanding Egyptian Military Expenditure." *SIPRI Background Papers* 25 (3) :1–24. Accessed December 10, 2022.

Kwiatkowski, D., P. C. B. Phillips, P. Schmidt, and Y. Shin. 1992. "Testing the Null Hypothesis of Stationarity Against the Alternative of a Unit Root: How Sure are We That Economic Time Series Have a Unit Root?" *Journal of Econometrics* 54 (1–3): 159–178. https://doi.org/10.1016/0304-4076(92)90104-Y.

Lee, J., and M. C. Strazicich. 2013. "Minimum LM Unit Root Test with One Structural Break." *Economics Bulletin* 33 (4): 2483–2492.

Maher, M., and Y. Zhao. 2022. "Do Political Instability and Military Expenditure Undermine Economic Growth in Egypt? Evidence from the ARDL Approach." *Defence and Peace Economics* 33 (8): 1–24. https://doi.org/10.1080/10242694.2021.1943625.

Nusair, S. A., and D. Olson. 2019. "The Effects of Oil Shocks on Asian Exchange Rates; Evidence from Quantile Regression Analysis." *Energy Economics* 78:44–63. https://doi.org/10.1016/j.eneco.2018.11.009 .

Öcal, N. 2002. "Asymmetric Effects of Military Expenditure Between Turkey and Greece." *Defence and Peace Economics* 13 (5): 405–416. https://doi.org/10.1080/10242690213511.

Öcal, N., and J. Yildirim. 2009. "Arms Race Between Greece and Turkey: A Threshold Cointegration Analysis." *Defence and Peace Economics* 20 (2): 123–129. https://doi.org/10.1080/10242690801962254.

Olson, M., and R. Zeckhauser. 1966. "An Economic Theory of Alliances." *The Review of Economics and Statistics* 48 (3): 266–279. https://doi.org/10.2307/1927082.
Özer, H. A. 2017. "Asymmetric Causality Between Economic Growth and Military Expenditures: The Case of Turkey." *The Empirical Economics Letters* 16 (9): 899–907.
Pan, C. I., T. Chang, and Y. Wolde-Rufael. 2015. "Military Spending and Economic Growth in the Middle East Countries: Bootstrap Panel Causality Test." *Defence and Peace Economics* 26 (4): 443–456. https://doi.org/10.1080/10242694.2014.891356.
Prontera, A., and M. Ruszel. 2017. "Energy Security in the Eastern Mediterranean." *Middle East Policy* 24 (3): 145–162. https://doi.org/10.1111/mepo.12296.
Richardson, L. F. 1960. *Arms and Insecurity: A Mathematical Study of the Causes and Origins of War*. Pittsburgh, PA: Boxwood.
Rosh, R. M. 1988. "Third World Militarization: Security Webs and the States They Ensnare." *Journal of Conflict Resolution* 32 (4): 671–698. https://doi.org/10.1177/0022002788032004004.
Saba, C. S. 2021. "Convergence or Divergence Patterns in Global Defence Spending: Further Evidence from a Nonlinear Single Factor Model." *Peace Economics Peace Science and Public Policy* 27 (1): 51–90. https://doi.org/10.1515/peps-2020-0012.
Sapiro, S. S., and R. S. Francia. 1970. "An Approximate Analysis of Variance Test for Normality." *Journal of the American Statistical Association* 67 (337): 215–216. https://doi.org/10.1080/01621459.1972.10481232.
Sapiro, S. S., and M. B. Wilk. 1965. "An Analysis of Variance Test for Normality (Complete Samples)." *Biometrika* 52 (3 and 4): 591–611. https://doi.org/10.1093/biomet/52.3-4.591.
Sezgin, S. 2001. "An Empirical Analysis of Turkey's Defence–Growth Relationships with a Multi-Equation Model (1956–1994)." *Defence and Peace Economics* 12 (1): 69–86. https://doi.org/10.1080/10430710108404977.
Smith, R. P. 1989. "Models of Military Expenditure." *Journal of Applied Econometrics* 4 (4): 345–359. https://doi.org/10.1002/jae.3950040404.
Smith, R. P. 2020. "The Influence of the Richardson Arms Race Model." In *Lewis Fry Richardson: His Intellectual Legacy and Influence in the Social Sciences. Pioneers in Arts, Humanities*, edited by N. P. Gleditsch. Vol. 27. Cham: Science, Engineering, Practice.
Stavrinos, V. 1992. "Defence Expenditure in Arms Competition: Modelling and Causality Analysis." *Greek Economic Review* 14 (1): 115–128.
Stavrinos, V. G., and G. A. Zombanakis. 1998. "The Vicious Cycle of the Foreign Military Debt." *European Research Studies* 1 (1): 5–16.
Sun, C. 2011. "Price Dynamics in the Import Wooden Bed Market of the United States." *Forest Policy and Economics* 13 (6): 479–487. https://doi.org/10.1016/j.forpol.2011.05.009.
Tan, A. T. 2013. *The Arms Race in Asia: Trends, Causes and Implications*. Routledge. https://doi.org/10.4324/9781315881690.
Tanchum, M. 2021 18 August. "The Race to Reset the Middle East's Maritime Map." Middle East Institute. Accessed December 14, 2022. https://www.mei.edu/publications/race-reset-middle-easts-maritime-map .
Yalta, A. T., and F. Tüzün. 2021. "Time Varying Determinants of US Demand for Defence Spending in the Post-Cold War Era." *Defence and Peace Economics* 32 (7): 829–846. https://doi.org/10.1080/10242694.2020.1725856.
Yildirim, J., and S. Sezgin. 2002. "The Demand for Turkey Defence Expenditure." *Defence and Peace Economics* 13 (2): 121–128. https://doi.org/10.1080/10242690210973.
Yildirim, J., S. Sezgin, and N. Öcal. 2005. "Military Expenditure and Economic Growth in Middle Eastern Countries: A Dynamic Panel Data Analysis." *Defence and Peace Economics* 16 (4): 283–295. https://doi.org/10.1080/10242690500114751.
Yolcu Karadam, D., J. Yildirim, and N. Öcal. 2017. "Military Expenditure and Economic Growth in Middle Eastern Countries and Turkey: A Non-Linear Panel Data Approach." *Defence and Peace Economics* 28 (6): 719–730. https://doi.org/10.1080/10242694.2016.1195573.
Zhong, M., T. Chang, S. Goswami, R. Gupta, and T. W. Lou. 2017. "The Nexus Between Military Expenditures and Economic Growth in the BRICS and the US: An Empirical Note." *Defence and Peace Economics* 28 (5): 609–620. https://doi.org/10.1080/10242694.2016.1144897.
Zivot, E., and D. W. K. Andrews. 1992. "Further Evidence on the Great Crash, the Oil-Price Shock, and the Unit-Root Hypothesis." *Journal of Business and Economic Statistics* 10 (3): 25–44. https://doi.org/10.2307/1391541.