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Role of military industries as a leading industry in the economic growth of selected countries

Amin Ali[a], Roya Aleemran[b,*], Sima Eskandari Sabzi[a]

[a]Department of Economics, Miyaneh Branch, Islamic Azad University, Miyaneh, Iran

[b]Department of Economics, Tabriz Branch, Islamic Azad University, Tabriz, Iran

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Abstract

Military and defence industries constitute one of the most critical strategic parts of any country, playing a vital role in ensuring national security. These industries influence various parts through diverse channels, impacting the economic standing and growth of nations. Moreover, countries often allocate a significant portion of their public expenditures to military and defence industries to counter external security threats. Given the importance of the topic, the primary objective of this research is to examine the impact of military industries' production in militarily producing countries on their economic growth. Data from 1990 to 2021 were analyzed using the dynamic panel least squares method to achieve this. The results indicate a significant positive impact of military industry production on the economic growth trajectory of countries producing military equipment. Additionally, variables such as foreign direct investment, net exports, technological advancement, inflation rate, and government size have a positive effect, while inflation rate and government size weaken economic growth in these countries. Therefore, policymakers and economic planners in militarily producing countries are recommended to allocate the military budget toward developing advanced military industries. This should be coupled with increased utilization of skilled and specialized labour, indigenous military and defence industry development, and reduction of reliance on military imports. These actions will likely lead to an improved trade balance, economic growth, and, subsequently, the economic condition of the nations.

Keywords: economic growth, foreign direct investment, military industry production, government size, inflation
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1 Introduction

One of the primary tasks of a government in economics is to create security, enabling conditions for employment, investment, and economic growth. Hence, initial military expenditures to ensure security can provide a foundation for foreign and domestic investment, leading to increased employment, demand stimulation, and economic prosperity [6]. While each country's government is responsible for ensuring security for its citizens, defence expenditures and allocations are also of significant importance to neighbouring countries. Other nations in the region also tend to feel less secure when the defence expenditures of a country appear excessive. Increasing defense expenditures for economic, political, and social security is necessary. In this context, the military-industrial complex plays a crucial

*Corresponding author
Email addresses: aali.amin94@gmail.com (Amin Ali), aleemran@iaut.ac.ir (Roya Aleemran), si.eskandari@iau.ac.ir (Sima Eskandari Sabzi)

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role. These institutions pursue their interests by perpetuating warfare in various countries. Consequently, they weaken economic growth, intensify arms competition, reduce political and economic independence, and burden the economies of purchasing countries by selling military products to them [19].

During the 1970s, the allocation of financial resources to defence matters in third-world countries increased faster. However, this trend was accompanied by a more gradual trajectory in the first half of the 1980s, followed by a further decline. By the end of the Cold War, this reduction in military expenditures persisted in these countries, excluding those in the Middle East region. On the other hand, it is worth mentioning that the primary motivation for escalating military expenditures in developing countries stems from their heightened security needs compared to advanced nations, encompassing both domestic and external dimensions. The constraints these countries face regarding establishing security through economic variables, such as low per capita income and substantial budgetary constraints, should also be noted [1].

The relationship between defence expenditures, which constitute a part of the overall government expenditures in any country, and economic growth has consistently been a significant topic in economic discussions and policies globally. Consequently, numerous studies have been conducted in various world regions, yielding diverse results. While some studies have found a positive impact of defence expenditures on economic growth, others have indicated a negative relationship between the two. The outcomes of each research endeavour can vary depending on the model used and the prevailing conditions of the examined region or countries. Additionally, the end of the Cold War has led to hopes for reduced defence budgets worldwide. Although general statistics and global reports show a decline in defence expenditures globally, some countries still allocate substantial amounts annually for defence purposes due to security concerns. Iran, for instance, is an example of such a country, boasting the highest military expenditure value. In 2007, Iran ranked among the top 15 countries globally with the highest military expenditures based on purchasing power and constant prices. Therefore, this current research seeks to answer whether the domain of defence economics, particularly the increase in military production, a significant aspect within the military sector, contributes to economic growth and development. The structure of the article is organized as follows: it begins with the theoretical foundations and a review of prior research, followed by an explanation of the research methodology. Subsequently, the research findings are examined and analyzed, leading to a conclusion and summary in the final section.

2 Theoretical foundations and review of previous studies

The field of defence economics represents a relatively new branch of economic studies that examines the management of defence expenditures during wartime and peacetime, along with the external effects of military spending on other economic sectors. In essence, defence expenditures in the economy are considered public goods, but defence economics scrutinizes the relationship between defence expenditures and economic growth through various avenues. Early empirical research in this area dates back to Benoit [9], who investigated the positive relationship between defence expenditures and economic development for 44 less-developed countries between 1950 and 1965. The simplicity of the research methodology and the lack of a robust theoretical framework prompted more extensive studies in this field, adopting more sophisticated methods and models. Some of these studies attempted to measure the defence spending-growth relationship from the demand perspective. This group of studies was largely based on Keynesian models. In this group, demand-side models, without considering the supply-side parameters of the economy, emphasized the existence of substitution effects between military expenditures and growth-inducing expenditures like investment and human capital expenditures, such as education and healthcare. This group generally proposed the presence of negative effects of defence expenditures on economic growth, termed the “first group” studies.

In contrast, another group of researchers approached the issue from the supply side of the economy, investigating the impact of defence expenditures on economic growth. This group believed that by influencing the fundamental factors of production (such as human capital, physical capital, natural resources, and technology), military expenditures could potentially boost potential production levels and consequently enhance economic growth. Neoclassical models primarily constitute this category of studies. Thus, supply-side models advocate a positive relationship between defence expenditures and economic growth. Notably, the extended Solow model by Knight et al. and the Feder model presented by Biswas and Ram are among the most significant models employed in this category of studies (“second group” studies).

Since neoclassical models mostly supported a positive relationship between military expenditures and economic growth, whereas Keynesian models tended to suggest adverse effects on economic growth, a simultaneous equations model was employed to address this issue. In this regard, Smith was among the first to utilize models related to simultaneous equations. These equations encompassed demand-side effects within Keynesian aggregate demand and supply-side effects through the neoclassical growth equation derived from the total production function. While

this model managed to provide a comprehensive depiction of the positive or negative relationship between economic growth and military costs, it received criticism due to its lack of foundation in fundamental theories and its reliance on anecdotal reasoning (third category of studies).

Another group of studies (the fourth category) examined the relationship between military expenditures and economic growth by combining interests and costs related to the military, considering a non-linear inverted U-shaped relationship. They believed that if the increase in the benefits of the military sector is more significant than its costs, economic growth will increase as the size of the military sector expands. Conversely, if the rate of increase in costs surpasses its benefits, economic growth will decline.

Examining various studies and different study categories indicates a lack of consensus, necessitating further investigation with multiple variables and high-capacity modeling techniques. Hence, the present research aims to investigate the extent to which the role of the military industry, considering factors such as investment, education, net exports, government size, and inflation conditions of different military equipment-producing countries (In the world, statistics and information on many countries that are capable of producing military equipment are not published. Therefore, this study has tried to select a list of most countries in the world for which data is reported, which are 35 selected countries as follows: Algeria, Argentina, Austria, Belgium, Brazil, Canada, China, Egypt, Finland, France, Germany, Greece, India, Iran, Italy, Japan, Kazakhstan, South Korea, Netherlands, Norway, Pakistan, Poland, Romania, Russia, Saudi Arabia, South Africa, Spain, Sweden, Switzerland, Thailand, Turkey, Ukraine, United Kingdom, United States and Vietnam.), contributes to their economic growth. This study considers the military industry a leading sector in the growth model. The subsequent sections of the article will provide a review of studies conducted abroad and domestically.

In a study conducted by Aizenman and Glick [3], the relationship between military expenditures, economic growth, and economic structure was examined through research conducted from 1989 to 1998 for 90 countries. In this context, the ratio of military expenditures to gross domestic product, the shadow variable of war or conflict tension, the initial level of real gross domestic product per capita, and other variables such as education (logarithm of education level in secondary and higher education), population growth rate, and the ratio of investment to gross domestic product were considered as control variables. Regression estimation revealed that military expenditures, including external threats, increase economic growth, but military costs calculated with considerations for rent-seeking behavior and corruption decrease economic growth.

In another study, Aizenman and Glick [4] examined the impact of military expenditures on the economic growth of world countries from 1990 to 1998, considering the level of external threats. The results of this study, using ordinary least squares (OLS) and panel data, indicated a significant negative effect of military expenditures and external threats on economic growth. However, an interactive effect between military expenditures and external threats on economic growth was positive, suggesting that the effect of military costs on economic growth is non-linear and dependent on the level of external threats. With an increase in external threats, the negative effect of military expenditures on economic growth diminishes, and economic growth can benefit from increased military costs.

Mylonidis conducted a study investigating the effects of military expenditures on the economic growth of European countries [17]. He employed the endogenous growth model by Barro [8] and econometric panel data analysis. The results of his study for the period 1960 to 2000 indicated that an increase in military expenditures has a negative impact on the economic growth trajectory of these countries.

Shahbaz et al. aimed to answer the question of whether defense expenditures contribute to economic growth in Pakistan during the period 1972-2008 [18]. To this end, they employed the Autoregressive Distributed Lag (ARDL) model for defense expenditures and economic growth and conducted econometric co-integration analyses. The results of their study, in the long run, indicated a negative relationship between military expenditures and economic growth.

Aziz and Asadullah [7] followed the empirical model of Aizenman and Glick to examine the effects of military expenditures and armed conflicts on the economic growth of 70 developing countries during the post-Cold War period, spanning from 1990 to 2013. They utilized a Cobb-Douglas function that includes political variables and a model encompassing interaction effects of threats and military expenditures. This study divided armed conflicts into internal and external conflicts and incorporated them into the model. For estimation, a combination of pooled ordinary least squares (POLS), fixed effects (FE), and generalized method of moments (GMM) with panel data was used. The findings demonstrated that the effect of military expenditures on economic growth resulting from facing armed conflicts overall is positive and significant. However, the impact of military expenditures on economic growth due to internal and external armed conflicts is distinct.

Ahad and Dar [2], in a study, investigated the distinct influence of military expenditures on the economic growth of three nations: the United States, the United Kingdom, and Russia, utilizing quarterly data spanning from 1992 to 2014.

Employing the nonlinear Autoregressive Distributed Lag (ARDL) model, an empirical investigation was conducted to ascertain the relationships. The findings reveal a negative long-term relationship between military expenditures and economic growth for the United States and the United Kingdom, while a positive correlation is observed for Russia.

Daddi et al [11] examined the influence of military expenditures on economic growth, adopting a semi-parametric nonlinear time series model for Italy. They identified a nonlinear association between military expenditures and economic development, indicating that lower military spending boost economic growth, while higher levels lead to its decline.

In a study focusing on China during 1990-2018, Khalaf and Saeed Ebrahem [16] utilized Vector Autoregression and Granger Causality methods. Their results demonstrated a bidirectional causal relationship between military expenditures and economic growth in China.

Among domestic studies, the seminal research by Beyzaie [10] examined the topic extensively. Employing a Keynesian demand model and Ordinary Least Squares (OLS) econometric method for 1351-1376, Beyzaie established a significant negative correlation between military expenditures and economic growth in Iran.

Hasani and Aziznejad [15] investigated defense expenditures' impact on Iran's economic growth from 1350 to 1382. Their innovative approach employed a four-equation system, utilizing Ordinary Least Squares (OLS), Two-Stage Least Squares (2SLS), and Three-Stage Least Squares (3SLS) methods. Their findings revealed substantial negative direct and indirect effects of defense expenditures on economic growth, influencing variables such as savings and trade balance.

Golkhandan et al. [14] conducted a research study to investigate the impact of military expenditures on the economic growth of countries in the MENA region from 1975 to 2009. The findings of this study, utilizing a generalized Solow model and the GMM econometric method, indicate a significant negative effect of military expenditures on the economic growth of these countries.

Furthermore, Fetr and Golkhandan [12] empirically tested the hypothesis of Guns versus Butter for countries with high, medium, and low incomes from 1995 to 2014. The results of this research demonstrate a positive and significant relationship between military expenditures and economic growth in high-income countries (Guns or Butter hypothesis), a negative and significant effect of military expenditures on economic growth in low-income countries (Guns or Butter hypothesis), and an insignificant effect of military expenditures on economic growth in medium-income countries (Neutral hypothesis).

Golkhandan [13], based on the works of Aizenman and Glick and the Johansen-Juselius cointegration method, revealed that the impact of the defense burden on Iran's economic growth depends on the level of external threats. With an increase in external threats, the negative effect of defense expenditures on economic growth diminishes, and it is expected that beyond a certain threshold of external threats, the influence of defense expenditures on economic growth becomes positive. The distinctive aspect and innovation of Golkhandan's study compared to previous domestic studies lies in the separate examination and quantification of the direct and indirect effects of defense expenditures on Iran's economic growth, along with the computation of their net effect.

Alavi et al. [5], in their research, employed a questionnaire-based and field study approach in a descriptive-survey analysis to scrutinize the role of the defense sector in the economic activities of the country, focusing on both approaches and impacts. Their study's results provide evidence for a direct correlation between allocated funds to the defense sector and the level of economic growth in the country.

A review of the existing studies on the relationship between defense expenditures and economic growth reveals that a conclusive result has not been reached. The outcomes vary based on the geographical circumstances of different countries. Consequently, a definitive and unequivocal answer cannot be provided. Additionally, while prior studies mainly concentrated on military expenditures and economic growth, this research strives to investigate the effects of the presence and expansion of military industries and the utilization of other industrial sectors. Strengthening the military industry, as a leading sector within non-equilibrium models, holds significant importance, enhancing other industries, increasing national production, and elevated employment levels. However, such studies remain scarce domestically and are limited in other countries, albeit with different variables. Moreover, the econometric analysis incorporates innovation by using Panel Dynamic Ordinary Least Squares (PDOLS) to examine economic methodology."

3 Research methodology

Stochastic trends can complicate the choice of estimation method, the interpretation of econometric results, and the reliability of forecasts obtained using econometric models. In other words, stochastic trends might lead to erro-

neous identification of relationships between variables in a study. Consequently, in the presence of stochastic trends, employing unsuitable estimation methods for the intended data is a possibility. Additionally, forecasts derived from such models might also be subject to distortion.

Hence, economists in recent years have turned their attention to the undesirable effects of stochastic trends on the results of econometric models, including conventional methods like Ordinary Least Squares (OLS), and have sought innovative approaches to address this issue. This is due to the observation that, even in cases where there is no actual relationship between variables in a study, common methods such as OLS may indicate significant relationships in the presence of stochastic trends. Such regressions are commonly referred to as spurious regressions.

In this regard, Engle and Granger introduced the concept of cointegration to avoid misleading outcomes from spurious regressions. This theory asserts that a cointegrating relationship exists in a group of non-stationary variables when at least one valid linear combination among the variables is present. The presence or absence of cointegration among the variables of a model significantly influences the forecasts generated by that model. Accordingly, if a cointegrating relationship is absent in a regression equation, the resulting forecasts from that model will be weak and unreliable. Therefore, economists have developed methods to test for stochastic trends in time series and regression residuals.

In this context, Stock and Watson extended the DOLS method to panel data and demonstrated that this approach could lead to estimators with asymptotically normal distributions centered around zero. They employed Monte Carlo algorithms to show that DOLS is a suitable model for addressing endogeneity and autocorrelation issues. This is because disregarding endogeneity can lead to simultaneous equation bias in coefficient estimation. Additionally, one of the advantages of the DOLS method is its applicability even in small samples, preventing simultaneous equation bias and maintaining a normal asymptotic distribution. Furthermore, the DOLS econometric method performs well with balanced and unbalanced panel data. This is achieved by introducing lagged and lead values to the first-differenced independent variables to alleviate the contemporaneous bias stemming from the endogeneity of independent variables. As a result, incorporating lagged and lead values of first-differenced variables can substantially reduce estimation errors in the DOLS model. The DOLS method is also useful in cases where the degree of cointegration among independent variables is different. Consequently, the DOLS econometric approach enables the estimation of cointegrating vectors composed of variables with varying orders of co-integration.

4 Data and research model

The current study uses data about all countries with military industries for which data are available. To this end, selected countries' data from 1990-2021 have been collected from the World Bank's website (World Development Indicators) and the Stockholm International Peace Research Institute (SIPRI) website.

The employed research model is based on a previously established framework and is formulated as follows:

$$EG_{it} = \beta_0 + \beta_1 MP_{it} + \beta_2 FDI_{it} + \beta_3 NE_{it} + \beta_4 GS_{it} + \beta_5 INF_{it} + \beta_6 HT_{it} + \varepsilon_{it} \tag{4.1}$$

in the above equation:

(EG) represents economic growth.

(MP) signifies the growth rate of government military sector production.

(FDI) represents foreign direct investment.

(NE) stands for net exports.

(GS) denotes the government size variable (the ratio of government expenditures to Gross Domestic Product).

(INF) signifies the inflation rate.

(HT) characterizes technological advancement.

(ε) accounts for error terms in the research model.

The indices (i) denote countries, and (t) signifies years.

5 Research findings

Before model estimation, assessing stationarity (absence of unit roots) in variables is imperative. Although in the presence of unit roots in study variables, differencing can render them stationary, differencing eradicates the long-term

relationships between variables at the variable level. Researchers often employ cointegration tests when observing unit roots in variables to mitigate this issue. When cointegration exists among the variables of a study, estimation of variables can be undertaken without fear of spurious regression at the level. Several tests have been proposed for examining the stationarity of variables. One of the most cited panel unit root tests is the Levin and Lin-Chu-Chen test, employed in the present study to assess variable stationarity. The null hypothesis of this test posits the presence of a unit root (non-stationarity) in the variable. The results of this test for both levels and first-differenced variables are presented in Table 1.

Table 1: Panel Unit Root Test Results for Research Variables

variables	**Levene's test at level**		**Levene's test with first-order differences**	
	Statistic value	**Significance value**	**Statistic value**	**Significance value**
EG	-19.00	0.000	–	–
MP	-0.02	0.48	-15.23	0.000
FDI	-0.56	0.28	-21.99	0.000
NE	-0.76	0.22	-24.75	0.000
GS	-1.23	0.11	-22.05	0.000
INF	-8.17	0.000	–	–
HT	-5.09	0.000	–	–

Based on the results presented in Table 1 from the Levin and Lin-Chu-Chen unit root test, economic growth, inflation rate, and technological advancement variables are stationary at the level, as their probability values (Prob) are less than 5%. However, military production, foreign direct investment, net exports, and government size variables have unit roots and are first-order integrated. Therefore, due to the presence of different orders of co-integrations among the research variables, investigating the existence of cointegration is necessary. In the present study, the Kao cointegration test has been employed for this purpose, and the results are presented in Table 2.

Table 2: Panel Kao Cointegration Test Results

Statistic	**Statistic Value**	**Significance value**
ADF Statistic	-4.16	0.000

Based on the results of the Kao cointegration test, the obtained statistic at the 5% critical level is -4.16, thus rejecting the null hypothesis of no cointegration among the research variables. Consequently, it can be inferred that a long-term relationship exists among the variables in the present study.

After confirming the presence of a long-term relationship among the research variables, we estimate the long-term relationship of the specified research equation using the dynamic panel least squares method. The estimation results are presented in Table 3.

Table 3: Dynamic Panel Least Squares Estimation Results

variables	**Coefficients**	**standard deviation**	**t statistic value**	**Significance value**
MP	0.90	0.39	2.29	0.022
FDI	0.59	0.08	7.22	0.000
NE	0.24	0.06	3.88	0.000
GS	-0.72	0.13	-5.23	0.000
INF	0.18	0.04	-4.12	0.000
HT	0.07	0.04	1.63	0.10
R^2			0.85	

The results of estimating the Panel DOLS model indicate that at the 5% significance level, there is a direct relationship between military production growth and economic growth in the selected countries under study. Specifically, a 1% increase in military production growth leads to an average rise of 0.90% in economic growth in countries producing military-industrial equipment. Additionally, the results reveal that foreign direct investment and net exports variables positively affect economic development with a 99% confidence level, and the technological advancement variable has a positive effect with a 90% confidence level. On the other hand, an increase in inflation and government size variables weakens economic growth in these countries with a 99% confidence level. Therefore, in line with economic realities,

it can be inferred that lower inflation rates and reduced government intervention, measured by the government size index, lead to improved economic growth in a country.

6 Conclusion and implications

The defence and military industry constitutes a significant portion of public expenditures in most countries. The military industry plays a crucial role in ensuring both domestic and international security and directly or indirectly impacts nations' economic growth. The military industry affects economic growth from various dimensions. One of these dimensions could be increasing overall demand and raising investment and employment, fostering economic growth. Furthermore, the military industry can enhance economic growth through its multiplier effect. This effect is influenced by physical and social infrastructure such as transportation, ports, roads, research, and education, as well as enhancing security and exporting military equipment and supplies, which benefit the non-military sector and contribute to economic growth.

Hence, the role of the military industry in the economies of nations is pivotal, and examining its relationship with economic growth trends can significantly aid economic policymakers and planners in making informed decisions. Therefore, due to the urgent need for sound economic policymaking, conducting research in this area and analyzing the results for macroeconomic planning is essential and valuable. In this regard, the present study investigated the role of military production alongside other influential factors on the economic growth trends of selected countries. To this end, the presence or absence of unit roots in the research variables was first examined using the Levin and Lin-Chu-Chen unit root test. As certain variables exhibited unit roots, the Kao cointegration test assessed a long-term relationship among the variables, confirming their existence.

Consequently, after confirming the long-term relationship, the study proceeded to investigate the impact of military production growth in conjunction with control variables on the economic growth of the selected countries using dynamic panel ordinary least squares (PDOLS) models. The results of the PDOLS model estimation reveal that military production growth directly affects the economic growth of countries engaged in the production of military equipment. Therefore, the existence and expansion of military production are crucial and necessary to ensure domestic investment security, attract foreign investments, increase employment, and promote economic growth. Moreover, the study's results highlight that foreign direct investment, net exports with 99% confidence level, and technological advancement with 90% confidence level have a positive effect on improving the economic growth status of countries engaged in military equipment and industry production, while inflation rates and government size, as measures of government intervention, weaken economic growth in these countries with a 99% confidence level.

Therefore, based on the obtained results, it is suggested that policymakers and planners in countries engaged in military equipment production prioritize defence expenditures towards the expansion of advanced military industries. This can be achieved through maximizing the utilization of skilled and specialized workforce, Indigenous development of military and defence industries, reducing dependence on imports of military equipment, and thus enhancing trade balance, economic growth, and overall economic status of the nations. It is worth noting that this expansion of defence expenditures must be optimally realized, such that prevention of negative consequences and wastage of resources in non-essential sectors is ensured.

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