
Indebtedness and growth in the EMU before the Covid-19 pandemic shock

Patrizio Morganti*

Abstract

Rising debt can threaten macroeconomic, financial, and fiscal stability, and thus fuels uncertainty among economic agents. Therefore, high levels of indebtedness may hinder economic growth especially for those economies with a large debt burden and may also amplify the volatility of GDP growth rates. This can be particularly true when we consider a currency area, such as the European Monetary Union (EMU), whose economies are characterized by different structural features and by political and social instability. In 2019, the private and public debt of the EMU reached 206% and 86% of GDP, respectively. The purpose of this paper is to investigate the relationship between economic growth and debt for the EMU countries during the 2000-2019 period using a two-steps approach. We first provide a breakdown of private and public debt-to-GDP ratios and their changes over time, both at the eurozone-level and at country-level. Then we employ fixed effects panel regression to investigate the relationships between i) real GDP per capita growth and debt, and ii) GDP growth volatility and debt, and to investigate which channels could be responsible for the effects of debt on economic growth. It emerges that debt-to-GDP ratios are linked negatively to economic growth and positively to growth volatility. Some policy implications arise, such as the need to stabilize private and public debt, promote growth, and foster coordination among the policies of the EMU member states.

JEL classification: E44, F65, H63, O47

Keywords: Private debt, Public debt, Economic growth, Growth volatility, Euro area.

1. Introduction

Since its creation in 1999, the euro area had to cope with challenges posed by the financial crisis, the new great recession, the sovereign-debt crisis, and finally the pandemic crisis. Accommodative monetary policy and financial conditions over the past few years have contributed to the buildup of high public and corporate debt in the eurozone countries. Overall private non-financial debt has increased from 160% of GDP in 2000 to almost 206% in 2019, mostly driven by the debt of the non-financial corporations (NFCs), while public debt rose from 70% to almost 86% with a peak of 95% in 2014. Private and public debt is high in a substantial number of European countries, with the majority of eurozone countries that have already breached the EU criterion that public debt should not exceed 60% of GDP. These hyper-debt signals cannot be neglected by regulatory authorities since they could materialize into serious threats to macroeconomic, financial, and fiscal stability of the euro area. Such

* Department of Economics, Engineering, Society and Business, Tuscia University. Via del Paradiso 47, 01100, Viterbo, Italy. E-mail: morganti@unitus.it

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vulnerabilities could be amplified by the different structural features that characterize the economies of each member state in a context of political and social instability. While leverage may support the economic recovery on the one side, it also increases the vulnerability of the non-financial sector and the cost of debt servicing on the other side.

The relationship between economic growth and debt has been extensively explored in the academia, leading to the main outcome that high debt, mostly government debt, has a negative impact on the growth rate of a country, and in many cases that impact gets more pronounced as debt increases. Our key contribution is to analyze the potential link between economic growth and debt not at the global level, rather at a limited sample of countries, such as those of the European Monetary Union (EMU).

The purpose of this paper is to analyze the relationship between debt and economic growth for the EMU countries following a two-steps approach. We first provide a breakdown of private (household and NFCs sectors) and public debt-to-GDP ratios and their changes over time, either at the eurozone-level and at country-level. Then we carry out an econometric exercise aimed to investigate the potential link between debt and economic growth for the 19 EMU countries over the 2000-2019 period. We point out that we intentionally decided to stop our analysis at the pre-pandemic period in order not to alter the results by excessive macroeconomic fluctuations caused by the pandemic shock after 2020.¹ In this regard, we believe that future research efforts intended to consider the structural break due to the pandemic crisis will have to focus on a broader time frame.

We employ two different panel datasets, non-overlapping 5-year averages and overlapping 5-year averages, to consider variations across countries and over time of the variables of our interest, while controlling for both country and time fixed effects.² Macroeconomic data have been collected from The World Bank's World Development Indicators (WDI) while debt-to-GDP ratios from the IMF's Global Debt Database. We also investigate the potential impact of each sector-indebtedness on real economy growth volatility, as measured by the standard deviation of the real GDP per capita

¹ Currently, the most up-to-date data are up to 2020.

² As a common practice in the recent literature, using 5-year periods allows to capture relationships between the variables in the medium-term, and thus purge cyclical movements.

growth rates. We expect to find some empirical evidence showing a negative link between growth and indebtedness of the non-financial sector of the economy on the one hand, and a positive link between growth volatility and debt on the other hand, implying higher risk connected to macroeconomic and financial stability.³

We also address two additional issues. The first one is whether private and public debt are complementary to economic growth, and the second one is to investigate which channels could be responsible for the effects of debt on economic growth. This could have relevant policy implications since the existence of complementarities between private and public debt as well as the understanding of the channels between debt and growth would suggest policy makers to be adopt policies mainly aimed to stabilize debt and rely on robust growth to ensure sustainability. The paper addresses three main questions: (i) does exist a statistically significant relationship between economic growth and debt for the EMU area? (ii) what about the relationship between debt and the volatility of GDP growth rates? (iii) what are the main channels through which the different sources of debt can influence economic growth?

The paper is organized as follows. After a brief review of the literature in Section 2, Section 3 provides a breakdown of private and public debt in the EMU by analyzing debt-to-GDP ratios and their changes over time, both at the aggregate- and at the country-level. Section 4 is devoted to data description and methodology, and Section 5 to results. Section 6 concludes. A description of variables and data sources is available in the Appendix at the end of the paper.

2. Related literature

Our paper is mostly related to the strand of the literature which focuses on the investigation of the debt and growth nexus.

Indebtedness among economic agents should be aimed to improve their welfare by allowing them to enjoy better and larger opportunities in terms of investments or consumption, while always being able to afford future debt service. However, the real world teaches us that over-borrowing may end up in bankruptcy, financial turmoil, liquidity dry-ups, and, in the worst cases, severe financial or sovereign-debt crisis. At this

³ See, for instance, Cecchetti et al. (2011) who explored the relationship between GDP growth volatility and debt.

regard, Cecchetti et al. (2011) point out the importance of looking carefully at the sources of non-financial debt, i.e. household, corporate, and public sector. The authors empirically examine the impact of debt on economic growth using a dataset on debt levels of 18 OECD countries from 1980 to 2010 (based primarily on flow of funds data). The results support the view that, beyond a certain threshold (85%, 90%, and 85% of GDP for government, corporate, and household debt, respectively), debt harms growth, even if they do not estimate the magnitude of the impact. They find out that debt is good at low levels, since it is a source of economic growth and stability; at high levels, private and public debt are bad, since they tend to increase volatility and retarding growth. In general, higher nominal debt raises real volatility, increases financial fragility and reduces average growth. In addition, Cecchetti et al. (2011) also investigate the link between debt and growth volatility, showing that high indebtedness amplifies the standard deviation of GDP growth rates.

The negative relationship between debt and future GDP growth has been explored also by Jordà et al (2016), Mian et al. (2017), Alter et al. (2018). In particular, Alter et al. (2018) document a negative relationship between household debt and future GDP for a set of 80 countries over the period 1950–2016. This relationship is explained by three mutually reinforcing mechanisms: i) debt overhang impairs household consumption when negative shocks hit, ii) an increase in household debt heighten the probability of future banking crises, which significantly disrupts financial intermediation, iii) crash risk may be systematically neglected due to investors' overoptimistic expectations associated with household debt booms. Drehmann et al. (2018) study the transmission mechanism from financial markets to real economic activity. They analyze the effects of household debt on the economy by developing a transmission mechanism focused on the flows of resources between borrowers and lenders, i.e. new borrowing and debt service. They construct a panel dataset of household debt in 16 countries showing that new borrowing increases economic activity but generates a pre-specified path of debt service that reduces future economic activity. In particular, when new borrowing is auto-correlated and debt is long term, two systematic lead-lag relationships emerge. First, debt service peaks at a well-specified interval after the peak in new borrowing, since debt service is a function of the stock of debt outstanding, which continues to grow even after the peak in new borrowing. Second, net cash flows from

lenders to borrowers reach their maximum before the peak in new borrowing and turn negative before the end of the credit boom. Jordà et al. (2013) use local projection methods to condition on a broad set of macroeconomic controls to study how past credit accumulation impacts key macroeconomic variables such as output, investment, lending, interest rates, and inflation. The authors use a dataset of 14 advanced countries between 1870 and 2008 and provide evidence that relatively to typical recessions, financial crisis recessions are costlier, and more credit-intensive expansions tend to be followed by deeper recessions (in financial crises or otherwise) and slower recoveries.

Eggertsson and Krugman (2012) suggest that, in order to avoid high unemployment and deflation, the public sector should borrow to fill the spending gap left by private sector borrowers as the latter repair their balance sheets. However, the capacity of the public sector to borrow is not unlimited. When a crisis strikes, the ability of the government to intervene depends on the amount of debt that it has already accumulated as well as what its creditors perceive to be its fiscal capacity—that is, the capacity to raise tax revenues to service and repay the debt. At this regard Mbaye et al. (2018) document another form of private sector “bailout” that they consider as much more common and universal than the typical bank bailout, which is a sort of debt “mutualization” not involving financial institutions, rather households and firms. The authors show that whenever the private sector is caught in a debt overhang and needs to deleverage, governments systematically come to the rescue through a counter-cyclical rise in government deficits and debt. Thus, excess private debt invariably leads to higher public debt once the private sector is forced to deleverage. The channel through which this debt substitution takes place is not so much the explicit assumption of private liabilities by the government but instead growth. Private deleveraging weighs on economic activity, thereby prompting both a cyclical deterioration in public finances and a counter-cyclical rise in public debt as governments borrow on taxpayers' behalf to minimize the drag on the economy. Reinhart et al. (2015) explores the instruments available to governments for re-normalizing public debt levels relative to nominal activity in the long run. They support the rationale that longer-term adjustment instruments are crucial to weighing alternative medium-term stabilization strategies.

Increasing debt is a matter of great concern for policy makers, especially regarding the understanding of the channels through which debt can influence real GDP growth.

Several works have tested which channels may prevail in the relationship between debt and growth. For instance, Clements et al. (2003) detects public investment to be an indirect source through which the lowering external debt can give significant boost to economic growth for low-income countries. Pattillo et al. (2004) show that the negative impact of high debt on growth operates both through a negative effect on physical capital accumulation and on total factor productivity growth (TFP). Schclarek (2004) extends the analysis of Pattillo et al. (2004) to advanced economies and confirms that debt accumulation negatively affects economic growth mainly through the channel of capital accumulation and moderately through TFP. Baum et al. (2013) and Riffat and Munir (2015) find that in addition to TFP, also private savings and investment are channels through which high debt can be detrimental for growth. As well as capital accumulation and total factor productivity, also the productivity of labor can matter as shown by Kumar and Woo (2010). The authors find that the inverse relationship between growth and debt is largely explained by a decline in productivity of labor mainly due to reduction in investments and slowdown in growth of capital stock brought by high level of indebtedness.

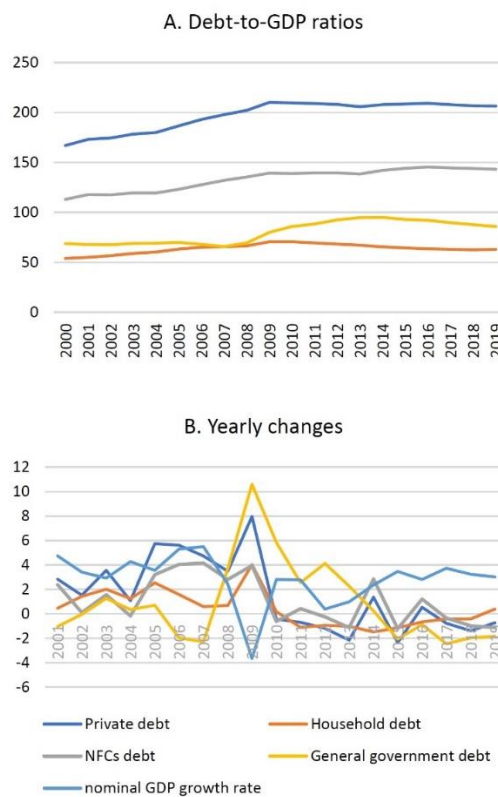
The paper is also related to the modern literature on finance and growth to the extent of the econometric methodology that we employ to address the debt and growth relationship. For instance, Beck et al. (2014a) investigate the effect of financial sector to growth volatility. They conduct both a cross-country and a panel analysis over a sample of 77 countries for the period 1980-2007 using non-overlapping 5-year windows, with the purpose to investigate how variation in financial sector size is associated with economic growth and growth volatility. The authors find that intermediation activities increase growth and reduce volatility in the long run. Over shorter time horizons a large financial sector stimulates growth at the cost of higher volatility in high-income countries, while intermediation stabilize the economy in the medium run especially in low-income countries. Modern contributions of the finance and growth literature adopt panel data estimations and control for both country and time fixed effects. A common practice is to control for over time variations by considering non-overlapping or overlapping 5-year windows to capture medium-term relationships between variables, purge business cycle frequencies from the data, and exploit time series information.

Among all we mention Bekaert et al. (2007), Cecchetti and Kharroubi (2012), Beck et al. (2014a,b, 2016), Morganti and Garofalo (2019).

3. A descriptive analysis

In this section, we analyze the trends of non-financial debt in the EMU-19 area during the 2000-2019 period. According to Figure 1, Panel A, private debt shows an increase up to 2009 (from 167% in 2000 to 203% in 2009), followed by a slight gradual reduction in the next decade (195% in 2019). Public debt shows a similar trend, with a peak of 95% in 2014, and a drop of almost nine percentage points between 2014 and 2019. It is interesting to look at the changes in debt-to-GDP ratios, which can stem from a change in debt levels or in GDP (Figure 1, Panel B). The most remarkable changes in public and private debt-to-GDP ratios have occurred during the 2007-2011 period (10.6% and 8%, respectively, between 2008-2009) which were amplified by a drop in GDP of -3.6% in 2009.

Figure 1. Private and public debt in the EMU area (2000-2019)

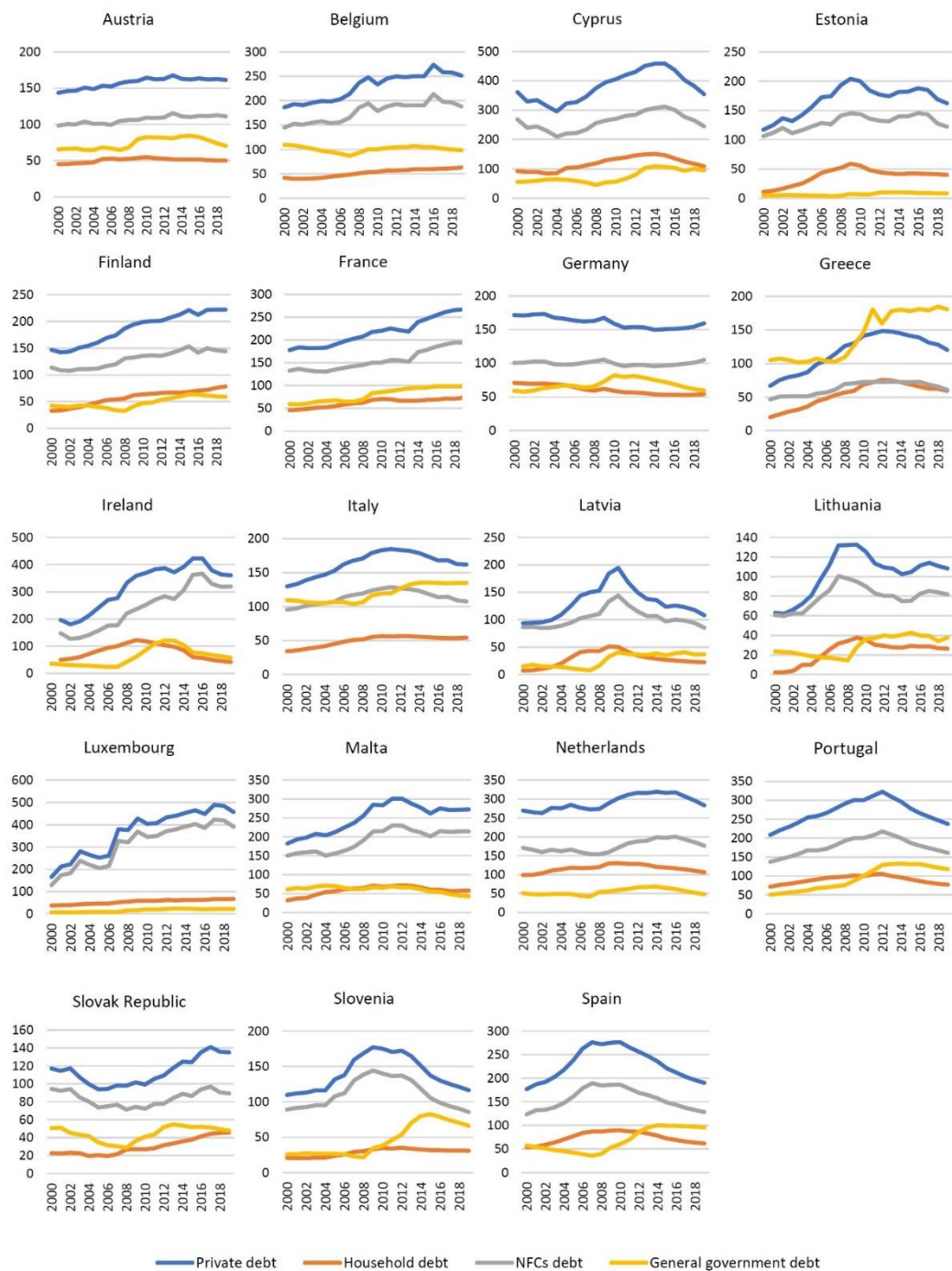


Panel A: yearly debt-to-GDP ratios, percentages. Panel B: yearly changes in debt-to-GDP ratios and yearly GDP growth rates, percentages. Source: IMF (2021).

Figures 2 and 3 provide a breakdown of debt-to-GDP ratios and their yearly changes for each country of the euro area. In general, the indebtedness of the private sector is well higher than public one. In many of the EU-19 countries, the non-financial corporate sector represents the greatest source of debt followed by public sector (Austria, Belgium, France, Lithuania, Slovenia, and Slovak Republic) or household sector (Cyprus, Estonia, Finland, Ireland, Latvia, Luxembourg, Netherlands, Portugal, and Spain). Cyprus, Luxembourg, Ireland, and Portugal exhibit, in sequence, the highest private debt and NFCs debt ratios, followed by Netherlands, Spain, Belgium. On the opposite, Greece, Germany, Austria, and Italy, show the lowest ones. Netherlands, Ireland, Portugal, and Spain show the largest household debt-to-GDP ratio. Things changes when looking at the public debt: Greece leads alone followed by Italy, Portugal, and Belgium. Luxembourg, Finland, and Netherlands exhibit the lowest ratios. Malta shows a very similar trend of both government and household debt-to-GDP ratios, while Germany had a very large household debt prior to the crisis which was overcome by the public debt in the post-crisis period. We observe only two important exceptions. Greece is the sole country with a public debt-to-GDP ratio larger than the private one: in 2000 the public debt was almost twice the private one, then it remained close to 100% up to the outbreak of the crisis while the private debt to GDP grew faster. Since 2008 the public debt-to-GDP ratio increased at a larger pace reaching over 180% after 2016. In Italy, even if overall private debt emerges to be higher than public debt, the public debt-to-GDP ratio has been always in line with that of the NFCs sector.

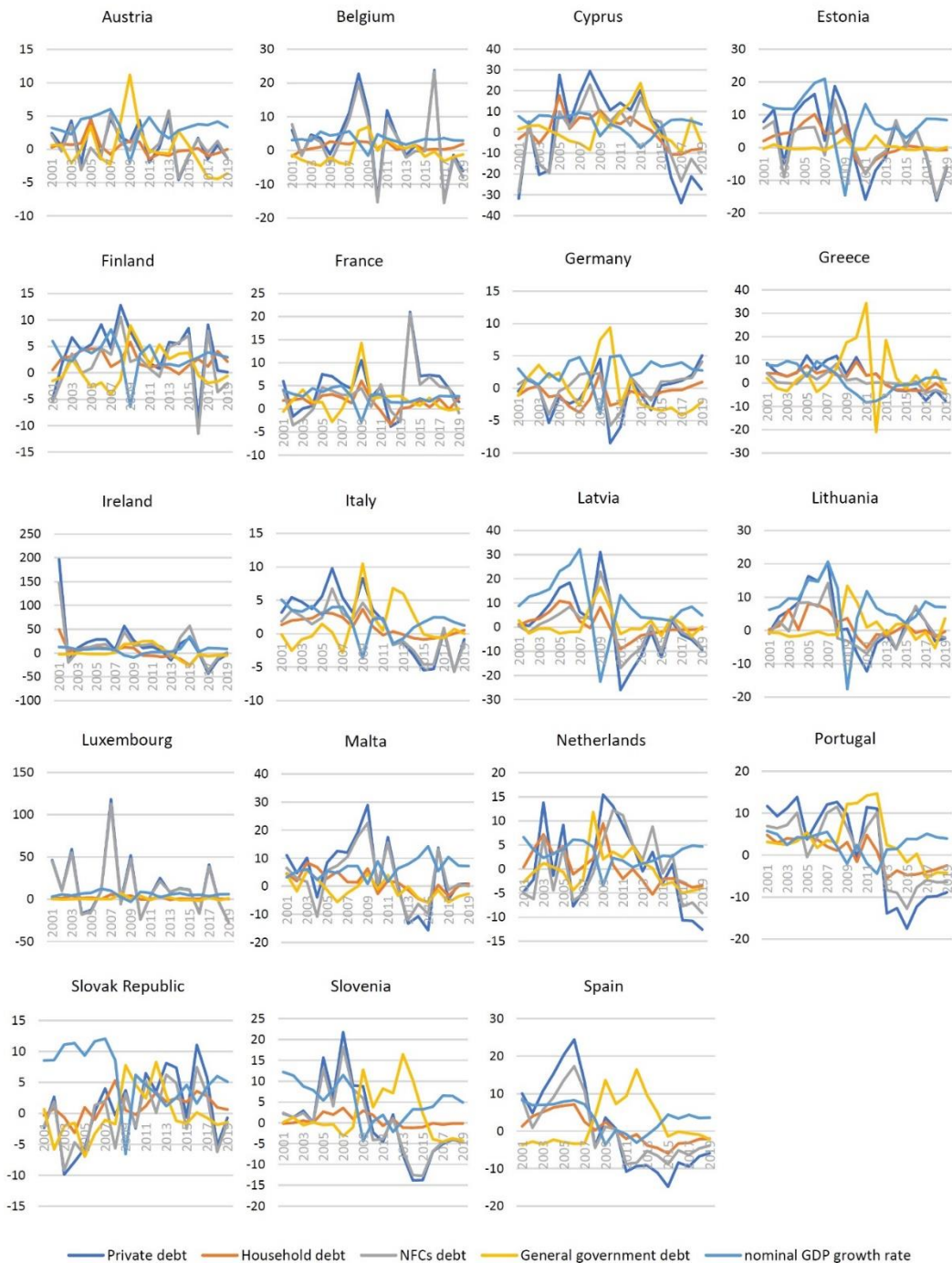
Looking at changes (Figure 3), during the 2007-2011 period debt-to-GDP ratios have been characterized by large volatility due to uncertainty generated by the financial crisis, showing sudden and sharp positive changes, around 10-15% for most countries. Estonia, Greece, Ireland, Latvia, Luxembourg, Malta, and Spain exhibit the largest variations in debt indicators. In addition, it is worth to point out that countries with the highest public debt-to-GDP ratio share the lowest private debt-to-GDP ratios, and vice versa. Separate considerations must be done for the public debt in Ireland: its ratio was nearly 30% up to 2007 (it was the second country with the lowest public debt), then it dramatically rose to 120% in 2012-2013, and it fell back to 57% during the recent year, reaching 57% in 2019.

Figure 2. Private and public debt-to-GDP ratios in EMU countries (2000-2019)



Source: IMF (2021).

Figure 3. Yearly changes in private and public debt-to-GDP ratios in EMU countries (2000-2019)



Source: IMF (2021).

4. Data description and methodology

The analysis is conducted for the EMU-19 sample of countries over the 2000-2019 period. The sample is not quite large, but it shows wide ranges of variation of variables across countries. Macroeconomic data have been collected from The World Bank's World Development Indicators (WDI), while debt-to-GDP ratios from the IMF's Global Debt Database. We investigate the relationships between i) real GDP per capita growth rates and non-financial debt, ii) standard deviation of real GDP per capita growth rates and non-financial debt, using four debt-to-GDP ratios, i.e., household, NFCs, overall private (household plus NFCs), and public debt. In addition, we consider a set of control variables that are usually recognized to influence economic growth in the standard literature, such as initial real GDP per capita (natural logarithm), age dependency ratio, inflation, ratio of government expenditure to GDP, and trade openness measured as the sum of exports plus imports to GDP.⁴ Investments (% of GDP), TFP, and savings (% of GDP), are the variables used to investigate debt channels. A detailed description of variables and data sources is available in the Appendix at the end of the paper.

We carry out fixed-effects panel regressions using two datasets: 1) data averaged over non-overlapping 5-year windows (4 observations per country, i.e., 2000-2004, 2005-2009, 2010-2014, and 2015-2019), and 2) data averaged over 5-year moving average windows (15 observations per country) to exploit the time series information.⁵ Using 5-year averaged-periods allows to capture relationships among variables in the medium-term, while 5-year moving average allow to purge cyclical movements in the medium run. Descriptive statistics and pairwise correlation coefficients for both datasets are reported in Tables 1 and 2, respectively.

⁴ A similar set of control variables has been used, for instance, by Beck et al. (2000), Beck and Levine (2004), Beck et al. (2012), Beck et al. (2014). In addition to the above-mentioned controls, Cecchetti et al. (2011) also use, for instance, domestic savings and population growth rates.

⁵ This approach has been already adopted in the finance and growth literature. See, for instance, Bekaert et al. (2007), Cecchetti and Kharroubi (2012), Beck et al. (2014), Beck et al. (2016), Morganti and Garofalo (2019).

Table 1. Descriptive statistics

	Obs.	Mean	Std. dev.	Min.	Max.
Panel A. Non-overlapping 5-year averages					
Economic growth	76	2.069	2.297	-4.571	8.821
Growth volatility	76	2.581	2.393	0.264	11.348
Private debt	76	210.147	90.067	68.900	468.898
Household debt	76	59.287	28.973	5.613	144.265
NFCs debt	76	150.859	70.926	50.180	404.473
Public debt	76	63.954	37.433	4.960	180.769
Age dependency	76	49.324	4.426	39.002	60.635
Initial GDP (ln)	76	10.113	0.568	8.830	11.442
Gov. exp.	76	19.485	2.445	12.265	25.905
Inflation	76	2.168	1.512	-0.261	8.462
Trade	76	126.934	73.818	48.415	393.544
Investments	76	22.055	3.925	11.058	34.998
TFP	56	1.402	1.805	-4.056	5.582
Savings	76	25.470	9.044	9.190	56.288
Panel B. 5-year moving average					
Economic growth	285	1.726	2.570	-5.612	10.751
Growth volatility	285	2.707	2.311	0.264	11.348
Private debt	285	215.057	89.567	72.302	468.498
Household debt	285	61.763	29.049	7.196	146.386
NFCs debt	285	153.293	70.116	51.041	404.516
Public debt	285	64.171	36.884	4.652	180.699
Age dependency	285	48.914	4.229	38.693	60.293
Initial GDP (ln)	285	10.117	0.552	8.873	11.438
Gov. exp.	285	19.631	2.374	12.717	25.936
Inflation	285	2.120	1.403	-0.766	8.728
Trade	285	127.011	73.638	48.305	394.673
Investments	285	21.944	3.689	11.084	33.944
TFP	210	1.062	1.862	-4.560	6.304
Savings	285	25.162	8.726	9.011	54.492

Table 2A. Pairwise correlations - Panel A. Non-overlapping 5-year averages

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) Econ. Growth	1.000													
(2) Growth volatility	0.145	1.000												
(3) Private debt	-0.291**	-0.007	1.000											
(4) Household debt	-0.542***	-0.122	0.751***	1.000										
(5) NFCs debt	-0.148	0.040	0.963***	0.545***	1.000									
(6) Public debt	-0.470***	-0.304***	0.047	0.313***	-0.067	1.000								
(7) Age dependency	-0.125	-0.248**	-0.074	0.019	-0.102	0.413***	1.000							
(8) Initial GDP (ln)	-0.432***	-0.153	0.567***	0.383***	0.563***	0.107	0.218*	1.000						
(9) Gov. exp.	-0.370***	-0.301***	-0.164	0.155	-0.272**	0.248**	0.448***	0.056	1.000					
(10) Inflation	0.201*	0.414***	-0.298***	-0.321***	-0.248**	-0.441***	-0.440***	-0.359***	-0.088	1.000				
(11) Trade	0.206*	0.139	0.483***	-0.024	0.624***	-0.385***	-0.314***	0.309***	-0.383***	-0.046	1.000			
(12) Investments	0.436***	0.438***	-0.161	-0.300***	-0.082	-0.561***	-0.187	-0.142	-0.155	0.551***	-0.069	1.000		
(13) TFP	0.686***	-0.139	-0.228*	-0.528***	-0.085	0.062	0.187	0.032	-0.197	-0.063	0.024	0.191	1.000	
(14) Savings	0.143	0.122	0.448***	-0.024	0.579***	-0.450***	-0.113	0.674***	-0.358***	-0.043	0.681***	0.242**	0.137	1.000

Table 2B. Pairwise correlations - Panel B. 5-year moving average

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) Econ. growth	1.000													
(2) Growth volatility	0.002	1.000												
(3) Private debt	-0.321***	0.037	1.000											
(4) Household debt	-0.513***	-0.066	0.775***	1.000										
(5) NFCs debt	-0.196***	0.076	0.962***	0.575***	1.000									
(6) Public debt	-0.488***	-0.189***	0.071	0.318***	-0.043	1.000								
(7) Age dependency	-0.199***	-0.141**	-0.058	0.037	-0.092*	0.439***	1.000							
(8) Initial GDP (ln)	-0.412***	-0.183***	0.544***	0.388***	0.538***	0.134**	0.246***	1.000						
(9) Gov. exp.	-0.348***	-0.224***	-0.134**	0.148***	-0.237***	0.280***	0.509***	0.079	1.000					
(10) Inflation	0.290***	0.221***	-0.321***	-0.351***	-0.265***	-0.460***	-0.430***	-0.379***	-0.133**	1.000				
(11) Trade	0.175***	0.168***	0.459***	-0.024	0.605***	-0.376***	-0.331***	0.285***	-0.367***	-0.042	1.000			
(12) Investments	0.482***	0.136**	-0.239***	-0.320***	-0.173***	-0.602***	-0.230***	-0.212***	-0.119**	0.655***	-0.095	1.000		
(13) TFP	0.732***	-0.080	-0.187***	-0.483***	-0.050	-0.000	0.214***	0.104	-0.175**	-0.073	0.059	0.174**	1.000	
(14) Savings	0.151**	0.077	0.422***	-0.038	0.555***	-0.465***	-0.146**	0.669***	-0.313***	-0.053	0.673***	0.169**	0.216**	1.000

The econometric specification of regression equations slightly changes depending on whether we consider data averaged over non-overlapping 5-year windows or data averaged over overlapping 5-year windows: in the first case we include country fixed effects, while in the second one we include both country and time fixed effects. We thus estimate the following regression equations for panel dataset 1):

$$growth_{i,t} = \beta_0 + \beta_1 debt_{i,t:j} + \beta_2 X_{i,t} + \mu_i + \epsilon_{i,t} \quad (1)$$

$$std_growth_{i,t} = \beta_0 + \beta_1 debt_{i,t:j} + \beta_2 X_{i,t} + \mu_i + \epsilon_{i,t} \quad (2)$$

$$growth_{i,t} = \beta_0 + \beta_1 debt_{i,t:j} + \beta_2 X_{i,t} + \beta_3 (debt_{i,t:1} \cdot debt_{i,t:4}) + \mu_i + \epsilon_{i,t} \quad (3)$$

$$std_growth_{i,t} = \beta_0 + \beta_1 debt_{i,t:j} + \beta_2 X_{i,t} + \beta_3 (debt_{i,t:1} \cdot debt_{i,t:4}) + \mu_i + \epsilon_{i,t} \quad (4)$$

where $growth_{i,t}$ and $std_growth_{i,t}$ denote, respectively, the average real GDP per capita growth rate and its standard deviation, for country i at time period t . $debt_{i,t}$ denotes the j -th debt-to-GDP ratio with $j=1,2,3,4$ associated, respectively, to private debt, household debt, NFCs debt, and government debt. Debt ratios are included one-at-a-time in regression equations (1) and (2), while in equations (3) and (4) and we include both overall private debt and public debt to examine their joint effect on the dependent variable. $X_{i,t}$ is the vector of control variables consisting of real GDP per capita (natural logarithm), age dependency ratio, inflation, government expenditure over GDP, and trade openness. μ_i denotes country-fixed effects used to control for unobserved heterogeneity across countries and thus account for common factors and unobservable, time-invariant, country-specific effects on economic growth.⁶ What we reasonably expect from the regressions results is debt-to-GDP ratios to be linked negatively with economic growth, but positively with growth volatility. For dataset 2) we run the following regressions:

$$growth_{i,t} = \beta_0 + \beta_1 debt_{i,t:j} + \beta_2 X_{i,t} + \mu_i + \lambda_t + \epsilon_{i,t} \quad (5)$$

⁶ See Beck et al. (2014), Beck et al. (2016), Morganti and Garofalo (2019).

$$std_growth_{i,t} = \beta_0 + \beta_1 debt_{i,t:j} + \beta_2 X_{i,t} + \mu_i + \lambda_t + \epsilon_{i,t} \quad (6)$$

$$growth_{i,t} = \beta_0 + \beta_1 debt_{i,t:j} + \beta_2 X_{i,t} + \beta_3 (debt_{i,t:1} \cdot debt_{i,t:4}) + \mu_i + \lambda_t + \epsilon_{i,t} \quad (7)$$

$$std_growth_{i,t} = \beta_0 + \beta_1 debt_{i,t:j} + \beta_2 X_{i,t} + \beta_3 (debt_{i,t:1} \cdot debt_{i,t:4}) + \mu_i + \lambda_t + \epsilon_{i,t} \quad (8)$$

where we also include time-fixed effects (λ_t), so we can capture variation in variable within countries and over time.

4.1. Debt channels

In this subsection, we provide the econometric specification for the set of regression equations used to test the channels which could be responsible of the relationship between debt and economic growth. To pursue this goal, we consider the variable of the channel under consideration as dependent variable which is regressed on debt variables and on the same set X_{it} of control variables (Pattillo et al. 2004, Riffat and Munir 2015). Given their relevance in the existing literature, we investigate the channels of investments, total factor productivity, and savings. We run regressions on non-overlapping 5-year data, Equations (9) and (10), and on 5-year moving average data, Equations (11) and (12).

$$channel_{i,t:k} = \beta_0 + \beta_1 channel_{i,t-1:k} + \beta_2 debt_{i,t:j} + \beta_3 X_{i,t} + \mu_i + \epsilon_{i,t} \quad (9)$$

$$channel_{i,t:k} = \beta_0 + \beta_1 channel_{i,t-1:k} + \beta_2 debt_{i,t:j} + \beta_3 X_{i,t} + \beta_4 (debt_{i,t:1} \cdot debt_{i,t:4}) + \mu_i + \epsilon_{i,t} \quad (10)$$

$$channel_{i,t:k} = \beta_0 + \beta_1 channel_{i,t-1:k} + \beta_2 debt_{i,t:j} + \beta_3 X_{i,t} + \mu_i + \lambda_t + \epsilon_{i,t} \quad (11)$$

$$\begin{aligned} channel_{i,t:k} = & \beta_0 + \beta_1 channel_{i,t-1:k} + \beta_2 debt_{i,t:j} + \beta_3 X_{i,t} + \beta_4 (debt_{i,t:1} \cdot \\ & debt_{i,t:4}) + \mu_i + \lambda_t + \epsilon_{i,t} \end{aligned} \quad (12)$$

where $channel_{i,t:k}$ denote the variable of the channel under consideration with $k=1,2,3$ associated, respectively, to investments (% of GDP), TFP, and savings (% of GDP). $channel_{i,t-1:k}$ is the lagged variable of the channel.⁷ Debt ratios are included one-at-a-time in regression equations (9) and (11), while in equations (10) and (12) we include both overall private debt and public debt to examine their joint effect on the dependent variable. $X_{i,t}$ is the vector of control variables.

5. Results

Table 3 reports regressions results for equations (1) and (3) in Panel A, and (5) and (7) in Panel B. In Models (1) to (4), debt-to-GDP ratios are included one-at-a-time, while in Model (5) we analyze the interaction between private and public debt. Let us first focus on non-overlapping 5-year window regressions (Panel A) which allows us to capture potential cyclical movements in debt-to-GDP ratios. It broadly emerges a negative relationship between debt and economic growth, since all of the debt-to-GDP ratios, except for the NFCs ratio, are statistically significant at the 1% (household debt) or at the 5% level (private and government debt). Specifically, a 1% change in private, household, or public debt-to-GDP ratio produces, respectively, a -0.019, -0.098 or -0.051 percentage points on real GDP per capita growth rates in the medium-run. When controlling for the joint effect of private and public debt on growth (Model 5) it emerges a statistically significant correlation with GDP growth at the 1% level. The estimated coefficient is smaller than the marginal effects of each single debt indicator, however this outcome implies that there may exist a complementarity effect between private and government debt that eventually fosters economic growth. Such complementarities could be to some extent related to the crowding out effect, i.e., an increase in government spending and in government debt can increase interest rates which in turn reduces investment spending by the private sector of the economy. A

⁷ For the non-overlapping 5year database, the lagged variable is referred to the previous 5year average.

drop in private investment spending implies a reduction in private indebtedness whose marginal effect on real GDP is eventually positive.

The same outcomes are basically observed with moving average data (Table 3, Panel B), though estimated coefficients emerge to be slightly larger than those observed with non-moving average data. Household and public debt are negatively correlated to economic growth with coefficients of -0.122 (1% level) and -0.049 (10% level), respectively. Overall private debt is statistically significant only when we consider its interaction with public debt: the estimated coefficients are -0.038 (1% level) for private debt and -0.150 for public debt (1% level), while the interaction term is positive, 0.0004 (1% level). Therefore, when private and public debt are both included in the regression equations their marginal effect on economic growth is negative and larger than when variables are included individually, while their interaction term is positive.

Turning to the control variables, we find evidence for a convergence effect in the growth regressions, as real GDP per capita enters negatively (significant at the 1% level) every regression model, evidence for a positive relationship between the dependency ratio and growth, a negative relationship between government expenditure and growth, and a positive linkage between trade openness and growth. Inflation does not enter significantly in a consistent manner across the regressions.

Table 3A: Economic growth and debt in the EMU - Panel A: non-overlapping 5-year windows

	Economic growth				
	Model 1	Model 2	Model 3	Model 4	Model 5
Private debt	-0.0192** (0.008)				-0.033*** (0.008)
Household debt		-0.0978*** (0.019)			
NFC debt			-0.008 (0.009)		
Government debt				-0.051** (0.019)	-0.117*** (0.036)
Private debt x gov. debt					0.0003*** (0.000)
Age dependency	0.196* (0.101)	0.118 (0.070)	0.206* (0.100)	0.354*** (0.069)	0.351*** (0.086)
Initial GDP(ln)	-8.549*** (2.567)	-4.579** (1.805)	-8.934*** (2.735)	-11.312*** (1.665)	-10.564*** (1.325)
Gov. expenditure	-0.799** (0.288)	-0.314* (0.159)	-0.962** (0.262)	-0.959*** (0.178)	-0.806*** (0.201)
Inflation	0.087 (0.098)	-0.0416 (0.141)	0.059 (0.107)	-0.113 (0.117)	-0.003 (0.082)
Trade	0.048*** (0.007)	0.027*** (0.008)	0.029** (0.012)	0.037*** (0.012)	0.070*** (0.012)
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Time fixed effects	No	No	No	No	No
Countries/Obs.	19/76	19/76	19/76	19/76	19/76
Adj.-R2	0.458	0.674	0.385	0.506	0.615

*The dependent variable is real GDP per capita growth rate. Constants, country and time fixed effects are not reported for brevity. Robust and clustered standard errors are reported in parentheses. *, **, *** denote, respectively, statistical significance at 10%, 5% and 1% level.*

Table 3B: Economic growth and debt in the EMU - Panel B: 5-year moving average

	Economic growth				
	Model 1	Model 2	Model 3	Model 4	Model 5
Private debt	-0.009 (0.010)				-0.038*** (0.013)
Household debt		-0.122*** (0.024)			
NFC debt			0.004 (0.010)		
Government debt				-0.049* (0.024)	-0.150*** (0.034)
Private debt x gov. debt					0.0004*** (0.0001)
Age dependency	0.301 (0.190)	0.065 (0.180)	0.316** (0.142)	0.429*** (0.137)	0.421*** (0.135)
Initial GDP (ln)	-7.754** (3.664)	-8.768*** (2.420)	-6.320* (3.574)	-11.985*** (3.241)	-12.042*** (2.429)
Gov. expenditure	-0.613* (0.295)	-0.301 (0.197)	-0.601** (0.266)	-0.885*** (0.254)	-0.764*** (0.245)
Inflation	0.292 (0.177)	0.136 (0.171)	0.249 (0.180)	0.161 (0.173)	0.199 (0.129)
Trade	0.065*** (0.016)	0.041* (0.022)	0.049** (0.017)	0.056** (0.019)	0.081*** (0.013)
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes
Countries/Obs.	19/285	19/285	19/285	19/285	19/285
Adj.-R2	0.583	0.711	0.576	0.608	0.712

*The dependent variable is real GDP per capita growth rate. Constants, country and time fixed effects are not reported for brevity. Robust and clustered standard errors are reported in parentheses. *, **, *** denote, respectively, statistical significance at 10%, 5% and 1% level.*

Empirical outcomes for the investigation of the growth volatility and debt nexus are reported in Table 4. Again, in Models (1) to (4), debt indicators are included one-at-a-time in the regression equations, while in Model (5) we consider the interaction between private and public debt. It broadly emerges that debt-to-GDP ratios are positively linked to the volatility of real GDP per capita growth rates, thus amplifying potential instability and risks connected to the real economy. According to Panel A (non-overlapping 5-year averages) only the coefficients for private and NFCs debt are statistically significant at the 1% level: a 1% change in either overall private debt or NFCs debt contributes to increase the standard deviation of GDP growth by, respectively, 0.034 and 0.040 in the medium-run. When we consider moving average data and control for both country and time fixed effects, in addition to private (0.023 at the 5% level) and NFCs debt (0.026 at the 5% level), we also find a positive and statistically significant coefficient for government debt (0.038 at the 5% level). No statistically significant link emerges for the interaction term between private and public debt. We also find evidence for a positive link between growth volatility and real GDP, and inflation (only for moving average data), while a negative link between growth volatility and government spending (especially for moving average data), and trade (especially for non-overlapping data). The effect of each debt variable, as well as the interaction between private and government debt, on economic growth and growth volatility is summarized in Figures 4 and 5.

Table 4A: Growth volatility and debt in the EMU - Panel A: non-overlapping 5-year windows

	Growth volatility				
	Model 1	Model 2	Model 3	Model 4	Model 5
Private debt	0.034*** (0.009)				0.039** (0.013)
Household debt		0.049 (0.031)			
NFC debt			0.040*** (0.009)		
Government debt				0.035 (0.023)	0.038 (0.050)
Private debt x gov. debt					-0.0001 (0.0001)
Age dependency	-0.123 (0.118)	-0.0918 (0.114)	-0.156 (0.112)	-0.241 (0.142)	-0.172 (0.162)
Initial GDP (ln)	5.275** (2.340)	3.347 (2.516)	6.939*** (2.197)	7.291* (3.502)	5.876* (3.359)
Gov. expenditure	-0.481* (0.267)	-0.487 (0.324)	-0.261 (0.194)	-0.165 (0.285)	-0.480 (0.300)
Inflation	0.379 (0.319)	0.520 (0.320)	0.331 (0.329)	0.585* (0.322)	0.405 (0.322)
Trade	-0.080*** (0.016)	-0.029 (0.019)	-0.086*** (0.015)	-0.038* (0.021)	-0.087*** (0.021)
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Time fixed effects	No	No	No	No	No
Countries/Obs.	19/76	19/76	19/76	19/76	19/76
Adj.-R ²	0.334	0.215	0.325	0.208	0.325

The dependent variable is the standard deviation of real GDP per capita growth rate. Constants, country and time fixed effects are not reported for brevity. Robust and clustered standard errors are reported in parentheses. *, **, *** denote, respectively, statistical significance at 0%, 5% and 1% level.

Table 4B: Growth volatility and debt in the EMU - Panel B: 5-year moving average

	Growth volatility				
	Model 1	Model 2	Model 3	Model 4	Model 5
Private debt	0.023** (0.009)				0.020 (0.014)
Household debt		0.028 (0.029)			
NFC debt			0.026** (0.011)		
Government debt				0.038** (0.013)	0.026 (0.032)
Private debt x gov. debt					0.00001 (0.0001)
Age dependency	0.193 (0.126)	0.209 (0.164)	0.144 (0.116)	0.065 (0.186)	0.123 (0.146)
Initial GDP (ln)	-1.545 (2.557)	-3.746 (2.829)	-1.635 (2.599)	-0.166 (3.375)	1.393 (3.012)
Gov. expenditure	-0.873*** (0.260)	-0.948*** (0.328)	-0.806*** (0.230)	-0.666* (0.317)	-0.708** (0.323)
Inflation	0.460** (0.210)	0.559** (0.218)	0.424* (0.218)	0.609*** (0.186)	0.528*** (0.179)
Trade	-0.029 (0.020)	0.001 (0.026)	-0.035 (0.021)	-0.002 (0.023)	-0.027 (0.021)
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes
Countries/Obs.	19/285	19/285	19/285	19/285	19/285
Adj.-R ²	0.538	0.498	0.538	0.509	0.546

The dependent variable is the standard deviation of real GDP per capita growth rate. Constants, country and time fixed effects are not reported for brevity. Robust and clustered standard errors are reported in parentheses. *, **, *** denote, respectively, statistical significance at 0%, 5% and 1% level.

Figure 4. Debt, economic growth, and growth volatility
(non-overlapping 5-year windows)

Dependent variable	Debt sources				
	Private (overall)	Household	NFC	Gov.	Private*Gov.
Economic growth	negative	negative		negative	positive
Growth volatility	positive		positive		

Figure 5. Debt, economic growth, and growth volatility
(5-year moving average)

Dependent variable	Debt sources				
	Private (overall)	Household	NFC	Gov.	Private*Gov.
Economic growth		negative		negative	positive
Growth volatility	positive		positive	positive	

5.1. Results for debt channels

The results related to the three channels are reported, respectively, in Tables 5, 6 and 7. The novelty of our contribution is to show the decomposed relationship between each channel and the different types of debt, i.e., households, NFC, and government. Using the non-overlapping 5year database, it emerges that overall private debt and household debt are negatively and significantly linked to TFP, while investments and savings are only influenced by a positive and significant effect of NFC. Public debt shows a disruptive and statistically significant effect on both investments (at the 1% level) and savings (at the 5% level). Regarding the moving average database, it emerges that investments are influenced only by household debt (negative link), TFP is positively influenced by the interaction between private and public debt, while savings are positively influenced by overall private debt, NFC debt, and the interaction between private and public debt.

Table 5. Investments channel

	Investments				
	Model 1	Model 2	Model 3	Model 4	Model 5
Panel A: non-overlapping 5-year windows					
Private debt	0.015 (0.014)				0.028* (0.014)
Household debt		-0.075 (0.043)			
NFC debt			0.036** (0.014)		
Government debt				-0.120*** (0.020)	-0.103*** (0.035)
Private debt x gov. debt					0.000 (0.000)
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Time fixed effects	No	No	No	No	No
Countries/Obs.	19/57	19/57	19/57	19/57	19/76
Adj.-R ²	0.736	0.755	0.757	0.848	0.615
Panel B: 5-year moving average					
Private debt	-0.006 (0.005)				-0.011 (0.009)
Household debt		-0.057*** (0.010)			
NFC debt			-0.000 (0.006)		
Government debt				-0.019 (0.012)	-0.036 (0.021)
Private debt x gov. debt					0.000 (0.000)
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes
Countries/Obs.	19/266	19/266	19/266	19/266	19/266
Adj.-R ²	0.949	0.961	0.947	0.949	0.759

*The dependent variable is gross fixed capital formation as a percentage of GDP. Other control variables, constants, country and time fixed effects are not reported for brevity. Robust and clustered standard errors are reported in parentheses. *, **, *** denote, respectively, statistical significance at 10%, 5% and 1% level.*

Table 6. TFP channel

	TFP				
	Model 1	Model 2	Model 3	Model 4	Model 5
Panel A: non-overlapping 5-year windows					
Private debt	-0.019* (0.009)				-0.052*** (0.016)
Household debt		-0.098*** (0.031)			
NFC debt			-0.016 (0.013)		
Government debt				0.016 (0.028)	-0.114* (0.058)
Private debt x gov. debt					0.0003*** (0.000)
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Time fixed effects	No	No	No	No	No
Countries/Obs.	14/42	14/42	14/42	14/42	14/42
Adj.-R ²	0.591	0.661	0.561	0.544	0.696
Panel B: 5-year moving average					
Private debt	0.001 (0.001)				-0.004 (0.002)
Household debt		0.007 (0.007)			
NFC debt			0.001 (0.002)		
Government debt				0.005 (0.010)	-0.020* (0.011)
Private debt x gov. debt					0.0004*** (0.0001)
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes
Countries/Obs.	14/196	14/196	14/196	14/196	14/196
Adj.-R ²	0.955	0.955	0.955	0.955	0.959

The dependent variable is total factor productivity. Other control variables, constants, country and time fixed effects are not reported for brevity. Robust and clustered standard errors are reported in parentheses. *, **, *** denote, respectively, statistical significance at 10%, 5% and 1% level.

Table 7. Savings channel

	Savings				
	Model 1	Model 2	Model 3	Model 4	Model 5
Panel A: non-overlapping 5-year windows					
Private debt	0.012 (0.009)				0.002 (0.014)
Household debt		-0.027 (0.049)			
NFC debt			0.021** (0.007)		
Government debt				-0.057** (0.022)	-0.094** (0.036)
Private debt x gov. debt					0.000 (0.000)
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Time fixed effects	No	No	No	No	No
Countries/Obs.	19/57	19/57	19/57	19/57	19/57
Adj.-R ²	0.863	0.860	0.869	0.883	0.615
Panel B: 5-year moving average					
Private debt	0.006* (0.003)				-0.003 (0.003)
Household debt		0.008 (0.013)			
NFC debt			0.007* (0.004)		
Government debt				-0.000 (0.012)	-0.030*** (0.009)
Private debt x gov. debt					0.0001*** (0.000)
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes
Countries/Obs.	19/266	19/266	19/266	19/266	19/266
Adj.-R ²	0.968	0.966	0.968	0.966	0.973

*The dependent variable is gross domestic savings as a percentage of GDP. Other control variables, constants, country and time fixed effects are not reported for brevity. Robust and clustered standard errors are reported in parentheses. *, **, *** denote, respectively, statistical significance at 10%, 5% and 1% level.*

6. Conclusions

This paper explores the potential implications of high indebtedness in EMU countries on their real GDP growth rates over the 2000-2019 period. It broadly emerges that debt-to-GDP ratios are negatively linked to economic growth while positively linked to growth volatility. In general, a 1% change in the private debt-to-GDP ratio produces -0.02 percentage points in real GDP per capita growth rates, and of 0.02/0.03 in the standard deviation of GDP growth rates; at this regard, the magnitude of household debt is very large and its effect on GDP growth rates is estimated at -0.1 percentage points. A 1% change in the public debt-to-GDP ratio produces a change of 0.05 percentage points in GDP growth, and of 0.04 in GDP growth volatility. Therefore, changes in government debt lead to larger changes in both GDP growth and growth volatility than changes in private debt. When we also control for the interaction term between private and public debt, it emerges a statistically significant correlation with GDP growth which suggests the existence of a complementarity that could be, to some extent, related to a kind of crowding out effect. In addition, we find that TFP, investments, and savings emerge to be the relevant channels through which debt can affect economic growth. In line with the existing literature, private debt and household debt are negatively and significantly linked to TFP and investments, while investments and savings are positively influenced by private debt, mostly by the NFC sector. Public debt shows a disruptive effect on both investments and savings.

Our results allow us to draw some policy implications. Rising debt in the EMU may turn to serious threats to macroeconomic, financial, and fiscal stability, that could be amplified by the context of high uncertainty that characterize the currency area. Rising debt poses several challenges to economic agents and policy makers, in terms of debt financing capacity and debt sustainability. Policy makers should be aware of the trade-off that a reduction in one of the previous issues may cause an increase in sovereign default risk (spreads rise, another issue for many EMU's countries), while the interventions needed to mitigate the latter would end up to austerity measures. Increasing growth volatility is not necessarily a bad signal, as it may denote a very flexible real sector where households, firms and labor markets quickly adjust to social and technological changes, but it could also denote periods characterized by high uncertainty and instability. These hyper-debt signals cannot be neglected by regulatory

authorities since they could pose several challenges to economic agents and policy makers in terms of debt financing capacity and sustainability, that can be amplified by adverse exogenous factors such as political and social instability, and recently the pandemic crisis. With high levels of debt, economies should stabilize their debt and rely on robust growth to ensure sustainability, but this seems not to be the case of EMU countries, whose average GDP per capita growth rates show a downward trend since 2007. Anyway, private and government debt require different treatments by policy makers according to their different nature. While the overhang of household and corporate debt may end up to default and bankruptcy for households and firms, the excess of government debt can lead to the government inability to deliver essential services for current and future generations. Prudential regulation and supervision need to consider the rising concern of high debt. Coordination among the policies of the EMU member states is, therefore, crucial for maintaining macroeconomic and financial stability, and fostering sustainable economic growth.

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Appendix

Data description and sources

Age dependency	Age dependency ratio (% of working-age population)	World Development Indicators, The World Bank (indicator code SP.POP.DPND)
Economic growth	Real GDP per capita growth rate	World Development Indicators, The World Bank (indicator code NY.GDP.PCAP.KD.ZG)
Government debt	General government debt/GDP	Global Debt Database, International Monetary Fund
Government expenditure	Government expenditures/GDP	World Development Indicators, The World Bank (indicator code NE.CON.GOV.TZ)
Growth volatility	Standard deviation of average real GDP per capita growth rate	
Household debt	Household debt/GDP	Global Debt Database, International Monetary Fund
Inflation	Consumer price annual % change	World Development Indicators, The World Bank (indicator code FP.CPI.TOTL.ZG)
Initial GDP (ln)	Natural logarithm of real GDP per capita (constant 2010 LCU) of the beginning year for each time period	World Development Indicators, The World Bank (indicator code NY.GDP.PCAP.KN)
Investments	Gross fixed capital formation/GDP	World Development Indicators, The World Bank (indicator code NE.GDI.FTOT.ZS)
Non-financial corporations (NFCs) debt	Non-financial corporations debt/GDP	Global Debt Database, International Monetary Fund
Private debt	Private debt/GDP	Global Debt Database, International Monetary Fund
Savings	Gross domestic savings (% of GDP)	World Development Indicators, The World Bank (indicator code NY.GDS.TOTL.ZS)
Total Factor Productivity (TFP)	TFP = economic growth – 0.3* capital growth	TFP has been computed following Schclarek (2004) and Riffat and Munir (2015), where capital growth is per capita capital stock growth. The series of capital stock was computed following perpetual inventory method as from King and Levine (1994), using 5 percent depreciation rate.
Trade	(imports + exports)/GDP	World Development Indicators, The World Bank (indicator code NE.TRD.GNFS.ZS)