LISBOA SCHOOL OF ECONOMICS & MANAGEMENT

MESTRADO

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DISSERTAÇÃO

THE ROLE OF GOVERNMENT DEBT ON ECONOMIC GROWTH

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Master in: Economics

Abstract
In our research, we study the effect of public debt on economic growth for annual and 5-year average growth rates, as well as the existence of non-linearity effects of debt on growth for 14 European countries since 1970 until 2012. We also consider debt-to-GDP ratio interactions with monetary, public finance, institutional and macroeconomic variables. We conclude that debt has a negative impact of -0.01% for each increment of 1% of public debt, although debt service has a 10 times worse effect on growth. We reach average thresholds for annual and 5-year average of 75% and 74%, respectively. Belonging to Eurozone has a detrimental effect of at least -0.5% for real *per capita* GDP, and banking crisis is the most harmful crisis for the growth phenomena.

JEL Codes: E62**,** H63, O47.
Keywords: government debt, economic growth, thresholds.

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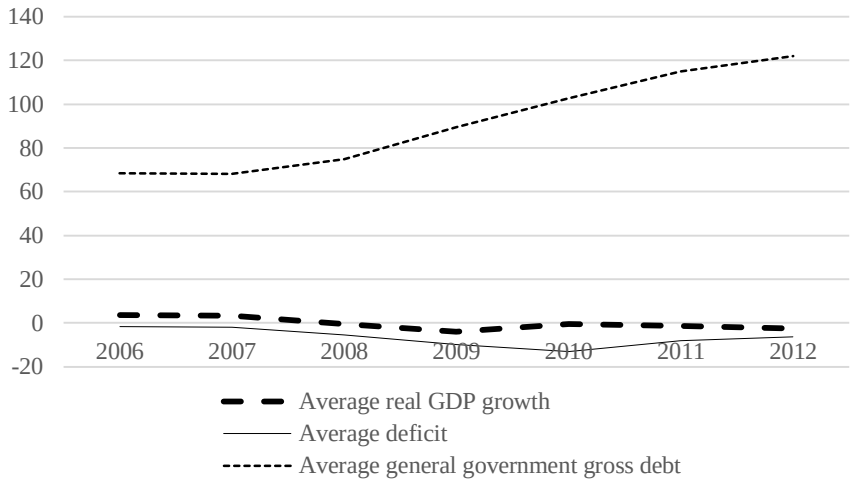
Contents

1. Introduction

In 2007, a financial crisis emerged from the U.S. financial system, namely, from the banking sector with the bankruptcy of Lehman Brothers. As a result, the fiscal imbalances of several countries grew in a way that originated a sovereign debt crisis, beginning in Greece and crossing all Euro-area countries, especially, the peripheral countries such as Portugal, Italy, Ireland and Spain.

During 2006 and 2012, in these particular countries, the general government gross debt ratio increased, on average, from 68.36% to 121.94% of GDP, and the budget deficit ratio grew, on average and in absolute terms, from 1.59% to 6.48% of GDP. However, when comparing the evolution of real GDP in these countries, it is evident a decline in that same period: in 2006 the mean of the real GDP growth rate was 3.73%, decreasing to -2.48% in 2012. All this evolution can be observed in Figure 1.

Figure 1: Evolution of public finance variables in Portugal, Ireland Italy, Greece and Spain between 2006 and 2012.



Source: World Economic Outlook, October 2013.

In addition to this economic performance, in 2010 a controversy aroused from the polemic Reinhart & Rogoff (2010) study about the effect of government debt on economic growth. Discussions regarding the evidence of mistakes in this paper fuelled the debate. Despite of economists and policymakers had focused their main debate in this central macroeconomics question, the economic and policy discussions have not being oriented yet, and in a precise way, for the real source of this problem. The multiple attempts taken by the governments until now just have prolonged the poor economic performance, along with several costs in general for the societies. Citing Buchanan (1966), the actual discussion around public debt has been a "murky battleground". In his article, Buchanan places an important question which could be the main query posed by the social scientists and politicians: "Who pays, and when, for public expenditures that are financed by debt issue instead of taxation or money creation?"

Wright (1943) says even though "our problem, let me again repeat, is not: Can deficits someday roll up an intolerable debt? Our problem is: What are the maladjustments which are making continued deficits necessary? (…) Are the taxes too heavy or too light, or are they poorly distributed and levied?"

In contrast with this reality, economic theory tells us that government debt could be an important vehicle to induce economic growth, and this dissertation pretends assess this issue. Besides this interaction, we also want to study possible evidence of an inverted U-shape relationship between debt and growth. As our results show, debt has a detrimental effect on growth, although debt service represents a larger damaging consequence for growth. We find too, evidence of debt thresholds around 75% and 74% for annual and 5-year average growth rates, respectively.

The remaining part of this dissertation is organized as follows. Section two provides a literature review regarding the theoretical viewpoints and the empirical works on the effect of public debt on economic growth and their relationship with monetary[1], public finance, institutional and, lastly, macroeconomic variables. Section three presents the methodology, several robustness tests, the data and its sources. Section four provides the empirical analysis. The last section presents the conclusions.

2. Literature Review

There is quite a lot of literature on economic theory about the importance of public debt on economic growth. Diamond (1965) describes a model that examines the long-run competitive equilibrium in a growth model and explores the effects of government debt on that same equilibrium. The author concludes that taxes have the same impact on individuals living during long-run equilibrium, whether they are used to finance internal or external debt. According to Feldstein (1985), in theoretical terms if the stock of capital is initially at an optimal level, it is better to finance a temporary increase in spending through debt because the excess burden of taxation depends on the square of the tax rate. When capital is below the optimal level, it is preferable to finance the amount of spending with taxation. These conclusions are taken from the relationship between capital intensity and the golden rule level: when capital intensity is less than the golden rule level, it implies that the government spending-labour force ratio is smaller than taxation *per capita* and so, the increase of debt must be financed by taxation.

[1] In these results we will also show results regarding the β - convergence process during the analysed time-span.

On the other hand, Martin (2009) tries to explain the level of debt affirming that the crucial determinant of this level is the compliance of households to substitute away goods being taxed by inflation. Despite of the welfare in an economy with debt being lower than an economy without debt, Wigger (2009) concludes that the generations could benefit from Ponzi schemes on issuing debt, depending on their preferences and on technology. Greiner (2012) relates a higher public debt ratio with a smaller long-run growth rate. However, in Greiner (2013), when the author assumes wage rigidity, the conclusion is different: public debt does not affect long-run economic growth or employment, only the stability of economy.

Focusing on empirical works about this subject, Schclarek (2004) investigates both linear and non-linear correlation among growth and government debt for developing and developed countries. For what matters in developed countries, the author does not find any linear or non-linear relationship between these two variables. Reinhart & Rogoff (2010) explore the possibility of a persistent relationship between high gross central government debt levels, economic growth and inflation based on a new database[2]. The authors affirm the existence of a weak link between growth and low levels of debt but when debt-to-GDP ratio is over 90%, the economies' growth rates are on average one percent lower than otherwise.

While exploring the influence of high public debt on long-run growth, based on a panel data of advanced and developing countries over 38 years, Kumar & Jaejoon (2010) reach two important conclusions: an inverse relationship between initial debt and growth; and the possibility of some non-linearity effects of debt on growth. Afonso & Jalles (2013) analyse the linkages between growth, public debt and productivity

[2] Database presented in Reinhart & Rogoff (2009) and Reinhart & Rogoff (2011).

throughout the analysis of 155 countries between 1970 and 2008. The authors conclude that there is a negative effect of debt ratio and financial crisis on economic growth. Still, higher debt ratios could benefit Total Factor Productivity (TFP) growth. Reinhart & Rogoff (2011) compiled a database on domestic debt which allows a better comprehension about the query of why the economies default on external debts at low thresholds of public debt.

Another empirical work that helps understanding the role of public debt on economic growth is provided by Cecchetti et al. (2011) who analyse the debt damage effect for 18 OECD countries in a 30 years' time span, reaching to an 85% government debt-to-GDP ratio threshold.

On the other hand, while investigating the same causality but now for twelve euro area countries between 1990 and 2010, Baum et al (2013) conclude there is a threshold rounding the 67% public debt ratio (above 95% there is a negative impact on economic growth) and the interest rates are pressured upward when debt ratio is greater than 70% of GDP. Checherita-Westphal & Rother (2012) study twelve euro-area countries since 1970 until 2010 and conclude that the negative effect of government debt on growth starts between 70% and 80%, and private saving, public investment and TFP are the channels whereby public debt is found to have a non-linear impact on growth. Introducing some political variables, Elgin & Uras (2012) relate the higher informal sector size with higher probability of sovereign default risk and country's public indebtedness, for 155 countries using data from 1960 until 2008. Heylen, et al (2013) analysing 132 fiscal episodes for 21 OECD countries over twenty-eight years and reach to a conclusion: consolidation programs of public debt reduction are more successful when they are followed by product-market deregulation and when they are

adopted by left-wing governments. Labour market deregulation could have a contrary effect on debt reduction, as well as wage bill cuts (this last point is only effective when government efficiency is low).

Gnegne & Jawadi (2013) investigate public debt and its dynamics for the UK and USA, which proved to be asymmetric and nonlinear, conclude that public debt seems to be based on several threshold effects that help to understand, with more accuracy, its dynamics. Certainly, macroeconomic events such as economic slowdowns, debt and financial crisis, as well as oil shocks, are proved to be important factors linked with structural breaks in public debt dynamics. In Kourtellos et al. (2013), a structural threshold regression methodology is used to investigate the heterogeneity causalities of public debt on economic growth. Reviewing the effect of political variables, the authors highlight an evidence of an inverse relationship of democracy degree on threshold effects.

Revising on the existing literature about the sustainability of public finances, Westerlund & Prohl (2010) examine both public revenues and expenditures for eight OECD countries through a nonstationary panel data approach, in which the authors do not reject the sustainability hypothesis. Fincke & Greiner (2011) study the reaction of primary surplus (in percentage of GDP) to variations in debt to GDP ratio in some euro area countries. Considering the group of PIIGS countries, their results show that only Ireland, Portugal and Spain give the impression of following a sustainable debt policy. For Greece, the conclusion of a sustainable debt policy is rejected, while for Italy the results are slightly dubious. Using a Keynesian framework, Leão (2013) affirms that under the full employment level, a rise in public spending may diminish the level of public debt-ratio. Teica (2012), for instant, proposes an analysis of public debt

sustainability in the euro area countries and states that debt sustainability can be achieved throughout a mix of budgetary and fiscal policies in order to reduce budget deficits and increase primary balances.

Other articles, as Wahab (2004) and Kolluri & Wahab (2007), distinguish the relation between government expenditures in different periods of economic growth (in expansionary and in a recession movements) for OECD and euro area countries. The first one suggests an inverse relationship, namely the results indicate that public expenditures increase less than proportionately in a time of growth, and decrease proportionately more on a recession. The second article evidences the increase of government expenditure during periods of a negative economic growth, and it also highlights the Wagner's proposition, which is less evident for euro-area members. On the other hand, in the Fölster & Henrekson (2001) article, the authors conclude that for all countries sample there is an evidence of both government expenditure and taxation being negatively related with growth.

In Campos, et al. (2006), the authors stress the importance of stock-flows reconciliation, that despite being commonly considered for many economists as a negligible entity to explain the dynamics of public debt growth, they found it as being a crucial determinant for debt dynamics. Contingent liabilities and balance-sheet effects, based on econometric tests done by the authors themselves, explain this variable. Gruber & Kamin (2012) examine the effect of the debt level and the fiscal balance for some OECD countries between 1988 and 2008, leading to a statistically significant impact of one percentage rise in the structural budget balance and net debt on the bond yield rates. Finally, Afonso & Jalles (2012), through a panel data of developed and emerging countries over 39 years, conclude a lesser economic growth in the presence of

increased fiscal policy volatility. Government spending presents symptoms of rigidity when compared with revenue during financial crisis periods.

3. Methodology and Data

3.1. Analytical Framework

This study uses the neoclassical growth model as the essential framework represented by the aggregate production function *Y=F(K,L)*, where *Y* is the aggregate output, *K* is the capital stock (both human and physical) and *L* is the labour force or population. Admitting the hypothesis of heterogeneity across economies and therefore, the existence of different steady states, from the analysis of this production function the concept of convergence arises. According to Barro & Sala-i-Martin (2004), "an economy grows faster the further it is from its own steady-state value" or, in other words, the model expects that economies with a starting lower value of real *per capita* income tend to grow faster than economies with higher values of real income.

However, in this dissertation we will consider different variables, namely the government debt-to-GDP ratio, once there are other aspects that can explain the convergence phenomena, besides considering only the initial *per capita* income. The aggregate production is now *F=(K,L,D)*, being *D* the debt-to-GDP ratio variable, which can be represented by the following equation:

(1) $$g_{it} = \alpha_{it} + \beta_{0it} y_{i0} + \beta_1 x_{it}^j + \beta_2 D_{it} + \eta_t + \nu_i + \varepsilon_{it}, t = 1,...,T; i = 1,...,N,$$

where g_{it} represents the real *per capita* GDP growth rate; y_{it} the real *per capita* income of 1970, the initial year of our time-span analysed; x_{it}^j, *j*=1,2 is a vector of control variables; D_{it} the government debt, in ratio to GDP terms; η_t and ν_i are,

respectively, the time effect and the country-specific effect; ε_{it} is an unobserved zero mean white noise-type column vector satisfying the standard assumptions; α, β_0, β_1 and β_2 are unknown coefficients to be estimated.

In order to study the non-linearity effect of government debt on economic growth, we will subsequently add to equation (1) the squared debt-to-GDP variable:

(2) $$g_{it} = \alpha_{it} + \beta_{0it} y_{i0} + \beta_1 x_{it}^j + \beta_2 D_{it} + \beta_3 D_{it}^2 + \eta_t + \nu_i + \varepsilon_{it}, t = 1,...,T; i = 1,...,N.$$

Moreover, we will add several variables described in section 3.3 in order to determine the effect of debt-to-GDP ratio in real *per capita* income while interacting with the mentioned variables.

3.2. Econometric approaches

3.2.1. Panel techniques

Instead of using cross-section methods to analyse the public debt effects on growth, we use panel data techniques to compute those dynamics on real *per capita* growth. One of the important advantages on using panel data estimation is to highlight the individual heterogeneity, once there are some differentiating features across cross section. Those particularities could, or not, be constant across time, in a way that time series or cross-sectional approaches may not take into account that referred heterogeneity leading to biased results. Amongst other advantages we can name in data panel techniques, the ones we find more important, especially to our study, are: a largest data set available, which allows identifying and measure with more accuracy the individual effects of the sample, contrarily to cross-section and time-series methods; less colinearity; and a greater efficiency in obtaining the estimation results.

On the other hand, we should also stress some problems related with panel data approaches, such as the possibility of an impact caused by unobserved heterogeneity, the lack of some particular data,[3] biased estimators due to incorrect specification of the model. Nevertheless, we should especially take into account problems related with endogeneity and cross-section dependence.

3.2.2. Heterogeneity

To deal with unobserved effects presented in equation (1), it is possible to apply a fixed effects or a random effects model. Admitting the existence of omitted variables and with the assumption of no correlation between the explanatory variables and the unobserved variables, the best way to handle with unobserved effects is using a random effects model. On the other hand, if the omitted variables and the explanatory variables are correlated, it is, then, preferred to apply a fixed effects model in order to deal with omitted variable bias.

Therefore, we apply the Hausman test to choose the best methodology to solve the problem of unobserved effects. The basic idea of this test is to examine if we can accept the null hypothesis, meaning that the random effects is the best solution, against its rejection, which concludes for the use of a fixed effects estimation. Through the Hausman test, the null hypothesis is rejected and so, we shall use the fixed effects estimation.[4]

[3] There are some variables for which there are no data available for some countries in particular years.
[4] For reasons of parsimony, the results for this test are not presented here. However, they are available in Appendix C – Additional econometric tests statistics, Table C1.

3.2.3. Endogeneity

As we mentioned earlier, the endogeneity problem is one of the main issues that can arise from panel data analysis. Once it could be present in regressors, one of the main objectives is to solve this problem in order to obtain unbiased estimators.

Endogeneity can emerge from omitted variables, measurement errors or simultaneity. This problem could lead to a rejection of "type 1 errors" or cause a failure when we pretend to reject the null hypothesis. Once the country-specific properties may carry on some unobserved omitted variables, for instance, by the misspecification of the model and with the natural consequence in obtaining biased estimators, that specific effect will not solve the endogeineity potential problem**.**

The Two Stage Least Squares estimator (2SLS) allows the correction of this problem of endogeneity, even for multiple endogenous explanatory variables. According to Wooldridge (2009), it is necessary to make use of order condition because when there is more than one endogenous variable, this could lead to a failure in the identification of the endogenous explanatory variable of our model. This referred condition uses the White diagonal covariance matrix in order to assume a residual heteroskedasticity.

3.2.4. Cross-sectional dependence

Sarafidis & Wansbeek (2010) mention that "one major issue that inherently arises in every panel data study with potential implications on parameter estimation and inference is the possibility that the individual units are interdependent." The presence of cross-sectional dependence causes misspecification of the model once the explanatory variables can be correlated with shocks or unspecified variables. The authors propose

several methods to solve this problem for the weak and strong cross-sectional dependence such as, the LM statistic test, also proposed by Breusch & Pagan, (1980). When *N* is large, LM statistic presents "poor size properties", citing the first authors' article. Taking into account the nature of our study – the number of variables, years and countries – it will be discarded the use of this statistical methodology.

According to Chudik, et al. (2009), the common correlated effects (CCE) estimator, studied by Pesaran (2006), allows the estimations to remain consistent and it also allows the asymptotic normal theory to still be applicable for a large number of weak and semi-weak factors in panel data studies. Therefore, it is used the Pesaran's CD test statistic in all of the methods used in the estimation. Lastly, we use the Generalized Least Squares (GLS) methodology to deal with cross-sectional dependence. As we will observe later in all the obtained results from econometric tests, we conclude that there is no cross-section dependence phenomenon, once the values computed for Pesaran's CD test statistic rejects this hypothesis.

3.3. Data

The model is estimated for a period between 1970 and 2012 and for 14 European countries: Austria (AT), Belgium (BE), Denmark (DK), Finland (FI), France (FR), Germany (DE), Greece (GR), Ireland (IE), Italy (IT), the Netherlands (NL), Portugal (PT), Spain (ES), Sweden (SE) and United Kingdom (UK). The dataset excludes some euro-area and OECD countries with poor data availability, in order to avoid a large measurement error.

The database[5] was collected from several sources. Real GDP (RGDP) *per capita* and Real GDP growth rate (RGDPGR), urbanization rate (URB), domestic credit to private credit sector in percentage of GDP (CREDIT), inflation as the percentage change in the cost of average consumer of acquiring a basket of goods and services (INFLATION) and trade openness throughout the sum of exports and imports of goods and services in percentage of GDP (TRADEOPE) were retrieved from the World Bank's World Development Indicators.[6] From AMECO database we collected the following variables: general government gross debt in percentage of GDP at market prices (DEBT), nominal short-term interest rate (SHORTINT), cyclically adjusted primary balance (CAPB), output gap relatively to potential GDP at market prices (OUTPUTGAP), general government total expenditures (EXP), primary budget balance (PBB), total budget balance (TBB), and debt service (DEBTS), which was constructed through the subtraction between primary budget balance and the total budget balance.

Population levels in thousands (POP), gross fixed capital formation growth rate (GFCF), average hours actually worked (AVH), annual growth rate, in percentage, of unit labour costs in total economy (ULC), the annual growth rate of labour compensation per unit of labour input in total economy (LC), current account balance as a percentage of GDP (CURRENT), long-term interest rates (LONGINT), rate of unemployment in percentage of total labour force (UNEM), taxes on goods and services as percentage of GDP (TGOODS), taxes on income and profits in percentage of

[5] The database used in this study is available in the following website: https://aquila2.iseg.ulisboa.pt/aquila/homepage/l37655/base-de-dados---tfm.-the-role-of-government-debt-on-economic-growth

[6] This dataset is available in the following website: http://data.worldbank.org/data-catalog/world-development-indicators

GDP (TINC), as well as life expectancy at birth, measured in number of years (LE), were taken from OECD.[7]

From Beck, et al (2009)[8], the liquid liabilities in percentage of GDP (M3), was used. Other variables, such as the index of human capital per person (HC), capital stock at constant 2005 national prices (K), total factor productivity at constant national prices (TFP), were based in Feenstra et al. (2013).[9]

In addition, we also use dummy variables. From Reinhart & Rogoff (2009)[10] database, we consider banking crises (BANKINGC), currency crises (CURRENCYC), inflation crises (INFLATIONC) and stock market crash (STOCKMARKETC) as dummies that take the value "1" for the specific year when the referred crises happen). Another variable from the same source we take into account is crises tally (CRISESTALLY), which represents the sum of each crisis in a particular year. Lastly, applying the criteria of (Afonso, 2005), we built a euro-zone (EURO), Maastricht Treaty (MAAS) and Stability and Growth Pact (SGP) dummies (the variable takes the value "1", if for each year the country is covered by such event). The descriptive statistics for all variables can be found in Table A1, in Appendix A.[11]

[7] This dataset is available in the following website: http://stats.oecd.org/#

[8] Data is available to download in the following website: http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/0,,contentMDK:20696167~pagePK:64214825~piPK:64214943~theSitePK:469382,00.html

[9] The referred is available to download in http://www.rug.nl/research/ggdc/data/penn-world-Table

[10] The collected variables are available in http://www.reinhartandrogoff.com/data/browse-by-topic/topics/7/. I would like to thank to Mr. Kenneth S. Rogoff who, due to lack of data in the referred website, provided me such data.

[11] It is important to highlight that some variables which are the logarithmic growth rates (computed by the author) of those variables not presented in this sub-section, are, in fact, shown in the Table of the descriptive statistics. To identify those variables, the suffix "GR" is added in the final of the respective variable acronym.

4. Empirical Analysis

For this analysis, we use two dependent variables: the real *per capita* GDP annual growth rate and the 5-year average of real *per capita* GDP growth rates. In the latter case the use of that variable takes into account the cyclical fluctuations in the real GDP path. In this study we use several explanatory variables to understand the behaviour of economic growth in the presence of public debt, as described before in sub-section 3.3. Since government debt will be interacting with different types of variables, we have decided to group them in 4 areas: monetary variables, namely interest rates; public finance variables; institutional variables; and macroeconomic variables. The variables used are presented in each table of results, with the respective code previously reported. For reasons of parsimony, we only show four tables in this section, namely regarding to some results where annual growth rates is the dependent variable. The other results are demonstrated in Appendix B.

4.1. Debt-growth relationship

Looking at all the results we can confirm the existence of the β-convergence process. The expected negative coefficient for the real *per capita* GDP is obtained and, in most of the cases, that coefficient is statistically significant at 99% level, meaning that the countries used in our sample converge themselves for their own steady-state in the analysed time span. In the case of 5-year average of economic growth there are some coefficients which have a positive signal but once they do not have any statistical significance for growth (at least a 90% level of significance) the relevance of those coefficients is not discussed.

In both cases of annual and 5-year average growth rates we obtain the expected negative sign for the debt coefficient. The detrimental effect of the debt-to-GDP ratio is around -0.01% for each level of 1% of government debt. For example, the level of debt in Greece in 2011, which was about 170.32%,[12] has a negative impact of about -1.7%.

Regarding the interest rates variables, the short-term nominal interest rate presents a statistical significance, in the majority of the regressions, with a positive sign at the 99% level in both cases of annual and 5-year average growth rates. Perhaps, it means that an increase in short-term interests could lead to a higher saving and thus, to a greater capital formation in order to leverage the growth rates in the short term. On the other hand, long-term interest rates have a negative sign. These impacts of both interest rates can be seen in Table 1.[13]

Regarding the results of the influence of debt on real growth, interacting with public finance variables, the main factor to highlight is the debt service coefficient. In fact, the results in all regressions exhibit a large detrimental impact for growth when compared with debt variable by 10 times, in absolute terms (see Table B4).[14] The primary budget balance, the cyclically adjusted primary balance and the total budget balance have the expected positive sign, which follows the idea of a balanced public finances that contribute positively for economic growth.

[12] This information was retrieved in Appendix A – Data Statistics.
[13] Other results regarding monetary variables are available in Tables B1, B2 and B3 in Appendix B.
[14] In Appendix B Tables B4, B5 and B6 also show the results related with public finance variables.

Table 1: Growth equations with linear debt effect on real GDP growth rate and with monetary variables.

Dependent variable:	OLS			OLS-FE			2SLS			GLS		
Real GDPpc growth	1	2	3	4	5	6	7	8	9	10	11	12
$rgdp_{it-1}$	-1.548*** (0.362)	-1.216*** (0.379)	-2.396*** (0.482)	-3.287*** (0.478)	-2.751*** (0.588)	-6.846*** (0.885)	-3.606*** (0.529)	-4.513*** (0.696)	-12.013*** (1.491)	-1.888*** (0.321)	-1.575*** (0.339)	-2.479*** (0.448)
$debt_{it}$		-0.013*** (0.004)	-0.012*** (0.004)		-0.007 (0.007)	-0.000 (0.007)		0.016* (0.009)	0.009 (0.009)		-0.009** (0.004)	-0.010** (0.004)
$shortint_{it}$			0.235*** (0.056)			0.206*** (0.060)			-0.261** (0.116)			0.251*** (0.054)
$longint_{it}$			-0.383*** (0.061)			-0.538*** (0.070)			-0.367*** (0.135)			-0.385*** (0.061)
Obs:	558	545	402	558	545	402	544	523	382	558	545	402
R-squared	0.053	0.072	0.144	0.112	0.110	0.231	0.104	0.079	0.060	0.074	0.081	0.149
DW-statistic	1.260	1.293	1.268	1.321	1.329	1.388	1.320	1.289	1.290	1.390	1.400	1.318
Pesaran CD statistic	23.236	23.337	23.074	23.789	23.681	23.728	23.006	21.189	21.680	22.926	23.099	22.894

Notes: *, ** and *** represent statistical significance at 10, 5 and 1 percent level respectively. The robust standard errors are in parentheses. The White diagonal covariance matrix is used in order to assume residual heteroskedasticity, except for the Generalized Least Squares methodology. DW-statistic is the Durbin-Watson statistic and Pesaran CD statistic is the Pesaran cross-section dependence statistic.

On the other hand, institutional variables demonstrate an evidence in which countries belonging to Eurozone suffer a growth decrease of more than -0.5%, existing even cases where this event presents an even more negative impact of -1%. The number of crises happened in a certain year has a negative sign, as we could expect.

In addition, banking crisis has the most negative crisis effect for economic growth, representing a downward dynamics on growth of more than -1%. Although stock market crashes are bad events for growth, they present themselves not statistically significant. Inflation crises and currency crises have also an undesirable and expected effect, having the latter crises about a half of the negative effect that inflation crises have.

Another important result to mention is the positive impact of the Stability and Growth Pact, which rely on a conclusion that the signature of this agreement lead to a better behave of public finances and, consequently, to a positive impact on economic growth.

However, the Maastricht Treaty has a dubious effect on the dependent variable, and in most cases, it not significant at a minimum of 90%, turning into a variable which does not need our moderation.

Table 2: Growth equations with debt linear effect on real GDP growth rate and with institutional variables.

Dependent variable:	OLS			OLS-FE			2SLS			GLS		
Real GDPpc growth	1	2	3	4	5	6	7	8	9	10	11	12
$rgdp_{it-1}$	-1.486***	-1.328***	-1.466***	-2.872***	-2.909***	-5.784***	-4.575***	-4.291***	-8.042***	-1.629***	-1.415***	-1.644***
	(0.373)	(0.375)	(0.430)	(0.600)	(0.587)	(0.958)	(0.722)	(0.696)	(1.133)	(0.337)	(0.312)	(0.370)
$debt_{it}$	-0.007**	-0.004	-0.004	-0.000	0.009	0.010	0.024***	0.031***	0.031***	-0.006*	-0.003	-0.002
	(0.004)	(0.004)	(0.004)	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)	(0.003)	(0.003)	(0.003)
$crisestally_{it}$	-0.971***			-0.928***			-0.873***			-0.794***		
	(0.140)			(0.147)			(0.156)			(0.124)		
$inflationc_{it}$		-1.480*	-1.501*		-1.444*	-1.371*		-1.383*	-1.355*		-0.841	-0.896
		(0.785)	(0.789)		(0.771)	(0.744)		(0.820)	(0.793)		(0.762)	(0.770)
$stockmarketc_{it}$		-0.236	-0.199		-0.116	-0.077		0.115	0.106		0.010	0.044
		(0.217)	(0.218)		(0.223)	(0.221)		(0.238)	(0.238)		(0.194)	(0.197)
$currencyc_{it}$		-0.752**	-0.784**		-0.676**	-0.721**		-0.595*	-0.696**		-0.705**	-0.731**
		(0.323)	(0.331)		(0.335)	(0.316)		(0.352)	(0.333)		(0.296)	(0.307)
$bankingc_{it}$		-2.149***	-2.070***		-2.225***	-1.977***		-2.451***	-2.122***		-2.048***	-1.975***
		(0.312)	(0.315)		(0.315)	(0.316)		(0.325)	(0.327)		(0.295)	(0.297)
$euro_{it}$			-0.836***			-0.605*			-0.525			-0.792***
			(0.312)			(0.331)			(0.347)			(0.286)
sgp_{it}			0.726**			1.429***			1.898***			0.775**
			(0.362)			(0.356)			(0.367)			(0.345)
$maas_{it}$			-0.032			0.670*			0.618*			-0.064
			(0.308)			(0.349)			(0.367)			(0.295)
Obs:	517	515	515	517	515	515	495	493	493	517	515	515
R-squared	0.134	0.176	0.185	0.155	0.201	0.233	0.126	0.183	0.217	0.122	0.181	0.192
DW-statistic	1.607	1.597	1.608	1.621	1.614	1.628	1.569	1.576	1.580	1.634	1.637	1.648
Pesaran CD statistic	20.648	3.983	4.495	21.235	7.314	8.103	18.856	9.015	9.348	20.886	5.621	6.187

Notes: *, ** and *** represent statistical significance at 10, 5 and 1 percent level respectively. The robust standard errors are in parentheses. The White diagonal covariance matrix is used in order to assume residual heteroskedasticity, except for the Generalized Least Squares methodology. DW-statistic is the Durbin-Watson statistic and Pesaran CD statistic is the Pesaran cross-section dependence statistic.

Analysing the results of the macroeconomic variables, presented in Table 4,[15] we can observe that taxation on capital and profits present a negative sign when statistically significant. Thus, it allows us to speculate about the possible burden of this type of taxation, given that there would remain fewer wealth to generate more capital. On the other side, the values obtained for taxation on goods and services do not follow the same constant pattern because they assume positive and negative statistical results. For that reason, it is no object of discussion in this analysis.

Another interesting result relies on the growth rate of credit to private sector. This variable induces a decline of economic growth by more than 0.01% per each amount of 1% increase of credit. According to Sassi & Gasmi (2014), this result is due to the larger proportion of credit conceived to households relatively to firms. The values of this paper confirms our results, in the sense that the households' credit effect on real *per capita* GDP is negative and it has a major role, in absolute terms, on economic growth. Contrarely to firms in which credit is used for productive investment, the growth of credit to households is followed by financial instability as well as the increase of external debt. A positive effect for the growth rate of *per capita* GDP is given by several variables, namely, annual growth rate of gross fixed capital formation, current account balance, trade openness, average hours worked and urbanization rate. Contrarily to these results, whenever liquid liabilities, life expectancy, the level of government expenditures and its annual growth rate, and unemployment rate are significant in statistical terms, they have an undesirable effect on economic growth.

According to economic theory, the output gap and total factor productivity variables present positive coefficients when the same are significant. In fact, a 1%

[15] Other results associated with macroeconomic variables are in Tables B10, B11 and B12 in Appendix B.

output gap beyond potential GDP will contribute for more than 0.5% of *per capita* GDP growth rate. Inflation, which is considered as a detrimental factor for real economic growth rate, follows a consistent pattern in the majority of cases, presenting the expected negative effect on growth in the regressions displayed by Tables 4, B10, B11 and B12.

Other results that must be highlighted are the fact that the level of population and the labour compensation per unit of labour have an important and positive explanation in the long-run (these results are just valid for regressions with 5-year average *per capita* growth rate as dependent variable). Even though the unit labour costs variable is significant, both in the short and long term, its effect differs across time: in annual terms, labour costs present as being negative for growth, but in a 5-year average, they achieve a positive result for economic path. Lastly, the human capital and the stock of capital do not present a constant sign across the several econometric tests, which do not lead us to a feasible conclusion for these two variables.

4.2. Non-linarities of government debt on growth

As proved in the previous section, government debt has a negative effect on growth, both in the short and long terms. Despite that behaviour, there are some articles which study the existence of a non-linear relationship between the debt ratio and the economic performance. As already mentioned, the evidence of an inverted U-shape is also detailed in this thesis. The threshold is associated with the level of government debt that most contributes to the economic growth. Supposing that we have a threshold of 60% of public debt-to-GDP ratio, for each additional value of 1% on debt from that point forward, the positive effect of debt on growth will consequently be lower, as its

levels continue to increase. These positive threshold effects may be related to the preference of government in releasing capital for the private sector and not relying only on taxation. Through this way, governments are able to stimulate investment and consumption by companies and households.

By adding the squared debt-to-GDP variable, equation (2) allows us not only to study the non-linearity effect of government debt on economic growth but also to analyse the values for the government debt thresholds. First, we decide to calculate these thresholds only when both coefficients of debt and debt squared are statistically significant, at least of 90% level; second, we derive equation (2), as demonstrated below in equation (3); third, we equalize to zero that first-derivative and get equation (4):

$$(3) \qquad \frac{\partial g_{it}}{\partial (D_{it}, D_{it}^{\,2})} = \frac{\partial (\alpha_{it} + \beta_{0it} y_{it-1} + \beta_1 x_{it}^{j} + \beta_2 D_{it} + \beta_3 D_{it}^{2} + \eta_t + \nu_i + \varepsilon_{it})}{\partial (D_{it}, D_{it}^{\,2})}$$

$$(4) \qquad 0 = \beta_2 + 2\beta_3 D_{it} \Leftrightarrow D_{it} = \frac{-\beta_2}{2\beta_3}.$$

To obtain the debt thresholds, we expect a negative β_3, i.e., a concave function of public debt effect on economic growth – the inverted U-shape. In Tables 3 and 4 we present some results for thresholds.[16]

Although we obtain threshold values that go from 49.49% to 108.24%, which depend on the econometric method used and on the set of variables, on average, the most observed threshold value is about 74.84% for annual growth rates.

For the 5-year average growth rate, we obtain a maximum effect of debt on growth of 74.44%, a similar value to the one we got on annual growth rates.

[16] Appendix B also exhibits the other obtained results for debt on the tables containing the debt-squared term.

Table 3: The non-linearity effect of public debt on real GDP growth rate, with public finance variables.

Dependent variable:	OLS			OLS-FE			2SLS			GLS		
Real GDPpc growth	1	2	3	4	5	6	7	8	9	10	11	12
$rgdp_{it-1}$	-1.912*** (0.441)	-1.562*** (0.441)	-2.531*** (0.438)	-4.134*** (0.827)	-4.320*** (0.884)	-5.187*** (0.744)	-5.479*** (1.037)	-7.260*** (1.174)	-5.791*** (0.794)	-2.260*** (0.401)	-1.789*** (0.425)	-2.998*** (0.409)
$debt_{it}$	0.061*** (0.016)	0.051*** (0.017)	0.081*** (0.017)	0.095*** (0.020)	0.092*** (0.021)	0.121*** (0.018)	0.128*** (0.026)	0.169*** (0.030)	0.135*** (0.022)	0.057*** (0.014)	0.046*** (0.016)	0.081*** (0.016)
$debt_{it}^2$	-0.001*** (0.000)	-0.000*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)	-0.001*** (0.000)
pbb_{it}	0.258*** (0.045)			0.309*** (0.045)			0.193*** (0.043)			0.290*** (0.038)		
$debts_{it}$	-0.030 (0.066)	-0.121* (0.069)		0.104 (0.086)	0.054 (0.088)		0.139 (0.103)	0.293*** (0.112		-0.045 (0.062)	-0.144** (0.065)	
$capb_{it}$		0.186*** (0.042)			0.254*** (0.046)			0.331*** (0.054)			0.208*** (0.041)	
tbb_{it}			0.244*** (0.042)			0.303*** (0.044)			0.191*** (0.044)			0.274*** (0.038)
Debt Threshold	59.647	51.813	75.585	70.533	66.259	78.990	82.339	83.684	84.117	58.299	49.493	77.063
Obs:	454	420	454	454	420	454	434	401	434	454	420	454
R-squared	0.250	0.185	0.211	0.308	0.247	0.296	0.269	0.216	0.264	0.274	0.195	0.228
DW-statistic	1.420	1.405	1.333	1.501	1.505	1.455	1.428	1.471	1.414	1.461	1.451	1.365
Pesaran CD statistic	20.583	22.070	21.259	20.951	22.621	20.886	20.885	19.977	20.798	19.632	21.547	20.265

Notes: *, ** and *** represent statistical significance at 10, 5 and 1 percent level respectively. The robust standard errors are in parentheses. The White diagonal covariance matrix is used in order to assume residual heteroskedasticity, except for the Generalized Least Squares methodology. DW-statistic is the Durbin-Watson statistic and Pesaran CD statistic is the Pesaran cross-section dependence statistic.

Analysing, on average, the results of each group of variables for annual growth rates, we get a maximum threshold for institutional variables of 95.84%, unlike for the macroeconomic variables case, which only obtain a lower value rounding 66.21%. The average thresholds obtained for the remaining variables, monetary and public finance, are 74.16% and 69.82%, respectively.

In the case of 5-year average growth rates, we reach to a high threshold of 91.27% for institutional variables (not on average, once there is only one result for this sample). In the case of public finance variables we get the minimum mean threshold, rounding the 63.11%.

Table 4: The non-linearity effect of public debt on real GDP growth rate, with macroeconomic variables.

Dependent variable:	OLS			OLS-FE		2SLS		GLS				
Real GDPpc growth	1	2	3	4	5	6	7	8	9	10	11	12
$rgdp_{it-1}$	-1,975***	-0,859***	-2,381***	-35,706***	-1,477	-8,682***	-19,918***	1,906	-7,140***	-1,959***	-0,817***	-2,338***
	(0,714)	(0,260)	(0,788)	(3,558)	(0,938)	(1,982)	(4,317)	(22,886)	(2,005)	(0,646)	(0,245)	(0,657)
$debt_{it}$	0,042**	-0,003	0,005	-0,012	-0,009	0,047*	0,105***	-0,040	0,048**	0,044**	-0,005	0,001
	(0,018)	(0,009)	(0,022)	(0,023)	(0,010)	(0,025)	(0,027)	(0,168)	(0,024)	(0,018)	(0,008)	(0,019)
$debt_{it}^2$	-0,000***	-0,000	-0,000**	-0,000	-0,000	-0,000***	-0,001***	0,000	-0,000***	-0,000***	-0,000	-0,000**
	(0,000)	(0,000)	(0,000)	(0,000)	(0,000)	(0,000)	(0,000)	(0,001)	(0,000)	(0,000)	(0,000)	(0,000)
pbb_{it}	0,259***		-0,111	0,280***		-0,110	0,220***		-0,107	0,273***		-0,117***
	(0,047)		(0,076)	(0,040)		(0,076)	(0,047)		(0,077)	(0,042)		(0,045)
$debts_{it}$	-0,038		-0,344***	0,186***		-0,179	0,385***		-0,200	-0,042		-0,337***
	(0,072)		(0,095	(0,071)		(0,135)	(0,093)		(0,136)	(0,071)		(0,078)
$tinc_{it}$	0,014			-0,105*			-0,215***			-0,005		
	(0,029)			(0,057)			(0,071)			(0,026)		
$tgoods_{it}$	-0,135*			0,150			0,533***			-0,049		
	(0,081)			(0,110)			(0,189)			(0,076)		
$\log(k_{it-1})$	-0,260**			11,709***			3,468			-0,265**		
	(0,130)			(1,914)			(2,263)			(0,125)		
$\log(tfp_{it})$	4,176***			39,517***			21,621***			4,278***		
	(1,267)			(3,113)			(4,156)			(1,269)		
$\log(hc_{it})$	0,632			25,501			12,357***			-0,201		
	(1,635)			(2,409)			(3,237)			(1,506)		
$inflation_{it}$		0,103***	-0,309***		0,085**	-0,268**		-0,223	-0,265**		0,112***	-0,348***
		(0,036)	0,114		(0,034)	(0,124)		(0,354)	(0,122)		(0,030)	(0,081)
$\log(pop_{it})$		0,020			-0,472			2,010			0,005	
		(0,065)			(2,616)			(18,134)			(0,059)	
$\Delta credit_{it}$		-0,015**			-0,017**			-0,1585			-0,011*	
		(0,007)			(0,008)			(0,610)			(0,006)	
$m3_{it}$		-0,003			-0,000			0,004			-0,001	
		(0,003)			(0,004)			(0,050)			(0,002)	

Dependent variable:	OLS-FE							GLS				
Real GDPpc growth	1	2	3	4	5	6	7	8	9	10	11	12
le_{it}		-0,165***			-0,130			-0,365			-0,173***	
		(0,041)			(0,090)			(0,979)			(0,036)	
$gfcf_{it}$		0,258***			0,255***			0,333			0,261***	
		(0,012)			(0,012)			(0,217)			(0,010)	
ulc_{it}		-0,192***			-0,211***			0,063			-0,188***	
		(0,033)			(0,033)			(0,445)			(0,027)	
$current_{it}$			0,122***			0,130**			0,128**			0,105**
			(0,041)			(0,052)			(0,053)			(0,032)
$tradeope_{it}$			0,010**			0,014			0,009			0,005
			(0,005)			(0,014)			(0,015)			(0,004)
exp_{it}			-0,034*			-0,083			-0,076			-0,033**
			(0,019)			(0,064)			(0,064)			(0,016)
$expgr_{it}$			-0,210***			-0,164**			-0,169**			-0,302***
			(0,064)			(0,066)			(0,067)			(0,038)
$unem_{it}$			-0,007			-0,098			-0,078			-0,035
			(0,043)			(0,078)			(0,078)			(0,039)
$outputgap_{it}$			0,551***			0,593***			0,596***			0,490***
			(0,085)			(0,088)			(0,089)			(0,056)
avh_{it}			0,004***			0,005			0,006			0,004***
			(0,001)			(0,004)			(0,004)			(0,001)
urb_{it}			0,031**			0,134***			0,120**			0,040***
			(0,013)			(0,053)			(0,053)			(0,012)
lc_{it}			0,009			-0,079			-0,071			0,032
			(0,060)			(0,068)			(0,067)			(0,053)
Debt Threshold	53.242					59.714	102.472		60.169	55.460		
Obs:	440	479	273	440	479	273	420	453	272	440	479	273
R-squared	0,248	0,735	0,658	0,558	0,753	0,710	0,469	0,430	0,709	0,265	0,747	0,724
DW-statistic	1,440	1,738	1,654	1,107	1,790	1,627	1,400	2,081	1,675	1,469	1,702	1,693
Pesaran CD statistic	20,045	7,307	13,983	13,669	7,199	14,980	17,429	4,473	15,209	19,483	7,742	10,146

Notes: *, ** and *** represent statistical significance at 10, 5 and 1 percent level respectively. The robust standard errors are in parentheses. The White diagonal covariance matrix is used in order to assume residual heteroskedasticity, except for the Generalized Least Squares methodology. DW-statistic is the Durbin-Watson statistic and Pesaran CD statistic is the Pesaran cross-section dependence statistic.

5. Conclusions

Today the academia and both sides of political spectrums discuss the role of government debt on economic growth, and it seems that we live in a "time of debt". But this "time of debt" we live in arose, mainly, when a certain kind of crisis recently emerged in 2007 with the bankruptcy of the biggest financial companies in the world, making us experience all of its consequences. What appeared to be a banking and financial crisis, it has become a sovereign debt crisis, affecting in particular the peripheral Eurozone countries.

In this thesis we have analysed the effect government debt has on real *per capita* GDP growth, annually and in 5-year average rates. We have also determined the effect of other variables while interacting with the sovereign debt-to-GDP ratio.

For 14 European countries and 43 years (1970-2012) we can conclude that, as usually affirmed, debt is negative for growth, both in short and long-terms. In addition to this fact, we highlight the process of convergence between our countries' sample. Looking at interest rates, short-term interest rate has a positive effect on growth, contrarily to the case of long-term rate. When we analyse both debt-to-GDP ratio and debt service variables, the last one has a much more negative effect on economic performance when compared with debt.

Contrarily to the Stability and Growth Pact signature, for which we have found evidence of positive contributions to economy once it had a disciplinable effect on public finances, the signature of the Maastricht treaty as well as the introduction of euro in some countries were some institutional events that led to a lower economic growth behaviour. Also, we stress the fact of banking crisis be the worst type of crisis that can occur in an economy.

Another important conclusion is that when debt interacts with macroeconomic variables we find evidences of unfavourable effects of taxation on capital and profits, the growth of credit to private sector as well as government expenditures. On the other hand, total factor productivity, current account balance and urbanization are some variables which contribute positively to growth.

Finally, we provide results showing the existence of an inverted U-shape relationship between debt ratio and economic growth. During the computation of the two average thresholds for this non-linear relationship, we have reached for annual and 5-year average growth rate thresholds of 75% and 74%, respectively. Therefore, and according to these values, government could keep debt levels under those values in order to avoid sovereign debt crises, like the one most countries in our sample are experiencing recently.

Although the undesirable debt effect, governments have the trade-off the increment of debt to stimulate aggregate demand and, posteriorly, growth. Debt should not be the main point in political and academic agenda if each economy had the sufficient and structural mechanisms to deal with it. Concentrating on how efficiently each economy could improve its economic path, surely is the best way to prevent the negative speculations about sovereign debt by financial markets, as we can see from the case of Greece, Ireland and Portugal – countries that have experienced a severe time of economic austerity.

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Appendix A – Data Statistics

Table A1: Summary statistics for the panel 1970-2012.

Variable	Mean	S.D.	Min.	Max.	Observations
RGDP	26641.64	9212.72	7235.73 (PT, 1970)	51676.84 (IE, 2007)	572
RGDPGR	1.78	2.49	-9.40 (FI, 2009)	10.59 (PT, 1973)	558
POP	26238.88	25317.20	2957.25 (IE, 1970)	82534.18 (DE, 2003)	601
GFCF	2.06	7.08	-33.51 (GR, 1974)	24.30 (GR, 1972)	594
ULC	5.62	6.34	-9.02 (AT, 1988)	39.34 (PT, 1975)	591
LC	5.98	5.02	-4.91 (GR, 2011)	31.26 (UK, 1975)	477
CURRENT	0.12	4.37	-14.96 (GR, 2008)	9.47 (NL, 2011)	348
LONGINT	7.26	3.46	1.40 (DK, 2012)	22.50 (GR, 2012)	445
AVH	1712.48	176.87	1381.00 (NL, 2010, 2012)	2208.00 (GR, 1983)	484
UNEM	8.37	3.79	1.56 (SE, 1989)	25.06 (ES, 2012)	377
EXP	48.51	6.48	28.73 (PT, 1977)	71.72 (SE, 1993)	484
EXPGR	0.50	4.47	-32.83 (IE, 2011)	30.77 (IE, 2010)	470
TINC	12.72	5.82	2.37 (GR, 1973)	31.16 (DK, 2005)	601
TGOODS	11.54	2.12	4.46 (ES, 1975)	17.03 (DK, 1986)	601
LE	76.38	2.95	66.40 (PT, 1971)	82.70 (IT, 2011)	564
M3	69.51	26.52	6.87 (IE, 1981)	180.33 (UK, 2009)	543
DEBT	56.11	29.18	1.72 (FI, 1974)	170.32 (GR, 2011)	589
INFLATION	5.81	5.58	-4.48 (IE, 2009)	28.78 (PT, 1984)	561
HC	2.65	0.35	1.66 (PT, 1970)	3.32 (DE, 2010, 2011)	588

Variable	Mean	S.D.	Min.	Max.	Observations
K	1866761.22	2099888.36	41184.71 (IE, 1970)	8873920.00 (DE, 2011)	588
TFP	0.94	0.11	0.63 (FI, 1971)	1.19 (ES, 1989)	588
URB	72.29	12.32	38.80 (PT, 1970)	97.51 (BE, 2012)	602
CREDIT	83.31	43.42	17.99 (GR, 1970)	232.10 (IE, 2009)	598
SHORTINT	7.52	4.99	0.57 (EMU, 2012)	24.56 (GR, 1994)	572
CAPB	0.96	3.35	-25.03 (IE, 2012)	10.46 (DK, 1986)	447
OUTPUTGAP	0.09	2.35	-11.92 (GR, 2012)	7.71 (PT, 1972)	580
PBB	0.84	3.59	-27.46 (IE, 2010)	11.62 (DK, 1986)	484
TBB	-3.27	4.22	-30.61 (IE, 2010)	7.73 (FI, 1976)	484
DEBTS	4.11	2.51	-12.60 (IT, 1993)	12.60 (FI, 1975)	484
TRADEOPE	72.19	33.21	25.79 (ES, 1970)	191.37 (IE, 2012)	602

Appendix B – Additional Results

Table B1: The non-linearity effect of public debt on real GDP growth rate, with monetary variables.

Dependent variable:	OLS			OLS-FE			2SLS			GLS		
Real GDPpc growth	1	2	3	4	5	6	7	8	9	10	11	12
$rgdp_{it-1}$	-1.548***	-1.443***	-2.390**	-3.287***	-3.536***	-6.734***	-3.606***	-5.570***	-11.720***	-1.888***	-1.731***	-2.518***
	(0.362)	(0.374)	(0.484)	(0.478)	(0.601)	(0.879)	(0.529)	(0.734)	(1.511)	(0.321)	(0.346)	(0.447)
$debt_{it}$		0.023	0.009		0.050***	0.016		0.098***	0.065**		0.014	0.004
		(0.015)	(0.020)		(0.017)	(0.021)		(0.019)	(0.030)		(0.014)	(0.019)
$debt_{it}^2$		-0.000**	-0.000		-0.000***	-0.000		-0.001***	-0.000**		-0.000*	-0.000
		(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)
$shortint_{it}$			0.217***			0.187***			-0.343***			0.243***
			(0.054)			(0.063)			(0.124)			(0.052)
$longint_{it}$			-0.347***			-0.500***			-0.225			-0.367***
			(0.060)			(0.078)			(0.153)			(0.060)
Debt Threshold					61.787			84.490	76.195			
Obs:	558	545	402	558	545	402	544	523	382	558	545	402
R-squared	0.053	0.088	0.147	0.112	0.139	0.233	0.104	0.107	0.039	0.074	0.086	0.156
DW-statistic	1.260	1.311	1.273	1.321	1.364	1.390	1.320	1.320	1.295	1.390	1.399	1.314
Pesaran CD statistic	23.236	23.377	23.140	23.789	23.743	23.795	23.006	21.299	21.846	22.926	23.112	22.894

Notes: *, ** and *** represent statistical significance at 10, 5 and 1 percent level respectively. The robust standard errors are in parentheses. The White diagonal covariance matrix is used in order to assume residual heteroskedasticity, except for the Generalized Least Squares methodology. DW-statistic is the Durbin-Watson statistic and Pesaran CD statistic is the Pesaran cross-section dependence statistic.

Table B2: Growth equations with linear debt effect in real GDP growth rate and with monetary variables, 5-year average.

Dependent variable: Real GDPpc growth 5-year average	OLS			OLS-FE			2SLS			GLS		
	1	2	3	4	5	6	7	8	9	10	11	12
$rgdp_{it-1}$	-1.548*** (0.183)	-1.208*** (0.189)	-1.397*** (0.315)	-3.450*** (0.314)	-2.787*** (0.334)	-4.075*** (0.511)	-3.832*** (0.346)	-3.820*** (0.363)	-5.846*** (0.706)	-1.706*** (0.144)	-1.419*** (0.156)	-1.798*** (0.262)
$debt_{it}$		-0.017*** (0.003)	-0.011*** (0.003)		-0.011*** (0.003)	-0.004 (0.004)		-0.000 (0.004)	0.008** (0.004)		-0.009*** (0.002)	-0.009*** (0.002)
$shortint_{it}$			0.121*** (0.027)			0.090*** (0.029)			0.071 (0.051)			0.076** (0.031)
$longint_{it}$			-0.147*** (0.035)			-0.229*** (0.037)			-0.282*** (0.058)			-0.111*** (0.041)
Obs:	558	545	402	558	545	402	544	523	382	558	545	402
R-squared	0.082	0.136	0.182	0.245	0.254	0.301	0.244	0.247	0.286	0.180	0.203	0.223
DW-statistic	0.385	0.415	0.462	0.468	0.480	0.517	0.473	0.480	0.508	0.404	0.417	0.443
Pesaran CD statistic	15.825	16.638	14.553	7.455	10.715	10.679	7.221	7.384	6.549	15.088	15.277	13.922

Notes: *, ** and *** represent statistical significance at 10, 5 and 1 percent level respectively. The robust standard errors are in parentheses. The White diagonal covariance matrix is used in order to assume residual heteroskedasticity, except for the Generalized Least Squares methodology. DW-statistic is the Durbin-Watson statistic and Pesaran CD statistic is the Pesaran cross-section dependence statistic.

Table B3: The non-linearity effect of public debt on real GDP growth rate, with monetary variables, 5-year average.

Dependent variable: Real GDPpc growth 5-year average	OLS			OLS-FE			2SLS			GLS		
	1	2	3	4	5	6	7	8	9	10	11	12
$rgdp_{it-1}$	-1.548***	-1.250***	-1.393***	-3.450***	-3.016***	-4.023***	-3.832***	-4.120***	-5.831***	-1.706***	-1.495***	-1.789***
	(0.183)	(0.197)	(0.315)	(0.314)	(0.345)	(0.498)	(0.346)	(0.375)	(0.707)	(0.144)	(0.162)	(0.264)
$debt_{it}$		-0.010	0.001		0.006	0.003		0.023**	0.011		0.001	-0.005
		(0.008)	(0.011)		(0.009)	(0.011)		(0.011)	(0.014)		(0.006)	(0.009)
$debt_{it}^2$		-0.000	-0.000		-0.000**	-0.000		-0.000**	-0.000		-0.000	-0.000
		(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)
$shortint_{it}$			0.110***			0.081***			0.067			0.074**
			(0.030)			(0.031)			(0.058)			(0.031)
$longint_{it}$			-0.125***			-0.211***			-0.275***			-0.104**
			(0.041)			(0.042)			(0.073)			(0.042)
Debt Threshold								68.951				
Obs:	558	545	402	558	545	402	544	523	382	558	545	402
R-squared	0.082	0.137	0.184	0.245	0.258	0.302	0.244	0.250	0.286	0.180	0.206	0.220
DW-statistic	0.385	0.416	0.461	0.468	0.483	0.515	0.473	0.483	0.507	0.404	0.419	0.441
Pesaran CD statistic	15.825	16.901	14.811	7.455	9.587	10.315	7.221	6.853	6.421	15.088	15.494	14.045

Notes: *, ** and *** represent statistical significance at 10, 5 and 1 percent level respectively. The robust standard errors are in parentheses. The White diagonal covariance matrix is used in order to assume residual heteroskedasticity, except for the Generalized Least Squares methodology. DW-statistic is the Durbin-Watson statistic and Pesaran CD statistic is the Pesaran cross-section dependence statistic.

Table B4: Growth equations with debt linear effect on real GDP growth rate and with public finance variables.

Dependent variable: Real GDPpc growth	OLS			OLS-FE			2SLS			GLS		
	1	2	3	4	5	6	7	8	9	10	11	12
$rgdp_{it-1}$	-1.418*** (0.440)	-1.054** (0.461)	-2.065*** (0.420)	-2.087*** (0.791)	-1.966** (0.941)	-3.683*** (0.700)	-3.257*** (0.988)	-4.074*** (1.170)	-4.479*** (0.762)	-1.740*** (0.402)	-1.339*** (0.432)	-2.466*** (0.404)
$debt_{it}$	-0.017** (0.008)	-0.024*** (0.008)	0.001 (0.006)	-0.017 (0.0119	-0.025** (0.011)	0.006 (0.009)	0.002 (0.013)	0.003 (0.014)	0.017* (0.009)	-0.015** (0.006)	-0.022*** (0.007)	0.006 (0.005)
pbb_{it}	0.214*** (0.040)			0.260*** (0.043)			0.128*** (0.042)			0.243*** (0.037)		
$debts_{it}$	-0.102 (0.076)	-0.191** (0.082)		-0.116 (0.095)	-0.187* (0.106)		-0.117 (0.115)	-0.058 (0.131)		-0.084 (0.065)	-0.177** (0.069)	
$capb_{it}$		0.128*** (0.040)			0.178*** (0.046)			0.220*** (0.054)			0.155*** (0.039)	
tbb_{it}			0.195*** (0.038)			0.233*** (0.042)			0.107** (0.045)			0.227*** (0.038)
Obs:	454	420	454	454	420	454	434	401	434	454	420	454
R-squared	0.191	0.131	0.144	0.238	0.177	0.195	0.189	0.151	0.146	0.221	0.150	0.168
DW-statistic	1.333	1.311	1.244	1.407	1.385	1.296	1.338	1.351	1.257	1.440	1.420	1.363
Pesaran CD statistic	20.745	22.207	21.702	21.167	22.527	21.691	21.376	20.876	21.340	19.965	21.790	20.862

Notes: *, ** and *** represent statistical significance at 10, 5 and 1 percent level respectively. The robust standard errors are in parentheses. The White diagonal covariance matrix is used in order to assume residual heteroskedasticity, except for the Generalized Least Squares methodology. DW-statistic is the Durbin-Watson statistic and Pesaran CD statistic is the Pesaran cross-section dependence statistic.

Table B5: Growth equations with debt linear effect on real GDP growth rate and with public finance variables, 5-year average.

Dependent variable: Real GDPpc growth 5-year average	OLS			OLS-FE			2SLS			GLS		
	1	2	3	4	5	6	7	8	9	10	11	12
$rgdp_{it-1}$	-1.465*** (0.304)	-1.500*** (0.341)	-1.909*** (0.264)	-3.047*** (0.639)	-3.903*** (0.822)	-3.902*** (0.485)	-3.412*** (0.678)	-4.567*** (0.884)	-4.490*** (0.487)	-1.330*** (0.207)	-1.391*** (0.241)	-1.936*** (0.193)
$debt_{it}$	-0.023*** (0.004)	-0.025*** (0.004)	-0.011*** (0.004)	-0.017*** (0.004)	-0.015*** (0.005)	-0.005 (0.004)	-0.011** (0.005)	-0.008 (0.006)	0.002 (0.005)	-0.019*** (0.003)	-0.018*** (0.003)	-0.002 (0.002)
pbb_{it}	0.112*** (0.020)			0.136*** (0.022)			0.136*** (0.027)			0.120*** (0.015)		
$debts_{it}$	-0.105** (0.045)	-0.120** (0.047)		-0.066 (0.060)	-0.041 (0.068)		-0.080 (0.063)	-0.025 (0.073)		-0.143*** (0.034)	-0.147*** (0.037)	
$capb_{it}$		0.105*** (0.023)			0.146*** (0.026)			0.176*** (0.033)			0.125*** (0.018)	
tbb_{it}			0.099*** (0.019)			0.121*** (0.021)			0.118*** (0.028)			0.109*** (0.016)
Obs:	454	420	454	454	420	454	434	401	434	454	420	454
R-squared	0.178	0.170	0.152	0.303	0.314	0.288	0.297	0.302	0.277	0.324	0.298	0.241
DW-statistic	0.353	0.346	0.336	0.419	0.422	0.402	0.459	0.468	0.437	0.512	0.490	0.441
Pesaran CD statistic	12.666	10.704	15.887	10.884	7.421	10.341	11.014	6.614	9.761	11.717	9.253	15.241

Notes: *, ** and *** represent statistical significance at 10, 5 and 1 percent level respectively. The robust standard errors are in parentheses. The White diagonal covariance matrix is used in order to assume residual heteroskedasticity, except for the Generalized Least Squares methodology. DW-statistic is the Durbin-Watson statistic and Pesaran CD statistic is the Pesaran cross-section dependence statistic.

Table B6: The non-linearity effect of public debt on real GDP growth rate, with public finance variables, 5-year average.

Dependent variable: Real GDPpc growth 5-year average	OLS			OLS-FE			2SLS			GLS		
	1	2	3	4	5	6	7	8	9	10	11	12
$rgdp_{it-1}$	-1.570*** (0.296)	-1.629*** (0.325)	-2.022*** (0.262)	-3.474*** (0.599)	-4.617*** (0.727)	-4.326*** (0.456)	-3.957*** (0.644)	-5.623*** (0.783)	-4.938*** (0.467)	-1.572*** (0.215)	-1.686*** (0.243)	-2.160*** (0.206)
$debt_{it}$	-0.007 (0.012)	-0.006 (0.014)	0.009 (0.013)	0.007 (0.0149	0.020 (0.014)	0.028* (0.015)	0.020 (0.016)	0.047*** (0.017)	0.043** (0.017)	0.008 (0.007)	0.017** (0.008)	0.026*** (0.008)
$debt_{it}^2$	-0.000 (0.000)	-0.000 (0.000)	-0.000* (0.000)	-0.000* (0.0009	-0.000*** (0.000)	-0.000*** (0.000)	-0.000** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)
pbb_{it}	0.121*** (0.023)			0.146*** (0.0239			0.152*** (0.029)			0.134*** (0.017)		
$debts_{it}$	-0.089** (0.043)	-0.103** (0.044)		-0.020 (0.057)	0.032 (0.060)		-0.017 (0.061)	0.091 (0.063)		-0.126*** (0.033)	-0.134*** (0.036)	
$capb_{it}$		0.120*** (0.028)			0.169*** (0.029)			0.213*** (0.035)			0.149*** (0.021)	
tbb_{it}			0.111*** (0.022)			0.141*** (0.023)			0.146*** (0.031)			0.125*** (0.017)
Debt Threshold						64.296		70.706	77.511		36.031	67.023
Obs:	454	420	454	454	420	454	434	401	434	454	420	454
R-squared	0.181	0.174	0.156	0.307	0.322	0.298	0.304	0.313	0.294	0.337	0.322	0.260
DW-statistic	0.356	0.349	0.339	0.422	0.430	0.412	0.467	0.487	0.456	0.530	0.521	0.459
Pesaran CD statistic	13.728	11.738	17.248	11.101	7.437	10.210	11.272	6.389	9.567	12.493	9.539	16.084

Notes: *, ** and *** represent statistical significance at 10, 5 and 1 percent level respectively. The robust standard errors are in parentheses. The White diagonal covariance matrix is used in order to assume residual heteroskedasticity, except for the Generalized Least Squares methodology. DW-statistic is the Durbin-Watson statistic and Pesaran CD statistic is the Pesaran cross-section dependence statistic.

Table B7: The non-linearity effect of public debt on real GDP growth rate, with institutional variables.

Dependent variable:	OLS			OLS-FE		2SLS			GLS			
Real GDPpc growth	1	2	3	4	5	6	7	8	9	10	11	12
$rgdp_{it-1}$	-1.527***	-1.409***	-1.519***	-3.180***	-3.283***	-6.426***	-5.097***	-4.884***	-9.058***	-1.665***	-1.514***	-1.713***
	(0.374)	(0.376)	(0.426)	(0.628)	(0.614)	(0.976)	(0.774)	(0.745)	(1.210)	(0.346)	(0.324)	(0.371)
$debt_{it}$	0.000	0.010	0.010	0.025	0.039**	0.047***	0.068***	0.080***	0.089***	-0.001	0.010	0.011
	(0.014)	(0.013)	(0.014)	(0.018)	(0.018)	(0.017)	(0.020)	(0.020)	(0.020)	(0.013)	(0.013)	(0.013)
$debt_{it}^2$	-0.000	-0.000	-0.000	-0.000	-0.000*	-0.000**	-0.000**	-0.000***	-0.000***	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$crisestally_{it}$	-0.968***			-0.917***			-0.855***			-0.792***		
	(0.140)			(0.148)			(0.158)			(0.125)		
$inflationc_{it}$		-1.528*	-1.549*		-1.544**	-1.487**		-1.544*	-1.543**		-0.874	-0.930
		(0.786)	(0.789)		(0.756)	(0.719)		(0.797)	(0.755)		(0.773)	(0.781)
$stockmarketc_{it}$		-0.200	-0.167		-0.068	-0.016		0.193	0.198		0.041	0.076
		(0.219)	(0.221)		(0.223)	(0.220)		(0.240)	(0.237)		(0.199)	(0.202)
$currencyc_{it}$		-0.782**	-0.809**		-0.708**	-0.763**		-0.635*	-0.752**		-0.733**	-0.752**
		(0.323)	(0.331)		(0.336)	(0.315)		(0.354)	(0.334)		(0.298)	(0.309)
$bankingc_{it}$		-2.154***	-2.076***		-2.216***	-1.953***		-2.440***	-2.085***		-2.056***	-1.981***
		(0.312)	(0.315)		(0.315)	(0.316)		(0.325)	(0.327)		(0.295)	(0.295)
$euro_{it}$			-0.828***			-0.615*			-0.543			-0.801***
			(0.311)			(0.328)			(0.347)			(0.287)
sgp_{it}			0.713**			1.503***			2.019***			0.757**
			(0.362)			(0.352)			(0.371)			(0.345)
$maas_{it}$			-0.059			0.712**			0.690*			-0.083
			(0.310)			(0.347)			(0.365)			(0.297)
Debt Threshold					85.993	83.301	100.987	108.244	100.656			
Obs:	517	515	515	517	515	515	495	493	493	517	515	515
R-squared	0.134	0.178	0.187	0.161	0.208	0.244	0.130	0.189	0.226	0.122	0.182	0.193
DW-statistic	1.607	1.600	1.611	1.626	1.623	1.642	1.569	1.581	1.590	1.633	1.639	1.651
Pesaran CD statistic	20.635	4.246	4.772	21.236	7.718	8.654	19.005	9.171	9.712	20.871	5.849	6.499

Notes: *, ** and *** represent statistical significance at 10, 5 and 1 percent level respectively. The robust standard errors are in parentheses. The White diagonal covariance matrix is used in order to assume residual heteroskedasticity, except for the Generalized Least Squares methodology. DW-statistic is the Durbin-Watson statistic and Pesaran CD statistic is the Pesaran cross-section dependence statistic.

Table B8: Growth equations with debt linear effect on real GDP growth rate and with institutional variables, 5-year average.

Dependent variable: Real GDPpc growth 5-year mean	OLS			OLS-FE		2SLS			GLS			
	1	2	3	4	5	6	7	8	9	10	11	12
$rgdp_{it-1}$	-1.270*** (0.180)	-1.192*** (0.179)	-0.946*** (0.202)	-2.770*** (0.344)	-2.857*** (0.344)	-4.018*** (0.619)	-3.793*** (0.372)	-3.694*** (0.377)	-5.775*** (0.717)	-1.381*** (0.157)	-1.286*** (0.157)	-1.209*** (0.185)
$debt_{it}$	-0.014*** (0.003)	-0.011*** (0.003)	-0.007*** (0.003)	-0.008** (0.004)	-0.002 (0.004)	-0.000 (0.004)	0.002 (0.004)	0.007* (0.005)	0.007 (0.005)	-0.007*** (0.002)	-0.004** (0.002)	-0.002 (0.002)
$crisestally_{it}$	-0.527*** (0.098)			-0.441*** (0.097)			-0.418*** (0.101)			-0.374*** (0.066)		
$inflationc_{it}$		-0.850* (0.474)	-0.914** (0.462)		-0.831* (0.428)	-0.829* (0.436)		-0.898* (0.461)	-0.898** (0.468)		-0.407 (0.490)	-0.504 (0.485)
$stockmarketc_{it}$		0.125 (0.194)	0.157 (0.193)		0.153 (0.191)	0.194 (0.190)		0.251 (0.201)	0.264 (0.199)		0.050 (0.105)	0.124 (0.102)
$currencyc_{it}$		-0.611*** (0.205)	-0.581*** (0.211)		-0.419** (0.205)	-0.425** (0.196)		-0.376* (0.215)	-0.420** (0.204)		-0.488*** (0.129)	-0.487*** (0.140)
$bankingc_{it}$		-1.407*** (0.165)	-1.330*** (0.162)		-1.270*** (0.156)	-1.098*** (0.163)		-1.348*** (0.164)	-1.103*** (0.171)		-1.107*** (0.138)	-1.016 (0.138)
$euro_{it}$			-0.935*** (0.187)			-1.054*** (0.202)			-0.945*** (0.203)			-0.970*** (0.169)
sgp_{it}			0.547** (0.216)			1.204*** (0.231)			1.504*** (0.234)			0.596*** (0.198)
$maas_{it}$			-0.403** (0.195)			0.181 (0.252)			0.352 (0.267)			-0.250 (0.163)
Obs:	517	515	515	517	515	515	495	493	493	517	515	515
R-squared	0.140	0.179	0.204	0.246	0.275	0.301	0.239	0.272	0.300	0.205	0.257	0.318
DW-statistic	0.484	0.532	0.556	0.537	0.579	0.620	0.534	0.590	0.637	0.522	0.591	0.658
Pesaran CD statistic	13.804	12.801	9.976	10.173	8.208	8.390	8.446	6.870	7.125	13.203	11.469	8.648

Notes: *, ** and *** represent statistical significance at 10, 5 and 1 percent level respectively. The robust standard errors are in parentheses. The White diagonal covariance matrix is used in order to assume residual heteroskedasticity, except for the Generalized Least Squares methodology. DW-statistic is the Durbin-Watson statistic and Pesaran CD statistic is the Pesaran cross-section dependence statistic.

Table B9: The non-linearity effect of public debt on real GDP growth rate, with institutional variables, 5-year average.

Dependent variable: Real GDPpc growth 5-year mean	OLS			OLS-FE		2SLS			GLS			
	1	2	3	4	5	6	7	8	9	10	11	12
$rgdp_{it-1}$	-1.238*** (0.190)	-1.191*** (0.189)	-0.955*** (0.208)	-2.842*** (0.359)	-2.978*** (0.360)	-4.249*** (0.615)	-3.901*** (0.390)	-3.854*** (0.394)	-6.110*** (0.711)	-1.380*** (0.164)	-1.307*** (0.163)	-1.231*** (0.189)
$debt_{it}$	-0.020** (0.008)	-0.011 (0.008)	-0.005 (0.008)	-0.002 (0.010)	0.008 (0.010)	0.013 (0.010)	0.011 (0.012)	0.021* (0.012)	0.027** (0.012)	-0.008 (0.006)	-0.002 (0.006)	0.004 (0.006)
$debt_{it}^2$	0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000** (0.000)	0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
$crisestally_{it}$	-0.530** (0.098)			-0.439*** (0.098)			-0.414*** (0.101)			-0.375*** (0.066)		
$inflationc_{it}$		-0.850* (0.475)	-0.922** (0.463)		-0.863** (0.426)	-0.871** (0.433)		-0.941** (0.458)	-0.960** (0.461)		-0.416 (0.491)	-0.518 (0.483)
$stockmarketc_{it}$		0.125 (0.197)	0.162 (0.196)		0.169 (0.193)	0.216 (0.191)		0.272 (0.203)	0.294 (0.200)		0.057 (0.106)	0.137 (0.103)
$currencyc_{it}$		-0.611*** (0.205)	-0.585*** (0.212)		-0.429** (0.207)	-0.441** (0.198)		-0.387* (0.218)	-0.439** (0.208)		-0.494*** (0.131)	-0.498*** (0.141)
$bankingc_{it}$		-1.407*** (0.165)	-1.331*** (0.162)		-1.267*** (0.157)	-1.089*** (0.164)		-1.345*** (0.164)	-1.090*** (0.172)		-1.113*** (0.140)	-1.026*** (0.139)
$euro_{it}$			-0.934*** (0.187)			-1.058*** (0.199)			-0.951*** (0.200)			-0.973*** (0.169)
sgp_{it}			0.545** (0.217)			1.231*** (0.229)			1.544*** (0.231)			0.579*** (0.199)
$maas_{it}$			-0.407** (0.195)			0.196 (0.254)			0.375 (0.270)			-0.258 (0.162)
Debt Threshold									91.271			
Obs:	517	515	515	517	515	515	495	493	493	517	515	515
R-squared	0.141	0.179	0.204	0.246	0.276	0.303	0.239	0.273	0.302	0.206	0.258	0.318
DW-statistic	0.484	0.532	0.557	0.537	0.583	0.626	0.535	0.594	0.646	0.523	0.593	0.662
Pesaran CD statistic	13.632	12.800	10.009	10.005	8.078	8.342	8.344	6.768	7.066	13.170	11.503	8.650

Notes: *, ** and *** represent statistical significance at 10, 5 and 1 percent level respectively. The robust standard errors are in parentheses. The White diagonal covariance matrix is used in order to assume residual heteroskedasticity, except for the Generalized Least Squares methodology. DW-statistic is the Durbin-Watson statistic and Pesaran CD statistic is the Pesaran cross-section dependence statistic.

Table B10: Growth equations with debt linear effect on real GDP growth rate and with macroeconomic variables.

Dependent variable: Real GDPpc growth	OLS			OLS-FE		2SLS		GLS				
	1	2	3	4	5	6	7	8	9	10	11	12
$rgdp_{it-1}$	-2.219***	-0.851***	-2.725***	-36.017***	-1.334	-9.101***	-27.051***	-2.717***	-7.917***	-2.193***	-0.821***	-2.421***
	(0.709)	(0.261)	(0.826)	(3.243)	(0.910)	(1.967)	(4.253)	(1.024)	(2.000)	(0.654)	(0.251)	(0.664)
$debt_{it}$	-0.023***	-0.008***	-0.041***	-0.018**	-0.019***	-0.021	0.011	-0.020***	-0.021	-0.021***	-0.006**	-0.038***
	(0.008)	(0.002)	(0.007)	(0.009)	(0.004)	(0.014)	(0.014)	(0.004)	(0.014)	(0.008)	(0.002)	(0.006)
pbb_{it}	0.224***		-0.150**	0.278***		-0.132*	0.207***		-0.129*	0.236***		-0.146***
	(0.044)		(0.068)	(0.040)		(0.074)	(0.046)		(0.074)	(0.041)		(0.041)
$debts_{it}$	-0.111		-0.374***	0.178**		-0.243*	0.248**		-0.259*	-0.115		-0.349***
	(0.080)		(0.093)	(0.072)		(0.134)	(0.100)		(0.137)	(0.074)		(0.077)
$tinc_{it}$	0.014			-0.100*			-0.161**			-0.013		
	(0.030)			(0.054)			(0.068)			(0.026)		
$tgoods_{it}$	-0.102			0.149			0.491***			-0.029		
	(0.083)			(0.111)			(0.180)			(0.076)		
$\log(k_{it-1})$	-0.164			11.873***			7.369***			-0.203*		
	(0.125)			(1.748)			(2.314)			(0.122)		
$\log(tfp_{it})$	5.717***			39.876***			29.119***			5.375***		
	(1.314)			(2.822)			(3.885)			(1.279)		
$\log(hc_{it})$	2.564*			25.842***			18.577***			2.283		
	(1.532)			(2.108)			(2.892)			(1.390)		
$inflation_{it}$		0.103***	-0.376***		0.087**	-0.375***		0.071**	-0.375***		0.112***	-0.376***
		(0.036)	(0.114)		(0.034)	(0.124)		(0.035)	(0.123)		(0.025)	(0.081)
$\log(pop_{it})$		0.024			0.072			1.386			0.004	
		(0.065)			(2.563)			(2.761)			(0.060)	
$\Delta credit_{it}$		-0.016*			-0.018**			-0.016*			-0.011**	
		(0.007)			(0.008)			(0.008)			(0.006)	
$m3_{it}$		-0.003			-0.001			-0.000			-0.000	
		(0.003)			(0.004)			(0.004)			(0.003)	

Dependent variable:	OLS			OLS-FE			2SLS			GLS		
Real GDPpc growth	1	2	3	4	5	6	7	8	9	10	11	12
le_{it}		-0.161***			-0.133			-0.059			-0.171***	
		(0.041)			(0.090)			(0.098)			(0.033)	
$gfcf_{it}$		0.259***			0.256***			0.255***			0.261***	
		(0.012)			(0.012)			(0.012)			(0.009)	
ulc_{it}		-0.192***			-0.212***			-0.207***			-0.189***	
		(0.033)			(0.033)			(0.033)			(0.021)	
$current_{it}$			0.133***			0.135**			0.135**			0.110***
			(0.041)			(0.053)			(0.054)			(0.032)
$tradeope_{it}$			0.009**			0.025*			0.020			0.006
			(0.005)			(0.014)			(0.015)			(0.004)
exp_{it}			-0.031			-0.045			-0.038			-0.029*
			(0.019)			(0.063)			(0.063)			(0.016)
$expgr_{it}$			-0.220***			-0.178***			-0.182***			-0.309***
			(0.065)			(0.067)			(0.068)			(0.038)
$unem_{it}$			-0.025			-0.115			-0.099			-0.036
			(0.046)			(0.081)			(0.080)			(0.040)
$outputgap_{it}$			0.589***			0.631***			0.634			0.522***
			(0.078)			(0.085)			(0.086)			(0.053)
avh_{it}			0.004***			0.005			0.006			0.003***
			(0.001)			(0.004)			(0.004)			(0.001)
urb_{it}			0.034***			0.143***			0.133**			0.039***
			(0.013)			(0.054)			(0.054)			(0.012)
lc_{it}			0.019			-0.044			-0.038			0.029
			(0.061)			(0.066)			(0.065)			(0.054)
Obs:	440	479	273	440	479	273	420	468	272	440	479	273
R-squared	0.219	0.735	0.651	0.558	0.752	0.700	0.503	0.750	0.698	0.234	0.748	0.718
DW-statistic	1.367	1.737	1.596	1.098	1.787	1.510	1.266	1.780	1.547	1.432	1.700	1.672
Pesaran CD statistic	20.043	7.277	13.579	13.604	6.913	13.890	16.528	6.769	14.201	19.715	7.739	9.635

Notes: *, ** and *** represent statistical significance at 10, 5 and 1 percent level respectively. The robust standard errors are in parentheses. The White diagonal covariance matrix is used in order to assume residual heteroskedasticity, except for the Generalized Least Squares methodology. DW-statistic is the Durbin-Watson statistic and Pesaran CD statistic is the Pesaran cross-section dependence statistic.

Table B11: Growth equations with debt linear effect on real GDP growth rate and with macroeconomic variables, 5-year average.

Dependent variable: Real GDPpc growth 5-year average	OLS			OLS-FE			2SLS			GLS		
	1	2	3	4	5	6	7	8	9	10	11	12
$rgdp_{it-1}$	0.274	-0.366	-2.780***	-7.725***	1.260	-4.468***	-14.735***	-1.450	-5.414***	-1.001**	-0.324	-3.016***
	(0.660)	(0.276)	(0.428)	(2.481)	(1.038)	(0.856)	(3.617)	(1.150)	(0.950)	(0.464)	(0.244)	(0.422)
$debt_{it}$	-0.017***	-0.005**	-0.028***	0.003	-0.005	0.022***	-0.002	-0.008*	0.022***	-0.023***	-0.002	-0.026***
	(0.005)	(0.002)	(0.005)	(0.006)	(0.004)	(0.008)	(0.006)	(0.004)	(0.008)	(0.004)	(0.002)	(0.004)
pbb_{it}	0.137***		0.011	0.069**		-0.055	0.134***		-0.057	0.122***		0.023
	(0.020)		(0.032)	(0.029)		(0.044)	(0.035)		(0.043)	(0.016)		(0.026)
$debts_{it}$	-0.107*		-0.332***	0.148*		-0.293***	0.162*		-0.280***	-0.192***		-0.296***
	(0.055)		(0.055)	(0.079)		(0.065)	(0.091)		(0.066)	(0.040)		(0.048)
$tinc_{it}$	-0.044			-0.008			-0.051			-0.013		
	(0.027)			(0.045)			(0.055)			(0.018)		
$tgoods_{it}$	-0.115**			0.444***			0.419**			-0.099**		
	(0.054)			(0.134)			(0.169)			(0.044)		
$\log(k_{it-1})$	-0.394***			-2.980**			0.624			-0.160**		
	(0.131)			(1.259)			(1.648)			(0.070)		
$\log(tfp_{it})$	0.480			14.636***			20.199***			1.228**		
	(0.807)			(2.744)			(4.082)			(0.584)		
$\log(hc_{it})$	-4.177**			10.817***			13.966***			-0.076		
	(1.765)			(2.232)			(3.119)			(0.863)		
$inflation_{it}$		-0.108***	-0.324***		-0.091***	-0.289***		-0.132***	-0.289***		-0.109***	-0.323***
		(0.036)	(0.048)		(0.035)	(0.0425)		(0.039)	(0.043)		(0.021)	(0.0394)
$\log(pop_{it})$		0.106*			4.830			7.240*			0.101**	
		(0.061)			(3.558)			(3.863)			(0.049)	
$\Delta credit_{it}$		0.003			0.000			0.005			-0.004	
		(0.007)			(0.006)			(0.006)			(0.006)	
$m3_{it}$		-0.004			-0.015***			-0.014***			-0.003	
		(0.003)			(0.004)			(0.004)			(0.002)	

Dependent variable: Real GDPpc growth 5-year average	OLS			OLS-FE			2SLS			GLS		
	1	2	3	4	5	6	7	8	9	10	11	12
le_{it}		-0.364*** (0.072)			-0.517*** (0.117)			-0.386*** (0.125)			-0.257*** (0.031)	
$gfcf_{it}$		0.061*** (0.015)			0.059*** (0.015)			0.056*** (0.016)			0.074*** (0.009)	
ulc_{it}		0.020 (0.029)			0.019 (0.029)			0.033 (0.030)			0.066*** (0.016)	
$current_{it}$			0.155*** (0.025)			0.154*** (0.033)			0.155*** (0.033)			0.142*** (0.020)
$tradeope_{it}$			0.002 (0.002)			0.006 (0.009)			0.009 (0.009)			-0.001 (0.002)
exp_{it}			-0.069*** (0.015)			-0.174*** (0.046)			-0.179*** (0.046)			-0.060*** (0.013)
$expgr_{it}$			-0.040** (0.016)			0.006 (0.014)			0.009 (0.014)			-0.035*** (0.012)
$unem_{it}$			-0.074** (0.029)			-0.207*** (0.040)			-0.219*** (0.041)			-0.087*** (0.026)
$outputgap_{it}$			0.013 (0.044)			0.006 (0.041)			0.003 (0.040)			-0.004 (0.035)
avh_{it}			0.002*** (0.001)			0.013*** (0.002)			0.013*** (0.002)			0.001** (0.000)
urb_{it}			0.016** (0.008)			0.009 (0.027)			0.017 (0.028)			0.022*** (0.007)
lc_{it}			0.123*** (0.041)			0.094*** (0.036)			0.088** (0.035)			0.115*** (0.031)
Obs:	440	479	273	440	479	273	420	468	272	440	479	273
R-squared	0.188	0.316	0.584	0.401	0.375	0.721	0.380	0.381	0.719	0.317	0.467	0.574
DW-statistic	0.372	0.619	0.996	0.501	0.671	1.329	0.609	0.697	1.316	0.530	0.818	0.922
Pesaran CD statistic	14.061	7.734	11.610	11.447	8.908	10.558	14.777	8.292	9.150	13.901	7.494	11.078

Notes: *, ** and *** represent statistical significance at 10, 5 and 1 percent level respectively. The robust standard errors are in parentheses. The White diagonal covariance matrix is used in order to assume residual heteroskedasticity, except for the Generalized Least Squares methodology. DW-statistic is the Durbin-Watson statistic and Pesaran CD statistic is the Pesaran cross-section dependence statistic.

Table B12: The non-linearity effect of public debt on real GDP growth rate, with macroeconomic variables, 5-year average.

Dependent variable: Real GDPpc growth 5-year average	OLS			OLS-FE			2SLS			GLS		
	1	2	3	4	5	6	7	8	9	10	11	12
$rgdp_{it-1}$	0.365	-0.392	-2.491***	-8.206***	1.154	-4.089***	-16.268***	0.573	-4.732***	-0.720	-0.352	-2.876***
	(0.647)	(0.277)	(0.424)	(3.103)	(1.042)	(0.837)	(5.097)	(8.661)	(0.916)	(0.460)	(0.242)	(0.424)
$debt_{it}$	0.007	0.011	0.010	-0.006	0.003	0.083***	-0.022	-0.015	0.083***	0.011	0.016***	0.031**
	(0.011)	(0.007)	(0.017)	(0.021)	(0.011)	(0.015)	(0.030)	(0.063)	(0.016)	(0.009)	(0.006)	(0.015)
$debt_{it}^2$	-0.000**	-0.000**	-0.000**	0.000	-0.000	-0.000***	0.000	0.000	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
pbb_{it}	0.150***		0.043	0.065*		-0.035	0.131***		-0.037	0.141***		0.058**
	(0.022)		(0.036)	(0.033)		(0.043)	(0.036)		(0.043)	(0.018)		(0.027)
$debts_{it}$	-0.080		-0.306***	0.135**		-0.236***	0.133*		-0.228***	-0.160***		-0.288***
	(0.054)		(0.055)	(0.065)		(0.064)	(0.070)		(0.065)	(0.040)		(0.047)
$tinc_{it}$	-0.044			-0.001			-0.040			-0.020		
	(0.027)			(0.050)			(0.063)			(0.017)		
$tgoods_{it}$	-0.127**			0.443***			0.410**			-0.100**		
	(0.054)			(0.131)			(0.161)			(0.044)		
$\log(k_{it-1})$	-0.430***			-2.726**			1.463			-0.232***		
	(0.128)			(1.281)			(1.980)			(0.073)		
$\log(tfp_{it})$	-0.094			15.192***			21.810***			0.728		
	(0.800)			(3.615)			(5.853)			(0.615)		
$\log(hc_{it})$	-4.896***			11.345***			15.302***			-1.550*		
	(1.708)			(3.158)			(4.739)			(0.930)		
$inflation_{it}$		-0.108***	-0.267***		-0.092***	-0.192***		-0.101	-0.192***		-0.106***	-0.274***
		(0.035)	(0.049)		(0.035)	(0.047)		(0.198)	(0.048)		(0.021)	(0.040)
$\log(pop_{it})$		0.095			4.426			9.697			0.087*	
		(0.061)			(3.769)			(8.665)			(0.050)	
$\Delta credit_{it}$		0.005			0.001			0.008			-0.003	
		(0.007)			(0.006)			(0.199)			(0.005)	
$m3_{it}$		-0.005			-0.015***			-0.009			-0.003	
		(0.003)			(0.004)			(0.019)			(0.002)	

Dependent variable: Real GDPpc growth 5-year average	OLS			OLS-FE			2SLS			GLS		
	1	2	3	4	5	6	7	8	9	10	11	12
le_{it}		-0.375*** (0.072)			-0.514*** (0.117)			-0.561 (0.395)			-0.271*** (0.030)	
$gfcf_{it}$		0.058*** (0.015)			0.058*** (0.015)			0.149 (0.095)			0.072*** (0.009)	
ulc_{it}		0.022 (0.029)			0.020 (0.030)			0.039 (0.181)			0.066*** (0.017)	
$current_{it}$			0.146*** (0.025)			0.149*** (0.033)			0.149*** (0.033)			0.133*** (0.019)
$tradeope_{it}$			0.002 (0.002)			-0.004 (0.009)			-0.002 (0.009)			-0.001 (0.002)
exp_{it}			-0.072*** (0.015)			-0.208*** (0.046)			-0.212*** (0.046)			-0.064*** (0.012)
$expgr_{it}$			-0.031** (0.016)			0.018 (0.014)			0.021 (0.014)			-0.025** (0.012)
$unem_{it}$			-0.059** (0.028)			-0.192*** (0.038)			-0.200*** (0.038)			-0.078*** (0.025)
$outputgap_{it}$			-0.019 (0.049)			-0.029 (0.041)			-0.031 (0.040)			-0.034 (0.036)
avh_{it}			0.002*** (0.001)			0.013*** (0.002)			0.013*** (0.002)			0.002*** (0.001)
urb_{it}			0.014* (0.007)			0.000 (0.026)			0.006 (0.027)			0.023*** (0.008)
lc_{it}			0.115*** (0.039)			0.062* (0.034)			0.059* (0.033)			0.108*** (0.028)
Debt Threshold						117.246			117.890		64.952	43.006
Obs:	440	479	273	440	479	273	420	453	272	440	479	273
R-squared	0.192	0.320	0.598	0.402	0.376	0.745	0.375	0.305	0.744	0.330	0.473	0.603
DW-statistic	0.376	0.618	0.995	0.503	0.669	1.383	0.618	0.927	1.374	0.547	0.822	0.926
Pesaran CD statistic	14.074	7.624	11.987	11.491	9.071	11.038	14.936	14.479	9.058	14.335	7.083	11.936

Notes: *, ** and *** represent statistical significance at 10, 5 and 1 percent level respectively. The robust standard errors are in parentheses. The White diagonal covariance matrix is used in order to assume residual heteroskedasticity, except for the Generalized Least Squares methodology. DW-statistic is the Durbin-Watson statistic and Pesaran CD statistic is the Pesaran cross-section dependence statistic.

Appendix C – Additional econometric-tests statistics

Table C1: Hausman-test results.

Method	OLS-FE		
Test	4	5	6
Table 1	28.970 (0.000)	15.452 (0.000)	36.203 (0.000)
Table 2	10.795 (0.013)	10.795 (0.0123)	29.513 (0.001)
Table 3	30.631 (0.000)	26.980 (0.000)	47.113 (0.000)
Table 4	289.094 (0.000)	29.949 (0.001)	95.846 (0.000)
Table B1	28.970 (0.000)	24.744 (0.000)	35.511 (0.000)
Table B2	23.808 (0.000)	11.286 (0.004)	34.071 (0.000)
Table B3	23.808 (0.000)	13.033 (0.005)	31.445 (0.000)
Table B4	19.489 (0.001)	14.969 (0.005)	19.836 (0.000)
Table B5	9.213 (0.056)	12.758 (0.013)	13.447 (0.004)
Table B6	12.979 (0.024)	16.417 (0.006)	19.782 (0.001)
Table B7	13.556 (0.009)	16.485 (0.021)	35.571 (0.000)
Table B8	12.106 (0.007)	11.869 (0.065)	22.317 (0.008)
Table B9	11.548 (0.021)	12.347 (0.090)	26.660 (0.003)
Table B10	326.161 (0.000)	28.399 (0.001)	83.483 (0.000)
Table B11	68.339 (0.000)	43.183 (0.000)	59.332 (0.000)
Table B12	97.205 (0.000)	41.179 (0.000)	69.741 (0.000)

Notes: The probability associated with the computed statistics are in parentheses.