Does public debt produce a crowding out effect for public investment in the EU?

This paper shows the detrimental effect of government debt on public investment in the EU

Mattia Osvaldo Picarelli
European Stability Mechanism

Willem Vanlaer
Hasselt University

Wim Marneffe
Hasselt University

European Stability Mechanism

Does public debt produce a crowding out effect for public investment in the EU?

Mattia Osvaldo Picarelli [1] European Stability Mechanism
Willem Vanlaer Hasselt University
Wim Marneffe Hasselt University

Abstract

This paper exploits a panel dataset for 26 EU countries, between 1995 and 2015, to examine the extent to which increased levels of public debt have led to reduced public investment, the so-called 'debt overhang' hypothesis. To address endogeneity concerns, we use an instrumental variable approach based on a GMM estimation. Our results validate the debt overhang hypothesis and remain robust across various estimation techniques. The GMM specification with year dummies indicates that a 1% increase in public debt in the EU brings about a reduction in public investment of 0.03%. Moreover, we find evidence that: 1) the results are mainly driven by high-debt countries; 2) the negative impact of debt on investment is slightly smaller in the Eurozone than in the entire EU; 3) both the stock and flow of public debt play a role in reducing public investment with the impact of the latter that is found to be more profound.

Keywords: public investment, debt overhang, credit rationing.

JEL codes: E22, F34

[1] Email: M.OsvaldoPicarelli@esm.europa.eu

ISSN 2443-5503
ISBN 978-92-95085-56-5

doi:10.2852/795853
EU catalog number DW-AB-18-008-EN-N

Does Public Debt Produce a Crowding Out Effect for Public Investment in the EU?*

Mattia Osvaldo Picarelli[†] [‡] Willem Vanlaer[§] Wim Marneffe[§]

April 18, 2019

Abstract

This paper exploits a panel dataset for 26 EU countries, between 1995 and 2015, to examine the extent to which increased levels of public debt have led to reduced public investment, the so-called 'debt overhang' hypothesis. To address endogeneity concerns, we use an instrumental variable approach based on a GMM estimation. Our results validate the debt overhang hypothesis and remain robust across various estimation techniques. The GMM specification with year dummies indicates that a 1% increase in public debt in the EU brings about a reduction in public investment of 0.03%. Moreover, we find evidence that: 1) the results are mainly driven by high-debt countries; 2) the negative impact of debt on investment is slightly smaller in the Eurozone than in the entire EU; 3) both the stock and flow of public debt play a role in reducing public investment with the impact of the latter that is found to be more profound.

JEL Codes: E22, F34

Keywords: Public Investment, Debt Overhang, Credit Rationing.

*We would like to thank Samantha Bielen, Steve Bond, Nicola Borri, Daragh Clancy, Aitor Erce, Carmine Gabriele, Paolo Manasse, Silvia Marchesi, Lorenzo Ricci, the participants at the 85th International Atlantic Economic Conference and the participants of the ESM internal seminar for their useful comments and suggestions. Karol Siskind provided excellent editorial support. The views expressed in this paper are those of the authors and do not necessarily reflect those of the ESM.

[†]Sapienza University of Rome/European Stability Mechanism.

[‡]Corresponding author: mattia.picarelli@gmail.com

[§]Hasselt University.

1 Introduction

The European Union (EU) has experienced a considerable increase in public debt as a result of the sovereign debt crisis. A significant amount of literature has been devoted, especially in the last decade, to studying the impact of this rise in debt on economic growth (Reinhart and Rogoff, 2010; Baum et al., 2013). In general, higher levels of debt can result in lower growth in three ways. Firstly, given the finite pool of financial resources, the more the government taps into the pool of loanable funds, the less capital there is available for private enterprises, which pushes up their borrowing cost, essentially crowding out private investment (Spencer and Yohe, 1970). Secondly, if financial markets start questioning the sustainability of a country, they will demand higher interest rates in order to compensate for the increased default risk. Higher interest rates for the sovereign, in turn, get transmitted to the private sector as government bonds are generally considered as a lower bound for interest rates (Das et al., 2010). Finally, Ricardian equivalence suggests that companies and households might anticipate a tax increase when the fiscal sustainability of a country is in doubt, resulting in reduced investment and consumption (Barro, 1998).

In addition, recent research has shown that at least part of the lacklustre recovery after the recent global financial crisis (GFC) can be attributed to the elevated levels of public debt (Reinhart et al., 2012; Chatterjee, 2013).When a country with a high level of sovereign debt faces a crisis, its ability to respond to that crisis, for example by adopting countercyclical fiscal policy, is severely impeded (Jordá et al., 2014).

Little research, however, has been devoted to the causal impact of high debt levels on the flow of public investment. This is rather surprising, as policy makers have clearly recognized the fact that the volume of public investment has declined over the past decade and that considerable efforts need to be undertaken to bridge this investment gap (Juncker, 2015). Moreover, there is little consensus, both in academic and policy circles, on the factors driving this drop in investment. On the one hand, the decrease in public investment might be primarily caused by the GFC as countries choose the path of least resistance when implementing fiscal austerity, and simply cut public investment rather than reducing other components of public expenditure. On the other hand, the decline might be caused by more secular factors (such as the aging of population) and driven by economic fundamentals.

The literature which does study the impact of sovereign debt on investment has mainly been

focused on developing countries, and more specifically on highly indebted and poor countries (HIPCs). The Latin-American debt crisis of the 1980s brought about a considerable amount of contributions on the effect of high public debt on investment in less developed countries (LDCs) (Krugman, 1988; Sachs, 1989).

Focusing on 26 EU countries over the period 1995-2015, this paper studies whether Europe suffers from a debt overhang effect. More specifically, we analyze whether the increase in public debt in Europe resulted in a decrease in public investment, offering a richer specification compared to the existing literature. We study whether this effect is more pronounced (i) in high-debt than in low-debt countries, (ii) pre-crisis vs crisis period, (iii) in EZ than in EU countries, and (iv) whether there is a threshold effect. Finally, we analyse (v) whether it is only the stock of debt that matters, or also the flow of public debt. To tackle this research question and the accompanying endogeneity concerns, we apply an instrumental variable approach by using a Generalized Method of Moment model, based on the GMM estimator of Arellano and Bond (1991).

The paper proceeds as follows: Section 2 provides some background on the sovereign debt crisis; Section 3 comprises a literature review; Section 4 describes the empirical analysis and its extensions and we conclude in Section 5.

2 Background on sovereign debt crisis

Starting from the end of 2009, the European Union suffered from a sovereign debt crisis.[1] To deal with this crisis, some governments implemented fiscal consolidation policies, raising taxes and lowering spending. However, these measures mainly had the effect of further lowering growth, especially in the short-run, which pushed up debt levels even higher; between 2007 and 2015, the average public debt-to-GDP level increased by 66.66% in the European Union and by 70.23% in the Eurozone. Some countries experienced an even steeper growth in public debt; in the so-called PIIGS countries (Portugal, Italy, Ireland, Greece and Spain) the debt-to-GDP ratio increased by 86.52%.

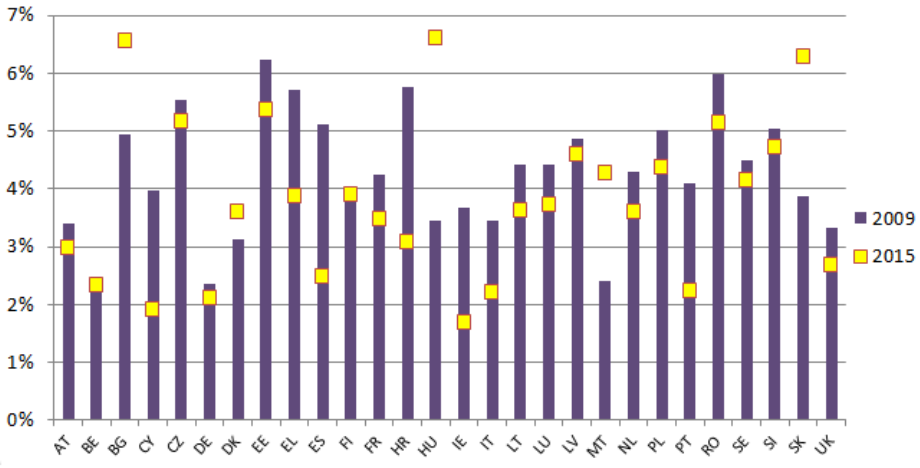
At the same time public debt levels in Europe surged, public investment plummeted. This decline in public investment is quite puzzling given the highly accommodative monetary policy implemented by the European Central Bank (ECB) over the past years. Public investment,

[1]The causes of this crisis are rather varied and extend beyond the scope of this paper. For a related discussion see Albanesi et al. (2017); Bayoumi (2017); Martin and Philippon (2017).

measured by Gross Fixed Capital Formation (GFCF), decreased by 6.32% in the EU since 2007. In the Eurozone, the decrease was more pronounced; public investment, as a percentage of GDP, declined by 11.08% since 2007. The PIIGS suffered an even sharper decline; GFCF-to-GDP decreased by 37.87% since 2007.

Figure 1 shows how public investment (as a percentage of GDP) declined substantially between 2009 and 2015 for 21 out of 28 European countries.

Figure 1: Public investment-to-GDP ratio

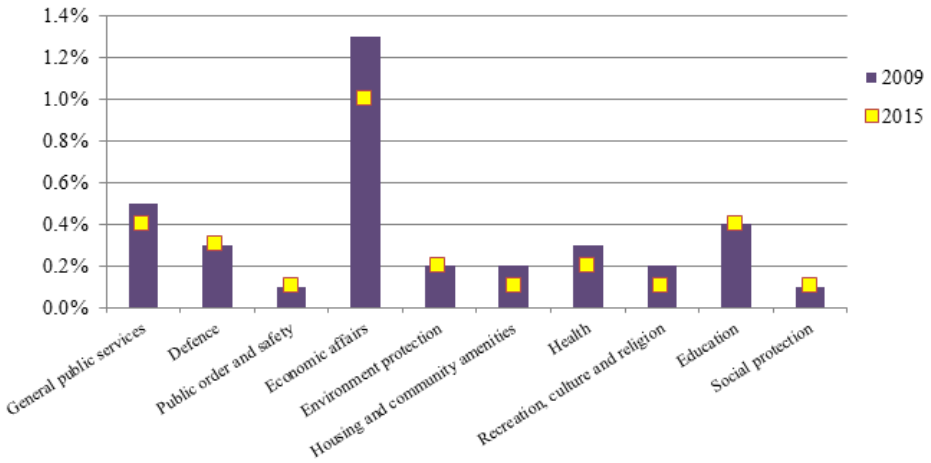


Source: Eurostat

It is interesting also to decompose public gross fixed capital formation expenditure by its socio-economic function in order to see how its main components have changed since 2009 (Figure 2). Five out of the ten groups used in this classification show a clear decline, while the other five categories remain relatively unaltered. In particular, the current level in health investment is quite low, which is especially worrisome, given that this is found to be a very significant determinant of long-term growth (OECD, 2016b).

There are numerous reasons why a sufficient level of public investment is warranted. Firstly, as mentioned before, public investment can positively impact long-term growth and labour productivity (OECD, 2016b; Abiad et al., 2016; Ganelli and Tervala, 2016). Secondly, public investment in areas such as education can produce significant spillover effects for the private sector, as firms benefit from a highly educated workforce. Thirdly, government investment in transport, for example, can lead to a crowding in effect of private investment, as companies can more easily get

Figure 2: Public investment-to-GDP ratio decomposition by function



Source: Eurostat (COFOG database)

their products to consumers. Fourthly, an adequate level of public investment in defence and security helps in dealing with terrorist threats. Finally, public investment can also be considered as a potentially useful counter-cyclical fiscal tool, something which is not considered extensively in the literature. Most studies show that public investment is pro-cyclical, mainly due to political motivations (Bove et al., 2017). Political considerations might even result in excessively large cuts in public investment when consolidation measures need to be introduced during or after an economic downturn, increasing then the degree of pro-cyclicality of this variable. This suggests a certain degree of state-dependency for this variable, which is important to contemplate, especially when hysteresis is a concern (OECD, 2016a; Fatas and Summers, 2018)[2].

The aforementioned benefits of public investment are also reflected in Europe 2020 (European Commission, 2010), the 10-year strategy proposed by the European Commission for advancement of the economy of the EU as it promotes "public funding for R&D", "efficient investment in education and training systems at all levels" and "key infrastructure investment in cross-border energy and transport networks, and low-carbon technology". It also says that "budgetary consolidation programmes should prioritise growth-enhancing items such as education and skills, R&D and innovation and investment in networks, e.g. high-speed internet, energy and transport interconnections".

[2]In presence of hysteresis, the effect of a public investment stimulus might indeed be stronger (OECD, 2016c).

3 Literature review

The debt overhang hypothesis was initially introduced by Myers (1977) when analyzing the determinants of corporate borrowing and, more specifically, in the context of the impact of excessive debt on investment decisions at firm level. Then, due to the Latin-American debt crises of the 1980s, several studies extended the analysis on debt overhang from a corporate context to a country-based approach. The aim of these studies was to explain the effect of higher sovereign debt on investment in less developed countries (Krugman, 1988, 1989; Obstfeld and Rogoff, 1996). Subsequently, the scope of this theory was extended to consider how high levels of debt might reduce the government's incentives to undertake structural reforms (Clements et al., 2003).

Table 1 below shows a brief overview of papers which are relevant to our research. We have focused solely on empirical literature, as this is most relevant to our study. The different papers will be discussed in more detail in the following subsections.

Table 1: Overview of relevant literature

Author	Countries	Dependent Variable	Econometric method	Debt variable
Balassone et al. (2011)	Italy	Growth	OLS, 2SLS	External debt
Borensztein (1990)	Philippines	Private investment	OLS	Private debt
Clements et al (2003)	55 HIPCs	Growth, public investment	FE, GMM	External debt, external debt service
Checherita and Rother (2012)	12 EZ countries	GDP growth, public investment	FE, 2SLS, GMM	Public debt
Cohen (1993)	81 LDCs	Domestic investment	POLS	Debt service, debt-to-export ratio
Cordella et al. (2010)	79 HIPCs	Real GDP growth	OLS, FE, SGMM	External debt, public debt, debt service, private debt
Deshpande (1997)	13 SICs	Domestic investment	FE, LSDV, OLS	External debt
Eberhardt and Presbitero (2015)	118 DCs, EMs and AEs	GDP	Error correction model	Total debt (external plus domestic)
Heinemann (2006)	16 OECD countries	Public investment	FE, OLS	Public debt
Reinhart and Trebesch (2015)	12 AEs and 41 EMs	Growth	FE, DID	Public debt, external debt, debt service
Turrini (2004)	14 EU countries	Public investment	FE, IV	Public debt
Valila and Mehrotra (2005)	14 EU countries	Public investment	FE, OLS	Public debt

Note: EZ stands for Eurozone, HIPCs for highly indebted and poor countries, LDCs for least developed countries, SICs for severely indebted countries, AEs for advanced economies and EMs for emerging markets.

3.1 Debt overhang, only in developing countries?

The debt overhang hypothesis has been tested mainly for highly indebted and poor countries. In general, two ways to test the debt overhang hypothesis have been used. In the first one, an investment function is estimated, in which a specific term is added to account for debt overhang. In a second one, different econometric techniques are used to study the causal relationship between high debt and low investment.

A seminal paper in the first category is Borensztein (1990a) in which the topic is studied first from a theoretical point of view, followed by an empirical approach (Borensztein, 1990b). The author estimated a neoclassical investment function, introducing various types of debt (i.e. sovereign debt, private debt, excess debt) as explanatory variables to test the debt overhang hypothesis in the Philippines in the 1980s. He finds that the stock of foreign debt acted as a disincentive to private investment, and especially so after 1982.

One of the most important contributions in the second category is provided by Deshpande (1997). The author uses a panel approach to find a significant negative impact of debt on investment for 13 severely indebted countries (SICs) from 1971 to 1991. She also introduced a time variable in order to capture the different investment climates over the period studied. She found that the time variable had a positive impact on investment until 1984, after which it largely became negative. In another paper (Deshpande, 1993), the author shifted the focus to several HIPCs over the period 1970-1990 and again found significant evidence for a negative link between debt and investment.

There are also several contributions to the literature that do not find evidence for the debt overhang hypothesis. Cohen (1991, 1993) finds no evidence of debt overhang for the LDCs in the 1980s. His results suggest that it is not the level of debt, but rather the debt servicing costs which act as a drag on growth: 1% of GDP paid abroad reduces domestic investment by 0.3% of GDP.[3] Hence, according to this paper, high debt cannot be seen as a predictor of low investment. Similarly, Karagol (2005) argues that it is misguiding to make generalizations on the relationship between (external) debt and growth as each country has an idiosyncratic combination of social, economic and political elements.

Testing the link between debt and investment is also important from a policy making perspective. Indeed, if a high stock of debt results in decreased investment, debt relief might be an effective way to aid heavily indebted countries. Several papers investigate the empirical validity of the debt overhang hypothesis for HIPCs. Arslanalp and Henry (2005, 2006) show the effectiveness of debt relief, where debt overhang, and not weakness of institutions or poor infrastructure, is the main impediment to growth. Similarly, Cordella et al. (2010) find that the effectiveness of debt relief depends on country's characteristics, such as the quality of its policies and institutions.

[3]However, Deshpande (1993) argues against the use of debt service as an explanatory variable because it might be influenced by a rescheduling process allowed in the past by creditor countries.

3.2 What is the link between debt and growth?

Another strand of literature takes a broader view and instead of focusing on debt and investment, looks at the link between debt and growth (see Panizza and Presbitero (2013) for a review). This is relevant for our research in two ways. Firstly, the literature on the link between debt and growth helps to identify control variables for our model. Secondly, one channel through which high debt can result in low growth is through reduced public investment, which is exactly the focus of this paper.

Some papers have identified a non-linear relationship between (external) debt and growth, the so-called Debt Laffer curve (Pattillo et al., 2011; Clements et al., 2003; Reinhart et al., 2012).[4] Clements et al. (2003), focusing on 55 low income countries (classified as eligible for the IMF's Poverty Reduction and Growth Facility) in 1970-1999, showed that high external debt can negatively affect growth through both a direct and an indirect effect. A direct effect is in place if a certain threshold is reached (50% for the ratio of external debt-to-GDP and 20-25% for the present value of this ratio) after which growth significantly slows down. An indirect effect works through the investment channel; the authors find that a 1% reduction in the external debt service results in a 0.2% increase in investment, which in turn leads to higher growth through an increase of the capital stock and the immediate impact on aggregate demand. Hence, the authors conclude that a debt reduction initiative for HIPCs might be useful as it results in an increase in the growth rate.

Reinhart et al. (2012) studied 26 cases of public debt accumulation in advanced countries since 1800. They find that the relationship between real GDP growth and the public debt-to-GDP ratio is rather weak for sovereign debt below 90% of GDP. For debt levels above 90% however, economic growth falls by around 1.2%. This 90% threshold for the negative effect of debt over growth is also observed in Checherita-Westphal and Rother (2012). Conversely, Eberhardt and Presbitero (2015) found evidence for the negative relation between debt and growth but not for the presence of a common debt threshold. Their research indicates that the link between total debt (domestic plus external debt) and long-run growth differs significantly across countries. Hence, this suggests there is substantial heterogeneity in the long-run relationship between these two variables. Balassone et al. (2011) also studied the negative link between debt and growth

[4]The Debt Laffer Curve is a concept often used in the sovereign debt restructuring literature. It refers to an inverse U-shaped curve that links the amount of debt of a debtor country to the creditors' expected repayment. This curve is used to explain that creditors might have an interest in forgiving part of the debt of a debtor country since it will increase their expected repayment.

focusing on Italy for the period 1861-2009. They found that external debt had a large negative effect on GDP growth, in particular before World War I. Critics argue that, while there may very well be a negative relationship between public debt and economic growth, the effect might work in the opposite direction: low growth causes the state revenues to fall and public expenditures to rise, thus resulting in a higher level of public debt (Vanlaer et al., 2015).

3.3 What determines public investment?

Due to the sovereign debt crisis in Europe, several EU countries, notably Portugal, Italy, Ireland, Greece and Spain have faced debt problems similar to those faced by the HIPCs. In order to test whether high sovereign debt results in low public investment, we must first develop a framework that incorporates the different determinants of public investment. Only a relatively small amount of studies investigate which factors have an impact on the evolution of public investment, especially for AEs. In addition, most studies focus on one country (Aubin et al. (1988) on France, Herenkson (1988); Kirchgassner and Pommerehne (1988) on Germany and Switzerland, Sorensen (1988) on Norway), with only a limited number of papers looking at a panel of different countries (De Haan et al. (1996) for 22 OECD countries). The explanatory variables that are used in the literature can be categorized into two groups. The first category includes macroeconomic variables, such as the rate of unemployment or the growth rate of real GDP , whereas the second category includes politico-institutional variables, such as the degree of fiscal federalism and the size of the public sector.

The number of papers which specifically examine the determinants of public investment in Europe is even more limited. Valila and Mehrotra (2005), using a panel co-integration model, study the evolution of public investment and public capital stock over the period 1972-2003 for 14 EU countries. They find that public investment has been mainly determined by national income, the fiscal stance and considerations on fiscal sustainability, whereas the Maastricht criteria required to join the EMU do not seem to play a significant role.

Going one step further, there are hardly any papers that look at whether public debt has an impact on public investment in Europe. Heinemann (2006) tries to explain the declining level of public investment in 16 OECD countries, most of which are European. The results indicate that increases in public debt since the 1970s severely restricted the ability to finance new investment.

Similarly, Bacchiocchi et al. (2011) show how high debt levels result in a decrease in public investment in all OECD countries, without specific differences between EZ/EU countries and non-EZ/EU countries. With a focus on just 12 EZ countries instead, Checherita-Westphal and Rother (2012) claim that public investment is one of the main channels through which debt can negatively affect economic growth.

In summary, the existing literature on debt overhang, suffers from two major limitations. Firstly, most research focuses on developing economies (Borensztein, 1990b; Deshpande, 1993) and those papers which do devote attention to developed economies, only look at a limited number of countries or at least not at the entire European Union (Herenkson, 1988; Kirchgassner and Pommerehne, 1988; Heinemann, 2006; Checherita-Westphal and Rother, 2012). Secondly, the problem of endogeneity is not always tackled properly (Valila and Mehrotra, 2005); a rudimentary (P)OLS or FE model is not sufficient to capture the potential endogeneity between public investment (i.e. the dependent variable) and several explanatory variables, such as public debt and the government deficit. Hence, we add to the existing literature by taking into account a rich set of explanatory variables to determine public investment, focusing on 26 EU countries and tackle the issue of endogeneity by using an instrumental variable approach based on the linear GMM estimator of Arellano and Bond (1991).

4 Empirical analysis

4.1 Data description

As discussed above, the central aim of this paper is to test the debt overhang hypothesis in developed countries. More specifically we study whether, for 26 EU countries[5] over the period 1995-2015, higher levels of public debt produced a crowding out effect for public investment. In order to do so, we start building an empirical model which contains the determinants of public investment. In this section, we describe all the different variables included in our model that we identified through the literature review discussed in Section 3. Table 2 in the Appendix provides a description of the variables and Table 3 the descriptive statistics for the period studied.

Given that our variable of interest is public investment, we focus on general government[6] gross

[5]Estonia and Ireland are excluded because of data limitations.

[6]According to Eurostat, the general government sector includes the central government, state governments,

fixed capital formation (i.e. GFCF)[7] . More specifically, we consider this variable as a percentage of GDP in order to overcome differences deriving from countries' welfare level. Regarding the determinants of public investment, we can categorize our control variables into three groups: 1) variables related to government's balance sheet; 2) variables explaining country's relationship with the rest of the world; and 3) variables related to country's internal characteristics.

In the first group, we consider interest rate, debt, and public expenditure. For interest rates, we focus on the long-term interest rate and more specifically, the 10-year government bond yield[8] . This variable is included to establish the effect deriving from a long-term measure of funding. Indeed, higher borrowing costs put pressure on government finances as interest expenses increase, in turn potentially affecting the government's decision on the level of public investment (i.e. a country's fiscal space). Then, for debt we look at the general government consolidated gross debt[9] as a percentage of GDP.[10] As explained before, this variable is taken into account to test the public debt overhang hypothesis, which is the focus of this paper.

For public expenditure, we focus on the general government total expenditure expressed as a percentage of GDP. [11] This variable is taken into account to see whether the total amount of public expenditure can influence its composition. [12] In particular, when it is necessary to adjust government expenditure, public investment might be postponed and then reduced. It is indeed 'politically easier' to cut government investment than to reduce other expenditure components, such as the wages of civil servants. Large expenditure now might in fact lead to restrictive future fiscal policies and there is evidence (Oxley and Martin, 1991; Roubini and J., 1989; De Haan

local governments, and social security funds.

[7]Data comes from Eurostat, which defines GFCF as resident producers' investment, less disposals, of fixed assets plus the additions to the value of non-produced assets deriving from the productive activity of government producer or institutional units. Fixed assets are considered as the produced assets used continuously in the production processes for more than one year. They do not include inventory investment (that might introduce a large degree of volatility), the ownership of companies, public-private partnerships projects (PPPs) and investment by state-owned enterprise.

[8]This is an important rate because it is the basis of the Maastricht criterion for the long-term interest rates that must be respected by the EMU candidate countries. Data come from Eurostat.

[9]It is defined in the Maastricht Treaty as the outstanding consolidated general government gross debt at nominal value at the end of the year. According to ESA2010, it is made up of the following categories of government liabilities: currency and deposits, debt securities and loans.

[10]In the empirical literature on debt overhang, External Debt is generally used as the main explanatory variable. This is due to the fact that this hypothesis has mainly been tested for emerging market or less developed countries where basically external debt is the most important debt component. In this paper instead, we focus on a group of advanced countries. Hence, the most important debt component to consider is represented by General Government Consolidated Gross Debt.

[11]Data come from the IMF's WEO database. This variable is defined as total expense plus the net acquisition of non-financial assets.

[12]Given that public investment is part of public expenditure, we tried another specification using government consumption. Results are similar to what showed in the paper.

et al., 1996; Keman, 2010) that during periods of fiscal consolidation capital expenditure is often reduced, sometimes in a drastic way.

From an international point of view, exchanges between countries might also play an important role in explaining the flow of public investment. Therefore, in the second group of variables, we consider trade, which is defined as the sum of exports and imports of goods and services, as a percentage of GDP[13]. In particular, we consider the trade-to-GDP ratio as a proxy for the openness of a specific country. The rationale behind this being that countries that are 'more open to trade' are subject to more foreign competition and consequently may need larger public investment in order to compete in international markets (i.e. offering appropriate infrastructures) (Sturm, 2001).

In the third group of variables, we consider private investment, gross national disposable income (GNDI) per capita, production expectations and a proxy for the business cycle. For private investment, we consider gross fixed capital formation of the private sector as a percentage of GDP[14] . This variable is taken into account in order to see if there is a potential displacement effect for public gross fixed capital formation; larger investment from the private sector might produce a crowding-in or crowding-out effect for public investment. In other words, this allows for testing whether private and public investment are substitutes or complements.

The variable GNDI per capita is taken into account in order to measure the 'maturity' of the economy[15]. In a country with low GNDI per capita (such as a less advanced economy), one might expect that investment needs are larger than those in a more mature economy. However, a priori it is difficult to establish the causal relation between this variable and public investment since it might also be that a less developed economy has a lower demand for infrastructures from its population and therefore investment will be lower.

Then, we compute the following variable in order to proxy the business cycle (Hallerberg and Strauch, 2002):

$$\Delta log y_{it} - \Delta log \bar{y_{it}}$$

where Δ is the first difference operator, y_{it} is the real output and $\bar{y_{it}}$ is the trend output[16].

[13]Data come from the IMF.

[14]Data are taken from AMECO. This variable includes financial and non-financial corporations, households and non-profit institutions serving households.

[15]Data from AMECO. This variable is defined as "Gross national income (at market prices) minus current transfers (current taxes on income, wealth etc., social contributions, social benefits and other current transfers) payable to non-resident units, plus current transfers receivable by resident units from the rest of the world".

[16]Data from AMECO and they are computed taking 2010 reference levels.

Basically, this measure represents the deviation of the actual from the trend GDP growth rate. It might also provide some information on whether a government uses public investment as counter-cyclical policy tool, in which case we would observe a negative relation between this measure and GFCF. In order to deepen the discussion about pro-cyclicality, we also take into account a proxy for future expectations. More specifically, we want to consider whether a positive outlook for the future can influence the investment decisions of the government today. If governments increase their public investment efforts when there is a positive view of the future, this would suggest that public investment decisions are generally pro-cyclical. More specifically, we consider production expectations that are computed by the European Commission as the sum of production and selling price expectations for the next three months[17]. These expectations are evaluated through qualitative surveys and the final values are computed as a simple average of the answers to specific questions[18].

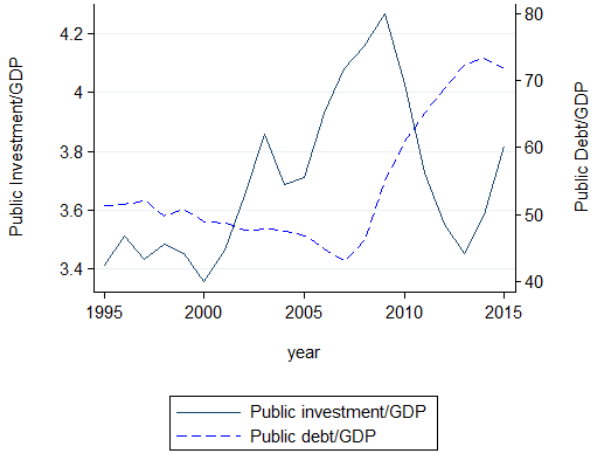
4.2 Descriptive analysis

The two most important variables that must be considered in order to test the debt overhang hypothesis are: public gross fixed capital formation and general government consolidated gross debt. Table 4 in Appendix A contains some descriptive statistics of these variables for each EU country included in our analysis. Public GFCF averaged 3.66% over the period under consideration and it was subject mostly to within-country variation. Conversely, public debt averaged 56.24% but it showed a more substantial variation across countries.

At first glance (Figure 3) it appears that higher debt levels (scale represented on the right hand axis) are associated with lower public investment (scale on the left hand axis) in the EU.

[17]Data are taken from the European Commission.
[18]For more information see European Commission (2017).

Figure 3: Average path of public debt-to-GDP ratio and public investment-to-GDP ratio for the EU countries

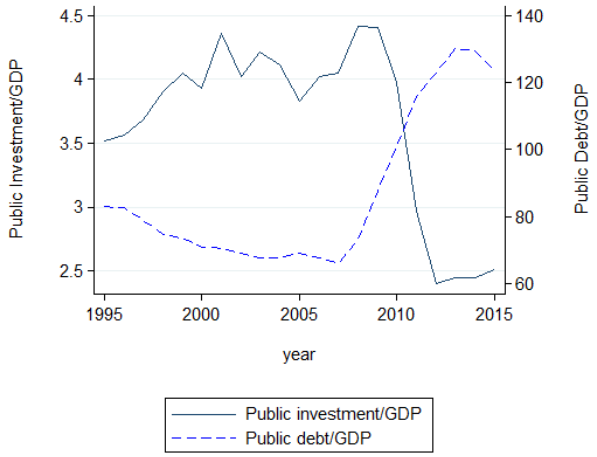


Source: Eurostat

While average public debt in the EU has increased by 66.67% since 2007 and by 30.43% since the Eurozone sovereign debt crisis in 2009, average public investment in the EU has showed an opposite path. It has indeed decreased by 6.3% since 2007 and by 10.4% since 2009. Another important stylized fact that can be derived from Figure 3 and from Figure 7 in Appendix C is that the average public investment was quite volatile, especially until 2009.

Figure 4 depicts the situation for the highly indebted EU countries, the so-called PIIGS. From this picture, the opposite paths for public debt and public investment are even more evident starting from 2008.

Figure 4: Average path of public debt-to-GDP ratio and public investment-to-GDP ratio for the PIIGS countries



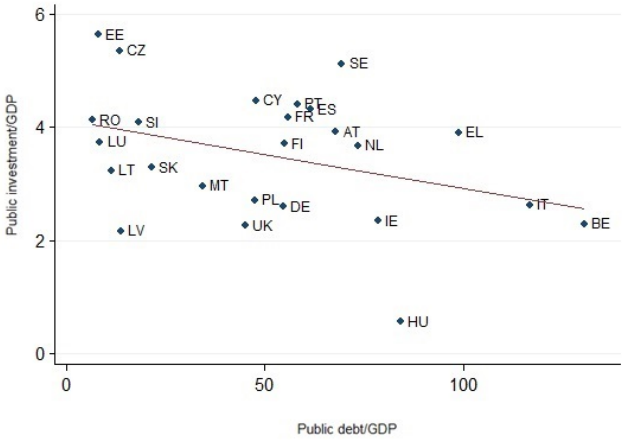
Source: Eurostat

For these countries, the increase in the average debt level and the decrease in the average public investment have been quite extraordinary: +86.52% since 2007 and +41.09% since 2009 for public debt and -37.87% since 2007 and -42.97% since 2009 for public investment.

In Appendix B - Table 5, we compute the correlation between public debt and public investment. In column 1 we report the unconditional correlation between the two variables for each EU country for the period 1995-2015. Then, we report in the other columns the same correlation conditional to the debt level being equal or larger than a certain percentile (i.e. 75%, 90% and 95%) in order to see if the correlation becomes stronger with increasing level of debt. According to the results, the simple correlation between public debt and public investment does not provide much explanatory power. No clear pattern emerges from these correlations.

The negative link between public debt and public investment can also be demonstrated when plotting the average public debt and the average public investment (i.e. the country average) for each country for the period 1995-2015 (Figure 5).

Figure 5: Link between average debt-to-GDP ratio and average investment-to-GDP ratios for each EU country (1995-2015)



Source: Eurostat

4.3 Model specification: static model

In order to test the debt overhang hypothesis, we start by using a Pooled Ordinary Least Squares (POLS) estimator[19]. The equation that we want to estimate builds on Checherita-Westphal and Rother (2012) and can be represented as follows:

[19]More specifically, we will use clustered standard errors asymptotically robust to both heteroscedasticity and autocorrelation.

$$public\,investment/GDP_{it} = \alpha + \beta \cdot public\,debt/GDP_{it-1} + \sum_{c=1}^{4} \gamma_c \cdot Controls1^{c}_{it-1} + \\ + \sum_{j=1}^{2} \gamma_j \cdot Controls2^{j}_{it} + \rho \cdot expectations_{it+1} + \epsilon_{it} \tag{1}$$

For i=1,...,26 EU countries[20] and t=1995,...,2015. Public investment is the public gross fixed capital formation-to-GDP ratio, α is the intercept, public debt is the public debt-to-GDP ratio and $Controls1$ is a set of control variables that includes the following variables: private investment is private gross fixed capital formation-to-GDP ratio, public expenditure is the public expenditure-to-GDP ratio, borrowing rate is the yield on the 10-year government bond, trade openness is the amount of trade in percentage of GDP. $Controls2$ is a set of control variables for which we look at contemporaneous relation with public investment and includes: income which is the logarithm of Gross National Disposable Income per capita and business cycle that represents the business cycle measure. Production expectations is the proxy for the economic outlook and ϵ_{it} represents the observation-specific errors (i.e. the disturbance terms). Then we augment this equation adding a year dummy that controls for year fixed effects and captures factors that vary over time but affect all countries (such as the effects of the global financial crisis).

A first important issue that must be acknowledged is the reverse causality that can appear in this equation. Indeed, variables like public debt, private investment and government public expenditure are determined simultaneously with our dependent variable and therefore the causality can also work in the opposite direction. For example, public investment might be a determinant of a larger public debt or of a larger public expenditure and this could bias the coefficients of the regression[21]. In order to mitigate this reverse causality problem, following Checherita-Westphal and Rother (2012) we take the one-year lagged value of all the potentially endogenous variables listed above[22]. In this regard, Valila and Mehrotra (2005) explain that the fiscal authority usually decides the amount of public investment according to information on some variables coming from the previous period. As explained before, there is indeed a lag between the time when investment is decided and when it is actually implemented. For Gross National Disposable Income and the

[20]Estonia is dropped because of missing data for the 10-year government bond yields (due to a very low government debt there are indeed no long-term governments bonds data available on the financial market for this country,) and Ireland because of missing data for production expectations.

[21]Public investment is usually financed through government debt issuances. Therefore, public investment (which is a flow variable) will not directly affect public debt (which is a stock variable) but rather its change. Hence, there is reverse causality in the sense that public investment is funded through debt issuance and then this translates into a larger stock of debt.

[22]Studying the error terms coming out from this regression also shows there is no problem with autocorrelation.

proxy for the business cycle instead we focus on the contemporaneous relation with public investment, whereas for production expectations we take the forward value. It is indeed reasonable to assume that the decision to invest might be influenced also by the expectations about the future. Results are presented in Table 6, column 1 in Appendix C. In the second column, we report the results using POLS with year dummies.

Next, we account for the existence of unobserved social and economic characteristics that are specific to each country in the sample but stay broadly constant over time. In other words, it is possible to assume that each country has its own characteristics and peculiarities that are correlated with the observed independent variables. For this reason then, the pooled OLS regression gives biased estimation and therefore a model that accounts for these 'fixed effects' should be preferred:

$$\begin{aligned} public\,investment/GDP_{it} = \alpha + \beta \cdot public\,debt/GDP_{it-1} + \sum_{c=1}^{4} \gamma_c \cdot Controls1^{c}_{it-1} + \\ + \sum_{j=1}^{2} \gamma_j \cdot Controls2^{j}_{it} + \rho \cdot expectations_{it+1} + v_i + \epsilon_{it} \end{aligned} \tag{2}$$

with v_i that represents the unobserved time invariant country-specific effects. Then, also in this case, we augment this equation considering the year dummies.

Results are presented in Table 6, column 3 in Appendix C. The specification with year dummies is presented in column 4. In both cases we control for heteroscedasticity by using clustered standard errors.

4.4 Static model - estimation results

The results from our initial analysis support the debt overhang hypothesis in the EU. The coefficient of the debt-to-GDP ratio is in fact always negative and significant across several model specifications. This means that an increase in public debt on average produces a negative effect on public investment. In particular, the coefficient of the debt-to-GDP ratio variable ranges between -0.0129 and -0.0194.

Another interesting result is related to the coefficient of the 10-year government bond yield. Since this variable represents the long-term funding cost, it can also be considered as a proxy for a credit rationing effect for a debtor country. The lower the rating of a specific country (i.e. the higher its riskiness), the higher the price that this country needs to pay in the financial markets

in order to raise money. Our results provide suggestive evidence for a credit rationing effect in the EU, in particular when country fixed effects and year dummies are taken into account. Moreover, in this specification, the negative effect that this variable produces on public investment is stronger than the effect deriving from the debt overhang.

Also the coefficients of the GNDI and public expenditure variables are positive and significant in the specifications where country fixed effects are included. This might indicate that more 'mature' countries (i.e. with higher GNDI per capita), prefer a larger role for the government, which results in a higher level of public investment. Regarding public expenditure, we do not find evidence that, between 1995 and 2015, more government expenditure implied a reduction in the level of public investment. Hence in the past, when government expenditure rose, this was not compensated for by lower public investment. Finally, we find also that the business cycle measure is significant with a positive sign in both specifications with year dummies, providing suggestive evidence of pro-cyclicality for public investment [23].

4.5 GMM and dynamic specification

The estimation described in the previous section presents two important drawbacks. The first is related to the problem of endogeneity in terms of reverse causality. In the previous paragraphs we claimed that in order to mitigate the potential reverse causality of some variables, we considered their lagged values. Although it is common practice in applied econometrics to reduce simultaneity problems (Green et al., 2005; Vergara, 2010; Stiebale, 2011), lagging potentially endogenous variables does not tackle properly the problem of reverse causality, especially for debt-to-GDP ratio given its high persistency.

In order to solve this problem, we use an instrumental variable approach (GMM). A positive feature of the GMM approach is that it allows to deal with the endogeneity problem mentioned before. A GMM technique is in fact based on a set of orthogonality restrictions (i.e. the moment conditions) and it finds estimates of the parameters in order to come as close as possible to achieve these orthogonality properties. In particular, we will follow Checherita-Westphal and Rother (2012) and we instrument the lagged value of public debt for each country with the average debt level of the other countries in the sample[24]. Results are presented in Table 7.

[23] This evidence for public investment is in line with Guerguil et al. (2017); Hallerberg and Strauch (2002).
[24] This can be considered as a good instrument if debt spillovers between EU countries are absent.

A second important drawback that has not been addressed yet, is that with the specifications described above, it is not possible to capture potential persistence in public investment. It might very well be the case that public investment today is in part determined by public investment in the past. In order to address this shortcoming, we use a dynamic specification and the equation that we want to estimate becomes:

$$\begin{aligned} public\,investment/GDP_{it} = {} & \delta \cdot public\,investment/GDP_{it-1} + \beta \cdot public\,debt/GDP_{it-1} + \\ & + \sum_{c=1}^{4} \gamma_c \cdot Controls1^{c}_{it-1} + \sum_{j=1}^{2} \gamma_j \cdot Controls2^{j}_{it} + \rho \cdot expectations_{it+1} + \\ & + \epsilon_{it} \end{aligned} \tag{3}$$

For i=1,...,N and t=2,...,T. Then, we augment this equation adding also the year dummies. The addition of the lagged dependent variable as a regressor produces the so-called "dynamic panel bias" (Nickell, 1981) since the fixed effects contained in the error term are by construction correlated with the lagged dependent variable. It means that the predictive power belonging to country-fixed effects might instead be attributed to the lagged dependent variable. In order to overcome this problem, we will use a difference-GMM approach that first transforms all the regressors taking their first differences and then applies a Generalized Method of Moments (Roodman, 2009). More specifically, we will use the Arellano Bond estimator with clustered standard errors. Moreover, as we did in our initial estimation (i.e. the POLS and the FE model), we take the lags of most regressors.

Since the difference-GMM generates a large number of instruments and this would weaken the power of the endogeneity test of the instruments, we follow Roodman (2009) to limit the number of instruments. In particular, we use a collapsed instruments set based on a limited number of lags of the endogenous variables[25]. According to the difference-in-Sargan test, we can assume that the instruments used in this specification can be considered as exogenous. Additional confirmation for the validity of the GMM instruments, comes from the serial correlation tests. According to the Arellano-Bond test for autocorrelation, we can reject at a 1% level of significance the null hypothesis of no autocorrelation of order 1 in first differenced-errors and we cannot reject the hypothesis of no autocorrelation of order 2.

[25]Conversely, using all the available instruments, their number would increase quickly with the time dimension of the panel. Using just a reduced number of instruments, we can also mitigate the problem related to the fact that too many instruments can create an overfitting for the endogenous variables (Roodman, 2009).

4.6 GMM and dynamic models - estimation results

The results of the last regressions are presented in Table 7 and 8. We again find support for the debt overhang hypothesis in the EU countries. According to the results in the dynamic specification with year dummies, a 1% increase in public debt is associated with a 0.03% reduction of public investment. Given the public investment levels prevalent in 2015, this corresponds to a reduction in public investment of around €1.85 billion. Moreover, according to the literature on dynamic models, we can also compute the long-run effect of public debt over investment applying the following approximation: $\frac{\beta}{1-\delta}$ where $(1-\delta)$ represents the rate of convergence. The value of interest is -0.03. Basically, this coefficient means that if debt permanently increases by one per cent, investment will be reduced by 0.066 per cent in the long-run, once year dummies are taken into account.

Moreover, as expected, the level of investment in the current year is significantly and positively influenced by the level of the previous year. This means that there is a certain degree of persistence in public investment that should be taken into account and therefore, a dynamic model is an appropriate specification for this kind of data[26].

We find similar results to the ones presented in the previous section for GNDI, the business cycle measure, private investment, public expenditure and production expectations (since their coefficients are both positive and significant), which is evidence for the robustness of our initial findings. Another significant coefficient in this specification is found for trade (negative coefficient), which might be considered as a sign that countries more open to international trade have a lower level of public investment (potentially because they substitute public investment for private investment or FDI).

4.7 Robustness check - common shock

In this section, we check the robustness of our results to potential bias coming from omitted variables. In particular, we test for the presence of a common shock that could have simultaneously affected both public investment and its determinants, and as a consequence the link between

[26]We tried also adding a second lag of the dependent variable but the coefficient is negative and not significant.

both. Following Erce (2015), we consider the CBOE Volatility Index (VIX)[27] as proxy for global shocks. This index is indeed usually considered as a barometer of volatility and uncertainty in financial markets. As we can see from the results presented in Appendix D, even if a common shock is taken into account, the negative link between public investment and public debt still exists and is significant.

4.8 Extension - pre vs. post-crisis period

In this section, we want to test whether the sovereign debt crisis had a significant impact on public investment. As shown in Section 2, sovereign debt increased markedly in nearly all EU countries over the period 2009-2015. We study whether the debt overhang effect is more pronounced in this period by adding a crisis dummy for the period 2009-2015. As can be seen from the results in Table 8, the dummy is not significant. The most likely reason is that there is a lot of heterogeneity with regards to the period during which the crisis affected a particular country. Some countries (such as Ireland) experienced an early crisis whereas other countries were affected by the crisis later. Moreover, public investment has been characterized by large volatility in a substantial amount of European countries (see Figure 7) and this makes difficult to find a specific effect during the years of the crisis valid for the entire sample.

4.9 Extension - threshold effect

In this section, we test for the presence of a threshold effect in the relation between public debt and public investment. More specifically, we want to see whether considering a debt-to-GDP ratio higher than a specific threshold produces a negative effect over public investment that is even larger. In doing that, we follow the related literature on the topic (described in the first section) that, usually focusing on the relation between debt and growth, shows how debt levels larger than a specific threshold produce negative consequences for the economy. More specifically, we create a dummy variable that assumes the value of 1 when the debt level is larger than 90% (following Reinhart and Rogoff (2010)) and 0 otherwise. As we can see from the results in Table 8 column 4,

[27]This index is computed from the S&P 500 stock index option prices. Data from Haver Analytics.

the threshold variable is actually negative but not significantly different from zero[28]. Thus, there is no evidence related to the fact that governments, when consolidating (because of high-debt levels), tend to cut the expenditure related to public investment and to the maintenance of public infrastructure.

4.10 Extension - high- vs. low-debt countries

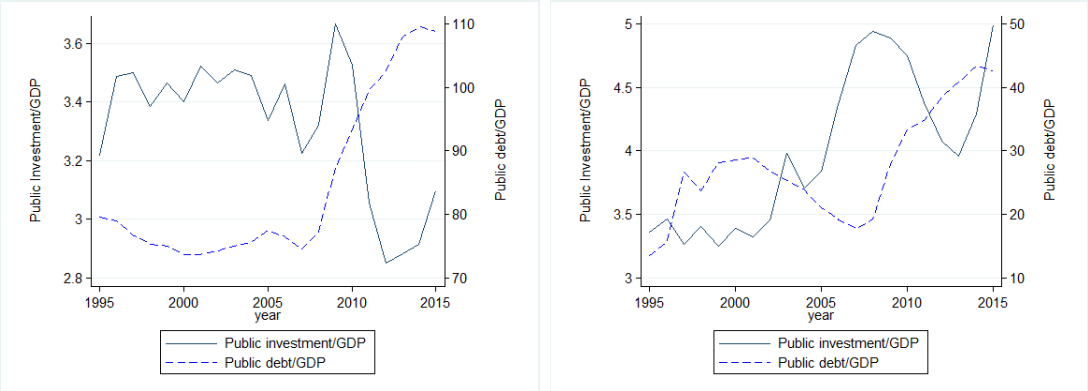
As an additional exercise, we divide the sample into three groups, according to their average debt level over the period 1995 and 2015 (high-debt, medium-debt, low-debt countries), to test whether the debt overhang effect is stronger in the high-debt group. As we can see from Figure 6 below, indeed the patterns are quite different if we focus on countries with high or low levels of debt. The results (Table 9) indicate that the impact of public debt on public investment is indeed stronger for high-debt countries than for low-debt countries where the coefficient is even positive but not significant. In the high-debt group, the coefficient for public debt is significant at the 0.05 level, whereas it is not significant in the low-debt group. This is also visualized in Figure 6 below, which shows that the relationship between debt and investment is indeed stronger for high-debt countries than for low-debt countries. For an average country in the high-debt group, the results suggest that a 1% decrease in public debt would increase public investment by €286 million (given the public investment levels prevalent in 2015). This provides some credence to the claim that excessive debt levels should be avoided and, if necessary, need to be addressed by fiscal consolidation measures.

For countries with medium levels of debt, we do not find evidence of a debt overhang effect but only of credit rationing suggesting that for this group of countries, the cost of servicing debt is more important - in determining the level of public investment - than the level of public debt.

Three other important results require further discussion: 1) public investment is quite pro-cyclical in countries with large and medium levels of debt. This is not the case for countries with low levels of debt where production expectations play instead a more important role; 2) the maturity of the economy has an important positive role for public investment in countries with medium and low levels of debt; 3) trade openness of countries with high debt results in more

[28]As additional test, we tried also using 60% as a threshold (following the Maastricht criteria) but again we do not find any significant result for the coefficient. This means that 60% or 90% cannot be considered as useful thresholds for the whole sample.

Figure 6: Average public investment and public debt for countries in the group of high-debt (left side) and in the group of low-debt (right side)



Source: Eurostat

public investment whereas the opposite is true for countries with medium levels of debt.

4.11 Extension - focus on the EZ

In this section, we focus specifically on countries which are part of the Eurozone (EZ) in order to see if the adoption of a common currency might have produced results different from our previous finding. In other words, we want to see whether the institutional arrangements of the EZ have had a specific impact on how debt-burdened countries allocate resources to public investment. For example, one of the euro convergence criteria stipulates that the annual government budget deficit must not exceed 3% of GDP. If a crisis hits, and government revenues fall and/or its expenditures rise, the government might have no other option than to cut spending on public investment, simply to adhere to the deficit requirement. Moreover, since the adoption of a single common currency implies respecting the Maastricht criteria, this can be considered as a way to group countries that are more similar to each other. Therefore, we focus on the 19 EZ member countries. According to the regression's results (Table 10) deriving from a dynamic specification, we find once again evidence of the debt overhang hypothesis. Interestingly, the negative effect of debt over the incentive to invest is larger[29] in the EU as a whole than in the euro area which might suggest that the institutional framework of the Eurozone actually does not act as a 'straightjacket' for countries that experience high-debt levels. The results for the other variables are in line with our previous analysis.

[29]The average coefficient is 0.018 for the EZ and 0.03 for the EU.

4.12 Extension - stocks vs. flows

In this last section we test another hypothesis: whether it is only a matter of the stock of outstanding debt negatively impacting investment or it is also a matter of the flow of debt (i.e. if rapid debt accumulation leads to lower investment). It is important indeed to study whether a flow-approach can give additional information to that provided by an approach focused on stocks. In debt sustainability analysis (DSA), the speed at which debt accumulates is an important factor and it is generally evaluated in conjunction with the growth rate of a country and its real interest rate (Guzman and Heymann, 2015). Gabriele et al. (2017) show that considering at the same time, in a DSA framework, both stock and flow[30] measures of debt, such as the gross financing needs (GFN), gives a more accurate picture of debt sustainability risks for a specific country.

In order to consider a flow-approach, we add the first difference of the public debt variable in order to see how its change can explain the path of public investment. Since the change in debt cannot be considered as an exogenous variable (because public investment is usually financed through government debt issuances), we instrument the change in debt with the debt maturing-to-GDP ratio[31]. This variable represents the amount of debt that is scheduled to mature in less than one year. It can be considered correlated with the change in debt but uncorrelated with the amount of investment today since the maturity of debt is set at its issuance. Hence, it can be considered as a good instrument. Then, we run an instrumental variable approach (GMM), as explained before, using clustered standard errors.

As shown in Table 11, the link between the change in public debt and public investment is negative and significant, as expected. Interestingly, the negative effect is much stronger than the effect produced by the debt stock. Thus, this suggest that both the level of public debt as well as its change matter in reducing public investment with the latter playing a more important role. The results for the other determinants are in line with our initial analysis.

[30]They focus on gross financing needs as flow variable that adds up interest payments, principal repayments, and primary deficit.

[31]Debt maturing-to-GDP data are downloaded for 25 countries from the ECB (data are not available for UK, IE and LU are missing).

5 Conclusion and policy implications

Identifying the determinants of public investment in EU countries is a topical subject given the downward trend showed by government investment in the last years. In particular, the current EU framework might represent an obstacle to the recovery of public investment because of the stringent rules established (such as the Stability and Growth Pact and the Fiscal Compact) that limit the fiscal manoeuvre of member countries. An attempt to change this framework was made in 2013, when the European Commission introduced the so called "Investment clause" which gives countries the possibility to deviate from the medium-term budgetary objective (MTO) if certain, albeit quite stringent[32]criteria are met: 1) GDP growth must be negative or GDP must be below its potential; 2) the deviation must not produce a deficit larger than the 3% threshold established in the Stability and Growth Pact; 3) public investment is related to projects co-funded by the EU; and 4) the country has to compensate for this deviation in the subsequent years, ensuring it reaches the MTO in four years.

Recently there has been a debate in the European Parliament on the possibility of excluding public investment, based on EU co-financed programmes, from the calculation of the deficit and debt requirements established in the SGP. This would introduce more flexibility in the EU framework with potential benefits for public investment, especially during times of crisis. However, this kind of rule should be carefully structured since it might produce a moral hazard problem in normal times, allowing countries to increase their debt levels by labelling unproductive public expenditure as productive public investment.

Surprisingly, the literature on which variables might have an impact on public investment in Europe is rather limited. Our paper furthers this literature, analysing several potential determinants of public investment and considering nearly the entire European Union. In particular, we focus on the link between public debt and public investment in order to study the debt overhang hypothesis. Because of the recent sovereign debt crisis that affected the whole EU, especially the southern European countries, this presents an interesting environment to test the hypothesis. In order to perform this exercise, we tackle the potential issue of reverse causality between debt and investment by using an instrumental variable approach based on the GMM estimator of Arellano and Bond (1991).

[32]Since many countries have been under the excessive deficit procedure in the last years, they have not had the possibility to use this option. In 2014, for example, only Bulgaria, Slovakia and Romania benefited from the investment clause.

The results of our empirical analysis show a significant negative link in the EU between general government consolidated gross debt and public investment[33]. Taking the results coming from the dynamic GMM specification, a 1% increase in public debt reduces public investment in the European Union by 0.03% (given the level of public investment prevalent in 2015 this would imply a reduction of around €1.85 billion). Thus, we find significant evidence to support the debt overhang hypothesis in Europe, as our results show that high debt can negatively affect public investment. From a policy perspective, fiscal consolidation measures might thus be justified[34].

In summary, this paper offers a contribution to the literature in various ways. We analyse the debt overhang effect for public investment, produced by an increase in public debt, through a broad variety of specifications, offering a richer characterization of this topic than other existing papers. Indeed, we study the link between public debt and public investment using a variety of econometric models and comparing high- vs low-debt countries, pre vs crisis period, EU countries vs EZ countries and stock vs flow measures. More specifically, we find that (i) the crowding out effect is in place mostly for the high-debt countries, (ii) it is not significantly stronger during and after the crisis (2009-2015), (iii) it is slightly stronger inside the entire EU than in the EZ, (iv) there is no threshold effect; and (v) the flow of debt has a stronger negative effect on investment than the stock of debt[35].

Two other interesting results can be derived from our analysis. First, it is quite difficult to explain the behaviour of public investment focusing only on macroeconomic variables. The explanatory power of the models used is indeed quite low and this might suggest an important role of politics and electoral cycle in driving public investment. Second, the credit rationing channel has a significantly larger impact on public investment than debt overhang. To the best of our knowledge, this is the first paper that aims to make this kind of comparison. However, this evidence holds only in some of the specifications used. The consequent policy implication might be that a measure focused on debt reduction would be less effective than an additional lending strategy - for example with a "concessional" interest rate - in order to restore public investment and then growth. Since the evidence is not robust across all the specifications used,

[33]This paper shows evidence that governments are inclined to reduce public investment when debt is high. A possible policy instrument to counter this inclination could be to increase EU funds available for investment in times of crises. See Carnot (2017) for a policy proposal on the establishment of a European Stabilization Fund.

[34]This paper does not offer a definitive answer to this discussion as a wide variety of issues needs to be considered, such as the extent to which these measures (i.e. fiscal consolidation) could affect negatively growth in the short-run.

[35]The last point in particular is quite interesting and often understudied in the existing literature. Here, we find evidence that a more rapid debt accumulation can be considered as a drag on public investment, even stronger than the effect produced by a large stock of public debt.

this comparison between a crowding-out effect and credit rationing warrants further analysis.

References

Abiad, A., D. Furceri, and P. Topalova (2016). The macroeconomic effects of public investment: Evidence from advanced economies. *Journal of Macroeconomics 50*, 224–240.

Albanesi, S., G. De Giorgi, and J. Nosal (2017). Credit growth and the financial crisis: A new narrative. *NBER Working paper No. 23740*.

Arellano, M. and S. Bond (1991). Some tests of specification for panel data: Monte carlo evidence and an application to employment equations. *Review of Economic Studies 58*, 277–97.

Arslanalp, S. and P. B. Henry (2005). Is debt relief efficient? *Journal of Finance 60(2)*, 1017–1051.

Arslanalp, S. and P. B. Henry (2006). *Helping the Poor to Help Themselves: Debt Relief or Aid.* in Sovereign Debt at the Crossroads: Challenges and Proposals for Resolving the Third World Debt Crisis, (edited by Chris Jochnick and Fraser Preston), Oxford University Press.

Aubin, C., J. Berdot, D. Goyeau, and J. Lafay (1988). *The Growth of Public Expenditure in France.* J.A. Lybeck and M. Henrekson (eds.), Explaining the Growth of Government, Amsterdam: North-Holland.

Bacchiocchi, E., E. Borghi, and A. Missale (2011). Public investment under fiscal constraints. *Fiscal Studies 32*, 11–42.

Balassone, F., M. Francese, and A. Pace (2011). Public debt and economic growth in italy. *Bank of Italy - Economic History Working Papers No. 11*.

Barro, R. J. (1998). *Reflections on Ricardian Equivalence.* In: Maloney J Debt and Deficits: An Historical Perspective. Edward Elgar; 1998.

Baum, A., C. Checherita-Westphal, and P. Rother (2013). Debt and growth: New evidence for the euro area. *Journal of International Money and Finance 32*, 809–821.

Bayoumi, T. (2017). *Unfinished Business: The Unexplored Causes of the Financial Crisis and the Lessons Yet to Be Learned.* Yale University Press.

Borensztein, E. (1990a). Debt overhang, credit rationing and investment. *Journal of Development Economics 32*, 315–335.

Borensztein, E. (1990b). Debt overhang, debt reduction and investments: The case of philippine. *IMF WP/90/77*.

Bove, V., G. Efthyvoulou, and A. Navas (2017). Political cycles in public expenditure: butter vs guns. *Journal of Comparative Economics 45*, 582–604.

Carnot, N. (2017). European fiscal governance and cyclical stabilisation: Searching for a lasting arrangement. *Intereconomics 3*, 148–154.

Chatterjee, S. (2013). Debt overhang: why recovery from a financial crisis can be slow. *Business Review Q2*, 1–9.

Checherita-Westphal, C. and P. Rother (2012). The impact of high and growing government debt on economic growth. an empirical investigation for the euro area. *European Economic Review 56(7)*, 1392–1405.

Clements, B., R. Bhattacharya, and T. Q. Nguyen (2003). External debt, public investment, and growth in low-income countries. *IMF WP/03/249*.

Cordella, T., L. A. Ricci, and M. Ruiz-Arranz (2010). Debt overhang or debt irrelevance? *IMF Staff Papers 57*, 1–24.

Das, U., M. Papaioannou, and C. Trebesch (2010). Sovereign default risk and private sector access to capital in emerging markets. *Journal Issue 10*.

De Haan, J., J. E. Sturm, and B. J. Sikken (1996). Government capital formation: Explaining the decline. *Weltwirtschaftliches Archiv 132(1)*, 55–74.

Dell'Erba, S. and U. Hausmann, R. Panizza (2013). Debt levels, debt composition, and sovereign spreads in emerging and advanced economies. *Oxford Review of Economic Policy 29(3)*, 518–547.

Deshpande, A. (1993). *Some aspects of international debt of developing countries*. unpublished PhD thesis.

Deshpande, A. (1997). The debt overhang and the disincentive to invest. *Journal of Development Economics 52*, 169–187.

Eberhardt, M. and A. F. Presbitero (2015). Public debt and growth: Heterogeneity and non-linearity. *Journal of International Economics 97(1)*, 45–58.

Erce, A. (2015). Bank and sovereign risk feedback loops. *ESM Working Paper Series 1*.

European Commission (2010). *Europe 2020: A Strategy for smart, sustainable and inclusive growth*.

European Commission (2017). *The Joint Harmonised EU Programme of Business and Consumer Surveys. User Guide*. European Commision.

Fatas, A. and L. Summers (2018). The permanent effects of fiscal consolidations. *Journal of International Economics 112*, 238–250.

Gabriele, C., A. Erce, M. Athanasopoulou, and J. Rojas (2017). Debt stocks meet gross financing needs: A flow perspective into sustainability. *ESM Working Paper Series 24*.

Ganelli, G. and J. Tervala (2016). The welfare multiplier of public infrastructure investment. *IMF Working Paper, No. 16/40*.

Green, R. K., S. Malpezzi, and S. K. Mayo (2005). Metropolitan-specific estimates of the price elasticity of supply of housing, and their sources. *American Economic Review 95(2)*, 334–339.

Guerguil, M., P. Mandon, and R. Tapsoba (2017). Flexible fiscal rules and countercyclical fiscal policy. *Journal of Macroeconomics 52*, 189–220.

Guzman, M. and D. Heymann (2015). The imf debt sustainability analysis: Issues and problems. *Journal of Globalization and Development 6(2)*, 387–404.

Hallerberg, M. and R. Strauch (2002). On the cyclicality of public finances in europe. *Empirica 29*, 183–207.

Heinemann, F. (2006). Factor mobility, government debt and the decline in public investment. *International Economics and Economic Policy 3*, 11–26.

Herenkson, M. (1988). *Swedish government growth: A disequilibrium analysis*. J. A. Lybeck and M. Herenkson (eds.), Explaining the growth of government, Amsterdam: North Holland.

Jordá, O., M. Schularick, and A. M. Taylor (2014). Private credit and public debt in financial crises. *FRBSF Economic Letter 7*.

Juncker, J. C. (2015). *Investment Plan.* Speech at the EIB Conference Investment Plan for Europe.

Karagol, E. (2005). A critical review of external debt and economic growth relationship: A lesson for indebtedness of countries. *Ege Akademik Bakis 4, No. 1-2*, 69–78.

Keman, H. (2010). Cutting back public investment after 1980: Collateral damage, policy legacies and political adjustment. *Journal of Public Policy 30*, 163–182.

Kirchgassner, G. and W. Pommerehne (1988). *Government spending in federal systems: A comparison between Switzerland and Germany.* in J. A. Lybeck and M. Herenkson (eds.), Explaining the growth of government, Amsterdam: North Holland.

Krugman, P. (1988). Financing vs forgiving a debt overhang. *Journal of Development Economics 29(3)*, 253–268.

Krugman, P. (1989). Private capital flows to problem debtors. *NBER Chapters in: Developing Country Debt and Economic Performance, The International Financial System 1*, 299–330.

Manasse, P. and N. Roubini (2009). 'rules of thumb' for sovereign debt crises. *Journal of International Economics 78(2)*, 192–205.

Martin, P. and T. Philippon (2017). Inspecting the mechanism: leverage and the great recession in the eurozone. *American Economic Review 107(7)*, 1904–37.

Myers, S. C. (1977). Determinants of corporate borrowing. *Journal of Financial Economics 5*, 147–175.

Nickell, S. J. (1981). Biases in dynamic models with fixed effects. *Econometrica 49(6)*, 1417–1426.

Obstfeld, M. and K. Rogoff (1996). *Foundations of International Macroeconomics.* Cambridge, MA: MIT Press.

OECD (2016a). Can an increase in public investment sustainably lift economic growth? *OECD Economics Department Working Paper No. 1351*.

OECD (2016b). The positive effect of public investment on potential growth. *OECD Economics Department Working Paper*.

OECD (2016c). What is the scope for public investment to lift long-term growth? *OECD blog*.

Oxley, H. and J. Martin (1991). Controlling government spending and deficits: Trends in the 1980s and prospects for the 1990s. *OECD Economic Studies 17*, 145–189.

Panizza, U. and A. F. Presbitero (2013). Public debt and economic growth in advanced economies: a survey. *Swiss Journal of Economics and Statistics 149(2)*, 175–204.

Pattillo, C., H. Poirson, and L. Ricci (2011). External debt and growth. *Review of Economics and Institutions 2(3)*.

Reinhart, C. M., V. R. Reinhart, and K. S. Rogoff (2012). Public debt overhangs: Advanced economies episodes sice 1800. *Journal of Economic Perspectives 26(3)*, 69 – 86.

Reinhart, C. M. and K. S. Rogoff (2010). Growth in a time of debt. *American Economic Review 100(2)*, 573–578.

Roodman, D. (2009). How to do xtabond2: An introduction to difference and system gmm in stata. *Stata Journal 9(1)*, 86–136.

Roubini, N. and S. J. (1989). Government spending and budget deficits in the industrial countries. *Economic Policy 8*, 99–132.

Sachs, J. (1989). Conditionality, debt relief, and the developing country debt crisis. *Developing Country Debt and Economic Performance 1*, 255 – 296.

Sorensen, R. J. (1988). *The growth of public spending in Norway 1865-1985.* in J. A. Lybeck and M. Herenkson (eds.), Explaining the growth of government, Amsterdam: North Holland.

Spencer, R. W. and W. P. Yohe (1970). The 'crowding out' of private expenditures by fiscal policy actions. *Federal Reserve Bank of St. Louis Review*.

Stiebale, J. (2011). Do financial constraints matter for foreign market entry? a firmâlevel examination. *The World Economy 34(1)*, 123–153.

Sturm, J. (2001). Determinants of public capital spending in less-developed countries. *Groningen: CCSO Working Paper 2001/7*.

Valila, T. and A. Mehrotra (2005). *Evolution and Determinants of Public Investment in Europe*. European and Investment Bank - Economic and Financial Report 2005/01.

Vanlaer, W., W. Marneffe, L. Vereeck, and J. Vanovertveldt (2015). Does debt predict growth? an empirical analysis of the relationship between total debt and economic output. *European Journal of Government and Economics 4(2)*, 79–103.

Vergara, R. (2010). Taxation and private investment: evidence for chile. *Applied Economics 42(6)*, 717–725.

Appendix A

Table 2: Variables description

Variable	**Description**
Public investment	Government gross fixed capital formation as percentage of GDP
Borrowing rate (LT)	10-years government bond yields
Public debt	General consolidated government gross debt as percentage of GDP
Public expenditure	General government total expenditure as percentage of GDP
Trade openness	Sum of export and import divided by GDP
Private investment	Private gross fixed capital formation as percentage of GDP
Income	Gross national disposable income per capita
Business cycle	Deviation of the actual from the trend GDP growth rate
Production expectations	Production expectations for the 3 months ahead + Selling price expectations for 3 the months ahead
Vix	Chicago Board Options Exchange (CBOE) Volatility Index
GFN	Gross financing needs as percentage of GDP

Table 3: descriptive statistics

Variable	**Observations**	**Mean**	**Sdt. Dev**	**Min**	**Max**
Public investment	540	3.66	1.08	0.56	7.33
Public debt	532	56.24	31.08	6.50	179.70
Income	540	2.70	0.85	-0.18	4.16
Business cycle	515	-0.066	2.61	-18.85	6.89
Private investment	540	18.51	3.56	4.73	32.29
Public expenditure	529	45.02	6.67	30.42	62.51
Borrowing rate (LT)	463	4.86	2.34	0.37	22.5
Trade openness	540	105.44	61.26	37.11	438.16
Production expectations	515	8.72	11.27	-24.10	55.43
Vix	540	20.58	6.02	12.37	32.65
GFN	439	14.29	8.47	-1.28	44.28

Table 4: descriptive statistics

Country	**Public debt/GDP**	**Public investment/GDP**	**SD Public debt/GDP**	**SD Public investment/GDP**
Austria	71.78	2.99	8.07	0.38
Belgium	105.83	2.24	11.66	0.15
Bulgaria	137.89	3.79	26.13	1.46
Croatia	55.09	4.99	19.53	1.33
Cyprus	64.18	3.95	18.8	0.94
Czech Republic	27.86	4.64	11.04	0.81
Denmark	41.96	3.08	6.78	0.37
Estonia	6.62	5.27	2.09	0.61
Finland	46.63	3.82	8.45	0.27
France	70.77	3.92	13.51	0.18
Germany	66.31	2.21	8.27	0.18
Greece	122.86	4.57	31.02	1.08
Hungary	67.72	3.80	10.06	1.24
Ireland	60.13	3.02	32.78	0.94
Italy	111.77	2.78	10.50	0.29
Latvia	21.87	3.54	13.90	1.44
Lithuania	24.57	3.57	10.24	1.00
Luxembourg	12.19	4.17	6.45	0.54
Malta	61.48	3.54	10.23	0.73
Netherlands	58.00	3.85	9.16	0.22
Poland	46.09	3.79	5.70	1.06
Portugal	78.05	4.00	29.35	1.08
Romania	22.71	4.12	10.05	1.46
Slovakia	40.34	3.93	9.52	0.91
Slovenia	35.56	4.20	19.94	0.48
Spain	61.5	3.78	19.43	0.82
Sweden	49.55	4.36	11.22	0.28
UK	54.32	2.42	20.57	0.53
EU	54.48	3.70	9.86	0.27

Note: In column 1 and 2 there are the average values of public debt and public investment; in column 3 and 4 there are their standard deviations.

Appendix B

Table 5: correlation table

Country	Correlation	75th percent.	90th percent.	95th percent.
Austria	0.26	-0.20	-0.89	1
Belgium	0.31	-0.62	0.52	1
Bulgaria	-0.58	-0.91	-1	-
Croatia	-0.88	-0.3	-1	-
Cyprus	-0.72	-0.97	-0.69	1
Czech Republic	0.005	-0.78	-0.54	-1
Denmark	0.01	-0.34	1	-
Estonia	0.20	0.19	-0.80	-1
Finland	0.66	0.09	-0.80	-1
France	-0.10	-0.81	-0.96	-1
Germany	-0.24	0.04	0.42	1
Greece	-0.70	0.14	0.04	-1
Hungary	-0.20	-0.89	-1	-1
Ireland	-0.77	-0.27	-1	-
Italy	-0.66	-0.97	-1	-1
Latvia	0.58	0.11	-0.73	-1
Lithuania	0.24	-0.86	-0.54	1
Luxembourg	-0.37	-0.77	-0.88	-1
Malta	-0.04	0.17	-0.11	1
Netherlands	-0.51	0.38	0.66	-1
Poland	0.75	0.14	-0.63	-1
Portugal	-0.83	-0.99	-0.95	-1
Romania	0.15	-0.86	-0.63	-1
Slovenia	0.53	0.35	0.76	-1
Slovakia	0.05	0.03	-0.95	-1
Spain	-0.88	-0.95	0.14	-1
Sweden	0.40	0.70	0.86	-1
UK	0.61	-0.91	0.48	-1
EU	-0.15	-0.73	-0.48	1

Note: In column 1 there is the correlation between Public debt/GDP and Public investment/GDP for the sample period 1995-2015; in column 2, 3 and 4 there are respectively the correlation conditional to Public debt/GDP being greater than the 75th percentile, the 90th percentile and the 95th percentile.

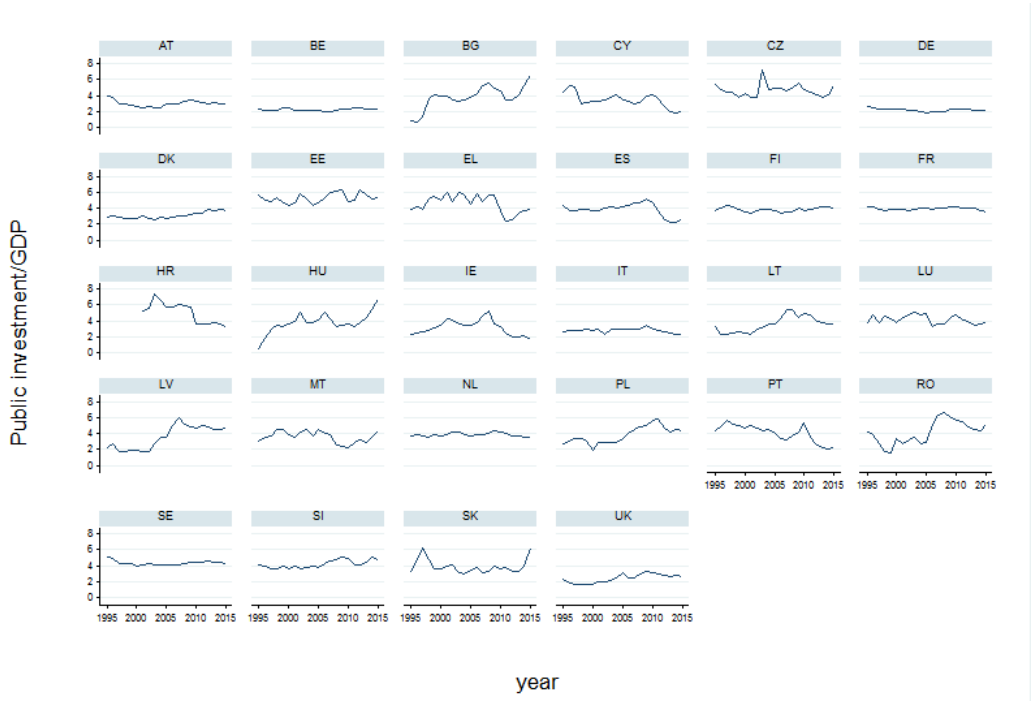
Appendix C

Table 6: baseline regression results for the EU countries: pooled OLS and fixed effects

Public investment				
Explanatory variables	POLS	POLS	FE	FE
Public debt$_{t-1}$	-0.014*	-0.015**	-0.019***	-0.013*
	(-2.06)	(-2.18)	(-3.12)	(-1.98)
Income$_t$	-0.528**	-0.453**	1.050*	2.222***
	(-2.44)	(-2.27)	(1.75)	(2.92)
Business cycle$_t$	0.180	5.235**	1.345	6.045**
	(0.13)	(2.12)	(0.98)	(2.76)
Private investment$_{t-1}$	0.030	0.028	0.059***	0.030
	(0.88)	(0.79)	(2.92)	(1.42)
Public expenditure$_{t-1}$	0.041	0.043	0.070***	0.066***
	(1.66)	(1.69)	(3.44)	(2.82)
Borrowing rate$_{t-1}$	0.016	0.056	-0.020	-0.066**
	(0.55)	(1.57)	(-0.60)	(-2.39)
Trade openness$_{t-1}$	0.001	0.0002	-0.006	-0.008
	(0.29)	(0.12)	(-1.22)	(-1.64)
Production expectations$_{t+1}$	0.003	0.010	0.006*	0.013
	(0.32)	(0.65)	(1.84)	(1.67)
Constant	3.478**	2.718	-1.935	-3.676
	(2.59)	(1.59)	(-0.85)	(-1.36)
N obs.	404	404	404	404
Country FE	No	No	Yes	Yes
Year FE	No	Yes	No	Yes
R^2	0.259	0.310	0.269	0.379

t statistics in parentheses (*p<0.10, ** p<0.05, *** p<0.01) computed using clustered standard errors.

Figure 7: Paths of public investment-to-GDP ratios for all the EU countries



Appendix D

Table 7: IV-GMM regression results for EU countries

Public investment	
Explanatory variables	GMM
Public debt$_{t-1}$	-0.017***
	(-2.84)
Income$_t$	0.957*
	(1.81)
Business cycle$_t$	1.440
	(1.06)
Private investment$_{t-1}$	0.066***
	(3.63)
Public expenditure$_{t-1}$	0.057***
	(2.63)
Borrowing rate$_{t-1}$	-0.040
	(-1.42)
Trade openness$_{t-1}$	-0.006
	(-1.23)
Production expectations$_{t+1}$	0.007*
	(1.87)
N. obs	390
Country FE	Yes
Hansen J	0.496

t statistics in parentheses (*p<0.10, ** p<0.05, *** p<0.01) computed using clustered standard errors.

Table 8: IV-GMM regression results for the EU countries

Public investment				
Explanatory variables	GMM	GMM	GMM	GMM
Public investment$_{t-1}$	0.544***	0.545***	0.544***	0.550***
	(4.84)	(4.30)	(4.84)	(4.84)
Public debt$_{t-1}$	-0.030***	-0.014*	-0.030***	-0.028***
	(-3.26)	(-1.73)	(-3.26)	(-2.79)
Business cycle$_t$	7.223***	0.945	7.223***	7.318***
	(2.86)	(0.41)	(2.86)	(2.90)
Income$_t$	0.693	0.178	0.693	0.712
	(1.40)	(0.42)	(1.40)	(1.45)
Private investment$_{t-1}$	0.012	0.033	0.012	0.014
	(0.47)	(1.19)	(0.47)	(0.54)
Public expenditure$_{t-1}$	0.019	0.003	0.019	0.017
	(0.43)	(0.07)	(0.43)	(0.38)
Borrowing rate$_{t-1}$	-0.033	-0.049	-0.033	-0.030
	(-0.68)	(-1.24)	(-0.68)	(-0.61)
Trade openness$_{t-1}$	-0.015***	-0.002	-0.015***	-0.015***
	(-2.62)	(-0.37)	(-2.62)	(-2.76)
Production expectations$_{t+1}$	0.011*	0.008*	0.011*	0.011*
	(1.65)	(1.92)	(1.65)	(1.65)
Crisis dummy		-0.022		
		(0.156)		
Vix$_t$			-0.030*	
			(-1.74)	
Public debt threshold(90)$_{t-1}$				-0.311
				(-1.07)
N. obs	378	378	378	378
Year FE	Yes	No	Yes	Yes
Difference in Sargan	0.362	0.516	0.362	0.311

t statistics in parentheses (*p<0.10, ** p<0.05, *** p<0.01) computed using clustered standard errors.

Appendix E

Table 9: Grouping countries according to debt levels - IV-GMM regression results

Public investment			
	High debt	Med. debt	Low debt
Explanatory variables	GMM	GMM	GMM
Public investment$_{t-1}$	0.214*	0.678***	0.371**
	(1.93)	(7.54)	(2.10)
Public debt$_{t-1}$	-0.012**	-0.0005	0.018
	(-2.09)	(-0.06)	(1.15)
Business cycle$_t$	14.870***	8.547**	5.026
	(5.13)	(2.48)	(1.32)
Income$_t$	-0.514	2.088***	2.509**
	(-0.59)	(3.07)	(1.96)
Private investment$_{t-1}$	0.052*	-0.007	0.056
	(1.86)	(-0.14)	(1.19)
Public expenditure$_{t-1}$	-0.043	-0.011	-0.056
	(-1.18)	(-0.27)	(-0.87)
Borrowing rate$_{t-1}$	-0.057*	-0.163**	0.165
	(-1.73)	(-2.13)	(1.61)
Trade openness$_{t-1}$	0.017***	-0.009*	-0.005
	(2.60)	(-1.89)	(-0.36)
Production expectations$_{t+1}$	-0.005	-0.008	0.022*
	(-0.62)	(-1.13)	(1.86)
N. obs	150	133	95
Year FE	Yes	Yes	Yes
Difference in Sargan	0.685	0.096	0.408

t statistics in parentheses (* p<0.10, ** p<0.05, *** p<0.01) computed using clustered standard errors. The thresholds for the debt averages (expressed as percentage of GDP), used to identify the three groups are: 40.3381 and 61.47619. The group of high debt countries includes: AT, BE, CY, DE, EL, FR, HU, IT, PT; the group of medium debt countries includes:, , DK, FI, ES, HR, MT, NL, PL, SE, UK; the group of low debt countries includes: BG, CZ, , LT, LU, LV, RO, SI, SK.

Appendix F

Table 10: Focus on the EZ countries - IV-GMM results

Public investment	
Explanatory variables	GMM
Public investment$_{t-1}$	0.543***
	(4.86)
Public debt$_{t-1}$	-0.018**
	(-2.46)
Business cycle$_t$	3.830***
	(2.03)
Income$_t$	1.543**
	(2.97)
Private investment$_{t-1}$	0.001
	(0.05)
Public expenditure$_{t-1}$	-0.038
	(-0.93)
Borrowing rate$_{t-1}$	0.005
	(0.14)
Trade openness$_{t-1}$	-0.008**
	(-2.01)
Production expectations$_{t+1}$	0.012**
	(2.05)
N. obs	269
Year FE	Yes
Difference in Sargan	0.101

t statistics in parentheses (* p<0.10, ** p<0.05, *** p<0.01) computed using clustered standard errors.

Appendix G

Table 11: Focus on flows for the EU countries - IV-GMM results

Public investment	
Explanatory variables	GMM
Δ Public debt$_{t-1}$	-0.123***
	(-2.83)
Public debt$_{t-1}$	-0.016**
	(-2.24)
Income$_t$	2.434***
	(4.49)
Business cycle$_t$	-0.026
	(-1.03)
Private investment$_{t-1}$	0.004
	(0.10)
Public expenditure$_{t-1}$	0.148***
	(4.22)
Borrowing rate$_{t-1}$	-0.007
	(-0.16)
Trade openness$_{t-1}$	-0.016***
	(-2.67)
Production expectations$_{t+1}$	0.012***
	(3.06)
N. obs	327
Country FE	Yes
Hansen J	0.79

t statistics in parentheses (* p<0.10, ** p<0.05, *** p<0.01) computed using clustered standard errors. The Hansen J's result reports the p-value.

European Stability Mechanism

6a Circuit de la Foire Internationale
L-1347 Luxembourg

Tel: +352 260 292 0

www.esm.europa.eu

info@esm.europa.eu