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The Crowding-Out Relationship Between Defense Expenditures and Public Education Expenditures: NATO Countries Analysis

Savunma Harcamaları ile Kamu Eğitim Harcamaları Arasında Dışlama İlişkisi: NATO Ülkeleri Analizi

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Abstract: In the mainstream economics and defense economics literature, the crowding-out relationship between defense expenditures and social welfare expenditures (education, health, social security, etc.) is discussed with the metaphor of "*Guns and Butter*". Here, it is basically stated how much of the scarce resources should be allocated to defense services and how much to social welfare services (education, health, social security, etc.) by emphasizing the constraints of resource distribution in the economy. However, defense expenditures item that maintains its importance, although the degree varies from country to country. For this reason, defense expenditures have an important place in the public expenditures of countries. Another important expenditure item among public expenditures is education expenditures. Education expenditures constitute a locomotive power in increasing economic growth and social welfare by providing human resources and human capital stock. Therefore, it is of great importance to determine the effect of defense expenditures on social welfare expenditures. As a matter of fact, there is a significant deficiency in the literature at the point of determining the dynamic relationship between both expenditure items. In this study, it is aimed to determine the exclusion effect of defense expenditures on education expenditures by dynamic panel data analysis for 27 countries that are members of the North Atlantic Treaty Organization (NATO) based on the 2000-2019 period. As a result of the analysis, a positive relationship was found between defense expenditures and public education expenditures. In other words, no crowding-out relationship was found between defense expenditures and public education expenditures.

Structured Abstract: There is no resource that will not be allocated when it comes to the existence and security of the state. However, the scarcity of resources and the abundance of public services necessitate the optimal allocation of existing resources. Defense services are also under budgetary and financial constraints. Therefore, the question of how much the defense expenditures will be, that is, at what point the optimal level will be determined, is an issue that should be emphasized for all countries. Because, countries' allocation of resources above the optimal level for defense services, and therefore excessive defense expenditures, will adversely affect social welfare expenditures. If resource allocation is below the optimal level, the social order may be endangered due to instability and turmoil. In other words, every deviation from the optimal level will

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cause countries to be negatively affected economically and socially. For this reason, it is of great importance to consider opportunities and costs when creating an optimal defense budget.

When a resource above the optimal level is allocated to defense services, this can create a serious burden on the limited budgets of countries. However, this situation may vary according to the defense industry production structure of the countries. Because, with the increase in the defense expenditures of the countries that are labor-intensive in the production of the defense industry, employment, education and occupational/technical training can be offered to a large number of people. In addition, since defense expenditures have positive externalities, they can increase factor productivity. In particular, fields that require advanced technology such as defense R&D, aeronautics and electronics require significant human capital. For this reason, the defense industry production structure of the countries is an important factor in examining the relationship between defense and education expenditures.

The main purpose of this empirical study, which was designed on the subject mentioned above, is to reveal the relationship between defense expenditures and public education expenditures of 27 NATO member countries in the 2000-2019 period. In the analysis part of the research, dynamic panel data analysis was used. In the analysis part, a single model was used to estimate the crowding-out relationship between defense expenditures and public education expenditures. First of all, the crowding-out relationship between defense expenditures and public education expenditures was analyzed. In addition, the effect of total public expenditures on public education expenditures, the effect of household expenditures on public education expenditures, the effect of annual growth rates on public education expenditures and the effect of population growth rates on public education expenditures were investigated. Within the scope of the analysis, first of all, the correlation relationship between the independent variables was analyzed in order not to cause the multicollinearity problem. As a result of the analysis, it was determined that there was no multicollinearity problem between the independent variables. Then, it was examined whether there was a cross-sectional dependence between the variables. As a result of the examination, it has been determined that there is a cross-sectional dependence between the variables and that the variables are not stationary. Then, in order to make the variables stationary, second generation unit root tests were applied for each variable and the variables were made stationary.

Findings from the research results, first of all, a positive relationship was determined between the defense expenditures of NATO member countries and public education expenditures at the 1% significance level. It has been determined that the 1% increase in the defense expenditures of the member countries increased the public education expenditures by 0.24%. With this result, it was determined that there was no crowding-out relationship between defense expenditures and public education expenditures, and it was determined that the Military Keynesian Theoretical Hypothesis was valid. When the relationship between total public expenditures and public education expenditures is examined, a statistically significant and positive relationship was found at the 1% level. The 1% increase in the total public expenditures of NATO member countries increased the public education expenditures of the member countries by 0.001%. When the relationship between household expenditures and public education expenditures was analyzed, a significant and positive relationship was found at the 10% significance level. The 1% increase in household expenditures of NATO member countries increased the public education expenditures of member countries by approximately 0.03%. However, a negative relationship was found between annual growth rates (GDP) and public education expenditures. Because the 1% increase in GDP decreased the public education expenditures of the member countries by approximately 0.01%. In other words, it has been determined that there is an crowding-out relationship between annual growth and public education expenditures. When the population change rate of the member countries is examined, no significant relationship was found between the population growth rate and public education expenditures.

In the study, it was concluded that there is no crowding-out between defense expenditures and public education expenditures. With the findings obtained, it can be described as positive in that defense expenditures do not adversely affect public education expenditures. However, it would be more beneficial for both Turkey and other NATO member countries to allocate resources to defense at an optimal level and to use the allocated resources rationally.

Keywords: Economics, NATO, defense expenditures, public education expenditures, crowding-out, dynamic panel data analysis

Öz: Ana akım iktisat öğretisinde ve savunma ekonomisi yazınında, savunma harcamaları ile sosyal refah harcamaları (eğitim, sağlık, sosyal güvenlik vb.) arasındaki dışlama ilişkisi "*Silah ve Tereyağı*" (Guns and Butter) metaforuyla tartışılmaktadır. Burada temel olarak, ekonomideki kaynak dağılımının kısıtları vurgulanarak kıt kaynakların ne kadarının savunma hizmetlerine ne kadarının sosyal refah hizmetlerine (eğitim, sağlık, sosyal güvenlik vb.) tahsis edilmesi gerektiği belirtilmektedir. Ancak savunma harcamaları, derecesi ülkeden ülkeye değişmekle birlikte her zaman önemini korumaktadır. Bu nedenle ülkelerin kamu harcamaları içerisinde savunma harcamaları önemli bir yer tutmaktadır. Kamu harcamaları içerinde bir diğer önemli harcama kalemi ise eğitim harcamalarıdır. Eğitim harcamaları, insan kaynağını ve beşerî sermaye stokunun oluşmasını sağlayarak ekonomik büyüme ve toplumsal refahın artmasında lokomotif bir güç oluşturmaktadır. Dolayısıyla savunma harcamalarının sosyal refah harcamaları üzerindeki etkisinin incelenmesi büyük önem arz etmektedir. Nitekim literatürde de her iki harcama kalemleri arasındaki dinamik ilişkinin belirlenmesi noktasında da önemli bir eksiklik bulunmaktadır. Bu çalışmada, savunma harcamalarının eğitim harcamaları üzerindeki dışlama etkisinin, 2000-2019 dönemi baz alınarak Kuzey Atlantik Antlaşması Örgütü (NATO) üyesi 27 ülke için dinamik panel veri analizi ile tespit edilmesi amaçlanmıştır. Analiz sonucunda savunma harcamaları ile kamu eğitim harcamaları arasında pozitif bir ilişki saptanmıştır. Diğer bir ifade ile savunma harcamaları ile kamu eğitim harcamaları arasında herhangi bir dışlama ilişkisi bulunmamıştır.

Anahtar Kelimeler: İktisat, savunma ekonomisi, NATO, savunma harcamaları, kamu eğitim harcamaları, dışlama etkisi, dinamik panel veri analizi

Introduction

Defense services are a pure public service where there is no competition in consumption, its benefit is indivisible and no one can be crowding-out from its benefit. Defense services are provided by the state in terms of these features. Therefore, the production and consumption of defense services are carried out by the budget law. Defense services are continuous services. Thus, expenditures for defense services constitute a large part of public expenditures and have an important place in expenditure items.

Another type of public goods and services in the public economy is education. Education is a semi-public goods and services. The contribution of education expenditures to the occurrence of human capital and its contribution to the development of the country cannot be denied. It is much more important to examine all the factors that will have negative effects on education, which is much more important especially for developing countries, and to take the necessary measures. There are opinions that defense expenditures can crowding-out productive expenditures on other components of the public budget, especially social welfare expenditures (education, health and social security, etc.). In this sense, it is important for countries to know whether defense expenditures create a crowding-out effect on education expenditures. Studies in this field are generally based on the basis of a country or a region and the relationship between total social welfare expenditures and defense expenditures. However, education expenditures are taken as a basis throughout NATO countries, which are important from the point of view of defense in this study. Since NATO member countries have relatively higher defense expenditures, determining the crowding-out effect of defense expenditures at the level of these countries will contribute to the field. In this framework, the aim of the study is to analyze the causal relationship between defense expenditures and public education expenditures for 27 NATO member countries with a dynamic panel data model. The findings obtained as a result of the analysis will be able to guide the policies to be followed in defense and education expenditures for countries.

The study consists of four chapters. In the first chapter, the place of defense and education services in the public economy is explained. In the second chapter, the relationship between defense and education expenditures is evaluated. In the third chapter, a general literature review was

conducted. The fourth chapter consists of the analysis chapter containing the dynamic panel data model. Empirical analysis was carried out according to three theoretical basic hypotheses explaining the crowding-out relationship between defense expenditures and public education expenditures. In the conclusion, the findings obtained from the empirical analysis are evaluated and suggestions are made.

The Public Nature of Defense and Educational Services

Defense services have the general characteristics of both national and regional public goods and services and global public goods and services. Due to the general characteristics of public goods and services, the supply of defense services is presented to the parliament with a draft budget law in representative democracies (Batırel, 2007, pp. 28-29). By adopting the draft law on the expenses of the defense service prepared by the government, the Parliament grants duties and powers to the political power. Thus, the decisions regarding the number of resources to be allocated to the defense service and how the allocated resources will be used are taken within the political process and are carried out by the political power. Defense service has a legal qualification as production and consumption in defense service is realized by budget law. Due to this feature, there is a legal obligation to perform the defense service (Bulutoğlu, 2003, p. 5).

Defense services are also regional public goods when offered to certain members in a certain geographical area. For example, the defense services provided by regional military pacts such as NATO are evaluated within this scope. As a matter of fact, the defense services provided by NATO are also club good for the member states in the agreement (Sandler & Tschirhart, 1997, p. 352). Defense services are included in the category of global public goods, which have cross-border externalities and provide peacekeeping and security. When defense service is delivered by international organizations such as the United Nations Security Council, its benefits can cross borders and have an impact on both the present generation and the future generation. The fact that the defense service is a global public good raises questions about how this service will be provided and how it will be financed. There are different opinions on this subject that are not decided definitively. For example, Mendez (1999) stated that the absence of a sovereign state at the global level will cause the "*free-rider problem*" in the global defense service.

Educational services are evaluated within the scope of semi-public goods and services. Because educational services in terms of their qualifications can be produced and marketed by the state or private sector. Because of these features, the social benefits of educational services resemble pure public services and individual benefits resemble private services (Turhan & Erol, 2020, pp. 18-19). In addition, since the marginal social benefit of education services is greater than the marginal private benefit, educational services have the characteristic of merit goods. For this reason, the state does not completely leave the production and delivery of educational services to the market. Because if it is released to the market, the price will be formed depending on the market conditions. In this case, individuals who do not have the power to purchase the service may be crowding-out from the service. Therefore, the state on the one hand, carried out the production and provision of educational services, and on the other hand, intervenes in the market with its regulatory and supervisory role.

The Relationship Between Defense and Education Expenditures

The polarization of the I and II World Wars in the 20th century and the Cold War that started after it has led to an increase in defense expenditures around the world. Especially during the Cold War period (1949-1991), the tension and chaos between NATO and the USSR increased the defense expenditures of NATO member countries (NATO, 1976, pp. 294-295; NATO, 1992, pp. 23-27). At the beginning of the 21st century, after the Al-Qaeda organization attacked the USA on September 11, 2001, the defense expenditures of NATO member countries increased. In this increase, the military operations carried out individually by the member states, especially the Afghanistan and Iraq operations carried out within the scope of the alliance, were also effective (Stiglitz & Bilmes,

2009, p. 31). In addition, the human tragedies caused by radical groups in the Middle East and the civil war that started with the Arab Spring in 2010 and still continues in Syria have increased the defense expenditures of NATO member countries (Giray & Taşdelen, 2018, p. 432). Finally, the crisis that started between Russia and Ukraine in 2014, resulting in war in 2022, caused an increase in the defense expenditures of the alliance members (Fiott, 2022, pp. 152-156). This increase has led to the thought that global public resources are transferred from social welfare areas (education, health, etc.) to defense areas (Dedebek & Meriç, 2015, p. 90). However, this is not clear. Because there is no consensus in the literature on the crowding-out relationship between defense and education expenditures. At this point, the literature differs in three main theory titles. The first of these theories is the *Military Keynesian Theoretical Approach*. The *Military Keynesian Theoretical Approach* is an approach that explains the impact of defense expenditures on public education expenditures within the framework of "*supply-side*" factors based on positive externalities. According to this approach, more defense expenditures lead to an increase in capacity utilization and a higher level of output through the "*multiplier effect*". In this case, defense expenditures create human capital and cause an increase in public education expenditures (Benoit, 1973, pp. 8-16; Kollias et al., 2004, p. 556).

According to the economists advocating the *Military Keynesian Theoretical Approach*, employment, education and occupational/technical education are offered to a large number of people through defense programs. Therefore, defense expenditures significantly alleviate the social and financial burden of the private sector. In addition, since defense expenditures have positive externalities, the factor can increase efficiency. In particular, defense research and development are seen as a way to stimulate the growth of high-tech sectors such as aeronautics and electronics (Looney, 1988, p. 50; Tekeoglu, 2008, pp. 20-22).

The second approach that allows to explain the exclusion relationship between defense expenditures and public education expenditures is the *Neo-Classical Theoretical Approach*. This approach sees the state as a rational actor balancing the security benefits and alternative costs of defense expenditures to maximize the nation's interests in a social welfare function. Therefore, the main point that this approach focuses on is the assumption that the resources allocated to defense expenditures cause a high opportunity cost by reducing public education expenditures. The *Neo-Classical Theoretical Approach* is based on the assumption that defense expenditures create a crowding-out effect on both social expenditures such as education and health, and other private consumption and investment expenditures. As a result of the crowding-out effect, scarce resources will be withdrawn from productive areas, and economic growth and social welfare will be negatively affected (Russett, 1969, pp. 412-426; Değer & Sen, 1995, p. 280; Giray, 2004, p. 191; Yakovlev, 2007, pp. 319-321; Dunne & Tian, 2013, p. 5; Dunne, 2015, p. 445; Zhao et al., 2017, pp. 703-718; Zhang et al., 2017, pp. 686-702; Fan et al., 2018, pp. 766-779).

The last theory that deals with the crowding-out relationship between defense expenditures and public education expenditures is the *Neutrality Hypothesis*. The *Neutrality Hypothesis*, contrary to the above-mentioned theoretical approaches is a hypothesis that argues that there isn't exist a crowding-out relationship between defense expenditures and social welfare expenditures. The *Neutrality Hypothesis* argues that the level of defense expenditures increases only as conflicts and threats increase. Thus, there is no crowding-out relationship between defense expenditures and public education expenditures (Biswas & Ram, 1986, pp. 361-372; Kusi, 1994, pp. 152-159; Chang et al., 2014, p. 177; Kovacevic & Smiljanic, 2017, pp. 413-431; Hatemi-J et al., 2018, p. 1195).

Literatur Review

The crowding-out relationship between defense expenditures and public education expenditures has been tried to be analyzed with various econometric models based on different time periods. Studies carried out in this context; time period, country group, econometric model and the

findings are explained. The studies carried out in this context are explained by taking into account the time period, the country group, the econometric model and the findings obtained.

Harris et al., (1985) examined the causality relationship between defense expenditures and education expenditures for twelve Asian countries with annual data for the period 1967-1983 with multiple regression analysis. They found a positive relationship in 6 countries (Burma, India, Korea, Malaysia, Sri Lanka and Thailand), negative in one country (Nepal) and meaningless in the rest of five countries (Bangladesh, Indonesia, the Philippines, Pakistan and Singapore). Hess and Mullan (1988) analyzed the causality relationship between defense and education expenditures with the Two-Stage Least Squares (2SLS) estimator using annual data from seventy-seven underdeveloped countries for the period 1982-1983. According to the findings obtained, it was resulted that defense expenditures did not have any effect on education expenditures. Yıldırım and Sezgin (2002) analyzed the relationship between defense expenditures and education expenditures with the annual data of the period 1924-1996 in Turkey in a multi-equation framework using the Seemingly Unrelated Regression (SUR) estimation method. As a result of the analysis, a positive relationship was found between defense and education. Ozsoy (2002) analyzed the effect of defense on education expenditures in Turkey with the smallest square's estimator. Within the scope of this analysis the time period 1925-1998 was taken as a basis. As a conclusion of the analysis, a negative relationship was obtained between defense expenditures and education expenditures. Giray (2004) analyzed the relationship between defense and education expenditures with data for the period 1980-2000 for Turkey with simple regression analysis. According to the findings provided as a conclusion of the analysis, a one-unit increase in defense expenditures increases education expenditures by 0.82%.

Hirnissa et al. (2009) investigated the crowding-out relationship between defense expenditures and education expenditures in eight Asian countries (Bangladesh, Indonesia, the Philippines, South Korea, Malaysia, Nepal, Singapore and Sri Lanka) for the period 1970-2005. In the research where the delayed autoregressive boundary test (ARDL-RECM) was applied, they stated that the results differed from country to country and that no significant relationship was detected. In addition, when we look at the country in particular a positive relationship has been found between defense expenditures and education expenditures in Bangladesh and Nepal. They attributed this to both countries investing in human capital while increasing their defense expenditures. Kollias and Paleologou (2011) analyzed the trade-off relationship between defense expenditures on education and social expenditures with vector autoregression models (VAR) based on the time 1972-2004 in Greece. As a result of their analysis found that defense expenditures positively affected both education expenditures and social expenditures. Lin et al. (2015) analyzed the relationship between defense expenditures and social welfare expenditures (education, health) over twenty-nine OECD countries over the period 1988-2005 using the System Generalized Moments Methods (System-GMM) a dynamic panel data model. In this analysis, they established two different models. In both established models, they found a significant and positive relationship between defense, education, and health expenditures.

Zhao et al. (2017), investigated the relationship between defense expenditures and public expenditures (science, education, culture and health) in China for the period 1952-2012. As a conclusion of the investigation, it has been shown that defense expenditures negatively affect public expenditures (science, education, culture and health). Bar-El et al. (2020), based on the arms race between Israel and Iran education and defense expenditures in both countries for years between 1993 and 2013; they investigated the relationship between relative military power, security level, civilian consumption expenditures, GDP and social welfare with dynamic panel analysis. As a result of the research, they determined a positive relationship between the variables. In other words, they determined that an increase in the importance of the countries in question to their future and/or the efficiency of the education system leads to increases in the human capital, civil services, national security, relative military power and social welfare. Biscione and Caruso (2021), analyzed data for

26 European countries using the 1990-2015 period using the Fixed Effect Model (OLS). According to the result obtained, no crowding-out relationship was found between defense expenditures and education expenditures.

Empirical Analysis

In this section, the empirical analysis will be presented. First, data and methodology will be described. In this research, the causality relationship between defense expenditures and public education expenditures will be analyzed with a dynamic panel data model. The analysis was performed using System-GMM, which is one of the dynamic panel data models.

Data and Methodology

There are 30 countries that are members of NATO in 2022. However, in this study, 27 countries[1] were contained in the analysis because the data of Montenegro and North Macedonia could not be reached and Iceland did not have a permanent army. Data from 2000 to 2019 were used.

An extensive literature review was conducted to decide on the variables to be used in the analysis. As a result of the domestic and foreign literature review, dependent (explanatory) and independent (explanatory) variables were determined. Information on the details of the identified variables is presented in Table 1.

Table 1: Summary Information on Dependent and Independent Variables

Variable Name	Code	Description	Data Source
Public Education Expenditures	PubEduEx	Ratio of Public Education Expenditures to GDP (%)	OECD, IMF
Defense Expenditures	DefensEx	Ratio of Defense Expenditures to GDP (%)	SIPRI
Public Expenditures	PublicEx	Ratio of Public Expenditures to GDP (%)	World Bank
Household Expenditures	HouseEx	Ratio of Household Expenditures to GDP (%)	World Bank
GDP	GDP	GDP (%)	World Bank
Population	Population	Annual Population Growth Rate (%)	World Bank

After explaining the variables used in the study and their determination methods, the model with dependent and independent variables was estimated as follows:

$$\mathbf{PubEduEx} = \beta_1 \mathbf{PubEduEx}_{it-1} + \beta_2 \mathbf{DefensEx}_{it} + \beta_3 \mathbf{PublicEx}_{it} + \beta_4 \mathbf{HouseEx}_{it} + \beta_5 \mathbf{GDP}_{it} + \beta_6 \mathbf{Population}_{it} + u_{it}$$

It was measured whether there was a multicollinearity problem between the independent variables used in the model. Multicollinearity problem is calculated to determine the correlation between each independent variable included in the analysis. Generally, if the coefficient between the independent variables in the correlation matrix is greater than 0.80, it indicates that there is a multicollinearity problem between the variables. In order to eliminate the multicollinearity problem, the relevant variable or variables should be removed from the analysis (Cengiz & Gör, 2016, p. 71). In this context, the correlation matrix of the variables used in the model created within the scope of the analysis is shown in Table 2.

[1] Albania, Belgium, Bulgaria, Canada, Croatia, Czech, Republic, Denmark, Estonia, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Luxembourg, Netherlans, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Turkey, United Kingdom and United States.

Table 2: Correlation Matrix of Variables Used in the Model

Variables	PubEduEx	DefensEx	PublicH	PublicEx	GDP	Population
PubEduEx	1.0000					
DefensEx	0.0587	1.0000				
PublicEx	0.5311	-0.1862	1.0000			
HouseEx	-0.2892	0.4917	-0.4971	1.0000		
GDP	-0.1579	-0.0106	-0.3243	0.0653	1.0000	
Population	0.0271	0.0230	0.0415	-0.4510	-0.0959	1.0000

Table 2 shows the correlation matrix that tests the multiple linear problem between the dependent and independent variables determined within the scope of the model. When the correlation coefficients between the independent variables in the model are examined, it is seen that the coefficients are at a very low level. The highest relationship is determined to be between the HouseEx variable and the DefensEx variable (0.49). It is determined that the correlation coefficients between the variables are less than 0.80. In addition, when the Variance Inflation Factor (VIF) values are taken into consideration, the coefficient of each independent variable is determined to be less than 10. As a result of these findings, it is understood that there is no multicollinearity problem between the independent variables in the model and it is seen that the selected independent variables are suitable for the model.

Cross-Sectional Dependence Test Results

One of the basic assumptions that must be met in order to analyze panel data sets correctly is to determine whether there is a cross-sectional dependence between all independent variables in the model. Because the cross-section dependence between the independent variables in the analysis significantly affects the accuracy and reliability of the analysis results. Therefore, before starting the analysis, it is essential to look at the cross-section dependence on both the model and the variable basis (Pesaran, 2021, pp. 13-50; Breusch & Pagan, 1980, pp. 239-253).

Breusch & Pagan (1980) LM test, Pesaran (2004) CD test and Pesaran, Ullah and Yamagata's (2008) NLM test can be used in case of cross-sectional dependence between units in the study. Breusch & Pagan (1980) LM test, where the time dimension (T) is greater than the cross-section dimension (N) (T>N); CD test (N>T) where the cross-section size (N) is greater than the time dimension (T) Pesaran (2004); Pesaran, Ullah, and Yamagata (2008) use the NLM test when N and T are both large (Yerdelen Tatoğlu, 2018, p. 237). Since the cross-sectional dimension of the study was N=27 and the time dimension were T=20 (N>T; 27>20), Pesaran (2004) CD and Pesaran, Ullah and Yamagata LM adj (2008) tests were used. Test results for cross-section dependence on both model and variable basis are shown in Table 3.

Table 3: Cross Section Dependency Test Results

Tests and Variables	Test Statistics	p -values
Pesaran (2004) CD	2.62	0.008***
Pesaran, Ullah and Yamagata (2008) LM adj	-2.997	0.002***
PubEduEx	17.1	0.000***
DefensEx	23,432	0.000***
PublicEx	15,505	0.000***
HouseEx	12,391	0.000***
GDP	51,072	0.000***
Population	.061	0.951

Notes: ***"***", "**" and "*" indicate that there is cross-section dependence at 1%, 5% and 10% significance levels respectively".***

H_0: "*There is no cross-sectional dependence*".

H_1: "*There is cross-sectional dependence*".

According to the cross-sectional dependency results of the model, the probability values of Pesaran (2004) CD and Pesaran, Ullah and Yamagata (2008) LM adj tests are less than 0.05 at the 1% significance level. Therefore, the H_0 hypothesis is rejected. Therefore, the alternative hypothesis "*there is horizontal dependence*" is accepted. In addition, it was examined whether there is a cross-section dependence in the variables used in the model. According to the findings, since the probability values of PubEduEx, DefensEx, PublicEx, HouseEx and GDP variables are less than 0.05 (0.000), the H_0 hypothesis was strongly rejected and the alternative hypothesis was accepted. As a result, the existence of cross-section dependence was determined both in the model and in most of the variables. For this reason, second generation unit root tests were applied to define whether the variables were stationary.

Panel Unit Root Tests

The stationarity tests of the variables in the model are carried out by taking into consideration the cross-section dependence and homogeneity characteristics as mentioned before. Because whether the variables meet the stationarity condition is of great significance in terms of the reliability of the analysis (Baltagi & Kao, 2000, pp. 5-7; Hurlin & Mignon, 2007, pp. 2-4). In this context, second generation unit root tests were applied for each variable in line with the results of cross-sectional dependence in both models and variables.

In the study, the stationarity test for each variable was used by Levin, Lin & Chu (2002), Breitung (2005), Haris & Tzavalis (1999), Hadri (2000), Im, Pesaran & Shin (2003), Fisher Augmented Dickey Fuller (Fisher ADF) and Fisher Philips Peron (Fisher PP) tests. However, the results of Levin, Lin & Chu (2002), Im, Pesaran & Shin (2003) and Fisher ADF tests have been reported. Test results are presented in Table 4.

Table 4: Unit Root Test Results for Variables

Variables	**Levin, Lin & Chu**		**Im, Pesaran & Shin**		**Fisher (ADF)**	
	Fixed	**Fixed, Trending**	**Fixed**	**Fixed, Trending**	**Fixed**	**Fixed, Trending**
PubEduEx	-4.3952 (0.000)***	-6.5877 (0.000)***	-3.1553 (0.000)***	-3.5790 (0.000)***	103.1677 (0.000)***	67.9863 (0.095)*
ΔPubEduEx	-11.0424 (0.000)***	-13.1026 (0.000)***	-11.8561 (0.000)***	-8.6418 (0.000)***	296.6733 (0.000)***	224.0242 (0.000)***
DefensEx	-4.0410 (0.000)***	-1.4221 (0.077)*	-2.2093 (0.013)**	2.2885 (0.988)	73.1401 (0.042)**	67.1864 (0.107)
ΔDefensEx	-6.0743 (0.000)***	-6.2232 (0.000)***	-6.2116 (0.000)***	-4.6638 (0.000)***	189,6900 (0.000)***	158.8965 (0.000)***
PublicEx	-2.5404 (0.005)***	-3.2456 (0.000)***	-1.1682 (0.121)	0.9452 (0.827)	51.7406 (0.562)	38,7304 (0.941)
ΔPublicEx	-14.2738 (0.000)***	-13.7488 (0.000)***	-12.2582 (0.000)***	-10.8376 (0.000)***	174.8116 (0.000)***	156.3371 (0.000)***
HouseEx	-3.3619 (0.000)***	-4.7744 (0.000)***	-0.3080 (0.379)	-2.2747 (0.011)**	61.0662 (0.237)	81.1066 (0.009)***
ΔHouseEx	-17.0506 (0.000)***	-15,2550 (0.000)***	-15.5268 (0.000)***	-12.9383 (0.000)***	216.3948 (0.000)***	278.6318 (0.000)***
GDP	-9.8175 (0.000)***	-8.9427 (0.000)***	-7.8096 (0.000)***	-5.6733 (0.000)***	142.2025 (0.000)***	109.8000 (0.000)***
Population	-5.3113 (0.000)***	-7.6473 (0.000)***	-5.4752 (0.000)***	-5.4895 (0.000)***	200.0064 (0.000)***	172.6183 (0.000)***

Notes: "*"**, *"**" and "*" are stationary at 1%, 5% and 10% significance levels respectively. Variables do not contain a unit root".*

Δ : "It shows that the first-order differences of the variables are taken".

H_0 : *"Variables are not static. Variables contain unit roo*ts".

H_1 : *"Variables are static. Variables do not contain unit roots".*

Table 4 indicates the results of Levin, Lin & Chu (2002), Im, Pesaran & Shin (2003) and Fisher ADF unit root tests, which contain both constant term and constant term and trend, regarding the variables used in the models.

Accordingly, as a result of LLC and IPS unit root tests conducted on the PubEduEx variable it was defined that the test statistics, which included both fixed and fixed and trending, were stable at the level of 1%. When the Fisher (ADF) test statistic was examined, it was obtained that the variable in question was stationary at the level of 1% in the fixed model and at the level of 10% in the fixed and trending model. However, in order to ensure uniformity between the unit root tests applied and to make the test statistic of the relevant variable less than 0.05, the difference process was applied. Therefore, the first order difference of the PubEduEx variable was received and made static at the level of 1% significance in all three-unit root tests. As a result of LLC, IPS and Fisher (ADF) unit root test statistics for the DefensEx independent variable, it was determined that the relevant variable contains a unit root and is not static at the level. The difference of the DefensEx variable from the first order is taken and made static at the level of 1% significance in all three-unit root tests. As a result of LLC, IPS and Fisher (ADF) unit root tests apply to the PublicEx variable, it was determined that the level of the relevant variable was not fixed. In other words, according to both test statistics, the H_0 hypothesis was not rejected. Therefore, the first-order difference of the PublicEx variable was received and made stationary at the level of 1% significance in all three-unit root tests. When the results of the unit root test statistics for the HouseEx variable were examined, it was seen that the fixed models of both IPS and Fisher (ADF) unit root tests of this variable were not static. Thus, the difference of the first order is received to stabilize the HouseEx variable. When the unit root test statistics of the GDP and Population variables were examined, it was found that both variables did not contain unit roots at the level and the variables were static. Therefore no difference was made for both variables.

Accordingly, as a conclusion of the LLC and IPS unit root tests for the PubEduEx variable, it was specified that both fixed and fixed-trend containing test statistics were stationary at the 1% level. Looking at the Fisher (ADF) test statistic, it was specified that while the variable in question was stationary at the level of 1% in the fixed model, it was stationary at the 10% level in the model with constant and trend. However, in order to ensure uniformity among the applied unit root tests and to make the test statistic of the relevant variable less than 0.05, the difference process was applied. For this reason, by taking the first-order difference of the PubEduEx variable, it was stabilized at the 1% significance level in all three-unit root tests. As a result of the unit root test statistics of the LLC, IPS and Fisher (ADF) for the SavH independent variable, it has been determined that the relevant variable contains a unit root and is not stationary at the level. Therefore, by taking the first order difference of the DefensEx variable, it was stabilized at 1% significance level in all three-unit root tests. As a conclusion of the LLC, IPS and Fisher (ADF) unit root tests for the PublicEx variable, it was specified that the related variable was not stationary at the level. In other words, H_0 hypothesis was not rejected according to both test statistics. Therefore, by taking the first-order difference of the PublicEx variable, it was stabilized at the 1% significance level in all three-unit root tests. When we look at the unit root test statistics for the HouseEx variable, it is seen that the fixed models of both IPS and Fisher (ADF) unit root tests of the said variable are not stationary. For this reason, the first-order difference" was taken to make the HouseEx variable stationary. When the unit root test statistics of the GDP and Population variables are examined, it has been determined

that both variables do not contain a unit root at the level and the variables are stationary. Therefore, no difference was made for both variables.

In summary, the stationarity tests of the dependent and independent variables used in the study were examined in detail. As a result of the examinations, the non-stationary variables were made stationary. Thus, the spurious regression relationship between the variables was tried to be prevented.

System GMM Estimation Model and Results

After the stagnation tests, the predicted model for determining the relationship between defense expenditures and education expenditures was re-examined. As a result of the findings, the model was re-established by including the variables taken from the first difference in the model. The final pattern of the installed model is as follows.

$$\Delta \mathbf{PubEduEx} = \beta_1 \Delta \mathbf{PubEduEx}_{it-1} + \beta_2 \Delta \mathbf{DefensEx}_{it} + \beta_3 \Delta \mathbf{PublicEx}_{it} + \beta_4 \Delta \mathbf{HouseEx}_{it} + \beta_5 \mathbf{GDP}_{it} + \beta_6 \mathbf{Population}_{it} + u_{it} \quad (1)$$

A model was established to specify the relationship between public education expenditures and defense expenditures of NATO member countries. In this context, the analysis findings of the relationship between defense expenditures and public education expenditures as well as other instrumental variables and public education expenditures are presented in Table 5.

Table 5: System GMM Estimation Results

Variables and Tests	**System - GMM**		
	Coefficient	**Standard Error**	**p - values**
ΔPubEduEx (-1)	.7581379	.0836271	0.000***
ΔDefensEx	.2461407	.0781252	0.002***
ΔPublicEx	.0019609	.0006741	0.004***
ΔHouseEx	.0346454	.0186033	0.063*
GDP	-.0186541	.0040343	0.000***
Population	.0194719	.018845	0.301
AR(1) Test			0.009***
AR(2)Test			0.126
Hansen Test			0.178

Notes: "The symbol "Δ" refers to the first-order difference of the variable. The signs "***", "**" and "*" indicate statistical significance levels of 1%, 5% and 10%, respectively". Model was estimated using the code "xtabond2" developed by Roodman (2009) and the STATA 16 package program.

In order for the system GMM estimator to derive reliable consistent and effective results, certain basic conditions must be met. These conditions are measured by various specification tests. The first of these tests is the Arellano and Bond Autocorrelation Test, which tests for the presence of autocorrelation problems in the models. AR(1) and AR(2) results can be examined within the scope of Arellano and Bond Autocorrelation Test. In the models created, especially the second order autocorrelation (AR (2)) condition must be met. In other words, the H_0 hypothesis, which is established as *"there is no first-order autocorrelation between error terms"* should not be rejected. As a matter of fact, it is seen that the p-value of AR(2) is higher than 0.05 (0.126) in the created model. Thus, since the H_0 hypothesis is not rejected, it is possible to say that there is no "*second-order autocorrelation problem"* in the model. Another important test to consider is the Hansen Test, which tests whether the vehicle variables used in the model are viable. According to the Hansen Test, it is expected that the H_0 hypothesis, which is established as "*excessive identification constraints*

apply", will not be rejected in order for the vehicle variables used in the model to be valid. Therefore, the p-value reached in the model must be higher than 0.05. Accordingly, Model shows that the p-value of the Hansen Test is higher than 0.05 (0.178). Therefore, it is possible to indicate that the vehicle variables used in the model are valid.

After it is determined that the conditions for AR(1), AR(2) and Hansen tests are met, the interpretation of the findings obtained in the model can be started. According to the conclusions of the System GMM analysis conducted with the dependent variable ΔPubEduEx (-1), it has been determined that there is a positive relationship at the level of 1% between the rate of public education expenditures in GDP and the previous period value. The 1% increase in delayed public education expenditures increases the current period public education expenditures of NATO member countries by approximately 0.75%.

The variable ΔDefensEx was found by taking the difference of DefensEx in the first degree and represents the ratio of defense expenditures of NATO member countries in GDP. It was determined that there was a positive relationship between the defense expenditures of NATO member countries and public education expenditures at the level of 1%. The 1% increase in the defense expenditure ratio of NATO member countries increases the public education expenditures of the member states by approximately 0.24%. The findings of the research are coherent with the results obtained by Verner (1983), Harris et al. (1985), Yıldırım & Sezgin (2002), Giray (2004), Hirnissa et al. (2009), Ali (2011), Kollias & Paleologou (2011), Lin et al. (2015), Huang & Ho (2018) and Bar-El et al. (2020). Thus, with defense expenditures, the formation of human capital can be ensured by providing education, employment and vocational/technical training to a great deal of people. Especially since soldiers and defense personnel are well trained physically and talented, defense expenditures support human capital formation. In addition, defense expenditures can increase education expenditures by contributing to the formation of effective demand in industrialized countries. This is an indication that NATO member countries also attach importance to their defense industries. As a result, when the analysis findings between the variables were investigated, it was determined that there was no Crowding-Out relationship between the variables. A result supporting the *Military Keynesian Theoretical Hypothesis* was obtained.

The variable ΔPublicEx was found by taking the difference of PublicEx in the first degree and represents the ratio of total public expenditure of NATO member countries in GDP. When the Table 5 is analyzed, it is seen that there is a statistically positive relationship between the total public expenditures of NATO member countries and public education expenditures at the level of 1%. The 1% increase in the total public expenditure ratio of NATO member countries slightly increases the public education expenditures of the member countries. In other words, as the share of NATO member states in the economy and their role in the economy increases, public education expenditures are also positively affected.

The causal relationship between this variable, defined as ΔHouseEx and representing the first-degree difference in the household expenditure rates of NATO member states and public education expenditures was analyzed. According to the findings taken as a conclusion of the analysis, a significant and positive relationship was found between household expenditures and public education expenditures at the level of 10% importance. The 1% increase in household expenditures of NATO countries increases the public education expenditure of the countries by approximately 0.03%. These findings in the study are also similar to findings of the study conducted by Lin et al. (2015).

Another explanatory variable is the annual growth rate, which is represented by GDP. When the relationship between GDP and public education expenditures is examined, a negative relationship is obtained at the significance level of 1%. Because the 1% increase in annual growth has reduced the public education expenditures of the member countries by approximately 0.01%. This shows that

when economic growth occurs in NATO member countries, public education expenditures do not increase in parallel. In other words, the rate of increase in annual growth is greater than the rate of increase in public education expenditures.

Finally in this model, the population variable refers to the annual population growth rate of NATO member countries. When the Table 5 was examined, no significant relationship was found between the annual population growth rate and public education expenditures. This shows that the public education expenditures of NATO member countries are not affected by the population growth rate. This finding obtained in the study is also similar to the finding of the study conducted by Lin et al. (2015).

Conclusion

Throughout history, states have had to attach importance to their defense forces so as to survive and maintain their sovereignty. This necessity led states to allocate more resources to defense on the one hand, and to political unification and integration and strong military alliances on the other. As a matter of fact, NATO can be shown as the best example of this in recent history. Because NATO is the most important military alliance in the world, which was established as a result of the arms race, the search for political balance and polarization.

Another important expenditure for countries is social welfare expenditures. Education comes first among these expenditures. Human capital is important for the development of the country. Defense and education services in the public economy require public financing as they are included in the public goods and services group. Three theories have been developed regarding the effect of defense expenditures on education expenditures as social welfare expenditures. The first of these is the "*Military Keynesian Theoretical Approach".* This approach explains the social welfare expenditures of defense expenditures within the framework of "*supply-side*" factors based on positive externalities. For example, training services are provided to a large number of people through programs in the defense industry. In addition, defense expenditures increase the quality of education services by increasing factor productivity. The second theory, the *Neo-Classical Theoretical Approach,* is based on the idea that defense expenditures like other public expenditures, create a crowding-out effect on both pure and semi-public goods and services and other private consumption and investments. This situation affects social welfare negatively by pulling scarce resources from productive areas such as education services. The last theory is based on the *Neutrality Hypothesis*. The *Neutrality Hypothesis,* contrary to the above-mentioned theoretical approaches, is a hypothesis that argues that there is no crowding-out relationship between defense expenditures and public education expenditures. In addition, the Neutrality hypothesis argues that the level of defense expenditure increases only with the increase of conflicts and threats.

In this study, which of these theories will be effective in the effect of defense expenditures on public education expenditures has been analyzed with the dynamic panel data model specific to NATO countries. As a conclusion of the analysis, a positive relationship at the level of 1% was found between the defense expenditures of NATO member states and public education expenditures. It has been specified that the 1% increase in the defense expenditures in the GDP of the NATO countries increased the public education expenditures by 0.24%. With this result obtained within the scope of the research, it was determined that defense expenditures had a positive effect on human capital formation and the *Military Keynesian Theoretical Hypothesis* was found to be valid. Therefore, according to the findings, it is seen that defense expenditures do not have a crowding-out effect on public education expenditures.

As can be seen from the findings of the analysis, there is no crowding-out relationship between defense expenditures and public education expenditures. With this result, it can be described as positive in terms of defense expenditures not affecting public education expenditures negatively.

However, contrary to what is expected and predicted in the fiscal literature, it has been specified that the increase in defense expenditures does not have a negative effect on public education expenditures. However, it would be more beneficial to allocate resources to defense at an optimal level and to use the allocated resources rationally. Increased defense expenditures should be best planned. The resources allocated to defense should be directed to the right projects. Threat assessments must be done correctly. The most appropriate weapon systems should be used. Cost-benefit analysis of expenditures in the field of defense should be done well. Otherwise, the resources allocated for defense will be made in areas far from the target.

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