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What impacts what: a battle between Private and Public Debts and GDP

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Abstract

Since the burst of the financial crisis, it became mandatory to understand the dynamics between public debt and GDP. However, the private debt and GDP correlation was overlooked. This paper aims to overcome this breach, by exploring the casual relationship between private and public debts and economic growth, for a panel of 21 OECD countries between 1995 and 2016. The empirical results suggest that an increase in GDP growth, *ceteris paribus*, affects positively the private debt growth whilst lowering public debt growth. Nevertheless, the results are somewhat different between countries that participate or not in the European Monetary Union.

Keywords: Panel VAR models; Reverse Causality; Public Debt; Private Debt; Economic Growth

1. Introduction

Issues on the impact of debt on economic growth soon started to be studied by economists. However, before the burst of the global economic crisis in 2008 and the consequent debt crisis in European countries, most studies were based on emerging economies with low income levels and mainly related to foreign debt (Patillo et al., 2002; Clements et al., 2003; Patillo et al., 2004; Schclarek, 2004). Moreover, at the time, studies on government debt were mainly concerned in proving Ricardian Equivalence[1]. In particular, for Abbas and Christensen (2007), the lack of interest on this relationship was the result of one of the three following aspects: i) data unavailability for a substantial part of the countries; ii) public debt considered an endogenous variable (as in Ricardian Equivalence theory); and iii) the size of government debt has not been, until 2008, assessed as a problem in developed markets.

Nevertheless, similar issues to the ones presented in this research have been addressed, already, in the twentieth century, presenting contradictory results. On the one hand, Modigliani (1961), Diamond (1965) and Saint-Paul (1992) concluded that rising public debt invariably contributes to lower economic growth. On the other, Patillo et al. (2004), based on 61 developing countries between 1969-98, found a nonlinear relationship between debt and economic growth, in which low levels of public debt are associated with stronger GDP growth rates while higher levels of public debt lead to an economic burden.

Notwithstanding, the heyday of studies on this matter has occurred in the aftermath of the financial crisis, not only because of its intensity but also due to the difficulty that countries faced in reducing their (still) excessive debt levels.

[1]Ricardian Equivalence states that a government cannot stimulate spending since people assume that the present gains will be offset by higher taxes in the future. Therefore, public debt does not have an impact on GDP growth.

Laubach (2009), using USA data between 1976 and 2006, concluded that public debt has a negative impact on economic growth through enhanced interest rates. This would be referred again two years later by Cochrane (2011), who alerted for the increasing probability of the occurrence of a sudden fiscal crisis when public debt grows, due to a loss of investors' confidence in government's ability to pay its liabilities, leading to a sharp rise of interest rates.

Ferreira (2009), using a VAR model and a Granger-causality relationship between real GDP per capita growth and public debt, for 20 OECD countries between 1988-2001, found a cause-effect relationship: not only that public debt always restricts economic growth, but also that a higher real GDP per capita growth rate reduces public debt. Misztal (2010), using a very similar methodology for 20 European Union members, between 2000-2010, confirmed that result.

Kumar and Woo (2010), based on between estimator (BE), fixed effects (FE) and system generalized method of moments (SGMM) techniques for a panel of 38 developed and emerging countries, found that a 10 percentage points (p.ps.) rise in debt to GDP ratio is associated with a decrease of 0.2 p.ps. in annual real per capita GDP growth, with the impact being moderately higher in emerging economies. The authors also found evidence of non-linearity between the two variables: the higher initial debt level, the greater the negative impact on economic growth.

Reinhart and Rogoff (2010), in a prominent article and using a threshold model based on data for 44 countries between 1970 and 2009, identified the presence of the "U inverted" relationship between the two variables. The authors documented that developed or emerging economies face a sharply decline in their potential growth when their debt to GDP ratio reaches 90%. And, despite Herndon et al. (2013) have exposed multiple coding errors in the Reinhart and Rogoff study, the same results, even when controlling the impact on inflation and take into consideration the level of openness of the economy, would be obtained later by Spilioti (2015) for Euro Area countries, using data from 1981-2014.

Notwithstanding, there are also some results not entirely consistent with the previous literature. Easterly (2001) argues that the causality runs from slow growth to high debt. Abbas and Christensen (2007) identified on a sample of 93 low income countries and emerging markets between 1975-2004 a positive correlation between public debt and GDP growth. Lof and Malinen (2013), using a panel vector autoregressive model, for 20 developed countries, did not find evidence that debt impacts economic growth, even when higher levels of public debt are considered and finally, Panniza and Presbitero (2014), using an instrumental variable model for a sample of OECD countries, have found a negative correlation between public debt and growth, but this relationship disappears once endogeneity is corrected by using a variable that captures valuation effects caused by the interaction between exchange rate volatility and foreign currency.

The 2008's financial crisis also sparked research interest in the impact of different sources of debt on economic growth, albeit at a lower extend. Incorporating private (household and non-financial corporations) and public debt is vital in terms of policy insights in order to understand the dynamics around episodes of crisis and financial stress. On this regard, Cecchetti et al. (2011) on sample of 18 OECD countries from 1980 to 2010 documented that when corporate debt goes above 90% of GDP, household debt and government debt separately exceed 85% of GDP, then each of one becomes a drag on economic growth.

Wächter (2012), by summing up all types of debt (households, non-financial corporate and government) found that the GDP is maximized for debt to GDP ratios between 200% and 220%, but short-term economic growth starts to decline for levels over 150%.

Sutherland et al. (2012) also documented evidence that high private debt levels create vulnerabilities and transmit macroeconomic shocks, as households and enterprises lose the ability to smooth consumption and investment. Moreover, it was found that during a recession,

debt tends to move from the private sector to the government sector. Batini et al. (2015) suggest that high private debt rather than high levels government debt is a source of more serious problems of macro-fiscal vulnerability, as it leads to sharp declines of economic activity in the presence of adverse shocks. The authors also found evidence that excessive delays in implementing fiscal austerity raises the likelihood of new fallouts, in particular if interest rates are already at the zero lower bound. This second result was confirmed in a latter research of Mian, Sufi and Verner (2017), as it was noticed that countries that face these stricter monetary policy constraints or that are more reliant on external borrowing, are the ones that observe deeper losses when household debt to GDP ratio increases – rather than corporate debt or public debt. Moreover, the authors believe the severity of the recent global recession and the subsequent high levels of unemployment were somewhat predicted by a global household debt cycle.

This dissertation attempts to provide further insights on this discussion, by including private debt (household and non-financial corporations) in the model alongside with public debt. All in all, it is hoped that this study will give an understanding of the following questions: (i) if there is a relationship between the different forms of debt and economic growth; (ii) what is the cause-effect relationship; (iii) whether the impacts are permanent with the strength to threaten the sustainability of the country[2]; (iv) if the relationship alters significantly when time-fixed effects are accounted for or not; and (v) whether the interest burden is a channel in which this dynamic relationships occurs.

In order to respond to the aforementioned questions, a Panel VAR (PVAR) was computed through the GMM estimator for a sample of 21 OECD countries from 1995 to 2016. After modelling debt and GDP as a multivariate dynamic process, impulse response plots were

[2] Namely, whether rising debt threats the ability of a country to continue to grow and pay off its debt.

produced to visualize the path of the different types of debt (private and public) and GDP for ten years after a shock hits any of these 3 variables.

The results of this thesis support the view that causality runs from economic growth to debt growth, albeit in different directions. In particular, empirical data shows that when controlling other factors of growth, an increase of 1 p.ps. in economic growth leads to a decrease of 0.9 p.ps. in public debt growth. Conversely, the same increase in GDP growth results in a rise of 1.1 p.ps. in private debt growth. The results also show that the impacts after a shock are only temporary, fading with a maximum of seven years. These results do not support, therefore, the trends that argue that is mandatory for governments to decrease public debt in order to restore the sustainability of the respective country. Notwithstanding, it is worth noting that when the sample was reduced to include only countries in the European Monetary Union (EMU), the conclusions were somewhat different. In particular, in this case, data suggest that an increase in public debt leads to a slightly smaller economic growth while an increase in GDP does not result in a reduction in public debt. Consequently, the immediate implication of this latter finding is that countries in the EMU should behave more prudently, as they can easier enter in a recessive economic phase.

The remainder of the essay is structured as follows. Section two provides background information on trends of private and public debt. Section three presents the data and the estimation model that will be used to estimate properly given the fixed effects and endogeneity problems. Section four contains the empirical results and some robustness tests. Finally, section five provides concluding remarks and further studies that should be held to really understand the dynamism between the variables.

2. Trends in aggregate public and private debt

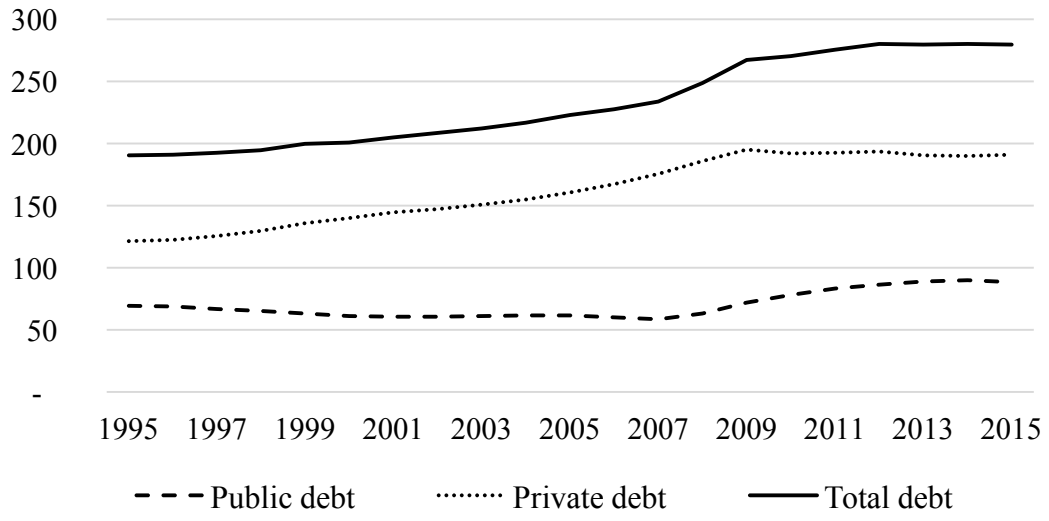
Since mid-1990s until 2012, advanced economies have observed a strong rise of indebtedness. Even though there is no consensus on the specific cause, this growth coincided with deeper financial market liberalization – which improved the stability of credit supply (Dynan et al, 2006) – and with the significant decline in real interest rates (Keen et al, 2010). The most prominent theory behind such reduction is the "Global Saving Glut Hypothesis" by Ben Bernanke, which argues that this evolution was the consequence of excessive savings compared to investment in emerging markets – a preference that derived from a poor social safety net, a desire for insurance and ageing populations' retirement needs. It is also likely that the rise in private debt has been particularly boosted, at least in some countries, by a friendlier tax policy, namely through preferential treatment of interests and tax relief mortgage interest payments along with explicit subsidies, which have encouraged companies to issue debt and household to buy new homes, respectively.

Figure 1 shows the average aggregate debt on the non-financial sector and its composition between 1995 and 2016 of the 21 OECD countries under analysis in this thesis[3]. Total debt combines public and private debt in which public debt corresponds to total government debt while private debt combines debt for households and non-financial corporations. According to figure 1, total debt as increased remarkably between 1995 and 2012. Starting at 190% of GDP in 1995, average total debt rose almost by 90 p.ps. until 2012 being, since then, somewhat flat. Until 2009, the upward trend in total debt was the result of increasing private debt (averagea growth rate of 3.4% year-on-year). As a result, right before the financial crisis, in 2007, private debt accounted for 75% of total debt. Notwithstanding, after the financial crisis hit the economies, rises in private debt came to a halt, stabilizing at approximately 190% of GDP,

[3] Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and United States

while public debt grew exponentially. This latter result was theoretical expected given that government revenues are positively linked to business cycles, while public spending is expected to be counter-cyclical.

Figure 1. Average aggregate debt as % of GDP over the sample of countries, 1995-2016



Source: IMF and BIS

3. Data and methodology

This essay uses annual data on 21 OECD countries[4] over the period 1995-2016. This choice offsets some critiques pointed out to previous studies, by including countries in a stable democracy, which pursue similar transparency goals in both fiscal and monetary policies (Ogowa, 2016). Moreover, the period under review includes a phase of economic expansion (the 1990s and the beginning of century), a financial crisis (2008-2012) and finally, a brief period of economic recovery (2013-2016). This sample also allows to check for eventual differences in responses to shocks between different subsamples, namely between countries that belong or not to the EMU or countries that suffered the most during the crisis, here

[4] Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and United States

interpreted as the economies that 8 years later had still not recovered to pre-crisis per capita GDP levels.

Data for the key variables such as GDP, population and public debt were obtained from the IMF WEO October 2017 database while private debt is from the BIS. Table 1, in the Appendix, presents the list of variables along with the respective description and sources, and Table 2 exhibits the country statistical summary.

The three main variables under analysis – private debt (P), public debt (G) and GDP (Y) - are presented in the logarithms of per capita variables, in real terms, in line with previous research (see e.g. Kumar and Woo, 2010 and Lof et al., 2013). However, considering the short period under analysis, population growth is not expected to drastically change the results.

To estimate the casual dynamic relationship between variables and to control for both unobserved heterogeneity in fixed effects[5] and the endogeneity problem that is likely to exist (see Panizza et al., 2012), a Panel VAR (PVAR) model was estimated, using the "difference general method of moments" (DGMM) (see Arellano and Bond, 1991).

The DGMM estimator uses the first-difference transformation to eliminate country-fixed effects[6], and combining therefore lagged levels of the dependent and endogenous variables as instruments. This is a common operation in the computation of dynamic panel data models, as the fixed-effects estimator is generally inconsistent for this type of models (Nickel, 1981).

To identify the shocks, a recursive structure was considered which makes the ordering of the variables relevant. An accepted view is that debt (public and private) boosts aggregate demand

[5] By using fixed effects, unobserved heterogeneity between countries can be restrained and the impact of debt on growth within a specific country can be measured.

[6] For an initial model $y_{i,t} = y_{i,t-1} + \alpha X_{i,t} + v_{i,t}$ and defining the full disturbance term as $v_{i,t} = \delta_i + \varepsilon_{i,t}$, the fixed effect δ_i drops when transforming the model into first differences $\Delta y_{i,t} = \Delta y_{i,t-1} + \alpha \Delta X_{i,t} + \Delta \varepsilon_{i,t}$

in the short-term but crowds out capital in the long-run, undermining the country's output (see Kumar and Woo, 2010). Not so straightforward is the causal relation between private and public debt. Nevertheless, there is some evidence that public debt is affected by governments' decisions to ease private borrowing restraints when private debt is presumably too high (see Batini et al., 2015). Therefore, private debt was placed before public debt, followed by GDP. As a robustness check, other recursive orders were considered as well, which ended up not having substantially different effects on the results.

All in all, the PVAR model estimated, after applying first-differencing is:

$$y_{i,t} = \alpha y_{i,t-1} + \beta y_{i,t-2} + \varepsilon_{i,t},$$

in which $y_{i,t} = (\Delta P_{i,t}, \Delta G_{i,t}, \Delta Y_{i,t})'$, α and β are a 3×3 coefficient matrix and $\varepsilon_{i,t}$ is a 3×1 (autocorrelated) residual term. The subscripts i and t denote country and year, respectively. The model includes only two lags, which are selected using the overall coefficient of determination (CD), as proposed by Michael and Inessa (2015), and which captures the proportion of the total variance that the model reproduces. According to the authors, the lag length is chosen merely through minimizing the AIC (Akaike's information criterion), BIC (Bayesian information criterion) and MQIC (Hannan-Quinn information criterion) criteria.

Given that the number of observations declines with the lagged variables included as instruments, it was chosen to use the GMM-style instrument as proposed by Holtz-Eakin (1988), in which missing values of instrument lags are replaced by zeros. Therefore, the sample gets bigger which results in more efficient estimates.

Finally, it was confirmed that the modulus of each eigenvalue of the estimated model is inferior to 1, which means that the model is stable. If this condition did not hold, then there would be no long-run equilibrium and the values in the future would just continue to increase, regardless

the existence of a shock or not. This is a necessary condition to produce and to obtain accurate results from the impulse response function.

4. Results

According to the results present in table 3 in appendix, there is, in fact, a dynamic relationship between private and public debts and GDP. In particular, data available suggests that a positive shock in economic growth in the previous period by one unit, *ceteris paribus*, increases private debt in the present by 1.10 percentage points (p.ps.). When private debt is changed by those 1.10 p.ps., government debt is impacted through this change by -0.12, which, consequently, positively affects GDP by 0.04.

Taking into consideration the magnitude of the impacts after the different shocks, it seems that the changes in GDP affect more public debt and private debt (albeit in different directions), than the other way around.

Additionally, the signals of these relationships do not seem surprising as there are fundamentals to support them: revenue received by the government evolves positively with economic growth, while the Government expenditure tends to decrease when GDP growth increases (via lower unemployment subsidies for instance); on the other hand, higher GDP growth is usually related with greater levels of job creation which supports households and businesses confidence levels, which in turn has a positive effect on private credit demand.

To understand in more detail the dynamic relationship between the three variables, it is crucial to scrutinize the Impulse Response Functions (IRF) derived from the model. An IRF simply illustrates how a stable model in equilibrium reacts to a disturbance in any of the included regressors and how and for how long it takes to return to the equilibrium after the initial shock. In this case, the ceteris paribus condition drops, and the different relationships between the

variables are accounted for. The confidence intervals were generated from the simulated impulse responses across 1000 Monte Carlo repetitions.

Figure 2 – Impulse-response functions computed from estimated PVAR (Eq. 1), for 20 countries over the period 1995-2016. Y-axis measured in %.

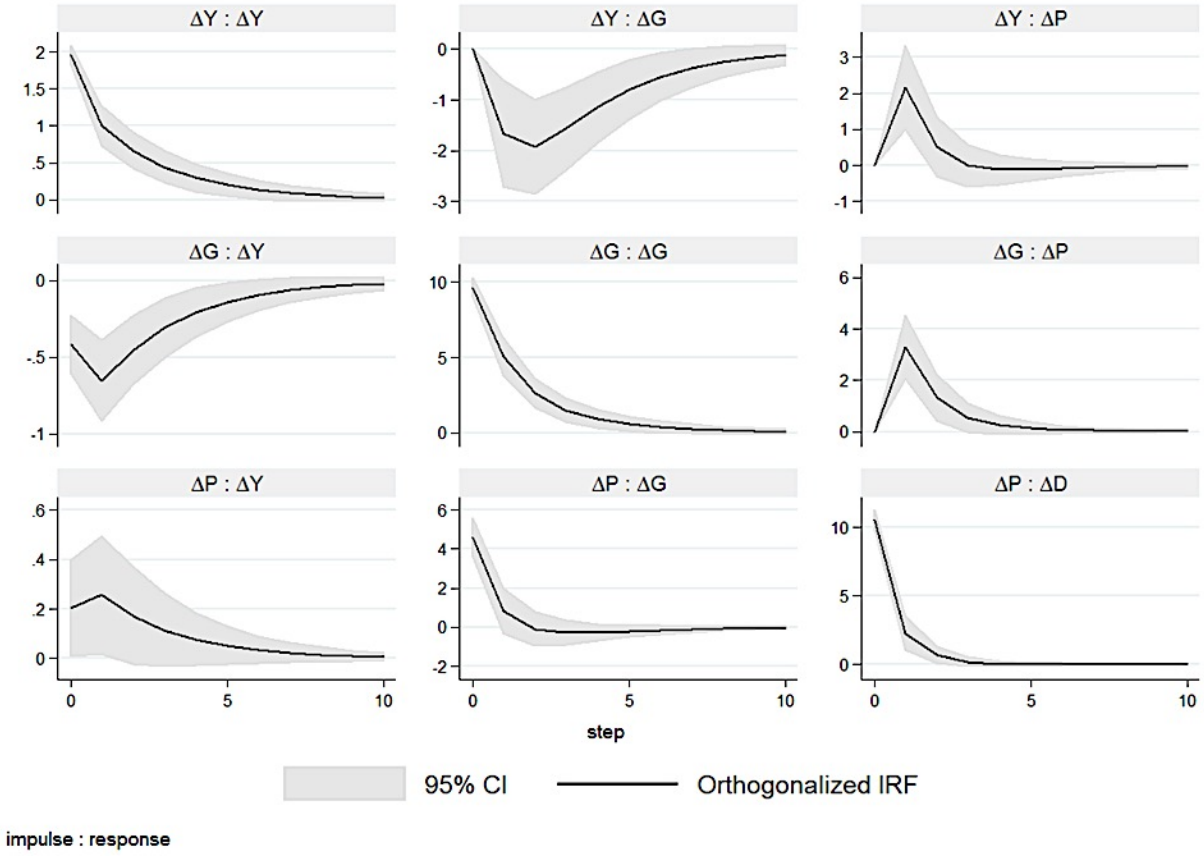


Figure 2 presents the impulse-response functions, where it is possible to capture the impact on economic growth (first column), public debt (middle column) and private debt (last column) for a period of ten years after a positive shock of one standard deviation to either growth (top row), public debt (middle row) or private debt (bottom row). Diagonal panels suggest that shocks to private debt is momentary, as the impacts fade out within the maximum of two years, while shocks to both GDP and public debt, despite being also temporary, are clearly more persistent petering out approximately only after seven periods.

The remain panels show the reaction on GDP after a shock in public and private debt, the impact on public debt after a shock in GDP and private debt, and, finally, the impact on private debt after a shock in GDP and public debt.

According to the second and third panels from the first row, data show evidence that a shock in GDP impacts significantly public and private debts, in opposite directions. Nevertheless, once again, the effect is only strong in the first couple of years, fading within three years in the private debt case, lasting for a bit longer in the case of public debt.

From the first and third panels from the second row, it seems that a positive shock in public debt impacts negatively GDP, while has a positive effect on private debt, although this latter impact holds for a minor period of time. Nevertheless, this impact is quite surprising, as it would be expected that an increasing public debt would lead to a decreasing private debt.

Lastly, according to the data, both GDP and public debt react temporarily and positively to positive shock in private debt, despite the impact on GDP being only marginal.

The IRFs support, therefore, the first conclusion in which the impact of a shock in GDP impacts in a bigger scale public debt and private debt than the other way around. This analysis shows additionally that all impacts are just temporary, fading within a maximum of seven years, suggesting that the presence of disturbances does not put the country sustainability on verge.

4.1 Robustness tests

In an attempt to find whether the conclusions are sensible to some specifications, the model was changed to include, in the first phase, time-fixed effects and lastly, different samples of countries according to some common characteristics. The results are presented in table 5 of the appendix.

Model 2 controls the possible presence of heterogeneity between years by including time-fixed-effects. Given the different phases that the sample includes (from expansion periods to deep financial crisis), it was likely that variance of the shocks would vary over time, leading to different results. Notwithstanding, the results are not significantly distinctive. The only disparity worth to identify is that in the current case, a shock of one unit in private debt in the past does not have a statistical effect on GDP, which is clearly against the theory that private debt raises economic growth trend. Once again, an increase in public debt leads to an increase in private debt, which is not coherent with the response of many governments in rising public debt to help the deleverage process of private households after the financial crisis that resulted in a sharp fall in private consumption. Therefore, this result shows a painful truth: while public debt soared, private-sector deleveraging did not occur as expected. Afterwards, countries end up with a higher than ever public debt stocks, which is the type of debt that damages economic activity growth.

In model 3, only the countries that belong to the European Monetary Union (EMU) were included, since the common currency came into circulation in 2002 until 2016, while in model 5 the remaining countries were included. In this case, once again it was not found remarkable differences in the results, yet the intensity in which the shock is felt in the two circumstances are important findings. In particular, it was uncovered that a shock in public debt in the past has an impact in GDP almost five times bigger in the EMU. Conversely, while in the remaining countries, a shock of one unit in GDP leads to a reduction of 0.8 p.ps. in public debt, in the EMU, the relationship is not even statistically significant. Moreover, when computed the model 3 taking into account the possibility of heterogeneity between years (results are presented in model 4), all relationship between the different variables drop, with exception for the negative causality between public debt and GDP. The results point out, thereafter, that the countries with no control on their monetary policy have not only increasing challenges to reduce their public

debt (and stimulate growth) but their public debt leads, in fact, to lower GDP growth. Hence, these countries need to have more prudent behaviours, as they can easily enter in a recessive path, having more difficulties to change their course.

The model 6 used only the countries that did not recover the levels of GDP per capita prior to the financial crisis – some of them even had international aid to assure the sustainability of the country in the short-term –, but the results are broadly in line with model 1.

Finally, it was opted to replace in the main model the variables public debt and private debt by the interest burden on them. The data was taken from Eurostat, and is available only to 14 out of 21 initial countries[7]. Once again, real per capita variables in logarithms terms were used. The purpose of this amendment was to see if the direction of the relationship changed when accounting only the effect of interest paid on that debt. The results are presented in table 6.

The results have altered slightly, but with no big surprises attached. Once again, the relationship goes from GDP growth to interest burden growth, but in this case, an increase of GDP growth leads to decrease in interest burden in both Private and Public sector. More importantly, this result suggests that a reduction in interest burden is the main channel of transmission between GDP and public debt – which latter was proven, with the results being on table 7, in appendix.

Regarding the private sector, since an increase in GDP leads to a reduction in private interest burden while increases private debt, it means that there are other factors that more than offset the decrease in implicit interest rate. One of this channels is the strong intensification of private consumption, as shown in table 8.

[7]Austria, Denmark, Finland, France, Ireland, Italy, Netherlands, Norway, Portugal, Spain, France, Sweden, Switzerland and United Kingdom.

5. Conclusions

Higher levels of indebtedness in developed countries for the last decades and particularly the strong acceleration in private debt observed before the financial crisis that followed by an enormous accumulation of public debt has resulted in an important debate regarding the sustainability of the countries. Following this trend, this paper aimed to provide further insights on this matter, by testing the dynamic relationship between private debt, public debt and GDP. It was found that increases in GDP growth, when controlling for other determinants of growth, affects positively private debt growth while lowers public debt growth, with the results, being, however, slightly different between countries that participate or not in the European Monetary Union. Particularly, it was found evidence that countries in the EMU have a bigger probability of entering in a recessive economic period, as increasing GDP does not result in lower public debt but an increase in public debt leads to a weaker GDP growth.

Finally, it was proved that the negative relationship between GDP and public debt holds even when the latter variable is replaced by the public interest burden. In fact, it was evidenced that an increase in GDP leads to a reduction in public debt through a lower interest burden, which mainly results from decrease interest rates – on this regard, certainly, the Quantitative Easing Program of the ECB has great responsibility.

5.1 Future research

Following the results of this thesis, there is room for future research in order to understand at higher extend the dynamics between debt and economic growth. Particularly, public and private debt should be replaced by external and domestic debt, to verify whether the links occur due to the type of debt or according to its holder. In fact, the lack of historical data in a common source for this sample of countries was the only obstacle to that analysis to not being performed

on this paper. Through that study it would be possible to understand why analysts and investors have significant different opinions regarding countries highly indebted as Italy and Portugal.

Taking into account the differences in the results between countries that belong to the EMU and the remaining economies, it would be useful to test if the results hold when included a greater sample of countries throughout more years. If so, it would also be interesting to test at what extend the lack of monetary policy damages the country's authorities capability to promote consumption and investment and, consequently, GDP.

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Appendix

Table 1 – Description of variables and data sources

Variable	Description	Source
$\Delta \boldsymbol{P}$ Gross domestic product per capita in constant 2010 USD$	The variable is constructed dividing GDP in constant 2010 USD$ for the variable "population", from the same source. The variable is logged and differentiated.	AMECO
$\Delta \boldsymbol{G}$ Private debt (household and companies' debt) per capita in constant 2010 USD$	The variable is constructed dividing "Credit to Non-financial corporations from all sectors at Market value" for the variable population. To put the variable in constant terms, the variable "GDP deflator" from AMECO is used. The variable is logged and differentiated.	Bank for International Settlements
$\Delta \boldsymbol{Y}$ Public debt per capita in constant 2010 USD$	The variable is computed using the variables "Gross government debt as % of GDP", "GDP at current USD$" and "Population". To put the variable in constant terms, the variable "GDP deflator" from AMECO is used. The variable is logged and differentiated.	IMF
ΔIP Private interest burden in constant 2010 USD$	The variable is constructed using the variable "interest paid" by non-financial corporations and households, divided by population. The variable was transformed in US Dollars, using the average exchange rate available in FRED. To put the variable in constant terms, the variable "GDP deflator" from AMECO is used. The variable is logged and differentiated.	Eurostat – Table Non-financial transactions
ΔIG Private interest burden in constant 2010 USD$	The variable is constructed using the variable "interest paid" by General Government, divided by population. The variable was transformed in US Dollars, using the average exchange rate available in FRED. To put the variable in constant terms, the variable "GDP deflator" from AMECO is used. The variable is logged and differentiated.	Eurostat – Table Non-financial transactions
ΔCP Private consumption in constant 2010 USD$	The variable is logged and differentiated.	AMECO

Table 2 – Summary Statistics by Country

	Real GDP per capita			Private debt per capita			Public debt per capita		
Country	**Min**	**Max**	**Average**	**Min**	**Max**	**Average**	**Min**	**Max**	**Average**
Australia	37,924.4	55,564.3	47,931.6	36,751.5	112,871.2	72,981.6	4,389.8	19,537.2	9,808.3
Austria	36,427.9	47,964.2	44,096.0	35,764.5	74,079.3	55,044.1	19,039.1	41,486.2	29,720.0
Belgium	35,288.5	45,618.4	42,028.0	35,317.5	94,613.3	65,671.6	29,481.1	48,228.0	40,552.7
Canada	37,635.8	50,679.1	45,651.1	40,903.3	94,819.9	66,081.3	23,578.9	42,684.9	31,564.6
Denmark	49,154.6	61,190.7	56,918.3	63,006.7	165,003.4	110,109.2	17,328.9	35,329.9	23,893.8
Finland	31,996.9	49,363.7	42,894.2	32,381.2	84,297.2	58,579.8	11,479.1	27,377.6	18,645.8
France	34,169.2	42,155.1	39,473.8	35,491.7	75,040.9	55,320.4	15,857.2	40,863.1	27,373.0
Germany	34,940.9	45,650.8	40,536.5	33,515.4	55,317.2	43,900.3	15,218.1	36,499.6	25,162.6
Greece	19,909.5	30,054.8	24,624.3	7,175.4	36,215.9	20,890.3	17,307.4	44,216.2	28,866.4
Ireland	28,772.7	67,588.3	47,275.5	24,224.4	172,942.1	97,855.5	10,120.1	57,503.5	26,883.8
Italy	32,829.9	38,009.7	35,399.3	19,117.4	48,092.5	33,033.9	26,068.7	44,451.4	36,303.5
Japan	40,326.6	47,672.7	43,835.4	52,610.7	83,581.0	63,873.9	32,529.3	117,918.1	66,851.2
Netherlands	38,436.1	52,135.8	47,558.5	56,359.5	130,254.1	95,087.6	15,394.1	34,434.9	25,383.9
New Zealand	83,635.2	102,530.9	96,916.4	24,546.8	69,559.3	49,137.1	4,206.7	12,102.5	7,473.6
Norway	22,588.9	33,019.2	28,378.0	87,337.8	211,351.8	147,314.6	14,427.9	46,341.9	27,109.2
Portugal	18,080.5	22,829.8	21,405.7	16,841.0	52,236.1	35,306.7	7,552.3	28,215.4	16,169.6
Spain	23,690.0	32,453.3	29,249.2	17,074.4	74,130.4	44,368.9	10,741.1	29,740.4	16,963.4
Sweden	37,687.0	56,205.7	48,350.0	47,202.3	136,721.6	87,815.2	16,320.3	28,409.4	21,797.1
Switzerland	60,855.9	76,116.8	69,887.1	73,347.4	182,706.9	121,877.1	22,284.0	39,130.3	31,402.8
U.K.	30,596.6	41,644.4	37,511.3	34,886.2	93,723.0	62,179.3	11,629.7	38,146.2	22,242.4
U.S.A.	38,632.7	52,152.4	46,824.3	46,317.8	83,654.4	68,677.4	23,864.4	56,040.3	36,361.6

Table 3 – Regression results for the first model

Final GMM Criterion Q(b)= 0.000			Nº of observations:399		Nº of panels: 21	
	Coefficient	Std. Err.	Z	P>|z|	[95% Conf. Interval]	
ΔP						
ΔP L1.	0.0242385	0.0643033	0.38	0.706	-0.1017937	0.1502706
ΔG L1.	0.3887471	0.0686298	5.66	0.000	0.2542352	0.523259
ΔY L1.	1.107942	0.3101401	3.57	0.000	0.5000788	1.715806
ΔG						
ΔP L1.	-0.1187902	0.0664202	-1.79	0.074	-0.2489714	0.0113911
ΔG L1.	0.4874378	0.0650122	7.50	0.000	0.3600163	0.6148594
ΔY L1.	-0.8532538	0.2731261	-3.12	0.002	-1.388571	-0.3179366
ΔY						
ΔP L1.	0.0343509	0.0117584	2.92	0.003	0.0113048	0.0573971
ΔG L1.	-0.0455315	0.0146682	-3.10	0.002	-0.0742808	-0.0167823
ΔY L1.	0.5126669	0.0665225	7.71	0.000	0.3822852	0.6430485
Instruments : l(1/2).(ΔP ΔG ΔY)						

Table 5 – Regressions results

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
ΔP						
ΔP L1.	0.0242	-0.0229	0.2039**	0.4402*	-0.0420	0.1465***
ΔG L1.	0.3887*	0.1797**	0.3960*	-0.0269	0.4039*	0.4482*
ΔY L1.	1.1079*	0.8537*	1.3743*	0.2261	0.9435***	1.1800*
ΔG						
ΔP L1.	-0.1188***	-0.1650**	0.0601	0.3195	-0.2875*	-0.0054
ΔG L1.	0.4874*	0.3828*	0.4700*	0.4669*	0.6201*	0.4099*
ΔY L1.	-0.8533*	-0.7783**	-0.0747	-0.3025	-0.7935***	-0.6467***
ΔY						
ΔP L1.	0.0344*	-0.0079	0.0702*	-0.0306	0.0380*	0.0556*
ΔG L1.	-0.0455*	-0.0183***	-0.1030*	-0.1008*	-0.0193***	-0.0720*
ΔY L1.	0.5127*	0.5668*	0.4033*	0.5902*	0.3933*	0.5667*
Lag number	2	2	1	1	1	1
Time Fixed Effects	No	Yes	No	Yes	No	No

Model 1: model that includes all 21 countries between 1995 and 2016.
Model 2: similar to Model 1, but includes Time Fixed Effects.
Model 3: model that includes only the countries that belong to the European Monetary Union (EMU), between 2001 and 2016: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal and Spain.
Model 4: similar to Model 3, but includes Time Fixed Effects.
Model 5: model that includes the countries that do not belong to the EMU, between 1995 and 2016: Australia, Canada, Japan, New Zealand, Norway, Sweden, Switzerland, United Kingdom and United States.
Model 6: model that only includes countries which did recovered yet the level of real GDP per capita registered before the financial crisis: Denmark, Finland, Greece, Italy, Netherlands, Portugal and Spain
Levels of Significance: * 1 percent, ** 5 percent, *** 10 percent

Table 6 – Regressions results of model with public and private tax burden and GDP

	Model 6
	Coefficient
ΔIP	
ΔIP L1.	1.5016*
ΔIG L1.	0.1798
ΔY L1.	-2.1179***
ΔIG	
ΔIP L1.	0.2302*
ΔIG L1.	0.0610
ΔY L1.	-1.4335**
ΔY	
ΔIP L1.	0.0028
ΔIG L1.	0.0209
ΔY L1.	0.3748*
Lag number	1

Model 7: model that includes the variables private tax burden, public tax burden and GDP, for 14 European countries between 1999 and 2016.

Table 7 – Regressions results of the casual relationship between public interest burden, public debt and GDP

	Model 7
	Coefficient
ΔIG	
ΔIG L1.	-0.0768
ΔGD L1.	0.5110*
ΔY L1.	-1.8783*
ΔGD	
ΔIG L1.	-0.1619**
ΔGD L1.	0.4910*
ΔY L1.	-0.5910
ΔY	
ΔIG L1.	0.02498
ΔGD L1.	-0.0298***
ΔY L1.	0.1977*
Lag number	2

Model 8: model that includes the variables public tax burden, public debt and GDP, for 14 European countries between 1999 and 2016.

Table 8 – Regressions results of model with private consumption and private debt

	Model 8
	Coefficient
ΔPD	
ΔPD L1.	0.2532*
ΔCP L1.	1.1169*
ΔCP	
ΔPD L1.	0.0149
ΔCP L1.	0.7064*
Lag number	2

Model 9: model that includes the variables private tax burden, public tax burden and GDP, for 14 European countries between 1999 and 2016.