Does Debt Have Threshold Effects on Medium-Term Growth? Evidence from European Union Countries*

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Abstract

Debt has become an important factor in economic activity and its extent has incentivized many researchers to incorporate it into contemporary growth models. On the positive side, debt has the ability to smoothen private consumption, firms' investment and government expenditure in relation to their corresponding income, subsequently leading to better capital allocation. However, the history of debt defaults and lessons from European sovereign debt crises, which were accompanied by strict austerity measures, have warned us about the danger of debt overhang and unsustainable debt burdens. This paper tackles the question of the existence of a turning point, at which the negative effects of debt start to prevail in the economic process. In the sample of European Union countries in the period from 1995 to 2019, the author of this paper investigated the presence of threshold effects of government, non-financial corporate and household debt on medium-term growth following the paper by Mika and Žumer (2017). The author first confirmed the concave-shaped relationship between public debt and growth with a threshold of 111.6% of GDP, based on Eurostat debt-to-GDP data. In contrast, private debt was found to have first lag effects with an accompanied convex-shaped relationship between private debt and growth and with a corresponding threshold of 149.8% of GDP. Next, the author divided private debt into non-financial corporate and household debt to investigate a more detailed relationship between debt and growth. Corresponding to the Global Debt Database, the concave-shaped relationship between public debt and growth was confirmed with a threshold of 104.8% of GDP. Both of the investigated types of private debt confirmed the previously explored lagged impact on medium-term growth and a convex-shaped relationship between non-financial corporate and household debt and growth. The threshold of non-financial corporate debt stands at 138.3% of GDP, while that for household debt is 145.1% of GDP. Considering the presence of thresholds may offer an important message to economic policymakers, as timely and suitable governance can lead to either higher economic growth or prevent adverse effects of excessive indebtedness.

* The views expressed in this paper are those of the author and do not necessarily represent those of the Ministry of Finance of the Republic of Slovenia.

Introduction

Throughout human history, debt has been an important factor in economic relations and has been well integrated into the economic activity of many different economic agents. Many economic subjects are facing a lack of financial resources, while, in contrast, there are plenty of economic subjects that have an excessive number of financial resources that have accumulated and are not currently required for their activity. The role of financial markets, or more specifically credit markets, is to connect credit surplus and credit deficit economic cells. Households, businesses, banks and governments have different ways of borrowing required funds, e.g. bonds, credit contracts or securitized bonds (Perkis, 2020).

Debt provides economic subjects with access to required financial resources that can ease their basic economic activities. The main role of debt for households is to smoothen consumption in relation to their income, while for companies it smoothens investments in relation to their revenue, and for governments it smoothens tax revenues in relation to their government expenditure. By aggregating the explained process, borrowing enhances the allocation of capital in all parts of the economy. Accumulation of capital is one of the most important growth factors and enhancing it with better allocation in the ongoing process can lead to higher economic growth. In addition to smoothening the consumption through an individual's lifespan, debt also has the ability to balance the consumption between different generations, as future generations would have greater human capital and better access to more productive technologies. Measuring and explaining debt dynamics is often focused on its relative terms as a percentage of GDP, which enables an appropriate comparison between countries and viable data input into regression analysis. On the one hand, debt enables better allocation and accumulation of capital and its excessive indebtedness, while on the other it has the potential to drag growth in the form of a lower accumulation of capital. Highly indebted economic subjects are more sensitive to changes in income, revenues and interest rates, therefore making them vulnerable to economic shocks and potentially higher probability of bankruptcy. Financing highly indebted economic subjects can stop in the event of lost trust in their solvency, which could on an aggregate level lead to lower consumption, investment and a higher unemployment rate as a result of increased bankruptcies. Combined, this can explain the lower aggregate accumulation of capital, while high nominal debt can increase the volatility of economic activity and market participants, while lowering the average growth rate (Cecchetti et al., 2011).

The basic arithmetic of government debt suggests that the government debt-to-GDP ratio is positively (in terms of an increase in the ratio) influenced by the higher real interest rate on debt, higher initial debt-to-GDP ratio or previous stock of government debt, and higher primary government deficit as a percentage of GDP, while higher growth rate has the potential to decrease governments' debt-to-GDP ratio. Governments can issue debt to cover the deficit between expenditure and tax revenues, however, excessive interest that needs to be paid off can create a debt burden. Structural budget deficits can, in the absence of tax rate increases or higher real interest rates, demand higher tax revenues, which should necessarily be even higher in the future in cases when potential tax rate increases are delayed (Blanchard, 2021, p. 481-486). In the short term, debt can devaluate with a high inflation rate, which may lead to a reduction in debt without debt consolidation and without consequent higher real interest rates or exchange rate depreciation (Hasanov & Cheriff, 2012). Boskin (2020) correlates increased indebtedness with higher future taxation, higher interest rates on further borrowing, harder budget planning, intergenerational inequity, higher eventual inflation and lower future incomes. Finally, the counter-cyclicality of fiscal policies is an important government feature to support the economy, which can be constrained in cases of high public indebtedness (Aghion & Kharroubi, 2013).

The automatic debt dynamics suggest that the government's debt-to-GDP ratio increases by itself when the interest-growth rate differential is positive. Therefore, a low implicit interest rate enables better conditions for government budget balance, nevertheless, governments also need to pay attention to other factors of debt dynamics (Barret, 2018). Furthermore, governments also borrow in foreign currency, which includes exchange rate and stock-flow adjustments into the group of important factors of debt dynamics. Additionally, privatizations, contingent liabilities and other flows have effects on public debt dynamics, but they do not have structural effects on debt (Acosta-Ormaechea, 2020).

Similar to government debt, increased indebtedness of the private sector can negatively influence the business process of companies, which can result in lower net profit, constraints to investment and the hiring of new employees. Furthermore, highly indebted companies have longer recovery periods after contractions and reach lower troughs. Nevertheless, debt has the potential to constrain companies to reinvest their returns as financial resources must cover obligations from debt, while new investors are unlikely to invest in highly indebted firms. On the aggregate level, these dynamics lead to a lower investment rate and consequently a lower growth rate (Randveer et al., 2011). Inefficient

allocation of financial resources in the economy due to high indebtedness is diminishing the potential of the economy. Debt has often a non-linear impact on economic growth, as its effects on the economy can differ at different levels of debt-to-GDP ratios. Debt structure has an important role in the evolvement of the economic process, which can expose its effects in the time of recessions, while indebtedness can decrease by itself in times of conjuncture and increased economic activity with absent purposely debt consolidation (Lim, 2019). However, there is a visible connection between economic development and an increase in the indebtedness of the economy, as the economic process also advances on account of increased borrowing (Ali Abass et al., 2011; Lim, 2019; Reinhart & Rogoff, 2010).

Theories of economic growth and different schools of economic thought do not have a straightforward answer to the question of the impact of debt on economic growth. Some eminent economists have explained the role of debt in either of the aforementioned positive or negative ways. Debt has not been included in models among growth factors under theories of economic growth, as financial indicators had a secondary role in economic processes and were therefore overseen by other factors, such as accumulation of capital, population growth, trade openness, etc. In addition to the Ricardian equivalence hypothesis, which attributes the neutral role of government debt, economists mainly described the debt as an important constraint to capital accumulation (Brue & Grant, 2013; Barro & Sala-i-Martin, 2004). Additionally, researchers mostly supported the negative relationship between debt and growth by including debt variables among other 'basic' growth determinants. However, empirical evidence has not found consensus on the existence of specific threshold debt effects on growth. Furthermore, in addition to different views on supporting the existence of a threshold between debt and growth and the presence of non-linearities, authors also found different and large confidence intervals of threshold estimations on similar samples (De Rugy & Salmon, 2020).

Even if researchers confirm the existence of a threshold between debt and growth, the key to debt for debt sustainability and protection ahead of adverse effects of debt is an awareness to realistically and timely monitor the primary balances, real interest rates and real growth rates. In addition to these three key variables, governments need to meet debt obligations at maturity and keep investors' interest in the newly issued debt, while there is no universal 'magic' threshold to determine if a particular debt is safe (Blanchard, 2022).

Even though debt-to-GDP ratios substantially increased during the Great Financial Crisis, there was an even greater increase during the COVID-19 pandemic. In advanced economies, public debt increased from around 70% of GDP in 2007 to 124% of GDP, while private debt increased in the same period from 164% of GDP to 178% of GDP. That surge in debt-to-GDP ratios is only comparable to World War II, as global debt accounted for USD 226 trillion at the end of 2020 and there was an increase in the debt ratio among all debt types. The increase in debt-to-GDP ratios was even greater for emerging markets and low-income developing countries, which have relatively bigger constraints on debt refinancing and relatively bigger interest rate pressures accompanied by shorter debt maturity than developed countries (Gaspar et al., 2021).

In times of debt surges, as was witnessed in the Great Financial Crisis and COVID-19 pandemic, it is reasonable to look for debt sustainability. This question has been enlightened by many researchers in the past, therefore, the author of this paper decided to carry out his own research on this pressing issue. In this study, an extension is made of the paper by Mika & Žumer (2017), which follows the Cecchetti et al. (2011) model specification. The author estimated different panel data models using the baseline least squares method and decided on the most appropriate model for further examination, while also exploring the threshold effects between debt and growth. The core sample in the study are European union countries covered in the period from 1995 to 2019. The first research hypothesis focused on the presence of statistically significant effects of public debt on economic growth, while the second focused on the existence of statistically significant effects of private debt on economic growth. Finally, the third research hypothesis focused on the existence of threshold effects between all corresponding types of debt and economic growth. The structure of the study is as follows. Section 2 focuses on a brief overview of existing literature on debt and growth nexus. In the empirical evidence, the author particularly focused on reviewing existing studies that mainly influenced the paper and included studies that examine similar samples to the one used in this paper. Section 3 provides a detailed explanation of the methodological approach and model specification used, as well as a description of the investigated data sample. Finally, Section 4 systematically provides results from the estimations and gives insights into the investigated issue. The results provided initially represent estimations for the models that include public and private debt. Thereafter, private debt and the provided results were divided with the model that includes government, non-financial corporate, and household debt.

Empirical Evidence

The role of debt in an economy has long been a subject of research. Debt instruments have an important place in economic theory as part of financial markets and represent a financial source for individuals and firms as well as governments. However, the milestone in empirical research on the influence of indebtedness on economic growth was set by the study of Carmen Reinhart and Kenneth Rogoff (2010) at the time of the rise of the sovereign debt crisis in the eurozone. Their notable paper encouraged academics to further analyze the interaction between debt-to-GDP ratio and economic growth and pursue a possible threshold level. The question of debt sustainability has also become intriguing for politicians and the general public as many countries faced austerity measures (de Rugy & Salmon, 2020). The key elements for statistical and empirical investigations are datasets of debt levels, which have been very limited in the past as there was limited debt data availability in terms of a time dimension, country coverage and debt completeness. Overall, the lack of comprehensive debt datasets was an important factor that has prevented researchers from examining debt more precisely (Ali Abass et al., 2010). Messages from empirical investigations of the relationship between debt and economic growth can significantly impact fiscal and macroprudential policies because taking policy measures that consider a corresponding threshold level would imply a boost to the economy or, on the flip side, prevent possible detrimental effects of indebtedness on economic growth.

The striking study by Reinhart and Rogoff (2010) investigated economic growth and inflation at different levels of government and external debt. Their study covers 44 countries over a period of the last 200 years with more than 3,700 annual observations of a vast number of explanatory variables, such as political systems, institutions, exchange rate systems and different historical circumstances. In order to study the relationship between both government and external debt and economic growth, they used an approach that examined average and median debt using histograms to determine the effects on economic growth and inflation. Their main findings were that there is a weak but significant negative relationship between government debt and real GDP growth when the debt-to-GDP ratio reached 90%. This threshold debt level does not differ between advanced and emerging economies and exceeding the threshold would cause a lower median growth rate of 1% and a lower average growth rate of several percent. Furthermore, external debt that consists of private and public debt induces emerging economies to have more demanding debt levels, as the estimated threshold for external debt adds up to 60% of GDP. The most likely reason for an even lower debt threshold for external debt is that the debt of emerging economies is usually denominated in foreign currency and reaching that threshold would drag economic growth by about 2%. Similarly, emerging economies have accompanied higher inflation rates when their debt-to-GDP ratio has increased, however, that does not apply to developed countries.

Nevertheless, estimates from 'Growth in Time of Debt' (Reinhart & Rogoff, 2010) were rejected by Herndon et al. (2014), who replicated the study and found the selective exclusion of available data, coding errors and inappropriate weighting of summary statistics that lead to serious miscalculations. They tackled these mistakes and corrected them by more accurately estimating the relationship between government debt and economic growth. Surprisingly, the new estimates on the same sample show that the average growth rate was 2.2% when countries' government debt was above 90% of GDP, which is well above the previously concluded negative effects on growth. This similarly applied to median growth rates, which were close but still above the estimates of Reinhart and Rogoff (2010). The key message from this replication is that median and average growth rates do not change substantially after surpassing the 90% debt-to-GDP ratio. However, the relationship between debt and growth varied between different observed periods as well as across countries. Furthermore, Herndon et al. (2014) stressed that the 90% debt-to-GDP ratio threshold cannot be defended by policymakers who demand austerity measures, and, regardless of these considered policy implications, they do not neglect the fact that Reinhart and Rogoff contributed to the important debate on debt sustainability issues. Regardless of the correctness of either study, this critique warns us that we must be really careful in determining the accurate relationship between debt and growth.

Reinhart and Rogoff (2010) point out that nonlinearities have a detrimental effect on the relationship between debt and economic growth and economies may have country-specific debt thresholds that have to be considered. The nonlinear impact of debt on economic growth can analogously open space to mildly increase the growth rate in the case of a lower debt-to-GDP ratio than the country's corresponding threshold (de Rugy & Salmon, 2020). In addition to the distinction between domestic and external debt, governments need to pay attention to debt composition as short maturities could lead to more vulnerability and less resilience in the event of economic shocks. In order to minimize debt service costs and reduce rollover risk, governments should focus on a prudent debt composition that reduces the risk of a sovereign debt crisis, lowers their risk premium and interest rate structure of debt

instruments, and minimizes the need for tax adjustments, otherwise the economy could face high welfare costs (Ali Abbas et al., 2014).

In the past decade, there have been numerous studies confirming that the government debt-to-GDP ratio is between 80 to 95% and that developing countries have debt burden pressures at lower debt levels. Nevertheless, there have also been a vast number of studies that rejected a possible threshold in the relationship between debt and economic growth. These studies are considered later in this section (de Rugy & Salmon, 2020), while studies that confirm the existence of a possible threshold level in the relationship between debt and economic growth are first discussed.

One of the highly influential papers was written by Cecchetti et al. (2011) who analyzed the influence of government, non-financial corporate and household debt on future medium-term economic growth in a sample of 18 OECD countries in the period from 1980 to 2010. They constructed a neoclassical growth model of overlapping five-year forward averages of the per capita income growth rate including contemporary growth factors, such as dependency ratio, trade openness, inflation, financial development, and both public and private debt-to-GPD ratios. The estimations from the least squares dummy variable (LSDV) regression support the possible danger of debt becoming a drag on growth and confirmed statistically significant thresholds for all considered types of debt. The threshold for government debt is around 85% of GDP and exceeding that level by 10 percentage points would decrease real per capita growth by one percentage point. For corporate debt, the threshold is estimated at 90% of GDP, however, its impact on economic growth is around half the size of the negative influence of government debt when exceeding the threshold level. Similarly, the authors' imprecise and non-robust estimate of the threshold level of household debt is around 85% of GDP.

Mika and Žumer (2017) based their regression on a similar econometric model and approach to that of Ceccheti et al. (2011) on a sample of 25 European Union countries between 1995 and 2015. However, they used a novel approach in researching debt and economic growth relationships by using the debt ratio with gross disposable income instead of GDP. The first part of their analysis focused on the short- to medium-term influence of government, non-financial corporate and household debt on three-year overlapping forward averages of the real GDP per capita growth rate using the LSDV estimator. For government debt, a 10% increase in private debt (i.e. non-financial corporate and household debt without considering financial corporate debt) and gross disposable income ratio would decrease forward economic growth from 0.17 to 0.21%. In contrast, a 10% increase in the public debt-to-gross disposable income ratio would increase future growth in the three-year average from 0.12 to 0.14%. Considering the squared explanatory variables of debt has only proven a statistically significant threshold level for household debt at the level of debt-to-gross disposable income of around 18%. Focusing on the long-term effects, the authors followed the approach of Eberhardt and Presbitero (2015) using the error correction model and confirmed the positive long-run relationship between private debt and gross disposable income, while there was a negative long-run connection between public debt and gross disposable income. The key message is that all the considered types of debt could possibly be a drag or catalyst for growth, as private indebtedness impedes economic growth in the short run and supports growth in the long run in the form of an increased level of income. Meanwhile, public debt has a role of increasing economic growth in the short run, which supports the view of counter-cyclical fiscal policies, while it could constrain the growth in the long run, as highly public indebted countries face a lower accumulation of capital and higher tax rates.

Similarly, a sample of 12 Euro area countries during the period from 1970 to 2008 was investigated by Checherita-Westphal and Rother (2012). Using a two-way fixed effects panel regression and the dynamic generalized moments method they confirmed a statistically significant non-linear relationship between government debt and economic growth. Their estimated threshold level for government debt-to-GDP ratio lies at about 90-100% of GDP, while negative growth effects could potentially start at levels of around 70-80% of GDP, as the economy faces lower private saving, public investment and total factor productivity. Mencinger et al. (2014) estimated the effect of government debt on economic growth in a sample of 25 European Union countries between 1980 and 2010 using a similar approach to that of Checherita-Westphal and Rother (2012). There was a confirmed concave-shaped non-linear government debt impact on economic growth with a potentially positive relationship with the low levels of government debt. Interestingly, there is a difference in the described relationship between newer and older members of the integration, as the threshold for the latter lies at around 80 to 94% of GDP, while the threshold for newer members is at about 53 to 54% of GDP.

Alfonso and Alves (2014) also investigated the relationship between government debt and economic growth of 14 European Union countries in the period from 1970 to 2012 with a two-way fixed effects panel, two-stage least squares, and generalized least squares models. They estimated that an increase in the government debt-to-GDP ratio of 1% decreases economic growth by 0.01%, proving that

debt servicing costs are highly constraining economic growth and that the estimated threshold level is at 75% of GDP. Gómez-Puig & Sosvilla-Rivero (2018) analyzed the relationship between government, non-financial corporate and household debt in a sample of 10 Euro area countries in the period from 1980 to 2015 using an error correction model. They estimated the threshold of government debt at 59% of GDP, the threshold level for corporate debt at 87% of GDP, and the threshold for household debt at significantly lower levels at 39% of GDP. The authors of the study pointed out that there is a considerable degree of heterogeneity between the investigated countries in all the effects of the corresponding types of debt on growth. Caner et al. (2010) found that the public debt threshold level for 101 developed and developing economies in the years from 1980 to 2008 at a 77% public debt-to-GDP ratio. Using the Hansen regression model and pooled least squares models, the authors found that a percentage point increase above this threshold would lead to a 0.017 percentage point reduction in economic growth. The costs of higher debt burdens can be even larger for developing economies, as their estimated threshold level stands at 64% of GDP accompanied by a 0.02 percentage point decrease in economic growth for each exceeded percentage point in the debt-to-GDP ratio above this threshold.

Finally, there have also been some studies that do not confirm the existence of a possible threshold in the relationship between debt and economic growth. Eberhardt and Presbitero (2015) investigated 118 countries in the period from 1961 to 2012 using an error correction model. Their study did not find a possible common threshold for the complete sample of countries; however, they did find that countries with higher debt levels and debt burdens have a lower long-run relationship between public debt and growth. Furthermore, their important contribution to the literature was a novel approach to addressing heterogeneity in the sample. They rejected a common threshold and confirmed the possibility of a country-specific threshold, which reflects the existence of heterogeneity between countries at different levels, shapes and forms of the debt-growth relationship. In such cases, one-size-fits-all policies that address debt sustainability with common measures can cause deterioration in the economic growth of some countries as a consequence of the confirmed heterogeneity across countries. Similarly, Chudik et al. (2015) also rejected the existence of the threshold effects in the relationship between public debt and economic growth using the Monte Carlo experiment method on a sample of 40 developing and advanced countries over the period from 1965 to 2010. However, they found a significant negative long-run impact of an increase in public debt on output growth. The authors pointed out that negative debt effects can possibly be prevented if a recent debt build-up is backed up by a credible fiscal policy plan and action that would return the debt levels to a sustainable path. The importance of the public debt trajectory was confirmed by Pescatori et al. (2014), who related high debt levels with higher volatility of the output, however, they did not find a significant threshold level in the medium-term relationship between public debt and economic growth.

It can be concluded from the empirical evidence that high debt levels have a high potential to cause a deterioration in economic growth. However, there is no consensus on the existence of the threshold levels and there are heterogenous estimates of a threshold between debt and growth in similar groups of countries. Nevertheless, studies often point out that the negative effects of debt on growth can be an important constraint factor, regardless of the possible positive effects that were expressed in a minor number of studies. Generally, the studies that confirm the negative debt and growth relationship are outweighed by the number of studies that find no effect and a positive influence of low debt levels on economic growth. Non-linearities in the relationship between debt and growth are an important factor to consider, as the impact of debt on the economy can rise and become stronger with increasing levels of debt. In addition to lower growth rates, high indebtedness can cause higher interest rates in the long run, as well as inflation and distortionary tax rates, and especially constraint of counter-cyclicality of fiscal policies (de Rugy & Salmon, 2020).

Empirical Strategy: Model Specification, Methodology and Data

The econometrical approach used in this paper is based on the short- to medium-term effects method used in the paper by Mika and Žumer (2017). For the purposes of this paper, a growth model was constructed that follows the specifications of the model of the aforementioned authors, which is common in literature exploring debt and growth nexus (e.g. Cecchetti et al., 2011). Similarly, to Mika and Žumer (2017), the author of this paper was constrained by the availability of data beyond 1995, therefore it was necessary to choose three-year overlapping forward averages of the real GDP per capita growth rate rather than five-year forward-looking averages, which would result in more observations being lost at the end of the period in an already relatively short period of observation. The explanatory variables follow an extended neoclassical growth model, which incorporates control variables of dependency ratio, human capital and inflation, in addition to initial real GDP per capita level, savings ratio, population growth and trade openness (Barro & Sala-i-Martin, 2014;

Cecchetti et al., 2011; Mika & Žumer, 2017). According to the theory of economic growth, standard signs would be expected in front of the regression coefficients in the estimations (i.e. a negative sign for the dependency ratio, a positive sign for the savings ratio, etc.). In concluding the empirical model, it is important to add debt indicators, which were divided into public and private debt. The author of this paper also wanted to explore the more detailed relationship between private debt and economic growth, therefore private debt was further split into household and non-financial corporate debt, while financial corporate debt was excluded from this analysis. Subsequently, the baseline regression model can be written using the following equation:

$$\begin{aligned} &\textit{Forward three-year averages of growth rate}_{i,t} = \beta_{1,i} + \\ &+ \beta_2\, \textit{initial GDP pc}_{i,t} + \beta_3\, \textit{inflation}_{i,t} + \beta_4\, \textit{savings ratio}_{i,t} + \\ &+ \beta_5\, \textit{population growth}_{i,t} + \beta_6\, \textit{human capital}_{i,t} + \\ &+ \beta_7\, \textit{dependency}_{i,t} + \beta_8\, \textit{trade openness}_{i,t} + \beta_9\, \textit{public debt}_{i,t} + \\ &+ \beta_{10}\, \textit{private debt}_{i,t} + u_{i,t} \end{aligned} \quad (1)$$

This paper follows the standard least squares methodological approach of examining panel data by firstly evaluating a pooled least squares, least squares dummy variable (LSDV) and random effects models (Gujarati, 2015, p. 327-328). Initially, linear models were evaluated that do not include missing squares of explanatory variables. Examining the models without non-linear effects allows a focus on the simple debt and growth rate relationship that would indicate the role of public and private debt in the medium-term economic growth function, while the possible statistically significant regression coefficients for both wider sector debt indicators would enable a possible distinction between types of debt in terms of magnitude and direction. From these three models, the author chose the most suitable for further examination using the restricted F-test and Hausman test. Thereafter, after choosing the most appropriate model that describes medium-run growth rate variability, missing non-linearities were included by adding squares of independent variables. Statistically significant squares of debt variables enabled the author to compute the possible threshold levels in the debt and growth relationship. Finally, as previously noted, private debt was divided into non-financial corporate and household debt to capture a relatively more comprehensive relationship between the different sectoral debt on growth rate.

Incorporating forward-looking averages of the dependent variable mitigates endogeneity bias and decreases reverse causality (Mika & Žumer, 2017). One of the advantages of incorporating the dependent variable with forward-looking averages is a decreased potential cyclicality of the growth rate and a more focused investigation on the medium-term economic growth rate relationship (Cecchetti et al., 2011). Such a dependent variable shortens the observation period at the start and the end of the time period, while it also imposes serial correlation of the stochastic term (Panizza & Presbitero, 2013). In contrast, the use of overlapping forward averages imposes the moving average structure of the error term. In order to mitigate this issue, Cecchetti et al. (2011) proposed the use of robust estimates of regression coefficients that compute the standard errors of coefficient estimates. The Eviews 12 econometrical software packages enabled the author to estimate the panel data with robust estimates of heteroscedasticity by using the White cross-section method, while the White period method enables robust estimates of serial correlation (Eviews, 2021). The use of these kinds of estimates with corrected standard errors would help to determine the variables that are troublesome and enables more robust estimates that are to a lesser extent influenced by the moving average structure of the error term. In this empirical strategy, the author also distinguishes public and private debt, wherein the latter is first examined together with its sectoral peers. Thereafter, models with sectoral debt data were examined that incorporate household, non-financial corporate and government debt, while, as mentioned above, the financial debt relationship with growth rate is beyond the scope of this analysis. Finally, the aim was to compute a robust model with a particular focus on the debt variables, therefore the author also looked for a possible lagged relationship of the independent variables with a forward medium-term growth rate.

This paper analyses 27 European union countries between 1995 and 2019. Annual data was collected for real GDP per capita in 2010 at constant prices (Eurostat, 2021a), gross savings-to-GDP ratios (The World Bank, 2021a), inflation measured as CPI (IMF, 2021a), trade openness in the percentage of GDP (The World Bank, 2021b), population growth rate (Eurostat, 2021b), the dependency ratio (The World Bank, 2021c), and human capital. The latter variable was initially included as years of secondary schooling (The World Bank, 2021d), then as average years of schooling of adults over the age of 25 (United Nations Development Programme, 2021). Similarly, the author focused on two different types of datasets for the debt data. Firstly, debt data was collected on relatively more aggregate data, i.e. data for public debt (Eurostat, 2021c) and private debt (Eurostat, 2021d). Secondly, for the purpose of obtaining relatively more granular private debt data, debt-to-GDP ratio datasets were accordingly taken from The Global Debt Database for non-financial corporate and household debt, and government debt. It is important to consider both public and private debt, as an extensive focus only on public debt may hide important dynamics of complete debt. There are some countries, such as Greece, which have relatively high public indebtedness and relatively low private indebtedness. Analogously, there are also examples of countries (e.g. the Netherlands) with a relatively

high level of private debt and a relatively low level of public debt (IMF, 2021b).

It was necessary to adjust the complete observed period to allow for the required recalculations. Firstly, the annual growth rate data was calculated from the real GDP per capita, which imposed the loss of the first observed year of 1995. Secondly, the dependent variable was computed as the forward-looking three-year average of the real growth rate, which means that the data in the current year is computed from the simple average of the growth rates in the following three years. For this reason, the computation of the dependent variable resulted in the loss of the last three years of the complete observed period. To conclude the adjustment of the observed period, the author examined the time period between 1996 and 2016, which represents 21-time unit observations. Finally, the author strived to make the panel as balanced as possible, therefore some countries had to be excluded from the cross-section part of the panel data. There was limited availability of data for various variables for Cyprus, Luxembourg and Malta, while data was lacking for real GDP per capita for Romania between 1995 and 2001 from the Eurostat database. These countries were therefore excluded from the empirical investigation, which means that 23 European Union countries were observed. However, some minor data are lacking for Denmark, Estonia, Croatia, Austria, Greece and Ireland, hence there is an unbalanced panel, which still has satisfactory data coverage.

Empirical Results

In this section, an econometrical analysis is provided of the panel data model of the medium-term growth rate that consists of 23 European Union countries over the period from 1996 to 2016. The author began by estimating the pooled least squares regression model of future medium-term average growth rates. From the theoretical point of view, there is an important weakness in the estimation methodology, as it does not account for heterogeneity between countries and time units, which could be problematic in a sample of European Union countries that are non-homogeneous and periods with a huge structural change at the time of the Great Recession (Gujarati, 2015, p. 328-329). Table 1 shows the estimations of the pooled least squares regression. There are various explanatory variables that are insignificant at a confidence level of more than 95% while the R-squared value is 30%, meaning that the model has a relatively low explanatory power. These estimations imply the aforementioned weakness – that the model assumes constant regression coefficients across countries and time.

The LSDV model of three-year overlapping averages of growth rates was then estimated. Based on Mika and Žumer (2017) and Cecchetti et al. (2011), two-way fixed effects model estimations were used that consider dummy variables for each cross-section and time unit. Country-specific and time-specific fixed effects allow heterogeneous properties to be captured that are not included in the panel observation units. The LSDV model estimations shown in Table 1 illustrate the relatively better explanatory power of the model in comparison with the pooled least squares model. The coefficient of determination amounts to 75.9% and only the population growth and dependency ratio are highly insignificant, while private debt is significant at 10% risk. There is a significant positive relationship between public debt and the medium-term growth rate, while private debt has a negative regression coefficient. These estimations are consistent with the results in the study by Mika and Žumer (2017). The positive public debt effects can be related to the encouraging role of the counter-cyclical fiscal policies. Debt allows a smoother consumption and transfers wealth between generations and through time, however, it is accompanied by the risk of debt sustainability and the possible inability to repay debt obligations (Cecchetti et al., 2011). This, however, does not apply to private debt, which can induce a relatively greater debt overhang than public debt (Randveer et al., 2011).

The final estimated model among the panel models that do not consider non-linear effects is the random effects model. The estimations of the random effects panel model in Table 1 show that only the variables for education and constant are statistically insignificant at less than 5 or 10% percent risk. All other regression coefficients are statistically significant at 5% risk, which represents the highest number of significant independent variables among the considered models. However, looking at the coefficient of determination, it can be seen that only 21% of the medium-term growth rate variability is explained by the explanatory variables, which means that the random effects model has the lowest explanatory power. From the theoretical point of view, the random effects model or the generalized least squares method is an appropriate estimation method for the samples with randomly selected cross-section units from the population (Pfajfar, 2018, p. 688). The sample used in this study has pre-determined cross-sections as a close group of European Union countries are examined, which implies the probable reason for the relatively low coefficient of determination.

Table 1

Estimates of the pooled least squares model, the LSDV model and the random effects model of forward medium-term growth

Explanatory variable	Pooled least squares	LSDV	Random effects
Constant	2.332658	-13.817620	-2.024171
	(-1.059911)	(-3.207827)	(-0.888969)
	(0.2898)	(0.0015)***	(0.3745)
Initial GDP pc level	-0.000030	-0.000239	-0.000064
	(-1.352545)	(-3.432327)	(-2.637109)
	(0.1769)	(0.0007)***	(0.0087)***
Inflation	-0.003906	-0.006372	-0.005896
	(-1.687433)	(-3.916736)	(-3.275962)
	(0.0923)*	(0.0001)***	(0.0011)***
Savings ratio	0.047011	0.098259	0.077486
	(1.296565)	(2.938983)	(2.326250)
	(0.1955)	(0.0035)***	(0.0205)**
Population growth	-1.000694	-0.318378	-0.775582
	(-4.266942)	(0.220128)	(-3.650056)
	(0.0000)***	(0.1489)	(0.0003)***
Human capital	-0.331869	2.112636	-0.092368
	(-2.509661)	(6.957421)	(-0.566432)
	(0.0125)**	(0.0000)***	(0.5714)
Dependency ratio	0.053732	0.012380	0.107013
	(1.514733)	(0.259872)	(3.019411)
	(0.1306)	(0.7951)	(0.0027)***
Trade openness	0.014554	0.019173	0.011667
	(3.886404)	(2.268416)	(2.704058)
	(0.0001)***	(0.0239)**	(0.0071)***
Public debt	-0.007291	0.048020	0.010708
	(-1.593867)	(5.506434)	(2.180690)
	(0.1117)	(0.0000)***	(0.0298)**
Private debt	-0.014891	-0.008937	-0.020765
	(-3.996181)	(-1.788141)	(-5.454911)
	(0.0001)***	(0.0746)*	(0.0000)***
R-squared	0.300037	0.759371	0.209949
Adjusted R-squared	0.285038	0.726905	0.193019
F statistic	20.00351	23.38981	12.40125
Prob. (F statistic)	(0.0000)***	(0.0000)***	(0.0000)***
Sum of squared residuals	2430.416	835.5148	2081.875
Durbin-Watson stat	0.509849	0.617344	0.553392

Notes: The t-statistics are shown in brackets below the coefficients and the p-values are shown in brackets below the t-statistics. The significance levels are denoted as: ***1% significance, **5% significance, *10% significance.

Source: Author's calculations

The estimations from the pooled least squares, LSDV and random effects model provide limited information for determining which model is the most appropriate for further examination. Considering the significance of the regression coefficients in the examined models, the random effects model proved to have the highest share of significant coefficients and, importantly, that model has both significant debt regression coefficients, however, this does not imply the necessary selection. The LSDV model has by far the highest explanatory power among the considered models and implies the probable choice of model, however, this information is insufficient to make a selection, therefore further tests would be required. Firstly, it is necessary to compare the pooled least squares and the LSDV model with the restricted F test (Gujarati, 2015, p. 331). That test considers the R-squared values of both models, the number of omitted variables in the pooled least squares model (i.e. the number of included dummy variables in the LSDV model ~ 42), the number of observations (430) and the number of all the explanatory variables in the LSDV model (52). The computed value of the restricted F test is 17.18, which is higher than the 1.42 critical value. Following the restricted F test, it can be claimed with great certainty that the LSDV model is more appropriate than the pooled least squares model for explaining the medium-term growth rate.

The Hausman test was used in order to select between the LSDV and the random effects model for further examination. This test checks the consistency of the estimations from the random effects model. Consistency would mean that there would be no significant difference between both models, while rejecting the null hypothesis would require a comparison of chi-squared statistics with the critical value to determine the most appropriate model (Baltagi, 2008, p. 72-73). The estimation from the Hausman test in Table 2 shows that there is more than 99% significance in claiming the difference between the LSDV and the random effects model. The chi-squared statistic value (222.5) is substantially higher than the critical value of the Hausman test (16.9), which means that the LSDV model is more appropriate for explaining the model of three-year forward averages of growth rates. Additionally, the provided estimation from the Hausman test confirms the presumption of the theoretical appropriateness of using the LSDV model rather than the random effects model on the closed group of countries in the sample. Finally, considering the described tests and information on the coefficient of the determination, the LSDV model can be selected for further examination.

Table 2
Hausman test

	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	222.465126	9	(0.0000)***

Source: Author's calculations

After selecting the LSDV model as the most appropriate for explaining the medium-term growth rate, the non-linear effects of the explanatory variables were considered. The missing squares of the independent variables were included using the omitted variables test to enhance the explanatory power of the model, with a particular focus on debt variables in order to compute the possible threshold effects. The estimates in Table 3 show that the extension of the model with the missing non-linearities has substantially increased the coefficient of determination and improved the significance of many variables where only population growth is insignificant. By including the squares of the initial GDP level, inflation and public and private debt-to-GDP ratios in the specification of the model, R-squared increased to 84.1%, while adjusted R-squared amounts to 81.8%, which is 9.1 percentage points higher in the adjusted coefficient of determination than in the model without non-linearities. Statistically significant squares of debt variables confirm the non-linear relation between both types of debt and growth and enable the shape of the relationship to be observed. The negative regression coefficient of the square of public debt indicates that public debt does not necessarily positively impact growth as there is a concave-shaped relationship between public debt and medium-term growth. In contrast, the positive regression coefficient of the square of private debt suggests that there is a convex-shaped relationship between private debt and medium-term growth. This exposes the necessary distinction between public and private debt, as focusing only on joint debt would conceal the important difference between both debt types.

However, it was necessary to check the robustness of the model on heteroscedasticity and serial correlation, which frequently pose difficulties in panel data. The author tested the robustness of the model on heteroscedasticity and serial correlation by estimating the White cross-section and White period method respectively. The examined extended model exhibited decent robustness on heteroscedasticity, as the estimations using the White cross-section period did not substantially worsen the significance of the regression coefficients. This, however, does not apply to the robustness of the model on serial correlation, because the estimation using the White period method exposed several drawbacks of the LSDV model of medium-term growth. Increased p-values of the numerous explanatory variables (particularly the constant variable and the square of private debt) undermine the desired robustness on serial correlation. Therefore, the author of this paper ascertained whether there was a possible lagged relationship between non-robust variables on serial correlation and medium-term growth. The key solution was consideration of the lagged impact of private debt on growth, which showed non-robustness on serial correlation with its current values. Including the first lag of private debt, as shown in Table 3, did not change the direction of the relationship of debt variables

or decrease the explanatory power of the model. Importantly, the model as a whole exhibited greater robustness on both heteroscedasticity and serial correlation. The relatively lower p-values of the White period method estimates imply the use of the first lag of private debt in the considered model, nevertheless, the variables that exposed non-robustness on serial correlation are still slightly insignificant at 5% risk, albeit lower than 10% risk.

Table 3

Estimates of the LSDV model of forward medium-term growth including non-linearities and considering lagged private debt

Explanatory variable	LSDV model including non-linearities	White cross-section estimation	White period estimation	LSDV model including non-linearities and lagged private debt	White cross-section estimation	White period estimation
Constant	19.790480			21.755090		
	(4.130314)	(3.193018)	(1.796194)	(4.389056)	(3.213215)	(1.917365)
	(0.0000)***	(0.0015)***	(0.0733)*	(0.0000)***	(0.0014)***	(0.0560)*
Initial GDP pc level	-0.001532			-0.001537		
	(-9.533008)	(-5.318935)	(-4.044352)	(-9.414475)	(4.770691)	(-3.856643)
	(0.0000)***	(0.0000)***	(0.0001)***	(0.0000)***	(0.0000)***	(0.0001)***
Inflation	-0.149369			-0.191239		
	(-4.968754)	(-4.364987)	(-3.955424)	(-5.356295)	(-6.329175)	(-3.413294)
	(0.0000)***	(0.0000)***	(0.0001)***	(0.0000)***	(0.0000)***	(0.0007)***
Savings ratio	0.131617			0.135765		
	(4.709175)	(4.257612)	(2.179490)	(4.751609)	(4.269456)	(-3.413294)
	(0.0000)***	(0.0000)***	(0.0299)**	(0.0000)***	(0.0000)***	(0.0007)***
Population growth	-0.224193			-0.229996		
	(-1.243024)	(-1.625082)	(-1.132933)	(-1.261920)	(-1.832565)	(-1.118917)
	(0.2146)	(0.1050)	(0.2580)	(0.2078)	(0.0677)*	(0.2639)
Human capital	1.439907			1.366968		
	(5.182432)	(5.800913)	(3.706276)	(4.743420)	(5.457811)	(3.698443)
	(0.0000)***	(0.0000)***	(0.0002)***	(0.0000)***	(0.0000)***	(0.0003)***
Dependency ratio	-0.213273			-0.227323		
	(-4.643034)	(-3.911881)	(-2.879531)	(-4.617026)	(-3.797022)	(-2.611612)
	(0.0000)***	(0.0001)***	(0.0042)***	(0.0000)***	(0.0002)***	(0.0094)***
Trade openness	0.027794			0.025679		
	(3.463267)	(2.967922)	(2.127632)	(3.006603)	(2.332437)	(1.811490)
	(0.0006)***	(0.0032)***	(0.0340)**	(0.0028)***	(0.0202)**	(0.0709)*
Public debt	0.092657			0.091456		
	(6.462513)	(6.046311)	(4.451892)	(6.360204)	(5.526348)	(4.624069)
	(0.0000)***	(0.0000)***	(0.0000)***	(0.0000)***	(0.0000)***	(0.0000)***
Private debt	-0.039770			— — —		
	(-4.012469)	(-3.306909)	(-2.082429)			
	(0.0001)***	(0.0010)***	(0.0380)**			

Table 3
Estimates of the LSDV model of forward medium-term growth including non-linearities and considering lagged private debt (cont.)

Private debt(-1)	– – –			-0.042246		
				(-4.493311)	(-3.608797)	(-2.355413)
				(0.0000)***	(0.0004)***	(0.0190)**
(Initial GDP pc level)^2	0.000000			0.000000		
	(7.607562)	(4.483094)	(3.274852)	(7.361690)	(3.865111)	(3.079498)
	(0.0000)***	(0.0000)***	(0.0012)***	(0.0000)***	(0.0001)***	(0.0022)***
(Inflation)^2	0.000134			0.000175		
	(4.762165)	(4.159454)	(3.773416)	(5.222841)	(6.157122)	(3.346168)
	(0.0000)***	(0.0000)***	(0.0002)***	(0.0000)***	(0.0000)***	(0.0009)***
(Public debt)^2	-0.000403			-0.000410		
	(-5.011916)	(-2.852684)	(-3.387622)	(-5.117323)	(-2.708236)	(-3.503298)
	(0.0000)***	(0.0046)***	(0.0008)***	(0.0000)***	(0.0071)***	(0.0005)***
(Private debt)^2	0.000126			– – –		
	(3.984748)	(2.829142)	(1.708848)			
	(0.0001)***	(0.0049)***	(0.0883)*			
(Private debt(-1))^2	– – –			0.000141		
				(4.674901)	(3.065987)	(1.916872)
				(0.0000)***	(0.0023)***	(0.0560)*
R-squared		0.840918			0.845282	
Adjusted R-squared		0.817524			0.822074	
F statistic		35.94526			36.4224	
Prob. (F statistic)		(0.0000)***			(0.0000)***	
Sum of squared residuals		552.3653			525.2987	
Durbin-Watson stat		0.799922			0.770976	

Notes: The t-statistics are shown in brackets below the coefficients and the p-values are shown in brackets below the t-statistics. The significance levels are denoted as: ***1% significance, **5% significance, *10% significance.
Source: Author's calculations

Subsequently, after completing the extended LSDV model of medium-term growth, the author moved on to computation of the thresholds in the debt and growth relationship. As previously mentioned, there is a concave-shaped relationship between public debt and medium-term growth with a computable maximum of the function, while there is a convex-shaped relationship between lagged private debt and medium-term growth that has a minimum in its threshold. For public debt, the threshold is 111.6% of GDP and exceeding that level of public indebtedness would start to produce negative effects on medium-term growth. This level is well above the 60% Maastricht convergence criteria for government debt and classifies more than three-quarters of European Union countries under that threshold in 2019 (e.g. only Greece, Italy and Portugal had government debt-to-GDP ratios above the threshold). In contrast, the minimum threshold of lagged private debt is 149.8% of GDP. Exceeding that threshold level of lagged private debt would cause an increase in medium-term growth, however, it is necessary to be cautious in dealing with private indebtedness, which several studies have shown to be a drag on growth. In 2019 there were 17 countries that were below the 149.8% threshold of GDP and an increase in their lagged private debt-to-GDP ratio would decrease the medium-term growth rate, while there were six countries that were above that threshold (Belgium, Denmark, Ireland, France, Portugal and Sweden).

After concluding the model in Table 3, in which the robustness of heteroscedasticity, and especially serial correlation, was improved through the implementation of the first lags of private debt, it is now possible to move on to a more detailed examination of the debt and growth relationship. The author's ultimate aim was to estimate the extended model that has more detailed specified private debt variables, therefore the debt variables were changed. Subsequently, private debt was divided into variables of non-financial corporate debt and household debt, while the data for public debt (labelled as government debt) was also changed in order to retain data complementarity and estimate debt data from the same database (IMF, 2021b). Similarly, financial debt was eliminated from this investigation, which is consistent with the studies by Cecchetti et al. (2011) and Mika & Žumer (2017). The human capital variable has previously been presented as the average years of secondary schooling, which does not necessarily reflect the nature of the knowledge and skills captured in human capital. Additionally, data was instead used for the average years of schooling of adults over the age of 25, which could better proxy the human capital.

Table 4 shows the estimation of the LSDV model for the future medium-term average growth rate with the aforementioned changes in the model specification. The author considered the previously explored lagged relation between private debt and medium-term growth and estimated the model with the first lags of both corporate and household debt. The introduction of different variables significantly enhanced the significance of the regression coefficients compared to the estimations in Table 3, as all explanatory variables are now statistically significant at 5% risk. An almost similar adjusted coefficient of determination can be seen when focusing on the explanatory power of the model, whereby capturing all the explanatory variables under statistical significance under 5% risk was an important achievement. The model in Table 4 explains 84.7% of the forward three-year averages of growth rate variability. The estimations using the White cross-section method indicated the appropriate robustness of the investigated model on heteroscedasticity, as the estimation with adjusted and robust standard errors showed the statistical significance for all the explanatory variables at 5% risk with the exception of the trade openness variable. In the previously investigated models, the author specifically focused on the robustness on serial correlation that somewhat undermined the desired robustness of the models. The model in Table 4 shows relatively acceptable robustness on the serial correlation, as most of the explanatory variables are significant at 5% risk. The estimation of the model using the White period method explored the statistical significance of all the variables at 10% risk with the exception of the trade openness variable. It can be concluded that the extended LSDV model of three-year overlapping averages of growth rates has a satisfactory significance of the regression coefficients and explanatory power, while it exhibits significant robustness on heteroscedasticity and has relatively adequate robustness on serial correlation.

Table 4

Estimates of the LSDV model of forward medium-term growth including government, non-financial corporate and household debt

Explanatory variable	LSDV model with specified corporate, household and government debt	White cross-section estimation	White period estimation
Constant	63.843360		
	(8.245848)	(6.201050)	(6.004979)
	(0.0000)***	(0.0000)***	(0.0000)***
Initial GDP pc level	-0.001928		
	(-11.944080)	(-5.274312)	(-5.740736)
	(0.0000)***	(0.0000)***	(0.0000)***
Inflation	-0.004161		
	(-2.950200)	(-6.350223)	(-3.505639)
	(0.0034)***	(0.0000)***	(0.0005)***
Savings ratio	0.543666		
	(4.558097)	(3.090628)	(2.917122)
	(0.0000)***	(0.0022)***	(0.0038)***
Population growth	-0.406748		
	(-2.245511)	(-2.510914)	(-2.151634)
	(0.0253)**	(0.0125)**	(0.0321)**

Table 4

Estimates of the LSDV model of forward medium-term growth including government, non-financial corporate and household debt (cont.)

Human capital – new variable	-3.576965		
	(-3.263636)	(-2.386073)	(-1.766589)
	(0.0012)***	(0.0175)**	(0.0782)*
Dependency ratio	-0.315437		
	(-6.316302)	(-4.263366)	(-3.499179)
	(0.0000)***	(0.0000)***	(0.0005)***
Trade openness	-0.046204		
	(-3.369919)	(1.599829)	(1.510526)
	(0.0008)***	(0.1105)	(0.1318)
Corporate debt (-1)	-0.046204		
	(-3.369919)	(-2.167234)	(-2.001242)
	(0.0008)***	(0.0309)**	(0.0461)**
Household debt (-1)	-0.072240		
	(-3.988055)	(-3.692109)	(-2.490383)
	(0.0001)***	(0.0003)***	(0.0132)**
Government debt	0.067302		
	(5.420891)	(3.848599)	(4.228403)
	(0.0000)***	(0.0001)***	(0.0000)***
(Initial GDP pc level)^2	0.000000		
	(8.950120)	(4.045847)	(4.355354)
	(0.0000)***	(0.0001)***	(0.0000)***
(Human capital)^2	0.148339		
	(3.056509)	(2.301466)	(1.701133)
	(0.0024)***	(0.0219)**	(0.0898)*
(Savings ratio)^2	-0.010999		
	(-4.058234)	(-2.775842)	(-2.804597)
	(0.0001)***	(0.0058)***	(0.0053)***
(Corporate debt (-1))^2	0.000167		
	(4.407263)	(2.565734)	(2.731501)
	(0.0000)***	(0.0107)**	(0.0066)***
(Household debt (-1))^2	0.000249		
	(2.587612)	(2.187775)	(1.855767)
	(0.0101)**	(0.0293)**	(0.0643)*
(Government debt)^2	-0.000321		
	(-4.114813)	(-2.044981)	(-2.351975)
	(0.0000)***	(0.0416)**	(0.0192)**
R-squared	0.300037	0.759371	0.209949
Adjusted R-squared	0.285038	0.726905	0.193019
F statistic	20.00351	23.38981	12.40125
Prob. (F statistic)	(0.0000)***	(0.0000)***	(0.0000)***
Sum of squared residuals	2430.416	835.5148	2081.875
Durbin-Watson stat	0.509849	0.617344	0.553392

Notes: The t-statistics are shown in brackets below the coefficients and the p-values are shown in brackets below the t-statistics. The significance levels are denoted as: ***1% significance, **5% significance, *10% significance.

Source: Author's calculations

As can be seen, the model in Table 4 is suitable for explaining the relationships between different growth factors and medium-term growth rate. The author's focus in this study was to investigate the debt and growth relationship. The changes introduced into the final model retained the significance for both the squares and linear debt variables, which enables the threshold to be computed for all three of the investigated types of debt relative to the forward overlapped three-year averages of growth rates. Similarly, the shape of the relationship between debt variables and the medium-term growth rate did not change in comparison with the model in Table 3. Government debt exhibited a concave-shaped relationship with medium-term growth, while both the lagged private debt variables displayed a convex-shaped relationship with the forward three-year averages of growth rate, as is the case with its common private debt peer. For government debt, the threshold stands at 104.8% of GDP, which is 6.8 percentage points lower than in the model in Table 3. According to IMF (2021b) data for 2019, Greece, Italy and Portugal stand above the computed threshold for government debt, while Belgium, France and Spain are slightly under the threshold with all other countries remaining well below 104.8% of the GDP threshold. These estimations support the Keynesian logic of counter-cyclical fiscal policies that boost aggregate demand also relative to the corresponding threshold.

The computed threshold level for lagged non-financial corporate debt is 138.3% of GDP. Similarly to the model in Table 3, it is necessary to be cautious when supporting the view of the positive effects of corporate indebtedness ratio above that threshold, as any type of high indebtedness has the potential to harm the economy rather than support it. In contrast, Austria, the Czech Republic, Estonia, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Poland, Slovakia, Slovenia and Spain had corporate debt-to-GDP ratios below the threshold by 2019. This would place them on the declining part of the squared concave-shape function, which can translate any increase of that ratio into lower medium-term growth rate. For lagged household debt, the threshold stands at 145.1% of GDP. The computed threshold for lagged household debt stands well above the household debt-to-GDP ratios for all corresponding countries based on 2019 data. This would mean that any increase in household indebtedness would decrease the medium-term growth rate.

Conclusion

In this paper, the author analyses the relationship between debt and growth with a particular focus on threshold effects. Theoretical and empirical evidence does not provide a straightforward answer on the dynamics of debt and growth nexus, as debt can either support or drag economic growth. However, existing literature has proven that there is significant potential for negative effects of high indebtedness on economic growth. Nevertheless, the presence of non-linear effects of growth variables has proven to be an important factor to consider. The author constructed a regression model of medium-term growth for the European Union countries covered in the period from 1995 to 2019 based on the study by Mika and Žumer (2017). Due to the availability of data and methodological limitations, the investigated models covered 23 European Union countries in the period from 1997 to 2016. The estimations provide an extension of the paper by Mika and Žumer (2017). Systematically, the LSDV model turned out to be the most appropriate model for further investigation among the pooled least squares, least squares dummy variable (LSDV) and the random effects models in terms of explaining the forward overlapped three-year averages of growth rates. This was further extended through the inclusion of the missing non-linearities of explanatory variables. The author can thus confirm the first two research hypotheses, which investigated the presence of the impact of public and private debt on medium-term economic growth. However, there is a distinct relationship between public and private debt, as public debt is positively correlated with medium-term growth, while private debt negatively impacts medium-term growth. These relationships are not unambiguous, as the inclusion of statistically significant omitted non-linear effects of explanatory variables revealed a more detailed relationship between both debt types and medium-term growth.

In the first part of the empirical analysis, the author confirmed the existence of a concave-shaped relationship between public debt and medium-term growth. There was also a focus on the robustness of the model on heteroscedasticity and serial correlation. The latter posed several problems for some explanatory variables that were undermining the desired robustness of serial correlation. The solution was to implement the first lags of private debt into the model specification, which enhanced the robustness of the model of serial correlation. Therefore, a convex-shaped relationship was confirmed between lagged private debt and medium-term growth. More specifically, the threshold for public debt stands at 111.6% of GDP, while the threshold for lagged private debt is 149.8% of GDP. Compared to the study by Mika and Žumer (2017), in this study the author introduced the first lags of private debt into the model, thus confirming the same regression coefficient prepositions for both public and private debt, while also confirming the existence of the threshold effects of both public and private debt on economic growth for which Mika and Žumer (2017) did not find statistically significant thresholds. While other studies of the threshold

debt effects on economic growth in the European Union sample found slightly lower thresholds for public debt and significantly lower thresholds for private debt, this study points out the position of most of the investigated countries on the declining part of the convex-shaped curve of lagged private debt and whether there are questionable significant positive effects of high private indebtedness on economic growth.

In the second part of the empirical analysis, the human capital variable was changed and private debt was divided into non-financial corporate debt and household debt, while the previously explored lagged effects of private debt on medium-term growth were considered. This model showed a greater significance of the regression coefficients than in the previously investigated models. It also exhibited similar explanatory power and indicated appropriate robustness on heteroscedasticity and relatively acceptable robustness on serial correlation. Thresholds were computed for all three investigated types of debt and a similar relationship was found between debt and growth. Government debt remained a concave-shaped relationship with medium-term growth and a threshold of 104.8% of GDP, which is 6.8 percentage points lower than in the previous model. Both lagged non-financial corporate debt and lagged household debt indicated a convex-shaped relationship, wherein corporate debt has a threshold of 138.3% of GDP and household debt 145.1% of GDP. These thresholds for private debt are relatively higher than in existing literature, which implies a significant awareness of confirming the previously doubted positive effects of high private indebtedness on growth. Similarly, a significant number of countries are situated on the declining part of the convex-shaped curve of lagged private debt, which explains the negative effects of further private debt-to-GDP ratios on medium-term growth rate.

The confirmed statistically significant non-linear effects of debt on medium-term growth enable the third research hypothesis to be confirmed, as significant thresholds were computed for all the investigated types of debt. This study supports the unambiguous relationship between debt and growth, as the former has the potential to be either a catalyst or a drag on economic growth. However, the author supports the view of debt as one of the important growth factors that must be considered in modern economics, in which there is a significant level of leverage of both public and private debt. In relation to existing literature, it is necessary to be especially careful when explaining the positive effects of debt, which can quickly turn out to be negative in the event of the presence of threshold effects. Economic policymakers should consider possible threshold debt effects on economic growth, as considering an appropriate threshold level for debt-to-GDP ratio would enable, on the one hand, higher economic growth, or on the other, prevent adverse effects of high indebtedness. The author's estimations provide an insight into the European Union debt characteristics, however, the implementation of general measures on debt in a highly heterogeneous group of countries like the members of the European Union must be considered very carefully. Some studies (e.g. Eberhardt & Presbitero, 2015) specifically warned of the existence of heterogeneity in the group of European Union countries, therefore further empirical investigation could focus on a smaller and more homogeneous group of European countries or investigate individual countries. A further extension of the study could possibly be related to the use of other econometrical methods, such as VAR or ECM, which are commonly used in the investigated issue.

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Ali obstajajo učinki praga vpliva dolga na srednjeročno gospodarsko rast? Primer držav Evropske unije

Izvleček

Dolg je postal pomemben dejavnik gospodarske aktivnosti in v skladu z razvojem dolga so ga številni raziskovalci vključili v sodobne modele gospodarske rasti. Pozitivni vidik zadolževanja predstavlja glajenje osebne potrošnje, investicij podjetij in vladnih izdatkov v odnosu do njihovega dohodka, kar vodi v boljšo alokacijo kapitala v gospodarstvu. Vendar so se v zgodovini pojavljali primeri bankrotov držav in izkušnje iz evropske dolžniške krize s spremljajočimi ostrimi varčevalnimi ukrepi, ki so nas opozorile na nevarnost prekomerne ravni in bremena dolga. V tem prispevku raziskujemo obstoj morebitnega praga vpliva zadolževanja na gospodarsko rast, pri katerem se izražajo negativni učinki dolga na gospodarsko aktivnost. Izhajajoč iz pristopa Mika & Žumar (2017) obravnavamo obstoj pragov povezave med dolgom vlade, podjetij in gospodinjstev ter srednjeročno gospodarsko rastjo na vzorcu držav Evropske unije med leti 1995 in 2019. Prvič, na podlagi podatkov Eurostat-a o javnem in zasebnem dolgu smo potrdili konkavno obliko povezave med javnim dolgom in gospodarsko rastjo z maksimumom pri 116,6 odstotkih BDP. Pri zasebnem dolgu smo odkrili enoletni odložen vpliv zasebnega dolga na gospodarsko rast in potrdili konveksno obliko povezave z minimumom pri 149,8 odstotkih BDP. Drugič, s pomočjo podatkov iz Global Debt Database smo razdelili zasebni dolg na nefinančni korporativni oziroma podjetniški dolg in dolg gospodinjstev, s čimer smo lahko podrobneje proučevali povezavo med dolgom in gospodarsko rastjo. Med javnim dolgom in gospodarsko rastjo smo potrdili konkavno obliko povezave z maksimumom pri 104,8 odstotkih BDP. Za oba tipa zasebnega dolga smo potrdili predhodno ugotovljen odložen vpliv na gospodarsko rast in konveksno obliko povezave. Pri vplivu podjetniškega dolga na gospodarsko rast smo potrdili prag z minimumom pri 138,3 odstotkih BDP, medtem ko smo pri vplivu dolga gospodinjstev na gospodarsko rast potrdili prag z minimumom pri 145,1 odstotkih BDP. Poznavanje praga vpliva zadolževanja na gospodarsko rast nudi odločevalcem ekonomske politike pomembno sporočilo, saj lahko ti s pravočasnim in primernim ukrepanjem omogočijo bodisi višjo gospodarsko rast bodisi preprečijo potencialne negativne učinke prekomerne zadolženosti.

Ključne besede: zadolženost, srednjeročna gospodarska rast, učinki praga