Defending the nation, securing the economy

Iulia-Cristina Iuga[1], Adela Socol[2]

[1] *"1 Decembrie 1918" University of Alba Iulia, Faculty of Economic Sciences, Department Finance-Accounting, Romania, ORCID: 0000-0002-2831-3055, iuga_iulia@yahoo.com;*

[2] *"1 Decembrie 1918" University of Alba Iulia, Faculty of Economic Sciences, Department Finance-Accounting, Romania, ORCID: 0000-0002-9774-2494, adela.socol@uab.ro.*

Abstract: *Literature on the effects of military expenses and GDP is mixed, although a significant body of research supports the hypothesis that military expenses positively impact GDP. To contribute to the literature, this article analyses whether military expenditures influenced GDP in 27 European Union member countries from 1998 to 2021 by studying two clusters specific to the analysed countries: NATO and non-NATO countries. The way in which military expenditures affect GDP has been analysed using both the classic static models for panel data (pooled OLS, fixed effects, random effects, feasible generalized least squares, panel corrected standard errors, Poisson pseudomaximum likelihood regression) as well as by applying dynamic panel model system GMM, reverse causality, and half-panel jackknife regression models, with unemployment and inflation selected as control variables. The findings indicate that the current values of military expenditures positively influence GDP in both clusters, while past values of military expenditures positively influence GDP in the NATO EU countries and negatively affect GDP in the non-NATO EU countries. There are several key differences between NATO EU members and non-NATO EU members, particularly in regard to their security commitments and defence spending. NATO members are part of a mutual defence pact, agreeing to the principle of collective defence, which also impacts public defence policies and public budgets. This paper offers practical value to policymakers, stakeholders, and academicians. In addition, it has two significant political implications. First, it highlights the role of military expenditures as a catalyst for economic growth but does not underestimate the dangers of using military spending as a pretext to stimulate employment. Second, it establishes the optimal proportion of military expenditures required to fulfil two essential targets of national and European policies – security and welfare.*

Keywords: *GDP, military spending, unemployment, inflation, GMM.*

JEL Classification: *E24, P24, P44, C23, H61, H50.*

APA Style Citation: Iuga, I.-C., & Socol, A. (2023). Defending the nation, securing the economy. *E&M Economics and Management*, *26*(4), 17–37. https://doi.org/10.15240/tul/001/2023-4-002

Introduction

Gross domestic product (GDP) is considered an indicator of a country's economic well-being. Military spending and states' welfare, represented by GDP, has been widely discussed in recent decades, since the 1970s and has increased in recent years (Benoit, 1978; Norkus et al., 2021; Topal et al., 2022). Conflict and insecurity are significant obstacles to economic growth (Dunne et al., 2005) and can be partially alleviated by increasing military spending. NATO's immediate response capability can only be achieved and maintained by ensuring adequate human, material, and logistical resources. Therefore, in NATO (North Atlantic Treaty Organisation), the defence and security expenses of the member states are very well established. All these resources, in turn, depend on the existing financial resources at the level of each member state. Given that the field of defence is part of the public sector, at the level of each state, military expenses are

allocated as a certain percentage of GDP. In the wake of the Cold War, many NATO countries' governments reduced their investments in their security. This trend was evident both in the developed European countries, NATO members, and in the new NATO member states experiencing fundamental transformation processes in the 1990s (Odehnal & Neubauer, 2020).

The NATO Summit of 2014 declared that NATO allies must aim to allocate 2% of their GDP towards their defence spending by the year 2024. With the complicated security situation in Europe from 2022, NATO has boosted its capability to defend its member countries against direct military threats.

In recent times, several NATO countries in Europe have started to boost their defence expenditure. However, only a limited number of NATO members have followed their long-standing political promise to dedicate 2% of their GDP to defence. Additionally, variations in the factors that influence military spending across NATO countries have resulted in an unequal distribution of the financial burden of defence spending among the member economies.

Of the 27 European Union (EU) member states, only 21 are NATO members. In all of these 21 states, the share of GDP allocated to military spending increased from 2014 to 2021 (Fig. 1). Consequently, in 2021, only 7 states (Croatia, Estonia, Latvia, Lithuania, Poland, Greece, and Portugal) out of 2021 fulfilled the political obligation to allocate 2% of their GDP to military expenditure. Greece ranked first, with a military expenditure value of 3.87% of its GDP. Most of the remaining 14 countries allocated between 1.5% and 1.95% of their GDP to military expenditure. However, some allies have indicated that their military spending will not rise to the recommended threshold by the 2024 deadline.

Six EU member states are not part of the NATO alliance: Austria, Cyprus, Finland, Ireland, Malta, and Sweden; five of these countries increased their share of military spending in GDP in 2021 compared to 2014 (Fig. 2). It should be noted that of the 6 countries that are not NATO members, only Finland committed more than 2% of its GDP to military expenditure in 2021. Among the other 5, Ireland was a typical case, with its percentage of military expenditure in GDP decreasing from 0.46 % in 2014 to 0.26% in 2021.

Most governments worldwide spend a large portion of their annual budgets on military expenditures because of the importance of national security. As a result, many studies have focused on the link between defence and economic growth. Moreover, the theoretical literature has long recognised the fundamental importance of public security for economic activity (Bernauer et al.,

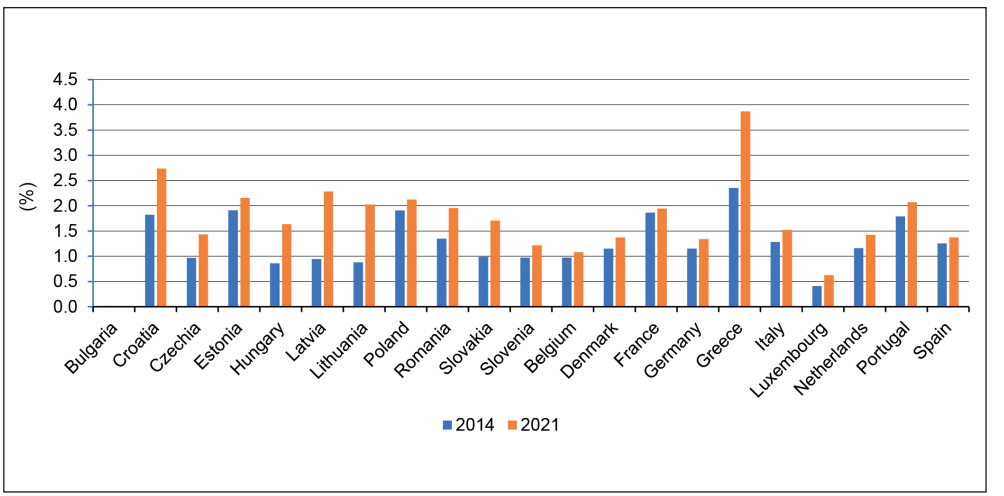

Fig. 1: Military expenditure percent of GDP (EU and NATO member countries)

Source: SIPRI databases

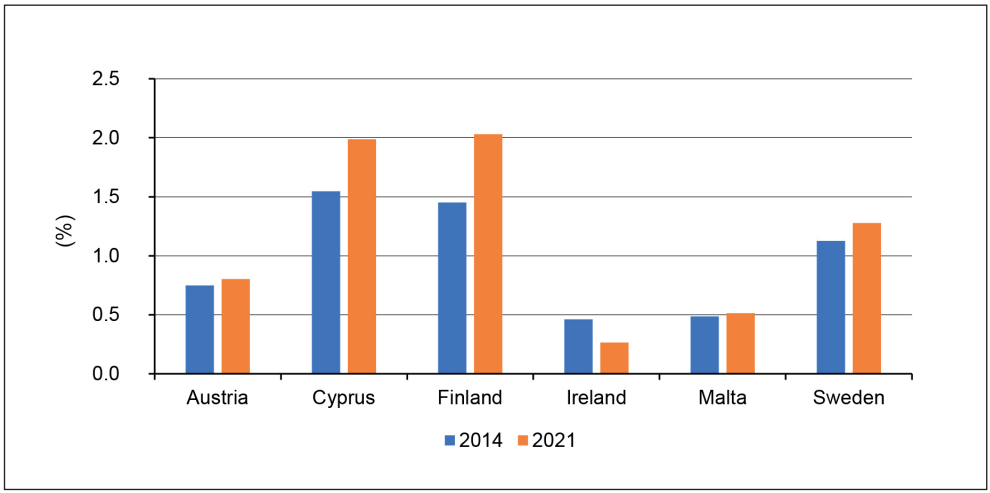

Fig. 2: Military expenditure percentage of GDP (EU and non-NATO members)

Source: SIPRI databases

2009). Consequently, the military sector tends to receive a large share of budgetary resources in most countries, but states vary considerably in the proportion of the resources they allocate to defence spending (Tao et al., 2020; Tiwari & Shahbaz, 2013; Topal et al., 2022; Topcu & Aras, 2015).

The relationship between military spending and GDP is an important and controversial issue. Some political leaders support the notion of increasing defence spending, while others stand for the opposite. Considering the central importance of this issue, scholars have devoted considerable attention to the complex relationship between defence spending and economic growth. Studying the influence of military spending on GDP is essential because it provides insights into the economic impact of defence budgets. It indicates how the allocation of significant public resources to the military sector can drive economic growth or, inversely, potentially divert resources from other productive areas. This research has important geopolitical implications, such as for the balance between security and economic development and the orientation of fiscal policy towards a more optimal distribution of resources.

Assessing the 2% foreseen in the 2014 Declaration at the NATO Summit in Wales, as well as the emergence of political and security events in Eastern Europe in 2022 (e.g., the geopolitical conflict between Russia and Ukraine), this paper attempts to determine the dynamic causality between military spending and GDP in all 27 EU member states. As it stands, there is no consensus on this topic, and relatively little attention has been paid to non-NATO EU member states. Moreover, no studies have looked at the military expenditure-GDP relationship while taking into account the criterion of NATO membership or compared the two groups of states (NATO states versus non-NATO states). However, examining the impact of military spending on GDP, specifically for NATO and non-NATO countries, can yield unique insights. The different security obligations, defence strategies, and external pressures faced by these two groups could significantly affect their defence expenditure and the economic impact of such spending. For NATO members, higher defence spending might be driven by collective defence obligations. By contrast, non-NATO states might have different motivations and constraints. Thus, such a study could help us to understand the broader geopolitical, economic, and fiscal implications of NATO membership, particularly in the context of the EU states.

This paper focuses on the influence of military spending on GDP in conjunction with the influence on GDP of two other extremely

important macroeconomic indicators: the inflation rate and the unemployment rate. The unemployment rate is closely linked to labour freedom (one of the four freedoms of the common market), meaning it is directly linked to labour migration within the EU. Meanwhile, the inflation rate indicates whether the member states' monetary, fiscal, and legislative government policies are effective. Inflation and unemployment rates are key macroeconomic indicators that directly impact GDP. For NATO and non-NATO countries, military spending can influence these rates (Nikolaidou, 2008; Odehnal & Neubauer, 2020). High defence spending may stimulate economic activity (Hung-Pin & Wang, 2022; Lin et al., 2015), thereby reducing unemployment (González-Astudillo & Roberts, 2022) but potentially causing inflation (Durguti et al., 2020; Stanić & Račić, 2019). Alternatively, resources allocated to the military sector could displace other productive investment, thus affecting job creation (Gricar et al., 2022; Malizard, 2014). The comparison between NATO and non-NATO countries allows us to observe differences in these dynamics potentially driven by defence obligations, adding a deeper layer to our understanding of how defence spending interacts with broader economic conditions.

The objectives of this research are as follows: to investigate whether NATO membership strengthens the correlation between military spending and GDP for both NATO and non-NATO EU member states; to emphasise the constraints on the development of the military expenditures of NATO allies in the EU; to analyse the impact of two critical macroeconomic indicators, namely unemployment and inflation, on GDP in both NATO EU member states and non-NATO EU member states; to provide reliable estimates of the relationship between military spending and GDP in the EU over the period 1998–2021; to understand how defence budget allocation impacts broader economic conditions in these countries, which could guide fiscal policy decisions and illuminate their geopolitical implications.

The analysis of the correlation between military expenditure and GDP and the quantification of the impact of military expenditure on GDP, corroborated by the analysis of the impact of inflation and the unemployment rate on GDP, is a key prerequisite for understanding the behaviour of EU member countries. Although the 27 states are members of the EU, representing a political and economic union, the differences in their development are evident and the allocation funds for defence purposes varies between states, according the development of the economic, security, and political factors that influence the military expenditures.

This paper attempts to answer two research questions:

RQ1: Does NATO membership impose a stronger correlation between military spending and GDP for each of the two groups of countries (NATO and non-NATO)?

RQ2: How significant is the influence of the two macroeconomic indicators (unemployment and inflation) on GDP in the case of the 21 NATO allies in the European Union from 1998–2021? Moreover, how significant is it in the case of the 6 states in the European Union that are not NATO members?

This paper makes a major contribution to the existing literature by examining the nuanced relationship between military spending, GDP, inflation, and unemployment rates in both NATO and non-NATO EU member states. It uniquely considers the influence of NATO membership on these dynamics, an aspect that until now has been left unexplored. The study also provides insights into how military expenditure allocation can impact broader economic conditions in these varying geopolitical contexts. Hence, it enriches our understanding of defence economics, fiscal policy decisions, and their geopolitical implications.

The research is divided into the following sections: introduction, theoretical background, research methodology, results and the last section concludes the study.

1. Theoretical background

The effect of military spending on GDP has long been a subject of intense debate. Several empirical studies on the relationship between military spending and GDP have been conducted, but their empirical findings remain inconclusive (Bayrak, 2019; Carter et al., 2021; Chowdhury, 1991; Churchill & Yew, 2018; d'Agostino et al., 2011; Heo & Ye, 2016; Hung-Pin & Wang, 2022; Khalid & Habimana, 2019; Norkus et al., 2021; Odehnal & Neubauer, 2020; Topal et al., 2022; Topcu & Aras, 2015; Yilgör et al., 2014). What these studies do demonstrate, however, is that military spending is a complicated concept, with economic capabilities, political processes, and

military linkages playing an interdependent role at the national, regional, and global levels.

Over time, military spending has been regarded as a crucial component of government budgets. As such, it has had a significant impact on macroeconomics. Many studies have attempted to explore the connection between military spending and GDP, which typically involves a country allocating a portion of its GDP for defence purposes (Bayrak, 2019; Bernauer et al., 2009; d'Agostino et al., 2011; Dunne & Nikolaidou, 2001). This is to ensure the state's internal and external security, as an increasing function for the threats against the nation's integrity (Bayrak, 2019). In this sense, it can be argued that defence spending can impact GDP directly or otherwise.

Various strands of the theoretical literature indicate different and conceptually ambiguous results regarding the military spending-GDP relationship, and empirical analysis has yet to resolve the issue decisively. Benoit (1978) was the first to study the relationship between military spending and economic growth, with many subsequent studies following suit.

The theoretical analysis of military expenditures is not a solely economic problem and, therefore, should not be analysed solely from an economic perspective. The analysis of military spending in the literature identifies four approaches – Keynesian, neoclassical, liberal, and Marxist – which analyse military spending from various angles. Keynesians focus on supply-side issues (excluding investment); according to the Keynesian perspective, military spending crowds out private investment, heightens inflationary pressures and diverts resources from more productive public investments in infrastructure, healthcare, and education (Dunne et al., 2001). Neoclassicists view defence spending as a state-provided public good that safeguards the nation's well-defined interests. Studies using neoclassical models focus on the ways in which defence spending affects economic growth (modernisation, infrastructure, and secondary technological benefits). Most studies based on neoclassical models have found there to be a positive relationship between military spending and economic growth. Liberals prioritise the interests of the whole of humanity over the interests of individual nation-states. Lastly, the Marxist approach views military spending only from a socio-political and strategic perspective.

Although there are in the previous literature a multitude of theories that explain economic growth (classical growth theory, neoclassical growth theory, endogenous growth theory, Harrod-Domar growth model, Keynesian theory, Schumpeterian growth theory, Rostow's stages of growth model, Solow-Swan growth model, Kaldor's laws of growth, institutional theories of growth), in our study, only two prominent theoretical constructs are considered – theoretical constructs that we believe optimally encapsulate the relationship between economic growth and military spending (neoclassical growth theory and endogenous growth theory).

Neoclassical growth theory, primarily based on Solow's model (1956), suggests that long-term economic growth is influenced by capital, labour, and technology. While labour and capital are subject to diminishing returns, technological growth drives steady economic expansion. Thus, continuous growth can only be maintained through technological progress, which is considered exogenous (external) and not explained within the model itself. The theory assumes market equilibrium and that economies naturally move towards a steady-state growth rate dictated by population growth, savings, and technological progress. Military spending and other macroeconomic indicators interact with these factors, impacting GDP growth.

In the context of neoclassical growth theory, military spending is considered a part of capital investment. However, its impact on economic growth can be complex. Initially, higher military spending may stimulate economic demand and create jobs (Bayrak, 2019). However, in the long term, military spending is viewed as unproductive because it does not directly contribute to technological progress – a key driver of sustained economic growth in this model. Indeed, overemphasis on military expenditure could divert resources away from productive investments, potentially leading to slower economic growth (Carter et al., 2021). Therefore, achieving the optimal balance of military spending is crucial for economic development under this theoretical framework.

Contrary to the neoclassical growth theory, the endogenous growth theory (Romer, 1990) posits that economic growth is primarily a result of internal factors rather than external ones. Introduced by Paul Romer (1990) and Robert Lucas (1988), amongst others, this theory emphasises the importance of investment

in human capital, innovation, and knowledge, which are all endogenous or internal to the economic system. The theory asserts that policy measures can have an impact on the long-term growth rate of an economy by influencing these factors. In other words, unlike the neoclassical model, growth in the endogenous model does not inevitably tend towards a steady state, and there are no diminishing returns to capital.

Endogenous growth theory emphasises the internal factors of an economy, such as innovation, human capital, and knowledge, in driving economic growth. In this theory, military spending can have diverse impacts. On the one hand, it can lead to technological advancements and human capital development, especially when it involves research and development, education (Lai et al., 2002), and training, thereby positively affecting growth (Churchill & Yew, 2018). On the other hand, excessive military spending may channel resources away from other vital sectors that directly contribute to endogenous growth factors, potentially slowing down economic growth (Heo & Ye, 2016). Thus, the net effect of military spending on economic growth under endogenous growth theory could be context-dependent.

Regarding the vast literature on the relationship between military spending and economic growth, some studies have shown contradictory effects (either positive effects or negative effects). Among the studies demonstrating the positive effects of defence spending on economic growth (Tiwari & Shahbaz, 2013; Wijeweera & Webb, 2011); Churchill and Yew (2018) show that the influence of military spending on economic growth, as measured by GDP, is more prominent in developed nations than in less developed nations. Moreover, in 2014, Yilgör et al. (2014) conducted research examining the connection between defence expenditure and economic growth in 11 countries that are members of NATO – the USA, Germany, Belgium, Denmark, France, Netherlands, the United Kingdom, Italy, Canada, Norway, and Portugal – for the period 1980–2007. The authors consider the correlation and causation of defence and economic growth and conclude that, in the long run, there is a correlation between defence spending and GDP. Furthermore, their use of a Granger causality test indicates that the proportion of defence spending in developed countries in GDP has led to GDP growth.

The positive relationship between military spending and GDP can be explained as follows:
i) Defence spending leads to security, which enables private economic agents to carry out productive economic activities without fear of external appropriation;
ii) In many countries, a percentage of defence spending is allocated to research and development activities. Military research and development lead to innovations that subsequently lead to applications in the civilian sector, increasing productivity and revenue (Bernauer et al., 2009). For example, the civilian sector has adopted technologies initially developed in the military sector, such as air transport, nuclear power generation, and radar and space technology. These technological spillovers improved the productive private sector;
iii) Military spending, directly and indirectly, facilitates economic growth by increasing purchasing power, increasing aggregate demand, and financing heavy industry, especially armaments (Looney, 1991).

In opposition to the arguments above, however, some studies claim that military spending can negatively influence social welfare because it causes less public spending to accumulate human capital, thus hindering economic growth and indirectly bringing losses to social welfare (d'Agostino et al., 2011; Khalid & Habimana, 2019). The main argument in this category is that military spending diverts civilian resources from more productive uses (Heo & Ye, 2016). Another argument is that, with the increase in military spending, there is a decrease in research and development in the civilian sector, which has significant implications for GDP because it diverts non-military research and development spending.

In contrast to these two sets of studies, a third set makes the following claims: i) there is no statistically significant relationship between these two variables (Gerace, 2002; Sekmen & Saribas, 2007), and this relationship cannot be generalised (Chowdhury, 1991; Lai et al., 2002; Mintz & Stevenson, 1995); ii) the impact of military spending on economic growth is limited (Chang et al., 2011; Wijeweera & Webb, 2011); and iii) the impact of defence spending on economic growth is neither universal nor constant over time (Dakurah et al., 2001; Saba & Ngepah, 2019; Tao et al., 2020; Topcu & Aras, 2015). Moreover, some studies observe all three types of effects

(positive effect, negative effect, and no effect) (Carter et al., 2021).

These contradictory findings of the empirical literature may stem from the fact that some of the theoretical effects highlighted above are conditioned by the local and sometimes even regional political, economic, and security context. Analytical results may vary depending on such things as the extent of use, how military spending is financed, externalities from military spending, and the effectiveness of military spending in countering the threat (Dunne et al., 2005). Moreover, existing empirical studies fail to consider the different time horizons over which the effects described above would occur.

The above discussion prompts us to propose the hypothesis of the study:

H1: There is a positive effect of military spending on GDP.

Military expenditure might induce immediate stimulative effects, yet it may also inadvertently lead to diminished private-sector investment, curtailed spending in productive sectors, or an escalation of public debt to unsustainable levels.

Regarding the crowding-out effect on private investment, military spending often requires a significant budget allocation. This potentially large allocation could reduce the availability of resources for private-sector investment (Fatehi-Sedeh & Safizadeh, 1989). Furthermore, if financed by rising interest rates, it can lead to "crowding out" whereby government borrowing makes borrowing more expensive for the private sector, which in turn discourages private investment.

In addition, an increase in military spending can lead to a reduction in government spending in productive sectors such as education, infrastructure, and healthcare (Dunne et al., 2001). These sectors often provide a greater multiplier effect for economic growth and overall societal well-being.

Furthermore, financing increased military spending can also lead to an increase in public debt if the government borrows money to finance it. This can also cause a diversion of resources from sectors with higher potential for economic growth, such as technology or manufacturing (Heo & Ye, 2016), and such a redirection, in turn, can harm the overall health of the economy by reducing efficiency and long-term growth potential. Consequently, these factors could have detrimental implications for long-term economic growth.

Military spending is considered to be conducive to social welfare in that it accumulates well-trained human capital, technological innovation, and spin-offs in the defence sector. However, several empirical studies reveal that increasing military spending impacts indirect channels, such as income inequality, economic growth, and unemployment (Malizard, 2014). Moreover, there is a close relationship between the unemployment rate, military spending, and economic growth (González-Astudillo & Roberts, 2022). Okun (1962) formulated the well-known rule of thumb that assigns roughly a 3% drop in GDP to a point increase in the unemployment rate of 1%. There are numerous studies that confirm that the unemployment rate is one of the essential factors of GDP growth (Gricar et al., 2022; Malizard, 2014; Stanić & Račić, 2019; Vyrostková & Mirdala, 2022). The unemployment rate negatively affects GDP growth (Gricar et al., 2022; Stanić & Račić, 2019).

Understanding the link between inflation and GDP growth is vital to improving any country's monetary policy because inflation is a monetary phenomenon (Burger & Šlampiaková, 2021). By contrast, GDP growth is a real phenomenon. Moreover, the characteristics of this link may be different in different countries, as well as in different periods of the same country. Several studies have investigated the link between inflation and GDP on a global scale, finding a negative relationship between the two variables (Barro, 1995; Denbel et al., 2016; Ghosh & Phillips, 1998; Ljupco et al., 2018; Stanić & Račić, 2019), while others argue that this relationship is non-linear (Eggoh & Khan, 2014; Fischer, 1993; Ghosh & Phillips, 1998).

2. Research methodology

Previous studies on the relationship between defence spending and economic growth are very diverse due to the variety of countries in the same region, different time periods in the same country, and various methodologies being used in manifold regions.

This study was divided into three panels to further develop the estimates and to test the robustness of the results. First, the EU countries were selected to explore the way in which military expenditure affects GDP, based on the annual data between 1998 and 2021. The decision to choose these states and this particular period lies in their common recent history, the elements of homogeneity generated

especially by the common regulations specific to the EU, which justifies the study of the general trends of the EU states. In addition to the analysis of all EU countries (EU 27), they were approached separately in two different clusters: on the one hand, the 21 countries of the EU and which are also the NATO countries (EU-NATO 21) – second cluster, and the other 6 countries that are not part of NATO were studied in the third cluster (EU non-NATO 6). The chosen analysis period starts at the end of the 1990s (especially given the availability of data for the ex-communist EU countries and which only in this period switched to democratic regimes) and extends until 2021, inclusive, which is of particular importance in terms of economics given that it marks the onset of the COVID-19 pandemic, which led to higher levels of inflation and unemployment than in previous years. As far as national defence systems are concerned, closely linked to public budgets, military spending proves to be, in the contemporary period, a vital element in shaping the premises of freedom and the democratic status of nations, which are concerned with the binomial defence of the nation and securing the economy.

To unearth the causal nexus between military expenditure and GDP, a panel data model was developed as follows:

$$GDP_{i,t} = \propto_0 + \propto_1 Military\ expenditure_{i,t} + u_{i,t} \quad (1)$$

Unemployment and inflation were considered control variables, based on the results identified in the previous studied literature.

$$GDP_{i,t} = \propto_0 + \propto_1 Military\ expenditure_{i,t} + \\ + \propto_2 Unemployment_{i,t} + \propto_3 Inflation_{i,t} + u_{i,t} \quad (2)$$

where: i – the country; t – the period; $u_{i,t}$ – the error term.

Econometric data were processed using STATA 17 (Stata/SE Prof + Plan (dl) 17).

Tab. 1 presents the description of the variables and data sources from which the information was gathered. To measure economic growth, the paper employs GDP, while to capture the essence of the governments' motivations for investing in defence, the military expenditure proxy was used. The other two major macroeconomic variables are monetary (inflation) and labour market (unemployment) phenomena, which are attributed to major economic imbalances or, on the contrary, contributions to economic growth.

The paper gradually approaches several static and dynamic panel methods, with the aim of identifying the most appropriate and robust methodologies for determining the causal links between the analysed variables. After conducting an analysis of the variables based on the classical linear regression method (e.g., stationarity of the data, multicollinearity between variables, homoscedasticity, serial correlation, or cross-sectional dependence), some models

Tab. 1: Variables and data sources

Variables	Symbol (unit)	Data source
Gross domestic product	GDP (billions of current USD)	The World Bank (https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?view=chart)
Military expenditure	Mex (billions of current USD)	The World Bank via Stockholm International Peace Research Institute (SIPRI). Yearbook: Armaments, disarmament and international security (https://data.worldbank.org/indicator/MS.MIL.XPND.CD?locations=US via https://milex.sipri.org/sipri)
Unemployment	Unemployment (% of total labor force)	The World Bank via International Labour Organization, ILOSTAT database (https://data.worldbank.org/indicator/SL.UEM.TOTL.ZS)
Inflation (annual consumer prices)	Inflation (%)	The World Bank via International Monetary Fund, International Financial Statistics and data files (https://data.worldbank.org/indicator/FP.CPI.TOTL.ZG)

Source: own

were progressively tested, starting with pooled ordinary least squares (OLS) to establish an initial basis for comparison.

We continued with the Poisson pseudomaximum likelihood regression (PPLM) method, suitable for log dependent variable (Correia et al., 2020). This method represents a cutting-edge methodology for the estimation of (pseudo-) Poisson regression models with multiple high-dimensional fixed effects, based on a reweighted least-squares algorithm.

The specific problems of unfulfillment of some classical regression assumptions (homoscedasticity, serial correlation, or cross-sectional dependence) lead to further use of fixed and random effect models, which unlike pooled OLS have the potential to better control for unobservable heterogeneities across countries over time that could affect the relationship between the variables (Gerged et al., 2023).

In the next stage of the research, two types of panel models were applied (feasible generalized least squares FGLS and panels corrected standard errors PCSE), chosen according to their potential to generate robust estimates under the conditions of unfulfilled mentioned assumptions of classical linear regression in the studied data.

Because static panel models do not take into consideration the dynamics of time-varying and the endogeneity of the variables, we applied a dynamic panel method – system generalised method of moments (GMM), that is capable to address the reverse causality problems as well as the serial correlation and unobserved heterogeneity (Forgione & Migliardo, 2020). In economic terms, endogeneity can be interpreted as the effect of the past on the present, both on the model (dependent variable) and on the independent variables, or as the causal relationship between regressors and explained variables along the time (Labra & Torrecillas, 2018).

We aim to identify the unidirectional or bidirectional links between the studied variables and for the analysis of the influence of the past values of the independent variables on GDP we computed a novelty Granger causality test and half-panel jackknife (HPJ) bias-corrected pooled estimator (Juodis et al., 2021; Xiao et al., 2022). In addition to this type of causality testing between the variables, the results obtained by applying the first two generations of causality tests were also analysed (Abrigo & Love, 2016; Dumitrescu & Hurlin, 2012; Holtz-Eakin et al., 1988; Lopez & Weber, 2017).

The basic summary statistics of the dependent and independent variables are presented in Tab. 2. The maximum and the minimum GDP indicate a high degree of dispersion of

Tab. 2: Descriptive statistics

Variables	Obs.	Mean	Std. dev.	Min	Max
GDP (USD billions), EU (27)	648	482.644	798.511	3.958	4,259.935
Mex (USD billions), EU (27)	648	7.048	12.031	0.025	56.647
Unemployment (%), EU (27)	648	8.607	4.296	1.810	27.470
Inflation (%), EU (27)	648	2.749	4.339	−4.478	59.096
GDP (USD billions), EU-NATO (21)	504	557.836	886.171	5.674	4,259.935
Mex (USD billions), EU-NATO (21)	504	8.423	13.284	0.042	56.647
Unemployment (%), EU-NATO (21)	504	9.056	4.542	1.810	27.470
Inflation (%), EU-NATO (21)	504	3.068	4.813	−1.735	59.096
GDP (USD billions), EU non-NATO (6)	144	219.473	181.516	3.958	635.663
Mex (USD billions), EU non-NATO (6)	144	2.235	2.048	0.025	7.887
Unemployment (%), EU non-NATO (6)	144	7.036	2.781	3.300	16.090
Inflation (%), EU non-NATO (6)	144	1.633	1.445	−4.478	5.590

Source: own

the GDP in the studied countries, which is justified given the different size of the countries in the EU, as well as the different speeds of economic development of the states, taking into account that new countries (including post-communist) joined after the 2000s and brought with them economic structural problems (11 new post-communist countries, of which 8 joined in 2004, 2 in 2007, and one in 2013). Moreover, the disparity between maximum and minimum military expenditure indicates a high degree of variety between the member states. The average GDP value is 482.644, ranging from 3.958 to 4,259.935, with a standard deviation of 798.511, which denotes a medium dispersion from the mean. The core explanatory variable, military expenses, has a mean of 7.048, ranging between 0.025 and 56.647, denoting a high degree of heterogeneity among the studied countries. Meanwhile, the control variables (unemployment and inflation) also exhibit large fluctuations between the minimum and maximum values for the countries and the analysed period, especially in 2020–2021. Two of these variables – GDP and military expenditure – are used in models in their logarithmic form because of the skewed distribution and the small and large values of the proxy across countries.

3. Research results

To study the data characteristics, we test the basic classical linear regression model assumptions – stationarity of the data, multicollinearity between variables, homoscedasticity, serial correlation, and cross-sectional dependence – in order to be able to apply the most appropriate models (Maladjian & Khoury, 2014). The preliminary investigation of the variables involves the study of the stationarity of data through a LLC Levin-Lin-Chu unit-root test, which demonstrates that the variables are stationary (the null hypothesis of LLC test for stationarity is rejected for all variables in level, except for lnMex in EU non-NATO PANEL, which is stationary in first-difference). Our investigation of the correlation between variables through the bivariate correlation matrix suggests that the dependent and explanatory variables are not correlated (except Mex and GDP). Also, by examining the VIF (variance inflation factor – another important tool that verifies multicollinearity), we prove the absence of multicollinearity, thus eliminating the risk of spurious correlations. The mean of VIF is under 1.5 for all three panels, which is below the threshold level, approximately 5, according to the main approach in the area (Koengkan et al., 2019). Homoscedasticity analysis, based on the Breusch-Pagan test and the white test,

Tab. 3: Pooled ordinary least squares and Poisson pseudomaximum likelihood regression models (1998–2021)

lnGDP	Pooled ordinary least squares (OLS)			Poisson pseudomaximum likelihood regression (PPML)		
	EU (27)	EU-NATO (21)	EU non-NATO (6)	EU (27)	EU-NATO (21)	EU non-NATO (6)
lnMex	0.8970*** (0.0050)	0.9140*** (0.0080)	0.9020*** (0.0050)	0.0340*** (0.0003)	0.0350*** (0.0003)	0.0360*** (0.0003)
Unemployment	−0.0270*** (0.0030)	−0.0230*** (0.0020)	−0.0210 (0.0290)	−0.0010*** (0.0001)	−0.0010*** (0.0001)	−0.0007 (0.0008)
Inflation	−0.0270*** (0.0050)	−0.0230*** (0.0030)	−0.0350 (0.0330)	−0.0008*** (0.0001)	−0.0007*** (0.00009)	−0.0010 (0.0010)
Const	6.8320*** (0.1270)	6.3710*** (0.2040)	6.8700*** (0.3480)	2.5130*** (0.0070)	2.5020*** (0.0080)	2.4830*** (0.0170)
R^2/pseudo R^2	0.9380	0.9540	0.8890	0.0180	0.0180	0.0160
Observations	648	504	144	648	504	144

Note: Standard errors in parentheses; ***significance at 1% level; PPML is based on ppmlhdfe Stata command, with robust and year fixed-effect option.

Source: own

emphasises heteroscedasticity in the residuals. Furthermore, for all three panels (EU, EU-NATO, and EU non-NATO), data analysis indicates serial correlation in the idiosyncratic error term and the cross-sectional dependence. The strategy of applying certain types of models was established based on these preliminary tests of the data from the three panels.

To explore the relationship between the variables, in order to establish an initial basis for comparison for the results obtained, we initially develop the pooled OLS model (Tab. 3). Except for two variables (unemployment and inflation) for the EU non-NATO model, all the remaining results are statistically significant, but in the conditions where some of the classical assumptions of the regression models are violated, the pooled OLS model can generate spurious results, which involves testing the data with models that consider the properties of the analysed panels.

The parameters of log-linearised models established by OLS are inconsistent in the presence of heteroskedasticity, which requires one to test the data using an appropriate method, such as PPML (Correia et al., 2020). The outcomes of the PPML technique are in line with the results obtained using the primary pooled OLS model, but with proper management of heteroskedasticity, PPML, proves to be more adequate.

Fixed-effects models are suitable for addressing unobserved heterogeneity (unexplained variation) among cross-sectional units (Duxbury, 2021), while the three data panels can continue to be analysed using the fixed effects (FE) and random effects (RE) models (Tab. 4). Here the results of the Hausman tests can also be found, according to which the FE model is suitable for the EU (27) and EU-NATO (21) panels, while the RE model proves to be adequate for the EU non-NATO (6) panel. Fixed effects models have been studied alternatively by including (or not including) time-fixed effects, with the latter variant producing statistically significant results for all variables for the EU (27) and EU-NATO (21) panels. In the EU non-NATO panel (6) the random effects model proves to be adequate, with the results being statistically significant only for the core explanatory variable, military expenditures.

Tab. 4: Fixed effects and random effects models (1998–2021)

lnGDP	Fixed effects (FE)						Random effects (RE)		
	EU (27)		EU-NATO (21)		EU non-NATO (6)		EU (27)	EU-NATO (21)	EU non-NATO (6)
lnMex	0.899*** (0.051)	0.346*** (0.052)	0.863*** (0.050)	0.392*** (0.050)	1.126*** (0.134)	−0.046 (0.270)	0.896*** (0.037)	0.875*** (0.035)	1.089*** (0.109)
Unemployment	0.004 (0.004)	−0.014*** (0.004)	0.001 (0.004)	−0.015*** (0.004)	0.005 (0.022)	−0.029** (0.008)	0.003 (0.004)	0.001 (0.004)	0.004 (0.021)
Inflation	−0.018*** (0.003)	−0.013*** (0.001)	−0.018*** (0.003)	−0.013*** (0.001)	−0.035 (0.027)	−0.049** (0.013)	−0.018*** (0.003)	−0.018*** (0.002)	−0.037 (0.027)
Const	6.503*** (1.127)	18.051*** (1.093)	7.233*** (1.100)	17.176*** (1.075)	2.028 (2.769)	25.979*** (5.555)	6.572*** (0.789)	6.975*** (0.748)	2.816 (2.263)
Time-fixed effects	No	Yes	No	Yes	No	Yes	No	No	No
R^2 within	0.798	0.939	0.829	0.953	0.692	0.927	0.798	0.829	0.692
R^2 between	0.939	0.955	0.958	0.971	0.900	0.735	0.939	0.959	0.900
R^2 overall	0.930	0.843	0.949	0.881	0.887	0.001	0.930	0.949	0.887
Hausman test (p > chi2)	0.021	0.000	0.016	0.000	–	–	–	–	0.323

Note: Standard errors in parentheses; ***significance at 1% level; FE and RE models are estimated with the option robust and the time-fixed effects are included in FE model (based on *F*-test testparm i.year we obtain that time-fixed effects are needed).

Source: own

The fixed effects (FE) and random effects (RE) models are based on the study of temporal effects, but without being configured to respond to potential data endogeneity problems, for which dynamic models are more suitable. Intermediate, up to the dynamic models, two panel-type methods were studied in order to manage heteroscedasticity, cross-sectional dependence, respectively serial correlation: Feasible generalized least squares (FGLS) and panel corrected standard errors (PCSE). The outcomes of these methods show that the signs and significance of the results were consistent with the results provided by the fixed effects (FE) technique, especially in regard to the EU (27) and EU-NATO (21) panels (Tab. 5). For the EU non-NATO (6) panel, the results are not as robust (except when using the FGLS method), which confirms the structural differences between the NATO and non-NATO countries.

To estimate the dynamic effects of military expenditure on GDP, we applied a two-step GMM technique, using lagged values of the dependent variables as regressors (Arellano & Bond, 1991; Roodman, 2009). Both the Arrelano-Bond (AR) and the Hansen test results prove the robustness of the estimates (Tab. 6) for the sample of EU countries as a whole and for the 21 NATO countries, with the same evolutionary meanings for the current values of independent variables as were obtained for the previous static panel methods (we thus record and prove positive relationships between the current values of military spending and GDP, while the current levels of unemployment and inflation negatively affect GDP). For the sample of non-NATO countries, the results are not as robust under the conditions of 1.0 values of the Sargan test, which could indicate the use of too many instruments and a small sample size (only 6 countries). Important contributions to the literature of the field (Labra & Torrecillas, 2018; Roodman, 2009) state that the estimators are developed for panels with short time dimensions, implying that they generate instrument sets whose number grows quadratically and that the instruments can overadapt endogenous variables by failing to expunge their endogenous components and biasing coefficient estimates. In the opinion of the aforementioned author, the possible vitiation of the Hansen test values should be accompanied by the report of the instrument count in order to disclose credible results.

Next, we studied the causality between the analysed variables by using the first-generation panel Granger causality tests (Lopez & Weber, 2017) and the second-generation Granger tests (Abrigo & Love, 2016; Dumitrescu & Hurlin,

Tab. 5: Feasible generalized least squares and panels corrected standard errors models (1998–2021)

lnGDP	Feasible generalized least squares (FGLS)			Panels corrected standard errors (PCSE)		
	EU (27)	EU-NATO (21)	EU non-NATO (6)	EU (27)	EU-NATO (21)	EU non-NATO (6)
lnMex	0.8970*** (0.0001)	0.9140*** (0.0007)	0.9030*** (0.0030)	0.897*** (0.008)	0.914*** (0.010)	0.902*** (0.017)
Unemployment	−0.0270*** (0.0001)	−0.0230*** (0.0001)	−0.0230*** (0.0030)	−0.027*** (0.004)	−0.023*** (0.003)	−0.021 (0.022)
Inflation	−0.0270*** (0.00008)	−0.0230*** (0.0001)	−0.0230*** (0.0070)	−0.027*** (0.002)	−0.023*** (0.002)	−0.035 (0.042)
Const	6.8320*** (0.0040)	6.3790*** (0.0200)	6.8470*** (0.0770)	6.832*** (0.208)	6.371*** (0.252)	6.870*** (0.408)
R^2	–	–	–	0.938	0.954	0.889
Observations	648	504	144	648	504	144

Note: Standard errors in parentheses; ***significance at 1% level; FGLS method is applied with the option panels (correlated), which uses heteroskedastic and correlated error structure; PCSE model is computed with the option hetonly, which specifies that the disturbances are assumed to be panel-level heteroskedastic.

Source: own

Tab. 6: System GMM models (1998–2021)

lnGDP	EU (27)	EU-NATO (21)	EU non-NATO (6)
L1.lnGDP	0.624*** (0.070)	0.668*** (0.079)	1.583*** (0.446)
lnMex	0.402*** (0.062)	0.380*** (0.071)	0.379* (0.205)
Unemployment	−0.011*** (0.004)	−0.008** (0.004)	−0.036*** (0.012)
Inflation	−0.009* (0.003)	−0.005** (0.002)	−0.026* (0.014)
Const	3.333** (0.545)	2.759*** (0.434)	–
Hansen test of overidentifying restrictions	26.530 p = 0.088	20.650 p = 0.297	0.000 p = 1.000
Arellano-Bond test for AR (1)	−3.700 p = 0.000	−3.420 p = 0.001	−2.320 p = 0.020
Arellano-Bond test for AR (2)	−2.220 p = 0.026	−2.320 p = 0.020	−0.940 p = 0.348
Observations	567	441	126
Number of instruments	25	25	24

Note: Standard errors in parentheses; ***, **, and *significance at 1, 5, and 10% level, respectively; Tab. 6 reports the results of the two-step system GMM, based on xtabond2 Stata command, with orthogonal, collapse, robust and split (only for first two models) options; additional independent variables are L2.lnGDP and L3.lnGDP (significant in all models and with negative results for second lag and positive for third); the instruments are the independent variables and unemployment variation (first two models)/variations of the independent variables (the last model).

Source: own

2012). The most important outputs of the causality techniques (Tab. 7) refer to a two-way (bidirectional) causality between military expenditure and GDP, which are mutually influenced (the key to interpreting causality tests is that previous values at lag 1 influence actual values). Considering the EU (27) and EU-NATO (21) panels, bidirectional causal links were also obtained for the remaining analysed variables (especially based on the second-generation tests), with an exception without statistical significance: lag of military expenditure does not cause Inflation (year 2021 was included in the analysis, with almost double the levels of inflation in the studied countries compared to 2020, suggesting that high contemporary inflation is definitely linked to other determinants besides previous military expense). The third panel, the EU non-NATO (6), is characterised by fewer two-dimensional relationships than the first two panels, but, interestingly, by including in the analysis the year 2021, we obtain statistical significance for the two-dimensional link between military expenses and GDP, which may lead to the preliminary assumption that previous values of military expenses contribute to the modification of current GDP values.

To ensure greater accuracy of the results, we analysed whether past values of independent variables cause GDP by computing the third generation of Granger-type causality tests (Juodis et al., 2021; Xiao et al., 2022), whose specificity is that, in addition to enabling us to assess causality, it helps us to obtain the results of an HPJ (half-panel jackknife) bias-corrected pooled estimator regression (Tab. 8).

Several important findings arise from our analysis. The influence of the past values of the military expenditure on GDP is statistically significant and positive only for the group of EU and NATO member countries, which confirms that, as past values of military expenditure increase, current GDP also increases. These results can be explained as follows:

Tab. 7: Granger causality between the variables, first-generation and second-generation tests (1998–2021)

Null hypothesis of no causality		EU (27)		EU-NATO (21)		EU non-NATO (6)	
		F-stat	*Z*-bar	*F*-stat	*Z*-bar	*F*-stat	*Z*-bar
lnGDP	L1.lnMex	1.289	4.543***	0.935	3.859***	0.062	2.418**
lnMex	L1.lnGDP	6.266**	4.663***	3.046*	1.422	0.681	7.232***
lnGDP	L1.Unemployment	0.038	2.493**	0.003	2.534**	1.428	0.547
Unemployment	L1.lnGDP	0.573	9.107***	0.954	8.258***	0.048	3.869***
lnGDP	L1.Inflation	0.883	3.209***	1.541	3.836***	0.058	−0.370
Inflation	L1.lnGDP	0.162	3.751***	0.211	3.424***	0.167	1.552
lnMex	L1.Unemployment	5.005**	10.692***	2.450	10.964***	0.344	2.168**
Unemployment	L1.lnMex	0.684	14.873***	0.987	12.379***	0.004	8.391***
lnMex	L1.Inflation	0.931	2.644***	0.276	3.034***	0.068	−0.067
Inflation	L1.lnMex	0.016	0.659	0.000	0.103	0.251	1.205
Unemployment	L1.Inflation	3.677*	14.838***	2.001	14.113***	2.106	5.074***
Inflation	L1.Unemployment	0.164	7.144***	0.025	5.235***	0.866	5.362***

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

Source: own

Tab. 8: Granger causality between the variables, third-generation tests HPJ (half-panel jackknife), and regression models (1998–2021)

lnGDP	EU (27)	EU-NATO (21)	EU non-NATO (6)
L1.lnMex	0.044* (0.026)	0.093*** (0.029)	−0.303*** (0.063)
L1.Unemployment	−0.007*** (0.001)	−0.006*** (0.001)	0.008** (0.003)
L1.Inflation	−0.017*** (0.001)	−0.019*** (0.001)	0.002 (0.006)
HPJ Wald-stat.	119.407***	133.507***	28.664***

Note: Standard errors in parentheses; ***, **, and *significance at 1, 5, and 10% level, respectively.

Source: own

i) The higher the level of military expenditure, the more the country in question maintains a stable level of security for a very long period of time, thus establishing investor confidence (Fatehi-Sedeh & Safizadeh, 1989). This means that defence spending produces security, which enables private economic agents to set up and carry out productive economic activities without fear of external appropriation (through investments it will increase GDP);

ii) In numerous countries, a percentage of the defence expenditure is allocated to research and development activities. Military research and development leads to innovations, which in turn lead to applications in the civilian sector, thus increasing productivity and revenues (Bernauer et al., 2009). For example, the civilian sector has adopted technologies that were originally developed in the military, such as air transport, nuclear power generation, and

the use of radar and space technology, each of which have boosted the productive private sector; iii) Military spending helps both directly and indirectly facilitate economic growth by increasing purchasing power, raising aggregate demand, and financing heavy industry, especially armaments (Looney, 1991).

In the literature, there are arguments to support the positive impact of defence expenditures on economic growth. For instance, Benoit (1978) observed that defence programmes in many countries have a significant effect on the civilian economy by providing food, housing, and clothing to individuals who would otherwise have to be supported by the civilian economy. Additionally, military programmes provide education, medical care, and technical training that has high civilian value. The military also engages in various public works projects and scientific and technical specialties that benefit the civilian population and conducts research and development activities that might not be carried out solely for civilian demand.

In contrast to the above results, for the group of non-NATO EU member countries, the influence of the past values of the military expenditure coefficient on GDP is statistically significant and negative, which implies that, as the level of military expenditure rises, GDP decreases. First, we document that it is possible for the effects of military expenditure on GDP to be negative. Indeed, as in the first argument, military spending can have a negative influence on social welfare as it leads to less public expenditure on the accumulation of human capital hampering economic growth and indirectly bringing losses to social well-being; plus, if governments prefer to cut other important public investments, such as education, public health, and infrastructure, in favour of increasing military spending, defence spending may decrease long-term economic growth (Topal et al., 2022). A second argument would be that the most negative effects of military spending on economic growth come from the aggregate part of supply, which deals with opportunity costs. These costs are associated with certain economic problems, such as inflation, imbalances in the international financial structure, and excessive public debt. The main argument in this category is that military spending diverts civilian resources from more productive uses (Heo & Ye, 2016). Another argument is that with the increase in military spending, there is a decrease in research and development spending in the civilian sector, leading to major implications for GDP because non-military research and development spending are diverted.

The differences in the findings obtained for the two groups of countries in our study may stem from the fact that some of the recorded effects are conditioned by the national and sometimes even regional political, economic, and security context. However, there are some reasons why the causal relationship between military spending and economic growth yields different results from one group of countries to another, such as different preferences applied in countries' defence policies and growth policies (Topal et al., 2022). Additionally, analytical results may vary depending on things like usability, how military spending is financed, externalities in military spending, and the effectiveness of military spending in countering the threat (Dunne et al., 2005).

Regarding the relationship between military spending and economic growth, it is advisable to consider the factors that could have negative implications for economic growth in the long run. Military spending can initially stimulate economic growth through job creation and increased demand. However, larger defence budgets may also reduce private investment (Fatehi-Sedeh & Safizadeh, 1989) due to the crowding-out effect. Furthermore, diminished government spending in productive sectors like education or infrastructure (Dunne et al., 2001), coupled with rising public debt (Heo & Ye, 2016), could curtail long-term economic growth. Additionally, diverting resources from high-growth sectors may limit economic efficiency. These factors could have detrimental implications for long-term economic growth.

Based on the previous models for the three panels – EU (27), EU-NATO (21), and EU non-NATO (6), the testing of our hypothesis led to the following considerations.

Regarding the military spending and GDP nexus, for the *H1* hypothesis, the results of most models indicate a positive correlation between current military expenditure and economic growth (GDP), with robust and reliable results both in the static and dynamic panel models. The results are consistent with relevant results from past literature (Churchill & Yew, 2018; Tiwari & Shahbaz, 2013; Wijeweera & Webb, 2011; Yilgör et al., 2014), meaning the *H1* hypothesis can be accepted

for the current level of military expenditures. Based on the new Granger causality method and half-panel jackknife bias-corrected pooled estimator regression (Juodis et al., 2021; Xiao et al., 2022), we found that past values of military expenditures positively influence GDP in the groups of EU and NATO-EU countries, while in the panel of non-NATO EU countries past values of military expenditure exert a negative influence on GDP. This invalidates the *H1* hypothesis for this group of countries (EU non-NATO), thus supporting previous research that emphasises the potential of military spending to inhibit economic growth (Topal et al., 2022).

Based on the negative coefficients in the predominant computed static and dynamic panel models, the results suggest evidence of a relationship between unemployment and economic growth, in line with previous research (Gricar et al., 2022; Hashmi et al., 2021). In both NATO and non-NATO EU countries, high unemployment rates negatively influence GDP because fewer people are contributing to the economy's productivity, leading to lower overall output. Additionally, prolonged unemployment can lead to a degradation of skills, further affecting productivity. This cycle of reduced productivity and economic output confirms the negative correlation between unemployment and economic growth. In the context of military spending, high unemployment may limit a country's ability to allocate resources to defence. For NATO members, who have agreed to spend a certain percentage of their GDP on defence, high unemployment and its consequent impact on GDP could hinder their ability to meet this obligation. The same negative sense of the unemployment GDP relationship is obtained for the non-NATO panel, but the results are statistically significant only in FGLS model.

Inflation, meanwhile, also has a negative relationship with economic growth, as was shown to be the case in previous studies (Denbel et al., 2016; Stanić & Račić, 2019). This is because high inflation erodes purchasing power, discourages savings and investment, and introduces uncertainty into the economy, thus negatively impacting GDP in both NATO and non-NATO EU countries (the latter panel shows less statistically significant results and only the FGLS model is robust). In relation to military spending, high inflation could devalue the real impact of defence budgets. Moreover, for NATO countries with specific defence spending commitments, high inflation could necessitate even greater nominal spending to maintain the agreed real value of defence contributions.

Finally, we emphasise that the main achievement regarding the core explanatory variable, military expenditures, is that NATO membership imposes a stronger correlation between military spending and GDP.

Conclusions

The role of military expenditure in ensuring the security and defence of the European nations has become increasingly salient in light of the war in Ukraine, which broke out in February 2022. More than ever, protecting freedom and democracy is a central theme for the EU states, national governments, and EU authorities. As a result, they have had to address security and defence challenges that have consumed significant public funds, while also dealing with the effects of economic recession, including unemployment and rising inflation. Thus, many governments have been presented with the dilemma of choosing between security and welfare.

This paper discussed the role of military expenditure, unemployment, and inflation in the GDP evolution of the EU countries, both in regard to NATO member states and non-NATO states. The current research was motivated by the need to resolve a vast antagonistic literature in which numerous macroeconomists, political economists, and scientists have laid out multiple mechanisms by which the interaction between defence budget growth and GDP can be theorised yet still fail to arrive at a consensus, with both positive and/or negative influences being found between different variables.

Our research analysis and findings are in line with the previous literature and conclude that the current and past values (first lag) military expenditure level positively influenced GDP between 1998 and 2021 in the EU and NATO EU countries. Regarding the group of non-NATO countries, given the small size of the studied sample, the statistical results differ in certain cases from the results obtained for NATO EU states. Moreover, the non-NATO countries are characterised by geopolitical features, historical particularities, and structural characteristics in the field of defence policies that differentiate them from NATO countries. These six studied non-NATO states did not adhere to the long-term political commitment

to allocate 2% of their GDP to their defence budgets until 2024. Even more strikingly, one of the non-NATO states has reduced its share of military spending in GDP in 2021 compared to 2014 (Ireland). In such a context, the results obtained denote notable peculiarities of non-NATO states, for which we have proven that the current values of military expenditures contribute to the growth of GDP, while the past values of military expenditures have the potential to inhibit GDP.

For all NATO and non-NATO EU countries, the robust results obtained in most of the studied static and dynamic panels models for two analysed proxies as control variables (unemployment and inflation) reveal the negative correlation of current and past values of unemployment and inflation with GDP. Also, a positive influence of GDP's past evolution (first lag) on its current values has been documented, based on a GMM approach.

These findings suggest two significant political implications: i) these results could be helpful to policymakers in the sense that governments can use military spending as a driver of GDP growth, but they must ensure that resources are appropriately managed and efficiently allocated to ensure such accelerated growth; ii) it is unwise for states to use defence spending to create jobs to stimulate their economies.

To conclude, there are key differences between NATO EU members and non-NATO EU members. The primary difference revolves around security commitments and defence spending. NATO members are part of a mutual defence pact binding them to the principle of collective defence. This means that an attack against one NATO member is considered an attack against all members. As part of their NATO membership, these countries have agreed to aim to spend at least 2% of their GDP on defence, although this target is not always met. This commitment can influence national budgeting decisions, as countries need to allocate significant resources towards defence. For NATO EU members, their obligation to aim for a specific defence spending target (2% of GDP) can lead to a more substantial immediate economic stimulus through job creation and increased demand in defence-related industries. This commitment can also lead to technological advancements driven by military research and development.

Non-NATO EU members, on the other hand, do not have this specific commitment. While they participate in collective security and defence policy frameworks within the EU, such as the Common Security and Defence Policy (CSDP), these commitments are generally not as binding as NATO's. Therefore, these countries might enjoy greater flexibility in their defence budgets and overall economic planning – a difference that could potentially influence the dynamics of economic growth, inflation, and unemployment between NATO EU members and non-NATO EU members, especially considering the significant resource allocation required for defence among NATO countries.

However, the potential drawbacks related to the crowding-out effect, public debt, and resource diversion could also be more pronounced in NATO EU countries due to their higher defence spending commitments. Thus, their economies may experience more significant trade-offs between military expenditure and investment in other productive sectors.

By contrast, non-NATO EU countries, with potentially lower military spending, may have more resources available for private investment and other public sector initiatives. The potential for crowding out, higher public debt, and resource diversion might therefore be less pronounced in these economies. However, these countries might also experience less of the immediate economic stimulus and technological development benefits associated with high levels of defence spending.

For NATO EU countries, the results confirm the neoclassical growth theory view that military expenditure, as a form of capital investment can stimulate growth through enhanced security, technological spillover, and demand increase. In non-NATO EU nations, though, the negative correlation supports the endogenous growth theory, highlighting the potential adverse effects of military spending crowding out essential investments in human capital and productive sectors, thus hampering long-term economic growth.

In spite of the key insights produced by our research, we must also acknowledge that it suffers from several limitations. The first is the limited timeframe in which we study the subject at hand (1998–2021), meaning that changes in economic, political, or security conditions after this period are not considered. Second, this study captures only some of the variables that

have been highlighted by previous literature as potentially impacting GDP; plus, there may be other factors influencing these variables, which are not included in the model. A potential avenue for future research could be to analyse different clusters of countries that could present the influences of military expenditures on GDP as well as broaden the horizon of analysis. Moreover, while the study focuses on EU countries, both NATO and non-NATO, its findings might not be generalisable to other regions or countries with different political, economic, or security contexts.

References

Abrigo, M. R. M., & Love, I. (2016). Estimation of panel vector autoregression in Stata. *The Stata Journal: Promoting Communications on Statistics and Stata*, *16*(3), 778–804. https://doi.org/10.1177/1536867x1601600314

Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Economic Studies*, *58*(2), 277–297. https://doi.org/10.2307/2297968

Barro, R. J. (1995). *Inflation and economic growth* (NBER Working Paper Series. Working Paper No. 5326). Federal Reserve Bank St. Louis Rev. (Vol. 78, pp. 153–169). National Bureau of Economic Research. https://doi.org/10.3386/w5326

Bayrak, R. (2019). Does the optimal size of defense expenditure exist? An empirical study on Turkey. *The Journal of Defence Sciences*, *18*(1), 135–160. https://doi.org/10.17134/khosbd.561221

Benoit, E. (1978). Growth and defense in developing countries. *Economic Development and Cultural Change*, *26*(2), 271–280. https://doi.org/10.1086/451015

Bernauer, T., Koubi, V., & Ernst, F. (2009). National and regional economic consequences of Swiss defense spending. *Journal of Peace Research*, *46*(4), 467–484. https://doi.org/10.1177/0022343309334617

Burger, P., & Šlampiaková, L. (2021). The effect of sectoral division on GDP per capita in the Slovak Republic. *E&M Economics and Management*, *24*(1), 21–37. https://doi.org/10.15240/tul/001/2021-1-002

Carter, J., Ondercin, H. L., & Palmer, G. (2021). Guns, butter, and growth: The consequences of military spending reconsidered. *Political Research Quarterly*, *74*(1), 148–165. https://doi.org/10.1177/1065912919890417

Chowdhury, A. R. (1991). A causal analysis of defence spending and economic growth. *Journal of Conflict Resolution*, *35*(1), 80–97. https://doi.org/10.1177/0022002791035001005

Churchill, S. A., & Yew, D. S. L. (2018). The effect of military expenditure on growth: An empirical synthesis. *Empirical Economics*, *55*(3), 1357–1387. https://doi.org/10.1007/s00181-017-1300-z

Correia, S., Guimarães, P., & Zylkin, T. (2020). Fast Poisson estimation with high-dimensional fixed effects. *The Stata Journal: Promoting Communications on Statistics and Stata*, *20*(1), 95–115. https://doi.org/10.1177/1536867X20909691

d'Agostino, G., Dunne, J. P., & Pieroni, L. (2011). Optimal military spending in the US: A time series analysis. *Economic Modelling*, *28*(3), 1068–1077. https://doi.org/10.1016/j.econmod.2010.11.021

Dakurah, A., Davies, S. P., & Sampath, R. K. (2001). Defence spending and economic growth in developing countries: A causality analysis. *Journal of Policy Modeling*, *23*(6), 651–658. https://doi.org/10.1016/s0161-8938(01)00079-5

Denbel, F. S., Ayen, Y. W., & Regasa, T. A. (2016). The relationship between inflation, money supply and economic growth in Ethiopia: Co integration and causality analysis. *International Journal of Scientific and Research Publications*, *6*(1), 556–565.

Dumitrescu, E.-I., & Hurlin, C. (2012). Testing for Granger non-causality in heterogenous panels. *Economic Modelling*, *29*(4), 1450–1460. https://doi.org/10.1016/j.econmod.2012.02.014

Dunne, J. P., Smith, R. P., & Willenbockel, D. (2005). Models of military expenditure and growth: A critical review. *Defence and Peace Economics*, *16*(6), 449–461. https://doi.org/10.1080/10242690500167791

Dunne, P., & Nikolaidou, E. (2001). Military expenditure and economic growth: A demand and supply model for Greece, 1960–96. *Defence and Peace Economics*, *12*(1), 47–67. https://doi.org/10.1080/10430710108404976

Dunne, P., Nikolaidou, E., & Vougas, D. (2001). Defence spending and economic growth: A causal analysis for Greece and Turkey. *Defence and Peace Economics*, *12*(1), 5–26. https://doi.org/10.1080/10430710108404974

Durguti, E., Krasniqi, E. H., & Krasniqi, D. (2020). Assessing the performance of factors

affecting the profitability of the banking system: Evidence from Kosovo. *European Journal of Sustainable Development*, *9*(2), 304–314. https://doi.org/10.14207/ejsd.2020.v9n2p304

Duxbury, S. W. (2021). A general panel model for unobserved time heterogeneity with application to the politics of mass incarceration. *Sociological Methodology*, *51*(2), 348–377. https://doi.org/10.1177/00811750211016033

Eggoh, J., & Khan, M. (2014). On the nonlinear relationship between inflation and economic growth. *Research in Economics*, *68*(2), 133–143. https://doi.org/10.1016/j.rie.2014.01.001

Fatehi-Sedeh, K., & Safizadeh, M. H. (1989). The association between political instability and flow of foreign direct investment. *Management International Review*, *29*(4).

Fischer, S. (1993). The role of macroeconomic factors in growth. *Journal of Monetary Economics*, *32*(3), 485–512. https://doi.org/10.1016/0304-3932(93)90027-d

Forgione, A. F., & Migliardo, C. (2020). CSR engagement and market structure: Evidence from listed banks. *Finance Research Letters*, *35*, 101592. https://doi.org/10.1016/j.frl.2020.101592

Gerace, M. P. (2002). US military expenditures and economic growth: Some evidence from spectral methods. *Defence and Peace Economics*, *13*(1), 1–11. https://doi.org/10.1080/10242690210966

Gerged, A. M., Beddewela, E. S., & Cowton, C. J. (2023). Does the quality of country-level governance have an impact on corporate environmental disclosure? Evidence from Gulf Cooperation Council countries. *International Journal of Finance & Economics*, *28*(2), 1179–1200. https://doi.org/10.1002/ijfe.2469

Ghosh, A., & Phillips, S. (1998). Warning: Inflation may be harmful to your growth. *IMF Staff Papers – International Monetary Fund*, *45*(4), 672–710. https://doi.org/10.2307/3867589

González-Astudillo, M., & Roberts, J. M. (2022). When are trend-cycle decompositions of GDP reliable? *Empirical Economics*, *62*(5), 2417–2460. https://doi.org/10.1007/s00181-021-02105-4

Gricar, S., Bojnec, S., Karadzic, V., & Backovic, T. (2022). Three decades of macroeconomic flux in Montenegro and Slovenia. *Montenegrin Journal of Economics*, *18*(2), 61–71. https://doi.org/10.14254/1800-5845/2022.18-2.6

Hashmi, S. M., Chang, B. H., & Rong, L. (2021). Asymmetric effect of COVID-19 pandemic on E7 stock indices: Evidence from quantile-on-quantile regression approach. *Research in International Business and Finance*, *58*, 101485. https://doi.org/10.1016/j.ribaf.2021.101485

Heo, U., & Ye, M. (2016). Defence spending and economic growth around the globe: The direct and indirect link. *International Interactions*, *42*(5), 774–796. https://doi.org/10.1080/03050629.2016.1149067

Holtz-Eakin, D., Newey, W. K., & Rosen, H. S. (1988). Estimating vector autoregressions with panel data. *Econometrica*, *56*(6), 1371–1395. https://doi.org/10.2307/1913103

Hung-Pin, L., & Wang, T. L. (2022). Does military expenditure promote economic growth and social welfare? Theoretical and empirical evidence in Taiwan. *Economic Computation and Economic Cybernetics Studies and Research*, *56*(2), 65–76. https://doi.org/10.24818/18423264/56.2.22.05

Juodis, A., Karavias, Y., & Sarafidis, V. (2021). A homogeneous approach to testing for Granger non-causality in heterogeneous panels. *Empirical Economics*, *60*(1), 93–112. https://doi.org/10.1007/s00181-020-01970-9

Khalid, U., & Habimana, O. (2019). Military spending and economic growth in Turkey: A wavelet approach. *Defence and Peace Economics*, *32*(3), 362–376. https://doi.org/10.1080/10242694.2019.1664865

Koengkan, M., Fuinhas, J. A., & Marques, A. C. (2019). The relationship between financial openness, renewable and nonrenewable energy consumption, CO2 emissions, and economic growth in the Latin American countries: An approach with a panel vector auto regression model. In M. Koengkan, J. A. Fuinhas, & A. C. Marques (Eds.), *The extended energy-growth nexus* (pp. 199–229). Elsevier. https://doi.org/10.1016/b978-0-12-815719-0.00007-3

Labra, R., & Torrecillas, C. (2018). Estimating dynamic panel data. A practical approach to perform long panels. *Revista Colombiana de Estadistica*, *41*(1), 31–52. https://doi.org/10.15446/rce.v41n1.61885

Lai, C. C., Shieh, J. Y., & Chang, W. Y. (2002). Endogenous growth and defence expenditures: A new explanation of the Benoit hypothesis. *Defence and Peace Economics*, *13*(3), 179–186. https://doi.org/10.1080/10242690210975

Lin, E. S., Ali, H. E., & Lu, Y. L. (2015). Does military spending crowd out social welfare expenditures? Evidence from a panel of OECD countries. *Defence and Peace Economics*,

26(1), 33–48. https://doi.org/10.1080/10242694.2013.848576

Ljupco, D., Hourvouliades, N., & Komic, J. (2018). Impact of interest rate and inflation on GDP in Bulgaria, Romania and FYROM. *Journal of Balkan and Near Eastern Studies*, *20*(2), 131–147. https://doi.org/10.1080/19448953.2018.1379746

Looney, R. E. (1991). The economics of third world defence expenditures: A survey of recent findings on the contrasting patterns of impact and determinants. *Journal of Third World Studies*, *8*(2), 219–241.

Lopez, L., & Weber, S. (2017). Testing for Granger causality in panel data. *The Stata Journal: Promoting Communications on Statistics and Stata*, *17*(4), 972–984. https://doi.org/10.1177/1536867x1801700412

Lucas, R. E. (1988). On the mechanics of economic development. *Journal of Monetary Economics*, *22*(1), 3–42. https://doi.org/10.1016/0304-3932(88)90168-7

Maladjian, C., & Khoury, R. E. (2014). Determinants of the dividend policy: An empirical study on the Lebanese listed banks. *International Journal of Economics and Finance*, *6*(4), 240–256. https://doi.org/10.5539/ijef.v6n4p240

Malizard, J. (2014). Defense spending and unemployment in France. *Defence and Peace Economics*, *25*(6), 635–642. https://doi.org/10.1080/10242694.2013.857450

Mintz, A., & Stevenson, R. T. (1995). Defence expenditures, economic growth, and the 'peace dividend': A longitudinal analysis of 103 countries. *Journal of Conflict Resolution*, *39*(2), 283–305. https://doi.org/10.1177/0022002795039002004

Nikolaidou, E. (2008). The demand for military expenditure: Evidence from the EU-15 (1961–2005). *Defence and Peace Economics*, *19*(4), 273–292. https://doi.org/10.1080/10242690802166533

Norkus, Z., Morkevičius, V., & Markevičiūtė, J. (2021). From warfare to welfare states? Social and military spending in the Baltic states 1918–1940. *Scandinavian Economic History Review*, *69*(1), 1–21. https://doi.org/10.1080/03585522.2020.1716060

Odehnal, J., & Neubauer, J. (2020). Economic, security, and political determinants of military spending in NATO countries. *Defence and Peace Economics*, *31*(5), 517–531. https://doi.org/10.1080/10242694.2018.1544440

Okun, A. M. (1962). Potential GNP: Its measurement and significance. In *Proceedings of the Business and Economics Statistics Section/American Statistical Association* (pp. 98–104). American Statistical Association.

Romer, P. (1990). *Endogenous technological change* (NEBR Working Paper Series. Working Paper No. 3210). National Bureau of Economic Research – Journal of Political Economy (Vol. 98, pp. 71–102). https://doi.org/10.3386/w3210

Roodman, D. (2009). How to do Xtabond2: An introduction to difference and system GMM in Stata. *The Stata Journal: Promoting Communications on Statistics and Stata*, *9*(1), 86–136. https://doi.org/10.1177/1536867X0900900106

Saba, C. S., & Ngepah, N. (2019). Military expenditure and economic growth: Evidence from a heterogeneous panel of African countries. *Economic Research Ekonomska Istraživanja*, *32*(1), 3586–3606. https://doi.org/10.1080/1331677X.2019.1674179

Sekmen, F., & Saribas, H. (2007). Cointegration and causality among defence expenditures, economic growth and level of exchange rate in Turkey. *The Empirical Economics Letter*, *6*(3), 193–203.

Solow, R. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics*, *70*(1), 65–94. https://doi.org/10.2307/1884513

Stanić, S., & Račić, Ž. (2019). Analysis of macroeconomic factors effect to gross domestic product of Bosnia and Herzegovina using the multiple linear regression model. *Economics*, *7*(2), 91–97. https://doi.org/10.2478/eoik-2019-0022

Tao, R., Glonț, O. R., Li, Z.-Z., Lobonț, O. R., & Guzun, A. A. (2020). New evidence for Romania regarding dynamic causality between military expenditure and sustainable economic growth. *Sustainability*, *12*(12), 5053. https://doi.org/10.3390/su12125053

Tiwari, A. K., & Shahbaz, M. (2013). Does defence spending stimulate economic growth in India? A revisit. *Defence and Peace Economics*, *24*(4), 371–395. https://doi.org/10.1080/10242694.2012.710814

Topal, M. H., Unver, M., & Türedi, S. (2022). The military expenditures and economic growth nexus: Panel bootstrap granger causality evidence from NATO countries. *Panoeconomicus*, *69*(4), 555–578. https://doi.org/10.2298/PAN170914002T

Topcu, M., & Aras, I. (2015). Defense spending and economic growth: Extended empirical analysis for the European Union. *Defence and Peace Economics*, *26*(2), 233–246. https://doi.org/10.1080/10242694.2013.774771

Vyrostková, L., & Mirdala, R. (2022). Inflation persistence and unit root tests in the Euro Area countries. *E&M Economics and Management*, *25*(4), 4–19. https://doi.org/10.15240/tul/001/2022-4-001

Wijeweera, A., & Webb, M. J. (2011). Military spending and economic growth in South Asia: A panel data analysis. *Defence and Peace Economics*, *22*(5), 545–554. https://doi.org/10.1080/10242694.2010.533905

Xiao, J., Juodis, A., Karavias, Y., Sarafidis, V., & Ditzen, J. (2022). *Improved tests for Granger non-causality in panel data* (MPRA Paper No. 114231). MPRA. https://mpra.ub.uni-muenchen.de/114231/

Yilgör, M., Erdal, T. K., & Çiğdem, A. S. (2014). Panel causality analysis between defence expenditure and economic growth in developed countries. *Defence and Peace Economics*, *25*(2), 193–203. https://doi.org/10.1080/10242694.2012.724879