Hybrid Threat Effects: Exploring Growth Linkages in Geopolitical Context

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Abstract

This paper aims at assessing the extent to which hybrid threats affect the rate of growth of an economy. The answer to this research question is considered by focusing on a specific pair of countries, namely Greece and Turkey, both being NATO members. We use a system of equations for each of the two counties which relate GDP growth rates to an interaction variable incorporating hybrid threats and defence equipment purchases. The results show that there is a statistically significant effect of the hybrid threat on the growth rate of both countries which, to a large extent, relates to the development of the domestic military industrial base. The policy implications derived point to the need for investment in the domestic defence technology and infrastructure, not only for reasons of deterrence, but also for promoting economic growth.

Keywords: Hybrid threats, Economic growth, Defence industry.

JEL Classification: C22; F52; H56; O40.

1. Introduction

A glance at the literature review section of this paper, below, indicates that there is no consensus as to whether the concept of hybrid warfare reflects new methods and ideas regarding warfare or, if instead it is "old concept with new techniques". Whatever the answer to this debate maybe, the fact remains that the specific concept became very popular following the Russo - Ukrainian war in 2014, with its popularity in the academic literature still going strong. But while the role of hybrid warfare in strategic studies has been thoroughly considered, this is not the case with its impact on economic activity and growth. Aiming at filling this gap in the literature, our paper examines the impact of hybrid threats on the rate of growth of an economy. We have opted for considering this specific issue in the context, of a pair of countries, namely Greece and Turkey, which, despite both being NATO members, have a long history of friction between them. We have linked the GDP growth rates to defence equipment purchases, considering an interaction variable representing hybrid threats, given that, to the best of our knowledge, such an interaction variable has not been employed before in the literature.

In such a context, we point out the links between hybrid threats and the growth of the Greek and Turkish economies. Using the NATO database, we construct a system of behavioural equations for both countries which we estimate using the three – stage least squares (3SLS) methodology. This aims at assessing the extent to which hybrid threats affect the performance of the two economies as this is measured by their growth rate. We also draw useful conclusions as to whether and how the development of a domestic defence industrial base (DIB) may contribute to the growth of the economies of Greece and Turkey. The paper points to the fact that provided that the industrial base of a country is considerably defence-oriented, it may contribute to self-sufficiency, immediate response in cases of threats, both conventional and hybrid in an environment in which the increased requirements in view of the recent geopolitical developments impose a prohibitive cost on the economy.

The remainder of the paper is organized as follows: The next section presents a brief literature review, followed by a description of the data properties and the

econometric methodology employed. We present and discuss the results derived in section 4, before our conclusions in the final section of the paper.

2. A Brief Literature Review

The war in Ukraine has triggered a considerable literature inflow on the subject of hybrid warfare. We shall begin with an interesting contribution in the form of a literature review in which Johnson (2018) considers the relevant contributions explaining the concept of hybrid warfare. The paper illustrates how this type of warfare has developed to being a manifestation of current frictions in armed conflict and points out that fighting hybrid wars involves more measures in the strategic and political domains rather than in the operational or tactical sphere. As Libiseller (2023) points out, the term "made its 'breakthrough' on the international stage only when NATO used it in reference to Russia's annexation of Crimea and involvement in civil war in Eastern Ukraine in 2014". Indeed, there are contributions like Mansoor (2012) who states that despite the fact that hybrid war is not new as a concept, it is a useful tool of analyzing wars past, present and future. "It is complex and does not conform to a one-size-fits-all pattern, but it makes use of all possible approaches, considering factors as strategic culture, historical legacy, geographic reality, economy and military factors". Giles (2015) agrees with the view that as long as there is not a specific definition of hybrid warfare it will suffer from having to be understood in too broad a perspective. On the other hand, Mumford (2020) states that, according to Luttwak (2021) strategy has a paradoxical logic. Therefore, Mumford continues, "despite that hybrid war is complex, paradoxical and nonlinear, all types of war strategies are paradoxical in the Luttwakian sense". Lasconjarias and Larsen (2015) define hybrid war as the true combination and blending of various means of conflict, both regular and unconventional, dominating the physical and psychological battlefield with information and media control, using every possible means to reduce one's exposure. Therefore, hybrid wars are sophisticated and come into play at every level of spectrum of conflict, from the tactical to the strategic. NATO Secretary General Jens Stoltenberg (2015) noted that the Trojan Horse might be the first hybrid warfare we know. According to NATO (2023) hybrid threats combine military and non-military as well

as covert and overt means, including disinformation, cyber-attacks, economic pressure, deployment of irregular armed groups and use of regular forces. In fact, “hybrid methods are used to blur the lines between war and peace and attempt to sow doubt in the minds of target populations, aiming at destabilizing and undermine societies”.

Mumford and Carlucci (2023) focus on the war in eastern Ukraine of 2014 and the South China Sea dispute. In fact, the title of their paper is “Hybrid warfare: The continuation of ambiguity by other means” as the symptom of a changing political environment. Indeed, Schroefl and Kaufman (2014) believe that “the core problem (regarding hybrid warfare) is more political than military”. Remaining in the case of Asia and the hybrid warfare issue, Aoi at al. (2018) in a special issue on the subject, explore the extent to which “hybridity” affects national policy, doctrines, and military transformation in Asia. They review the concept of ‘hybrid warfare’ to support their view that regional strategic thinking and practice have long been shaped by features of hybrid warfare. They also point to the impact of maritime geography concerning ‘hybrid’ courses of actions as regards ‘grey zone’ operations, considering ways to attain effectiveness of such strategies. To stress the intertemporal character of hybrid warfare, frequent references to Clausewitz (1993) are used, e. g. Milevski (2023), Deep (2015) with the latter quoting that “Every age has its own kind of war, its own limiting conditions, and its own peculiar preconceptions”.

Apart from politics and international relations, the issue of hybrid warfare is also related to the science of economics. More specifically, Bluszcz and Valente (2022) estimate the causal effects of the Donbass war on Ukraine’s GDP. According to the paper, Ukraine’s per capita GDP has been reduced during the war by 15.1% on average for 2013–2017, while the corresponding figure for the Donetsk and Luhansk region is 47% for 2013–2016. Given the extent of the damage, the paper discusses mechanisms related to the impact of the war on economic performance as these are related to the role of government in hybrid conflict management. Further in the area of economics, Sokhatskyi et al. (2020) discuss the impact of defence spending and public debt on the economic growth of US, China, Russia, Israel, Ukraine and Moldova. The paper uses a dynamic regression model to determine the impact of a hybrid war on the GDP growth rates of these countries.

Focusing on specific countries seems to be popular in the literature. Thus, Schnaufer (2017) uses the term non-linear war to describe Russia's actions during the war in Ukraine. The term non-linear war (NLW) is described as "the application of collective subversive measures on a state(s) by another state actor, targeting its government, population, and vital social functions". Such actions aim at fulfilling a grand strategy without a clear declaration of war. Further on the Russian case, Wither (2016) places the debate about hybrid warfare in a broader analytical and historical context focusing on the Russian approach to hybrid warfare as demonstrated by operations in Ukraine. Suckhov (2021) in his turn explains how the hybrid warfare concept impacts Russian political and military practice. It explains how the concept of a hybrid war affects the understanding of warfare by the new generation of the Russian military policy and how it is now embedded in the thinking of the elites. Concerning other individual counties involved in a hybrid warfare environment, Kotoulas and Pusztai (2020), consider the emigration flows from Turkey to Greece as being part of a greater hybrid warfare strategy of the former against the latter at a first round and against the EU in general. Finally, Rauta and Monaghan (2021), contribute to the hybrid debate by distinguishing between threats and warfare. Focusing on the United Kingdom's policy on the issue, the argue that this "closes the gap between stagecraft and statecraft". Once this is done, according to the authors, then Britain needs to consider a certain number of issues from its experience and through that, help international policy and research communities address the issue of hybrid warfare accordingly.

3. Data Statistical Properties and Econometric Methodology

3.1 Data Sources and Description of Variables

Our research question is approached via a system of equations that relates GDP growth rates to a hybrid threat variable and the demand for defence equipment purchases. To account for the threat, we construct an interaction variable that considers hybrid threats, not only conventional (Sandler and Hartley, 1995), but unconventional as well, in the sense proposed by Mansoor (2012), Lasconjarias and Larsen (2015) and

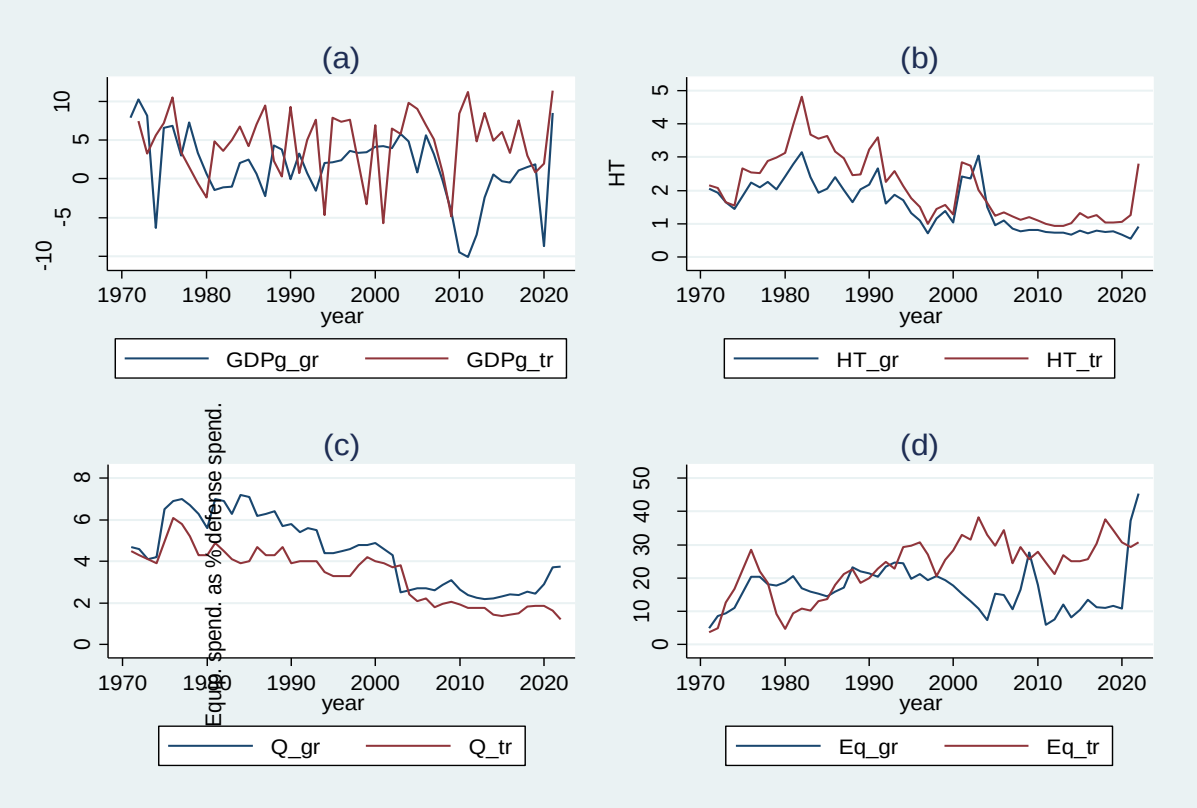
NATO (2023). To do so, we create a new interaction variable which is the enemy's demand for defence spending as a percentage of GDP, multiplied by the Geopolitical Risk Index. This composite variable aims at introducing the impact of hybrid warfare, which according to the definitions cited above includes a broader field of covert and overt threats. The advantages of such an interaction variable are that it captures hybrid threats in both their regular and unconventional sense at a worldwide scale. Assuming that Greece and Turkey are risk takers in the global geopolitical scene, they can be taken as considering such a Global Geopolitical Risk Index in their decision-making process. In terms of the technicalities of the issue, we take the average of the following categories of conventional and unconventional threats, namely War Threats (Category 1), Peace Threats (Category 2), Military Buildups (Category 3), Nuclear Threats (Category 4), Terror Threats (Category 5), Beginning of War (Category 6), Escalation of War (Category 7), Terror Acts (Category 8). To the best of our knowledge an interaction variable between conventional and unconventional threats has not been employed before in the existing literature.

Using various sources, we collect yearly data during the time period 1971 – 2022 for Greece and Turkey. Table 1 summarizes the variables used in our system, the notation and the corresponding sources.

Table 1: Variables, notation, and sources

Variable	Notation	Source
GDP growth rate (annual)	GDP_g	World Development Indicators (World Bank)
Total demand for defence spending (% of GDP)	Q	NATO – Information on Defence Expenditures (https://www.nato.int/cps/en/natohq/topics_49198.htm)
Demand for equipment spending (% of total defence spending)	Eq	NATO – Information on Defence Expenditures (https://www.nato.int/cps/en/natohq/topics_49198.htm)
Interaction (hybrid) variable between	HT	Geopolitical Risk Index https://www.policyuncertainty.com/gpr.html NATO – Information on Defence Expenditures

conventional and unconventional threats		(https://www.nato.int/cps/en/natohq/topics_49198.htm)
Geopolitical Risk Index	gpr	Geopolitical Risk Index https://www.policyuncertainty.com/gpr.html
Spill – ins[1]	S	NATO – Information on Defence Expenditures (https://www.nato.int/cps/en/natohq/topics_49198.htm)
Gross capital formation (% of GDP)	Inv	AMECO World Development Indicators (World Bank)
Current Account (% of GDP).	CA	World Development Indicators (World Bank)



[1] Spill – ins of an alliance member i is calculated as the total defence spending of the (n-1) remaining members expressed as the total NATO demand for defence spending as a percentage of all NATO n members GDP.

Figure 1: a. GDP growth rates. **b.** Interaction threat variable (conventional and hybrid) **c.** Demand for defence spending (% GDP) **d.** Equipment defence spending (% of total defence spending)

Figure 1 displays the time evolution of main variables of our model for Greece and Turkey, respectively. Figure 1b shows that the hybrid threat variables of the two countries follow similar paths but the Turkey's threat variable fluctuates at higher levels compared to that of Greece. Similar paths are observed for both countries when it comes to their demand for defence spending as a percentage of GDP (fig.1c) where we observe that Greece's share of demand for defence spending is higher than that of Turkey, partly because of the need of the country to counterbalance the higher Turkish GDP, both in terms of rates (fig. 1a) and absolute values. Finally, the share of equipment defence spending on the corresponding total spending, reported in figure 1d, reveals that, with the exception of the period from early to mid-80's and after 2020, Turkey's equipment share in total defence spending has been substantially higher compared to Greece's. This may be explained by the following factors: First, because Turkey has invested in capital - intensive Armed Forces contrary to Greece. In fact, according to the NATO database (Table 2), Greece's spending for personnel increased from 63.7% of total military spending in 1990 to 75.6% in 2020, while the corresponding share of equipment has decreased from 21.8% to 12.1%. On the contrary, Turkey's spending on equipment has increased from 20.7% of total military spending in 1990 to 28.2% in 2020, while the expenditure on personnel has increased only by 5.5% since 1990. Therefore, it becomes evident that Turkey has chosen to channel more funds to equipment compared to personnel. Second, Turkey has chosen to develop a solid national defence industrial base (DIB), which, according to Sandler and Hartley (1995), means that, at least at the early stages, the country bears the development costs (R and D, lack of economies of scale etc.), thus implying a higher share of equipment spending.

Table 2: Personnel and equipment spending as % of total defense spending for Greece (Gr) and Turkey (Tr).

Year	Personnel-Gr	Equipment-Gr	Personnel-Gr	Equipment-Tr
1990	63.7	21.8	46.1	20.7
2000	62.9	18.3	41.9	33.6
2010	58.1	27.1	49.7	27.9
2020	75.6	12.1	50.6	28.2

Table 3 presents summary statistics for the variables used. We observe that the mean GDP growth rate of Turkey (4.6 %) is three times higher than Greece's (1.5%). Both countries exhibit negative but moderate skewness in their GDP growth rates which is a sing of symmetrical distribution. The same conclusion is reached when it comes to the kurtosis of their GDP growth rates whose values are close to 3 (mesokurtic), which is also a sing of normal distribution. Further, we observe that both countries spend, on average, more that 3% of their GDP for their defense (4.5 % of GDP for Greece and 3.3 % for Turkey), while Turkey's share of equipment on total defense spending is much higher than Greece's (23.3 % and 16.8 %, respectively). Our evidence is also consistent with a higher volatility of Greece's defense spending, compared to Turkey's. It also holds that both countries' kurtosis and skewness values indicate that total defence spending and spending for defence equipment exhibit symmetrical and normal distribution. When it comes to the interaction variable between conventional and hybrid threats we find that the average threat is more intense in Turkey (2.1) compared to Greece (1.5). In addition, we observe that the volatility of the hybrid threat variable, namely the standard deviation, is also higher in Turkey (0.98) compared to Greece (0.73). The asymmetric features of Turkey's and Greece's threats become evident by the values of kurtosis (2.6 and 1.9, respectively).

Table 3: Summary statistics

Variable	No. of obs.	Mean	Median	Standard Deviation	Skewness	Kurtosis
GDP_{g_gr}	51	1.505	2.018	4.490	-0.715	3.522
Q_{gr}	52	4.470	4.550	1.672	0.094	1.628
Inv_{gr}	52	21.141	20.283	6.519	0.719	3.627
CA_{gr}	45	-4.615	-3.461	3.464	-1.196	3.817
Eq_{gr}	51	16.795	16.400	7.346	1.380	6.576
HT_{gr}	51	1.543	1.499	0.730	0.341	1.926
S	52	3.644	3.050	1.156	0.507	1.820
GDP_{g_tr}	50	4.623	5.039	4.172	-0.714	2.994
Q_{tr}	51	3.303	3.800	1.296	-0.067	1.901
Inv_{tr}	51	23.197	23.718	5.096	-0.127	1.889
CA_{tr}	48	-2.534	-2.399	2.337	-0.110	2.850
Eq_{tr}	51	23.290	25.080	8.631	-0.605	2.645
HT_{tr}	52	2.088	1.889	0.975	0.655	2.563

3.2 Econometric methodology

Following Zellner and Theil (1962) we develop a three – stage least squares (3SLS) system of four equations, the parameters of which will be estimated jointly. Since we focus our empirical analysis on Greece and Turkey, namely two countries whose decisions concerning defence spending and other geopolitical issues are interrelated in an arms race environment (Kollias and Paleologou, 2002, Andreou and Zombanakis 2006; Öcal and Yildirim, 2009; Palaios and Papapetrou, 2023), we need an econometric methodology that will estimate all the parameters of a system of equations jointly. The main advantage of the 3SLS methodology is that it allows for the possibility of contemporaneous correlations between the disturbances in a model of different structural equations (Johnston and Dinardo, 2007). Therefore, we develop a system of jointly estimated equations of the following form:

$$\begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{bmatrix} = \begin{bmatrix} Z_1 & 0 & \dots & 0 \\ 0 & Z_2 & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \dots & Z_n \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_n \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \varepsilon_n \end{bmatrix} \quad (1)$$

The above set of n equations can be written as

$$y_i = Z_i\beta_\iota + \varepsilon_i, \;\; i = 1, \dots n \qquad (2)$$

Where, y_i is an $n\ x\ 1$ vector of observations on the ith variable, Z_i is an n x k_i matrix representing both the endogenous and the exogenous right – hand – side variables in the set of equations, β_i is a k_i x 1 vector of coefficients and ε_i is an n x 1 vector of disturbances. Specifically, our set of the four jointly estimated equations using 3SLS methodology, is the following:

$$GDP_{g\_gr_t} = a_0 + a_1 Q_{gr_t} + a_2 Inv_{gr_t} + a_3 CA_{gr_t} + \varepsilon_{1t} \qquad (3)$$

$$Q_{gr_t} = \beta_0 + \beta_1 Eq_{gr_t} + \beta_2 HT_{gr_t} + \beta_3 S_t + \varepsilon_{2t} \qquad (4)$$

Where $HT_{gr_t} = gpr_t$ x Q_{tr_t}

$$GDP_{g\_tr_t} = \gamma_0 + \gamma_1 Q_{tr_t} + \gamma_2 Inv_{tr_t} + \gamma_3 CA_{tr_t} + \varepsilon_{3t} \qquad (5)$$

$$Q_{tr_t} = \delta_0 + \delta_1 Eq_{tr_t} + \delta_2 HT_{tr_t} + \delta_3 S_t + \varepsilon_{4t} \qquad (6)$$

Where $HT_{tr_t} = gpr_t$ x Q_{gr_t}

$GDP_{g\_gr_t}, GDP_{g\_tr_t}, Q_{gr_t}, Q_{tr_t}$ represent the endogenous variables of our system. All the other variables are considered exogenous and uncorrelated with the disturbances. Therefore, the exogenous variables are taken to be instruments for the endogenous variables.

4. Empirical Results and Discussion

Our results point to the effect of the hybrid threat variable on the GDP growth rates of Greece and Turkey through the demand for defence expenditure. This allows for the possibility of contemporaneous correlation between the disturbances in different

structural equations because the relevant decisions of the two countries are interrelated in an arms race environment[2].

Table 4: Estimation results using three – stage least squares methodology.

	(1)	(2)	(3)	(4)
Ind. Var.	GDP_{g_gr}	Q_{gr}	GDP_{g_tr}	Q_{tr}
Q_{gr}	-0.957**			
	(0.393)			
Inv_{gr}	0.819***			
	(0.135)			
CA_{gr}	0.628***			
	(0.166)			
Eq_{gr}		0.0453***		
		(0.0148)		
HT_{gr}		0.430**		
		(0.177)		
S		1.199***		0.798***
		(0.141)		(0.204)
Q_{tr}			2.766***	
			(0.729)	
Inv_{tr}			0.660***	
			(0.187)	
CA_{tr}			-0.966***	
			(0.235)	
Eq_{tr}				0.0603***
				(0.0189)
HT_{tr}				0.561***
				(0.188)
Constant	-7.921***	-1.164***	-22.75***	-2.166**
	(1.847)	(0.416)	(6.496)	(0.929)
Obs	45	45	45	45
R-squared	0.461	0.817	0.254	0.617

Notes: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.
GDP_g denotes the GDP growth rate, Q denotes total military spending as a percentage of GDP, Inv is gross capital formation as a percentage of GDP, Eq is the share of equipment spending as a percentage of total military spending, HT is the interaction variable between conventional and hybrid threats, S denotes spill-ins from NATO allies.

[2] As a robustness analysis we also perform alternative methodologies of simultaneous equations systems as seemingly unrelated regression (SURE), multivariate regression (MVREG), equation by equation OLS and two – stage least squares (2SLS). The results remain qualitatively the same and they are available by the authors upon request.

Table 4 presents the estimation results of our four equations system. Columns one to four show the estimation results of each equation, with the first row of each column indicating the endogenous, namely the dependent variable of each system equation. Regarding Greece's equations 1 and 2 (columns one and two), we observe the following: When it comes to the equation of the demand for military spending (eq. 2) we find a statistically significant positive effect of the spill – ins variable, the equipment spending variable and the hybrid threat variable on the total military spending. Further, when it comes to the growth equation of Greece (eq. 1) we find a statistically significant negative effect of the total military spending on the GDP growth rate and positive coefficients for investments and the current account. In the case of Turkey's demand for defence spending equation (eq. 4), we observe a positive and statistically significant impact of the spill – ins variable, the equipment spending variable and the hybrid threat variable on the total military spending. In addition, concerning the growth equation of Turkey (eq. 3), we find statistically significant coefficients for the investment and current account variables, but, contrary to the case of Greece, a positive impact of the total defence spending on the GDP growth rates. However, it should be noted that despite the fact that Turkey aims to be self-reliant on its own defence expenditure, we observe that there is a cost for that policy. As revealed by the coefficients of the equipment spending on the total defence expenditures, an increase in Turkish equipment spending leads to a higher increase in total military expenditure of Turkey, compared to Greece. Combining this finding with the previous one, namely the positive impact of the Turkish military spending on the country's GDP growth rate, we conclude that despite the benefits on the GDP because of the industrial military base of Turkey, the cost of acquiring the domestically produced military equipment remains high.

In addition, we find positive and statistically significant coefficients of spill – ins on the total military expenditures for both countries, which rules out the possibility of free riding. When it comes to the impact of the hybrid threat variable, we observe that in both cases the impact on the total military expenditure is positive and statistically significant. Our results are in line with Sandler and Hartley (1995) which also find empirical evidence that rival defence expenditures tend to raise a nation's demand for

defence. As expected, the magnitude of the threat impact is higher in the case of Turkey which implies that the country responds to possible threats using hard power while Greece's reaction is of lower intensity (soft power), in the sense mentioned by Sørensen et al. (2022). The difference in the response may attributed to the different geopolitical context of the two countries as well as the participation of Greece in the European Union, which is in favor of the use of soft power and diplomacy in facing threats.

Table 5: Estimated Elasticities

Type of elasticity	estimated elasticities for Greece	estimated elasticities for Turkey
$\frac{\%\,\Delta Q}{\%\,\Delta HT}$	0.148	0.354
$\frac{\%\,\Delta Q}{\%\,\Delta Eq}$	0.169	0.422
$\frac{\%\,\Delta GDP}{\%\,\Delta HT}$	-0.421	0.699
$\frac{\%\,\Delta GDP}{\%\,\Delta Q}$	-2.839	1.976
$\frac{\%\,\Delta GDP}{\%\,\Delta Eq}$	-0.480	0.836

Notes: The elasticity with respect to each variable is calculated according to the following formula: $\varepsilon = \frac{\left(\frac{\Delta Y}{Y}\right)}{\left(\frac{\Delta X}{X}\right)} = \frac{\Delta Y}{\Delta X}\frac{\bar{X}}{\bar{Y}}$, where $\frac{\Delta Y}{\Delta X}$ is the estimated coefficient obtained usisng the 3SLS methodology (see results in table 2)

Based on the estimated coefficients presented in table 2, we calculate the respective elasticities depicted in table 5. A close look at the elasticities may highlight the following comparisons and policy issues: As our primary focus is on hybrid threat on growth, we note that the elasticity of GDP growth rate with respect to hybrid threat is positive for Turkey and negative for Greece. We believe that this finding is justified, given that an increased threat leads to increases in demand for defence spending. This, in its turn, brings about a different impact on each of the two countries GDP growth

rate depending on the level of national DIB and its contribution to the total output of the economy. Given that the Turkish defence industry is prosperous and growing at high paces as opposed to that of Greece, it follows that the Turkish economy benefits from the domestic production and acquisition of the required military equipment. This finding is corroborated by the higher response of total defence spending to threats in Turkey compared to Greece.

Further, we observe that the elasticity of total demand for defence with respect to the hybrid threat is for both countries positive and inelastic, but it is substantially higher for Turkey, in line with the results of the estimated coefficients. The interpretation of this finding is twofold: First, it is a sing of the use of hard versus soft power for Turkey and Greece, respectively, due to the differences in the geopolitical context and the institutional environment of the two countries. Second, according to Vuković et al. (2016) in the case of hybrid war the rapidness or inertia in the making of political decision plays a decisive role in the outcome of the conflict. Therefore, a higher elasticity of total demand for defence with respect to the threat variable implies a faster response on behalf of the political and military hierarchy of Turkey against the hybrid threat, which gives the country a decisive advantage.

In addition, the elasticity of total demand for defence with respect to the demand for defence equipment is positive and inelastic for both countries. However, we observe that the elasticity of Turkey is substantially higher than that of Greece's, which indicates that a 1% increase in the demand for defence equipment in Turkey costs more than in Greece, as it leads to a higher percentage increase in the demand for total defence spending. A first possible explanation for the higher cost relates to the fact that the Turkish military industrial base lacks an efficient mechanism for science and technology policy-making mechanism, which is the major obstacle toward sustainable development (Mevlutoglou, 2017). A second explanation is that the Turkish DIB does not seem to have achieved efficiency and massive production yet so that it cannot take advantage of economies of scale. The latter explanation is justified by Sandler and Hartley (1995), who state that the increased cost may be due to the high development costs, cost and time overruns, costs trends, lack of economies of scale and learning process and cost of stretching out programs. Furthermore, Hartley (2008) mentions that

"there is strong evidence in favour of a positive relationship between annual defence R&D spending made 10–25 years earlier and equipment quality, and the relationship is subject to substantial diminishing returns". Therefore, it takes time for the DIB to produce qualitative and competitive military equipment and even though Turkey has a more advanced defence industrial base (DIB) compared to Greece it is still more costly for the former to acquire domestically produced military equipment.

Overall, despite the higher cost of domestic military production for Turkey, which obviously burdens the fiscal balance, we find that the Turkish DIB benefits the country's economy when it comes to GDP growth rate. This is a finding in line with Doulos et al. (2021) who find that when defence spending on equipment is to a large extent imported, as in the case of Greece, it deprives the economy of valuable sources.

5. Conclusions

This paper provides empirical evidence on the impact of hybrid threats on the rate of growth. The answer is attempted by focusing on a specific pair of countries, namely Greece and Turkey, both being NATO members, for the period 1971 – 2022. To model our research question, we develop a system of equations which relate GDP growth rates to a hybrid threat variable and defence equipment purchases, an approach which we believe is novel in this field thus far. Since the decisions concerning defence spending and other geopolitical issues of those countries are interrelated due to the arms race between them, we use the three-stage least squares econometric methodology that allows for the possibility of contemporaneous correlations between the disturbances in a model of different structural equations.

In this context we show that a variety of covert and overt threats can exercise a considerable effect (positive in the case of Turkey and negative in the case of Greece) on the GDP growth. In fact, these results are in line with the corresponding impact of the demand for defence spending on the GPD growth rates of the two countries (positive in the case of Turkey and negative in the case of Greece). We interpret this finding as being a result of a solid and constantly developing Turkish defence industry which boosts economic growth. Despite that, the elasticity of total demand for defence with respect to the hybrid threat is for both countries positive and inelastic, but it is

substantially higher for Turkey revealing that the Turkish economy is not yet in a position to benefit in fiscal terms from the rising DIB.

Overall, the policy implications derived point to the need for investment in domestic defence technology and infrastructure, not only for reasons of hybrid threat deterrence, but also for promoting economic growth.

Author contributions

The authors have equally contributed to all parts of this paper. All the authors have read and approved the final manuscript.

Data Availability Statement

The data employed in this research paper and the codes to replicate the results are available upon request.

Declarations

Consent for publication

This study presents original material that has not been published elsewhere.

Disclosure Statement

The authors declare that they have no competing interests, or other interests that might be perceived to influence the results and/or discussion reported in this paper.

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