

The Relationship between the Public Debt and Economic Growth: An Analysis of PIIGS Countries

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Abstract

The financial crisis that was started in the last months of 2008, spread out to all world countries in short-term and had broken out as public debt in the European Union and Euro area. Most affected countries from this financial crisis had been Portugal, Ireland, Italy, Greece, and Spain were named as PIIGS countries of Europe. The effect of public debt on economic growth had been analyzed for PIIGS countries in this study. First, cross-sectional dependency and homogeneity tests had been performed for variables. The existence of cointegration between series had been analyzed by cointegration test with a multi-structural break is developed by Westerlund (2009). While cross-sectional dependency has been determined for general of the panel at the result of the analysis made, it has been seen that series are not stationary in the level and they become stationary when their first differences are taken. In addition, it had been found that there is cointegration between series at the result of cointegration that considers structural breaks.

Keywords: Economic Growth, Panel Data Analysis, Public Debt.

JEL Classification: E6, E60, F4.

1. Introduction

Economic crisis started in United States at first in 2008 and spread out to all world countries had become major issue of capitalist economic system and integrated economies. Financial crisis that turns to liquidity crisis in interbank markets and financial markets had become as debt crisis in continental Europe. *Europe Debt Crisis* had showed up as synthesis of macroeconomic and financial distress of countries

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with effects of global crisis. Crisis that was experienced differently in every country had affected some countries deeply. Most affected five countries are Greece, Ireland, Spain, Portugal and Italy. First country that debt crisis broke out firstly had been Greece. While first Greece than Ireland, Portugal and Spain have been EU member countries that crisis deepen, Italy had followed to these countries and expectations had been comprised about that first Belgium and England then other EU countries also will go through a crisis in international markets. Gradually deepening debt crisis in Greece in 2010 had created many big problems not in this country only in also Euro Area (Akçay, 2012:16).

In Ireland, crisis had occurred when government debt stock and raises in budget deficit are also added to housing industry and banking shortages. Government and private sector debts, current deficit and budget deficit increasing had put the country into trouble in Portugal that competitive capacity decreased. Problems in housing and banking sector, increasing of government debt stock and private sector and raises in unemployment rates had caused to crisis in Spain. Government and private sector debts, raises in budget deficit and recession had dragged the country into crisis in Italy. Economic growth rate and public debt rates belonging to countries that was most affected from global economic crisis had been shown in following figures. As seen from both figures, while economic growths of related countries were showing negative tendency in era of 2007-2013 that crisis was more intense, lot in GDP of public debt has gradually increased between these years in same countries.

In figure1, economic growth rates have been given for Greece, Spain, Ireland, Italy and Portugal that were named as PIIGS countries since 2005. In the figure, although growth rates were positive until 2008 that global financial crisis came up, it has been seen that this rate turned to zero and even negative in some countries in global crisis year. It has been seen that the effect of crisis continued to 2013 and growth rates increased to positive in other countries except Greece since this date. This situation has shown how especially PIIGS countries from European Union countries were affected by crisis.

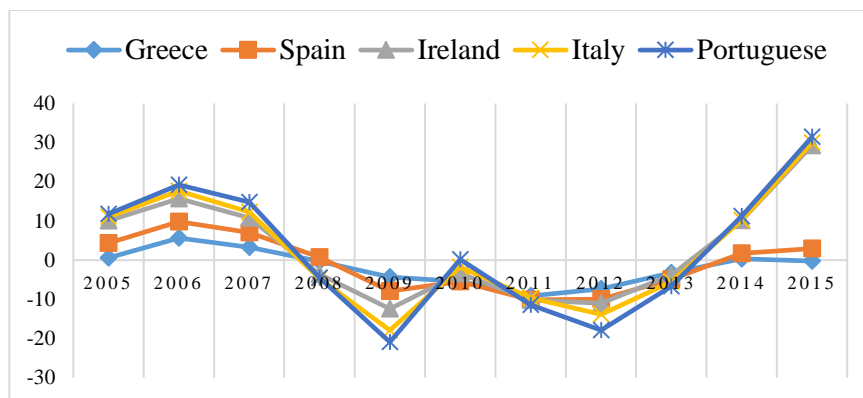


Figure 1: PIIGS Countries Economic Growth Rates (%)
Source: World Bank (WDI)

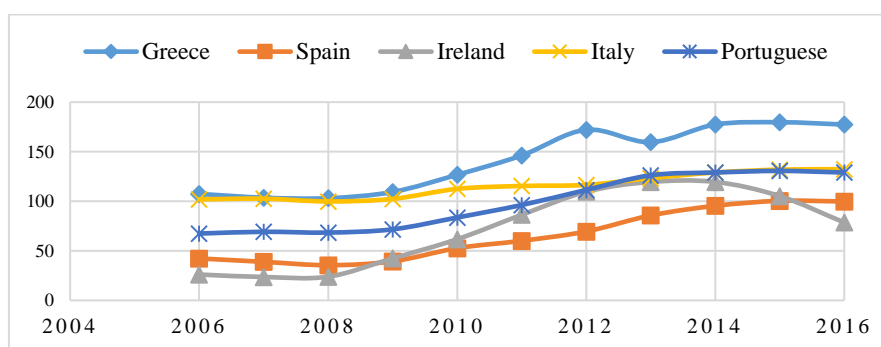


Figure 2: PIIGS Countries Public Debt (GDP %)
Source: Eurostat (Europe Statistics Office)

Figure 2 has shown the lot of public debt in GDP in PIIGS countries. As seen from figure, showing regular increase of public debts with global financial crisis has drawn the attention. It has confronted that lot of public debt in GDP had been above this level after crisis in Ireland and Spain that it was under 50% especially before global crisis in fact Ireland had exceeded 100% after 2011 as a quite situation.

Although every country has different financial and economic problems, common problem of countries is public debt. Therefore, effects of public debt on economic growth had been examined for PIIGS countries in the study.

2. Literature Research

When it was looked at studies that relation between loan and

economic growth was examined, studies that discuss relation between mostly public debt and economic growth has drawn the attention. In literature, negative relation between public debt and economic growth had been found besides it has been come upon to studies finding positive relations.

Cordella (2005) had analyzed relation between public debt and economic growth in study that he made for 79 developing countries between 1970 and 2002. In addition, negative relation between economic growth and public debt had been determined.

Reinhart and Rogoff had examined relation between public debt and growth and inflation for twenty developed countries between 1946 and 2009. In the result of analyzed conducted, it had been found that rate of public debt and GDP on above 90% decreased the growth rate.

It has been seen that high public debt decreased the growth in study which relation between public debt and economic growth was examined in 38 developed and developing countries in between years of 1970 and 2007. While analysis result shows that economic growth decreased when public debt showed increasing, on the other hand, decreasing of public debt will increase economic growth (Kumar and Woo, 2010).

Checherita and Rother (2010) had examined the effect of public debt on economic growth for 12 Europe Area countries in period of 40 years since 1970 and they had determined a non-linear relation between public debt and economic growth as same as before studies.

Cecchetti (2011) had analyzed the relation between financial non-sector debt and GDP for 18 OECD countries in the era of 1980 and 2006. According to empirical analysis, it had been determined that there is a non-linear effect of financial non-sector debt on economic growth.

Baum et al. (2012) had researched the relation between public debt and economic growth to investigate the sustainability of debt between years of 1990 and 2010 in 12 Euro Area. In the result of analysis, they had come up to conclusion that public debt affected the economic growth as positively and meaningfully. In addition, it had been seen that this relation turned to negative and meaningful relation when rate of public debt to GDP exceeded 90%.

Presbitero (2012) had researched effect of public debt on economic growth in low and middle-income countries in the era of 1990 and 2007. In the study results, it had been found that when the rate of public debt to GDP exceeded 90%, effect on economic growth is negative.

Mencinger and Aristovnik (2013) had tried to analyze the short-term effects of public debt on economic growth as empirically for old member states of EU in between 1980 and 2010, and new member states in between 1995 and 2010 in the analysis that was made for 25 European Union countries. In the result of study, it has been seen that it turned to a negative relation when rate of public debt to GDP exceeded 80%-90% in old member states and 53-54% in new member states. It had been reached the end of that threshold value in new member states is lower than in old member states.

Zouhaier and Fatma (2014) had analyzed the effect of public debt on economic growth in 19 developing countries in the era of 1990-2011 by the help of dynamic panel data analysis. At the result of empirical analysis, it had been determined that effect of public debt is negative on economic growth.

Matiti (2013) had conducted a regression analysis using data from 2002 to 2003 and 2011-2012 to examine the relationship between public debt and economic growth in Kenya. In the study results, it had been found that domestic debt is characterized by higher interest rates compared with those on external debt, which is contracted mainly on concessional terms, and it is therefore expensive to maintain.

Mousa and Shawawreh (2017) had examined the relation between public and economic growth for Jordan by using annual data in between 2000 and 2015. Analysis results are in direction of those effects of public debt and especially external debts are negative on economic growth.

Gomez and Rivero (2017) had examined the impact of public debt on economic growth for the Euro Area in the period 1961-2013. In practice, annual data were analyzed using the ARDL boundary test approach. The study concluded that public debt in European countries had a negative impact on economic growth in the long-run.

3. Methodology and Empirical Analysis

In the study, annual Gross Domestic Product (annual % change), public debt (GDP %) and gross capital formation (annual % change) data that belong to 5 PIIGS countries which are the member of European Union in the era of 1995 and 2015 had been used. To show economic growth, GDP variable had been used as dependent variable. Public debt variable used in the study had been obtained from Eurostat (European Statistics Office) and GDP and capital variable had been obtained from World Development Indicators (WDI) database of World Bank. For analysis, Gauss 10 program and codes that were written for this program had been used.

Model that will be guessed in the study is as follows:

$$GDP_{it} = \alpha_{it} + \beta_1 publicdebt_{it} + \beta_2 capital_{it} + e_{it} \quad (1)$$

First, cross-sectional dependency and homogeneity tests had been conducted for the variables. Not considering of cross-sectional dependency and homogeneity tests for choosing unit root tests, which are to be conducted, is going to make analysis results as unbiased and consistent. While there is cross-sectional dependency between series, making analysis without consideration of this situation has affected the results significantly (Peseran, 2004).

3.1 Testing Cross-sectional Dependency

Existence of cross-sectional dependency has been checked by Breusch-Pagan (1980) CDLM₁ test when time dimension is bigger than cross-sectional dimension; it has been checked by Peseran (2004) CDLM₂ test when time dimension is equal to cross-sectional dimension; and it has been checked by Peseran (2004) CDLM test when time dimension is smaller than cross-sectional dimension. These tests have been deviated when group average is different than zero. LM test statistic is in the following as initial state:

$$LM = T \sum_{i=1}^{N-1} \sum_{j=i+1}^N (\hat{\rho}_{ij}^2) \sim \frac{\chi_{N(N-1)}^2}{2} \quad (2)$$

Peseran et al. (2008) had corrected this deviation by adding

variance and average to test statistic. For this reason, name has been identified as deviation corrected LM test (LM_{adj}). (LM_{adj}) is as follows:

$$LM_{adj} = \left(\frac{2}{N(N-1)} \right)^{1/2} \sum_{i=1}^{N-1} \sum_{j=i+1}^N \hat{\rho}_{ij}^2 \left(\frac{(T-K-1) \hat{\rho}_{ij} - \hat{\mu}_{Tij}}{v_{Tij}} \right) \sim N(0,1) \quad (3)$$

Null and alternative hypotheses that test the existence of cross-sectional dependency, which takes part in the study, are as follows:

H_0 : There is not cross-sectional dependency.

H_1 : There is cross-sectional dependency.

When probability value obtained at test result is smaller than 0.05, H_0 hypothesis has been rejected at 5% significant level and it has been decided that there is cross-sectional dependency between units composing the panel (Pesaran et al., 2008).

Existence of cross-sectional dependency between variables have been showed in the following Table 1.

Table 1: Cross-sectional Dependency Test Results

CD Test	Test Statistic	Probability Value
CDLM1 (Breusch,Pagan 1980)	97.882	0.000***
CDLM2 (Pesaran 2004 CDLM)	19.651	0.000***
CDLM (Pesaran 2004 CD)	9.779	0.000***
LMadj (Pesaran vd. 2008)	20.399	0.000***

***, **, * have been showed that null hypothesis was rejected in significant level of 1%, 5% and 10%, respectively.

As seen from Table 1, H_0 hypotheses had been highly rejected since probability values are smaller than 0.05. It had been decided that there is cross-sectional dependency in series. In this case, there is cross-sectional dependency in countries composing the panel. A public debt shock that lived in one of the countries has affected other countries. Therefore, public debt or Gross Domestic Product shock that happened in one of these countries had affected the other countries. For this reason, policymakers should consider other countries' politics and shocks that affect public debt or GDP of these countries to determine economic policy in these countries.

3.2 Homogeneity Test

Homogeneity test had been investigated by delta tests of Peseran and Yamagata (2008). Error term has shown normal distribution during $\sqrt{N}/T \rightarrow \infty$ under null hypothesis of slope homogeneity so delta tilde statistic of Peseran and Yamagata has shown standard normal distribution. For small sample, Peseran and Yamagata (2008) had suggested corrected delta tilde statistic. This statistic has also normal distribution specifications. Thereby, null hypothesis, which argues that slope coefficients are homogeneous when probability values of test statistic are smaller than significant level of 0.05, are going to be rejected. Null and alternative hypotheses that enable testing whether slope coefficients are homogeneous or heterogeneous for each country are as follows:

H₀: Slope coefficients are homogeneous.

H₁: Slope coefficients are not homogeneous.

Table 2: Homogeneity Test Results

	Test Statistic	Probability Value
Delta_tilde	-1.068	0.857
delta_tilde_adj	-1.180	0.881

Table 2 has shown homogeneity test results. Null hypothesis that homogeneity was accepted according to delta test results, which were made to determine whether slope coefficients become different among cross sections or not has been accepted. This result makes sense with acceptations due to similarities of countries to each other in terms of economic structure.

3.3 Panel Unit Root Tests

Panel of unit root tests have been highly accepted in statistical sense according to time series of unit root tests that consider information about only time dimension in terms of that data pays attention to information about both time and cross-sectional dimension (Güloğlu and İspir, 2008).

Panel unit root tests that were used mostly in literature are tests of Levin and others (2002), and Im, Peseran and Shin (1997). These tests

are defined as first generation unit root tests in literature and have not considered cross-sectional dependency. Therefore, first generation root tests have assumed that cross-sectional units composing the panel are independent in despite of existence of mutual interaction among economic variables that were commonly mentioned by disregarding this.

However, for situation which cross-sectional units were affected by same type shock, suggesting cross-sectional independency is not going to be a realistic approach. Also, assuming that is going to cause in highly rejection of null hypothesis according to O'Connell (1998).

Unlike first generation panel root tests, second generation panel unit root tests that consider cross-sectional dependency have given information about which one of the series composing the panel is stationary or not one by one.

Since cross-sectional dependency were found among countries composing the panel in the study, unit root test that was developed by Smith et al. (2004) and was one of the second-generation root tests which consider cross-sectional dependency had been used to examine stability of series. This test has taken into consideration of cross-sectional dependency while making unit root testing. While there is cross-sectional dependency between series, making analysis by disregarding this situation has affected the obtained results (Breusch and Pagan, 1980; Pesaran, 2004). While unit root tests are chosen, not considering cross-sectional dependency have made the analysis results unbiased and consistent (Pesaran, 2004).

\bar{t} test which was developed by Smith et al. (2004) and is a version of panel unit root test that belongs to Im et al. (2003) has been calculated as:

$$\bar{t} = N^{-1} \cdot \sum_{i=1}^N t_i$$

Mentioned tests are based on unit root null hypothesis (Özcan and Ari, 2013: 43).

Whether series include unit root had been examined by test developed by Smith et al. (2004) and results had been shown in below. Unit hypotheses are as follows:

$H_0: \beta_i = 0$: Series is not stable.

$H_1: \beta_i < 0$: Series is stable.

When probability value of calculated test was smaller than 0.05, H_0 has been rejected and it is decided to that series are stable.

Table 3: Smith et al. (2004) Bootstrap Panel of Unit Root Test Results

Level	With Constant		With Constant and Trend	
	Test Statistic	Bootstrap Probability Value	Test Statistic	Bootstrap Probability Value
GDP	-1.939	0.224	-2.081	0.567
Public Debt	-2.405	0.228	-2.811	0.071
Capital	-0.870	0.875	-1.955	0.672
First difference				
GDP	-3.081	0.001***	-3.133	0.000***
Public Debt	-2.232	0.049**	-2.221	0.000***
Capital	-3.296	0.000***	-3.542	0.000***

In next level of analysis, Bootstrap panel unit root test that was developed by Smith et al. (2004) considers cross-sectional dependency and provides results for countries composing the panel had been applied. According to results obtained from table, it has been seen that variables are stable at their first difference.

3.4 Cointegration Test with Multi Structural Breaks

This test developed by Basher and Westerlund (2009) had tested existence of cointegration relation between series which are not stable at level in the case of presence of more than one structural breaks in relation of cross-sectional dependency and cointegration. This method has allowed to maximum three structural breaks in constant term and trend of cointegration equation. Developed test statistic is as follows:

$$Z(M) = \frac{1}{N} \sum_{i=1}^N \sum_{j=1}^{M_j+1} \sum_{t=T_{ij-1}+1}^{T_{ij}} \left(\frac{S_{it}^2}{(T_{ij}-T_{ij-1})^2 \widehat{\sigma}_i^2} \right) \quad (4)$$

It is $S_{it} = \sum_{s=T_{ij-1}+1}^t \widehat{W}_{st} \cdot \widehat{W}_{it}$ is inclusion vector that was obtained from an effective estimator as same as alternating least squares (LS) method. $\widehat{\sigma}_i^2$ is also long-term variance estimator based

on \widehat{W}_{it} . When $Z(M)$ is simplified by taking averages of cross-sections, it has become as below:

$$Z(M) = \sum_{t=T_{ij-1}+1}^{T_{ij}} \left(\frac{S_{it}^2}{(T_{ij}-T_{ij-1})^2 \sigma_t^2} \right) \sim N(0,1) \quad (5)$$

This obtained test statistic has shown normal distribution and hypotheses of it are as follows:

H_0 : There is cointegration relation between series.

H_1 : There is not cointegration relation between series.

H_0 has been accepted when probability value of calculated test is smaller than 0.05 and it has been decided to presence of cointegration relation between series.

Table 4: Westerlund Cointegration with Multi Breaks Test Results

	LM Test Statistic	Asymptotic Probability Value	Bootstrap Probability Value	Decision
In Constant	0.461	0.322	0.780	There is cointegration
In Constant and Trend	0.480	0.316	0.650	There is cointegration
Break in constant	0.733	0.232	0.660	There is cointegration
Break in Constant and Trend	853.167	0.000	0.190	There is cointegration

According to second-generation panel of unit root test results in Table 4, long-term relation between public debt, capital and GDP that are stable in first difference had been tested by panel cointegration with multi structural break method developed by Westerlund (2006). Method has initiated results for four different situations as existence and non-existence in both constant and trend in model.

When dates that have structural breaks was examined, it has been seen that breaks showed up in years after generally 2008 global crisis in related countries. It has been seen that structural breaks happened because of constantly increasing of public debt lot in GDP of these countries since experienced crisis until today.

Table 5: Structural Breaks Numbers and Dates of five PIIGS Countries in Cointegration Equation

Countries	Break Number	Break Dates		
Portugal	2	2004	2013	-
Ireland	2	2008	2015	-
Italy	2	2010	2015	-
Greece	1	2013	-	-
Spain	3	2001	2009	2014

4. Summary and Concluding Remarks

Increasing in public deficits is one of the biggest reflections of global financial crisis on economy. There are several reasons of reaching to higher levels of public deficits in crisis period. Multiple constituencies and tax reduction applied by governments in crisis periods had played an important role among these reasons. Important increases had happened in the countries' debt stocks due to that many countries, which try to finance their public expenses, chose the loan method because of decreases happened in tax incomes over against crisis. Therefore, crisis that turned to liquidity crisis in financial markets had become as debt crisis in Europe continent.

Most affected countries from debt crisis in Europe are Greece, Ireland, Spain, Portugal and Italy that were named as PIIGS countries. Private sector debt with failure to thrive had been an important factor that runs the country into crisis as well as public debt in Portugal, which is not the only problem. In Ireland, budget deficits had continued to increase since global crisis because of resource of government to banking sector. The reason of running country into crisis by increasing of Greece loan burden had been making finance of public expenses and growth by borrowing. In addition, Spain had confronted many economic crises in its history but it had experienced the crisis in different aspects than other EU countries. While Europe was dealing with debt crisis, Spain had struggled with both housing crisis and debt crisis. In this case, it has been necessary to take concrete steps for structural reforms in PIIGS countries that were the most affected Europe Union countries from crisis. New criteria should be determined for financial approach as well as for economic and monetary

approaches; effective regulating and monitoring mechanisms should be constituted.

In this study, relation between public debt and economic growth had been examined for five Europe Union countries. Cross-sectional dependency and homogeneity tests had been applied to consider firstly intercountry interaction in the research. Since existence of cross-sectional dependency between countries had been found, panel unit root test and cointegration test that enable to cross-sectional dependency had been used. According to unit root test result, while it has been seen that all variables are stable at their first difference, it had been concluded to that there is relation between variables in long term. Furthermore, it had been seen that structural break dates belonging to cointegration model had showed up at years after 2008 global crisis in all related countries. It has been seen that structural breaks happened because of constantly increasing of public debt lot in GDP of these countries since experienced crisis until today.

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