Causality between Spending and Revenue in Case of Greece through Toda and Yamamoto Methodology

Chaido Dritsaki
Associate Professor
Department of Accounting and Finance
Western Macedonia University of Applied Sciences
Greece

Abstract

This paper examines the relationship between government spending and revenues in Greece for the period 1980-2015. The Augmented Dickey-Fuller (ADF) and Phillips-Perron tests are employed to examine the order of integration of the variables used in the model. For the long run analysis, ARDL bounds testing approach is used as it was formed by the papers of Pesaran et al. (2001). Causality test using the Toda and Yamamoto (1995) Granger non-causality procedure was employed in order to examine Granger causalities between variables. The results of co-integration of ARDL test showed that there is a co-integrated relationship between government spending and revenues. Also, causality test showed that there is a unidirectional causal relationship between spending and revenues in Greece with direction from government revenues towards spending.

Keywords: Government Spending, Government Revenue, ARDL Bounds Testing, Toda-Yamamoto Causality Test.

JEL Classifications: C50, E23, J24.

1.Introduction

The relationship between government spending and revenues is one of the ordinary problems on public economics. One of the main discussions on public economics is the pursuit of the relationship between government revenues and spending. For this issue, important theoretical and empirical research has been conducted so that governments can maping out their economic policies and forecasting their budget's deficit. During the last decades, many papers have examined the relationship between government spending and revenues. From a political perspective, this relationship is important especially for Greece, which suffers from fiscal deficits during last years. Budget deficit in Greece is present throughout the examined period of this study. In other words, budget deficit is one of the key characteristics of Greek economy.

Greek economy had impressive upward trends after the Second World War. The continuous convergence with developed countries stopped in 1973 due to the first Oil Crisis. The situation became worse in 1979, when the second Oil Crisis burst. In January 2002, Greece and other eleven countries of Eurozone obtained a common currency, euro. The accession of Greece in Eurozone was accomplished with the successful convergence route of public measures and the realization of four out of five Maastricht criteria on 2000 (inflation, government's deficit, long term borrowing rate, exchange rate mechanism, public debt). Gross domestic product continued to increase above the average of European Union due to investment infrastructure related to the Olympic Games 2004. However, from 2001 until 2005, Greece violated the criteria of Stability Treaty which referred to the deficit under 3%. From the end of 2009 and the beginning 2010, Greek economy faces serious problems not only due to international economic crisis but also to uncontrolled expenses until the 2009 elections. It recorded the second largest annual budget deficit and the second largest public debt in European Union. Public debt of 2009 reached 15,4% of GDP and the increasing debt levels reached 127,1% of GDP. All these led to a high borrowing cost thus a serious economic crisis. There was an alarm for excessive public debt on 2010.In Commission it was argued that the unpleasant situation of some member countries was the result of the Keynesian borrowing policies that some policy makers together with Central Bankers of European Union have followed. Many economists proposed the imposition of a number of structural policies in order to control public debt such as the imposition of restrictive measures and higher taxes.

Other officers claimed that the emergency measures should bring cruel punishments to those countries that receive help from Community. Furthermore, there was a savage criticism against speculators for market manipulation: Chancellor Angela Merkel stated that “organizations that were supported by public capitals, exploit fiscal crisis in Greece and anywhere else”. On May 2010 a Memorandum signed among International Monetary Fund, European Union and European Central Bank covering the borrowing needs of the country.

When there exists budget deficit in a country, then the revenues are lower than spending. Reversely, when government spending is less than revenues, there is budget surplus. When governments need to reduce unemployment they use the policy of budget deficit. On the other hand, when the deficit exists for a long time period, then an important problem arises in society and the government should find a solution. One solution is either to reduce government spending or increase revenues. Certainly, the funds of government revenues should be stable having the lowest variations. In order to achieve the aforementioned aim, each government should be familiar with government spending and revenues. It has been observed that in some cases, revenue increase or expenditures reduction influences its corresponding variable and makes the adopted policy ineffective. Thus, a government should know how the dependent variables affect government spending before deciding for the spending reduction or revenues increase. So, it is necessary the government to find a relationship between government spending and revenues to reduce deficit. The aim of this paper is to examine this relationship for Greece for the period 1980-2015, which is in an unfavourable situation in relation to other countries of EU during last years. The rest of this paper is organized as follows: Section 2 is a brief overview of the theoretical literature. Section 3 gives an empirical literature review. Section 4 describes data and methodology. Section 5 presents the empirical the results. Finally, Section 6 provides the concluding remarks.

2. *Theoretical Literature Review*

There are four aspects about the relationship of government spending and revenues. The first one refers that government spending must be expanded according to revenues. Thus, spending should follow revenues. This means that if revenues (taxes) increase, in that case government can increase spending. So revenues are remedy for minimizing public deficits. This view is supported by Friedman (1972, 1978) and Blackley (1986) who show that there is positive causal relationship between revenues and spending. Specifically, Friedman claims that tax increase will lead to more spending and also he says: “A government could not reduce deficit by increasing taxes because this increase will cause more spending thus leaving the deficit in a high level”. Friedman suggests the tax reduction as a solution for budget’s deficit, given that taxes have a positive causal relationship with government spending. According to Friedman, a reduction on taxes will result on higher deficits which will influence the government to decrease government spending.

Contrary to Friedman, Buchanan and Wagner (1977,1978) claim that tax increases result on government spending reductions. According to Buchanan and Wagner, the reduction of government spending restricts government to finance the budget deficit. So, they argue that while tax changes drive to spending changes, the relationship between these two variables is a negative one. The second view is supported by Peacock and Wiseman (1961) claiming that increases on government spending generates increases on revenues. According to this view, the level of spending is first determined by the government and the revenues tax policy is defined which will accommodate the desired level of spending. Another view on this issue is that of Roberts (1978) as far as the deep recessions are concerned. He claims that the increases on spending and taxes are necessary. Another version on this view can be found on the works of Barro (1974, 1979, 1986). On his papers, Barro refers to the tax smoothing hypothesis, where government spending is considered as an exogenous variable to which taxes adjust. Moreover, the intertemporal budgets show that an increase in current expenditures is matched by higher future taxes. The third view is that government can change spending and revenues (taxes) at the same time. This view is supported by Musgrave (1966) and is referred as fiscal synchronization hypothesis which entails that there is a bilateral causality between spending and revenues. Furthermore, Barro (1979) suggested a tax smoothing model for the hypothesis of tax synchronization. This model is based on the Ricardian equivalence and supports that deficit financed by government’s expenditure today results in future tax increase. Finally, the fourth view is supported by Baghestani and McNown (1994) refers that government spending and revenues is determined by long run economic growth so a causal relationship of revenues and spending is not expected.

3. Empirical Literature Review

Even if during the last decades many papers have been published in various countries, the direction of causal relationship between government spending and revenues has not yet been found. Many papers refer on the four aspects mentioned in the previous section. The use of different econometric methods and different periods ended up on different contradictory results. The results also differ as far as the direction of causality is concerned having an effect on the economic policymaking of each government both in long and short run level. For developing countries there have been many studies which examined the relationship between government spending and revenues. Shah and Baffes (1994) on their paper for three Latin American countries (Argentina, Mexico and Brazil) found a bidirectional causal relationship between government spending and revenues for Argentina and Mexico whereas for Brazil this relationship was unidirectional with direction from revenues to spending. Owoye (1995) investigated the causal relationship between revenues and spending for G7 countries. He found a bidirectional causality for five out of seven countries and for Japan and Italy he found a unidirectional causal relationship with direction from revenues to spending.

Hasan and Lincoln (1997) using quarterly data for United Kingdom from 1961-1993 and Johansen cointegration technique found causal relationship between government spending and tax revenues. Park (1998) examined causal relationship between government revenues and spending for Korea for the period 1964-1992. The results showed a unidirectional causal relationship from revenues to spending. Abdul et al. (2000) examined the causal relationship between government spending and tax revenues for Malaysia for the period 1960-1997 using the Toda-Yamamoto technique. The results of their paper showed bidirectional causal relationship between the examined variables. Kollias and Makrydakis (2000) examined the relationship between taxes and government spending for four countries of EU. The results of their paper showed that the long run relationship between the variables is valid only for Greece and Ireland but not for Spain and Portugal. Furthermore, causality results showed that there is a bidirectional causal relationship for Greece and Ireland, whereas for the other two countries this causal relationship does not exist.

Chang et al (2002) on their paper examined the relationship between revenues and taxes for ten industrial countries including three Asian countries like Taiwan, Korea and Thailand. On their paper except for government spending and taxation they include GDP as a control variable. The Johansen cointegration test showed a cointegrating vector for seven out of ten industrial countries (UK, USA, South Korea, Japan, Taiwan, South Africa and Australia). Causality testing showed a unidirectional causal relationship from government revenues to spending for UK, USA, South Korea, Japan, Taiwan and one way causal relationship from government spending to revenues for South Africa and Australia. Finally, for New Zealand and Thailand there was no causal relationship.

Al-Qudair (2005) examined the long run relationship between public spending and revenues for the Kingdom of Saudi Arabia using Johansen cointegration technique and error correction model for causality testing. Cointegration results showed the existence of long run relationship between public spending and revenues. Causality testing demonstrates the existence of bidirectional causal relationship between government spending and revenues in long and short run basis.

Narayan and Narayan (2006) on their paper they used the Toda and Yamamoto technique for the countries of Mauritius, South Africa, Peru, Guyana, Haiti, Chile, Uruguay, Venezuela, Ecuador, El Salvador, Guatemala and Paraguay in order to examined the causal relationship between government spending and revenues. The results showed that there is a unidirectional causal relationship from revenues to government spending for Mauritius, Chile and El Salvador while for Haiti there is evidence for supporting the fiscal synchronization hypothesis. Finally, for South Africa, Peru, Guyana, Uruguay, Guatemala and Ecuador there is no causality between the examined variables. Emelogu and Uche (2010) studied the relationship between government spending and revenues in Nigeria using data from 1970 till 2007. Using cointegration techniques such as Engel-Granger two-step method and Johansen procedure, they found a long run relationship among variables. Afterwards, causality test using error correction model showed a unidirectional causal relationship with direction from revenues to spending. The empirical paper of Ali and Shah (2012) in the case of Pakistan for the period 1976-2009 showed that there is no causal relationship between revenues and spending both in long and short run level. Apergis et al. (2012) examine budgetary disequilibria for Greece using annual data from 1957-2009 and TAR and MTAR models.

The results of their paper showed a unilateral causal relationship between revenues and expenditure with direction from revenues to expenditure while long run results showed asymmetric responses both in revenues and expenditure.

Saysombath and Kyophilavong (2013) investigated the relationship between spending and revenues for Lao People's Democratic Republic during the period 1980 until 2010. Applying ARDL cointegration procedure in combination with Granger causality they found a long run causal relationship between spending and revenues with direction from spending to revenues.

Kollias et al. (2014) in their paper examine the relationship between government revenues and expenditure in United Kingdom between two political parties. Using quarterly data from 1961-2011 and asymmetric error correction models, they conclude that there are differences in the speed at which fiscal imbalances are corrected from Labor party and Conservative party. Labors operate under a soft budget while Conservatives support a hard one. Finally, Nwosu and Oka for (2014) examined the relationship between revenues and spending and divide each one in two groups. Revenues are divided in revenues on oil and non-oil, whereas spending is divided in current and capital. This paper employs data for the period 1970-2011 and Johansen cointegration technique and error correction mechanism. The results of this paper showed that total spending (current and capital) have a long run and a unidirectional causality relationship with total revenues (oil and non-oil) with direction from total spending to total revenues.

4. Methodology

The link between government spending and revenue is specified as follows:

$$GS_t = \alpha_0 + \alpha_1 GR_t + e_t \qquad (1)$$

and

$$GR_t = \beta_0 + \beta_1 GS_t + \varepsilon_t \qquad (2)$$

where the GS_t is of the overall government spending to GDP ratio, and the GR_t is of the overall government revenue to GDP ratio. The e_t and ε_t are error terms. We expect that α_1 and $\beta_1 > 0$.

Logarithmic transformation of the above equations would leave the basic equations as follows:

$$LGS_t = \gamma_0 + \gamma_1 LGR_t + u_t \qquad (3)$$

and

$$LGR_t = \delta_0 + \delta_1 LGS_t + v_t \qquad (4)$$

L=Natural Logarithms.

4.1 Order of Integration

On this section we test the order of integration of time series. For this test, we use augmented Dickey-Fuller (ADF) test (1979,1981) and Phillips-Perron (PP) (1988). The results on the test give the opportunity to determine the most suitable test of series cointegration or in other words, the long run relationship between them.

4.2 CointegrationTests

On this paper, we adopt the Autoregressive Distributed Lag test (ARDL) as it was formed by the papers of Pesaran and Shin (1999) and Pesaran, Shin and Smith (2001). This test in relation to other cointegration test has some advantages such as:

- It can be used also in series that are not integrated same order.
- It has more power when the sample size is small.
- It allows the series to have different lags.
- It determines a dynamic model of unrestricted error within a linear transformation.

The equations for the ARDL approach are the following:

$$\Delta LGS_t = b_0 + \sum_{i=1}^{p} b_{1i} \Delta LGS_{t-i} + \sum_{j=0}^{q} b_{2j} \Delta LGR_{t-j} + \varphi_1 LGS_{t-1} + \varphi_2 LGR_{t-1} + \mu_t \qquad (5)$$

$$\Delta LGR_t = h_0 + \sum_{i=1}^{p} h_{1i}\Delta LGR_{t-i} + \sum_{j=0}^{q} h_{2j}\Delta LGS_{t-j} + \pi_1 LGR_{t-1} + \pi_2 LGS_{t-1} + v_t \quad (6)$$

Where p and q is the lag order of variables ΔLGS_{t-i} and ΔLGR_{t-j} respectively.

We continue with the Bounds test on equations (5) and (6). This test uses F distribution and the null hypothesis of no cointegration of series is the following:

$H_0 : \varphi_1 = \varphi_2 = 0$ and $H_0 : \pi_1 = \pi_2 = 0$ (No cointegration of series)

against the alternative hypothesis of series cointegration

$H_1 : \varphi_1 \neq \varphi_2 \neq 0$ and $H_1 : \pi_1 \neq \pi_2 \neq 0$ (series cointegration)

If the bounds test will lead to series cointegration we can continue with the estimation of the long run relationship of series from equations (7) and (8), as well as the restricted error correction model from equation (9) and (10).

$$LGS_t = \mu + \alpha_1 LGS_{t-1} + ... + \alpha_p LGS_{t-p} + \gamma_0 LGR_t + \gamma_1 LGR_{t-1} + ... + \gamma_q LGR_{t-q} + u_t \quad (7)$$

$$LGR_t = \omega + \delta_1 LGR_{t-1} + ... + \delta_p LGR_{t-p} + \beta_0 LGS_t + \beta_1 LGS_{t-1} + ... + \beta_q LGS_{t-q} + v_t \quad (8)$$

$$\Delta LGS_t = c_0 + \sum_{i=1}^{p} c_i \Delta LGS_{t-i} + \sum_{j=0}^{q} d_j \Delta LGR_{t-j} + \vartheta_1 z_{t-1} + \mu_{1t} \quad (9)$$

$$\Delta LGR_t = g_0 + \sum_{i=1}^{p} f_i \Delta LGR_{t-i} + \sum_{j=0}^{q} k_j \Delta LGS_{t-j} + \vartheta_2 \lambda_{t-1} + v_{1t} \quad (10)$$

Where p and q is the lag order of variables ΔLGS_{t-i} and ΔLGR_{t-j} of equation (9) and ΔLGR_{t-i} and ΔLGS_{t-j} of equation (10) respectively. The terms z_t and λ_t are the errors terms which are created by the cointegrating regressions of equations (7) and (8).

4.3 Testing Stability in ECM

The existence of dynamic restricted error correction model which comes from equations 9 and 10 does not necessarily imply that the estimated coefficients are stable. For this reason, Pesaran et al. (1995, 2001) suggested the estimated coefficient stability test on the estimated models using the Brown et al. tests (1975) known as cumulative sum of residuals (CUSUM) and cumulative sum of squares residuals (CUSUMSQ) stability tests.

4.4 Causality Analysis

On this section we examine the causal relationship between government spending and revenues using a seemingly unrelated regression model. Toda and Yamamoto (1995) in order to investigate causality, they developed a method based on the estimation of an adjusted VAR model ($k+d_{max}$), where k is the optimal time lag on the first VAR model and $d_{max}$is the largest integration order on the variables of the VAR model. On this paper, we adopt the Toda and Yamamoto causality test (1995) contrary to the traditional Granger test (1969) for the following reasons:

- Granger test can provide spurious regressions to the functions with time lags of integrated variables.
- F-test can be used only when the variables are cointegrated.
- Error correction model developed by Engle and Granger (1987) and VAR correction model developed by Johansen and Juselius (1990) as alternative causality tests are cumbersome and sensitive to the values of the parameters in finite samples and therefore their results are unreliable (see Toda and Yamamoto 1995, and Zapata and Rambaldi 1997).
- The augmented causal approach introduced by Toda Yamamoto (1995) applies the asymptotic Chi-square distribution. The most important advantage on this procedure is that it is not essential to pre-test the integration or co integration order between the variables (see Toda Yamamoto, 1995 and Dolado & Lütkepohl, 1996).
- Toda and Phillips (1993) on their paper claim that Granger causality with error correction test can lead to mistaken conclusions from the dependence of some asymptotic parameters in some cases.
- Finally, according to Rambaldi and Doran (1996), Toda and Yamamoto test for non-Granger causality is done with the modified Wald test (MWald) and on Seemingly Unrelated Regression models (SUR models).

VAR model of Toda and Yamamoto causality is formed as follows:

$$LGS_t = \mu_0 + \left(\sum_{i=1}^{k} \alpha_{1t} LGS_{t-i} + \sum_{i=k+1}^{d_{\max}} \alpha_{2t} LGS_{t-i} \right) + \left(\sum_{i=1}^{k} \beta_{1t} LGR_{t-i} + \sum_{i=k+1}^{d_{\max}} \beta_{2t} LGR_{t-i} \right) + \varepsilon_{1t} \quad (11)$$

$$LGR_t = \varphi_0 + \left(\sum_{i=1}^{k} \gamma_{1t} LGR_{t-i} + \sum_{i=k+1}^{d_{\max}} \gamma_{2t} LGR_{t-i} \right) + \left(\sum_{i=1}^{k} \delta_{1t} LGS_{t-i} + \sum_{i=k+1}^{d_{\max}} \delta_{2t} LGS_{t-i} \right) + \varepsilon_{2t} \quad (12)$$

Where the optimal time lag of the first VAR model and d max is the largest integration order on the variables of the VAR model. The null hypothesis of no causality is defined for every equation on VAR model. For example LGR_t variable cause LGS_t variable ($LGR_t \Rightarrow LGS_t$) when $\beta_{1t} \neq 0, \forall i$.

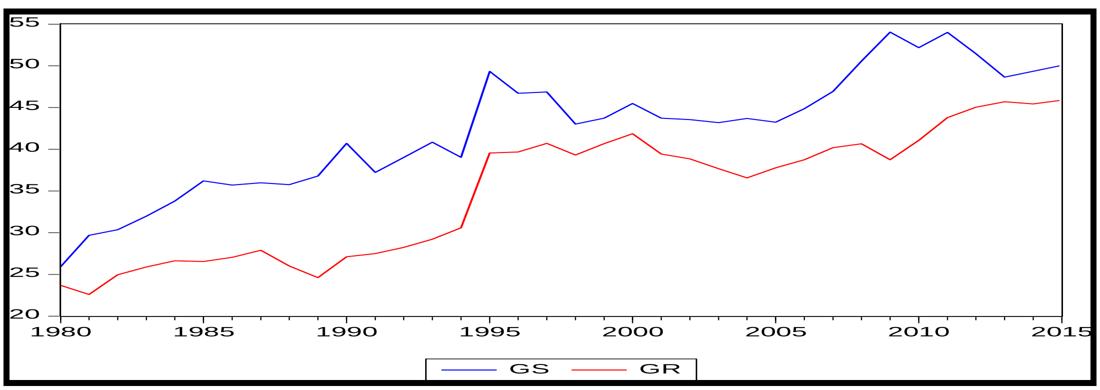
Toda and Yamamoto test for no Granger causality can be done for every integration order of variables, either they are cointegrated or not, given that the reverse roots of autoregressive polynomial should be inside of the unit circle. Thus, the Toda and Yamamoto causality test will be valid.

5. Empirical Results

5.1 Data

On diagram 1the overall government spending to GDP ratio and government revenue to GDP ratio for Greece is presented for the period 1980-2015.On this diagram we have to point out that government spending all through the examined period is larger than revenues.

Diagram 1: The Government Spending and Government Revenues as Percent of GDP between 1980 and 2015.



The study uses annual time series data and covers the period 1980 to 2015. The data were obtained from the International Financial Statistics (IFS).All data are in real terms. The logarithm of the overall government expenditures to GDP ratio and the logarithm of overall government revenues to GDP ratio are used in the empirical analysis. This data transformation is occurred in order to reduce the heteroscedasticity problem (see Gujarati 2004).

5.2 Order of Integration

Table 1.UnitRootTests

Variable	**ADF**		**P-P**	
	C	C,T	C	C,T
LGS	-2.761(0)***	-3.48(0)***	-2.767[0]***	-3.49[0]***
ΔLGS	-7.554(0)*	-7.752(0)*	-7.585[1]*	-7.881[3]*
LGR	-1.047(0)	-1.903(0)	-1.054[1]	-1.996[1]
ΔLGR	-5.608(0)*	-5.589(0)*	-5.613[1]*	-5.593[1]*

Notes:

1. *, ** and *** show significant at 1%, 5% and 10% levels respectively.
2. The numbers within parentheses followed by ADF statistics represent the lag length of the dependent variable used to obtain white noise residuals.
3. The lag lengths for ADF equation were selected using Schwarz Information Criterion (SIC).
4. Mackinnon (1996) critical value for rejection of hypothesis of unit root applied.

5. The numbers within brackets followed by PP statistics represent the bandwidth selected based on Newey West (1994) method using Bartlett Kernel.
6. C=Constant, T=Trend, Δ=First Differences, L=Natural Logarithms.

The results on table 1 show that series exhibit different integration order. The government spending series is null order I(0) in 10% level of significance whereas the government revenues series is integrated first order I(1). Thus, for the long run relationship of the series the most suitable is that of Pesaran et al (2001), the autoregressive distributed lag (ARDL) methodology.

5.3 ARDL Bounds Testing Approach

From equations (5) and (6) of unrestricted error model we can find the maximum values of p and q lags using the Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC), Hannan-Quinn Criterion (HQC), and Likelihood Ratio (LR) criteria. The results of the secretarial are presented on table 2.

Table 2. VAR lag order selection criteria

Lag	LogL	LR	FPE	AIC	SBC	HQC
equation (5)						
0	54.294	NA	0.0024	-3.1803	-2.9490	-3.1049
1	54.254	0.0683*	0.0022*	-3.2421*	-3.0571*	-3.1818*
2	54.305	0.0172	0.0026	-3.1164	-2.8389	-3.0260
3	54.319	0.0219	0.0027	-3.0528	-2.7290	-2.9473
4	54.827	0.0537	0.0028	-3.0211	-2.6510	-2.9005
equation(6)						
0	55.839	NA	0.0022	-3.2799	-3.0486	-3.2045
1	55.426	0.6921*	0.0021*	-3.3178*	-3.1328*	-3.2575*
2	55.855	0.0270	0.0023	-3.2165	-2.9389	-3.1260
3	55.864	0.0128	0.0025	-3.1525	-2.8287	-3.0469
4	56.628	0.1337	0.0025	-3.1373	-2.7672	-3.0166

Notes: *denotes the optimal lag selection

The results on table 2 show that in all criteria, the maximum number of lags for the series on both equations is 1. The order of optimal lag length on equations (5) and (6) is chosen from the minimum value of AIC, SBC and HQC criteria. On table 3 we present there salts of the secretarial.

Table 3.Order of optimal lags ARDL (p,q)

ARDL(p,q)	AIC	SBC	HQC
Equation (5)			
(p=1, q=0)	**-3.189**	**-2.965**	**-3.113**
(p=1. q_1=1)	-2.733	-2.308	-2.656
Equation (6)			
(p=1, q=0)	**-3.199**	**-2.974**	**-3.122**
(p=1. q_1=1)	-2.743	-2.519	-2.667

Notes: *denotes the optimal lag selection, Statistics in bold denote the value of the minimized AIC, SBC and HQC. There Sulston table 3 show that ARDL (p,q) model with p=1 q=0 lags is the best for both equations. Continuing on table 4, we employ the error in dependence test (LM test) until first order (maximum number of lags).

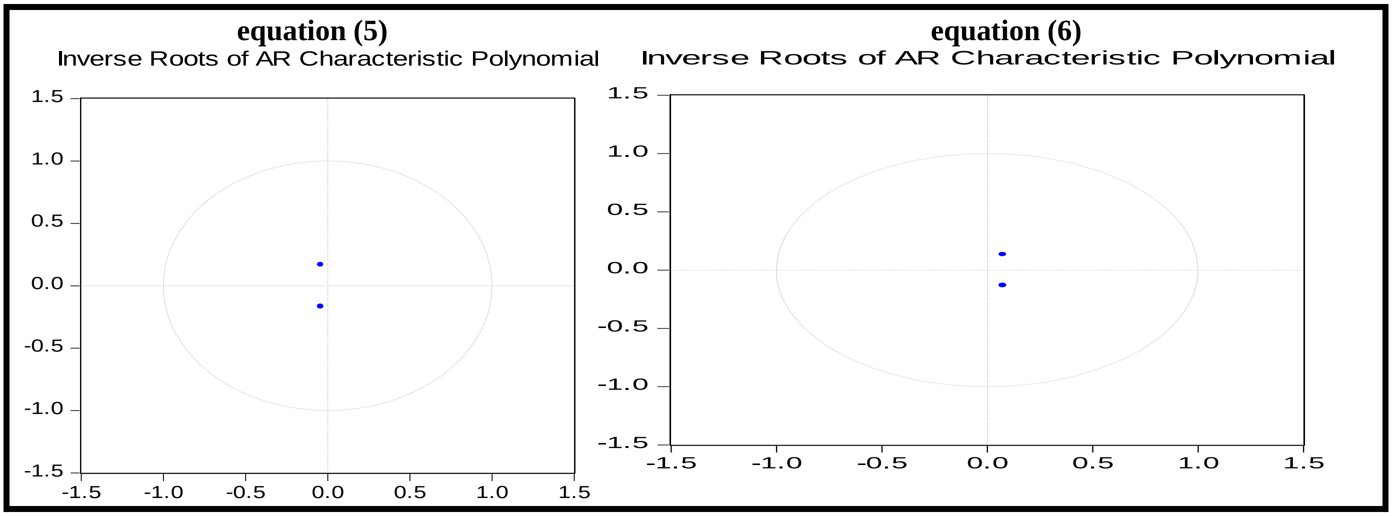
Table 4.Error Independence Test (LM Test)

Equation (5)	
F-stat =1.384	Prob. F(1,28)=0.249
N*R^2=1.602	Prob. X^2(1)=0.2056
Equation (6)	
F-stat =2.453	Prob. F(1,28)=0.142
N*R^2=2.672	Prob. X^2(1)=0.121

Notes: N=observations.

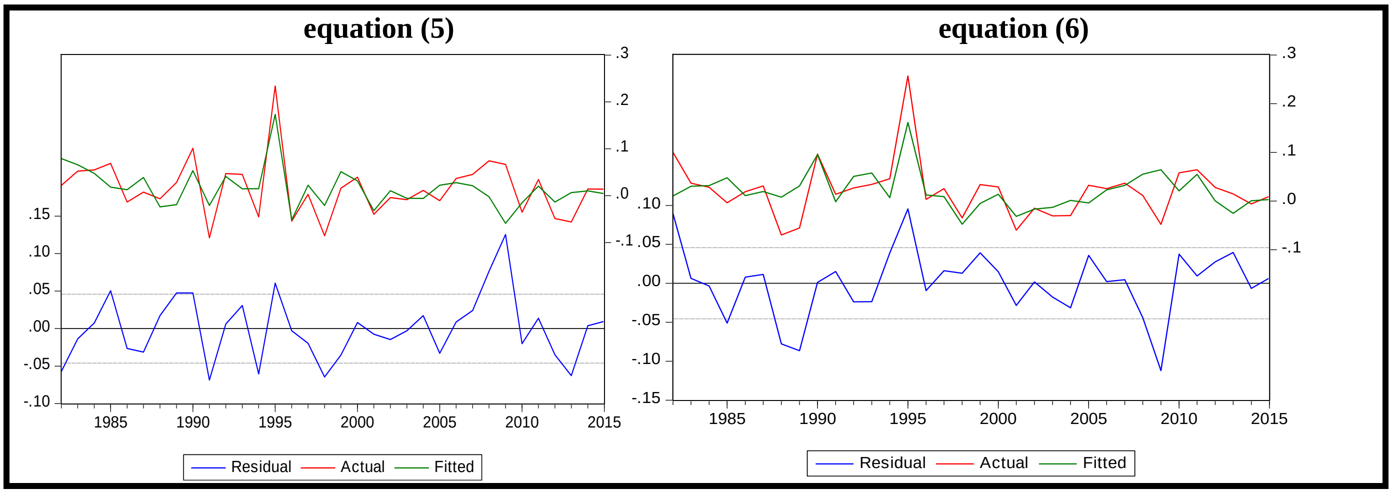
The results on the above table present that errors are not auto correlated. We continue with dynamic stability test of ARDL(1,0) model for both equations. This test is employed with unit cycle. If reverse roots of equations (5) and (6) are inside the unit cycle then the models are dynamically stable.

Diagram 2: Dynamic Stability of Models



The results of diagram 2 show that there is a dynamic stability of models on both equations. It is advisable before continue with bounds test, to present the actual and fitted residuals from both equations ARDL(1,0) autoregressive unrestricted error correction model.

Diagram 3: Actual and Fitted Residuals of Models



We continue by conducting cointegration test of bounds autoregressive distributed lag. In other words, we test if φ_1 and φ_2 as well as π_1 and π_2 coefficients are null on our estimated models.

Table 5.Bounds Test (Wald Test)

Test Statistic	Value	df	Probability
equation (5)			
F-statistic	4.860*	(2,29)	0.086
Chi-square	5.321	(2)	0.069
equation (6)			
F-statistic	2.158	(2,29)	0.137
Chi-square	4.316	(2)	0.1155

Notes: Table CI (iii) page 300 of Pesaran et al. 2001 gives lower and upper bounds for 10%, 5% and 1% level of significance [4.04, 4.78], [4.94, 5.73] and [6.84, 7.84] respectively. *, ** and *** showsignificanceat10%, 5% and 1% levels respectively.

The results on the above tables how that F-statistic value is larger only on equation (5) from the upper bound on Pesaran et al tables (2001) for 10% level of significance and (k+1)=2 variables. Thus, we say that there is a cointegrating relationship between examined series only on equation (5) for 10% level of significance. On the following table the results from the estimation of unrestricted error correction model are presented (equation 5).

Table 6. Estimation of Unrestricted Error correction Model

Dependent variable = ΔLGS_t		
Short run analysis		
Variables	Coefficient	t-statistic
Constant	0.488	2.330
ΔLGS_{t-1}	-0.164	-2.206
ΔLGR_t	0.603	4.102
LGS_{t-1}	-0.237	-1.826
LGR_{t-1}	0.114	2.139
R^2	0.486	
F-stat	3.881	
D-W	1.726	
Diagnostic Test	X^2	Probability
Normalily	2.722 (2)	0.256
Serial Corr.	1.602(1)	0.205
ARCH	0.775(1)	0.378

Notes: ***, ** and * show significant at 1%, 5% and 10% levels respectively. Δ denotes the first difference operator, X^2 Normal is for normality test, X^2 Serial for LM serial correlation test, X^2 ARCH for autoregressive conditional heteroskedasticity, ( ) is the order of diagnostic tests.

The results on table 6 show that both statistic and diagnostic tests are quite satisfying. Before continuing on the next step, we get the long run results from the unrestricted error correction model equation (5).

$$-\left(\frac{LGR}{LGS}\right)=-\left(\frac{0.114}{-0.237}\right)=0.481$$

So, we can stress that an increase of government revenues by 1% will cause an increase on government spending by 0.48% approximately. We proceed to estimate the long and short run relationship of the series on equations (7) and (9).

Table7.Estimation of the Long and Short Run Relationship

Dependent variable = LGS_t		
Long run analysis		
Variables	Coefficient	t-statistic
Constant	1.181***	5.973
LGR_t	0.722***	12.90
R^2	0.830	
F-stat	166.5	
D-W	0.560	
Diagnostic Test	X^2	Probability
Normalily	0.808 (2)	0.667
Serial Corr.	1.987(1)	0.231
ARCH	0.300(1)	0.583
Dependent variable = ΔLGS_t		
Short run analysis		
Variables	Coefficient	t-statistic
Constant	0.020421*	1.839922
ΔLGS_{t-1}	-0.168359*	-1.849982
ΔLGR_{t-1}	0.058175**	2.282945
z_{t-1}	-0.105358***	-2.627097
R^2	0.071897	
F-stat	0.774666	
D-W	1.994039	
Diagnostic Test	X^2	Probability
Normalily	2.534(2)	0.452
Serial Corr.	0.007(1)	0.978
ARCH	0.154(1)	0.694

Notes: ***, ** and * show significant at 1%, 5% and 10% levels respectively. Δ denotes the first difference operator, X^2 Normal is for normality test, X^2 Serial for LM serial correlation test, X^2 ARCH for autoregressive conditional heteroskedasticity and X^2 White for white heteroskedasticity . ( ) is the order of diagnostic tests.

The results of unrestricted error correction model ECM (table 6) differ from those of restricted error correction model ECM (table 7). But coefficients' signs on both models are in accordance with theory, but the significance is more strong on the restricted ECM. Furthermore, the error correction term coefficient is negative and statistically significant in 1% level implying that the speed in adjustment in long run equilibrium is 0.10% approximately. In other words, each disequilibrium caused by government revenues can be reformed by 0.10% in one year. The results on table 7 show that both statistic and diagnostics stare quite satisfying. There stricted dynamic error correction model, derived by ARDL bounds test through a simple linear transformation, incorporates the short run dynamic with long run equilibrium. The negative and statistical significant estimation of coefficients on error correction terms z_{t-1} on equation (9) show a long run relationship between the examined variables. On the following diagrams (3) and (4) we examine the dynamic stability of restricted error correction model with Brown et al. (1975) tests.

Figure 3: Plot of Cumulative Sum of Recursive Residuals

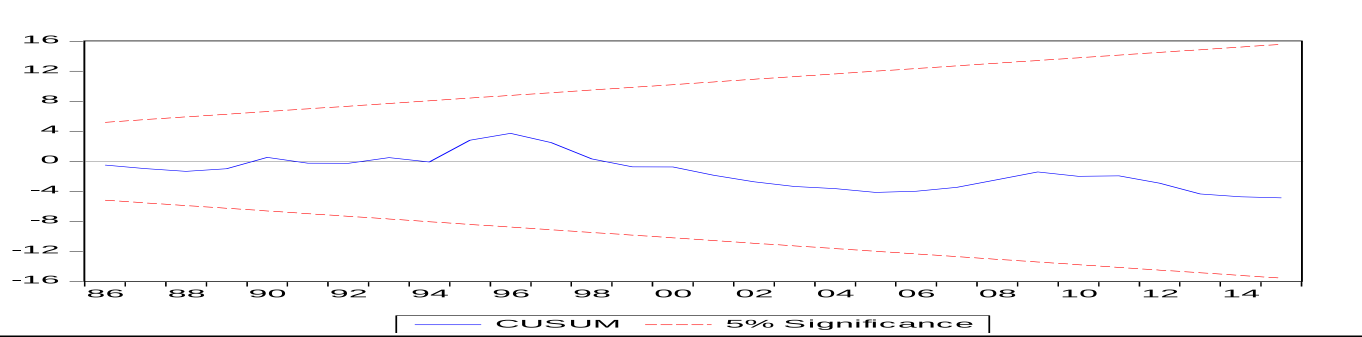
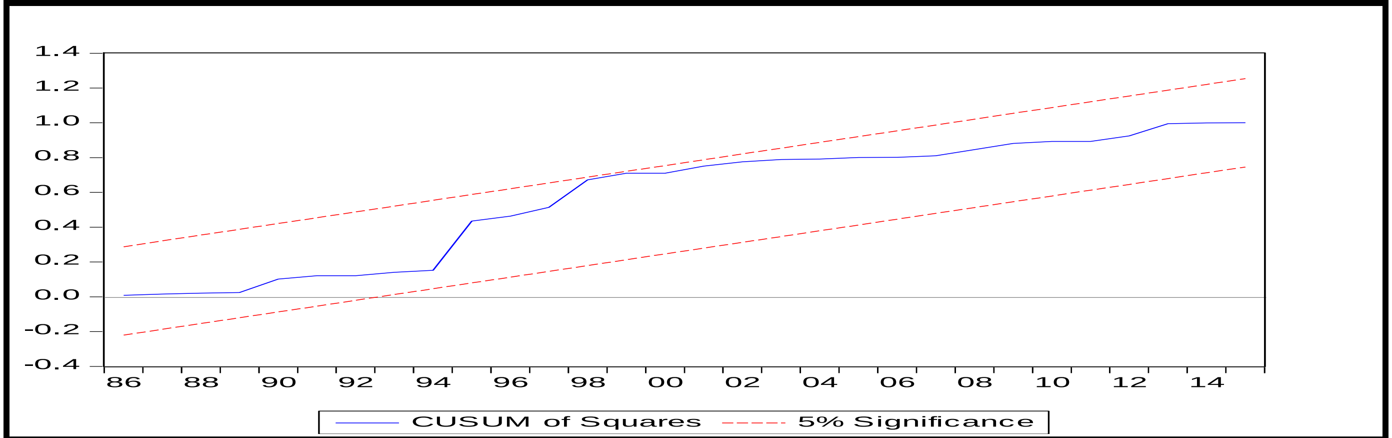


Figure 4: Plot of Cumulative Sum of Squares of Recursive Residuals



From the above diagrams we can see that there is a dynamic stability on model's coefficients that we examine.

5.4 Toda –Yamamoto Causality Test

Table 8 present the results on causality test of Toda and Yamamoto according to equations 11 and 12.

Table 8. Toda and Yamamoto no-causality test.

Excluded	Lag(k)	Lag(k+dmax)	Chi-sq	Prob.	Direction of Causality
Dependent variable: LGS					
LGR	1	1+1	4.175	0.077	LGS=>LGR*
Dependent variable: LGR					
LGS	1	1+1	0.031	0.984	LGR # LGS

Notes: The (k+dmax) denotes VAR order. The lag length selection was based on LR:sequential modified LR test statistic (each test at 5% level), FPE: Final predictionerror, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ:Hannan-Quinn information criterion. ***, ** and * denotes 1% and 5% , 10%significance level, respectively. =>denotes one - way causality, #denotes not causality. EViews 9.0 was used for all computations.

The results on the above test show that there is a unidirectional causal relationship between spending and revenues for Greece with direction from government revenues to spending.

6. Summary and Conclusions

In this paper, an effort was made in order to find the causal relationship between government spending and revenues in Greece. For this analysis, we used annual data for the period 1980-2015.We examined the relationship between government spending and revenues in Greece, using Pesaran et al. (2001) cointegration given that data had different integration order. Afterwards, we test the direction of causality among the examined variables using the Toda and Yamamoto methodology. The results of our paper support the Friedman, Buchanan and Wagner hypothesis that government revenues cause spending. The determination of causal relationship between these two macroeconomic measures is of vital importance in order to ensure and adopt the most suitable tax policy.

The results of this paper also show that there is a long run relationship between government revenues and spending. These results also show that an increase of government revenues by 1%, increase the government expenditure only by 0.48% approximately. Even if GDP enlargement by average was higher from the average of the countries of European Union in 1990, between 2001 and 2008, country's GDP increased on average annual rate 4,3% compared to that of Eurozone which was 3,1%.At the same time, government expenditure increased by 87% while revenues increased only by 31%. This resulted on deficits which were beyond the rules of Stability and Development Pact. The boom of these deficits can be explained from an insufficient public administration, a costly retirement system and a huge tax evasion.

However, Greek economy faced and continues to face serious problems including high unemployment, bureaucracy and corruption. Due to international economic crisis, the enlargement rate of economy had a negative sign for the first time on 2009 after nineteen years. In 2009, deficit was above 13% of GDP. At the same time, the country financed the deficits of international capital markets. The returns of 10-year Greek bonds were 10-40 units above the German ones. During crisis, the Greek bonds were 400 units below the German ones. This had as a result the disloyalty of international investors to Greek economy. In 2009, Greece had the second lowest grading in EU (after Poland) according to the Index of Economic Freedom. Greece suffers from high levels of political and economic corruption and low competitiveness compared to European partners.

Furthermore, the international economic crisis of 2008 led to a dramatic liquidity problem in Greece in such a way that it could not face its debt obligations. The result was the introduction of austerity measures by the government including dramatic reductions on expenditure and increases on tax revenues. Still, these measures didn't soothe investors in international capital markets. As a result, European Union and International Monetary Fund provided help to the Greek government in order to avoid the default of debt and also to avoid the domino effect to the other countries of Eurozone. (Apergis et al. 2012).

Today Greece faces a serious crisis due to its debt. This paper examined the long and short run between revenues and expenditures, their influence on public debt as well as the causal relationship between revenues and expenditures. Causality results show a unidirectional causal relationship with direction from government revenues to expenditures. This outcome is in accordance with the paper of Apergis et al (2012) as far as the causality between the two variables is concerned.

This result also highlights that the increase of expenditures can be accomplished only with the increase of revenues so that the economy can recover. In another case, the deficit will expand resulting in a larger debt. Therefore, to stop this policy government should:

- Reduce the size of large consecutive spending and turns to investments' spending.
- Should reduce function's cost.
- Should differentiate its economic policy and try to find out other revenue sources (apart from taxes) in a way that will repair the difference between revenues and spending reducing thus reducing budget's deficit.
- Finally, taxes play an important role in the economy. Taxes on various sectors should be reformed in such a way that economy will start with new investment which will bring more revenues.

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