Defense Expenditures and Income Inequality: Evidence from Chosen Euro Using Countries

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A B S T R A C T

This paper, aims to find the cointegration and the causality between income inequality and defense expenditures in fifteen European Union member countries that used euro currency before, during and after the global economic crises in the period of 2005-2016. Applying cointegration and causality tests to the panel data, the paper aims to fill the gap about income inequality and defense expenditures relation in the literature.

1. Introduction

The linkage between income inequality and defense expenditures gains importance after the study of Abell (1994). After his study, scholars started to examine the relation among income inequality and defense expenditures. In the literature, most of the studies focus on a single country and use time series analysis. A limited number of studies focus on a group of countries and use panel data analysis. The studies of Ali and Galbraith (2003), Töngür and Elveren (2013 and 2017), Lin and Ali (2009), Ali (2012) are the examples of these studies. Besides, in the literature there isn't any study including European Union countries or euro using countries.

For this reason, the aim of this study is to investigate the relation between income inequality and defense expenditures of the fifteen euro using countries (Austria, Belgium, Portugal, Cyprus, Luxembourg, Malta, Netherlands, France, Finland, Germany, Italy, Ireland, Greece, Spain and Slovenia), which had undergone the same monetary policy under the monetary policy of European Central Bank, had experienced a major economic crisis in the last decade and was beginning to overcome the effects of the crisis today.

In the study, first the theoretical perspective of the defense expenditure and income inequality described, then literature about the topic is examined. After the literature survey, the data and methodology used in the model is explained with equations. In section five, empirical findings are calculated with EViews 9SV program and in conclusion section the findings of the calculations are interpreted.

2. Theoretical Perspective

Since there is not any specific model or theory explaining the relationship between the income inequality and defense expenditure, there are three hypotheses can be proffered (Lin and Ali, 2009; Elveren, 2012; Wolde-Rufael, 2016a).

First, from the *inequality-widening* hypotheses view, with the boost of the defense industry, the workers in this industry will be better paid than the less skilled workers of the other industries, so defense expenditures may enlarge the wage gaps between defense and non-defense industry workers. The better paid workers relative to other less-skilled labor force in the non-defense industry, can widen inter-sectorial wage gaps (Ali, 2007; Wolde-Rufael, 2016a).

Second, like Keynesian approach, *inequality-narrowing* hypotheses suggest that higher defense expenditure can create higher aggregate demand and employment in defense related industry if the military production is home grown (Lin and Ali, 2009; Elveren, 2012; Wolde-Rufael, 2016a).

Third, the *neutrality-hypotheses* suggest that the effect of defense expenditures on income distribution may be remissible if military expenditure constitutes a petty part of total state expenditure and if the defense industry labor force constitutes a petty part of the total labor force (Wolde-Rufael, 2016a).

3. Literature Survey

Until the Abell's (1994) study about the linkage between income inequality and defense expenditures, majority of the studies about defense expenditures are linked with macroeconomic variables like unemployment, inflation, and etc. After his study, number of the studies about defense expenditures and income inequality started to raise. This is the main reason for the finite number of the studies in the literature. The literature parallel to our study is shown in Table1.

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Table 1. Literature Survey

Authors	Data	Method	Variables	Result
Ucal, Karabulut and Bilgin	Israel (1960-2007)	Structural VAR model	Defence spending and income inequality (GINI coefficient)	Defense expenditures lead to income inequality.
Ali and Galbraith	Global data (1987-2007)	Panel regression analysis	Arms Imports as % Total Imports, total imports as % of GNP, per capita military expenditure, GDP growth rate, armed forces per thousand people and real GDP per capita.	Increase in country's military expenditure could increase income inequality.
Töngür and Elveren	37 countries (1988-2003)	Dynamic panel data analysis	Size of the armed forces, real GDP per capita, GDP growth, number of terrorist incidents and share of arm imports in total imports.	Positive relation among income inequality and defense spending. Also, terrorist attacks in the countries affect both income inequality and defense spending.
Töngür and Elveren	82 countries (1988-2008)	Dynamic panel data analysis	Human capital index (HCI) based on years of schooling and returns to education, military expenditures as % of GDP, population growth, gross fixed capital formation % of GDP, real GDP per capita, real growth rate of GDP per capita, industrial pay inequality index.	Defense expenditures and income inequality have negative, but HCI has positive impact on economic growth.
Töngür and Elveren	Turkey (1963-2008)	Augmented Solow growth model	Military expenditures, Gross capital formation % of GDP, labor force, GDP per capita, Inequality and human capital.	Income inequality has a positive impact on economic growth but military spending has not any effect on economic growth.
Elveren	Turkey (1963-2007)	Ordinary Least Squares method and Granger casuality test	Income inequality (Theil Index) and defence spending.	Defense expenditures have an effect on income inequality.
Shahbaz, Jahromi and Malik	Iran (1969-2011)	ARDL bound test	Income inequality, economic growth and defense spending	Among variables long run relationship found and economic growth has positive impact on inequality.
Hirnissa, Habibullah and Baharom	Selected Asian countries (1970-2005)	ARDL bound test	Defense spending and income inequality	Malaysia (one-way casuality from defense spending to income inequality), Singapore (bi-directional casuality from each variables). There are no relationship for the remaining countries.
Lin and Ali	58 countries (1987-1999)	Panel Granger casuality test	Military spending and inequality indexes (Theil and EHII)	There is no casuality between variables.
Ali	Middle Eastern and North African (MENA) countries (1987-2005)	Panel regression analysis	Inequality index (Theil), military expenditure as % GDP, real GDP growth rate, armed forces per 1000 people, major economic shock, import of arms as % of total imports, real per capita income, Israeli military expenditure as % GDP and real oil prices	Defense expenditures have a strong & negative effect on inequality index. In chosen countries increase in defense expenditures could decrease the level of inequality.
Taş, Örnek and Aksoğan	Turkey (1970-2008)	Johansen cointegration, Granger casuality test and VAR model	Inequality index (Theil), growth and defense expenditure	From defense spending to income inequality one-way causality. Also, defense spending is quite strong in explaining income inequality.
Aksoğan and Elveren	Turkey (1970-2008)	Johansen cointegration and Granger casuality test	Inequality index (Theil), growth and defense/education/health expenditures	Both in long and short term there is a cointegration among variables. Judging from the relationship among defense spending, health expenditures and education, defense spending and educational spending led to income inequality, but health spending was found to have a beneficial effect on income inequality.
Meng, Lucyshyn and Li	China (1989-2012)	Basic cointegration and Granger causality tests	Defense spending and income inequality (GINI coefficient).	Increase in defense spending increase the income inequality.
Abell	United States (1072-1991)	Regression analysis	Taxes, inflation, income distribution (difference among highest and lowest quintiles of aggregate family income and Gini coefficient), Military spending (growth rate of nominal military spending as a percent of nominal GDP and growth rate of real military spending) and interest rates.	Increase in military expenditures widen the gap between the wealthy and the needy.
Raza and	Pakistan	ARDL bounds	Military spending as % GDP, real per	Military spending has positive relationship with

Authors	Data	Method	Variables	Result
Shahbaz	(1972-2012)	test, Granger and Toda- Yamamoto Modified Wald causality tests	capita income and real GDP.	the income inequality.
Wolde-Rufael	Taiwan (1976-2011)	ARDL bounds test, Granger casuality and Toda-Yamamoto non-causality tests	Real defense spending, Gini coefficient and various percentages of lowest/highest and disposable income shares.	Among variables there is a long run relation and defense expenditures cause income inequality to rise.
Wolde-Rufael	South Korea (1965-2011)	ARDL bounds test, Granger casuality test	Real defense spending, Gini coefficient	Among variables there is a long run relationship. Defense spending has positive and considerable effect on income inequality. Increase in defense spending (1%) increased the Gini coefficient by 0.38%. In addition to this from defense spending to income inequality there is one-way casuality.

4. Data and Methodology

4.1. Data

In the model, there are two variables. The source for Defense expenditure as of % GDP (DE) data is Stockholm International Peace Research Institute (SIPRI). The source for Gini coefficient used as Inequality index (InEq) is Eurostat. Due to the data availability problem for the Gini coefficient from Eurostat the data set is started from 2005.

4.2. Methodology

4.2.1 Panel Unit Root Test

The most important issue related to time series is whether these series are stationary or not. In order to obtain an econometrically meaningful relationship among the variables, the data analyzed must be stationary and not contain the unit root. For this reason, when working with time series, firstly the stationary of the series should be tested. If the variance, mean and covariance of a time series stay fixed over time, then the series is said to be stationary (Aksoğan and Elveren, 2012:269).

Panel data is more complex than time series and most important factor in panel data is heterogeneity. In particular, not every individual in the panel may have the same characteristics, that is, they may be different in terms of not being stationary or stationary (being co-integrated or not co-integrated). Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) tests are the most agreed unit root tests used on panel data and the remaining unit root tests for panel data are based on the expansion of the ADF unit root test (Asteriou and Hall, 2007:366). In the model, Im, Pesaran & Shin (IPS, 2003) and Levin, Lin & Chu (LLC, 2002) unit root tests are employed on data.

4.2.2 Panel Cointegration Test

The most widely used cointegration test for testing the presence of long run cointegration in panel data is recommended by Pedroni (1999 and 2004). In the model the seven heterogeneous cointegration tests for testing the panel data. The test applied as follows like Bangake and Eggoh (2012) and Bildirici's (2004a and 2004b) econometric models.

$$\Delta DE_{it} = \alpha_i + \delta_i t + \beta_i InEq_{it} + \varepsilon_{it} \quad (1)$$

where i=1, ..., N stands for each country in the panel and t=1,…,T stands for time period. In the equation, αi and δi parameters are representing the individual and trend effects for cross sections. ε i,t parameter is representing the residual terms which shows the deviations from the long run relations. The consequent root test is applied on the residuals as follows:

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

In the cointegration test, recommended by Pedroni (1999), it is tested that if $\rho=1$ in the null hypothesis. Among the seven heterogeneous cointegration tests, the first four are specified as within dimension based statistics ($\rho i=\rho<1$ for all i) and based on pooling. These are; Philips-Perron type p-statistics, Philips-Perron type t-statistics and augmented Dickey-Fuller t-statistics. All seven tests are constructed to test the null hypothesis of no cointegration.

4.2.3 Causality Test

Cointegration tests solely answer the question whether is there any long run cointegration among the variables, but do not give the answer about the course of causality. To find the course of the casuality between DE and InEq, the method suggested by Dumitrescu and Hurlin (2012) was employed in testing the presence of the causality. The advantages of this method are; can also be used when the time dimension is smaller or larger than the horizontal section length and can be used in the unbalanced panel data sets (Dumitrescu and Hurlin, 2012). Another characteristic of this test is it can analyze both the presence and absence of a cointegration. Therefore, the Dumitrescu-Hurlin panel causality test was chosen for the causality analysis in the model. The panel Granger causality test (homogenous non-causality (HNC)) given by Dumitrescu and Hurlin (2012) is expressed as follows:

$$y_{it} = \sum_{k=1}^{K} \gamma_i^{(k)} y_{i,t-k} + \sum_{k=1}^{K} \beta_i^{(k)} \chi_{i,t-k} + \varepsilon_{i,t} \quad (3)$$

This model can be used to test if χ causes y where χ and y are two stationary series (in our model DE and InEq)(Anoruo and Elike; 2015:1019). The method to define the presence of

casuality is to test χ (significant past values) and y (present values) like in Granger (1969). Thence the null hypothesis is expressed as follows:

$$H_0 : \beta_i = 0, \quad \forall_i = 1,2,....N \tag{4}$$

this comply with the lack of casuality for all individuals in the model. The test supposes that there may be causality for some individuals, but this is not necessary for entire individuals. Thence the alternative hypothesis is expressed as follows:

$$H_1 : \beta_i = 0, \quad \forall_i = 1,2,....N_1$$
$$\beta_i \neq 0, \quad \forall_i = N_1 + 1,...., N \tag{5}$$

When HNC considered, alternative hypothesis lets some of the individual vectors (βi) to be equals to zero. The Dumitrescu and Hurlin (2012) causality test includes three statistics, these are:

$$(W_{N,T}^{HNC}) = 1/N \qquad \sum_{i=1}^{N} W_{i,T} \tag{6}$$

In average statistics hypothesis (6) $W_{i,T}$ symbolize the Wald statistics values for cross sections (Akbaş et al.: 2013:802). The average statistic given in (6), with asymptotic distribution, is associated with the null HNC hypothesis and expressed as follows:

$$Z_{N,T}^{HNC} = \sqrt{\frac{N}{2K}(W_{N,T}^{HNC} - K)} \qquad T,N \to \infty \; N(0,1) \tag{7}$$

$$W_{i,T} = (T\text{-}2K\text{-}1) \qquad i = 1.....N \tag{8}$$

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

The average statistic given in (6), with semi-asymptotic distribution, is associated with the null HNC hypothesis and expressed as follows:

$$Z_N^{HNC} = \frac{\sqrt{N\left[W_{N,T}^{HNC} - N^{-1}\sum_{i=1}^{N} E(W_{i,T})\right]}}{\sqrt{N^{-1}\sum_{i=1}^{N} Var(W_{i,T})}} \; N \to \infty \; N(0,1) \tag{9}$$

5. Empirical Evidence

In the research, the decomposition of the panel data was employed in three step procedure. In the first step, IPS and LLC unit root tests are employed to the variables to test the unit root. In the second step, Pedroni panel cointegration test was applied to test the cointegration among the variables. In the third step, Dumitrescu-Hurlin panel casuality test was employed to test the casuality between the variables (Bildirici and Bohur, 2015:199).

5.1. Unit Root Test Results

Levin, Lin & Chu (LLC, 2002) and Im, Pesaran & Shin (LPS, 2003) unit root tests are employed to the variables to find if the chosen series is stationary or not. The unit root test results are shown in Table 2. In the result InEq is stationary but DE has a unit root and non-stationary. After taking the first differences of the series, the same root tests are employed again and the variable DE 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	*InEq*	-2.31826	0.0102**	-1.88938	0.0294**		
	DE	1.00445	0.8424	-0.69164	0.2446		
LLC	*InEq*	-5.14024	0.0000***	-5.30671	0.0000***	0.02634	0.5105
	DE	-0.48356	0.3143	-5.88873	0.0000***	-2.59354	0.0047***
		Individual Intercept (1st Diff.)		**Individual Intercept and Trend (1st Diff.)**		**Without Individual Intercept and Trend (1st Diff.)**	
		Stat.	**Prob.**	**Stat.**	**Prob.**	**Stat.**	**Prob.**
IPS	*InEq*	-4.10229	0.0000***	-2.01324	0.0220**		
	DE	-3.54350	0.0002***	-1.48416	0.0689		
LLC	*InEq*	-6.82756	0.0000***	-7.59178	0.0000***	-10.7130	0.0000***
	DE	-5.89559	0.0000***	-5.81174	0.0000***	-8.88018	0.0000***

Note: ** stands for significance at 5% and *** stands for 1% confidence levels.

5.2. Cointegration Test Results

After the panel data become stationary, Pedroni (1999) and Kao (1999) panel cointegration tests are employed to the series on account of find if there is any long run cointegration among variables. The test result is shown in Table 3. In the result; both panel cointegration test statistics deny the null hypothesis (no cointegration). This shows the presence of long run cointegration among Gini coefficient (InEq) and Defense expenditures (DE).

Table 3. Cointegration Test Results

Pedroni Panel Cointegration Test Results				
Individual Intercept				
	Stat.	**Prob.**	**Weighted Stat.**	**Prob.**
Panel v-Statistic	-1.047009	0.8525	-1.442804	0.9255
Panel rho-Statistic	-3.307369	0.0005***	-3.568477	0.0002***
Panel PP-Statistic	-10.30487	0.0000***	-10.57006	0.0000***
Panel ADF-Statistic	-5.182270	0.0000***	-5.621006	0.0000***
Group rho-Statistic	-1.995633	0.0230**		
Group PP-Statistic	-15.43767	0.0000***		
Group ADF-Statistic	-5.609884	0.0000***		
Individual Intercept and Individual Trend				
Panel v-Statistic	-3.837030	0.9999	-4.123042	1.0000
Panel rho-Statistic	-0.046383	0.4815	-0.195090	0.4227
Panel PP-Statistic	-12.86497	0.0000***	-15.90511	0.0000***
Panel ADF-Statistic	-5.320201	0.0000***	-6.650006	0.0000***
Group rho-Statistic	0.874191	0.8090		
Group PP-Statistic	-20.16374	0.0000***		
Group ADF-Statistic	-5.940422	0.0000***		
Without Intercept or Trend				
Panel v-Statistic	1.392734	0.0819	0.706958	0.2398
Panel rho-Statistic	-6.049798	0.0000	-6.476137	0.0000***
Panel PP-Statistic	-9.510040	0.0000***	-10.14760	0.0000***
Panel ADF-Statistic	-5.705458	0.0000***	-5.959841	0.0000***
Group rho-Statistic	-3.935483	0.0000***		
Group PP-Statistic	-16.65418	0.0000***		
Group ADF-Statistic	-6.917817	0.0000***		

Kao Panel Cointegration Test Results		
	t-stat	**Prob.**
ADF	-2.383519	0.0086***
Residual variance	0.000231	
HAC variance	7.96E-05	

Note: ** stands for significance at 5% and *** stands for 1% confidence levels.

5.3. Causality Test Results

On account of to test the causality among variables causality test, panel causality test suggested by Dumitrescu and Hurlin (2012), employed on the variables. The result of the test is shown in Table 4. In the result, no causal relationship was found from InEq to DE and from DE to InEq in 2005-2016 period.

Table 4. Causality Test Results

	W-Stat.	**Zbar-Stat.**	**Prob.**
InEq does not homogeneously cause DE	4.75954	0.66284	0.5074
DE does not homogeneously cause InEq	1.37222	-0.91144	0.3621

6. Conclusion

The objective of this research is, to peruse the relation among income inequality and defense expenditures in euro using countries before, during and after the global economic crisis. In the literature, majority of the studies about defense expenditures focus on the relations with economic growth. Several of them focus on the relation between income inequality and defense expenditures, among these studies none of them is focusing on the euro currency users during the global economic crisis. Considering this lack, this study will fill a gap on the literature about relationship among income inequality and defense expenditures.

There are two major findings of this research. First, during the 2005-2016 period among the euro using countries there is a long run cointegration among income inequality and defense expenditures. This result corresponds with the most of the studies in the literature (Wolde-Rufael (2016a-2016b), Meng, Lucyshyn and Li (2013), Shahbaz, Jahromi and Malik (2012), Töngür and Elveren (2013), Elveren (2012), Raza and Shahbaz (2014), Taş, Örnek and Aksoğan (2013), Aksoğan and Elveren (2012).

Second, in the euro using countries during the chosen time period there is not any causal relationship found among income inequality and defense expenditures. This result is contrary with most of the researches in the literature, but corresponds with the result of Lin and Ali's (2009) study which focused on 58 countries for the period of 1987-1999. The reason of this result can be linked with the economic crisis, because during economic crisis defence expenditures (also public expenditures) decrease and unemployment increase. As to future research, panel data analysis including

the crisis dummy variable can be studied in order to examine the crises effect on defense expenditures and public expenditures.

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