9. NEW EVIDENCE FROM GOVERNMENT DEBT AND ECONOMIC GROWTH IN CORE AND PERIPHERY EUROPEAN UNION COUNTRIES: ASYMMETRIC PANEL CAUSALITY

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Abstract

This paper aims to investigate the asymmetric panel causality between general government debt and economic growth for European Union core and periphery countries using annual data from 1980 to 2018. The results show that there is evidence for different combinations of the asymmetric causality relationship between variables. Also, while the inner core panel group and individual results are partially inconsistent, the results regarding the periphery constitute integrity. On one hand core results may indicate the presence of different and powerful factors that lead to positive and negative effects. On the other hand, the general government debt increased in the periphery refers to positive causal effects on economic growth. Besides, while general government debt and economic growth variables indicate cross-sectional dependency, the variables are homogeneous for both panels.

Keywords: public debt, growth, fiscal policy, asymmetric panel causality

JEL Classification: H63, O40, E62, C40

1. Introduction

What kind of a process are modern economies going through in the 21st century regarding debt-growth debate? The number of answers given to this question concerning the causality relationship is very limited in literature.

In modern economies, in the last thirty years of the 20th century, the foremost among the most important economic problems that the policymakers were faced with was the effects of government debts as the debts had rapidly risen in the USA and European countries. In the past, the argument that public debts arose from problems such as war and depression was the refuge of policymakers (Elmendorf and Mankiw, 1998). However, Reinhart and Rogoff's (2010a) opinion regarding the effects of the debts of the peace period rather than the debts of the war period on economic growth in the 21st century that we will be discussing was the

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messenger of the new situation that faced the economic system. Hence, government debts have been increasing and economic activity has been decreasing historically (Mbeya *et al*., 2018b).

While the size of government debts is effective on social and economic balances (Gnegne and Jawadi, 2013; Devita *et al*., 2018; Coccia, 2015; 2016; Mutascu, 2016; IMF, 2015; Eichengreen *et al*., 2019; Blanchard, 2019), it is also crucial for the policymakers (Coccia, 2017). The government debt/GDP (henceforth debt), which is among the fiscal variables that show the size of the public in the general economy (Checherita-Westphal and Rother, 2012) was brought to the agenda again after the Global Financial Crisis (henceforth GFC). However, due to this indicator's sphere of influence and degree, the approach to public debt changed significantly during the process of crisis. The main reason behind this change of approach is the 2008 GFC and the Eurozone Debt Crisis (henceforth EDC) which began in 2009 (Swamy, 2015; Cecchetti *et al*., 2010; Stockhamer *et al*., 2015).

Eurozone has been attracting attention with low output and increasing debt in the last ten years (IMF, 2019). The crisis in Europe has turned from a banking crisis to a Debt Crisis (henceforth DC) threatening the reliability of the Euro, which is the world's second important reserve currency (Overbeek, 2012). Following Greece, the shrinking growth in Italy and Spain made it difficult to decrease debt and shrinking policies made the conditions in these countries a little harder (Apeldoorn, 2014; Kapoor and Coller, 2014; Serapioni and Hespanha, 2019). Stopping this increase in public debts also became one of the main goals of the European Union (henceforth EU) governments (Marinescu and Albu, 2018).

Addressing the DC literature of the last ten years (Checherita-Westphal and Rother, 2012) or the last twenty years (Chang and Chiang, 2011) in modern economies is an optimistic approach, because the historical background of debt shows that such crises are not new. Indeed, according to Köse *et al*. (2020), modern economies have been facing the fourth DC wave since the 1970s. The first of these crises, Latin America DC, ended in 1980 (Cooper *et al*., 1994; Chang and Chiang, 2011). The second is the Asian Crisis that arose in the late 1990s and the third is the 2007-2009 GFC. All of these debt crises resulted in a "fiscal crisis" (Köse *et al*., 2020). However, the greatest debt wave that emerged after World War II is GFC (Cecchetti *et al*., 2010; Buchanan, 2012; Yared, 2019).

Rapid debt increase in developed countries has been instrumental in intensely reconsidering debt theory approaches regarding the last forty and perhaps fifty years (Cecchetti *et al*., 2010; Checherita-Westphal and Rother, 2012). In the 2008-2009 period, Ireland's debt/GDP reached 230% (Wigger and Hansen, 2013). As for the expected effects of debt, they differ from developing to developed countries (Kumar and Wo, 2010). Therefore, the level of development has a decisive role in debates about debt.

According to this information, it is possible to separate DC as before and after 2008. The developing country assessment of DC is usually conducted regarding the period before 2008. However, after the 1970, increased debt had become visible in some developed European countries due to low growth performance (Beqiraj *et al*., 2018). Yet, although an increasing debt assessment was made for the USA since 1970 (Joint Economic Committee, 2015; Graeber, 2011), due to the increasing public expenditures and decreasing tax revenues after the Great Depression, the debt rate was observed to exceed 100% (Auray *et al*., 2019). In the United Kingdom, the declining debt acceleration beginning with the 1950s started to increase again after GFC (Ellison and Scott, 2017; Eichengreen *et al*., 2019). Also, government debt/GDP reached 230 percent in Japan (Mbaye *et al*., 2018a).

These recent developments on debt also encourage discussions on the fourth wave of DC. However, according to Köse *et al*. (2020), the fourth wave of debt particularly refers to the emerging economies and countries in the low-income group.

Before 2008, debt was discussed on a theoretically different ground. These discussions were based on the debt overhang hypothesis based on the views of Krugman (1988) and Sachs (1989). According to the hypothesis, in countries with high debt burdens, most of the revenues obtained from growth are used for debt payments. These results mean a decrease in domestic investments (Sen *et al*., 2007; Panizza and Presbitero, 2013b; Eberhardt, 2017). The negative effects of government debts on economic growth have been expressed by Modigliani (1961), Diamond (1965) and Saint-Paul (1992) (Ferreira, 2009; Cecchetti *et al*., 2010). As can be understood from the explanations above, whereas it is possible to classify DC by periods and countries, the theoretical approaches discussing the effects of debt on economic growth also differ, as described in the following section.

The fact that the third debt wave deeply affected the developed EU countries was forcefully determining the sample in this study. Besides, differently from previous studies examining the effects of debt on economic growth in EU inner core and inner periphery countries, in this study an asymmetric panel causality approach, which was developed by Hatemi-J (2011; 2012) and had a nonlinear structure (Tiwari, 2014), was used. This study aims to contribute to the literature in this sense.

In this context, the study mainly focuses specifically on the following research questions: i) How does the asymmetric causality from debt to economic growth, between third and fourth wave DC develop in EU inner core and inner periphery countries? ii) Does this relationship look different in the EU inner core and inner periphery? iii) Do debt and economic growth shocks affect members in EU inner core and inner periphery, in other words, does DC tend to spread?

There are very few causality studies on this subject in literature. As a matter of fact, there are also opinions that the literature is insufficient regarding the investigation of the causality between debt and economic growth (Swamy, 2015). Also, that the correlation does not mean causality despite the negative correlation between variables (Panizza and Presbitero, 2013a; Panizza and Presbitero, 2014). This study contributes to several domains that were revealed in the literature. First, the number of studies dealing with causality in debt-growth debates is limited. Secondly, the methods preferred by the studies investigating causality in the literature can only show the direction of causality, whereas the asymmetric causality test shows the direction and sign of causality. Finally, the debt-growth debate did not address the issue of the core's debt or crisis imports to the peripheries in literature.

In this study, which consists of seven parts, after the introduction, the second part includes the theoretical framework and the third part includes summary information about some of the outstanding studies in the literature. In the fourth part, data and empirical methods are introduced. In the fifth part, empirical findings are presented and then, in the discussion part these findings are evaluated. Finally, the conclusion part ends with some determinations, suggestions and implications.

2. Theoretical Framework

This part describes possible relationships between debt and economic growth within the framework of Classic, Keynesian and Neoliberal approaches.

Budget deficits and debts can serve two purposes. The first is the redistribution of income over time and for generations; and the second is to minimize the tax loss that occurs with the production of public goods and services (Cukierman and Meltzer, 1989; Alesina and Tabellini, 1990). An increase in the debt burden of the countries will result in the transfer of a large part of the current production to the lenders and a decrease in potential investments (Krugman, 1988). However, economics or public finance approaches also reveal different views on the relationship between debt and economic growth. This distinction between opinions is due to the differentiation of the effect according to the periods.

According to the traditional fiscal approach, public debt may stimulate demand in the short-run, but the exclusion effect of debts on capital in the long-run has negative consequences on growth (Elmendorf and Mankiw, 1998; Panizza and Presbitero, 2013b; Eberhardt and Presbitero, 2015; Puig and Rivero, 2017; Dombi and Dedâk, 2019). In this framework, Classical Economics argues that the state should pursue a neutral fiscal policy and that it should not resort to borrowing (Bhattarai, 2013) other than conditions such as natural disasters and war requiring large expenditures (Tsoulfidis, 2011). However, the Keynesian approach recognizes that expansionary fiscal policies (Dombi and Dedâk, 2019) or budget deficit policy can be used as an element of balance in case of underemployment and stagnation (Greiner, 2011; Butkus and Seputiene, 2018). Therefore, it was assumed that budget deficit policy would increase employment, consumption, and investments (Smyth and Hsing, 1995). However, uncertainties brought about by macroeconomic imbalances may result in low economic growth in the short-run by creating a public debt problem (Cochrane, 2011; Dreger and Reimers, 2013; Panizza and Presbitero, 2013b; Eberhardt and Presbitero, 2015). According to the liberal-based movements, Keynesian economics does not consider the long-run monetary effects of budget deficits; it only considers its real effects in the short run (Jahan *et al*., 2014). In this context, compared to traditional growth models, government debts will negatively affect growth with their reducing effects on savings and capital accumulation (Eberhardt and Presbitero, 2015; Puig and Rivero, 2017).

The biggest reaction to using the budget deficit as a policy instrument came from the Public Choice theorists who developed the state theory of neoliberals. The Public Choice approach criticized public debt on the grounds that it would transfer loads to future generations. Also, this approach draws attention to the economic cost of borrowing (Tempelman, 2007). On the other hand, Monetarists stated that the expansionary fiscal policy would render borrowing obligatory. In addition, the fact that the national income level does not change despite the expansionary fiscal policy was named as the full crowding-out effect (Smyth and Hsing, 1995; Puig and Rivero, 2015).

Another different view on the effects of debt was put forward by Barro, a member of the School of Rational Expectations. With reference to Ricardo, Barro stated that individuals are completely neutral regarding tax payment and lending. Because, according to Ricardo, debt is nothing more than deferred taxes. With reference to this suspicion, Barro questioned whether government bonds create an increase in wealth (Drakos, 2001). Buchanan (1976) named Barro and Ricardo's similar views on this subject as *Ricardian equivalence* (Belingher and Moroianu, 2015). Ricardian equivalence hypothesis argues that there is no difference in the budget regarding the results it will yield between tax and it's financing and borrowing and it's financing. (Barro, 1989). Thus, debt will not have an impact on economic growth (Bal and Rath, 2014; Puig and Rivero, 2015).

In most of the opinions so far, the focus is on the short- and long-run effects of debt on economic growth. While the short-run positive effects are partially based on the Keynesian approach, the long-run negative effects are based on the *financial crisis theory* of the

Neoliberal Approach (Panizza and Presbitero, 2014). The neoliberal approach, which explains the negative effects of debt on economic growth, mainly emerged as a reaction to the Keynesian approach.

3. Survey of Literature

Most of the empirical studies developed based on the theoretical approaches described in Part two focused on the negative effects of debt on economic growth in the long run. Therefore, these studies refer to the Neoliberal approach.

While the starting point of the possible relations between debt and economic growth is linear models, models assuming a nonlinear relationship between the variables in question have also become widespread recently. Nonlinear studies have used the threshold method based on the *inverse-U shape* assumption to investigate the negatively oriented relationship between debt and economic growth. Some pioneering studies investigating the relationship between external debt and economic growth within the framework of the nonlinear model are those of Pattillo *et al*., (2002), Clements *et al*., (2003), Smyth and Hsing (1995) and Cohen (1997). In addition, Schclarek (2004) found no linear and negative relationship between gross government debt and economic growth in developing countries, and no linear and non-linear relationship in industrialized countries. One of the pioneering studies that tested the debt overhang hypothesis with the help of linear models was conducted by Sen *et al*. (2007).

The debt overhang hypothesis developed by Krugman (1988) and Sachs (1989) laid the groundwork for analyzing the relationships between debt and economic growth by the threshold method (Eberhardt, 2017). Analyses made using this method especially accelerated with GFC and EDC. Therefore, it was necessary to reconsider the evaluation that "Serious discussion of fiscal policy has almost disappeared" made by Solow (2002).

Reinhart and Rogof (2008; 2009a; b, 2010a; b, 2011) were pioneers in the empirical analysis of EDC using the threshold method. Reinhart and Rogof's (2008; 2009a; b) studies came up with a technical answer to a theoretical question such as *when do public debts start to be harmful?*

Studies investigating the relationship between debt and economic growth differ greatly in terms of method, sample and period. However, a significant part of these studies has common findings on the negative effects of debt on economic growth. The studies of Reinhart and Rogof (2010b), Kumar and Wo (2010), Cecchetti *et al*. (2011), Afonso and Jalles (2013), Afonso and Alves (2015), Eberhardt and Presbitero (2015), Égert (2015), Mitze and Matz (2015), Siddique *et al*. (2016), Brida *et al*. (2017), Karadam (2018) and Whajah *et al*. (2019) can be given as examples in this regard.

Still, some studies provide evidence regarding the positive or no effect of debt on economic growth. Baum *et al*. (2013), Lof and Malinen (2014), Panizza and Presbitero (2014) may be considered as examples in this regard. According to Baum *et al*. (2013), in 12 EU member states, debt has a positive impact on economic growth in the short run. While the debt/GDP ratio, where the effect approaches zero or disappears is 67%, in countries where this rate is 95% and above, the effect in question turns to negative. Lof and Malinen (2014) investigated the relationship between debt and economic growth in 20 developed countries. The results showed that the increases in growth rates negatively affected the debt, but no evidence of the negative effect of debt on growth could be found. Panizza and Presbitero (2014) could not find evidence of the causal relationships in OECD countries and expressed the results

as follows (Panizza and Presbitero, 2014): "We started this paper with a question. Does debt have a causal effect on economic growth? Unfortunately, our answer to this question is: We don't know".

Apart from these, the studies of Kourtellos *et al*. (2013) and Eberhardt (2017) differ from other studies in terms of sample, period and results. Kourtellos *et al*. (2013) analyzed the relationship between debt and economic growth for 82 countries classified according to democracy levels, also considering different transmission mechanism[2] (henceforth DTM) for the periods 1980-1989, 1990-1999 and 2000-2009. The results of the study reveal that while in countries with high institutional quality, debt does not affect growth, in countries with low institutional quality, the increase in debt leads to a low growth rate. Eberhardt (2017) investigated the relationship between debt and economic growth using the threshold method for 4 OECD countries with the help of 1800-2010 period data, also in different intervals for 23 countries and covering some developed countries as well. According to Eberhardt (2017), no threshold estimation is possible, since there is no evidence of a long-run relationship between debt and economic growth.

Although some studies differ in terms of method and period, they are similar in terms of the EU sample. Checherita-Westphal and Rother (2012) investigated the nonlinear relationship between debt and economic growth with data from the 1970-2008 periods for the 12 countries in the Eurozone. In this study, in which DTM was also considered, debt was found to have a negative effect on economic growth. Dreger and Reimers (2013) investigated the relationship between debt and economic growth for 12 countries in the Eurozone and 18 countries out of the Eurozone with the data of the period 1991-2011 based on the fiscal sustainability model. According to the findings, the debt threshold value is theory-oriented and depends on macroeconomic conditions. The results of the study showed that the negative effects of debt/GDP ratio were limited to Eurozone countries and sustainable debts have positive effects on growth. Mencinger *et al*. (2014) divided 25 EU member states into two separate groups as old and new. The relationship between debt and economic growth for the old members was tested with the data of the period 1980-2010 and for the new members with the data of the period 1995-2010. Empirical results confirmed the inverse-U shape relationship between public debts and economic growth.

Dincă and Dincă (2015) investigated the relationship between debt and economic growth, in the period of 1999-2010 for 10 former Communist countries, which have recently become EU members, also considering DTM. In this study, which shows that a nonlinear relationship between variables is correct, the threshold value was estimated as 50.89%. Puig and Rivero (2017) grouped Eurozone countries as core and periphery and analyzed the relationship between debts and economic growth for the period 1961-2015. Estimation results show that the threshold value is 40% in the core countries and 50% in periphery countries.

Kempa and Khan (2017) investigated the relationship between debt and economic growth in the period 1991-2014 for 11 Eurozone countries, also taking into account DTM. The sample was divided into 3 groups according to the economic weights of the countries in the union, i.e., Germany as a stand-alone, core and periphery countries. The findings showed that the debt increases in Germany caused an increase in core and periphery debt levels. Conversly, the debt level of the core increases significantly in the short run in response to a debt shock in the periphery, but periphery debt rises enduringly regarding a debt shock in

[2] *In this study, it is stated that the econometric models in empirical studies include various variables as well as debt and economic growth with the expression "as well as considering different transmission mechanisms."*

the Eurozone core. Puig and Rivero (2018) used the 1980-2015 period data for two different sample groups, i.e., the EU core and periphery. "Non-financial debt" variables belonging to households, corporations and government were preferred to represent the debt. In this study, the relationship between the variables was examined for baseline model, asymmetric model and threshold model, also considering DTM. According to the asymmetric test results, an asymmetrical relationship was found between the variables. In addition, threshold values were estimated as 87% for corporate debt, 59% for public debt and 39% for household debt.

In some studies, in addition to the long-run effects of debt on growth, causality relationships were also investigated. The works of Swamy (2015) and Lim (2019) can be considered as examples in this regard. Swamy (2015) investigated the relationship between debt and economic growth for 252 countries for the period 1960-2009. The sub-groups of the sample were formed as a debt regime, economy groupings, income groupings, political governance groupings, and regional groupings. While the results of the threshold values differed, it was estimated to be 78% for the EU. According to the Dumitrescu-Hurlin panel causality test results, (in a homogeneous panel), there is a bidirectional causality between variables. Lim (2019), however, investigated the relationship between debt and economic growth, based on data of the period 1952-2016 for 41 developed and emerging countries. The results of the study indicate a negative relationship between debt accumulation and economic growth. In addition, according to Toda and Yamamoto (1995) causality test results, while the temporal differences of growth are effective on debt, the temporal changes in debt do not affect growth (with the exception of first differences parsimonious model).

The number of studies that present strong or weak evidence regarding the causality relationship between debt and economic growth, available at the time of the preparation of this study, is very small. As a matter of fact, there are also opinions that the literature is insufficient regarding the investigation of the causality between debt and economic growth (Swamy, 2015) and also that the correlation will not mean causality despite the negative correlation between variables (Panizza and Presbitero, 2013a; Panizza and Presbitero, 2014). Summary information on the studies investigating the causality relationships between debt and economic growth by direct causality analysis are given in Table 1.

Table 1. Literature of Causality

Author/Authors Year	Period	Sample	Method	Variables	Causality Results
Jayaraman and Lau (2009)	1988-2004	6 PIC	PGC	RY, ED, EX, DF	RY↔ED (short-run)
Ferreira (2009)	1988-2001	20 OECDC	PGC	CPS, GDD, Y	Y ↔ CPS and GDD
Ajovín and Navarro (2015)	1980-2009	16 OECDC	PBGC	AD, GD, PD, CD, HD, RY	AD→RY, GD→RY, PD→RY, CD→RY HD→RY, RY→AD, RY→GD, RY→PD RY→CD, RY→HD
Puig and Rivero (2015)	1980-2013	11 EMUC	PGC	GD, RY	GD→RY GD↔RY GD≠>RY
Ferreira (2016)	2001-2012 2007-2012	28 EUC	PGC, GMM, OLS	RY, GD, PD, ED	RY ↔ PD
De Vita *et al*. (2018)	1970-2014	10 EMUC, U.S, UK, Japan	LGC NLGC SYS-GMM GC	GD, RY	GD↔RY, GD→RY
Çiftçioğlu and Sokhanvar (2018)	1995-2014	CEE	PFE, PGC	ED, RY, PRY	ED→RY, RY→ED ED≠>RY

Notes: GC: Granger Causality, PBGC: Panel Bootstrap GC, LGC: Linear GC, NLGC: Non-Linear GC, PGC: Panel GC, PFE: Panel Fixed Effect, OLS: Ordinary Last Square, AD: All Debt, GD: Government Debt, ED: External Debt, PD: Private Debt, CD: Corporation Debt, HD: Household Debt, RY: Reel GDP, EX: Export, DF: Budget Deficit, CPS: Current primary surplus/GDP, GDD: Gross Government debt/GDP, PRY: Reel Per Capita GDP, EUC: European Union Countries, EMUC: European Monetary UC, PIC: Pacific Island Countries, OECDC: OECD countries, UK: United Kingdom, CEE: Selected Central and Eastern EC, →: Uni-directional causality ↔: Bi-directional causality, ≠>: no causality.

4. Data and Metodology

In this study, the asymmetric causality relationship between debt and economic growth was investigated for two panels, i.e., Inner Core (Panel-I: Austria, Belgium, Finland, France, Germany, Netherlands[3]) and Inner Periphery (Panel-II: Cyprus, Greece, Ireland, Italy, Portugal, Spain) for the period 1980-2018. In the core and periphery classification of EU countries, the grading, the theory of which Sepos (2016) explained extensively and which Bartlett and Prica (2016) also used, was considered. General government debt (percent of GDP) representing debts and real GDP growth (annual percent change) representing economic growth were preferred. For variables, respectively,*gd* and *rg* abbreviations were used. Both variables were obtained from the IMF online database.

[3] *The 1980 value of the real GDP growth (annual percent change) variable for this country is taken from the study of Paolo* et al*. (2013), which was published by IMF.*

The investigation of the asymmetric causal relationship between *gd* and *rg* could be initiated with unit root tests. However, the preliminary tests - cross-section dependency tests and homogeneity tests - are decisive in the preference of appropriate unit root tests for the samples. Therefore, the study was started with cross-section dependency tests and among these tests, the ones developed by Breusch and Pagan (1980) (LM_{BP}) and Pesaran *et al*. (2008) (LM_{adj}) were preferred. These tests also comply with the T>N (T: Times, N: Number of cross section) criteria. Another leading test is the homogeneity test, developed by Pesaran and Yamagata (2008) ($\tilde{\Delta}, \tilde{\Delta}_{adj}$). According to the results of the pioneering tests, the stationarity levels of the unit root tests and series developed by Smith *et al*. (2004) were investigated. Finally, the asymmetric panel causality test developed by Hatemi-J (2011; 2012) was applied to estimate the causality relationship between the variables.

Cross-section Dependency and Homogeneity Tests:

Cross-section dependence tests can provide information about dependence or interaction between units. These tests can help to evaluate the relationship between debt and economic growth of each panel and to reveal the differences and similarities. In addition, cross-section dependency tests can provide serious information about economic and fiscal integration or globalization. On the other hand, homogeneity tests (delta tests) can provide information about the structural differences of the series of units. In most of the recent empirical studies - and especially in studies such as Cecchetti *et al*. (2011) Checherita-Westphal and Rother (2012), Eberhart (2017), Panizza and Presbitero (2013b) - it is stated that heterogeneity is correct due to the structural differences of countries (*a priori*). However, it is also important to test whether homogeneity is verified for variables and panels or not.

The pioneer of cross-sectional dependency tests is the Lagrance Multiplier (LM) test statistic developed by Breusch and Pagan (BP) (1980) (LM_{BP}). When N is constant and T is $\rightarrow \infty$, it can be applied to test the cross-sectional dependency in heterogeneous panels. However, the bias-adjusted cross-sectional dependence test (LM_{adj}) developed by Pesaren *et al*. (2008) is suggested for the solution of some problems arising from time and sample size. This test can also be applied in T N or N T situations. Besides these, the delta tests developed by Pesaran and Yamagata (2008) can be utilized to determine whether the slope coefficients of each unit in the panel are different. Pesaran and Yamagata (2008) maintained that the $\tilde{\Delta}$ test can be used for large samples and the $\tilde{\Delta}_{adj}$ test can be used for small samples.

Unit Root Tests:

In this study, the second-generation unit root tests developed by Smith *et al*. (2004) were preferred with reference to preliminary tests results. Thanks to the unit root test, the stochastic properties of the series were examined. Smith *et al*. (2004) developed more powerful versions of commonly used panel unit root tests. In addition, these tests take into account the cross-sectional dependency together with the bootstrap method (Romero, 2008). These unit root tests are also suitable for T N. This test, developed by Smith *et al*. (2004), can test the unit root existence with five different methods. Only two of these methods were used here[4]. The first of these can be described as $\bar{t}$ test, and the second as Max tests (WS_i).

[4] *For details, see Smith* et al. *(2004).*

Asymmetric Panel Causality Test:

According to Hatemi-J (2011), the potential asymmetric effects ignored in causality approaches are important. The asymmetric causality test developed by Hatemi-J (2011; 2012) is used to determine causality relationships with their positive and negative aspects in panel data analyses. This test explains the causality relationship between variables on the basis of positive and negative shocks and draws on the assumption that these shocks have different effects on causality.

Hatemi-J (2011; 2012), took the random walking processes of two integrated series such as x_{it} and y_{it} in the determination of the asymmetric causality relationship. Hatemi-J (2011; 2012) asymmetric causality test consists of three stages. The first is to disintegrate the series under study in positive and negative cumulative sums. It is in the form of positive and negative

$\varepsilon_{1i}^{+} = \max\ (\varepsilon_{1i},0)$, $\varepsilon_{21i}^{+} = \max\ (\varepsilon_{2i},0)$, $\varepsilon_{1i}^{-} = \min\ (\varepsilon_{1i},0)$ and $\varepsilon_{2i}^{-} = \min\ (\varepsilon_{2i},0)$ shocks. Secondly, to show the total causality of positive and negative shocks $y_t^{+} = (y_{1t}^{+}, y_{2t}^{+})$, assumption and the VAR-SUR (k) (Vector Autoregressive-Seemingly Unrelated Regression) model is estimated as in equation 1:

$$\begin{bmatrix} x_{it}^{-} \\ y_{it}^{-} \end{bmatrix} = \begin{bmatrix} \alpha_{i0} \\ \beta_{i0} \end{bmatrix} + \begin{bmatrix} \sum_{j=1}^{p} \alpha_{i1j} & \sum_{j=1}^{p} \alpha_{i2j} \\ \sum_{j=1}^{p} \beta_{i1j} & \sum_{j=1}^{p} \beta_{i2j} \end{bmatrix} * \begin{bmatrix} x_{it-j}^{-} \\ y_{it-j}^{-} \end{bmatrix} + \begin{bmatrix} \varepsilon_{i1}^{-} \\ \varepsilon_{i2}^{-} \end{bmatrix} \qquad (1)$$

The number of lags (k) is selected according to the information criteria (Akaike Information Criterion, Hatemi-J Information Criterion, etc.). In order to test the asymmetric causality running from x_{it}^{-} to y_{it}^{-} the null hypothesis is x_{it}^{-} does not cause y_{it}^{-}. Finally, these hypotheses are estimated by Wald statistics prepared by Hatemi-J (2011; 2012). The asymmetric causality can also be tested for the each combination $\{x_{it}^{+}, y_{it}^{+}\}, \{x_{it}^{+}, y_{it}^{-}\}, \{x_{it}^{-}, y_{it}^{+}\}$(Hatemi-J *et al*., 2018).

Stationarity levels of the series are different does not pose an obstacle in terms of the Hatemi-J (2011; 2012) asymmetric causality test. Because this test is based on the Toda Yamamoto (1995) approach, where VAR model is augmented with a redundant unrestricted lag in order to take into account the effect of one unit root (Hatemi-J and Roca, 2016; Hatemi-J and El- Khatip, 2016; Hatemi-J *et al*., 2018).

This method provides effective results for two issues, the first of which is: in case the series are I(0) and I(1), the number of appropriate panel causality tests is few in the literature and this is one of them. Secondly, this method shows positive and negative shocks, but others cannot provide this, and the theory already discusses not only the direction of the effect of the series on each other, but also the sign of the effect. In these respects, this method is more useful.

5. Empirical Findings

Cross-sectional dependency and homogeneity test results of debt and economic growth variables of the EU core and periphery countries are given in Table 2.

Table 2. Results of Cross-section Dependency and Slope Homogeneity Tests

Tests	LM_{BP}		LM_{adj}		$\tilde{\Delta}$		$\tilde{\Delta}_{adj}$	
Sample	Gd	Rg	Gd	Rg	Gd	Rg	Gd	Rg
Inner Core	53.352[a]	49.386[a]	5.209[a]	-0.151	0.383	-0.143	0.398	-0.149
Inner Periphery	43.726[a]	59.733[a]	8.204[a]	6.200[a]	-1.417	0.084	1.475	0.088

Notes: Cross-section dependency tests report that level and constant statistics. a, %1 indicate the significance level.
Source: Author' estimations.

According to these results, the cross-sectional dependency hypothesis is accepted for both variables in each panel of the series. In other words, panel members are mutually integrated with each other. Namely, a shock that occurs in a unit is also effective in other units (vice versa). In addition, according to the delta test (a posteriori) results show that the null hypothesis suggesting that the slope coefficients are homogenous is accepted for each panel contrary to what is suggested in the literature.

The results obtained from Smith (2004) unit root tests in determining the stability degrees of the series are shown in Table 3.

Table 3. Results of Panel Unit Root Tests

Variables	Gd				Rg			
Tests	$\bar{t}_S$		$\overline{WS_S}$		$\bar{t}_S$		$\overline{WS_S}$	
	C.	C, T	C.	C, T	C.	C, T	C.	C, T
Sample								
Inner Core	-1.5	-2.2	-0.6	-1.9	-4.5[a]	-4.6[a]	-4.6[a]	-4.7[a]
Inner Periphery	-1.4	-2.4	-0.8	-2.5	-2.9[a]	-3.3[a]	-3.1[a]	-3.5[a]
	ΔGd				ΔRg			
Inner Core	-3.8[a]	-3.9[a]	-3.7[a]	-4.1[a]	-6.3[a]	-6.2[a]	-6.4[a]	-6.4[a]
Inner Periphery	-3.7[a]	-3.8[a]	-3.9[a]	-3.9[a]	-7.0[a]	-6.9[a]	-7.1[a]	-7.2[a]

Notes: A rejection of the null hypothesis of non-stationarity for a given panel indicates that at least one country in the panel does have a unit root and is stationary. The bootstrap p-values are, in each case, based on 5,000 simulations. Δ indicates that variables the first difference. C indicates Constant and C, T indicates Constant and trend. a %1 indicate the significance level.
Source: Author' estimations.

In the results of unit root tests, while the debt series is I (1) for both panels, the economic growth series is I (0). According to these results, while the debt series is stationary in the first difference (or does not contain unit root in first difference), the economic growth series is stationary at the level (or does not contain unit root in level).

After the unit root test, asymmetric causality findings can be listed. Panel group test results and individual test results showing asymmetric causality relationships between debt and economic growth are included in Table 4.

Table 4. Results of Asymmetric Panel Causality Test

Country	Null Hypothesis	Mwald Stat.	Prob.	Country	Null Hypothesis	Mwald Stat.	Prob.
Austria	$Gd^+ \neq> Rg^+$	0.407	0.524	Cyprus	$Gd^+ \neq> Rg^+$	23.143[a]	0.000
	$Gd^+ \neq> Rg^-$	0.011	0.916		$Gd^+ \neq> Rg^-$	0.026	0.871
	$Gd^- \neq> Rg^-$	0.055	0.815		$Gd^- \neq> Rg^-$	0.901	0.342
	$Gd^- \neq> Rg^+$	1.366	0.242		$Gd^- \neq> Rg^+$	0.095	0.758
Belgium	$Gd^+ \neq> Rg^+$	6.474[c]	0.011	Greece	$Gd^+ \neq> Rg^+$	5.593[b]	0.018
	$Gd^+ \neq> Rg^-$	2.418	0.120		$Gd^+ \neq> Rg^-$	0.085	0.771
	$Gd^- \neq> Rg^-$	0.280	0.597		$Gd^- \neq> Rg^-$	0.252	0.615
	$Gd^- \neq> Rg^+$	0.248	0.618		$Gd^- \neq> Rg^+$	0.070	0.792
Finland	$Gd^+ \neq> Rg^+$	26.112[a]	0.000	Ireland	$Gd^+ \neq> Rg^+$	4.885[b]	0.027
	$Gd^+ \neq> Rg^-$	10.301[a]	0.006		$Gd^+ \neq> Rg^-$	0.010	0.920
	$Gd^- \neq> Rg^-$	44.333[a]	0.000		$Gd^- \neq> Rg^-$	0.002	0.961
	$Gd^- \neq> Rg^+$	1.479	0.473		$Gd^- \neq> Rg^+$	0.111	0.739
France	$Gd^+ \neq> Rg^+$	1.733	0.188	Italy	$Gd^+ \neq> Rg^+$	0.258	0.611
	$Gd^+ \neq> Rg^-$	0.457	0.499		$Gd^+ \neq> Rg^-$	0.099	0.754
	$Gd^- \neq> Rg^-$	12.209[a]	0.002		$Gd^- \neq> Rg^-$	1.479	0.224
	$Gd^- \neq> Rg^+$	0.116	0.734		$Gd^- \neq> Rg^+$	0.170	0.680
Germany	$Gd^+ \neq> Rg^+$	0.858	0.354	Portugal	$Gd^+ \neq> Rg^+$	0.001	0.976
	$Gd^+ \neq> Rg^-$	2.903[c]	0.088		$Gd^+ \neq> Rg^-$	0.038	0.845
	$Gd^- \neq> Rg^-$	7.120[a]	0.008		$Gd^- \neq> Rg^-$	2.835[c]	0.092
	$Gd^- \neq> Rg^+$	0.103	0.748		$Gd^- \neq> Rg^+$	0.230	0.631
Netherlands	$Gd^+ \neq> Rg^+$	0.018	0.895	Spain	$Gd^+ \neq> Rg^+$	12.151[a]	0.000
	$Gd^+ \neq> Rg^-$	0.294	0.588		$Gd^+ \neq> Rg^-$	1.390	0.238
	$Gd^- \neq> Rg^-$	0.001	0.978		$Gd^- \neq> Rg^-$	0.028	0.867
	$Gd^- \neq> Rg^+$	0.009	0.925		$Gd^- \neq> Rg^+$	0.327	0.568
Panel-I	$Gd^+ \neq> Rg^+$	42.076[a]	0.000	Panel-II	$Gd^+ \neq> Rg^+$	58.336[a]	0.000
	$Gd^+ \neq> Rg^-$	22.022[b]	0.037		$Gd^+ \neq> Rg^-$	4.732	0.966
	$Gd^- \neq> Rg^-$	67.781[a]	0.000		$Gd^- \neq> Rg^-$	11.238	0.509
	$Gd^- \neq> Rg^+$	6.648	0.880		$Gd^- \neq> Rg^+$	4.451	0.974

Notes: Optimal lag length in VAR models were determined based on SBC information criteria (r). For the Panel-I Maximum lag length is 3 ($r+d_{max}$, 2+1), For the Panel-II Maximum lag length is 2 ($r+d_{max}$, 1+1), The symbol X ≠> Y indicates that there is no causality from variable X to variable Y. a %1, b %5, c %10 indicate the significance level.
Source: Author' estimations.

According to Table 4, panel group results of asymmetric causality (henceforth PGAC) reveal that the null hypothesis of positive shock in debt not causing positive and negative shocks in economic growth can be rejected and the null hypothesis of negative shock in debt not causing negative shocks in economic growth can be rejected for the Inner Core. However, the null hypothesis of negative shock in debt not causing positive shocks in economic growth cannot be rejected for the Inner Core.

For the Inner Periphery, PGAC shows that the null hypothesis of positive shock in debt not causing positive shocks in economic growth can be rejected. However, PGAC shows that the null hypothesis of positive and negative shock combinations in debt not causing negative and positive shocks in economic growth cannot be rejected.

According to Table 4, Inner Periphery of individual asymmetric causality (henceforth IAC) test results can be classified into two groups. IAC results for the first group show that the null hypothesis of positive shock in debt not causing positive shocks in economic growth can

be rejected in Cyprus, Greece, Ireland, and Spain. In the second group, only the IAC results of Portugal show that the null hypothesis of negative shock in debt not causing negative shocks in economic growth can be rejected. The IAC results other than these ($Gd^{+}\neq>Rg^{-}$, $Gd^{-}\neq>Rg^{-}$, $Gd^{-}\neq>Rg^{+}$) can not be rejected for all Inner Core cross-countries (except Portugal).

According to Table 4, the Inner Core of IAC results are more complex than Inner Periphery. For instance, Finland's respective IAC results show that the null hypothesis of positive and negative shock in debt not causing positive and negative shocks in economic growth can be rejected. Likewise, positive shock in debt not causing negative shocks in economic growth and negative shock in debt not causing negative shocks in economic growth can be rejected; however, IAC results show that the null hypothesis of negative shock in debt not causing positive shocks in economic growth cannot be rejected in Finland.

On the other hand, Germany's IAC results show that the null hypothesis of positive shock in debt not causing negative shocks in economic growth and negative shock in debt not causing negative shocks in economic growth can be rejected. However, IAC results show that the null hypothesis of positive shock in debt not causing positive shocks in economic growth and negative shock in debt not causing positive shocks in economic growth cannot be rejected in Germany. In addition to these, Belgium's IAC results show that the null hypothesis of positive shock in debt not causing positive shocks in economic growth can be rejected. The IAC results of France show that the null hypothesis of negative shock in debt not causing negative shocks in economic growth can be rejected. The IAC combinations other than these cannot be rejected for Belgium and France. Besides, the IAC results of Inner Core members Austria and Netherlands ($Gd^{+}\neq>Rg^{+}$, $Gd^{+}\neq>Rg^{-}$, $Gd^{-}\neq>Rg^{-}$, $Gd^{-}\neq>Rg^{+}$) cannot be rejected.

6. Discussions

Recent panel empirical literature (except for Panizza and Presbitero (2014), Eberhardt (2017) in the literature of this study) identifies the statistically significant relationship between debt and economic growth. However, these studies point to different threshold effects for different periods and it is seen that there is no clear threshold value. In addition, a large part of the recent debt and economic growth relationship literature (except for Baum (2013) in the short-run for the literature of this study) provides evidence of the crowding-out effect. However, in cases of uncertainty, expansionary fiscal policies may also have positive effects on economic growth in the long-run (Panizza and Presbitero, 2013b).

In few and linear causality studies, different causality findings are found between debt and economic growth. In this context, two studies (Puig and Rivero (2015), Çiftçioğlu and Sokhanvar (2018) in the literature of this study), in which no causality can be detected between debt and economic growth, stand out, because the sample of these studies consists of the EU members and the period also includes the EDC period. The asymmetric causality test, which is the focus of this study, refers to a situation in which macroeconomic variables have different responses to positive and negative shocks and no linear causality. Asymmetric causality test results between variables - being confirmed in different combinations - are similar to those of Puig and Rivero (2018).

The findings in the context of economic, fiscal integration and globalization can be summarized as follows: Cross-section dependency test results show the interaction of the variables of debt and economic growth for both samples and these results are consistent with the results of Kempa and Khan (2017). Still, most of the studies in the literature act on the basis of (*a priori*) heterogeneity.

7. Conclusions

This study investigated the theoretical relations between economic growth and public debt of the EU central and peripheral countries with a non-linear causality approach. In the first stage, his study conducted cross-section dependency tests to understand whether there is an interaction between countries' over debt and growth variables. According to these test results, EU central and peripheral countries affect and are affected by each other in terms of debt and growth variables. These results also confirm the spreading adventure of the last debt crisis. It also confirms that the EU core and peripheral countries have become fully integrated.

In the second stage, we investigated whether the sample was similar in terms of economic and financial understanding with homogeneity tests. According to the homogeneity test results, the countries are similar. In other words, shocks in countries affect panel members in a similar way. These results shed light on the sample financial integration. Homogeneity test results (a posteriori) of this study show that the variables are homogeneous for both samples. Despite the different economic characteristics of countries, basic variables such as debt and economic growth show homogeneity with the effect of fiscal structure or neoliberalism. Yet, these findings may also indicate structural differences between the core with export-based growth model and the periphery with a relative consumption-based growth model.

In the third stage, there were unit root test results selected based on the findings of the prior two tests. The unit root test results give us two important pieces of information about the series. First, the results for both panels show that the economic growth series is stationary at the level. Accordingly, for the sample, growth is stable and the effect of shocks is temporary. However, the debt series is stationary at first difference, so the series is affected by external shocks.

The asymmetric causality test results are as follows: Firstly, the Ricardian equivalence hypothesis is valid in Austria, Netherlands, and Italy. Secondly, it shows that the Keynesian Approach is valid in Belgium, Cyprus, Greece, Ireland, and Spain ($Gd^{+}\rightarrow Rg^{+}$). It reveals that the Keynesian Approach is valid in France and Portugal ($Gd^{-}\rightarrow Rg^{-}$). Finally, whereas the Keynesian Approach is supported in Finland ($Gd^{+}\rightarrow Rg^{+}$, $Gd^{-}\rightarrow Rg^{-}$), another finding, ($Gd^{+}\rightarrow Rg^{-}$) which supports the Neoliberal Approach (Gd+→ Rg-) was also obtained. A similar situation applies to Germany: Whereas one finding supports the Keynesian Approach ($Gd^{-}\rightarrow Rg^{-}$), another finding supports the Neoliberal Approach ($Gd^{+}\rightarrow Rg^{-}$).

The relationship between debt and economic growth is rather complex. But why not consider the possibility of the rope being short rather than the well being deep? The fact that the only obstacle to progress is *again the state* may not be one of the answers.

The increasing trend in debt is based on concrete data and is clear, but clarity on why it has increased has not been adequately expressed. Yet, the reason for the tendency of GDP to decrease is reminiscent of the old crises of neoliberalism and borrowing may be inevitable when one does not have money in such an environment.

This study may stand out with the findings regarding the above-mentioned asymmetric causality relationship between debt and growth, but it may also help raise some old questions.

The most important aspect of the empirical discussions on debt and growth is that the methods consider structural breaks and apply non-linear methods, as non-linear methods are more realistic. The second is the debt variable (debt/growth) although this is an algebraic

issue, it can manipulate researchers. In addition, there is still insufficient evidence that the 2008/09 crisis was a "debt crisis".

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