

Global Analysis of the Impact of Military Expenditure on Economic Growth

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Abstract

Military expenditures can indirectly affect the economy by reducing risk and creating stability, or by increasing the level of income through the production of military goods and services. Therefore, this research has been conducted with the aim of investigating the role of military expenditures in economic growth. For this purpose, the statistical population consists of 81 countries worldwide during the years 1998-2022. The estimations were made using the two-way panel data method. In this regard, the factors affecting economic growth are the variables of military expenditures, inflation rate, trade, unemployment rate, and government size. All collected data are from the World Bank database, in millions of US dollars and at constant 2017 prices.

According to the estimates, military expenditures, with a coefficient of 1/12, have a negative and significant impact on economic growth. On the other hand, economic growth has a positive and significant relationship with the variables of trade and government size, and a negative and significant relationship with the unemployment rate variable. Based on the results, it is suggested that if a country is not facing regional threats, and considering the positive impact of trade and government size on economic growth, governments should try to increase the necessary resources for other sectors, especially the education and health sectors; in order to help increase the level of economic growth of countries through the expansion of production of goods and services, reducing the unemployment rate, and supporting exports.

Keywords: Defense Economy, GDP Per Capital, Panel-Data.

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Introduction

Defense economics is a branch of science that applies economics to issues of national defense. It was first initiated by Hitch and McKean (1960) in an article titled "The Economics of Defense in the Nuclear Age," in which they characterized the problem of national defense as an economic one (Saputro et al., 2020). According to the perspective of Hartley and Sandler (1995), from a macroeconomic viewpoint, defense economics, by considering the three main components of economic activity (namely the government, firms, and households), studies resource allocation, income distribution, economic growth, and economic stabilization (ibid.). Based on defense economics, the impact of using the defense budget on the economy can be analyzed according to either the demand/consumption or the supply/production approaches (Saputro et al., 2021).

From another perspective, defense economics involves examining the impact of resource scarcity in limiting the defensive activities of countries, while simultaneously developing such activities. Furthermore, given that nations operate within an international system comprising other states and numerous non-state actors, defense economics must unite the interactions of different countries as they seek to provide regional and international security, of which they themselves are a part. In summary, it can be said that defense economics determines the impact of defense activities on the broader international economy and the effect of this economic system on the matter of defense (Hartley, 2007; as cited in Khashei Varnamkhasti & Vaezi, 2021).

The relationship between military expenditures and economic growth has attracted the attention of many economists and researchers since the seminal study by Benoit (1973). Subsequently, numerous studies have been conducted at the level of individual countries or using samples comprising multiple countries; however, the results obtained have not been consistent. Nevertheless, the examination of this topic still requires further discussion and analysis. Generally, it is believed that a relationship exists between military expenditures and the economy, but these effects vary from country to country, and there is still no conclusive consensus from the empirical tests conducted (Juliana et al., 2022).

After World War II, it was expected that the total military expenditures of the world's countries would trend downward. Given the constraints on economic resources, changes in a country's military budget lead to changes in its non-military sector budgets, which can affect their economies

through various ways and channels. The nature of this impact can differ depending on various conditions (geographical location, level of economic development, strategic circumstances, type of governing system, etc.), and the exact nature of this effect has always been a subject of debate. This issue is particularly more significant for less developed countries. This is because these countries, while progressing in various fields and requiring optimal resource allocation, have fewer resources and less efficiency and effectiveness in economic activities compared to developed countries, and they need optimal resource allocation for their development. On the other hand, targeted military expenditures provide security in society, which is a very important matter and a prerequisite for creating and maintaining stability in various dimensions, including a country's economic dimensions. In other words, economic growth and public welfare can occur under the umbrella of security, allowing households, firms, and other sectors of the economy to benefit from its existence (Manzoor & Seyghalani, 2022).

The direction and magnitude of the relationship between military expenditures, as an indicator of defense economics, and economic growth, as one of the most important macroeconomic variables, is a topic that economists have debated for many years. In recent studies concerning military expenditure and its impact on economic growth, Saputro and Meirinaldi (2019) state that security stability and the strategic growth of an industry have a simultaneous effect on increasing macroeconomic stability. Furthermore, Dexino et al. (2022) argue that defense economics is a driving force for a country's economy and consider national economic growth to be a result of the independence of the defense industry (Juliana et al., 2022).

Given the extensive studies aimed at improving the level of economic growth and development in most countries worldwide, examining the important and influential factors on economic growth remains highly significant and essential. Therefore, the objective of this research is to analyze and investigate the influential factors, particularly the key role of military expenditures on economic growth, from a different perspective, despite the multitude and diversity of existing studies in this field. Accordingly, this study encompasses 81 countries¹ from all continents

¹. In this research, for selecting the statistical population, all countries worldwide were initially considered. However, due to the unavailability of certain statistical data and information, some countries were excluded, and only 81 countries were ultimately approved for the study.

with diverse economic backgrounds, covering the period from 1998 to 2022.

Theoretical Foundations and Research Background

Theoretical Foundations of the Research Defense Expenditures

Defense expenditures, also referred to as military expenditure or military budget, constitute a portion of the government's budget used by the defense and military sector to secure the country against internal and external threats. In reality, military expenditure is one of the most significant components of public expenditures in the national budget. It includes the production (or import) of goods such as machinery and equipment, costs for maintenance and repairs, research and development activities, and compensation for services provided by military and civilian personnel in the defense sector (Korkmaz, 2015). The definitions provided for defense expenditures are largely consistent across almost all countries worldwide. Another definition, endorsed by the International Monetary Fund (IMF) and the International Institute for Strategic Studies (IISS), states that defense expenditures represent the total financial resources allocated by the government for the maintenance of armed forces and other defense-related activities (Kumar, 2017; as cited in Tavakolian & Sahraei, 2021).

In Table 1, the defense economics indicator (military expenditures based on GDP percentage) for the countries studied¹ is ranked for the years 2012, 2017, and 2022.

¹. It should be noted that due to the unavailability of some statistical information, 81 countries were ultimately selected as the sample for this study. These countries are as follows: Algeria, Australia, Armenia, Azerbaijan, Bahrain, Belgium, Brazil, Cameroon, Colombia, Chile, Croatia, Egypt, France, Georgia, Indonesia, Iraq, Italy, Japan, Kazakhstan, South Korea, Kuwait, Lebanon, Malaysia, Nicaragua, Nepal, Pakistan, Portugal, Russia, Senegal, Singapore, South Africa, Spain, Sudan, Sweden, Tunisia, Ukraine, Uruguay, United Kingdom, Vietnam, Zimbabwe, Yemen, United States, Uganda, Turkey, Thailand, Tajikistan, Netherlands, Saudi Arabia, Romania, Poland, Oman, Niger, New Zealand, Switzerland, Morocco, Mexico, Malta, Kenya, Jordan, Jamaica, Israel, Ireland, Iran, India, Guinea, Honduras, Germany, Denmark, China, Canada, Cambodia, Bulgaria, Bolivia, Belize, Belarus, Bangladesh, Argentina, Angola, Albania.

	2012 ¹		2017 ²		2022 ³	
	Country	Quantity	Country	Quantity	Country	Quantity
Average	2.11		2.10		2.28	
5 countries with the highest military expenditure	Oman	10.58	Saudi Arabia	10.22	Ukraine	33.54
	Saudi Arabia	7.67	Oman		Saudi Arabia	7.42
	The Zionist usurper regime	5.64	Algeria	5.92	Oman	5.16
	Emirates	5.07	Kuwait	5.60	Jordan	4.84
	Jordan	4.65	The Zionist usurper regime	5.43	Algeria	4.77
5 countries with the least military expenditure	Mexico	0.475	Ireland	0.306	Ireland	0.225
	Ireland	0.512	Mexico	0.436	Argentina	0.411
	Malta	0.527	Malta	0.479	Zimbabwe	0.427
	Nicaragua	0.665	Nicaragua	0.626	Malta	0.499
	Netherlands	0.666	Netherlands	0.665	Kazakhstan	0.509

Table 1: Ranking of military expenditure index (based on GDP percentage) in the countries studied

Source: World Development Index

Table (1) data indicates that the average share of military expenditure from GDP in the studied countries ranges between 2% and 2.5%. Furthermore, according to conducted reviews, Saudi Arabia, Oman, Jordan, and the Zionist usurper regime have consistently allocated the highest military expenditures in the world, while Mexico, Ireland, Malta, and Nicaragua have generally held the lowest rankings for military expenditure. On the other hand, in 2022, due to the outbreak of wars, Ukraine ranked first in terms of highest military expenditure, and Ireland had the lowest level of military expenditure.

¹. Statistics for Sudan were not available during this period.

². Statistics for Yemen were not available during this period.

³. During this period, statistics for the UAE, Yemen, Vietnam, Sudan, and Lebanon were not available.

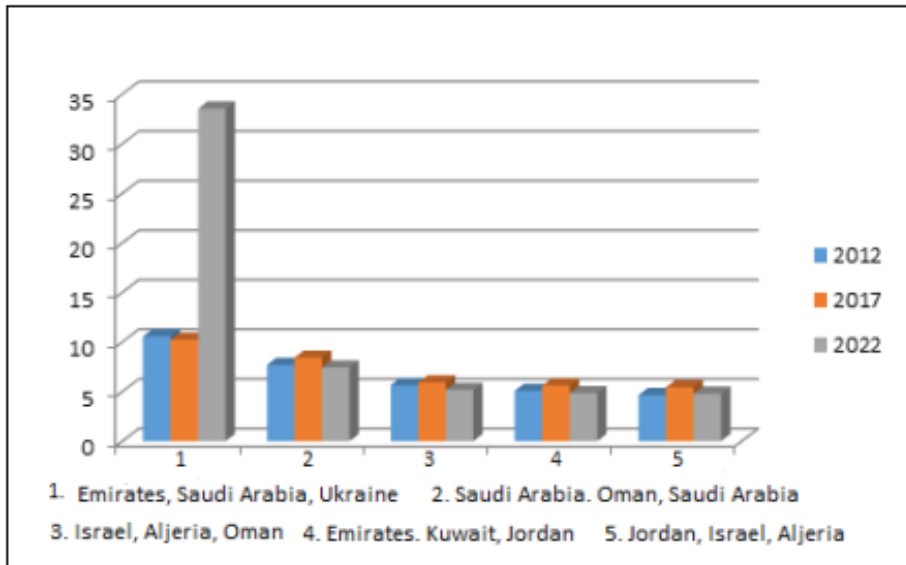


Fig. 1 Five countries with the highest military expenditure

Source: Research findings

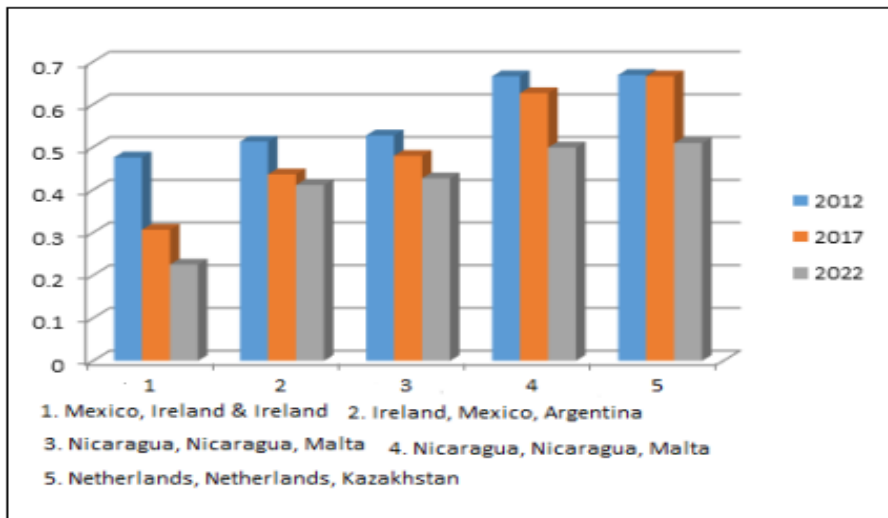
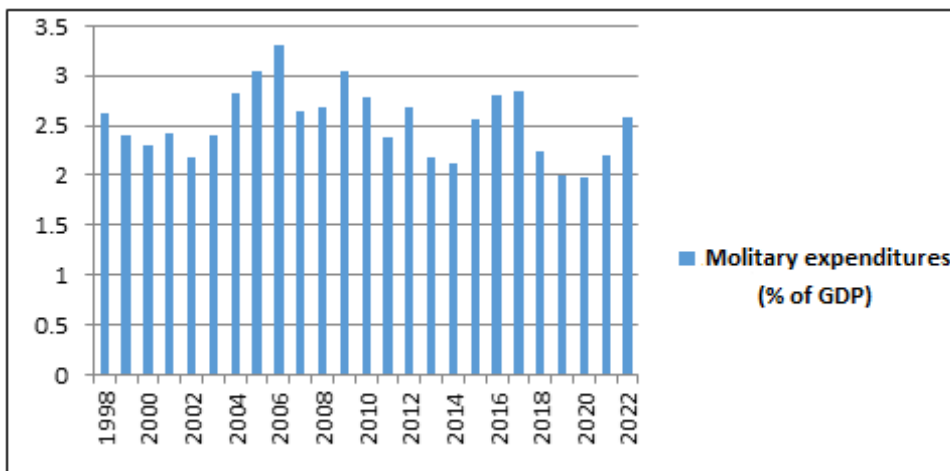


Fig. 2 Five countries with the lowest military expenditure

Source: Research findings

It should be noted that, the level of military expenditure in Iran has experienced significant fluctuations, in such a way that the maximum military expenditures in 2006 and 2009 were 3.31% and 3.04%, while the



minimum level of these expenditures in 2019 and 2020 were 1.97% and 2.00%, respectively.

Fig.3 Military expenditures in Iran in 1998-2022

Source: Research findings

Economic growth

Achieving economic growth is one of the most important macroeconomic objectives for countries, and the causes behind it have always attracted the attention of many economists. In the system of national accounts, Gross Domestic Product (GDP) at market prices is defined as the market value of all final goods and services produced within the domestic territory of an economy by resident producers. In another definition, economic growth is “a continues increase in National Income (NI) or Gross National Product (GNP) over time¹” (Lutz, 2002; as cited in Najafi & Mirzababazadeh, 2019).

Generally speaking, economic growth is influenced by two main groups of factors:

- A quantitative increase in factors of production (labor, capital, land, and other natural resources).
- An increase in qualitative factors (including technological change, which affects productivity; economies of scale²; and human capital

¹. It mainly refers to real GDP (at constant prices).

². Economies of scale refer to the phenomenon where the cost per unit of production decreases as the volume of output increases.

through the enhancement and improvement of individuals' productive capacity) (Mousavi Jahromi, 2010).

Theories of economic growth began with the publication of Adam Smith's *The Wealth of Nations* (1776) and the classical and neoclassical growth models of the twentieth century, which initiated formal growth modeling, and continued through modern (endogenous) growth models from the second half of the 1980s up to the present.

The following are statistics for the 5 countries with the highest and lowest GDP per capita among the 81 selected countries for 2022.

Gross Domestic Product (billion dollars)			
5 countries with the highest GDP		5 countries with the lowest GDP	
Ireland	97316	Niger	547.5
Netherlands	90057	Uganda	934
Singapore	67948	Guinea	994.5
America	63720	Yemen	1018
Australia	60972	Sudan	1025
GDP per capita growth (billion dollars)			
5 countries with the highest GDP per capita growth		5 countries with the lowest GDP per capita growth	
Armenia	13.02	Ukraine	-16.72
Georgia	10.84	Belarus	-3.89
Bulgaria	10.56	Sudan	-3.53
Poland	8.29	Russia	-1.73
Niger	7.82	Yemen	-0.65

Table 2. GDP per capita ranking in 2022

Source: Research findings

According to statistical data collected from the World Development Indicators (WDI, 2017), the highest GDP per capita in 2022 belonged to Ireland, the Netherlands, and Singapore, while the lowest GDP per capita belonged to Niger, Uganda, and Guinea. Furthermore, in the analysis of GDP per capita growth, the highest growth in 2022 belonged to Armenia, Georgia, and Bulgaria, while the lowest growth belonged to Ukraine, Belarus, and Sudan.

It should be noted that Iran has experienced high GDP per capita growth since 2020. Specifically, its GDP per capita growth rose from -4.13% in 2019 to 2.47% in 2020; it then increased by 3.96% in 2021. However, in 2022, it decreased by 3.04%.

The literature on economic growth points to various factors that influence growth fluctuations. Some of the most important factors will be discussed below.

Military expenditures and economic growth

According to a study by Juliana et al. (2022), governments can exert influence the economy through military expenditures, which serves as one of their implemented policies. In general, the impact of military expenditure on economic growth can vary depending on various factors such as the level of development (Golkhandan, 2014), income level (Fotros & Golkhandan, 2017), regional dependencies (Chen et al., 2014), reliance on oil revenues (Molaei & Golkhandan, 2016), among other factors (Golkhandan & Mohammadian Mansour, 2019). The following section will address how military expenditure affects economic growth.

A) The positive impact of military expenditures on economic growth

1. Research and development in the defense sector can have a positive impact; military research and defense expenditure will lead to technological innovation. In developing countries, defense economy can contribute to the creation of socio-economic structures. For instance, participation in R&D, training and provision of skilled personnel, and creating necessary infrastructure can foster economic development and growth.

2. Increased military expenditure can enhance security, thereby maintaining stability in the business environment and creating favorable conditions for attracting foreign investors. Security also safeguards property rights and market dynamism, thus promoting economic growth in today's global system.

3. The positive effect of defense expenditure can occur through an increase in aggregate demand (the Keynesian effect). Increased demand plays a significant role in raising the utilization of idle capital, reducing the unemployment rate, and increasing profits, which in turn encourages further investment, all of which lead to economic growth.

4. With an increase in defense expenditure, the skills of a segment of the population are enhanced through the training of military personnel. As the economy moves towards full employment, and by maintaining stability and providing infrastructure, it has a stimulating effect on growth.

B) The Negative Impact of Military Expenditure on Economic Growth

- 1. Military expenditure negatively affect economic growth through the crowding-out effect on the private sector. Substantial defense expenditures, directed towards arms accumulation and enhancing military capacity, disrupt resource allocation and divert resources from productive activities. Military expenditure can be harmful as it adversely affects investment, savings, human resources, and infrastructure programs.
- 2. Military expenditure can hinder economic development by reducing savings and causing the misallocation of resources away from more productive uses in either the public or private sector. Therefore, government spending on national defense involves significant opportunity costs and can lead to a reduction in economic output.
- 3. An increase in defense expenditure may not stem from the need for security but rather it is due to rent-seeking by the complex military-industrial sector. This can drive an increase in armaments and a military posture that exceeds a country's rational share, potentially leading to heightened political tension or war, and ultimately reducing economic growth.

Trade and economic growth

An increase in the level of a country's trade strengthens economic growth. This means that the expansion of exports, through competition in tradable goods, leads to an increase in the efficiency of domestic production. Consequently, it improves the quality of these goods and reduces their prices. International trade also increases the import of capital goods, raw materials, and essential intermediate and productive inputs, which are highly efficient in the production process. Furthermore, the import of technology and technical knowledge from industrialized countries to non-industrialized developing countries is one of the benefits of free trade that stimulates economic growth in developing nations (Jahani & Farahani-Fard, 2020).

Unemployment and economic growth

The negative relationship between the unemployment rate and the GDP growth rate was first proposed by Okun Role (1963). According to Okun's Law, a one-percentage-point decrease (increase) in the unemployment rate

leads to an approximately 3 percent increase (decrease) in the economic growth rate. Following Okun, many economists conducted numerous empirical studies¹ using various methods to estimate the validity of the law, while other studies² indicate the instability of this relationship. Therefore, the relationship between these two variables is not symmetrical in most countries (Raisi & Zahedian, 2020).

Exchange rates and economic growth

The exchange rate is considered one of the most important macroeconomic variables, and how it is determined has always been a significant topic and challenge in the realm of policy-making. The exchange rate can have diverse and contradictory effects on economic growth. For example, an increase in the exchange rate can enhance the competitiveness of domestic producers, whose production is not heavily dependent on foreign currency, leading to strengthened exports and economic growth. However, this same increase in the exchange rate can, by raising the production costs for domestic producers whose output has high import intensity, lead to a weakening of aggregate supply and economic growth in the country (Motahari et al., 2017).

Government Size and Economic Growth

With the emergence of new endogenous growth models since the mid-1980s, the impact of government on countries' growth has gained importance. Endogenous growth models argue that the internal mechanisms of an economy (such as human capital development, productivity enhancement, education, an adequate level of knowledge and skills, research, etc.) play a role in economic growth. Barro (1990), one of the pioneers in this field, believes that the size of government has two different effects on economic growth. On the one hand, an increase in government expenditures leads to higher taxes, which reduces the economic growth rate through a disincentive effect; on the other hand, an increase in government expenditure raises the marginal efficiency of capital in both the public and private sectors, thereby leading to economic growth (Khodaadad Kashani et al., 2020).

¹. Including: Gordon (1984), Noster (1986), Kaufman (1988), Harris et al. (2001), Siloupoul et al. (2004), Fuco (2008), and Lal et al. (2010).

². For example: Blanchard et al. (1987), Kuarsma (2003), Chang Hong et al. (2005), and Nooteck (2007).

The importance of the relationship between military expenditures and economic growth

One of the most important motivations for countries in allocating financial resources to defense expenditures is their need for security. In developing countries, the limitation of financial resources on the one hand, and the existence of unused capacities in various economic sectors on the other, have placed policymakers in a dilemma of choosing between security and economic growth. Specifically, in public perception and according to some studies, a country that holds a superior military position internationally is expected to have a superior economy. However, this proposition has numerous counterexamples. The central question, therefore, is: what impact do defense expenditures have on a country's economy? The answer to this question spans two perspectives. Some researchers¹ argue that higher defense spending leads to the contraction of other sectors of the economy, thereby reducing economic growth. Conversely, other studies² highlight the positive effect of increased defense expenditures on economic growth, suggesting that higher defense expenditures expand government spending, which ultimately boosts domestic production and fosters economic growth (Tavakolian & Sahraei, 2021).

In discussing the significance of defense expenditures in the economy, two general perspectives can be considered: the importance of defense spending from the viewpoint of ensuring internal security, and its importance from the perspective of macroeconomic effects.

Depending on their utility (effectiveness in countering threats) or side effects, defense costs can be analyzed from two principal viewpoints:

A) The Neoclassical Viewpoint or Supply-Side Models

From this viewpoint, the impact of military expenditure on economic growth is mediated through the availability of production factors—including labor, capital (both physical and human resources), and technology—all of which exert a potential influence on economic output. This theory posits that real per capita output and the growth of the capital stock remain constant over a given period, even in the presence of short-term fluctuations. It is further assumed that increases in labor and capital, at a constant level, will raise total output to a new, stable equilibrium

¹. Looney (1986) & Faini, et al (1984)

². Ward, et al (1991), Landau (1993) & Santhirasegaram (2008)

(Solow, 1957). Consequently, changes in total output can be explained by changes in capital and labor inputs (Juliana et al., 2022).

On the supply side, an increase in the provision of defense services will engage more economic factors, leading to a rise in production and welfare levels, and ultimately fostering economic growth (Tavakolian & Sahraei, 2021). Several studies investigating the impact of military expenditure on economic growth have been formulated based on supply-side specifications, such as those by Atesoglu and Muller (1990), Mueller and Atesoglu (1993), Ward and Davis (1992), and Atesoglu (2002), which identified a positive relationship between military spending and GDP growth (Khalid & Abdulrazak, 2015). Furthermore, a supply-side spillover effect can occur as the military sector provides various types of public infrastructure (e.g., dams, communication networks, roads, airports, highways, and other transportation networks), thereby contributing to private sector production (Lee, 2021).

From the neoclassical perspective, defense expenditures negatively affect economic growth by crowding out the private sector and channeling resources that might otherwise generate higher output in the private sector compared to defense and its related areas. In cases where a country's defense sector is underdeveloped, national defense becomes highly dependent on the import of defense goods. This, in turn, can also negatively impact economic growth through increasing foreign debt and transferring valuable resources abroad (Manzoor & Seighalani, 2022).

B) The Keynesian Viewpoint or Demand-Side Models

According to the view of West and Farr (1990), if the resource allocation effect appears, it leads to the crowding-out of investment and will result in a decrease in aggregate output growth. In fact, this model explains that the growth rate is a function of capital growth; therefore, when this effect appears, the transition that occurs causes a decrease in capital growth, followed by a reduction in the total output growth rate (Saputro et al., 2021).

Given the government's budget constraints, an increase in defense expenditures leads to the substitution of these expenditures for civilian spending, higher taxes and foreign debt, etc., ultimately reducing economic growth. On the other hand, a change in capital stock and the substitution effect of military spending for private sector investment spending may reduce economic growth in subsequent periods (Tavakolian

& Sahraei, 2021). Lee (2021) argues that the demand-side effect shows that an increase in military spending increases the level of output through the multiplier effect. Finally, the security effect resulting from military expenditure, by facilitating the inflow of foreign investment and new technology, may increase the level of output (Golkhandan, 2023).

Proponents of high military spending emphasize that, according to Keynesian theory, defense expenditure acts as a catalyst for economic growth (Khalid & Abdulrazakq, 2015). This means that if the positive effect of defense expenditure occurs through an increase in aggregate demand (the Keynesian effect), the increased demand plays a significant role in raising the utilization of idle capital, lowering the unemployment rate, increasing profits, and consequently encouraging further investment—all of which lead to economic growth. Thus, defense expenditure is recognized as a fiscal policy tool to increase demand or reduce demand constraints (Juliana et al., 2022).

In the domain of the relationship between defense spending and economic growth, the diverse results can be attributed to the variety of theoretical models or econometric techniques employed. Some studies¹ align with Benoit's findings, which support the Keynesian perspective on the impact of military spending, while other studies² have confirmed a negative correlation between defense spending and economic growth, contradicting Benoit's study. Additionally, another segment of studies³ has found no significant relationship between the two variables, and some researchers⁴ have confirmed a bidirectional relationship between military spending and economic growth. Overall, all these conducted studies still indicate the importance of investigating the impact of military spending on economic growth. As Kollias et al. (2004) argue, this relationship cannot be generalized across countries and over time (Khalid & Abdulrazakq, 2015). Accordingly, a significant portion of the discussions in the economics of defense is dedicated to the empirical examination and testing of the impact of military spending on the economic growth of various countries. Therefore, this research also attempts to analyze and estimate

¹. For example, the studies of Smith (1980), Fredriksen and Looney (1983), Looney (1983), Faini et al. (1984), Biswas (1993), Chletsos and Kollias (1995), Sezgin (1997), Brumm (1997), Eizenman and Glick (2003), and Yildirim et al. (2005).

². For example, the studies by Lim (1983), Deger and Smith (1983), Starr et al. (1984), Cappelen et al. (1984), Dunne and Mohammed (1995), Galvin (2003), Atesoglu (2002), Halicioglu (2004), Bass (2005), and Savoie et al. (2008).

³. For example, Chowdhury (1991), Mintz and Stevenson (1995), and Dakoura et al. (2001).

⁴. Such as Joerding (1986), Kollias and Paleologou (2004), and Kollias et al. (2007).

the importance of this indicator on economic growth within an extensive statistical population and for a 24-year time period.

Research Background

Foreign Studies

Saeed (2023) conducted a study titled “The Impact of Military Expenditure on Economic Growth in 133 Countries during 1960-2012.” The results indicated that military expenditure has a significant negative effect on economic growth; such that a one-percent increase in military expenditure reduces economic growth by approximately 1.10 %.

Juliana et al. (2022), using a descriptive-research approach, identified and analyzed the implementation of defense industry policies in supporting national economic growth. The results indicated that the defense industry contributed to national economic growth during the COVID-19 pandemic.

Saba and Ngepah (2020) studied the relationship between defense expenditure, economic growth, and economic development in 72 developing countries from 1990 to 2018. The results indicated the existence of long-term and bidirectional relationships between military spending and both economic growth and development.

Ofino and Orisadare (2020) examined the relationship between defense expenditure and economic growth in Nigeria. The findings from their research revealed that no relationship was observed between defense expenditure and economic growth in Nigeria during the studied period, in either direction.

Domestic studies

Shiri Jian et al. (2024), in an article titled “Defense Expenditure and Macroeconomic Variables in Iran: A Vector Autoregression (VAR) Model”, examined the relationship between defense expenditure and macroeconomic variables in Iran for the period 1980-2022 using the Vector Autoregression (VAR) technique and the Toda-Yamamoto causality test. The causality test results indicated a bidirectional causality between defense expenditure and economic growth variables, and a unidirectional causality from defense expenditure to the employment variable. The study's results did not confirm a causal relationship between defense expenditure variables and trade balance, inflation, or imports. Furthermore, impulse response functions showed that a positive shock to military expenditures leads to an increase in the variables of economic

growth, imports, and employment, and a decrease in the variables of inflation rate and trade balance in subsequent periods.

Golkhandan (2023) modeled the nonlinear relationship between military expenditure and unemployment in 171 countries worldwide during 2001-2020 using a panel threshold method. The results indicate that the impact of the military burden on unemployment is nonlinear and follows a U-shaped relationship. The estimated threshold value for military spending was approximately 1.61% of GDP. In other words, below the threshold, the military burden had a significant negative effect on the unemployment rate; however, after exceeding this threshold, the military burden had a significant positive effect on the unemployment rate, which confirms the hypothesis of Lee (2021).

Manzoor and Seighalani (2022) examined the impact of military expenditure on macroeconomic variables in Iran. The results obtained from the simulation output of the variable in the model indicate a positive impact of military expenditure on the production and consumption growth.

Tavakolian and Sahraei (2021) investigated the economic effects of defense expenditure, the manner and extent of the impact of this sector and its budget on other macroeconomic variables. The results demonstrate that in the event of a shock to government defense expenditure, both households and firms benefit from this shock by gaining utility and profits respectively, and both total output and non-oil production in Iran's economy increase.

Based on the theoretical foundations and research background, despite a significant volume of studies having examined the impact of military expenditure on economic growth, there is no empirical consensus regarding whether the effect of this variable on economic growth is positive or negative. Furthermore, Kumar (2017), in a study, found that the size and pattern of a country's military expenditure depend not only on its GDP or financial capacity but also on various other factors, such as economic, non-economic, domestic, foreign, political, and geographical factors (Nasrabadi and Fatemi Zardan, 2021). Likewise, Rahman and Siddiqui (2019) argue that military expenditure is not the only effective option influencing economic growth and is merely one economic-security variable; alongside it, other influencing factors must also be examined. For this purpose, studying this field requires that institutional and social issues, along with other economic variables, be considered for further investigation. Therefore, the primary necessity of this research is to

examine the impact of the key variable of military expenditure on economic growth according to recent statistical data and for a large statistical population. The statistical population employed in this study consists of 81 countries worldwide during 1998-2022, and other variables affecting economic growth will be studied and analyzed alongside military expenditure as the key variable.

Methodology

Based on the theoretical foundations presented in this field (with emphasis on the studies of Saeed (2025) and Rahman and Siddiqui (2019)), the relationship between military expenditure and economic growth, along with other influencing factors during the years 1998-2022 in 81 countries¹, has been addressed. The estimations were carried out using Stata 17 software and the Panel Data Method according to the following model:

Equation 1:

$$Y_{it} = \alpha_0 + \alpha_1 Arm_{it} + \alpha_2 Inf_{it} + \alpha_3 Tra_{it} + \alpha_4 Un_{it} + \alpha_5 Re_{it} + \alpha_5 Gc_{it} + \mu_t + \varepsilon_{it}$$

Where the dependent variable Y is GDP per capita (economic growth index) in million dollars.

Independent variables used are:

Arm: Ratio of military expenditure to GDP; as an indicator of defense economy

- **Inf:** Implied GDP
- **Tra:** Trade in terms of
- **Un:** Total unemployment
- **Re:** Real effective exchange rate
- **Gc:** Government final consumption expenditure

¹. Albania, Algeria, Angola, Argentina, Armenia, Australia, Austria, Azerbaijan, Bahrain, Bangladesh, Belarus, Belgium, Belize, Bolivia, Brazil, Bulgaria, Cambodia, Cameroon, Canada, Chile, China, Colombia, Croatia, Denmark, Egypt, France, Georgia, Germany, Guinea, Honduras, India, Indonesia, Iran, Iraq, Ireland, Italy, Japan, Jamaica, Jordan, Kazakhstan, Kenya, South Korea, Kuwait, Lebanon, Malaysia, Malta, Mexico, Morocco, Nepal, Netherlands, New Zealand, Nicaragua, Niger, Nigeria, Oman, Pakistan, Poland, Portugal, Romania, Russia, Saudi Arabia, Senegal, Singapore, South Africa, Spain, Sudan, Sweden, Switzerland, Tajikistan, Thailand, Tunisia, Turkey, Uganda, Ukraine, United Arab Emirates, United Kingdom, United States, Uruguay, Vietnam, Yemen, Zimbabwe

The explanatory variables used in this study and their extraction source are presented in Table 4:

Variables	Symbol	Index	Unit
Dependent variable	GDPP	Economic growth index	Million dollars
Military expenditure (of % GDP)	Arm	Defense economy index	of % GDP
Inflation rate	Inf	Implicit GDP index	%
Trade	Tra	Trade (of % GDP)	%
Unemployment	Un	Total unemployment (as a percentage of the total labor force)	%
Exchange rate	Re	Real effective exchange rate index	Km
Size of government	Gc	Government final consumption expenditure (of % GDP)	%

Table 4. Variables used in the model estimation

Source: Research findings

It should be noted that the aforementioned data has been collected from the World Bank's World Development Indicators (WDI) database, expressed in millions of US dollars at constant 2017 prices. This ensures that all countries under examination share a uniform informational baseline. The reason for using a single source is that it generally reduces computational errors in both the data collection and calculation methodologies.

Data analysis and research findings

In panel data econometrics, it is assumed that the data used exhibit cross-sectional independence. However, dependence between cross-sectional units can arise from factors such as externalities, regional and economic linkages, unaccounted-for interdependence among residual components, and unobserved common factors across different sections. Failure to account for cross-sectional dependence may lead to unreliable and misleading results (Hoyos and Sarafidis, 2006). Therefore, the first step in panel data econometrics is to test for cross-sectional independence in the data. For this purpose, several tests have been developed, such as the Breusch-Pagan (1980) and Pesaran's Cross-Sectional Dependence Test (2004), whose null hypothesis is cross-section independence.

In this study, Pesaran's CD test for cross-sectional dependence has been used. Among the advantages of this test is that it is applicable to both balanced and unbalanced panel data and performs well in small samples. Specifically, unlike the Breusch-Pagan method, it provides reliable results for large cross-section dimensions and small-time dimensions (Souri, 2015). The results of this test are presented in Table (5) below:

Variables	Statistics	P-value
Pesaran's Cross-Sectional Dependence Test	-31.02	0.000

Table 5. Pesaran's CD Test Results

Source: Research findings

Considering the results from Pesaran's CD test, the null hypothesis of cross-section independence in the model studied is rejected in 99% probability; therefore, the examined data exhibit cross-sectional dependence.

It should be noted that once cross-sectional dependence is confirmed in panel data, the use of conventional panel unit root methods — such as Levin-Lin-Chu (LLC), Im, Pesaran & Shin (IPS), etc. — may increase the likelihood of obtaining spurious unit root results. To address this issue in the econometric literature, second-generation panel unit root tests that account for cross-sectional dependence have been proposed, among which is the Cross-sectional Augmented Dickey-Fuller (CADF) test.

Variables	Statistics	Significance	Result
Gross Domestic Product per capita (GDPP) at the level	3.72	1.00	Non-stationary
GDPP at first difference	-10.95	0.000	Stationary at the level with 99% probability
ARM	-1.45	0.073	Stationary at the level with 99% probability
Inf	-16.08	0.000	Stationary at the level with 99% probability
Tra at the level	-4.8	0.000	Stationary at level
Tra at first difference	-21.51	0.000	Stationary at first difference with 99% probability
Un at the level	1.55	0.94	Non-stationary at the level
Un at first difference	-18.37	0.000	Stationary at first difference with 99% probability
Re at the level	1.80	0.96	Non-stationary at the level

Re at first difference	-15.42	0.000	Stationary at first difference with 99% probability
Gc at the level	0.36	0.64	Non-stationary at the level
Gc at first difference	-22.62	0.000	Stationary at first difference with 99% probability

Table 6. The stationary test results**Source:** Research findings

Based on the information in Table (6), the variables of military expenditure and inflation rate are stationary at the level with a 95% probability level. On the other hand, the dependent variable GDP per capita and other variables—trade, unemployment rate, government expenditure, and exchange rate—became stationary at the first difference with a 99% probability level.

Westerlund Cointegration Test	Statistics	P-value
Variance ratio	10.82	0.000

Table 7. Westerlund Cointegration Test results**Source:** Research findings

Based on the conducted cointegration test, the null hypothesis of no cointegration is rejected with 99% probability, and the existence of a cointegrated long-term relationship among the model's variables can be accepted. Consequently, in estimating the final model, the variables can be used in their levels.

Next, to estimate the introduced model, it is necessary to determine the appropriate estimation method. The Chow test (with the null hypothesis of no fixed effects) was used to choose between the Pooled OLS estimation method and the Panel Data method. Then, to determine the final estimation method and select between the one-way and two-way panel models, the relevant diagnostic tests (to account for time and cross-sectional effects) are employed. In a one-way panel, it is assumed that there are individual differences among cross-sectional units and that these differences remain constant over time. However, in addition to individual effects, time effects may also be present¹, in which case a two-way panel model (incorporating

¹. Indeed, in two-way effects models, it is assumed that the error term also has a time structure; meaning that part of its variation is related to time. This component of the error changes over time but remains constant across cross-sectional units (countries) and can represent unaccounted-for time-fixed effects in the regression model. Therefore, by examining two-way effects, the simultaneous significance of both time and cross-sectional effects can be tested.

both individual and time effects) is used. Therefore, accounting for these effects in the estimation is of great importance (Souri, 2015).

Subsequently, the Hausman test is conducted to choose between the fixed effects and random effects methods. The null hypothesis of this test is that there is no correlation between the individual effects and the explanatory variables (random effects) (ibid.). The results obtained from the tests are presented in Table (8).

Statistics	Value	Probe	Result
Chow Test (F-Limer Test)	31.11	0.000	Confirmation of Panel Data
Tests for Group and Time Effects ¹	21.66	0.000	Confirmation of the existence of two-way cross-sectional and time effects
Hausman test	40.76	0.000	Confirmation of the Fixed Effects Method

Table 8. Panel Test Results

Source: Research findings

According to the results above, the null hypothesis of the Chow test, which states the existence of fixed effects, is confirmed with 99% probability, and the desired model is estimated using panel data. Furthermore, based on the one-way vs two-way panel data, the null hypothesis of no group differences over time is rejected with 99% probability, indicating that the model must be estimated as a two-way panel data model. Additionally, based on the results of the Hausman test, fixed effects are confirmed with 95% probability, and the null hypothesis of random effects is rejected. Therefore, considering the tests summarized in the table above, the introduced model is estimated using a two-way fixed effects panel data method.

Therefore, in general, and based on the tests presented in the above table, the final estimation of the model introduced in this study is conducted using two-way panel data with fixed effects. Before proceeding with the final estimation of the model, it is necessary to ensure the absence of heteroskedasticity and autocorrelation among the variables. Accordingly, the Wald and Wooldridge tests are employed to examine heteroskedasticity and autocorrelation in the model. The results of these tests are presented in Table (9).

¹. Test for one-way and two-way effects

Test	Statistics	Significance
Wald Test for Heteroskedasticity	65.81	0.000
Wooldridge Test for Autocorrelation in Panel Data	64.21	0.000

Table 9. Diagnostic Tests for Heteroskedasticity and Autocorrelation

Source: Research findings

Based on the obtained results, according to the Wald test, the null hypothesis of homoskedasticity is rejected with 99% probability; likewise, according to the Wooldridge test, the null hypothesis of no autocorrelation is also rejected. Therefore, the estimated model exhibits heteroskedasticity and autocorrelation, and the final model must be estimated using the GLS method. The subsequent results are presented in Table (10).

Variables	Coefficient	Statistics of “t”	Probability level
Arm	-1.12	-9.56	0.000
Inf	0.0006	0.06	0.949
Tra	0.056	8.60	0.000
Un	-0.472	-11.10	0.000
Re	0.006	1.05	0.292
Gc	0.869	14.56	0.000

Table 10. Results of the estimates taken from the model

Source: Research findings

According to the results of the final model estimation, military expenditure (represented by the variable Arm) has a significant negative impact on the GDP per capita of the studied countries with 99% probability. Specifically, if military expenditure increases by one percent, GDP per capita will decrease by 1.12 units. It is worth noting that among the other variables examined, the variable Arm has the greatest impact, highlighting the importance of paying closer attention to this indicator for enhancing GDP per capita in the studied countries. In line with the theoretical foundations discussed, the negative impact of military spending on economic growth can be justified. In other words, as military expenditures rise, fewer resources remain available for investment in other areas such as infrastructure, healthcare, education, and the production of ordinary goods (Rahman & Siddiqui, 2019). Additionally, military spending may crowd out private sector investment, thereby reducing economic growth in subsequent periods (Tavakolian & Sahraei, 2021). Therefore, these countries should maintain military expenditures at lower levels to avoid adverse effects—a point elaborated in the theoretical section. It should be noted that the negative impact of military spending on

economic growth has been confirmed in studies by Saeed (2023), Rahman and Siddiqui (2019), Khalid and Abdulrazakq (2015), Mowlaei and Golkhandan (2015), Dunne (2010), and Golkhandan and Mohammadian Mansour (2019).

Another variable affecting GDP per capita is trade (Tra), measured as a percentage of GDP. This indicator has a significant positive impact on the GDP per capita of the studied countries with 99% probability; meaning that every one-unit increase in the level of international trade leads to an increase in economic growth by 0.06 units. The obtained results are consistent with studies conducted by Chen and Gupta (2012), Isaksson (2012), Tsen (2010), Jahani and Farahanifard (2020), and Sazvar et al. (2019).

In examining the impact of the unemployment rate (Un) on per capita GDP, with a coefficient of -0.47, a negative and significant relationship was found. The inverse relationship indicates that as the unemployment rate increases in the countries studied, economic growth declines. This finding is consistent with Okun's Law (1962) and is also supported by previous studies by Resurreccion (2014), Moosa (2008), Raeisi & Zahedian (2020), and Motameni et al. (2018).

Another influential variable is the government size (Gc). According to the obtained results, a positive and significant relationship has been found between the indicator of the government size and GDP per capita. This means that an increase in government size, measured by government expenditures, may potentially direct spending towards capital expenditures or the development of infrastructural sectors, and could even lead to greater participation by the private sector, thereby fostering increased economic growth and development in the country. It is worth noting that in this study, the impact of government size—measured by the indicator of government expenditures (as a percentage of GDP)—on economic growth was found to be positive and significant. This result is consistent with numerous existing studies. For example, research conducted by Fallahi and Haj Amini (2015), Khodadadkashi et al. (2020), Maleki Hasanvand et al. (2019), Khodaveisi and Ezzati (2018), and Sokhanvar (2018) all confirm the positive impact of government size on economic growth.

Finally, among the other variables examined, the indicators of inflation rate and exchange rate do not have a significant impact on the GDP per capita of the studied countries. Regarding the non-significant effect of

inflation on economic growth, the perspective of Rational Expectations theorists can be reviewed. They emphasize that if monetary policies are implemented in a pre-announced and predictable manner, the Phillips curve will be vertical even in the short run, and economic policy will have no effect on production and employment. Consequently, the relationship between inflation and production would be unacceptable in both the short and long run (Mozafari et al., 2020). It is worth noting that the non-significance of the inflation variable on economic growth has been confirmed in studies by Sidrauski (1967), Bullard and Keating (1995), Mukoka (2018), and Tiwari et al. (2019). Also, regarding the non-significant impact of the exchange rate on economic growth, according to the Monetary Approach, attention should be paid to the interactions between the external sector and the monetary sector of the economy. This approach assumes that absolute Purchasing Power Parity (PPP) and arbitrage are permanently maintained, and resources are fully utilized. Under these assumptions, exchange rate changes have no effect on output because, according to the PPP theory, changes in the exchange rate level will have a one-to-one effect on domestic prices (Motahari et al., 2017). The non-significant impact of the exchange rate on economic growth has also been confirmed in the studies conducted by Tang (2015), Amiri et al. (2021), and Shojaei et al. (2023) in the services sector.

In examining the cross-sectional effects of military expenditure on GDP per capita, the results indicate that during the studied years, a non-significant relationship between this variable and GDP per capita was found only in Portugal, Chile, and Armenia, while in other countries the relationship remained significant. That is, a negative and significant relationship between military spending and GDP per capita was observed in Brazil, Cameroon, Colombia, Croatia, Malaysia, Nicaragua, Nepal, Pakistan, Russia, South Africa, Ukraine, Tunisia, Uganda, Romania, Poland, Morocco, Mexico, Malta, Iran, China, Bulgaria, Bolivia, and Belize. In the other studied countries, this relationship was positive and significant, which is theoretically acceptable.¹

Indeed, some countries, by allocating research and development expenditures in the defense sector, contribute to improving socio-economic infrastructure, creating security, maintaining stability in the business environment, and fostering favorable conditions for attracting

¹. The reasons for the positive impact of military spending on economic growth are explained in detail in the theoretical foundations section.

foreign investors, thereby promoting economic growth. On the other hand, the positive effect of defense expenditures can, through an increase in aggregate demand (Keynesian effect) via investment in the defense sector, generate positive externalities in the private sector, such as the development of technology spillovers and human capital formation.

Conclusion and Suggestions

Defense economics, as an interdisciplinary field of study, gained significant attention among economists after its introduction by Hitch and McKean in 1960 and thereafter, applying economic principles to national defense issues. Since a country's economic capacity is considered a key factor in enhancing its international and regional power, it is essential to determine the optimal and necessary level of military expenditure when allocating the budget, conducting study in this area is of great importance. Today, various global studies have recognized and addressed this issue. Therefore, given the importance of defense economics and the role of military expenditure, as well as the significance of economic growth and development in all countries worldwide, this research aims to discuss and analyze the impact of defense economics on economic growth in 81 countries over a 25-year period.

Based on the results of the estimated model, military expenditure has a significant negative impact on the GDP per capita of the studied countries, in such a way that the more military spending level, GDP per capita will decrease by 1/12 coefficient. It is worth noting that among the other variables examined, the military expenditure variable has the greatest impact, highlighting the importance of paying closer attention to this indicator in order to expand GDP per capita in the studied countries. The negative impact of military expenditure on economic growth has been confirmed in studies by Saeed (2023), Rahman and Siddiqui (2019), Khalid and Abdulrazzaq (2015), Molaei and Golkhandan (2015), Dunne (2010), and Golkhandan and Mohammadian Mansour (2019).

Another variable affecting GDP per capita is trade, which is measured as a percentage of GDP and has a significant positive impact on the GDP per capita of the studied countries. This means that each unit increase in the level of international trade will lead to an increase in the economic growth by 0.06. The obtained results are consistent with the studies of Chen and Gupta (2012), Isakksson (2012), Tsang (2010), Jahani and Farahani Fard (2020), and Sazvar et al. (2019). Regarding the impact of

the unemployment rate on GDP per capita, a significant negative relationship with a coefficient of -0.47 was found. This result aligns with Okun's Law (1962), which posits that for every one percentage point decrease (or increase) in the unemployment rate, the economic growth rate increases (or decreases) by approximately three percent. Finally, among the other variables examined, the inflation rate and exchange rate indicators do not have a significant impact on the GDP per capita of the studied countries.

In examining the cross-sectional effects of the military expenditure variable on GDP per capita, the results indicate that during the years under study, a non-significant relationship between this variable and GDP per capita was found only in Portugal, Chile, and Armenia, but in other countries, the relationship remained significant.

Finally, based on the results obtained from the estimated model and considering the negative impact of military spending on economic growth, it is recommended that the level of military expenditure in national budgets be optimally determined to prevent the waste of resources. On one hand, countries' resources should be directed more towards educational and healthcare expenditures to lead to an increase in their economic growth levels. On the other hand, given the positive impact of trade and government size on economic growth, governments should increase the resources needed for other sectors, expand the production of goods and services, reduce the unemployment rate, and support exports in order to further increase economic growth.

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