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The Defense Spending and GDP Nexus in the Middle East: Evidence from Gradual and Nonlinear Structural Shifts

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ABSTRACT

This study examines the long-run relationship between defense spending and economic growth in 14 Middle Eastern countries from 1988 to 2023. Using Fourier LM unit root and Fourier ADL cointegration models, we account for gradual and nonlinear structural shifts often missed by conventional tests. Results show that most defense spending and GDP series are non-stationary but cointegrated once smooth breaks are incorporated. Income elasticity estimates reveal wide variation: oil-based economies such as Kuwait maintain rigid defense budgets, while the UAE and Lebanon show disproportionately higher responsiveness. Findings highlight how fiscal capacity and geopolitics shape defense and growth dynamics.

Keywords: Cointegration, Defense Spending, Fourier Approximation, Middle East Countries
JEL Classifications: C32, H56, O53

1. INTRODUCTION

Defense spending has long been a defining feature of fiscal policy in the Middle East, a region frequently characterized by ongoing security challenges, territorial conflicts, and shifting geopolitical alliances. Countries such as Saudi Arabia, the United Arab Emirates, and Israel allocate a significant portion of their GDP to military budgets, far exceeding global averages (SIPRI, 2024). These high defense allocations are often justified by national security concerns, strategic ambitions, and the need to project regional influence.

While military investments can stimulate the economy through job creation, defense procurement, and technological spillovers (Atesoglu, 2002; Awaworyi and Yew, 2018), they may also limit growth by crowding out productive public expenditures in areas such as infrastructure, education, and healthcare (D'Agostino et al., 2017; Azam, 2020). This trade-off becomes especially critical in economies that depend heavily on oil revenues, which are susceptible to volatility, thereby complicating fiscal planning and long-term investment strategies.

Traditional econometric models have primarily assumed a stable and linear relationship between defense spending and economic growth. However, such assumptions are often unrealistic in the Middle Eastern context, where economic structures evolve in response to political instability, external shocks, and fluctuating oil prices. Standard structural break models also fall short in capturing gradual or endogenous shifts in macroeconomic dynamics. As a result, this study uses sophisticated time-series econometric methods, including the Fourier ADL cointegration model (Enders and Lee, 2012) and the Fourier LM unit root test (Banerjee et al. 2017), which are designed to account for smooth, non-linear changes in economic relationships over time.

The dataset includes yearly defense spending and real GDP data for 14 Middle Eastern countries, collected from the SIPRI Military Expenditure Database and the World Bank. This study aims to examine the existence and characteristics of long-term equilibrium relationships between defense spending and economic growth, while accounting for structural nonlinearities and gradual shifts unique to Middle Eastern economies. The research also investigates the responsiveness of defense spending to changes in national income, measured through the income elasticity of defense budgets. The findings will provide a nuanced understanding of the interplay between fiscal priorities and economic performance in a region where the balance between security and development is particularly delicate.

The remainder of the paper is structured as follows. Section 2 reviews the relevant literature. Section 3 describes the econometric framework, focusing on unit root and cointegration methodologies that accommodate an unknown number of smooth structural shifts through a Fourier transformation. Section 4 introduces the dataset and reports the empirical findings from the unit root and cointegration analyses, together with the results of the elasticity estimations. Finally, Section 5 discusses the findings, their implications, and concludes.

2. LITERATURE REVIEW

The long-term relationship between defense spending (DS) and economic growth (GDP) has generated varied findings across countries and empirical methodologies. Earlier theoretical and empirical studies also examined the potential relationship between military expenditure and economic development in developing economies (Deger & Smith, 1983). In advanced economies such as those within NATO and the OECD, defense outlays often serve multiple objectives—ranging from maintaining military readiness to fostering technological innovation and supporting alliance obligations. Despite these roles, the economic effects of DS remain theoretically ambiguous and empirically inconsistent. Studies suggest that the outcomes are highly contingent on the estimation approach and country-specific conditions (Dunne and Uye, 2010; Aizenman and Glick, 2006).

Among NATO countries, several studies have examined the presence of cointegration between DS and GDP using both time-series and panel approaches. Additional empirical evidence from European economies further supports the importance of examining defense expenditure within different institutional and economic contexts (Chang et al., 2014). For example, Kollias et al. (2004) applied panel cointegration tests to NATO members and found weak or no long-run relationship in most cases. Similarly, Dunne and Nikolaidou (2012) used dynamic panel techniques to show that the economic impact of defense spending is highly heterogeneous across alliance members, depending on strategic roles, defense industry capacity, and fiscal policy alignment. Countries like the United States, with a large defense-industrial base, demonstrated positive growth linkages, whereas smaller contributors like Portugal or Belgium showed no significant effect. Oh et al. (2025) supported evidence of stochastic co-movement between defense spending and GDP in NATO member states, examined on a country-by-country basis for the period 1988-2022.

The OECD countries present a similar pattern. Narayan and Singh (2007) conducted a panel cointegration analysis across OECD economies and concluded that only those with well-developed domestic military sectors, such as the U.S., France, and the U.K., exhibited long-run cointegration between DS and GDP. For nations heavily reliant on defense imports or characterized by stable security environments, the relationship was either neutral or negative. Recent advancements by Yildirim and Sezgin (2021) using ARDL bounds testing confirmed these findings, emphasizing the role of structural and industrial factors in shaping the defense-growth nexus. Evidence from the MENA region also indicates that the relationship between defense spending and economic growth varies across countries depending on economic structure and fiscal priorities (Abdel-Khalek et al., 2019).

In the context of the top 10 global military spenders, including the U.S., China, India, Russia, Saudi Arabia, the U.K., France, Germany, Japan, and South Korea, results vary widely. Hou (2009) found that while countries with strategic export-oriented defense industries experienced positive long-run effects on GDP, others like Saudi Arabia and India, where spending is high but largely import dependent, showed limited or negative growth effects. These disparities underscore the importance of considering defense composition, fiscal sustainability, and geopolitical strategy in DS-GDP analyses.

Studies employing Fourier-based cointegration techniques (e.g., Aydın et al., 2022; Ucler, 2024) demonstrate that smooth structural changes, such as defense reforms, alliance shifts, or geopolitical shocks, can significantly influence long-run relationships. These methods provide more accurate modeling for countries with changing defense postures and are particularly relevant for comparative analyses across Middle Eastern, NATO, and top-spending nations.

Although numerous studies have examined the defense spending–GDP nexus in NATO, OECD, and other top-spending countries, the evidence remains context specific and method dependent. Some advanced economies, particularly those with integrated defense industrial bases, exhibit a stable long-run relationship, while others demonstrate weak or inconsistent patterns. By contrast, despite the Middle East's considerable political, religious, and geopolitical importance, comparative analyses of defense spending and economic growth in the region are still limited. To address this gap, the present study employs advanced non-linear cointegration models for strategically important Middle Eastern countries, providing fresh insights into the long-term economic consequences of defense investment.

3. METHODOLOGY

This study analyzes the long-run relationship between defense spending (DS) and GDP for key Middle Eastern countries by applying modern econometric methods that allow for gradual structural changes over time, as suggested by Enders and Lee (2012) and Banerjee et al. (2017). First, the research tests whether the natural logarithms of defense spending per capita and real GDP per capita are stationary using the Fourier LM unit root test, which improves traditional unit root tests by including flexible trigonometric terms that approximate smooth shifts in the data. After identifying non-stationarity, the Engle and Granger (1987) and the autoregressive distributed lag (ADL) (Banerjee et al., 1998) tests are used as a benchmark to test for cointegration, followed by the Fourier ADL cointegration test to detect a stable long-run relationship while capturing unknown smooth breaks. For countries where cointegration holds, the income elasticity of defense spending is calculated from the Fourier ADL estimates to show how sensitive defense spending is to changes in economic output, providing a nuanced view of the region's security and fiscal dynamics.

3.1. Unit Root Test

To examine whether the time series for military expenditure per capita and real GDP per capita are non-stationary, this study implements the Fourier LM unit root test introduced by Enders and Lee (2012). Unlike conventional unit root tests such as the Augmented Dickey-Fuller (ADF) or Phillips-Perron (PP) tests, which either assume no structural breaks or only abrupt changes at known points, the Fourier LM test is designed to detect smooth structural changes. This feature is particularly appropriate for Middle Eastern economies, where defense spending and economic performance may shift gradually over time due to long-term policy reforms, shifts in oil markets, and evolving regional conditions.

The Fourier LM unit root test incorporates a flexible trigonometric approximation into the standard test equation, allowing the trend component of the time series to adapt smoothly rather than change abruptly. The test is estimated using the following model:

$$\Delta y_t = \phi \tilde{s}_{t-1} + \alpha_0 + \alpha_1 \Delta \sin\left(\frac{2\pi kt}{T}\right) + \alpha_2 \Delta \cos\left(\frac{2\pi kt}{T}\right) + \sum_{m=1}^{p} \lambda_m \Delta \tilde{s}_{t-m} + \varepsilon_t \quad (1)$$

where $\tilde{s}_t$: Detrended series, $k=1,2,\ldots,5$: A single frequency, p: The number of included lagged detrended series to control for possible serial correlation in ε_t, T: The number of observations, and α_0, α_1, α_2, and λ_m: Estimated coefficients. The detrended series is: $\tilde{s}_{it} = y_t - \tilde{\xi} - \tilde{\delta}_0 t - \tilde{\delta}_1 \sin\left(\frac{2\pi kt}{T}\right) - \tilde{\delta}_2 \cos\left(\frac{2\pi kt}{T}\right)$ where $\tilde{\xi} = y_{i1} - \tilde{\delta}_{0i} - \tilde{\delta}_{1i} \sin\left(\frac{2\pi kt}{T}\right) - \tilde{\delta}_{2i} \cos\left(\frac{2\pi kt}{T}\right)$ and $\tilde{\delta}_{0i}$, $\tilde{\delta}_{1i}$, and $\tilde{\delta}_{2i}$: The estimated coefficients.

The null hypothesis (H_0: $\varphi = 0$) states that the series exhibits a unit root and is therefore non-stationary, whereas the alternative hypothesis (H_A: $\varphi < 0$) indicates stationarity once smooth structural variation is incorporated through the Fourier terms. The frequency parameter k is estimated by minimizing the residual sum of squares (SSR), allowing the data itself to determine the presence, shape, and timing of any gradual structural breaks without requiring prior knowledge of their occurrence.

3.2. Cointegration Test

Once it is confirmed that the log-transformed time series for defense spending per capita and real GDP per capita are non-stationary and integrated of order one, the next step is to test whether the two variables share a stable long-run equilibrium relationship. Detecting cointegration is crucial in time-series econometrics because it implies that, despite short-term deviations, the variables move together over time and any disequilibrium is corrected.

Standard residual-based tests, such as Engle and Granger, assume that any structural changes in the cointegration relationship are either non-existent or occur as abrupt breaks at known points in time. However, in many real-world situations, particularly in Middle Eastern economies, structural adjustments in fiscal policy, defense priorities, and macroeconomic frameworks often evolve gradually. These smooth changes can arise due to sustained oil market cycles, progressive policy reforms, or evolving geopolitical conditions. If such smooth structural shifts are not accounted for, the power of conventional cointegration tests can be significantly reduced, potentially leading to misleading inferences (Gregory and Hansen, 1996).

To address this limitation, the study extends the analysis by applying the Fourier Autoregressive Distributed Lag (Fourier ADL) cointegration test developed by Banerjee et al. (2017). This approach augments the standard ADL framework by adding a Fourier series approximation that allows the model to capture unknown, gradual structural shifts in the long-run relationship without requiring prior knowledge of when or how these shifts occur.

Formally, the Fourier ADL model of Banerjee et al. (2017), which does incorporate trigonometric terms (sine and cosine), can be expressed as follows:

$$\Delta lnDS_{1t} = s(t) + \delta' DS_{t-1} + \gamma' GDP_{t-1} + \phi' \Delta GDP_t + \varepsilon_t \quad (2)$$

Where,

$$s(t) = \gamma_0 + \gamma_1 t + \sum_{k=1}^{q} \gamma_{1,k} \sin\left(\frac{2\pi kt}{T}\right) + \sum_{k=1}^{q} \gamma_{2,k} \cos\left(\frac{2\pi kt}{T}\right), \quad q \le T/2 \quad (3)$$

In Eq. (2), the parameter $k = 1, 2, \ldots, 5$ corresponds to a specific frequency, while $q = 2, 3, 4, 5$ represents the number of frequencies contained in the approximation. T is the number of observations. The disturbance term is assumed to follow an independent and identically distributed process with constant variance, such that $\epsilon_t \sim iid\,(0,\ \sigma^2_{\varepsilon_t})$. The optimal values of lags, k, and q are selected using Akaike's information criterion (AIC). The test statistic is obtained from the t-statistic associated with testing $\delta = 0$ in Eq. (2). The null hypothesis (H_0: $\delta = 0$) indicates no cointegration, whereas the alternative hypothesis (H_A: $\delta < 0$) supports the presence of a long-run equilibrium once smooth structural changes are incorporated.

4. DATA AND EMPIRICAL RESULTS

4.1. Data

The empirical analysis in this study relies on an unbalanced dataset covering 14 strategically significant Middle Eastern countries: Bahrain, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, the United Arab Emirates (UAE), and Yemen. These countries were selected due to their diverse levels of defense spending, varying economic capacities, and the unique security contexts that shape fiscal decision-making in the region.

Annual data on defense spending per capita, expressed in constant US dollars, was obtained from the Stockholm International Peace Research Institute (SIPRI) Military Expenditure Database. This source is widely regarded for its comprehensive and consistent tracking of global defense budgets. Real GDP per capita figures, also measured in constant US dollars, were retrieved from the World Bank's World Development Indicators to ensure comparability across countries and over time (World Bank, 2024).

To facilitate econometric analysis, both series were transformed into natural logarithms, which stabilizes the variance and facilitates the interpretation of elasticity measures. The study period spans 1988-2023, capturing multiple episodes of economic and geopolitical significance, including oil price shocks, regional conflicts, and structural economic reforms.

4.2. Fourier LM Unit Root Test

To examine the integration properties of defense spending and GDP series prior to cointegration analysis, we implement the Fourier LM unit root test developed by Enders and Lee (2012). This method allows for smooth, nonlinear deterministic shifts in the data-generating process by incorporating trigonometric terms and is particularly suitable for countries experiencing gradual structural transformations, such as defense policy transitions or macroeconomic realignments.

Following Enders and Lee (2012), we consider a grid search over the low-frequency Fourier terms $1 \leq k \leq 5$, selecting the frequency that minimizes the sum of squared residuals. Critical values at the 1%, 5%, and 10% significance levels were simulated based on 20,000 replications for $T = 50$, approximating our sample size ($T = 36$). These values vary across frequency levels and are reported beneath Table 1.

The test statistics from the Fourier LM unit root test for both defense spending (DS) and GDP across 14 Middle Eastern countries are summarized in Table 1. At the 5% level, the null hypothesis of a unit root is rejected only for Egypt (DS) and Iraq (GDP). No other series is significant at the 5% or 10% level for its corresponding Fourier frequency (k). This means that the majority of the data series remain non-stationary, even when smooth structural breaks are taken into account.

Accordingly, among the 28 series examined (14 defense spending and 14 GDP), only two, Egypt's defense spending and Iraq's GDP, exhibit stationarity at the 5% significance level. The remaining 26 series are integrated of order one, $I(1)$, despite allowing for smooth structural breaks. This confirms the appropriateness of applying nonlinear Fourier-based cointegration methods in the next stage of analysis.

4.3. Cointegration Test

4.3.1. Cointegration test results without structural breaks

Because cointegration analysis requires both variables to be integrated of order one, Egypt (stationary defense spending) and Iraq (stationary GDP) are excluded from the cointegration tests. The cointegration sample, therefore, consists of 12 Middle Eastern countries. To evaluate the long-run equilibrium relationship between defense spending and GDP, we begin with conventional cointegration tests that do not account for structural breaks - specifically, the Engle and Granger (1987) residual-based test and the autoregressive distributed lag (ADL) test (Banerjee et al. 1998). As shown in Table 2, the Engle and Granger test rejects the null hypothesis of no cointegration only for two countries: Kuwait and Syria at the 1% and 10% level, respectively.

The ADL test identifies more robust evidence of cointegration. Kuwait again displays strong cointegration with a t-statistic of −20.728, significant at the 1% level. Iran (−4.187) and the United Arab Emirates (−5.966) also reject the null hypothesis at the 1% level, while Saudi Arabia (−3.434) is significant at the 5% level. Jordan (−3.337) and Syria (−3.110) are significant at the 5% and 10% levels, respectively. In contrast, no evidence of cointegration is found for Bahrain, Lebanon, Oman, Qatar, or Yemen under both testing methods.

Table 1: Unit root test for defense spending and GDP

Counties	Defense spending			GDP		
	t – stat	$\hat{k}$	Lags	t – stat	$\hat{k}$	Lags
Bahrain	−2.953	1	1	−2.803	2	0
Egypt	−4.247**	1	1	−3.216	2	1
Iran	−3.252	1	0	−2.775	1	0
Iraq	−1.753	2	0	−3.495**	3	3
Israel	−1.669	4	3	−2.665	1	3
Jordan	−2.075	1	0	−1.813	2	2
Kuwait	−2.774	2	2	−2.794	1	1
Lebanon	−3.404	1	1	−3.620	1	1
Oman	−2.890	1	0	−2.026	2	0
Qatar	−0.000	2	3	−2.817	1	0
Saudi Arabia	−2.947	1	0	−2.878	2	0
Syria	−1.325	1	0	−2.771	1	3
UAE	−1.247	5	0	−2.790	2	0
Yemen	−2.246	1	0	−2.872	1	1

***, **, and * denotes 1%, 5%, and 10% significance level, respectively. The 1%, 5%, and 10% critical values for the Enders and Lee (2012) tests (T=50) are−4.84, −4.19, −3.88 (k=1), −4.33, −3.62, −3.24 (k=2), −4.04, −3.30, −2.94 (k=3), −3.86, −3.15, −2.82 (k=4), −3.76, −3.08, −2.76 (k=5)

Table 2: Cointegration tests without structural breaks

Countries	(a) Engle and granger		(b) ADL		
	t-stat_{EG}	Lags	t-stat_{ADL}	Lags	
				dY	dX
Bahrain	−2.803	1	−2.103	2	1
Iran	−2.335	0	−4.187***	1	1
Israel	−0.980	3	−1.507	2	2
Jordan	−3.537	3	−3.337**	1	2
Kuwait	−6.424***	3	−20.728***	3	1
Lebanon	−1.779	1	−0.63	3	1
Oman	−2.454	0	−1.296	3	1
Qatar	−0.331	0	−0.000	2	1
Saudi Arabia	−3.510	1	−3.434**	1	1
Syria	−3.811*	0	−3.110*	1	2
UAE	−2.003	0	−5.966***	2	2
Yemen	−2.785	0	−0.527	2	2

(a) The 1%, 5%, and 10% critical values for the EG test from the response surface approach of MacKinnon are−4.76, −4.04, and−3.69, respectively. (b) The 1%, 5%, and 10% critical values for the ADL test (T=50) are−3.95, −3.29, and−2.94, respectively. (c) ***, **, and *denotes 1%, 5%, and 10% significance level, respectively

These results suggest that conventional linear cointegration models, which ignore potential structural breaks, detect long-run relationships in only a minority of cases. This highlights the importance of adopting more flexible testing frameworks, such as those incorporating smooth structural shifts, to better capture underlying dynamics in the region.

4.3.2. Cointegration test results with smooth structural breaks

To address the limitations of conventional cointegration tests that fail to account for structural instability, we applied the Fourier ADL (FADL) cointegration test proposed by Banerjee et al. (2017). Unlike traditional methods, this approach accommodates smooth structural breaks through trigonometric terms, allowing for gradual, nonlinear changes in the cointegration relationship over time. Table 3 presents the results for both single-frequency and cumulative-frequency variants of the FADL test.

Based on the single-frequency results, six countries, including Israel (–5.676, $k = 4$), Jordan (–4.774, $k = 3$), Lebanon (–5.514, $k = 2$), Oman (–5.245, $k = 1$), Saudi Arabia (–4.975, $k = 2$), and the United Arab Emirates (–7.902, $k = 2$), are significant at the 1% level. Three additional cases, such as Bahrain (–4.020, $k = 3$), Iran (–3.673, $k = 5$), and Kuwait (–3.354, $k = 5$), are significant at the 5% level. Syria (–1.548, $k = 3$), Yemen (–1.334, $k = 3$), and Qatar (–0.000, $k = 3$) show no statistical evidence of cointegration. Overall, these results indicate that when smooth structural breaks are incorporated using a single frequency, the majority of the sample exhibits a long-run equilibrium relationship between military expenditure and economic output.

The cumulative-frequency Fourier ADL (FADL) model is used to test for cointegration when the relationship between defense spending and GDP may have been affected by more than one smooth structural shift over time. By adding multiple Fourier components ($q > 1$) to the deterministic term, this method can model several gradual, nonlinear changes, unlike the single-frequency version that captures only one main break (Enders and Lee, 2012; Banerjee et al., 2017). This is relevant in economies where defense–growth dynamics may have been shaped by repeated policy adjustments, geopolitical events, or economic cycles. However, including additional Fourier terms also increases the number of estimated parameters, which reduces degrees of freedom and can lower the statistical power of the test in short time series like the one used here ($T = 36$) (Banerjee et al., 2017).

The cumulative-frequency specification, which incorporates multiple Fourier terms to capture more complex structural patterns, applies stricter critical thresholds. This reduces the number of significant cases relative to the single-frequency approach. Kuwait remains highly significant at the 1% level (–14.088), while Jordan retains significance at the 5% level (–5.959). In contrast, several countries significant under the single-frequency model, including Israel, Lebanon, Oman, Saudi Arabia, and the UAE, do not meet the elevated critical values when multiple frequencies are included. This suggests that while the cumulative-frequency approach offers greater flexibility, it may also dilute statistical power due to the estimation of additional parameters, particularly in relatively short time series (Banerjee et al., 2017).

4.4. Income Elasticity

After confirming the existence of a long-run cointegrating relationship between defense spending and GDP for most of the countries under study, the next step is to estimate the income elasticity of defense spending. This measure reflects the responsiveness of defense expenditure to changes in national income and is obtained from the long-run coefficients of the Fourier ADL cointegration model. From Eq. (2), the income elasticity of defense spending (DS) is derived as the ratio of the percentage change in defense spending to the percentage change in income (proxied by GDP), expressed as:

$$\text{Income elasticity of DS} = \frac{\%\ \text{Change in DS}}{\%\ \text{Change in GDP}} = -\frac{\gamma}{\delta} \qquad (4)$$

Here δ is the adjustment coefficient on lagged defense spending, and γ captures the long-run effect of GDP on DS. The negative sign arises from the normalization in the error-correction formulation, where δ is typically negative under cointegration. Hence, the long-run elasticity is identified through the ratio of the estimated coefficients δ and γ.

Table 3: Cointegration tests with smooth breaks

Counties	(A) FADL (single frequency)				(b) FADL (cumulative frequency)			
	t-stat ($\hat{k}$)	$\hat{k}$	Lags dY	dX	t-stat ($\hat{q}$)	$\hat{q}$	Lags dY	dX
Bahrain	−4.020**	3	5	5	−4.634	3	1	2
Iran	−3.673**	5	1	5	−1.728	2	1	2
Israel	−5.676***	4	3	5	−3.753	2	3	1
Jordan	−4.774***	3	1	2	−5.959**	3	3	1
Kuwait	−3 0.354**	5	5	3	−14.088***	3	1	2
Lebanon	−5.514***	2	2	3	−3.140	3	3	3
Oman	−5.245***	1	2	3	−2.780	2	3	3
Qatar	−0.000	3	5	1	−0.000	2	2	1
Saudi Arabia	−4.975***	2	3	2	−4.241	2	3	2
Syria	−1.548	3	4	5	−3.253	3	3	3
UAE	−7.902***	2	5	5	−2.603	3	3	3
Yemen	−1.334	3	5	5	−3.413	3	3	3

(a) The 1%, 5%, and 10% critical values of Banerjee et al. (2017) tests with single frequency are: −4.86, −4.15, and−3.79 (k=1); −4.56, −3.79, and−3.39 (k=2); −4.27, −3.51, and−3.13 (k=3), −4.12, −3.37, and−3.00 (k=4); −4.04, and−3.30, −2.94 (k=5). (b) The 1%, 5%, and 10% critical values of Banerjee et al. (2017) tests with multiple frequencies are: −5.63, −4.88, and−4.50 (q=2); −6.34, −5.54, and−5.13 (q=3); −7.03, −6.17, and−5.74 (q=4); −7.70, −6.77, and−6.30 (q=5).(c) ***, **, and * denotes 1%, 5%, and 10% significance level, respectively

Table 4: Long-run elasticity estimates

Countries	Delta	Gamma	Income elasticity
Kuwait	−0.398	0.052	0.130
Iran	−0.645	0.199	0.308
Oman	−0.865	0.458	0.529
Jordan	−1.189	0.859	0.723
Israel	−0.796	0.615	0.773
Bahrain	−0.841	0.659	0.784
Saudi Arabia	−1.096	1.093	0.997
Lebanon	−1.160	1.162	1.002
UAE	−3.048	3.610	1.184

Both coefficients, δ and γ, are obtained from the single-frequency FADL estimation

As shown in Table 4, the results indicate heterogeneity across countries in the responsiveness of defense spending to changes in income. The elasticity values range from 0.130 in Kuwait to 1.184 in the United Arab Emirates (UAE). When elasticity is below one, defense outlays increase at a slower pace than income growth, implying that defense functions as a basic or essential expenditure that governments sustain regardless of economic cycles. By contrast, elasticity values greater than one suggest that defense spending rises more rapidly than income, reflecting a discretionary or income-sensitive component within national budgets.

Kuwait (0.130), Iran (0.308), and Oman (0.529) show relatively low elasticities, indicating that their defense budgets are rigid and only weakly responsive to income growth, with defense treated as a core, non-discretionary expenditure largely insulated from cyclical variations in GDP. By contrast, Jordan (0.723), Israel (0.773), and Bahrain (0.784) exhibit moderate elasticities, where increases in income translate into proportionally higher defense outlays, though still below the level at which spending becomes highly income-sensitive. Saudi Arabia (0.997) and Lebanon (1.002) lie at or near unit elasticity, suggesting a nearly one-to-one relationship between GDP growth and defense spending, underscoring the centrality of defense within their fiscal priorities. The UAE (1.184), however, stands out with an elasticity exceeding unity, implying that defense is highly income-elastic; in this case, rising national income disproportionately boosts defense expenditure, reflecting both heightened security priorities and the country's resource-driven fiscal capacity.

Taken together, the findings underscore a gradient of defense-income sensitivity across the region. Oil-rich economies such as Kuwait exhibit low elasticities, likely reflecting stable defense commitments irrespective of income fluctuations. In contrast, states like the UAE and Lebanon show high elasticity, pointing toward a more dynamic linkage where defense budgets expand aggressively during periods of income growth.

Overall, the elasticity estimates provide insight into the strategic priorities of Middle Eastern countries. Those with lower elasticities appear to maintain essential defense levels irrespective of economic cycles, while countries with higher elasticities tend to scale military budgets more aggressively in response to economic growth (Hong, 2003; Sandler and Shimizu, 2014; Oh et al., 2025). These findings align with earlier research suggesting that fiscal flexibility and geopolitical orientation shape the defense-income nexus in heterogeneous ways across the region.

5. CONCLUSION

This study investigated the long-run relationship between defense spending and economic growth in 14 Middle Eastern countries over the period 1988–2023, employing Fourier LM unit root and Fourier ADL cointegration techniques to account for smooth structural shifts. The empirical results reveal that conventional cointegration methods, which assume linearity and abrupt breaks, detect limited evidence of long-run co-movement between defense expenditure and GDP. By contrast, the Fourier-based approach provides stronger and more robust evidence of cointegration in the majority of countries, underscoring the importance of modeling gradual, nonlinear changes in fiscal and macroeconomic dynamics.

The estimated income elasticities reveal significant variation across the region. In countries such as Kuwait, Iran, and Oman, defense expenditure shows a relatively fixed character, remaining stable regardless of fluctuations in national income. Jordan, Israel, and Bahrain display moderate income responsiveness, with defense budgets that expand gradually as economies grow. Saudi Arabia and Lebanon exhibit near-proportional responses, where changes in GDP are closely mirrored by defense spending. The UAE, however, demonstrates a distinctly expansive pattern: as income rises, defense spending grows at an even faster pace, reflecting both its elevated security priorities and substantial fiscal resources.

These results highlight that defense spending in the Middle East is shaped less by a uniform economic principle than by country-specific fiscal capacity, geopolitical imperatives, and security strategies. In some states, defense operates as a baseline commitment largely insulated from economic cycles, while in others it scales more dynamically with economic performance.

From a policy perspective, these results carry two implications. First, governments with high elasticities should be mindful of the potential crowding-out effects of defense spending on growth-enhancing investments, particularly during income booms. Second, countries with rigid defense budgets face risks of fiscal stress during downturns, especially in contexts of oil price volatility. Recognizing the asymmetric nature of defense–income linkages is thus essential for balancing security imperatives with sustainable economic development.

Finally, this study underscores the methodological value of Fourier-based cointegration approaches for analyzing economies characterized by persistent shocks and gradual transformations. Future research could extend this framework to examine interactions with political institutions and external security alliances, or explore dynamic effects using nonlinear causality models. By situating Middle Eastern defense spending within a flexible econometric framework, this study advances understanding of the long-term trade-offs between national security and economic growth in a strategically significant region.

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