

PUBLIC DEBT AND ECONOMIC GROWTH: A REVIEW OF CONTEMPORARY LITERATURE

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Abstract

This article reviews the most important contributions to literature on “public debt - economic growth” relationship. Most relevant studies are empirical. Some of them are based on causality tests, albeit with no clear conclusion as to what the causes and what the effects are. We also indicate important gaps, which have not been considered and these are either periods of economic crises or “secular stagnation” phenomena. We suggest that policy makers and investors should reconsider not only the so-called 90% “threshold hypothesis” but also the causality itself, because there is no necessary theoretical consensus so far.

JEL Classification: E60, H63, O43

Keywords: Public debt; economic growth; financial crises; causality; threshold hypothesis; secular stagnation.

Acknowledgements: The authors would like to thank the anonymous referees for their valuable comments that have been truly helpful and improved the accuracy of the arguments this paper invokes. We also owe a heartfelt thank you to our colleagues (especially Prof. G. Bitros, Prof. G. Noja, Prof. M. Cristea, and Prof. El. Thalassinos) at ICABE-2020 for their helpful comments on a previous version of the paper presented there. We would also like to thank Associate Prof. S. Arvanitis from the Hellenic Mediterranean University (HMU) and Prof. P. Pantelidis from the University of Piraeus, members of the PhD supervision committee of Mr. N. Filippakis, for their constant assistance in this effort, and finally the Dept. of Accounting and Finance of the HMU for its technical assistance (libraries, databanks, and other resources) for this Phd course. The usual disclaimer applies.

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Introduction

The global financial crisis of 2007-2009 (GFC-2008) has revived the debate on the nexus between public debt (PD) and economic growth (EG). The large PD increase during the last decades and, particularly, after the GFC-2008 has brought about a more spirited discussion among academics and policy makers concerning the effect of government debt on the economy. The influential paper by Reinhart and Rogoff (RR, 2010, p.573) supporting that "*...whereas the link between growth and debt seems relatively weak at 'normal' debt levels, median growth rates for countries with public debt over roughly 90 percent of GDP are about one percent lower than otherwise; average (mean) growth rates are several percent lower*" established a new consensus for the PD-EG nexus. Negative interaction between debt and growth in a non-linear relationship over a specific limit of debt (the "threshold hypothesis") has been characterised by the first wave of literature as a "stylized fact". Some researchers (Panizza and Presbitero, 2014; Eberhardt and Presbitero, 2015; Gomez-Puig and Sosvilla-Rivero, 2015) identify serious technical challenges when validating the methodology. Among others, they revealed cross-country heterogeneity, parameter instability, and endogeneity problems. These problems have converted the "threshold hypothesis" from an examination of correlation to the identification of causality even in statistical terms (Granger causality) without economic grounds. Theoretical literature to date seems not to have supported any one-way conclusion in the debt-growth nexus.

In this article we review the most important contributions to the relationship between PD and EG. Specifically, we classify relevant studies into two categories, i.e., those with and those without causality tests in order to detect the relevant causal relationship. Papers of both categories seem to adopt some restrictions on the examination of correlation and causality. For example, RRs' (2010) highly stylised descriptive analysis neither refers to other factors of economic development nor examines the possibility of any causal relationship, whether unidirectional or bidirectional, across countries (Eberhardt and Presbitero, 2015). Furthermore, the attempt to identify bidirectional causality between debt and growth leads some researchers to adopt the standard linear, Granger-causality test overlooking the possibility of a non-linear nexus (De Vita *et al.*, 2018).

The main contribution of the methodological classification used in this paper is the identification of three important issues, which literature has not yet explicitly considered: First, unlike previous studies, the importance of financial crises is highlighted; this lowers economic activity causing high indebtedness in the public sector in its attempt to "save" the productive private sector. More often than not literature examines the interaction between (public) debt and (economic) growth but does not consider the harmful impact of financial distress on growth. Second, necessary attention is paid to long-term interest rates since it is an important channel through which the increase of public debt can influence growth. Most of the studies find that higher public debt related to higher sovereign risk premia leads to higher long-term

interest rates (Baum *et al.*, 2013). However, in economically advanced countries, high levels of sovereign debt are usually observed concurrently with low respective interest rates today. Third, emphasis is placed on the future economic framework that will form the bases for literature analysis of the nexus PD and EC. This could be a “secular stagnation” environment which will be consistent with a binding environment of zero-lower bound (ZLB), low economic activity and price inflation below the target. The paper is organised as follows. Section 2 describes the theoretical underpinnings; section 3 describes the methodology employed; and section 4 presents the classification of research topics and gaps detected. The discussion appears in section 5, while section 6 concludes the paper.

Theoretical Underpinnings

In previous years, the focal point of the debate of the effect of government debt on domestic output was to investigate how a large PD could become detrimental for EG, in the short or long run. There are three main theoretical approaches to this discussion.

The first one is based on the Keynesian theory, through the textbook IS-LM model, which implies the existence of a positive nexus between PD and EG. This view relies on the effectiveness of expansionary fiscal policy in increasing aggregate demand and output, income, employment and EG, particularly when the economy is around the liquidity trap (Ewaida, 2017). The argument is consistent with the “conventional view” that, in the short run, GDP is demand-driven and could become efficient as fiscal policy stimulates it, under the well-known conditionalities. In this case, moderate PD levels have a positive short-run impact on EG, such as improving “monetary policy, strengthened institutions, enhanced private savings, deepened financial intermediation, or smoothed distortionary taxation over time (Gómez-Puig and Sosvilla-Rivero, 2018, p. 211)”.

On the contrary, the position that an increase in PD always reduces long-run EG is the second strand of the literature, which refers to the neoclassical and the endogenous growth models. This theory is based on the crowding out effect, suggesting that PD crowds out private investments through the higher levels of interest rates it provokes (Modigliani, 1961; Diamond, 1965; Saint-Paul, 1992). Specifically, in the long run, decrease in public savings leads to a higher budget deficit, which is not entirely offset by an increase in private savings. As a result, national savings decrease, which also drives national investments to lower levels. This will have an adverse impact on the GDP leading to: “...smaller capital stock, higher interest rate, lower labor productivity and wages. Lower foreign investment (or higher foreign inflows), instead, will have a negative effect on foreign capital income and will thus lower the country’s future GNP. This negative effect of an increase in public debt on future GDP (or GNP) can be amplified by the presence of distortionary taxes (Panizza and Presbitero, 2013, p.177)”.

From an inter-temporal perspective, the traditional neoclassical approach pointed out that an increase in national debt (both internal and external) can be beneficial for contemporary generations, but places a burden on future ones causing a reduction in private stock of capital. Modigliani, (1961) and Diamond (1965) came to the same conclusion suggesting that external debt has detrimental effects on long run growth because of the taxes needed to finance interest payments.

During the 1990s, endogenous growth models tried to illustrate which way the long run growth could increase in without being exclusively based on exogenous or “residual” technological changes as Solow’s model supports (Tamborini and Tomaselli, 2020). Nevertheless, they reached the same conclusion that an increase in PD reduces growth rate and there is always a future generation that will be burdened by it (Saint-Paul, 1992).

The conventional view on the distinction between PD short-and long-term influences ignore the fact that prolonged recessions could reduce future potential output causing permanent loss of real output level (Cerra and Saxena, 2008). This means that running fiscal deficits-so as to increase PD-may have both short-and long-run positive impact on output. In the same vein, DeLong and Summers (2012) support that expansionary fiscal policy is efficient enough and probably self-financing in an economy that is under pressure with short-term nominal interest rates at their zero-lower bound. Furthermore, some of the literature argues that the role of hysteresis is truly determining, and it should be seriously considered so that potential output remains constant. This is contrary to the notion of many economists that output remains invariable even after wide and extended recessions. According to DeLong and Summers (2012), and Fatas and Summers (2018), the attempt of many countries to implement fiscal consolidation to reduce PD generates a strong hysteresis effect leading to a higher debt-to-GDP ratio through their long-term negative impact on output.

Finally, the third theoretical aspect in the PD-EG nexus is related to the Ricardian equivalence theorem. The basic assumption here suggests that PD-EG interaction is neutral because the level of government debt generated is repaid through future taxes. In this context, a rational individual would be more eager to save at present by purchasing government debt securities and diminishing consumption to be able to pay future taxes. Reduction in public savings is expected to be fully offset by a corresponding reduction in the private sector. Consequently, the aggregate demand will remain unchanged whether the government chooses to increase taxes today or in the future. Thus, the debt burden on growth is neutralised, since interest rates and private consumption are not expected to be modified (Jurgen, 2019).

However, the major concern of literature, as reviewed, is that there is no integrated theoretical framework yet for the relationship between PD and EG. Despite the wide variety of (mainly empirical) explanations and insights on the debt-growth nexus, no unified theoretical proposal has been reached yet (Tamborini and Tomaselli, 2020).

Methodology

Table 1 presents in summary the identity, methodology and main findings of selective relevant literature papers. Furthermore, studies are distinguished into those with and those without causality tests so as to detect the relevant nature of the relationship.

Table 1. Selective studies on the relationship between public debt and economic growth. Studies with explicit causality tests.

A. Studies with causality tests.

Ref./ Author/Year	Countries / Sample period	Methodology	Main Conclusions	Causalities
1. Jacobs <i>et al.</i> (2020)	27 EU and 4 OECD countries / 1995-2013	Tri-variate PVAR model with Granger causality tests.	They find <i>negative</i> Granger causal ($\bar{\rightarrow}$) link from economic growth (EG) to public debt (PD) but not vice versa, irrespective of the level of debt. There is positive correlation between debt ratio (Dr) and long-term real interest rate (LTRIR). $EG \bar{\rightarrow} PD; \text{Corr.}(Dr, LTRIR) > 0$	A
2. Pegkas <i>et al.</i> (2020)	12 Eurozone Countries / 1995-2016.	Panel Cointegration analysis and Granger causality tests.	There is bi-directional causality (\leftrightarrow) between PD and EG. Negative long-run effect of PD on EG. The GFC-2008 has substantial negative effect on EG. $EG \leftrightarrow PD; EG = f(\bar{PD}, \bar{DumGFC'08})$	C
3. Lim (2019)	41 Advanced & Emerging eco. / 1952Q1 – 2016Q3	m-variate homogeneous panel VAR with Granger causality tests.	He finds that <i>total</i> (private + public) debt (<i>TD</i>) impulses generate a small but negative growth effect. The decomposition of TD indicates that, on average, PD expansions are responsible for EG contractions. For the Euro Area sub-sample, he presents evidence for a toxic bank-sovereign doom loop, while the effects of capital flows (CF) appear to be more persistent, especially after the GFC-2008, in mitigating the debt effect. $TD \bar{\rightarrow} EG; PD \bar{\rightarrow} EG$	B
4. De Vita <i>et al.</i> (2018)	11 Eurozone countries, US, UK, and Japan / 1970-2014.	Time series; standard linear Granger causality tests; VAR model.	No robust evidence of long run bi-directional causality (\leftrightarrow) between PD and EG. Heterogeneous results between countries mainly occurred due to differences in PD structure and composition. $EG \overset{?}{\leftrightarrow} PD; \text{heterogeneity among countries}$	D
5. Gomez-Puig and Sosvilla-Rivero (2017)	11 EMU countries / 1961-2015.	Neoclassical growth model of Solow, with Granger-causality tests and yearly time series.	PD increase induces harmful effect on EG before the official fiscal limit of European Stability and Growth Pact. The negative Granger causality of $\Delta(PD)$ on EG, as regards the Dr threshold and intensity, is not the same in all Eurozone (EZ) countries. $PD \bar{\rightarrow} EG; \text{threshold} < 0.9$	B
6. Bell <i>et al.</i> (2015)	Reinhart and Rogoff's (2010) data made available by Herndon <i>et al.</i> (2014) / 1900-2009; 1946-2009.	Multi-level causality modelling method.	The relationship between PD and GDP across countries has been found unstable. The negative relationship between PD and EG derives from the effect of the EG on PD, rather than the opposite. There are important differences in the overall trend of countries' EG over time. $EG \bar{\rightarrow} PD; \text{heterog. in countries' EG}$	A

7. Gomez-Puig and Sosvilla-Rivero (2015)	11 EMU countries / 1980-2013.	Granger- causality approach and endogenous breakpoint tests.	They find negative Granger – causality ($\bar{\rightarrow}$) between changes in PD [$\Delta(PD)$] and EG in some of the countries studied between the break date and the end of the sample period in 2013. EMU ¹ countries present heterogeneous relations between PD and EG and vice versa. $\Delta(PD) \bar{\rightarrow} EG$; heterogeneity in (PD-EG) EMU members	B
8. Puente-Ajovin and Sanso- Navarro (2015)	16 OECD countries /1980-2009.	Panel Granger causality tests.	They do not find any causal effect of PD on EG ($\overset{NO}{\rightarrow}$). Possibly it is low EG that leads to high levels of PD. They find evidence of a causal effect of private non-financial debt (PriNFD) on EG. $PD \overset{NO}{\rightarrow} EG$; $PD = f(\bar{EG})$; $PriNFD \bar{\rightarrow} EG$	A-

B. Studies with no causality tests.

Ref./ Author/ Year	Countries / Sample period	Methodology	Main Conclusions	PD-EG relations
9. Swamy (2020)	252 countries / 1960-2009.	Extended Solow growth model with PVAR.	There is a <i>negative</i> long-term effect of PD on EG, which is not the same for all countries and mainly depends on debt regimes and other important macroeconomic variables. $EG = f(\bar{PD})$	B-
10. Karadam (2018)	134 countries (23 adv. + 113 developing eco.) / 1970-2012	Panel Smooth Transition Regression (PSTR) model.	He finds that the nonlinearity of the relationship depends on the structure of PD. The level of the threshold, which is lower for developing countries, depends on the degree of economic development, of indebtedness and of the time horizon of PD. The threshold (DrT) depends on country development level. $EG_{it} = f\left(\overset{\pm}{PD}_{it}\right), i = \text{country}, t = \text{time},$ $DrT = \begin{cases} 106\% \text{ for Advanced eco.} \\ 88\% \text{ for developing eco.} \end{cases}$	B-
11. Eberhardt and Presbitero (2015)	118 developing, emerging and advanced economy countries/ 1960-2012.	Linear & non- linear novel specif. & diagn. based on log- linearised Cobb- Douglas function augm. with a PD stock term.	They find little evidence for a negative relationship between PD and long-run EG. Due to heterogeneity of specific characteristics across countries, the authors do not support the existence of a common debt threshold. $EG = f(\bar{PD})$; non-uniform threshold.	B-
12. Afonso, and Jalles (2013)	155 adv. + developing countries / 1970-2008.	Growth equations and growth accounting techniques.	There is a negative effect of PD on EG. For OECD countries, the longer the average debt maturity the higher the EG. Fiscal consolidation promotes EG in a non-Keynesian fashion. For countries with $Dr > 90\%$ ($<30\%$), the EG impact of 10% increase in the Dr is -0.2% (0.1%). An endogenous DrT of 59% may be derived. $EG = f(\bar{PD})$; 59% DrT.	B-

1. European Economic and Monetary Union (EMU)

13. Baum <i>et. al.</i> (2013)	12 EMU countries / 1990-2010.	Dynamic non-linear threshold panel data model.	The short run impact of PD on EG is positive (+) when $Dr \cong 67\%$, while it turns negative (-) for $Dr > 95\%$. Long-term interest rate (LTIR) increases when $Dr > 70\%$. $EG = f(Dr)$, $f = \text{concave}$; $\text{threshold} = (0.95)$; $Dr > 0.7 \Rightarrow \uparrow \text{LTIR}$	B-
14. Kourtellos, Stengos & Tan (2013)	82 countries / 1980-2009. Three 10-y. growth periods.	Structural threshold regression (STR) using an augmented Solow growth model.	When a country's Democratic institutions (INST) are below a particular quality level, then, higher PD leads to lower EG (all else being equal). However, if a country's INST are of sufficiently high quality, then PD is growth-neutral. Long run effects of PD on EG. $INST = \begin{cases} \text{Low Quality: } EG = f(\overline{PD}) \\ \text{High Qual.: } \uparrow PD \rightarrow \text{neutral on EG} \end{cases}$	B-, C
15. Checherita-Westphal and Rother (2012)	12 Eurozone countries / 1970-2011.	Panel FE models corrected for heteroskedasticity and autocorrelation.	Significant non-linear relationship between PD and EG. When PD is $> 90\%$ of GDP, on average, it is detrimental for EG. $EG = f(Dr)$, $f = \text{concave}$; $\text{threshold} \cong (0.9-1.0)$	B-
16. Cecchetti, Mohanty & Zampolli (2011)	18 OECD countries / 1980 – 2010	Standard growth (EG) regressions, augmented with information about PD levels.	For countries with $Dr > 85\%$, PD is detrimental for EG. High levels of debt create volatility and have a negative impact on EG. $EG = f(\overline{PD})$; $85\% DrT$	B-
17. Kumar and Woo (2010)	38 advanced and developed economies / 1970-2007.	Panel models in a Cobb-Douglas production function.	There is an inverse relationship between initial PD and subsequent EG. On average, 10% increase in the initial Dr is correlated with slowdown in annual real per capita EG (rpcEG) of around 0.2% per year. $EG = f(\text{init. } \overline{PD})$; $\uparrow 0.1Dr \Rightarrow \downarrow 0.002\text{rpcEG}$	B-
18. Reinhart and Rogoff (2010)	20 advanced and 24 emerging countries / 1900-2009 1946-2009.	Descriptive empirical approach using a multi-country historical dataset.	When $Dr > 90\%$ of GDP, then EG drops to -0.1%. $Dr > 0.9 \Rightarrow \downarrow 0.001EG$	B-

Notes: Last column refers to the second criterion for classifying studies (Granger causality or effects). The symbols there stand for: A = negative Granger-causality from EG to PD; A- = negative effect of EG on PD; B = negative Granger-causality from PD to EG; B- = negative effect of PD on EG; C = bi-directional Granger-causality between EG and PD; D = No-robust evidence of Granger-causality between EG and PD; EG = economic growth; PD = public debt; Dr = debt ratio; DrT debt ratio threshold; DM (EM) = developed (emerging) market economies; n. -eff. = neutral effects; INST = Democratic institutions.

Classification of Research Topics and Detection of Gaps

In Table 1 we classify the studies selected from the literature on the “public debt (PD) - economic growth (EG)” relationship in two categories, according to causality tests performed.

In the first category there are studies that used the causality methodology (Table 1, part A). Puente-Ajovin and Sanso-Navarro (2015) examined 16 countries of the Organization for Economic Co-operation and Development (OECD), using panel-Granger causality tests, and they did not find a causal effect of government debt on GDP. Probably it is the low EG that leads to high levels of debt. Bell *et al.* (2015) used a multi - level modelling method with RR's data and concluded that there is variation between PD and EG. The negative nexus between debt and growth derives from the effect of growth on debt rather than the other way around. Gomez-Puig and Sosvilla-Rivero (2015), in a Granger-causality approach for eleven European Economic and Monetary Union (EMU) countries, confirm, a negative causality for some of these due to changes in sovereign debt to EG ratio. EMU economies present heterogeneous relations among relevant variables. De Vita *et al.* (2018) conducted Granger causality tests and VAR models for eleven EMU economies along with the US, the UK, and Japan, and found no robust evidence of long run bi-directional causality between debt and growth. In the same way, Gomez-Puig and Sosvilla-Rivero (2015) demonstrated heterogeneous results between countries due to differences in the structure and composition of their debt. In addition, Pegkas *et al.* (2020) analysed twelve Eurozone economies and provided evidence for a bi-directional causality between PD and EG. Among others, these authors emphasised the magnitude of the financial crisis in 2008 as a cause for the negative effect of PD on GDP. Gomez-Puig and Sosvilla-Rivero (2017) attributed the harmful effect of increasing debt to economic activity before the official fiscal limit of European Stability and Growth Pact (ESGP). Adopting time series on yearly data in the neoclassical growth model of Solow, for a sample of eleven EMU countries has shown the negative Granger-causality of changes in debt on growth for some of them. The debt threshold is not the same for all Eurozone economies. However, Jacobs *et al.* (2020) examined a tri-variate panel VAR-model (PVAR) in a sample of 27- European Union (EU) and four OECD countries detecting a causal link from EG to PD but not vice versa, irrespective of the level of debt. The authors also confirmed that there was positive correlation between the debt ratio and long-term real interest rates.

In the second part of Table 1 we classified studies that have not used causality tests in researching the EG-PD relationship. Even after ten years, the seminal work of RR still influences a broad strand of the literature concerning the PD-EG relationship. Based on a multi-country historical dataset, through a descriptive approach, it was found that “...median growth rates for countries with public debt over roughly 90 percent of GDP are about one percent lower than otherwise; (RR, 2010, P.573)”. Herndon *et*

al. (2014) strongly criticised RRs' research and identified three problems: first, their selective data exclusions, second, their coding errors, and, finally, their inappropriate weighing methodology. After their recalculation of RRs' data, Herndon *et al.* (2014) found that when the public debt/GDP ratio is higher than 90%, the growth that is revealed is, actually, positive, i.e., 2.2%, rather than negative, i.e., -0.1%. Despite such criticism and the serious technical challenges of the validity of RRs' methodology, the establishment of a 90% threshold as a "stylized fact" appears to offer strong support for implementing austerity policies on both sides of the Atlantic (Europe and the United States). Some researchers, such as Herndon *et al.* (2014), Dafermos (2015), Eggert (2015a), Eggert (2015b) and Amann and Middleditch (2020) have replicated (corrected and recalculated) the methodology and data of RRs' with the intention of revising RRs' postulation.

Some of the studies presented in Table 1 have analysed the "debt threshold hypothesis", detecting a negative interaction between PD and EG and concluded on a non-linear relationship when exceeding a specific limit of debt. Checherita-Westphal and Rother (2012), using a panel model of fixed-effects for twelve Euro-area countries, claim there is a significant, non-linear relationship between government debt and GDP growth. Exceeding the 90%-100% of the GDP threshold, PD is, on average, detrimental for economic activity. In the same context, Baum *et al.* (2013), using a dynamic non-linear threshold panel model for the same twelve Eurozone countries, argued that the short run impact of debt on GDP growth is positive when the ratio of public debt to GDP is around 67%. For higher debt ratios, above 95%, the influence of an additional debt has a detrimental effect on EG. From an empirical point of view, it is claimed that the emergence of cross-country heterogeneity and parameter instability over time have led the consensus of debt-threshold hypothesis to be reverted (Amann and Middleditch, 2020). Panizza and Presbitero (2014) stressed that the crucial point is the appearance of endogeneity problems in econometric modelling, which affect the "true" link between debt and growth. A Vector Autoregressive (VAR) model is a typical non-theoretical time-series method to treat endogeneity and analyse the dynamic interactions between the variables studied (Jacobs *et al.*, 2020). The result of a high level of sovereign debt could originate from low economic activity that determines the interaction between PD and EG.

Kumar and Woo (2010), examining a sample of 38 advanced and developing economies adopted panel models in a Cobb-Douglas production function and demonstrated the existence of an inverse relationship between initial debt and subsequent growth. These authors proved that an average of 10% increase in the initial debt to GDP ratio was linked to a slowdown in real per capita GDP growth of around 0.2% per year. Eberhardt and Presbitero (2015) employed novel linear and non-linear specifications and diagnostics, from the time-series literature adapted for use in the panel, based on a log-linear Cobb-Douglas production function augmented with a debt stock term.

Studying 118 countries, these authors presented little evidence for a negative relationship between PD and long-run growth. Due to the heterogeneity of specific characteristics across countries, Eberhardt and Presbitero (2015) did not support the existence of a common debt threshold. Swamy (2020) estimated the debt–growth interaction using an extended Solow growth model with PVAR in a sample of 252 countries. He found a negative effect of PD on EG, which is not the same for all countries, and is mainly depended on debt regimes and other important macroeconomic variables.

However, all studies, whatever their methodology, appear to have some limitations. As Bell *et al.* (2015) observed, “...empirically, both the presence and shape of any relationship is dependent on the specification of the model and the statistical method being used.” The PD-EG relationship seems to be no exception.

To date, RRs’ paper has been the most influential yet controversial study in relevant literature. In their effort to establish a clear conclusion with strong policy influence, they, however, failed to exploit the potential of their data. They simplified their conclusion about the “debt-threshold hypothesis” without examining the possibility that the frame is dependent on each country individually. The authors’ purpose was “to build the case for a stylised fact” (Bell *et al.*, 2015), but their highly stylised descriptive analysis does not refer to other determinantal factors of economic development, nor does it examine the possibility of any causal relationship, either unidirectional or bidirectional, across countries (Eberhardt and Presbitero, 2015). Beyond this context, the work of RRs’ presents many statistical and methodological limitations. The authors do not use a formal statistical framework and their panel is unbalanced. However, for explication purposes, they take into consideration that the panel is balanced and use strong assumptions about the homogeneity between countries, thus implying that different countries converge to a same rate of equilibrium, without considering the consequences of debt overhang from one country to another (Chudik *et al.*, 2015). There are some reasons to believe that equilibrium in the relationship of PD to EG is not the same across countries. First, production technology according to the “new growth” theory differs from country to country; second, the ability to accept high levels of debt is determined by a number of country-specific characteristics; and, third susceptibility to PD is not only subject to debt levels but also to debt composition (Eberhardt and Presbitero, 2015). RRs’ weighted methodology seems to be arbitrary and unfounded regarding the way means and medians were generated. “The impact of RRs’ approach is to greatly amplify the effects of short-term episodes with high public debt levels in calculating the overall impact of high public debt on GDP growth (Herndon *et al.*, 2014).” Methodologically, the studies of this era, apart from examining non-linearities and detecting a common debt threshold, do not take into consideration that the effect of debt accumulation on EG is determined by the time horizon within which this relationship is analysed (Gomez-Puig and Sosvilla-Rivero, 2018). Generally speaking, the work of RR appears to have certain common methodological characteristics with some other studies of the first surge of literature papers, such as

those of Checherita and Rother (2012) and Baum *et al.* (2013). The main common characteristic of these studies is that they “...use econometric models that are limited to either explain the short- or long-term impacts of debt on growth and not both (Juergen, 2019, p. 7).”

Besides the limitations of the first literature stream, the second one also displays some constraints regardless of the specific methodological approach that it follows. The shift from correlation to causality leads research to using the Granger causality test. However, the effort to identify bidirectional causality between debt and growth leads some studies into adopting the standard linear Granger causality test, overlooking the possibility of a nonlinear nexus. This method is defective because the typical Granger causality method has little power in identifying nonlinear causal relationships (De Vita *et al.*, 2018). In addition, when the causal relation is being estimated (between debt and growth nexus) it is crucial to consider the existence of cross-country dependence and heterogeneity (Puente-Ajovin and Sanso-Navarro, 2015). An important restriction emerging when this relationship is analysed is that “over time, growth is highly erratic compared to debt which changes much more slowly. This means that when using debt to explain growth, we will only be able to account for a small proportion of the variance of growth (Bell *et al.*, 2015).”

Furthermore, some studies present limitations in Cobb–Douglas production function regarding the returns to scale of the factors (Gomez-Puig and Sosvilla-Rivero, 2018). Other papers based their methodological framework on an extended Cobb–Douglas function using only the PD next to the capital variable. Exempting private debt is decisive since private debt is one of the main factors entailed in financial instability and economic crises.

Another important limitation the literature does not consider when measuring debt is “...that a high proportion of foreign currency denominated debt could increase financial fragility and lead to sub-optimal macroeconomic policies (Eberhardt and Presbitero, 2015).” The sample period and the model play an essential role in methodology, while a primary concern is to preserve some homogeneity. Despite the efforts of some studies to achieve this goal, there were too many restrictions in their dataset. Swamy (2020) argues that his work is unique in addressing, *inter alia*, matters of data adequacy and country coverage. He presents new empirical evidence based on a sizeable dataset that includes 252 countries. Nevertheless, in our point of view, it is quite doubtful if this large sample can be homogeneous. In accordance with the recent trend that examines the causality in PD–EG interaction, it is admitted, along with the authors supporting this view, that low economic activity could be the reason for high indebtedness.

The discussion on literature methodology presented above reveals some possible research gaps. First, it is noted that there is no systematic analysis of the impact of GDP on PD as a result of the global financial crisis of 2008 (GFC-2008). With the exception of some studies claiming that financial crises negatively affect growth path

(see Checherita-Westphal and Rother, 2012; Gomez-Puig and Sosvilla-Rivero, 2015; Juergen, 2019; Lim, 2019; Amann and Middleditch, 2020; Pegkas *et al.*, 2020), the majority of literature does not examine this prospect. Even a few studies that identify the role of financial crises, and specifically the GFC-2008, as a driver of high indebtedness, encounter two main problems. On the one hand, their sample period is limited to that around the onset of the crisis, or, at best, they examine a few of the years following it, which means not estimating the overall consequences of the turmoil; on the other hand, their approximation is somewhat superficial, without reaching deeper into the matter. This research gap is apparent in the case of the Eurozone sovereign debt crisis in 2010, as an aftermath of the impact of GFC-2008. Most EMU countries presented low EG and high PD after 2008. Especially countries of the periphery (Greece, Italy, Spain, Portugal, and Ireland) came up against serious macroeconomic imbalances, which, in some cases (Greece), were extreme.

Second, the high level of debt has a negative effect on capital stock and economic growth. According to the 'conventional' view "*the issuance of government debt stimulates aggregate demand and economic growth in the short run but crowds out private capital and reduces national income in the long run* (Elmendorf and Mankiw, 1999)". The long term-interest rates could be an important channel through which the increase of PD can influence growth. *Higher public debt is likely to be associated by investors with higher sovereign risk premia, which could be translated into higher long-term interest rates. In turn, this may lead to an increase in private interest rates and a decrease in private spending growth, both by households and firms, which are likely to dampen output growth* (Baum *et al.*, 2013).

Regarding this point of view, we remark that in the last decade, although PD is at high levels in advanced countries, the long-term interest rates remain low, obviously due to huge Central Banks' intervention creating excess liquidity in capital markets. If we consider the example of the Eurozone, the literature that examines the interaction of PD and economic activity has not sufficiently answered why the long-term interest rates after 2013 have remained at low levels and the debt of many of these economies is so high.

Third, it has to be emphasized that the current macroeconomic ill of "secular stagnation", that is, chronic ZLB, anaemic growth, and price inflation below target, cannot be ignored in pertinent research. These three factors should not be absent from the research on causalities of the PD-EC relationship. Recent "secular stagnation" state in most of the OECD countries should be perceived as a permanent effect of financial crises and ineffectiveness of formal economic policy.

Discussion

Our purpose in this survey is to illustrate selective literature papers concerning the relationship between PD and EG. RRs' work has managed to establish a highly "stylised fact", while preventing the identification of relevant causality. However, concerning the latter, it has driven recent papers to move away from correlation. Krugman (2013) pointed out the importance of RRs' research as the "*...more immediate influence on public debate than any previous paper in the history of economics*". The establishment of a 90% threshold as a "stylised fact" appears to offer strong support for implementing austerity policies on both sides of the Atlantic, namely, Europe and the United States. Nevertheless, the results of these policies were devastating in terms of, at least, unemployment and per capita income, especially for many economies in the periphery of the Eurozone (Herndon *et al.*, 2014; Romer and Romer, 2018; Amann and Middleditch, 2020).

The classification of the studies presented above reveals some strong and weak points regarding their techniques. On the one hand, as Panizza and Presbitero (2014) demonstrate, the importance of PD dynamics and history of a specific economy related to the structure of this debt could together play a crucial role when examining this correlation. On the other hand, when we investigate causation, in some cases, the Granger-type causality test focuses exclusively on a bivariate relationship, thus providing only partial equilibrium results. It does not take into consideration the influence of other macroeconomic and institutional variables that could endogenously affect both debt levels and EG (De Vita *et al.*, 2018).

Our methodology illustrates some research gaps in the relationship examined. Many studies support that the decrease of EG is the cause for the increase in sovereign debt. We emphasise the importance of economic and financial crises for lowering economic activity. It is obvious that financial crises are one of the main influential factors for real national income, as has been proven in the case of the GFC-2008. Romer and Romer (2017) found that in the aftermath of financial crises, the real GDP plunged with asymmetric variability; not only was it statistically significant but persistent too, although moderate in magnitude.

Therefore, the 2008 global economic and financial collapse should be clearly considered not only a period of significant financial turmoil but also one of a highly correlated distress call. Proano *et al.* (2014) confirm that financial crises are a decisive factor of non-linearity between debt and GDP. High levels of financial distress (such as the GFC-2008) negatively affect EG, irrespective of PD level. In the same context, Reinhart and Rogoff (2009) argue that the recessions caused by financial crises end at some point in time, but are usually accompanied by huge increases in government debt. This implies a protracted contraction of national output.

Focusing, now, on the EMU, relevant literature identifies the interaction of the level of debt and the level of financial distress and provides evidence that high debt reduces the level of economic activity during periods of financial turbulence. This is demonstrated particularly in peripheral countries of the “union” rather than in stand-alone economies (Proano *et al.*, 2014). From a macroeconomic point of view, output decline in the aftermath of a financial crisis is much more harmful for monetary union member-countries, since they do not have control over the currency in which their debt is issued, while their fiscal policy is monitored by supranational authorities, as opposed to a stand-alone country that usually has both its own control and monitoring (De Grauwe, 2011). In addition, the financial turmoil itself entails characteristics of exogenous variation and induces reduction of GDP (Romer and Romer, 2018).

Consequently, literature finds that higher PD, linked to higher sovereign risk premia, leads to higher long-term interest rates through a non-linear relationship. Ardangna *et al.* (2007), using a panel VAR estimation, argue that when the debt ratio exceeds 65%, debt has a positive effect on these interest rates. Baum *et al.* (2013), considering two time periods, namely, 1990-2007 and 1990-2010, show that a threshold value over 76.3% of the GDP, induces PD interest rates to rise. Jacobs *et al.* (2020), using a panel VAR model, also found that, for over-indebted countries, increase in long-term real interest rates has a negative impact on economic activity, causing further increase in PD, thus producing a vicious circle.

All these studies appear to have a common characteristic: their sample horizon is, at its best, until the year 2013. This means that they do not consider the fact that after the year 2009 for the United States and 2013 for the Eurozone, the new reality is ZLB economic environment, which includes zero or negative real interest rates. In their work, Jacobs *et al.* (2020) raise a question for future research: “...*why the long-term interest rate in one country stays at quite a low level in spite of large public debt, while it sharply rises in another country under the same circumstances?*”. This is their way of making a reference to Greece and Japan. The question could have already been answered since both these strongly heterogeneous countries appear with an anemic EG, negative real interest rates, and high levels of PD.

Future research on the PD-EG relationship must consider the new environment of “secular stagnation”, that is, all three components of chronic binding ZLB, low growth rates, and price inflation below target (Eggertsson *et al.*, 2019). It should also be proposed that inflation of stock prices be added, as a result of excess liquidity, or cheap money offered by central banks. On the one hand, “Japanification” or a long-term liquidity trap implies that low interest rates are expected to last for several years; on the other, negative rates, such as those of the Eurozone, or slightly raised policy rates, such as those of the United States, produce reasonable expectations for ineffective monetary policy (Blanchard and Summers, 2020). Contrary to macroprudential policy, and ten years after RRs’ work, some researchers (Eggertsson *et al.*, 2019) (although not arguing for higher PD), find evidence that increasing government

debt is an efficient approach to avoid secular stagnation. However, contrary to the traditional view, some others (Blanchard, 2019) support the view that increasing debt does not entail any fiscal cost or welfare loss. Examining the magnitude of interest rates in a welfare framework through intergenerational transfers, the important role of both the average safe rate and the average (risky) marginal product of capital can be observed. The crucial question is whether the safe interest rates will remain below the level of growth rates. If this happen, a “new normality” is going to be created, which means that this situation will likely be more the historical norm, than the exception.

If this “new normality” becomes true, we will probably face the challenge to re-evaluate the perspective of the improvement of debt sustainability through expansionary fiscal policy. Thus, as Furman and Summers, (2020) propose, “...it is more appropriate to compare debt stocks to the present value of GDP or interest rate flows with GDP flows”. As a result, the increase of output is more than the rise in debt and interest payments, thus reducing the debt-to-GDP ratio. Productive public investments with remarkably high rates of return could be an approach to increase an economy’s potential output. Public spending in research, infrastructure, and education is very possible in order to have utility “...far greater than the costs of any additional debt accumulation...” repay these investments in present value terms (Furman and Summers, 2020). Blanchard (2019) claims that in a secular stagnation environment, “...a number of arguments against high public debt, and in particular the existence of multiple equilibria where investors believe debt to be risky and, by requiring a risk premium, increase the fiscal burden and make debt effectively riskier. This is a very relevant argument, but it does not have straightforward implications for the appropriate level of debt.”

This paper includes, among others, the impact of increasing PD on interest rates and growth, which seems to be the core of future debate on the PD-EG nexus, providing a fruitful discussion on costs of debt and relevant policy.

Conclusions

The continuing debate on the PD-EG nexus proves that it is a more complex issue than that of the descriptive view of Reinhart and Rogoff (2010) in their seminal paper. Empirical evidence of relevant literature should be taken into account with caution, since, as has been shown through this paper, there is no pertinent comprehensive economic theory yet.

This article surveys the most important contributions in the literature that examine the interaction between PD and EG. We have classified studies into two main categories according to whether they use causality tests or not. In the survey done no clear support was found in favour of the position that PD (or EG) is the cause or the result. In the first category of the sample of studies surveyed, approximately half of those with causality tests proved that EG is the cause and PD is the effect in their

relationship. However, one should not forget that causality tests show the relation of the underlying statistical properties of the data used, not the underlying economic reasoning. The same approximate conclusion can be reached when considering the second half of Table 1, even though, most studies seem to have found PD as statistically significant in explaining the variability of EG. However, these identified models present no explicit theoretical foundation that has actually been tried to sketch through empirical methodology.

In addition, the negative interaction on a non-linear relationship over a specific PD limit, the so-called “threshold hypothesis”, has been characterised as a “stylised fact”. However, cross-country heterogeneity, parameter instability, and endogeneity problems converted this hypothesis from examining correlation to identifying causality, as mentioned above.

In this context, the methodology of this study has offered the opportunity to indicate three important issues relevant literature has not yet taken into account. First, no systematic analysis on the impact of GDP growth on PD has been found as a result of financial distress, such as the global economic and financial crisis of 2008. This is clear in the case of the Eurozone, where many countries have presented low EG and high PD after 2008. Second, although relevant literature argues that higher PD is correlated with higher sovereign risk premia, which, in turn, leads to higher long-term interest rates, one could observe that in the last decade, advanced economy countries present low levels of both long-term interest rates and EG. Furthermore, the literature surveyed did not take into consideration that, after 2009 for the United States and 2013 for the Euro area, the new reality has been a ZLB economic environment. Third, it is highlighted that further research in the PD-EG nexus must be examined under “secular stagnation” conditions, which have not yet been studied; these are characterised by restrictive ZLB, low EG rates and price inflation that falls below target.

It is remarkable that contrary to macro-prudential policy, some researchers support the view that increasing government debt is a natural approach to avoid secular stagnation. In any case, whether this argument becomes the “new normality” or not, it certainly offers food for future debate.

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