# The Nexus Between Defense Spending and Growth: Empirical Analysis of First Euro Users

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# The Nexus Between Defense Spending and Growth: Empirical Analysis of First Euro Users

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## Abstract

*The purpose of this research is to investigate the cointegration and causality among defense spending and economic growth and to emphasize the basic relationship between them. In the study, the very first users of the euro as a currency in European Union has been researched with panel data cointegration and causality techniques and tried to fill the gap in the literature related to the defense spending-economic growth relation in euro using countries. The results show that, there is a long run cointegration but there is not any causal relationship between defense spending and economic growth. In the literature, the majority of the work related to this topic focalize on a single country and use time series analysis. The remaining works focalize on a society of countries and use panel data analysis. However, in the literature there is lack of work analysing the euro using countries in European Union. From this perspective, since there is no previous study including solely euro using countries, this study distinguishes from other studies.*

**Keywords:** *Panel Data Analysis, Defense Spending, Economic Growth.*

## Introduction

The connection among defense spending and economic growth gained stature after the studies of Benoit (1973,1978) and studied broadly after his work which propound that defense spending positively influence the economic growth. Defense spending is country's share that a country allocates from national income at the expense of giving up its prosperity, and are expenditures made in order to ensure the continuity of the country's national presence and sovereignty (Koban,1998).

The size of the defense spending of the countries depends on factors such as foreign policy preferences, geopolitical position of the country, military education level and current threats. However, the foremost factor determining defense spending is the economic structure of the country and the size of the budget state allocated to this issue (Çevik and Bektaş, 2019:229-230).

In the literature, the majority of the work related to this topic focalize on a single country and use time series analysis. The remaining works focalize on a society of countries and use panel data analysis. The works of Balan (2015), Çetin and Güzel (2019), Dash, Bal and Sahoo (2016), Georgantopoulos (2012), Gökbunar and Yanıkkaya (2004), Yolcu Karadam, Yıldırım and Öcal (2016), Hou and Chen (2013), Huang, Wu and Liu (2017), Pan, Chang and Wolde-Rufael (2015), Töngür and Elveren (2017), Turan, Karakaş and Özer (2018), Yakovlev (2007), Yıldırım, Sezgin and Ocal (2005) and Yıldırım and Öcal (2016) are the samples of these studies. Especially the studies of Kollias and Paleologou (2010), Topcu and Aras (2015), Dudzeviciute, Peleckis and Peleckiene (2016) focused on European Union countries. However, in the literature there is lack of work analyzing the euro using countries in European Union. From this

perspective, since there is no previous study including solely euro using countries, this study distinguishes from other studies.

Therefore, aim of this work is to fill the gap in the literature about examine the relation among economic growth and defense spending of the eleven euro using countries in European Union. The reason for choosing only eleven countries (Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain) out of nineteen countries is the chosen countries are the very first countries started using Euro by January 1st, 1999 as a "book money". Another common point of these countries is their monetary policy is steered by European Central Bank.

In this work, initially literature review regarding the subject is perused. Following the literature review, methodology and data employed in the model is elucidated withal equations. The empirical results are computed with EViews 11SV software and in conclusion part the results of the computations are construed.

**Literature Review**

Benoit (1973) is the prime researcher to demonstrate a substantial relationship among economic growth and defense spending economic growth for the time period studied for forty four less developed countries and to find a causal relationship among economic growth and defense spending. Additionally, Benoit (1978) defined the aspect of the causality from defense spending to economic growth. This topic has attracted the interest of scholars and since the late 1970's a large literature has emerged. In the literature, the relationship regarding causality among economic growth and defense spending is evaluated over four distinct hypothesis. These are respectively; feedback hypothesis, neutrality hypothesis, defense expenditure-based growth hypothesis and growth-based defense

expenditure hypothesis. Chang, Lee, Hung and Lee (2014), Zhong, Chang,Tang and Wolde-Rufael (2014), Pan et al.,(2015) and Hatemi-J, Chang,Chen, Lin and Lupta (2018).

Although it is stated in these hypothesis that the causality relationship between economic growth and defense expenditures may be uni-directional, furthermore to this they also suggest that there is a reciprocal causality relationship among economic growth and defense spending. Lastly, the neutrality hypothesis points out that there isn't any causal relationship among economic growth and defense spending (Hatemi-J et al., 2018). In addition to these, it would not be wrong to consider defense expenditures as an element of public expenditures. Under this topic, there are generally two recommendations regarding the relationship between GDP and government spending: Wagner Law points out that the public sector inclined to grow as GDP grows; and the Keynesian foundation assumes that public expenditures cause GDP growth (Liu, Hsu and Younis:2008). The literature parallel to our work is shown in Table1.

**Table 1.** Literature Survey

| Authors | Data | Method | Variables | Result |
|---|---|---|---|---|
| Abdel-Khalek, Mazloum and El Zeiny | India (1980-2016) | Time series and Hendry General to Spesific | Trade openness, military spending, received aid, government spending and GDP. | There is no causal relationship among economic growth and defense expenditure. |
| Ageli and Zaidan | Saudi Arabia (1970-2012) | Granger casuality test | Defence expenditure as a share of GDP and real GDP except oil income. | Among variables there is a cointegrating relationship. |
| Anwar, Rafique and Joiya | Pakistan (1980-2010) | Johansen cointegration and Granger casuality test | Total exports and imports as a share of GDP, gross domestic investment as a share of GDP, military expenditure as a share of GDP and GDP. | There is a long run relationship among economic growth and defense spending. Economic growth granger causes defense spending. |

| Authors | Data | Method | Variables | Result |
|---|---|---|---|---|
| Balan | 12 MENAT Countries (Middle East, North Africa and Turkey) (1988-2013) | Bootstrap panel Granger causality test | Real per capita GDP, per capita military expenditure and political instability score. | For Lebanon; positive causality from political defense spending &instability to economic growth.<br>For Lebanon, Morocco, Saudi Arabia, Jordan and Turkey; positive causality from economic growth &political instability to defense spending.<br>For Turkey, Egypt and Israel; positive causality from economic growth &defense spending to political instability. |
| Çetin and Güzel | MENA countries (1990-2017) | Panel econometric models. | Inflation rate, economic growth, total government spending, military spending and financial development level | 1% increase in military spending cause 0.06% decrease in economic growth. It shows that military spending has a negatory effect on economic growth. |
| Çevik and Bektaş | Turkey (1968-2017) | Frequency domain causality test | Real GDP and real defense expenditures | There is unidirectional causality from defense expenditures to economic growth. |
| Dash, Bal and Sahoo | BRIC countries (1993-2014) | Pedroni cointegration and Granger casuality test | Real per capita defense expenditure, real per capita GDP, real defense expenditure and real GDP. | There is a long run cointegration between variables, rise in the economic growth (1%) has conduce rise in real defense expenditure (0,54%) and there is two-way causality between variables |
| Dudzeviciute, Peleckis and Peleckiene | European Union (2004-2013) | Granger casuality test | Per capita GDP and defense expenditure as a share of GDP. | The countries grouped by per capita GDP, except one group (lower middle income) there is a negative relationship between variables. From the causality perspective, both Keynesian and |

| Authors | Data | Method | Variables | Result |
|---|---|---|---|---|
| | | | | Wagner approach revealed. |
| Georgantopoulos | Balkan Countries (Albania, Bulgaria, Greece and Romania) (1988-2009) | Johansen cointegration and Granger casuality tests | Military spending as a share of GDP and GDP growth rate | There are not any bidirectional causality between variables in all countries. But, for Albania and Bulgaria; there is unidirectional causality from military expenditures to GDP. |
| Gökbunar and Yanıkkaya | 144 countries (29 developed and 85 developing) (1980-1997) | Regression analysis | Military expenditure as a share of GDP, arms import as a share of total import and number of military personnel as a share of total population | There is no cointegration between military expenditure and economic growth except one specification. In developing countries rise in military expenditures positively affects rise in economic growth but in developed countries there is no relation between variables. |
| Gökmenoğlu, Taşpınar and Sadeghieh | Turkey (1988-2013) | Johansen cointegration and Granger casuality test | Defense expenditures and GDP. | Defense spending and economic growth have long run equilibrium relationship. In addition to this, there is a unidirectional causality from economic growth to defense expenditure, but there is not any causality from defense spending to economic growth. |
| Halıcıoğlu | Turkey (1950-2002) | Johansen and Juselius cointegration tests | Real aggregate output, real consumption, real defense expenditures, real non-defense government expenditures, real investment, real net exports and real defense expenditures. | Increase or decrease in Turkey's military spending leads to changes in the macroeconomic stability in the long term. |

| Authors | Data | Method | Variables | Result |
|---|---|---|---|---|
| Hatemi-J, Chang, Chen, Lin and Gupta. | China, Japan, France, Russia, Saudi Arabia and USA (1988-2013) | Asymmetric Granger causality test | Per capita real military expenditures and per capita real GDP | France, Saudi Arabia, Russia, USA; Growth-led hypothesis is supported. China and Japan; Military-led hypothesis is supported. |
| Heo | USA (1954-2005) | Augmented Solow Model | Employed labour, defense spending, private sector savings, capital depreciation and GDP | The defense spending does not affect the United States economy. |
| Hou and Chen | 35 Developing Countries (1975-2009) | Augmented Solow Growth Model | Real per capita GDP, military expenditure as a share of GDP (five year average), investment as a share of GDP (five year average), average number of years of schooling of both sexes 25 years of age or older and five year average population growth rate | Military expenditures has a significant and negative effect on economic growth. |
| Huang, Wu and Liu | 77 countries (1996-2014) | Panel smooth transition VAR model | Growth rate of GDP and defense expenditure as a share of GDP | Both defense spending and economic growth has a negative effect on each other. There is a bi-directional causality between variables but this bi-directional nexus is non-linear and varies with time. |
| Kollias | Turkey (1954-1993) | Vector auto-regression and Granger causality tests | Defense expenditure as a share of GDP and growth rates. | There is not any causality among defense spending and economic growth. |
| Kollias and Makrydakis | Greece (1955-1993) | Granger casuality test | Defense expenditure as a share of GDP and real GDP. | There is no causal relationship among variables. |
| Kollias and Paleologou | EU-15 countries (1961-2002) | Fixed panel data analysis | GDP growth rate, investment as a share of GDP and defense | The growth rate has a significant positive effect on the share of defense |

| Authors | Data | Method | Variables | Result |
|---|---|---|---|---|
| | | and VAR modelling | expenditure as a share of GDP. | spending and the share of investment. |
| Liu, Hsu and Younis | USA (1947-2002) | Granger casuality test | Net interest payment, other function expenditure, physical resources expenditure, defense expenditure and human resources expenditure | There is not any Granger causality among growth and national defense expenditure. |
| Pan, Chang and Wolde-Rufael | 10 Middle East Countries (1988-2010) | Bootstrap panel Granger causality test | Real per capita GDP, real per capita military spending and real per capita capital stock | For Turkey; unidirectional Granger causality from military spending to economic growth.<br>For Syria, Kuwait, Lebanon and Egypt; unidirectional Granger causality from economic growth to military spending.<br>For Oman, Bahrain, Saudi Arabia and Jordan; no causality among variables. |
| Paparas, Richter and Paparas | Greece and Turkey (1957-2013) | Granger casuality test | Real GDP and defence expenditure as a share of GDP | Greece: Long run relationship among variables.<br>Turkey: There is not any long run relationship among variables.<br>There is no causality among countries. |
| Sezgin | Turkey and Greece (1955-1994) | Engle-Granger two stage test | Gross domestic savings, inflation rate, defense expenditure, GDP and labour force. | Both for Turkey and Greece there is a significant and positive relationship among economic growth and defense spending. |
| Sheikh, Akhtar and Mushtaq | Pakistan (1972-2016) | Augmented Solow Growth Model with Harrod- | Gross capital formation, military spending, GDP, population, labour force and Gini | Defense spending enhance the economic growth. |

| Authors | Data | Method | Variables | Result |
|---|---|---|---|---|
| | | neutral technology | coefficient | |
| Topal | Turkey (1960-2016) | Engle-Granger and Johansen cointegration tests, Toda-Yamamoto and Hacker-Hatemi Bootstrap casuality tests | Per capita income and defense spending | There is a unidirectional causality from defense spending to economic growth. In addition to this defense spending in Turkey affect the level of per capita income negatively in the long run. |
| Topcu and Aras | European Union (1973-2010) | Granger and Toda-Yamamoto causality tests | GDP per capita and defense spending | There are vice versa sided unidirectional, bidirectional and no causality results found in a group of countries. |
| Töngür and Elveren | 82 countries (1988-2008) | Dynamic panel data analysis | Real per capita growth rate of GDP, , population growth, real GDP per capita, gross fixed capital formation as a share of GDP industrial pay inequality index, Human capital index (HCI) based on years of schooling and returns to education, military expenditures as % of GDP. | Income inequality and defense expenditures both have negative effect, but Human capital index (HCI) has positive impact on economic growth. |
| Turan, Karakaş and Özer | 12 High and 29 Low income countries (1988-2016) | Panel cointegration and causality test | Per capita GDP and defense spending as a share of GDP. | High income countries; unidirectional causality from military expenditures to per capita GDP.<br>Low income countries; there is not any causality between variables.<br>There is cointegration between variables both in high and low income countries. |

| Authors | Data | Method | Variables | Result |
|---|---|---|---|---|
| Ucan, Öztürk and Akyıldız | Turkey (2006-2015) | Johansen cointegration, Granger casuality test and VAR model | GDP and defense spending | There is a bidirectional causality between economic growth and defense spending. |
| Umar and Bakar | Malaysia (1980-2014) | Toda-Yamamoto dynamic Granger causality test | Arms import expenditure, defense expenditure and GDP. | There is bidirectional causality among economic growth and defense expenditure. |
| Waszkiewicz | Visegrad countries (1993-2015) | VECM approach and Granger casuality test | GDP per capita and military expenditures | There is not any causality within Visegrad countries. |
| Wijeweera and Webb | Sri Lanka (1976-2007) | VAR model | Interest rate, real military spending, real income and real non-military spending | 1% increase on military spending cause 0.05% increase on economic growth. At the same time period 1% increase on non-military spending cause 1,6% increase on economic growth. It shows that military spending has a positive effect on economic growth yet not high as non-military spending. |
| Yakovlev | 28 Countries (1965-2000) | Panel data analysis, Solow and Barro Growth models | Growth rate of real per capita GDP, initial real per capita GDP , the average number of years of schooling attained by both sexes 25 years old and over at all levels of education, annual population growth rate,real investment as a share of GDP and net arms exports. | Higher defense spending and net arms exports lead to lower economic growth separately, but higher defense spending is less harmful to growth if the country is a net arms exporter. |
| Yıldırım, Sezgin and Ocal | MENA countries and Turkey | Cross-section and dynamic panel | GDP growth rate, real growth rate of defense expenditure, | Defense expenditure enhances growth in all countries. |

| Authors | Data | Method | Variables | Result |
|---|---|---|---|---|
| | (1989-1999) | estimation techniques | investment to GDP ratio, labour force growth rate and investment to GDP ratio. | |
| Yıldırım and Öcal | 128 Countries (2000-2010) | Augmented Solow Growth Model | National income, private-sector savings as a share of GDP, technological progress, labour force growth rate, capital depreciation and share of defense spending in GDP. | Defense spending has a positive effect on e growth, a significant spatial dependence on that time period. |
| Yolcu Karadam, Yıldırım and Öcal | Turkey and Middle Eastern Countries (1988-2012) | PSTR model | Defense spending as a share of GDP, arms import, real per capita GDP, population and gross-fixed capital formation as a share of GDP | Although the impact of defense spending on economic growth is positive at low values of transition variables, it shows that negative effects are observed for their high values, therefore increases in defense spending and arms imports have negative effects on growth. |

## Data and Methodology

### Data

In our model, two different data is used and derived from two sources. The source for real GDP growth is World Bank and the source for defense e spending as a share of GDP is Stockholm International Peace Research Institute. Since the using of euro currency started as a "book money" by 1999, the data after 1999 is used in the model. Besides, in the model, real GDP growth will be shown as GDP and defense spending as a share of GDP will be shown as DS.

## Methodology

### *Panel Unit Root Test*

The foremost matter pertinent to time series is if these series are stationary or not. For the purpose of acquire an econometrically significant relationship between the variables, the data perused should be stationary and not include the unit root. Therefore, while working with time series, initially the stationary status of the series must be tested. If the mean, covariance and variance of the time series remain constant over time, at that time the series is named to be stationary (Aksoğan and Elveren, 2012:269). Panel data analysis is more complicated than time series analysis and foremost element in panel data analysis is heterogeneity. Specifically, not each individual in the panel may have the identical characteristics, they may be distinct in the matter of not being stationary or stationary. Augmented Dickey-Fuller (ADF) and Dickey-Fuller (DF) tests are the very concerted unit root tests applied on panel data and the remaining unit root tests for panel data are stand on the dilation of the ADF unit root test (Asteriou and Hall, 2007:366). In this work, Im, Pesaran and Shin (IPS, 2003) and Levin, Lin and Chu (LLC, 2002) unit root tests are applied on data.

### *Panel Cointegration Test*

The cointegration test, which is widespread used to test the existence of long run cointegration in panel data, is suggested by Pedroni (1999 and 2004). In Pedroni's model for panel data there are seven heterogeneous cointegration tests. In our model cointegration test is applied as below alike Bangake and Eggoh (2012) and Bildirici's (2004a and 2004b) models.

$$\Delta GDP_{it} = \alpha_i + \delta_i t + \beta_i DS_{it} + \varepsilon_{it} \qquad (1)$$

In the equation (1) , t=1,…,T represents time period, i=1, ...,N represents either country, $\alpha$i and $\delta$i parameters are representing the individual and trend effects for cross sections in the panel. $\varepsilon_{i,t}$ parameter is representing the residual terms which stands for the deflections from the long run relation. The following root test is applied on the residuals as below:

$$\varepsilon_{it} = \rho_i \varepsilon_{it-1} + \upsilon_{it} \qquad (2)$$

In the cointegration test recommended by Pedroni (1999), it was tested that if $\rho$=1 in the null hypothesis and all tests are built to test the null hypothesis of no cointegration between variables. The initial four of the seven cointegration tests, pointed out as dimension based statistics and based on pooling. Kao (1999) error cointegration test (based on Engle-Granger) is the second cointegration test applied. In Kao test, to find the Schwarz criterion and long-term variance when there is an individual constant. It has been estimated using Newey-West estimators. The third cointegration test applied to the model is; Johansen cointegration test, which is a generalized version of Engle and Granger method as multiple equations. In Johansen (1988) cointegration test, the equation system of the series that are stationary of the identical degree is based on the VAR (Vector Auto Regression) analysis, which includes the level and lag valuation of each variable in the system. The equation system is stated as below:

$$X_{t=}\mu+\phi D_t+\Pi_p X_{t-p}+.....+\Pi_1 X_{t-1}+\varepsilon_t \qquad (3)$$

$$t:1,….,T$$

***Causality Test***

Finding the direction of causality is an another important issue while working on panel data, because cointegration tests only give the reply about whether there is a long run cointegration exists among the variables.

In our work, in order to specify the course of the causality among GDP and DS the method suggested by Dumitrescu and Hurlin (2012) used to investigate the existence of the causality. By using this test, both the presence or absence of causation can be found and another advantage of using this test is that it can be used in unbalanced panel data. For this reason, the Dumitrescu-Hurlin panel causality test was selected to test the causality analysis in the work. The panel Granger causality test (homogenous non-causality (HNC)) described by Dumitrescu and Hurlin (2012) is stated as below:

$$y_{it} = \sum_{k=1}^{K} \gamma_i^{(k)} y_{i,t-k} + \sum_{k=1}^{K} \beta_i^{(k)} \chi_{i,t-k} + \varepsilon_{i,t} \qquad (4)$$

Like in Granger's (1969) work the method to determine the existence of causality is to test y (present values) and χ (significant past values).Thus, the null hypothesis is shown as below:

$$H_0 : \beta_i = 0, \quad \forall_i = 1,2,....N \qquad (5)$$

The test assumes that there may be causation for some individuals, but this is not necessary for all individuals. Therefore, the alternative hypothesis is expressed as below:

$$H_1 : \beta_i = 0, \quad \forall_i = 1,2,....N_1$$
$$\beta_i \neq 0, \quad \forall_i = N_1 + 1,...., N \qquad (6)$$

When HNC take into account, alternative hypothesis allows some of the individual vectors (βi) to be equals to zero. There are three statistics included in Dumitrescu and Hurlin (2012) causality test, these are shown as below:

$$(W_{N,T}^{HNC}) = 1/N \qquad \sum_{i=1}^{N} W_{i,T} \qquad (7)$$

Wald statistics values for cross sections symbolized with W i,T in average statistics hypothesis (7) (Akbaş, Şentürk and Sancar, 2013:802). The average statistics with asymptotic distribution shown in equation (7), , is related with the null HNC hypothesis and shown as below:

$$Z_{N,T}^{HNC} = \sqrt{\frac{N}{2K}(W_{N,T}^{HNC} - K)} \qquad T,N\to\infty \; N(0,1) \qquad (8)$$

$$W_{i,T} = (T\text{-}2K\text{-}1) \qquad i=1.....N \qquad (9)$$

$$\frac{\tilde{\varepsilon}_i \phi_i \tilde{\varepsilon}_i}{\tilde{\varepsilon}_i M_i \tilde{\varepsilon}_i}$$

The average statistics with semi-asymptotic distribution shown in equation (7), is related with the null HNC hypothesis and shown as below:

$$N\to\infty \; N(0,1) \qquad (10)$$

**Empirical Evidence**

In this work, the empirical computation of the panel data was employed in three step process. The initial step starts with unit root test, to test the unit roots are stationary or not, LLC and IPS unit root tests are applied to the data. Following the initial step, Pedroni, Kao and Johansen-Fisher cointegration tests for panel data was applied in the second step. In the last step, panel casuality test suggested by Dumitrescu Hurlin was employed to the data (Bildirici and Bohur, 2015:199).

**Unit Root Test Results**

Initially, Im et al.(2003) and Levin et al.(2002) unit root tests are applied to the data to find if the series is stationary or not. In Table 2, results of the unit root tests are shown. As we see in Table 2, GDP is stationary but DS is non-stationary and has a unit root. When we take the first differences of

the series and apply the same root tests also the variable DS becomes stationary.

**Table 2.** Unit Root Test Results

| Method | Series | Individual Intercept (Level) | | Individual Intercept and Trend (Level) | | Without Individual Intercept and Trend (Level) | |
|---|---|---|---|---|---|---|---|
| | | **Stat.** | **Prob.** | **Stat.** | **Prob.** | **Stat.** | **Prob.** |
| **IPS** | GDP | -7.27931 | 0.0000*** | -4.89282 | 0.0000*** | | |
| | DS | -1.25764 | 0.1043 | -1.19157 | 0.1167 | | |
| **LLC** | GDP | -8.66833 | 0.0000*** | -7.55014 | 0.0000*** | - | |
| | DS | -2.76472 | 0.0028*** | -1.22387 | 0.1105 | - | 0.0014*** |
| | | **Individual Intercept (1st Diff.)** | | **Individual Intercept and Trend (1st Diff.)** | | **Without Individual Intercept and Trend (1st Diff.)** | |
| | | **Stat.** | **Prob.** | **Stat.** | **Prob.** | **Stat.** | **Prob.** |
| **IPS** | GDP | 11.9258 | 0.0000*** | -9.77841 | 0.0000*** | | |
| | DS | -7.02404 | 0.0000*** | -5.47806 | 0.0000*** | | |
| **LLC** | GDP | -13.6042 | 0.0000*** | -11.2309 | 0.0000*** | -17.2836 | 0.0000*** |
| | DS | -7.90193 | 0.0000*** | - | 0.0000*** | -10.5042 | 0.0000*** |

**Note:** The symbols ** and *** indicate significance at the 5% and 1% confidence levels, respectively.

## Cointegration Test Results

After the panel data became stable, Pedroni (1999), Kao (1999) and Johansen-Fisher (1988) panel cointegration tests were applied to the series to fish out whether there is a long term cointegration among variables. Pedroni and Johansen-Fisher panel cointegration tests out of three tests applied to determine the presence of cointegration in the model showed that there is cointegration. However, Kao cointegration test revealed that

there is no correlation between variables. Since most of our tests reveal the presence of cointegration in the model, it has been accepted that there is a correlation between defense expenditures and GDP in the long run.

**Table 3.** Cointegration Test Results

| **Pedroni Panel Cointegration Test Results** | | | | |
|---|---|---|---|---|
| **Individual Intercept** | | | | |
| | **Stat.** | **Prob.** | **Weighted Stat.** | **Prob.** |
| **Panel v-Statistic** | -1.433422 | 0.89241 | -1.648963 | 0.9504 |
| **Panel rho-Statistic** | -7.401963 | 0.0005*** | -6.638800 | 0.0002*** |
| **Panel PP-Statistic** | -15.90049 | 0.0000*** | -17.42232 | 0.0000*** |
| **Panel ADF-Statistic** | -10.44378 | 0.0000*** | -11.47033 | 0.0000*** |
| **Group rho-Statistic** | -4.696884 | 0.0000*** | | |
| **Group PP-Statistic** | -23.05196 | 0.0000*** | | |
| **Group ADF-Statistic** | -12.61190 | 0.0000*** | | |
| **Individual Intercept and Individual Trend** | | | | |
| **Panel v-Statistic** | -4.117310 | 1.0000 | -4.278042 | 1.0000 |
| **Panel rho-Statistic** | -4.151926 | 0.0000*** | -3.256092 | 0.0006*** |
| **Panel PP-Statistic** | -17.59373 | 0.0000*** | -23.26289 | 0.0000*** |
| **Panel ADF-Statistic** | -10.28694 | 0.0000*** | -11.80524 | 0.0000*** |
| **Group rho-Statistic** | -1.561189 | 0.0592 | | |
| **Group PP-Statistic** | -30.969890 | 0.0000*** | | |
| **Group ADF-Statistic** | -12.05197 | 0.0000*** | | |
| **Without Intercept or Trend** | | | | |
| **Panel v-Statistic** | 0.265649 | .2868 | 0.375171 | 0.3538 |
| **Panel rho-Statistic** | -11.22737 | 0.0000*** | -10.59712 | 0.0000*** |
| **Panel PP-Statistic** | -13.04067 | 0.0000*** | -13.22440 | 0.0000*** |
| **Panel ADF-Statistic** | -9.621763 | 0.0000*** | -10.68017 | 0.0000*** |
| **Group rho-Statistic** | -7.692606 | 0.0000*** | | |
| **Group PP-Statistic** | -20.80490 | 0.0000*** | | |
| **Group ADF-Statistic** | -13.60719 | 0.0000*** | | |

| **Kao Panel Cointegration Test Results** | | |
|---|---|---|
| | **t-stat** | **Prob.** |
| **ADF** | -1.410750 | 0.0792 |
| **Residual variance** | 26.95268 | |
| **HAC variance** | 2.037895 | |

| **Johansen-Fisher Panel Cointegration Test Results** | | | |
|---|---|---|---|
| **Fisher Stat.** (from trace test) | **Prob.** | **Fisher Stat.** (from max-eigen test) | **Prob.** |

| | | | | |
|---|---|---|---|---|
| **None** | 212.0 | 0.0000*** | 156.5 | 0.0000*** |
| **At most 1** | 111.7 | 0.0000*** | 111.7 | 0.0000*** |

**Note:** The symbols ** and *** indicate significance at the 5% and 1% confidence levels, respectively.

### Causality Test Results

The causality test suggested by Dumitrescu and Hurlin (2012) was applied to the variables in our model. According to the results in Table 4, no causality relationship from DS to GDP and from GDP to DS was found in 1999-2019 period.

**Table 4.** Causality Test Results

| | **W-Stat.** | **Zbar-Stat.** | **Prob.** |
|---|---|---|---|
| **DS does not homogeneously cause GDP** | 3.29505 | 1.08744 | 0.2768 |
| **GDP does not homogeneously cause DS** | 1.33468 | -1.20133 | 0.2296 |

## Conclusion

The purpose of this study is to investigate the cointegration and causality among defense spending and economic growth and to emphasize the basic relationship between them. Since the Benoit's (1973,1978) work, defense expenditures-growth relation has been studied by various scholars. When we examine these studies in some of them are focused on a single country and the rest of the studies are focused on a group of countries.

In this study, macroeconomic variables of the very first users of the euro currency examined. As well-known, euro currency started to be used by eleven European Union members (Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain) at January 1st, 1999 as a "book money" and only used in electronic transfers and accounting purposes. After three years usage as "book

money" it started to be used as cash by January 1st, 2002. The fact that the euro is steered by a European Central Bank is an another reason why I consider the countries using the euro in this study. The methodology of the study rely on the Pedroni, Kao and Johanser-Fisher panel cointegration and Dumitrescu-Hurlin panel causality tests as most of the scholars use especially for the similar studies.

As an output there are two empirical findings in this study. The first one is there is a long run cointegration among defense spending and economic growth in the countries covered in this study. This result matches with the results of Ageli and Zaidan (2013), Dash et al., (2016), Gokmenoglu et al.,(2015), Turan et al.,(2018).

The second empirical finding of this study is, there is not any causal relationship among economic growth and defense spending. This result supports the neutrality hypothesis in the literature. Furthermore, partly and completely matches with the results of Abdel-Khalek et al., (2019), Kollias (1997), Kollias, C. and Makrydakis, S. (2000), Liu et al., (2008), Pan et al., (2015), Paparas et al., (2016), Topcu and Aras (2015), Waszkiewicz (2020). The reason why the result of this study is different from Benoit's study is that Benoit's (1973,1978) studies include developing countries, but it is due to the fact that the euro user countries discussed in this study are developed countries.

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