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Economic consequences of high public debt and challenges ahead for the euro area

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Abstract
The aim of this paper is to reflect on the economic consequences of high public debt and the challenges ahead for the euro area. The paper reviews the economic risks associated with regimes of high public debt through DSGE model simulations and stresses the need for comprehensive solutions to mitigate such risks in the future. While the large public debt build-up following the global financial and economic crisis acted as a shock absorber for output, keeping public debt at high levels is a source of vulnerability in itself, particularly given the arising fiscal and economic pressures from ageing. Moreover, in the euro area, where monetary policy focuses on the area-wide aggregate, countries with high levels of indebtedness are poorly equipped to withstand asymmetric shocks. Looking at the historical evidence, the paper reviews the menu of tools at hand for euro area governments to further reduce their debt ratios. It posits that the urgency of efforts in this respect depends on risks to public debt sustainability. In the context of the broader reform agenda on how to strengthen EMU resilience, the paper acts as a reminder that further risk reduction and institutional reform is needed.

JEL: E62; H63; O40; E43

Note: This paper summarizes part of the findings and reflections of an expert-team set up in the context of the ESCB Working Group on Public Finance, whose work was concluded in May 2017 and incorporated in the 2017 ESCB Public Finance Report. As such, this year is the cut-off date for the analysis herein presented. The authors would like to thank Alexander Mahle, Matthias Schoen and Nikolai Staehler (Bundesbank) for their valuable input to the team work, as well as Frank Smets, Christophe Kamps, Ad van Riet, Cláudia Braz, Thomas Warmedinger, Philipp Rother, and the members of the ESCB Working Group on Public Finance for their useful comments and suggestions on this paper. We also gratefully acknowledge valuable input and suggestions, including with data provision and interpretation, from Henri Maurer and Patrick Grussenmeyer (ECB, DG-Statistics), Othman Bouabdallah, Niccolò Battistini, Jacopo Cimadomo, Francesco Berardini, Simone Pesce (ECB, DG-Economics) and David Pichler. Any remaining errors are ours. The views expressed in this paper are those of the authors and do not reflect those of Banco de Portugal, the European Central Bank, Banco de España, Banca d'Italia or the ESCB Working Group on Public Finance and its members.

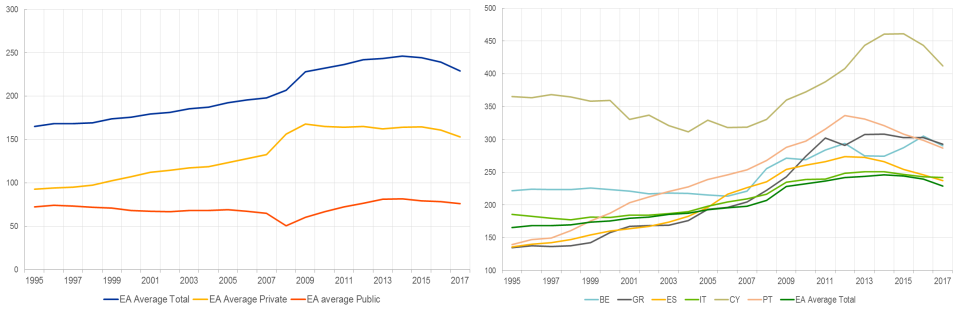
1. Introduction

The aim of this paper is to reflect on the current debate on public debt and sovereign creditworthiness in the euro area. This debate is an essential piece in the context of the broader reform agenda on how to strengthen the resilience of the European Economic and Monetary Union (EMU). The paper reviews the risks associated with regimes of high debt and stresses the need for comprehensive solutions to mitigate such risks in the future.

The global financial and economic crisis left a legacy of historically high levels of public debt in advanced economies, at a scale unseen during modern peace time. According to the European Commission's Spring 2017 forecast database, in the US, the gross government debt-to-GDP ratio rose from 64% in 2007 to 105% at the end of 2015, while in Japan, it reached extremely high levels rising from 177% to 248%. In the euro area, the general government debt ratio aggregated across member countries rose from 65% of GDP in 2007 to 94.3% in 2014, slightly declining afterwards[1] (see panels (a) and (b)). Given the extreme severity of the crisis, coined by many as the "great recession", this debt build-up acted as a shock absorber for output, through the work of automatic stabilisers, costs incurred in the stabilisation of the financial sector, and fiscal stimulus measures granted at the beginning of the crisis. Three euro area countries (Greece, Italy and Portugal) continue to have public debt ratios above 120% of GDP and another four (Cyprus, Belgium, Spain and France) above 90% (see panel (c) of Figure 1). Only Estonia, Luxembourg and Slovakia managed to keep their debt below the SGP threshold of 60% of GDP, starting from very low levels before the crisis. While debt ratios declined in several euro area countries in the years ahead of the crisis (2000-2007), a faster reduction would have been desirable under the favourable economic circumstances at that time, especially in countries whose debt ratio was above the SGP threshold. Hence, many governments failed to build up sufficient fiscal buffers before the crisis, which reduced their resilience to subsequent shocks.

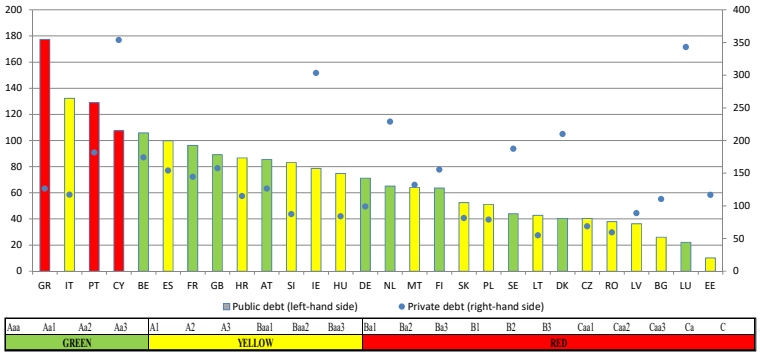
A high public debt burden is problematic especially in a monetary union like the euro area, in which fiscal policies remain at national level, while member states share the same currency and lack monetary policy autonomy. In this institutional set-up national fiscal policies carry the burden to adjust to asymmetric shocks. However, euro area countries with high levels of public debt are poorly equipped to carry out this stabilisation task. Risks to debt sustainability in a member state can entail risks to financial stability and the stabilisation of the euro area as a whole. As stipulated in the EU Treaty, this also implies that national economic policies are a matter of common concern and should not be allowed to impose disproportionate costs on other EMU participants. Nor should the role of proper euro area stabilisation and private risk-sharing be ignored. On the contrary, they

1. To 91.3% of GDP in 2016 and projected to decline further to 89% in 2018 according to the European Commission's Spring 2017 forecast. Figure 1 shows public debt data as of end-2015 to ensure consistency with the consolidated private sector debt data availability at the time of writing.



(a) Total debt in the euro area: overall, public and private debt (percent of GDP)

(b) Total debt: six most (publicly) indebted countries in the EA (percent of GDP)



(c) High public debt burden *vs* sovereign risk (percent of GDP, end-2015)

Figure 1: Debt overhang in euro area economies

Sources: Own calculations and Eurostat, European Commission (Ameco, Sprign 2017 vintage) and Moody's (sovereign ratings as of end-2016).
Notes: Public debt stands for general government gross debt (EDP concept). Private debt stands for the stock of liabilities held by the sectors Non-financial corporations and Households and Non-Profit institutions serving households, as per the Macroeconomic Imbalance procedure (MIP) scoreboard, consolidated data. Own representation regarding the heatmap categories of sovereign ratings.

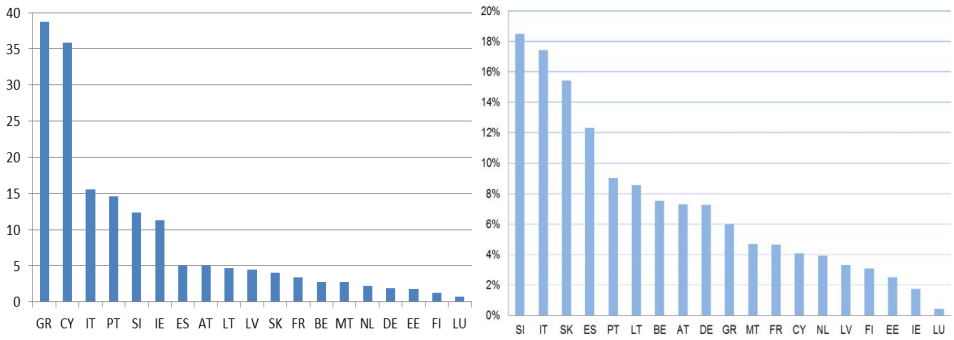
are important and further research – outside the scope of this paper – should be dedicated to the subject.

At the same time, private sector indebtedness weighed heavily on the euro area economy, which has been facing the problem of multi-sectoral deleveraging needs. The financial crisis that started in 2007 arguably resulted from an excessive private credit boom (see panels (a) and (b) in Figure 1).[2] In some euro area countries, part of the private sector debt built-up before the crisis migrated towards the government balance sheet. Spain recorded by far the largest increase in the

2. See Constâncio (2015).

consolidated gross debt of households (HH) and non-financial corporations (NFC) before the crisis, followed by Estonia, Ireland, Lithuania and Greece. After the crisis, private debt ratios surged in Ireland and Cyprus, while rising significantly also in Belgium, Finland, France and Greece. Private indebtedness (consolidated HH and NFC) is still at startling levels in several euro area countries, in particular Cyprus, Luxembourg and Ireland (over 300% of GDP at end-2015), Netherlands and Portugal (aproximately 200% of GDP).[3] Nine EA countries had private debt ratios at end-2015 above the indicative threshold of 133% of GDP, which is used to signal vulnerabilities in this indicator under the Macroeconomic Imbalance Procedure (MIP). Only two of the countries with heavy public debt burdens (Greece and Italy) have a private debt ratio below the MIP threshold.

Moreover, the still present sovereign-bank nexus remains a source of vulnerability for sovereign debt. The share of non-performing loans (NPLs) in the banking sector is high especially in Greece and Cyprus, but also in Italy, Portugal, Slovenia, and Ireland. Following reforms in this area in most countries, NPLs are generally on a declining trend. However, when coupled with relatively high exposure of monetary and financial institutions (MFIs) to domestic government debt, risks can compound when both sectors are vulnerable (Figure 2).



(a) Gross non-performing debt instruments (percent of total gross debt instruments, end Q2-2016)

(b) MFI exposure to domestic government (percent of total assets, end Q3-2016))

Figure 2: NPLs and bank-sovereign linkages

Sources: ECB and National Supervisory Authorities.

The ongoing and further anticipated deleveraging in the private sector, while posing some risks in the near-term, is also outlook-positive over the longer run. Such positive effects are expected as non-performing loans are being replaced with

3. For some countries (in particular, Belgium, Ireland, Luxembourg and Cyprus), domestically consolidated debt does not represent (may over-estimate) the size of domestic NFC debt given that it includes cross-border inter-company loans used by multinationals located in the country.

more healthy, new ones that add to the productive capacity of the economy and where excessive corporate and household debt declines at a measured pace.

The euro area sovereign debt crisis of 2010 revealed important deficiencies in both the EMU architecture and in the way market pressure works. The common European framework was lacking in essential parts of governance, supervisory institutions and backstop facilities. Moreover, market discipline failed before the crisis, with spreads not properly reflecting sovereign risk, whether because markets were myopic or assessed the "no bailout clause" in the EU Treaty not to be credible. During the crisis, market beliefs in the previously perceived "safety" of government debt, *inter alia*, supported by the regulatory treatment of sovereign exposure, unwounded rapidly. Against this background, cross-border spillovers of sovereign distress in the euro area were quick to take their toll, reinforced by the sovereign-bank nexus.

Some of the deficiencies exposed by the crisis have meanwhile been mitigated over several rounds of reforms in the European governance framework. A major lesson from the crisis is that there was insufficient emphasis on the role of debt in the EU's fiscal governance framework. A new debt rule was introduced in 2011 to operationalise the (60%) debt criterion under the Pact. In addition, a critically lacking procedure to identify and prevent macroeconomic imbalances (MIP) was introduced in the context of the 2011 (Six-pack) reforms. Furthermore, the EMU has now various crisis mechanisms in place, in particular the temporary liquidity provision for sovereigns under the European Stability Mechanism (ESM). A European Banking Union was created, including the Single Resolution Mechanism for banks. Currently, discussion is ongoing on how to proceed with regard to strengthening the EMU.

However, deficiencies in the European governance framework remain and continue to pose risks. The implementation of fiscal rules – strengthened on paper but not in practice – is seen by many to have failed building confidence in fiscal sustainability at national level, which is a prerequisite for any further move towards shared fiscal sovereignty. The debt rule is a constraining factor mostly for countries with very high levels of debt. In light of low growth and inflation, some of these have recently faced difficulties to deliver the fiscal adjustment required to put debt on the appropriate downward path. Likewise, the MIP rules remain untested and no country identified with significant macroeconomic imbalances has so far been subject to the required procedures. Overall, risks to sovereign debt sustainability remain high in many euro area countries. On the other hand, risk sharing – both private and public – is still underdeveloped when the EMU as a union of sovereign states is compared to federal states. Banking union is still not completed. What has been called the "doom loop" between banking and sovereign risk remains unresolved.[4] Finally, the experience with the Maastricht Treaty framework showed

4. See Cœuré (2016).

that the best rules are ineffective if their implementation is not ensured by strong institutions.

More recently, the fiscal debate has shifted to the need to balance stabilisation and sustainability needs, especially in the euro area[5]. This policy debate acknowledges that while there is a strong correlation between sustainability risks and stabilisation needs, high debt countries in the euro area should give priority to the sustainability objective. On the other hand, while acknowledging that "inherited public debt, though accumulated for good reasons, represents a deadweight burden on the economy, dimming both its investment and growth prospects", Ostry *et al.* (2015) challenge the need to reduce debt levels in countries far below their debt limit, those being, however, estimated in most cases at very high levels (see also Ghosh *et al.*, 2013).

Against this background, the focus of the current paper is on sustainability, for whose assessment the level of public indebtedness is an important ingredient. There is no simple indicator for gauging whether government debt is, in practice, sustainable or not. Sustainability of government debt means that the accumulated debt can be serviced at any point in time. This requires governments to be both solvent and liquid.[6] A comprehensive DSA framework should generally consider not only debt dynamics, but also the level *at which debt stabilises*, test the resilience of the debt path under various adverse scenarios and account for other relevant indicators (e.g. a government's gross financing needs, the structure of government debt, the scope for contingent liabilities, the quality of institutions and political risks).[7]

The current paper is structured into two main parts, which mirror the analysis of risks and lessons from the past/challenges for the future, including in terms of future institutional reforms. The first part focuses on economic consequences of high debt. The paper first reviews the theoretical and empirical literature on the macroeconomic impact of public debt, with focus on the channels through which high debt can ultimately affect growth. It then examines the topics of long-term growth and economic resilience to shocks in regimes of high public debt in countries belonging to a monetary union by means of DSGE model simulations. The second part looks into debt reduction strategies. More specifically, it first reviews the literature on past episodes of public debt reduction and summarises its results in terms of driving factors for successful deleveraging. It then focuses on relevant

5. See *inter alia*, ECB (2016b), Kamps *et al.* (2017), Bańkowski and Ferdinandusse (2017), EC (2016b), IMF (2017).

6. For a review of the theoretical and practical concepts of sustainability, see ECB (2012a) and Bouabdallah *et al.* (2017).

7. See, for instance, the framework outlined in Bouabdallah *et al.* (2017). Similarly, in its sustainability assessments under the European governance framework, the European Commission uses three indicators aimed at summarising short, medium and long-term risks, alongside a more comprehensive DSA framework, which includes the debt level as an important metric of sustainability risks.

recent experiences among euro area countries. Finally, it reviews the existing policy recommendations from the academic, international institutions and market-based research on the type of measures needed to deal with the current, primarily public, debt overhang and how to strengthen market discipline in the euro area to deal with future debt crises.

2. Economic consequences of regimes of high public debt

2.1. Literature review

Debt – private and public – is integral to the functioning of a market economy. In the private sector, credit is essential to facilitate productive investment and growth over time. In both the public and private sector, debt can have beneficial effects in terms of smoothing consumption and financing lumpy investment. In most advanced economies, as well as in most macroeconomic models,[8] public debt has been perceived, at least before the crisis, to be safe (Cœuré, 2016). When it carries low credit risk, by providing a relatively safe and liquid asset, also in the form of collateral for refinancing operations, public debt plays a vital role for the functioning of the financial system and the transmission of monetary policy. Other contributions conclude that public debt can have positive effects on welfare as long as it provides a safe asset for insurance against both idiosyncratic and aggregate risks.[9]

Public debt acts as a buffer in case of large shocks, especially during financial and economic crises. Summarising the economic theory in this area, Scott (2010) concludes that "in the wake of large adverse shocks (...) the optimal response is to use debt as a buffer stock". He also claims that "debt should show large and long-term shifts and there is no presumption that governments need to reduce debt to pre-crisis levels" and that in any case "fluctuations in government debt after such adverse shocks are long lasting. (...) Debt stabilization occurs over decades, not within a decade". However, this result holds in a framework in which tensions in financial markets are excluded and debt overhangs are assumed to have no long-term costs on the economy.

8. Assuming a full consolidation between the balance sheet of the central bank and that of the fiscal authority, government debt is considered risk-free in nominal terms. For the euro area, in particular, institutional design like the prohibition of monetary financing and the no bail-out clause (articles 123 and 125 of the EU Treaty) make such models unrealistic.

9. However, the literature on the relationship between public debt and welfare remains ambiguous, with several studies indicating a negative impact of debt on welfare or optimal debt levels that are either very small or negative (government should accumulate net assets). This is especially the case when welfare (asset holding) is concentrated on a minority of households or when the government seeks to smooth tax distortion over time and thus needs asset buffers to offset adverse shocks. For a review, see Dieppe and P. Guarda (eds.) (2015).

When debt is high, in both the private and the public sector, it becomes risky for the economy. Essentially, one needs to recognise that government debt even in advanced economies, and especially in those belonging to monetary unions, is not risk free. See also vanRiet (2017) for an exposition of this issue in EMU. The credit risk should properly reflect economic fundamentals and ultimately capture sustainability risks. This includes giving consideration to the level of public indebtedness. In practice, being ultimately determined by markets, credit risk is difficult to capture accurately, and may be inter-twined with the other components of sovereign bond spreads, like investors' risk aversion and liquidity risk.

Under these circumstances, the literature is rather consensual that high public debt poses significant economic challenges and makes the economy less resilient to shocks.[10] Debt overhangs can exert adverse pressure on the economy through multiple channels.

First, a high debt burden makes the economy more vulnerable to macroeconomic shocks. By restraining the room for counter-cyclical fiscal policy and through spillover effects to the private sector, a public debt overhang can deepen volatility, restrain economic recovery or hurt the economy even in the short-run if aggressive consolidation needs to be implemented in recessions. High government borrowing requirements can make a country more prone to liquidity shocks and defaults. Perceived sovereign vulnerability, reflected in higher risk premia and borrowing costs, can spill over to other sectors or jurisdictions, especially in integrated economic and monetary unions. Investors may thus more easily question the sustainability of fiscal policies of a sovereign with a high debt burden, particularly when its fiscal track-record and growth prospects are poor. In particular, the "diabolic loop" between sovereign and bank credit risk through the so-called "balance sheet channel" was considered by many to be the hallmark of the sovereign debt crisis in the periphery of the euro area (Brunnermeier *et al.*, 2016). At the same time, through the country-spillovers channel, the materialisation of risks to sovereign debt sustainability can have adverse implications not only for the country concerned, but also for other members of the monetary union.

The capacity of the euro area member states to withstand adverse shocks was identified as a major challenge from the beginning (Lane, 2012). On the one hand, countries in a monetary union may be faced with an over-borrowing incentive problem if they can free ride on the ability of others or of the central authority to be bailed-out in case of problems threatening the union as a whole. On the other hand, in a monetary union, fiscal policies take an additional role as a tool for

10. See various communication since the crisis from IMF (2010a,b, 2013a,b), BIS (2010, 2014), EC (2016a). For ECB publications, see discussions on the relationship between fiscal-monetary and financial sector interactions in EMU in ECB (2012b), for the relationship between debt and growth, see ECB (2013) and for risks and vulnerabilities associated with regimes of high debt, see ECB (2016a). More recent IMF research (Ostry *et al.*, 2015) has challenged in particular the level up to which debt is considered to be safe, with estimates of (generally very high) public debt limits ranging widely across countries and time periods.

counter-cyclical macroeconomic policy as long as debt is sustainable at the national level.

Second, and related to the above, the theoretical and empirical literature suggests that high debt burdens can ultimately impede long-term growth. This is particularly the case when debt is contracted to finance unproductive expenses or beyond optimal (growth-maximising) levels of public capital stock. Moreover, the quality of a country's institutional framework is also likely to affect the relationship between debt and growth, with particularly low growth performance in situations of high debt coupled with poor institutions and conversely, a cushioned impact of high debt in situations of very strong institutions.[11] A long string of research tends to conclude that high public debt can adversely affect growth through the channels of sovereign spreads (confidence effects) and sovereign yields,[12] financial intermediation (bank credit),[13] higher future distortionary taxation,[14] future crowding-out of private investment (debt is a dead-weight burden on the economy),[15] a reduced capacity to finance future public investment,[16] increased uncertainty and catalyser for banking crisis.[17] This literature is reviewed in more detail in the following sub-section.

Finally, as regards vulnerabilities, the debt level is not the only relevant dimension. Other characteristics defining its composition, like the maturity structure, are also important. In the euro area, the rise in public debt since the onset of the financial crisis was accompanied by a change in its structure with great degree of heterogeneity across countries (see Hartwig-Lojsch and Slavik, 2011). This aspect is relevant since a recent strand of the literature has highlighted that the financing method and the resulting composition of public debt can also have sizeable economic effects for two main reasons.[18] First, a greater share of short-term debt may make a government more vulnerable during a crisis, because

11. See Masuch *et al.* (2016) for an analysis of EU economies.

12. See Codogno *et al.* (2003), Schuknech *et al.* (2009), Barrios *et al.* (2009), Attinasi *et al.* (2010) and Corsetti *et al.* (2013) for the effect on spreads and Ardagna *et al.* (2004), Laubach (2009), Baum *et al.* (2013) for the effect on long-term sovereign interest rates (also related to the channel of private investment crowding-out).

13. See deBonis and Stacchini (2013) for the impact on bank credit and Jordà *et al.* (2016) for the effects in the aftermath of crises. The latter paper explores a historical database on public- and private-sector debt build-ups for advanced countries for the period 1870–2011 and finds that although high public debt build-ups are not correlated with a greater likelihood of financial crisis, a high level of public debt does tend to exacerbate the negative effects of post-crisis financial sector deleveraging.

14. In line with Barro (1979), Dotsey (1994). This can in turn affect precautionary savings and consumption today.

15. Aizenman *et al.* (2007), Woo and Kumar (2015), Ostry *et al.* (2015).

16. Chalk and Tanzi (2004), Checherita and Rother (2012).

17. See Brunnermeier *et al.* (2016).

18. See, for example, Bacchiocchi and Missale (2005), Faraglia *et al.* (2008), Alfaro and Kanczuk (2009), Arellano and Ramanarayanan (2012), or Hatchondo and Martínez (2013).

of the need to roll over increased amounts of debt. Moreover, in case a debt crisis mixes elements of illiquidity and insolvency, like the euro area sovereign crisis, the government would be vulnerable to pieces of bad news, whose real impact would be amplified by creditors' unwillingness to roll over their claims (see Borensztein *et al.*, 2005;Jeanne, 2004). Second, in an increasing interest rate environment, interest payments rise faster the higher the fraction of short- to long-term debt (Das *et al.*, 2010). Finally, other authors have argued that a government may want to issue more short-term debt as a signalling device, in an asymmetric information environment, to show its commitment to fiscal consolidation and debt stabilization. If considered credible by the markets, this may in turn contribute to reducing the cost of debt servicing (Missale *et al.*, 1997).

2.1.1. ***The theoretical literature on public debt and economic growth***. In line with the general views on fiscal policy, the theoretical literature on the relationship between public debt and economic growth is not consensual. Exogenous growth models allow only for level not long-term growth effects of changes in fiscal policy variables, while endogenous models predict permanent effects on the economic growth rate (particularly with productive government activity increasing growth). Assuming that the Ricardian equivalence does not hold in full, the conventional view of public debt (see Elmendorf and G, 1999) is that debt can stimulate aggregate demand and output in the short run, but crowds out capital and reduces output in the long run.[19]

The early literature argued that the national debt would be a burden for future generations in the form of a reduced flow of income. Modigliani (1961), refining contributions by Meade (1958), argued that the lower future income would be induced by a lower stock of private capital. Apart from a direct crowding-out effect of private investment, he also pointed to the impact on long-term interest rates, possibly in a non-linear form "if the government operation is of sizable proportions it may significantly drive up [long-term] interest rates since the reduction of private capital will tend to increase its marginal product" (p. 739). Even when the national debt is generated as a counter-cyclical measure and "in spite of the easiest possible monetary policy with the whole structure of interest rates reduced to its lowest feasible level" (p. 753), the debt increase will generally not be costless for future generations despite being advantageous to the current generation. Diamond (1965) adds the effect of taxes on the capital stock and differentiates between public external and internal debt. He concludes that, through the impact of taxes needed to finance interest payments, both types of public debt reduce the available lifetime consumption of taxpayers, as well as their saving, and thus the capital stock. In addition, he contends that internal debt can produce a further reduction in the capital stock arising from the substitution of government debt for physical capital building in individual portfolios.

19. See conclusions in Panizza and Presbitero (2013) and Woo and Kumar (2015).

Several theoretical contributions have focused on the adverse impact of external debt on the economy and the circumstances under which such impact arises.[20] In this line of research, Krugman (1988) coined the term of "debt overhang" as a situation in which a country's expected repayment ability on external debt falls below the contractual value of debt. Cohen (1993) theoretical model posits a non-linear impact of foreign borrowing on investment and, as suggested by Clements *et al.* (2003), this relationship can arguably be extended to growth. Accordingly, up to a certain threshold, foreign debt accumulation can promote investment, while beyond such a point the debt overhang starts adding negative pressure on investors' willingness to provide capital. Arguably, such models refer to both public and private (external) debt. Moreover, as pointed out in Panizza and Presbitero (2013), it is not clear whether the external debt argument could be easily applied to advanced economies in which the majority of debt holders are resident. On the other hand, for the advanced economies of the euro area, as discussed above and shown in Figure 1, the public debt overhang may be more pernicious given that it is denominated in a currency that the issuing government cannot control through monetary policy.

Later endogenous growth models show either a negative impact of public debt on growth or a positive one up to certain limits, depending mostly on the type of public goods financed out of debt. In Saint-Paul (1992)'s endogenous growth model, an increase in public debt always reduces the growth rate as there exists a future generation that will be harmed by such a measure. Moreover, he points out that contingent liabilities - more specifically for that model, an unfunded social security system - "necessarily reduce(s) the growth rate". At the same time, he concludes that a reduction in public debt, although it increases the growth rate cannot be Pareto-improving as one current generation must be harmed. Building on Barro (1990)'s endogenous growth model with public good services, Aizenman *et al.* (2007) show that with an effective upper bound on tax revenue due to distortions and imperfect tax enforcement, a high debt burden lowers the productive government spending, which reduces in turn the return to capital and the long-term growth rate. Adam and Bevan (2005) show that an increase in productive government expenditure, financed out of a rise in the tax rate, will be growth-enhancing only if the level of (domestic) public debt is sufficiently low. Similarly, Checherita-Westphal *et al.* (2014) extend the endogenous growth model by Aschauer (2010), in which the public capital stock has a non-linear impact on economic growth, to cover the impact of public debt. Assuming that government debt is used to finance productive public capital (the golden rule of investment), an increase in debt would have positive effects up to a certain threshold and negative effects beyond it.[21]

20. For more details on the literature review on this topic see Clements *et al.* (2003).

21. Greiner (2012) criticises such models and concludes that the non-linear relation between debt and growth is given by the growth-maximising tax rate. Allowing for a more general debt policy would lead to a monotone and negative relationship between public debt and steady-state growth.

Outside the strict scope of the growth literature, non-linearities may arise if the economy is subject to a public debt limit. Whether the fiscal limit is a point or a distribution, it is the result of models incorporating sovereign default. See, among others, Bi and Traum (2012) and Bi and Leeper (2010) for a forward-looking (DSGE) model and Ghosh *et al.* (2013) for a reduced form model. In such models, fiscal policy has clear implications for sovereign credit risk in the sense that for economic or political reasons, taxes and spending can no longer adjust to stabilise debt and/or investors lose confidence in the country's ability to guarantee public debt sustainability.

2.1.2. ***The empirical literature on public debt and economic growth***. Initially confined to external debt, the empirical literature on public debt and growth has attracted growing attention since the beginning of the crisis.[22] While the economic growth rate is likely to have a linear negative impact on public debt, high levels of public debt are also likely to be damaging for long-term growth. The causality is likely to go both ways.[23]

Several studies find a negative relationship between government debt and (per capita) real GDP growth, especially beyond a certain threshold. For stylised facts, descriptive statistics and correlations between debt and growth, see Figure 3 and Table 1. As shown in Reinhart and Rogoff (2010) (henceforth RR) and in several subsequent studies following their initial paper critique,[24] long-run growth rates in advanced economies for high debt regimes (above an exogenously chosen threshold of 90% of GDP) are at least 1 percentage point lower than in regimes of low debt. This conclusion is robust to changes in country or long time period samples. Panel (a) of Figure 3 shows results used in the RR paper, indicating that mean or median growth rates at high debt ratios are about half those at low debt.[25] Looking in more details at country-specific episodes of high debt (defined such that gross public debt exceeds 90% of GDP on a sustained basis), Reinhart *et al.* (2012) (henceforth RRR) find that such episodes are associated with lower growth compared to other periods (on average, 1.2 p.p. lower than in regimes of debt below 90%). See panel

22. In early Working papers from IMF, ECB, World Bank, Banca d'Italia and BIS research (Woo and Kumar, 2015; Checherita and Rother, 2012; Caner *et al.*, 2010; Balassone *et al.*, 2011; Cecchetti *et al.*, 2011), the impact of initial high public debt on growth of real GDP per capita is analysed by applying various econometric techniques.

23. See Imbs and Ranciere (2012).

24. The critique in Herndon *et al.* (2014) referred to coding errors, selective exclusion of available data and unconventional weighting of summary statistics. For the 20 advanced economies over the period after WWII, 1946-2009, the corrected growth rate was found at high debt ratios to be 2.2% instead of -0.1% in the original study. The challenged RR results are less strong, but not invalidated. While admitting the data coding error, RR showed in subsequent papers that the growth rate in regimes of high debt, while positive, was still much lower than in regimes of low debt (for the period 1946-2009, at 2.2% vs. 4.1%).

25. In the corrected RR sample of 20 advanced economies over the period 1790-2009, the mean (median) growth rate is 1.7% (1.9) for regimes of high debt ($>$90% of GDP) and 3.7% (3.9) for debt ratios$<$30%.

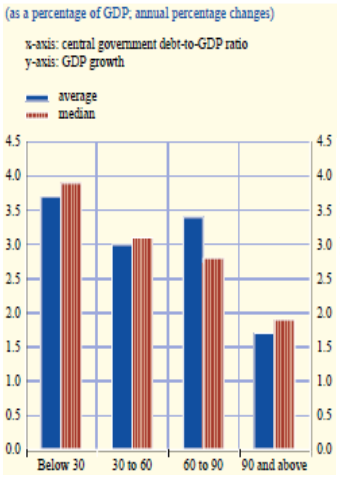
(b) of Figure 3. The vast majority of high debt episodes identified (23 out of 26) coincide with substantially lower growth. Most of them (20 out of 26) lasted more than a decade, making the authors suggest that they cannot be only the result of debt building up during recessions. Though most episodes are associated with higher real interest rates, the authors conclude that the growth-reducing effects of high debt appear to be transmitted through other channels as well (in 11 episodes the real interest rates are not materially higher). While several high debt episodes, especially after the WWI and WWII, ended in default and debt restructuring, the authors challenge the view that the main cost of high public debt ultimately comes from sovereign default.

Similar stylised facts and correlations remain valid for euro area country subsamples. In the RR sample of 20 advanced economies, the (unweighted) country growth average of the 11 euro area member states included[26] is 2.% for regimes of debt above 90% of GDP and 3.9% for debt lower than 30% (2.8% when the debt ratio is between 30 and 60% of GDP). In the RRR paper, Greece and Italy are among the euro area countries found most often in regimes of high debt and lower growth (in several cases, not only war-related, the episodes ending in defaults and debt conversion). A negative (unconditional) correlation between the starting level of public debt and growth holds in the full euro area sample also for more recent periods, including the crisis (see panel (c) of Figure 3. Countries with lower debt levels at the start of the euro area sovereign debt crisis (in 2009) experienced on average less severe growth losses in the subsequent period. Many of the countries starting with a higher level of debt had less room for counter-cyclical fiscal policies over the crisis, which contributed to the later lower growth. In a simple panel regression model for the 19 euro area countries over the period 2003-2014, a fiscal loosening is found to improve the output gap, but this effect is much weaker for countries with higher debt ratios (Table 1).

Going beyond simple correlations, several empirical studies (spanning all major institutions) find a negative, mostly non-linear, impact of public debt on growth.[27] In case of endogenous thresholds, most studies report around 90% of GDP, with smaller or wider confidence bands depending on country sample selection. Similar debt thresholds are found in the literature on early signals of sovereign distress. For instance, the debt sustainability analysis framework of the International Monetary

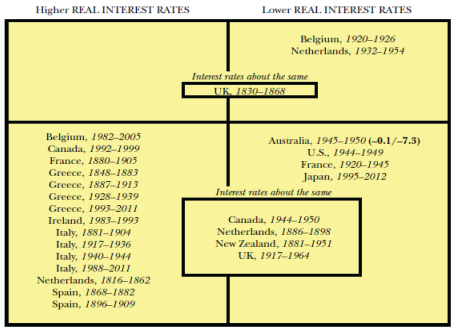
26. Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal and Spain.

27. Woo and Kumar (2015) find evidence of nonlinearity with higher levels of initial debt (above around 90 percent of GDP) having more significantly negative effects on subsequent growth. For the euro area sample before the crisis, Checherita and Rother (2012) find an inverted U-shape relationship between public debt and growth with a median debt threshold endogenously determined at 90-100% of GDP. Subsequent research for the euro area (Baum *et al.*, 2013) investigates the short-run impact of public debt on GDP growth for a more recent period (1990-2010). The authors find a positive and highly statistically significant effect, which decreases however to around zero and loses significance beyond public debt-to-GDP ratios of around 67%. For high debt-to-GDP ratios (above 95%), additional debt is found to have a negative impact on economic activity.



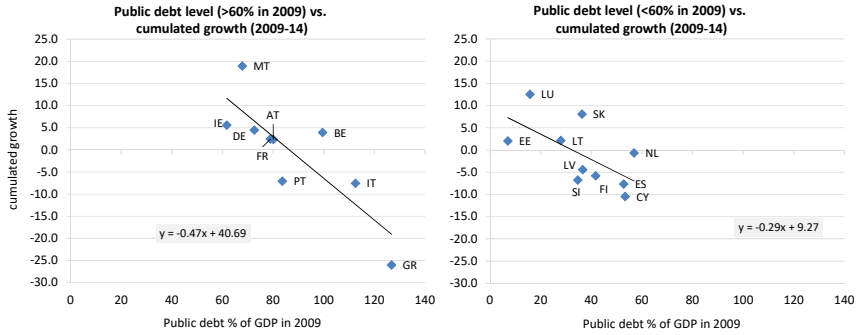
(a) Real GDP growth and central government debt (selected advanced economies, 1790-2009)

Source: Reinhart and Rogoff (2010).



(b) Real growth and real interest rates for 26 high debt episodes (advanced economies, 1800-2011)

Source: Reinhart *et al.* (2012).



(c) Starting public debt level and subsequent growth in the euro area over 2009-2014

Sources: EC Ameco database and own calculations. The full sample includes the current 19 euro area member states.

Figure 3: Debt and growth: stylised facts

Fund adopts a debt ratio of 85% of GDP to flag fiscal risks in advanced economies, with a similar threshold found by the European Commission for the EU sample and used in its S-0 indicator. Several papers investigate the effect of both public and private debt on growth and find that both matter.[28] Finally, various market research papers (e.g., Buiter and Rahbari, 2012 and McKinsey Global Institute, 2015) point

28. Cecchetti *et al.* (2011) use a sample of 18 OECD countries for the period 1980-2010 and find results supporting the view that debt is bad for growth beyond a certain level.

	Overall EA sample	**debt>60%**	**debt<60%**
Δ SPB$_{(t-1)}$	**-0.696*** **	**-0.476*** **	**-0.646***
constant	-0.536*	-1.475***	0.454
Obs.	184	99	85
R-sq within	0.09	0.10	0.04
Δ SPB$_{(t-1)}$	**-0.561*** **	**-0.334** **	**-0.707** **
LT Int. rate$_{(t)}$	-0.644***	-0.355***	-1.231***
Inflation $_{(t-1)}$	0.054	0.095	0.117
constant	2.148***	-1.475***	5.467***
Obs.	184	99	85
R-sq within	0.17	0.18	0.2

Table 1. Public debt level and short-term impact of fiscal policy on economic activity: euro area over 2003-2014

Sources: EC Ameco database and own calculations.
Notes: Regression results from panel regression with country fixed effects on a sample of 19 euro area countries. Dependent variable is annual output gap$_t$. ΔSPB denotes the change in the structural primary balance as a proxy for discretionary fiscal policy. Its coefficient is a proxy for an overall fiscal multiplier (a negative coefficient denotes a negative short-term impact of fiscal consolidation, or alternatively, a positive short-term impact of fiscal stimulus).
Significance: * p<.1; ** p<.05; *** p<.01

to the negative impact of both public and private debt overhang on output growth and need for deleveraging.

Critiques of the empirical literature on debt and growth refer mostly to issues of endogeneity and challenges to a universally-valid debt threshold. In a survey of the literature, Panizza and Presbitero (2013) conclude that the case for a causal effect running from high debt to lower growth still needs to be made. They posit that the relationship between debt and growth is characterised by country-heterogeneity and it may depend on various factors, such as institutional quality, dimension of the public sector, how and why debt has been accumulated, its structure and composition. Ostry *et al.* (2015) conclude that no threshold of government debt is universally valid. Instead, they suggest that "it may be helpful to think of debt levels as falling into three zones: a green zone, in which fiscal space is ample; a yellow zone, in which space is positive but sovereign risks are salient; and a red zone, in which fiscal space has run out". Further, they conclude that reducing debt when a country is in the green zone "is likely to be normatively undesirable as the costs involved will be larger than the resulting benefits". Chudik *et al.* (2017) also fail to find evidence for a universally valid debt threshold in a sample of 40 advanced and emerging economies over 1965-2010. However, their results indicate that regardless of the threshold, there is a significant negative effect of public debt build-up on output growth. Moreover, if the increase in the debt-to-GDP ratio turns out to be permanent, it will have negative effects on economic growth in the long run. Eberhardt and Presbitero (2015) also find some evidence for a negative relation between public debt and growth, but not for a common debt threshold.

While country-heterogeneity is indeed important, estimates at individual country level are subject to very high uncertainty. For instance, the papers focusing on debt-limits in the spirit of Ghosh *et al.* (2013) mostly find very high debt thresholds. However, these are debt limits associated with sovereign default, i.e., beyond which output collapses in the shorter run and from which governments are well advice to stay sufficiently apart. Several such studies distinguish between optimal or steady-state debt ratios and risky debt levels or debt limits beyond governments default. In many of these studies, steady-state debt ratios are estimated or calibrated at around (or below) 60% of GDP.[29] Moreover, debt limits based on past data estimation do not usually take into account various sources of government contingent liabilities.

2.2. Model simulations

This section discusses macroeconomic implications of the public debt level in a general equilibrium modelling framework. To this end, the section uses three global DSGE models: EAGLE (ESCB), GEAR (Bundesbank) and the BE model (Banco de España). All these models are globally sharing the same new-Keynesian framework, but have specific features, which will be exploited to enrich our set of simulation. The EAGLE model splits public expenditures between consumption and investment and gives them an active role in agents' decision problem. The GEAR model has a sound labour market and a comprehensive fiscal sector. The BE model, featuring borrowing constrains in the private sector and long-term private debt, can be used to evaluate the interaction between public debt, private debt and growth. The EAGLE model is calibrated for the euro area to Periphery (Greece, Italy, Portugal and Spain) vs. Core (the rest of the euro area), the rest of the world and the US. BE is a closed monetary union with two countries or regions: the "periphery" and the "core", while GEAR is estimated on German and euro area data. See Appendix 1 for an overview of the main features in the three models.

The introduction of a sovereign risk premium in DSGE models is needed to get a significant effect of the debt level. In standard DSGE models, like the ones currently used for policy simulations, the initial level of debt does not significantly affect the size of multipliers (i.e., output is broadly unaffected by the debt level in case of a shock bringing the economy away from its steady-state). Yet, as pointed out in the previous section (and in various empirical studies used in model calibrations), there is also strong evidence that important nonlinearities are at play between debt and output.[30] To capture such effects, the paper follows Corsetti *et al.* (2013) and allows for sovereign default as a consequence of government's inability to raise

29. See Ghosh *et al.* (2013), who estimate long-run debt ratios for advanced economies of 60-70% of GDP or Checherita-Westphal *et al.* (2014), who find an optimal debt ratio of 50% of GDP for the euro area countries based on estimated output elasticity of the public capital stock. In this same line, Andrés *et al.* (2017b) estimate the optimal debt ratio for Spain to be around 60% of GDP.

30. As confirmed also by Batini *et al.* (2016), Schularick and Taylor (2012), Jordà *et al.* (2013).

the funds necessary to honour its debt obligations. Consequently, the sovereign risk premium responds to changes in the fiscal outlook of the country and the probability of sovereign default is closely and non-linearly linked to the level of public debt.[31] More specifically, sovereign default is associated with the notion of a fiscal limit in a manner similar to Corsetti *et al.* (2013) and Bi and Leeper (2010): whenever the debt level rises above the fiscal limit, a default will occur. The fiscal limit is determined by a stochastic process capturing the uncertainty that surrounds the political process in the context of sovereign default. The models thus assume that in each period the limit will be drawn from a specific distribution.[32] Beyond this limit, the probability of default is certain.[33] From a theoretical perspective, the fiscal limit depends on the economy's Laffer curve, which arises from distorting taxes and constrains the government's ability to service its debt. If the tax rate is on the "slippery" side of the Laffer curve, then the government is unable to raise more tax revenue through higher tax rates (see Trabandt, 2011 and Bi, 2011).

Changes in the sovereign risk premium are assumed to affect the cost of financing for both the government and the private sector. In the former (public channel), the government has to finance higher interest payments and thus to increase distortions in the economy via higher taxes. In the latter (private investment channel), the sovereign risk spills over to the private sector. Given that our models do not have a fully- fledged financial sector with explicit lenders and borrowers, the "Corsetti" approach cannot be fully implemented here. An alternative strategy consists in introducing financial frictions in the private sector, which would depend on tensions in the public sector. To this end, a sort of "default probability" in the private sector that would co-move with the one in the public sector is introduced in the models. This can be achieved by increasing the costs of private investment financing, or equivalently, by augmenting Tobin's Q. Tobin's Q will thus increase in the models with the default probability of the public sector. Intuitively, private sector capital investment becomes more risky (more projects in the private sector face uncertainty and financing problems and are, therefore, also subject to default) whenever government default becomes more likely. Figure 4 provides a schematic representation of the role of public debt in the short-run transmission channels of shocks, including the above-described effects.

31. Notice that the public debt in EAGLE cannot be internationally traded.

32. In the case of EAGLE a normal distribution (like in Darracq Pariès *et al.*, 2016) is assumed, in the case of GEAR a beta distribution (like in Corsetti *et al.* (2013)), and in the case of the BE model a logistic distribution (like in Bi and Traum, 2012). Parameters determining slope and curvature of the distribution function are calibrated to be in line with Corsetti *et al.* (2013).

33. Following Laubach (2009), Attinasi *et al.* (2017) adopt an alternative approach. The public debt risk premium in the euro area countries is assumed to consist of a transitory and a permanent component. The transitory component is country-specific and captures the impact of growth in actual domestic government debt-to-GDP ratio. The permanent component is common to all the members of the monetary union and captures the impact of a level change of the area-wide government debt-to-GDP ratio with respect to the initial level.

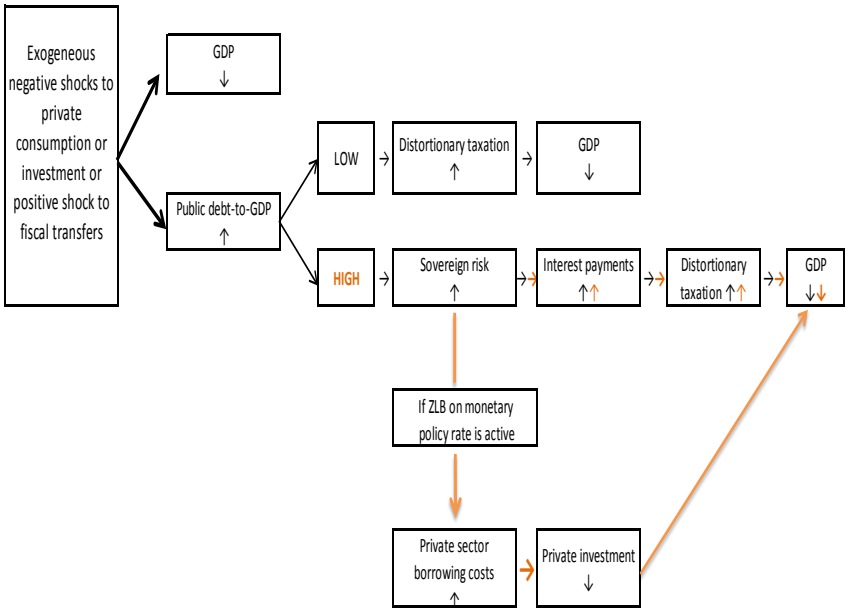


Figure 4: The role of public debt in the short-run transmission channels of shocks

Source: Own representation.

The model simulations in this section aim at investigating two broad categories of effects of high debt regimes: (1) short-run effects capturing the resilience of the economy to shocks; (2) long-run effects on output and growth. As these exercises use our standard (large-scale) policy models with a very detailed fiscal block and various types of economic agents (Ricardian and non-Ricardian in EAGLE and GEAR, patient and impatient in the BE), any optimal fiscal policy computation or sound welfare analysis cannot be implemented in a straight-forward manner. For obvious computational reasons, such analyses would require a more simplistic model setup. In this respect, taking a more theoretical perspective, Smets and Trabandt (2012) examine the implications of high government debt for optimal monetary policy in response to a large recessionary shock at the zero lower bound (ZLB) for the policy rate. They show that under optimal policy, the central bank reduces the risk premium on government debt to stabilise the economy. Regarding the role of debt management, also in an optimal policy framework, Cantore *et al.* (2017) show that the speed of debt consolidation is fast only if the government lacks commitment or if the initial public debt-overhang is very high and the government cannot access official bailout schemes curbing risk premia.[34]

34. Regarding fiscal consolidation strategies, see Kilponen *et al.* (2015) which provides a comprehensive cross-country comparison using various policy models.

Overall, this paper implements four simulation scenarios, three on the short run and one on the long run. The short run simulations assess the impact of the public debt level on the *resilience* of the domestic economy in a period of recession with an area-wide monetary policy constrained by the ZLB. They have been designed to answer the following questions: (i) What would be the short-term cost in terms of domestic output losses of a very high level of debt (scenario 1)? (ii) What would be the consequence of adverse shocks when the economy is in a liquidity trap (scenario 2)? (iii) What would be the role played by private deleveraging (scenario 3)? In addition, the long-run simulations aim at answering the question: (iv) What would be the *long-term* cost of a high debt burden (scenario 4)?

The main results of these simulations are the following: (i) A high level of public debt makes the economy more vulnerable to shocks (crises); (ii) High public debt prolongs the time spent at the ZLB; (iii) International spillovers increase the time spent at the ZLB for the high public debt economy; (iv) A higher level of public debt crowds-out private debt in the short and long run; (v) High public debt restricts the scope for counter-cyclical fiscal policy; (vi) A high level of public debt affects adversely potential (long-term) output, with a significant impairment in case of most distortionary taxation and large sovereign risk premium.

2.2.1. ***Short-run simulations testing the resilience of the economy to shocks in regimes of high public debt***. The following simulation set-up is used to generate results in this section.

Regimes of debt and types of shock: From a practical modelling perspective, each scenario is computed for low and high-very high levels of public debt.[35] In each case, the economy starts at the steady state but with a different initial level of debt.[36] A shock is applied to consumption and/or investment in the private sector to bring the domestic economy into a deep recession. These shocks to demand ensure that both inflation and output decrease, a reflection of the economic developments following the financial crisis. In the model, the shocks are implemented on the consumption preference and, respectively, the Tobin's Q. In addition to these two real shocks, a compensatory fiscal shock (stimulus) leads to an increase in public transfers.

Monetary policy: As previously mentioned, in the three models, when monetary policy is unconstrained (normal times) it can compensate most of the adverse impact on the (currency area) economy stemming from tensions on sovereign

35. This is implemented in the three models as follows: Low debt: 60% of GDP in EAGLE and GEAR and 25% in the BE model; High/very high debt: 120% in EAGLE, 90% in GEAR and 75% in BE.

36. Contrary to part of the theoretical literature, standard (large size) DSGE models do not allow multiple regimes with a transition probability of moving from one regime to another. For an example of such models, see Bi and Leeper (2013) applied to questions of fiscal sustainability for Greece and Sweden.

spreads. In this case, simulations show that the additional adverse impact of the shock in regimes of high public debt is rather limited. Common monetary policy reacts, however, only at area-wide level (to area-wide inflation and output gap). In case of asymmetric shocks, it will react according to the relative size of the (high debt) country in the area-wide conditions. Nonetheless, one salient feature of the crisis is the lower bound on interest rates faced by the monetary authority (scenario of ZLB). In this section, the constraint on the monetary policy rate is implemented in the EAGLE model in two ways. In scenario 1, economic agents fully expect that interest rates will be fixed for a given period of two years (the pre-announced or "forward guidance" scenario). In scenario 2, the length of the ZLB depends on the shocks and is endogenously computed in the model according to the values of output growth and inflation (variables entering the Taylor rule followed by the monetary authority). Furthermore, in order to bring the euro area economy to the ZLB, shocks need to be large enough and/or global. Contrary to scenario 1 where the shock is local (implemented in the domestic economy in an asymmetric fashion), in scenario 2 the recession is assumed to be global (worldwide). The simulation period focuses on the shorter term, more specifically, on the length of the ZLB period (8 quarters) since: (i) the exit from the liquidity trap and the implementation of non-standard policy measures are out of the scope of our analysis, and (ii) our (otherwise large) models do not have all the required features in this respect, such as long-term bonds.[37]

Further sensitivity analysis: The three short-term scenarios presented below are accompanied by sensitivity analyses to assess the robustness of our results to the uncertainty on some key parameters, alternative policy rules or alternative economic environments.

Scenario 1: Domestic shocks and forward guidance

All shocks in this scenario are implemented at the domestic level in the periphery economy. They are assumed to last for one year while the nominal interest rate is (exogenously) fixed for two years (as explained above). To clearly disentangle the impact of each shock and the role of the private investment channel, shocks are introduced sequentially. The consumption shock (implying a 2 percentage point decrease in the consumption share) has been calibrated to trigger a strong decrease of domestic GDP to mimic conditions during the great recession.[38] The private investment channel mimics the recent low investment environment. The investment shock triggers an extra GDP loss of around 1% (the investment share is decreased by 5 percentage points). The results - herein presented with the EAGLE model -

37. As mentioned, for alternative models, see Smets and Trabandt (2012) and Cantore *et al.* (2017).

38. For sake of comparison, Gerali *et al.* (2015) running the same type of exercise for Italy, have generated a 8% drop in GDP after 3 years.

show that a higher level of public debt makes the domestic economy more vulnerable to shocks.

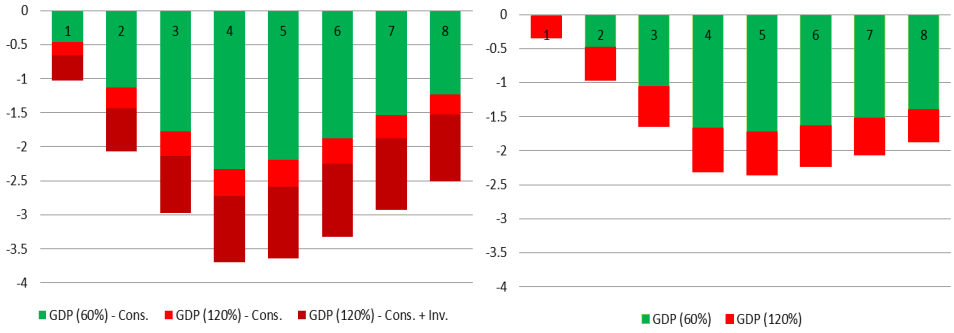
The green bars show the impact of an adverse shock on consumption shock when the public debt-to-GDP level is low (60%; see Figure 5 - panel (a)). In this case, as there are no tensions on sovereign spreads, the spillovers to the private sector are muted. The risk premium channel does not play a significant role. On the contrary, when the debt-to-GDP ratio is high (surpasses 120%, red bars), a significant output loss occurs, that is, by around 15% (depending on the period given nonlinearities in the model) more compared to the initial situation (green bars).[39] The economy is clearly worse off. After an adverse consumption preference shock, households increase their savings, which are thus reallocated towards private investment. At the same time, the government needs to increase taxes to finance higher interest payments. Against this background, domestic inflation is pushed further down. As monetary policy cannot be accommodative, real interest rates are slightly higher, which hurts the economy.

The private investment channel deteriorates further the economic activity (dark red bar in panel (a) of Figure 5). The private investment channel takes into account the corporate risk shock, which subsequently links the sovereign spread to the cost of financial intermediation. In the absence of tensions (when debt is low), financial markets are not affected and the economy is immunised against this extra source of uncertainty. When the level of debt is high, the associated increase in the sovereign risk premium is transmitted to the cost of financing in the economy, making investment more vulnerable. In this case, the negative impact on GDP becomes more significant (the extra GDP loss is around 60% depending on the period compared to the low debt case, green bars). This is because the recession is more pronounced (there is a further drop in private investment) and the deterioration in the debt-to-GDP ratio is larger. Subsequently, the higher sovereign spreads are translated into higher costs of financing and larger financial uncertainty.

The shock illustrated in panel (b) of Figure 5 evaluates the implications in terms of GDP of an increase in lump-sum fiscal transfers aimed at mitigating the adverse impact of the recession on private consumption. In terms of distributional effects, transfers are targeted to be more favourable to non-Ricardian households (in a proportion of one to three). The shock is calibrated to increase transfers by 1% of nominal GDP. With fiscal transfers, the impact of the recession is mitigated (the GDP loss in Figure 5 is lower than in panel (a) for the same private consumption shock; see green and light red part of the bars). However, in regimes of high debt (red bar), the GDP loss is now about 30% larger than in regimes of low debt. Moreover, in the last two quarters of the simulation period, the GDP loss reverses (higher in the presence of fiscal transfers). This shows that the positive gains induced by transfers are largely compensated by the burden of debt or, equivalently,

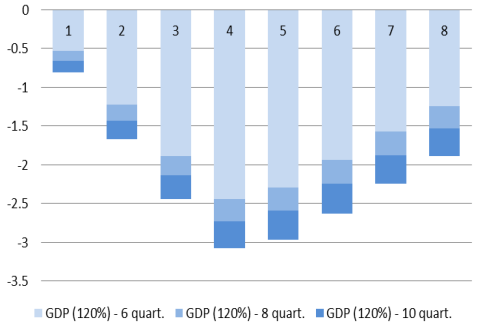
39. The size of the loss depends obviously on the size of shock and by how much the debt ratio is impacted by the shock.

that a high debt restricts the scope for counter-cyclical fiscal policy (see also below for more simulations).

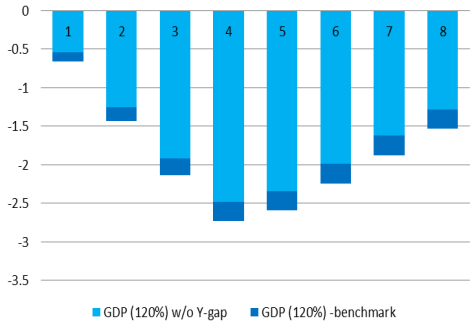


(a) Private consumption shock (benchmark) and investment shock

(b) Private consumption shock and compensatory public transfer shock



(c) Role of monetary policy: length of fixed interest rate period



(d) Fiscal policy objective: priority to sustainability in regime of high debt

Figure 5: Resilience of the economy to shocks in regimes of high debt: impact on GDP

Sources: Own calculations.
Notes: All panels show impact on GDP (level of debt-to-GDP ratio in parenthesis). The lower panels show sensitivity analysis around the benchmark (private consumption shock) only for regimes of high debt as follows: panel (c) - impact of the length of the period monetary policy is constrained and panel (d) impact of the fiscal policy rule (switching off the parameter associated with output gap in the fiscal policy rule , see GDP (120%) w/o Y-gap, vs. the benchmark of a standard rule in which fiscal instruments are reacting to both debt stabilisation (sustainability) and output stabilisation.

As shown in panel (c) of Figure 5, a prolonged period of constrained monetary policy is more detrimental for a high debt economy. As mentioned before, the reaction of monetary policy and the perception of agents thereof are crucial to explain the short-term reaction of the (euro area wide) economy

to shocks at the ZLB.[40] (see also ECB, 2014 and Kilponen *et al.*, 2015). More specifically, the duration of the fixed interest rate period affects significantly the behaviour of economic agents. In case of large adverse shocks, a longer period of constrained interest rates will further deteriorate the growth prospect. Our benchmark simulations (private consumption shock) rest on the assumption that interest rates cannot move for 8 quarters. Against this background,[41] alternative periods of 6 (lighter blue bar) and 10 quarters (darker blue bar), all in regimes of high public debt, are considered. Panel (c) of Figure 5 highlights two aspects. First, it shows that our simulations are quite robust as losses in regimes of high debt remain large. Second, the length of the period during which monetary policy is constrained has an asymmetric impact, reflecting nonlinearities of the model. When interest rates are fixed for 6 quarters, the GDP gain compared to the benchmark (8 quarters) simulation is around 0.25 percentage point. When interest rates are fixed for 10 quarters, the extra loss is around 0.35.

A high public debt burden reduces the scope for counter-cyclical fiscal policy (panel (d) of Figure 5). In our benchmark simulations fiscal instruments react to both the debt-to-GDP ratio (debt stabilisation, an important component of fiscal sustainability[42]) and output gap (fiscal stabilisation objective). As documented in Appendix 1, this benchmark specification is quite standard. In practice, fiscal policy is often used to smooth fluctuations in economic activity, particularly in advanced economies. At the same time, in periods of severe recession, letting automatic stabilisers operate fully can be counter-productive for a high debt economy under market pressure. Delaying the debt reduction increases the burden of interest payments for the government. From a model perspective, it is possible to assess what would be the gain of privileging a debt reduction strategy in regimes of high debt by annulling the parameter associated with the output gap in the fiscal rule (lighter blue bar). In this case, Figure 5-panel (d) shows that GDP will decrease on average by 0.25 percentage point less compared to the benchmark scenario. This confirms the idea that in case of high vulnerability, the consolidation needs to be faster. As in Figure 5-panel (b), this scenario suggests that a high debt burden constrains the scope for counter-cyclical fiscal policy.

In these policy simulations, the fiscal authority uses the labour income tax (LIT) to stabilise the debt ratio. An alternative scenario considers VAT tax. Taking the consumption shock as a benchmark, simulations suggest that increasing VAT instead of LIT does not help to mitigate the recessionary impact of the crisis on

40. Common monetary policy reacts to area-wide inflation and output gap. In case of asymmetric shocks, it will react according to the relative size of the (high debt) country in the area-wide conditions.

41. As used also in de deJong *et al.* (2017).

42. A comprehensive debt sustainability (DSA) framework should generally consider both debt dynamics (stabilisation) and the level at which debt stabilises, test the resilience of the debt path under various adverse scenarios and account for other relevant indicators. See in this respect ECB (2015) and Bouabdallah *et al.* (2017)

economic activity. The VAT hike depresses further private consumption bringing HICP further down. In turn, real interest rates are higher implying a greater loss of GDP. Nevertheless, when the ZLB period is over, the recovery is faster.

Results are consistent across models. Focusing on the benchmark case, simulations conducted with both Eagle and GEAR highlight the consistency of results across models. This brings forward two remarks. First, as already shown in the literature, when monetary policy is constrained, the size of fiscal multipliers is larger. Second, when the level of debt is high, the resilience of the economy to shock is lower and the scope for counter-cyclical fiscal policy is limited.

Scenario 2: Time spent at the ZLB and international spillovers

Given the crucial role played by monetary policy in crisis times, scenario 2 considers an alternative way to constrain the monetary policy rate, as well as global shocks and the effect of international spillovers. The implementation of monetary policy during the crisis and its perception by economic agents largely determine the reaction of the economy to shocks. Against this background, the ZLB condition is implemented in a straightforward way. The monetary authorities follow a Taylor rule in normal times (delivering a non-negative interest rate); otherwise, the nominal interest rate equals zero. Technically, the Taylor rule is replaced by a function that returns the maximum of the Taylor rule itself or zero. A succession of large unexpected global shocks brings the euro area economy to the ZLB and into the liquidity trap (see Gomes *et al.*, 2015).[43] From a practical perspective, the consumption and investment shocks last a sufficiently long period to drive the interest rate to the lower bound for two years. Agents correctly forecast the impact of each shock as they hit the economy, but are unaware of the future shocks. The situation is similar to one in which factors not included in the model affect agents' confidence, such as a sequence of bad news regarding the financial health of the banking sector. This behaviour can be simulated in the model as a gradual erosion of consumers and firms' confidence (approximated in our case by a suite of unexpected shocks). The recession is first assumed to be worldwide (global). Against this background, shocks are hitting simultaneously each block of the model and are similar across periods.

Figure 6 (solid lines) shows that an economy exposed to a higher level of public debt (red) and hit by worldwide (WW) shocks will be more vulnerable at the ZLB than the low debt economy (green). The burden of a higher cost of financing and its adverse impact on domestic demand will prolong the time spent in the liquidity trap. At the same time, the more vulnerable economy will enter faster the ZLB. Compared to the low debt case, the high debt economy will stay one year longer at the ZLB. Such results are consistent with Corsetti *et al.* (2013). Since the

43. The alternative of having single-period shocks driving the entire episode was rejected because of the sheer size of the shock needed and the extreme reaction of the model, accompanied by numerical problems (see Gomes *et al.*, 2015).

recessionary shock is so severe that the ZLB is binding, higher sovereign spreads (in deviation from the risk free rate) are translated into higher real interest rates.

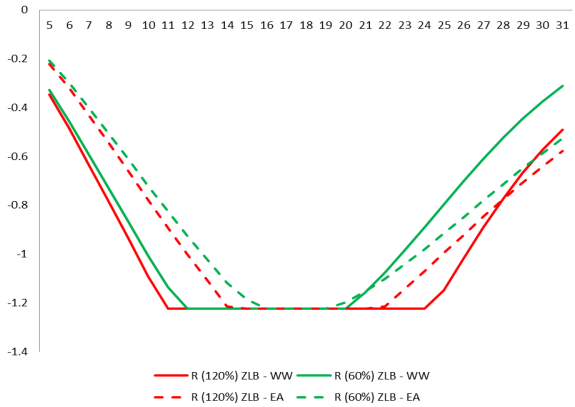


Figure 6: Resilience of the economy to shocks in regimes of high debt: Time spent at the ZLB and international spillovers (Nominal interest rate expressed in pp deviation from steady state; X-axis: number of quarters)

Source: Own calculations.
Notes: WW stands for a scenario of worldwide shocks assumed to affect the economy. EA stands for domestic (euro area) shocks.

Consequently, private expenditure and output are falling more when the level of debt is higher. Furthermore, the high debt economy is more vulnerable to external shocks originating outside the euro area countries (in the US and the rest of the word). When external shocks are limited to the euro area (dotted lines), the low debt economy will spend less time at the ZLB than the riskier economy. By comparing the worldwide (WW) crisis scenario and the euro area-wide scenario, it is possible to assess the importance of international spillovers. Figure 6 shows that the globalisation of the crisis is more costly for the economy with a debt problem. It will stay 5 quarters more at the ZLB instead of 7 (compare the differences between the solid and dotted lines in the red versus the green scenario).

Scenario 3: The role of private indebtedness

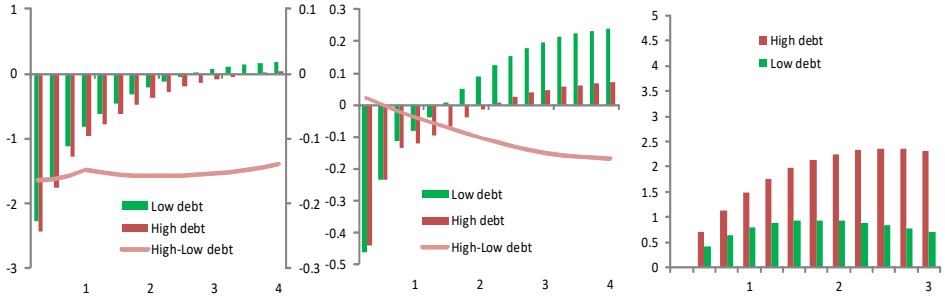
A higher level of public debt exacerbates private sector constraints through the crowding out of private debt. The BE model offers in particular the possibility to analyse economic developments in the presence of private borrowing and deleveraging.[44] In this exercise, a large and persistent demand shock is run in the first quarter to bring the economy to the zero lower bound. In addition, a fiscal

44. See Andrés *et al.* (2017a) for a detailed description of how private borrowing and deleveraging is introduced in a closed economy version of the model and Arce *et al.* (2016) for the two-region euro area version of the model. Finally, for a detailed description of the public sector in the model see Andrés *et al.* (2016).

expansion (increase in government consumption, G) raises public debt by around 3%. High public debt is considered in this model to be 75% of GDP and low debt 25% of GDP. In the left hand side and centre panels of Figure 7 , the green bars represent the dynamics of GDP for the periphery under the low debt steady state calibration, while the red bars capture the effects for the high debt calibration. The line is the GDP difference between the high and low debt regimes. In the right hand side chart, the bars represent the dynamics of the debt-to-GDP ratio in the periphery under high (red) and low debt (green) steady state calibrations.

In terms of results, first, as in previous exercises, an economy with high debt is less resilient to a demand-based recession (see left hand side chart). Second, when there is in addition a fiscal expansion (middle chart), the difference in the output response in regimes of high versus low debt is smaller in the short run (and might even be positive on impact), while it converges to a similar effect in the middle run (three years). That is, the higher public debt exacerbates private sector constraints by crowding out the private debt. In this situation, fiscal policy is more effective on the short run (at least on impact) as it provides additional income to the constrained agents. As the high debt economy accumulates even more public debt, the increase in the risk premium and the crowding out of private debt more than compensates the gain from relieving the financially-constrained agents. The differential impact turns negative and increases until both cases converge and the high public debt economy becomes less resilient.

Therefore, there is a trade-off between the short-term gains from an active fiscal policy and the medium-term costs from higher interest payments and the corresponding crowding out of private debt. This trade-off is most pronounced in regimes of high debt, which highlights again the constraint of a debt-burdened economy to implement counter-cyclical fiscal policies.



(a) GDP in periphery: C shock (b) GDP in periphery: C+G shocks (c) Public debt/Y in periphery: C+G shocks

Figure 7: Resilience of the economy to shocks in regimes of high public debt: Rise in public and private indebtedness

Sources: Own calculations.
Notes: C shock denotes a negative private consumption shock. G shock denotes a positive government consumption shock. High (public) debt is considered in this model to be 75% of GDP and low (public) debt 25% of GDP; GDP: percentage deviation from steady-state; Public debt-to-GDP ratio: percentage point deviation from steady state; X-axis: number of years

2.2.2. ***Long-term analysis.***

Scenario 4: Comparative static analysis of the level of public debt in the long-run

To assess the long-term losses implied by the level of public debt, a comparative static exercise is conducted with all models. In particular, the steady state is computed for different initial values of the public debt-to-GDP ratio (ranging from 60 to 120%) and the output losses are derived relative to the initial steady state at the lower bound for the debt ratio (60%). The amount of the loss will, *inter alia*, depend on the fiscal instrument used for adjustment.

GEAR model: To understand the mechanisms at play, Table 2 decomposes the long-term impact of a higher level of debt according to the role played by the risk premium (RP) in GEAR. More precisely, it considers three cases: (i) a debt increase in the rest of the euro area without risk premium (1st column), (ii) a debt increase in the rest of the euro area with risk premium only in the public sector (2nd column), and (iii) a debt increase in the rest of the euro area with spillovers of the risk premium to the private sector. In this case, it is assumed that a higher risk premium in the public sector also augments financing costs in the private sector. The spillovers can be full (last column of the table) or partial (half pass-through to the private sector; 3rd column). Results are shown for the two regions in the calibrated GEAR model: Germany and the rest of the euro area.[45] The initial

45. Simulation results emerging from the GEAR model are not driven by having the model estimated for Germany and the rest of the Euro area in qualitative terms, but they are an outcome of

steady-state debt level of 60% in both regions is increased to 90% in the rest of the euro area (whilst it is kept at 60% in Germany) and financed with distortionary labour income taxes. Results are shown in Table 2 in percent (percentage point) deviation from the initial steady-state values.

	HD (no RP)	HD (RP in public sector)	HD (RP in pub and priv, inter)	HD (RP in pub and priv, full)
in Germany				
GDP	-0.002	-0.069	-0.079	-0.089
Priv. consumption	-0.003	-0.084	-0.096	-0.109
Priv. investment	-0.003	-0.088	-0.101	-0.114
Unemployment rate	0.001	0.021	0.024	0.027
Real wages	-0.002	-0.068	-0.079	-0.089
in rest of the Euro Area				
GDP	-0.081	-2.617	-3.024	-3.413
Priv. consumption	-0.111	-3.640	-3.665	-3.706
Priv. investment	-0.091	-2.973	-5.094	-7.111
Unemployment rate	0.049	1.752	1.671	1.597
Real wages	0.039	1.274	0.663	0.085
Labor tax rate	0.451	12.623	12.138	11.690
Debt-to-GDP ratio	90.000	90.000	90.000	90.000

Table 2. Long-term impact of higher level of public debt (labour income taxes): GEAR model

Source: Own calculations.
Notes: Simulations show the long-term impact (deviations in percent, and respectively, percentage point from the initial steady-state levels of the respective variables; public debt ratio at 60%) in regimes of high public debt (HD at 90% of GDP implemented in the rest of the euro area). The increase in debt is financed with distortionary labour income taxes. HD (no RP) is a scenario of debt increase in the rest of the euro area without risk premium. HD (RP in public sector) is a scenario of debt increase with risk premium only in the public sector. The last two columns denote a debt increase with half, and respectively, full spillovers of the risk premium to the private sector.

A large and widely transmitted sovereign risk premium impairs significantly the potential output. In the absence of risk premium (column 1), the long-term impact on GDP is rather limited. It reflects the mechanical effect of the increased amount of interest-bearing debt that the government has to finance (quantity effect), which results in slightly higher labour income taxes. On the contrary, there are significant adverse effects on the high debt economy (rest of the euro area) when the risk premium has a long-term role: the GDP loss increases from less than 0.1 to 2.6% (column 2). In addition to the quantity effect just described, including a risk premium on government bonds now entails a significant price effect, increasing the additional long-run financing needs of the government resulting from higher debt. The tax rate needs to be significantly increased to finance the extra costs. Private consumption deteriorates by 3.6 instead of 0.1% in the previous case. The spillovers

the structural model as such. However, quantitatively, the results may change slightly when taking into account another country composition

to the German economy is mechanically larger (-0.069 instead of -0.002) although identical in relative terms (around 0.03 by taking the ratio of the two impacts).[46] When the sovereign risk premium spills in part (half) to the private sector (column 3), the GDP loss increases by 0.4 relative to the previous simulation due to a larger drop in private investment (from 3 to 5%). The subsequent deterioration in firms' prospects induces downward pressures on private wages: real wage growth is now halved (0.66 against 1.27%). As a consequence, the unemployment rate does not change significantly (around 1.6 in both cases). When the spillovers from the public to the private sector are full (column 4), private investment deteriorates even further (by 7 instead of 5%), implying a very limited change in private wages (less than 0.1). Compared to the partial effect, full spillovers imply an extra GDP loss of around 0.4 (3.4 vs. 3%).

The result of a negative long-run effect of public debt on growth is robust to the fiscal instrument used to finance the debt. Table 3 presents results for GDP effects under the same simulation set-up, now using alternative fiscal instruments for debt financing, i.e., non-distortionary lump-sum taxes and public expenditures.[47] As expected, when a non-distortionary instrument is used by a government to finance its debt (first column), there is no impact on GDP in the absence of risk premium spillovers to the private sector. The reason is that households who benefit from receiving higher interest payments from holding public debt are also those who need to balance the government budget in the long run by having to pay higher lump-sum taxes. Their permanent income will not be altered (which is, in part, related to Ricardian equivalence). Only when the public sector risk premium negatively affects private sector financing, the economy is affected by distortions and GDP falls (by around 0.6% with partial spillovers and twice as much in the presence of full spillovers). Compared to the labour taxes case, the use of public expenditures (third column) produces almost the same quantitative GDP losses as does an increase in the labour tax rate. However, the transmission is slightly different. In the latter case, the cut in public spending depresses aggregate demand in the economy. Yet, because public purchases are assumed to be wasteful (does not increase utility), this cut now crowds in private consumption. Whether or not this is, in relative terms, more beneficial from the households' perspective depends on how much they evaluate public purchases in utility.[48]

46. The size of international spillovers depends on trade shares, which are not affected in the long run.

47. As public purchases in GEAR are assumed to not play a productive and/or utility-enhancing role in the economy, the results of the latter simulation should be seen as an upper bound. The negative impact of higher interest payments on public debt financed by reduced public purchases could be weaker if there was, for example, a sufficiently high crowding-in of private consumption as in the model by, among others, Coenen *et al.* (2013).

48. Furthermore note that, in the GEAR model, public consumption entails a full home bias by assumption. Were the public sector to also purchase goods from foreign economies, spillovers could be larger than in the other simulations.

	Lump-sum taxes	Labour taxes	Public purchases
No risk premium (RP)	0	-0.08	-0.09
RP in public sector	0	-2.62	-2.64
RP in public and private sector (intermediate effect)	-0.62	-3.02	-3.07
RP in public and private sector (full effect)	-1.19	-3.41	-3.48

Table 3. Long-term GDP impact of higher level of public debt: alternative fiscal instruments: GEAR model

Source: Own calculations.
Note: High public debt at 90% of GDP.

BE model: As previously mentioned, the BE model includes an explicit private (households) debt channel absent in the other models. As such, it can assess the long-term role of public and private deleveraging. A similar steady-state comparative statics exercise is run for a debt-to-GDP ratio increasing from 60 to 80 to 100%. Two cases are considered: using alternatively a non-distortionary (lump-sum tax) and a distortionary (consumption tax) instrument to close the fiscal rule. The results are presented in Table 4 and show that public debt crowds out private (households) debt.[49] This result is slightly stronger for distortionary taxation than for lump-sum taxes. The rise in public debt increases the probability of default of the government; this increases the risk premium and therefore the interest rate to be paid on public debt. The higher interest payments have to be financed by raising lump-sum taxes (or VAT), which in turn reduces disposable income of all households. This is particularly damaging for those households that are (endogenously) financially constrained, therefore forcing them to reduce their debt holdings.

The crowding out effect is particularly strong when public debt increases to 100% of GDP since household debt drops by more than 30 percentage points. In addition, all households, but especially the constrained ones, reduce their consumption and investment, which reduces GDP.[50] These effects are slightly stronger when the government uses VAT to keep its budget balanced (the model does not have a direct link between the risk premium of public debt and the one of private debt; this would make the crowding out effects much stronger). Furthermore, Table 4 explicitly illustrates the importance of the non-linearities introduced by the sovereign risk premium between the debt level and GDP: the higher the level of debt, the closer we are to the debt limit and thus the GDP loss

49. Since BE model assumes a closed monetary union, it rules out the effects of public debt through international capital markets.

50. Notice that differences between the GEAR and BE results (tables 3 and 4 respectively) stem mainly from two sources. First, in the GEAR model there is full spillover of the government risk premium to the private sector financing costs. Second, different distortionary instruments are used in each case (labour taxes vs. VAT).

increases much more than proportionally.

		Lump-sump taxes		Tax on consumption	
		Change vs 60%		Change vs 60%	
	change	80	10	80	100
in Core					
GDP	%	-0.08	-0.35	-0.08	-0.38
Priv. Consumption	%	-0.36	-1.51	-0.37	-1.67
Priv. Investment	%	-0.36	-1.51	-0.37	-1.67
Employment	%	0	0	0	0
Real wage	%	-0.37	-1.51	-0.37	-1.67
in Periphery	%				
GDP	%	-0.92	-3.76	-1.16	-4.68
Priv. Consumption	%	-0.79	-3.38	-1.16	-4.49
Priv. Investment	%	-0.38	-1.22	-0.2	-1.16
Employment	%	-0.98	-3.99	-1.19	-4.89
Real wage	%	0.37	1.55	0.37	1.69
Real estate prices	%	-0.16	-0.66	0.16	0.73
Lump-sum taxes-to-GDP ratio	pp	0.28	0.65	0	-0.01
Private debt-to-GDP ratio	pp	-6.23	-33.14	-5.55	-31.93
Households debt-to-GDP ratio	pp	-6.19	-32.94	-5.45	-31.59
Entrepreneurs debt-to-GDP ratio	pp	-0.03	-0.2	-0.09	-0.33
Debt-to-GDP ratio	pp	20	40	20	40

Table 4. Long-term impact of higher level of debt: BE model

Source: Own calculations.
Note: The table presents the percentage point deviation from steady state with debt at 60% of GDP.

EAGLE model: Figure 8 presents similar results implied by various initial debt levels now using EAGLE. More specifically, it compares the output losses (defined by the percentage deviation of the steady-state GDP from the steady-state output in an economy where the initial debt-to-GDP ratio is equal to 60%) for three alternative fiscal instruments: lump-sum taxes, consumption taxes and labour income taxes. Results show that when the fiscal authority can rely on lump-sum taxes the level of debt does not exert an impact on the economic activity (unless risk premia spill over to the private sector). In addition, in line with the conventional public finance view, labour income taxes are more distortionary than consumption taxes (about three times larger negative effect when the debt ratio is increased to 120% of GDP). Overall, these results suggest that the higher the debt level the stronger the impact on long-run output, in particular when the fiscal instrument (taxation) used to finance debt is distortionary.

3. Public debt reduction episodes and challenges ahead

Against the background of a large build-up of government debt in the euro area, the question about the available strategies to bring down the high debt ratios has gained prominence. This part of the paper aims at contributing to this discussion

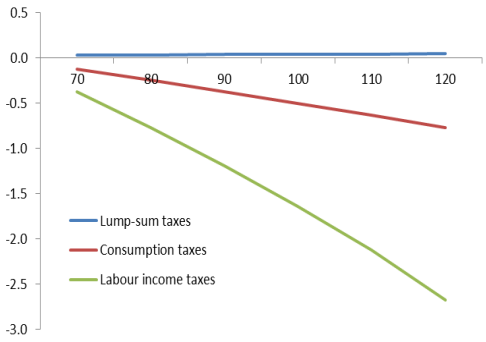


Figure 8: Long-term GDP impact of the initial level of debt – EAGLE model (percentage point deviation from steady state with debt at 60% of GDP)

Source: Own calculations.

by documenting the key drivers of past successful debt reduction episodes and evaluating them against the background of the current environment. To this end, the section first reviews the empirical literature specifically focusing on past debt reductions and then discusses experiences in euro area countries (Box 1). It concludes by presenting a menu of options to reduce debt going forward.

Starting from the standard debt-dynamics equation, the debt-to-GDP ratio is affected by several variables: primary balance, nominal GDP growth, interest rates on public debt, and deficit-debt adjustment (DDA). As surveyed in the literature, debt surges have typically resulted from a combination of deteriorating fiscal balances (primary deficits) and long periods of adverse (positive) interest-growth rate differentials, given by low economic growth and/or high interest rates. DDAs have also been a key driver of debt increases, especially when growth is subdued, since they reflect, *inter alia*, asset valuation, currency strength and impact from support to the financial sector, which vary with the economic cycle.[51]

3.1. Past episodes of debt reduction: literature review

There is a strand of literature documenting the explanatory factors of successful debt reduction episodes, largely focusing on the post-WWII period and both emerging and advanced economies. In broad terms, these studies show that reductions of debt levels are typically achieved through a combination of factors, i.e., fiscal consolidation, economic growth, supportive interest rate developments via accommodative monetary policy (dubbed "orthodox" options by Reinhart *et al.*, 2015) and/or some form of financial repression and deficit-debt adjustments, including restructuring and explicit defaults ("heterodox" options). Table 5 below provides a snapshot of these empirical findings (darker shades stand for more

51. See, *inter alia*, Abbas *et al.* (2011); Abbas *et al.* (2013) and Jaramillo *et al.* (2016).

frequently quoted debt-reduction factors in the episodes covered by the respective papers and surveys). Out of the aforementioned factors, fiscal consolidation and economic growth are more commonly pointed out as the main drivers of successful debt reduction episodes.

Paper	Sample	Criterion for identifying episodes	Magnitude achieved	Success criterion	Debt-reducing factors (darker shades for most quoted)(1)				
					1	2	3	4	5
Abbas *et al.* (2013)	30 advanced economies;1980-2012	Sustained reduction of debt-to-GDP ratio by more than 5 p.p.; 26 episodes of debt reversal	From 6 p.p. to 84 p.p. of GDP (average: 26 p.p.)	-					
Abbas *et al.* (2011)	174 countries (both advanced and emerging economies); 1791-2009	Sustained reduction of debt-to-GDP ratio by more than 10 p.p.; 66 episodes of debt reversal	From 11 to 223 p.p. of GDP (average: 38 p.p. of GDP)	Sustained reduction for, at least, 5 years.					
Baldacci *et al.* (2012)	Both advanced and emerging economies; 1980 -2010	Periods of at least 2 consecutive years of reduction in the debt-to-GDP ratio; 120 episodes of debt reversal	In half of the episodes, debt-to-GDP ratio was brought down by at least 20 p.p.	Distance to sustainability targets (set at 60% and 40% of GDP, respectively for advanced and emerging economies)					
Nickel *et al.* (2010)	EU-15 countries; 1985-2009	Periods of negative year-on-year change in debt-to-GDP ratio; 191 episodes of debt reversal	Average across episodes: 36.9 pp of GDP.	Major episodes correspond to reductions in the debt-to-GDP ratio by at least 10 p.p. across 5 consecutive years.					
Reinhart and Trebesch (2014)	Advanced economies in 1920-1939 period; emerging economies in 1979-2010.	Focusing specifically on defaults; External debt credit events; either a single default or the last write-off in a sequence; identifies 45 episodes.	Average: 21 and 16 p.p. of GDP, respectively for advanced and emerging economies.	Economic performance during and after the episodes assessed in terms of per capita GDP level, credit ratings, debt servicing burdens, government revenue, exports and public debt level.					
Reinhart and Rogoff (2013)	Emerging and advanced European economies; between WWI and WWII	Credit events involving the sovereign; focuses specifically on default episodes.	-	-					

Table 5. Summary literature review on past debt reduction episodes

Source: Own representation.
Note: (1) Codes for different debt-reducing factors are defined as follows: 1 = Consolidation; 2 = Interest-growth differential; 3 = Inflation; 4 = Financial repression; 5 = Restructuring.

Strengthening fiscal positions is crucial to ensure debt sustainability and, as fiscal fundamentals are found to feed into sovereign risk premia, sound positions decrease the likelihood of financing disruptions (Cottarelli and Jaramillo, 2012). Several empirical analyses (e.g., Nickel *et al.*, 2010; Baldacci *et al.*, 2012) have indeed shown that lasting public debt reductions are associated with sustained consolidation of public finances. Past experience shows that many EU Member

States have achieved significant primary surpluses over extended periods,[52] though the most recent experience in the euro area is more mixed.

The magnitude of fiscal adjustments does not appear to be a strong determinant of the success of debt reductions, but their timeliness, pace and composition does. A quick policy reaction to imbalances is key to restore credibility and front-loaded fiscal adjustments tend to increase the likelihood of faster and sustained debt reductions, particularly for countries with higher initial debt-to-GDP ratios and already facing market pressure (Nickel *et al.*, 2010). Political economy considerations and perceived credibility of adjustments are also crucial in this respect. For a discussion on the pace of consolidation and factors affecting fiscal multipliers in relation to debt reductions, see Warmedinger *et al.* (2015). In terms of composition, most studies find that expenditure-based consolidations are the most effective in bringing down government debt (Alesina and Ardagna, 2013; Baldacci *et al.*, 2012). In particular, fiscal adjustments driven by cuts in current expenditure items, such as the government wage bill and social transfers, are found to contribute to sustained debt reduction episodes.

Notwithstanding the general consensus on the role of sound public finances in successful debt reversals, it is important to note the potential for trade-offs between fiscal policy decisions and economic growth. If the sustainability of public finances is put into immediate question, evidence of strong commitment by means of front-loaded consolidation may be necessary to strengthen confidence. Empirical analyses have shown that consolidations are more likely to generate debt reduction in sustained growth environments (e.g., Abbas *et al.*, 2013), but aggressive front-loaded consolidations may take a toll on economic growth through fiscal multiplier effects, at least in the short run. This interplay between growth and fiscal policy may result in short term increases in debt-to-GDP ratios, especially in cases when fiscal multipliers are large (Warmedinger *et al.*, 2015; Cottarelli and Jaramillo, 2012). This includes periods of bad economic times, financial crisis and/or when monetary policy is constrained at the zero-lower bound. Moreover, some studies point to larger and lasting effects, if front-loaded consolidation exacerbate hysteresis effects in the economy and thus affect potential growth (see DeLong and Summers, 2012). At the same time, however, empirical work has found that short-term fiscal multipliers are smaller when debt is high (see, *inter alia*, Burriel *et al.* (2010) for the euro area case and Warmedinger *et al.*, 2015 for a review). Moreover, since multipliers vary widely across instruments, the choice between specific instrument(s) for fiscal adjustment plays an important role in tailoring growth effects. For a review of fiscal multipliers and the pace of consolidation, see ECB (2014).

52. Overall, ten EU Member States (Belgium, Bulgaria, Denmark, Ireland, Spain, Italy, Luxembourg, Netherlands, Finland and Sweden) recorded uninterrupted episodes of primary surplus for ten or more years since late 1970s. In cumulative terms up to 2009, the primary balance surplus stood at over 50% of GDP in seven EU Member States (Belgium, Bulgaria, Denmark, Ireland, Luxembourg, Netherlands and Finland). See ECB (2011a,b).

Monetary policy is also found to have contributed to past debt reductions. Central banks can support a debt-reversal environment through accommodative monetary policy decisions. For instance, Hellebrandt *et al.* (2012) provide evidence that an accommodative stance of monetary policy (materialising in low interest rates and high liquidity) increases the likelihood of success and credibility of fiscal adjustments. Moreover, Abbas *et al.* (2014) document that, in the post-WWII period, central banks of advanced economies supported an environment of moderate to strong inflation by resorting to unconventional monetary policy instruments, e.g. by increasing their holdings of government debt to historically high levels. Higher inflation is conducive to an erosion of the real value of debt and can also help strengthening primary balances, e.g. due to inertia in expenditure adjustments, fiscal drag on the revenue side (especially if progressive tax brackets are not indexed) and seigniorage gains. Nonetheless, some empirical studies (e.g., Abbas *et al.*, 2013) have found that inflation has provided a minor contribution in recent episodes of debt reversal. This is consistent with the fact that higher inflation increases nominal interest rates through the Fisher effect, leading to higher interest expenditure. This downplays the debt-eroding effect of inflation, particularly for countries with high debt-to-GDP levels. Additionally, there is evidence that the debt-eroding effects that follow an inflation shock are transitory and that relying on inflation to bring down the real value of debt raises risks of de-anchoring expectations (Akitoby *et al.*, 2014; Nickel *et al.*, 2010).

Another way to deal with public debt surges in past periods relied on **financial repression**, including direct lending from banks to governments, imposing caps on interest and deposit rates, or restricting cross-border foreign exchange transactions. The rationale for this sort of measures is to ensure demand for sovereign debt at low real interest rates. In the post WWII-period, financial repression measures resulted in low nominal interest rates which, combined with moderate to high inflation rates across advanced economies, delivered negative real rates and thus contributed to reducing debt levels (Reinhart and Sbrancia, 2015). However, active financial repression promotes an inefficient allocation of resources. Moreover, the direct and/or indirect channelling of resources to the public sector may induce crowding-out of private investment. For the recent experience in the euro area, some authors (e.g., vanRiet, 2018) posit that the various policies targeted at supporting fiscal, financial and monetary stability in the wake of the crisis belong to the wide range of tools of financial repression and have contributed to relieving sovereign liquidity and solvency stress.

Past debt reductions were also achieved through (negative) **deficit-debt adjustments**-DDAs (see, for instance, findings in Abbas *et al.*, 2013; Nickel *et al.*, 2010, and Weber, 2012). In particular, negative DDAs reflected valuation effects on debt denominated in foreign currencies, the usage of privatisation proceeds to redeem debt and debt restructuring. In the case of advanced economies, changes in debt levels arising from exchange rate appreciation are relatively limited, as most debt is denominated in domestic currency (Nickel *et al.*, 2010). Privatisations have been extensively used in the past as part of debt-reduction strategies, including in

the euro area context and, more specifically, in the run-up to EMU (vonHagen and Wolff, 2006). Privatisations contribute to reducing gross debt and may potentially generate efficiency gains for the economy as a whole. With regard to their direct impact on public finances, however, one also has to reckon that privatisation processes may lower government revenue flows in the future. If privatisations and other transitory DDA operations are hastened and conducted primarily to hide actual deficits, this may undermine the credibility of (structural) fiscal rules and may create risks through higher contingent liabilities (see Buti *et al.*, 2007).

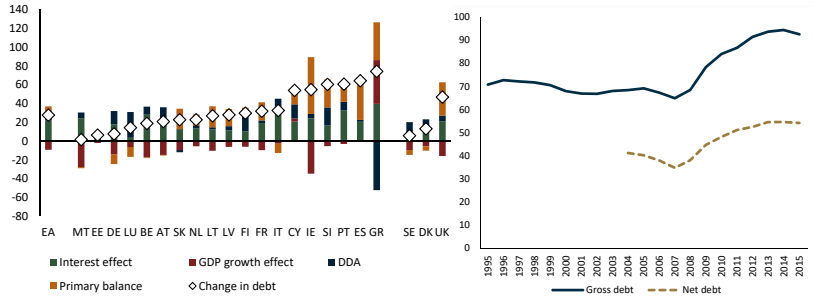
Finally, several studies document that, throughout history, high public debt levels have been dealt with through some sort of **debt restructuring**, including conversions, renegotiations and defaults (affecting DDAs). See, *inter alia*, Sturzenegger and Zettelmeyer (2008), Reinhart (2013), Reinhart and Trebesch (2014). Empirical evidence of the consequences of debt restructurings is, however, far from consensual and largely conditional on the specificities of each process. As previously mentioned, the literature suggests severe negative effects of disorderly sovereign default. On debt restructuring, Reinhart and Trebesch (2014) suggest that growth prospects improve and interest burdens decline in the aftermath of operations involving debt write-offs.[53] In a macroeconomic model setting, focusing on monetary union, Forni and Pisani (2013) suggest high and persistent output losses and higher borrowing costs, especially if the share of debt held by domestic entities is large. Among other reasons, fears of contagion and reputational costs, as well as the availability of external official financial assistance, may explain why debt restructuring operations were rather rare in advanced economies in the post-WWII periods, though not before.[54] In this regard, support from multilateral institutions may play an important role, not only by contributing to addressing short-term liquidity problems, but also when the attached conditionality supports reforms in the domestic economy and fundamentally decreases the probability of default (vanRiet, 2018). However, if sovereign debt has been assessed (usually under a financial assistance programme) as being unsustainable, restructuring operations are inevitable.

53. The authors document that improvements in macroeconomic conditions (mainly in terms of growth and debt-to-GDP) of debtor countries are observed only if debt relief operations involve face value debt write-offs. Softer forms of debt relief, such as maturity extensions and interest rate reductions, are not generally followed by higher economic growth or improved credit ratings.

54. See Reinhart (2013) who document that in the period 1920-1960, 13 of 21 advanced economies had at least one credit event involving the sovereign. A number of countries, including some current euro area members, had multiple debt crises. As regards the post WW-II period, Greece's 2012 private sector involvement (PSI) was one of the largest credit events in recent times. Through this operation, Greek government debt held by the private sector was cut down by approximately 60 percent and the debt-reducing impact of DDA reached close to 40 p.p. of GDP in 2012 (Amador *et al.*, 2016).

Box 1. Euro area experience in selected episodes of public debt reduction

Before looking into past episodes of public debt reduction, it is worthwhile recalling the severity of the most recent episode of debt hike in the euro area. Several factors contributed to the cumulative increase in the euro area public debt ratio during 2007-2015, most strongly the unfavourable interest-growth rate differentials. Subdued nominal GDP growth, coupled with an increase in interest costs, were the key drivers of euro area debt build-up during this period (see Figure A, panel (a)). This was particularly the case for Greece, Italy, Portugal and Cyprus. Fiscal imbalances have also played a non-negligible role. The occurrence of primary deficits partially reflected early stimulus measures to counteract the effects of the recession and in several cases also the bailing out of financial sector institutions. The latter factor is especially relevant in explaining the increase in Ireland's debt-to-GDP ratio from 24 percent of GDP in 2007. It should be highlighted that, in some member states, including those facing financing disruptions during this period, the accumulation of primary deficits had started well before the crisis. When the crisis materialized debt levels were already historically high. Regarding deficit-debt adjustments (DDA), their contribution to the increase in the euro area public debt was relatively minor. This, however, masks non-negligible debt-increasing effects in many countries. In particular, the accumulation of financial assets (especially equity and debt instruments) into governments' balance sheets was significant in several member states, in part reflecting the impact of financial sector assistance measures. In this respect, net government debt has increased by less than gross debt during the crisis (see Figure A, panel (b)).



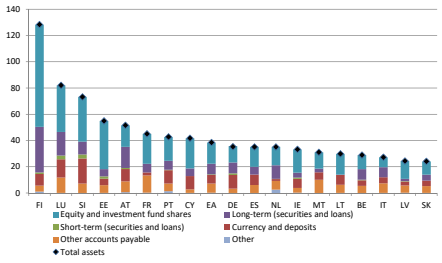
(a) Breakdown of the change in debt-to-GDP ratio over 2007-2015 (percentage points, cumulative)

(b) Euro area gross and net government debt-to-GDP ratios over 1995-2015 (percentage of GDP)

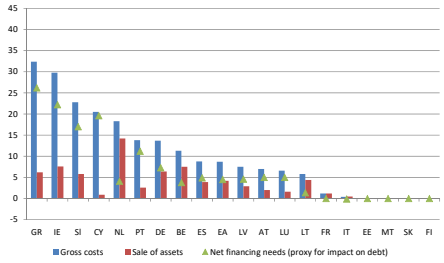
Figure A: Euro area debt build-up and its decomposition

Sources: ESCB and Eurostat.
Notes: Net government debt corresponds to gross debt (according to the Maastricht definition) minus corresponding financial assets in governments' balance sheets. In panel (a) three non-euro area countries (Sweden, Denmark and the United Kingdom) are shown for comparison. In Ireland, the 2015 debt data reflect the massive GDP reclassification. In Greece, the negative (debt-reducing) DDA reflects the impact of the 2012 PSI.

The impact of government support to the financial sector granted during the crisis has not been negligible, having contributed to deteriorating public finances in the vast majority of member states. In gross (net) terms, these operations led to an increase in government financial needs by 8.7 (4.5) per cent of GDP during the 2008-2015 period in the euro area as a whole, while it reached a particularly relevant magnitude in the countries caught up in the sovereign debt crisis. Most of this impact reflects the recording of equity, debt securities and other assets of banking institutions in governments' balance sheets. Since 2008, part of the assets acquired has been sold (see Figure B, panel (b)). Still, by end-2015 the recovery rate of these investments stood at 48.8 per cent for the euro area aggregate (see Table A). In terms of country-specific recovery rates, they ranged between 4.3 percent in Cyprus and 77.6 percent in the Netherlands. In addition to the actual impact of financial sector assistance on government debt, such operations also led to an increase in the stock of government contingent liabilities.[1] After it reached 7.3% of GDP at the height of the crisis (2009), the euro area stock of explicit contingent liabilities linked to financial sector assistance declined to 2.0% of GDP at the end of 2015. Finally, it is also worth highlighting that these government interventions have had a negative impact on government fiscal balances (1.9 per cent of euro area GDP during the 2008-2015 period; see Table A).



(a) Total financial assets in EA countries (stock as of end-Q3 2016, percentage of GDP)



(b) Government assistance to the financial sector over 2008-2015 (percentage of GDP)

Figure B: Financial assets and potential for further gross debt reduction

Sources: Eurostat and ESCB.
Notes: In panel (a), "Other" includes monetary gold and special drawing rights, insurance, pension entitelments, financial derivatives and employees stock options; Data for GR's total financial assets are not available. In panel (b), gross costs denote acquisition of financial assets. For technical details on statistical recording, see Maurer and Grussenmeyer (2015).

	2008	2009	2010	2011	2012	2013	2014	2015
Total costs (annual, mill. EUR)	182659	52082	245178	-4292	73147	-35997	-21281	-13317
Cumulative	1.7	2.2	4.6	4.5	5.2	4.9	4.7	4.5
Losses (deficit/ surplus)	0	0.1	0.8	0.9	1.4	1.6	1.8	1.9
Rate of asset recovery	0.1	25.1	17.1	24.4	31.3	42.8	45	48.8
Contingent liabilities	4.9	7.3	5.4	5.4	5.4	4.5	2.6	2

Table A. Government assistance to the financial sector over 2008-2015 (percentage of 2015 GDP)

Sources: Eurostat and ESCB.
Notes: Total costs and losses are shown in cumulative terms. For technical details on statistical recording, see Maurer and Grussenmeyer (2015).

The magnitude of the current public debt overhang is unprecedented, but episodes of debt reduction are not a novelty in the euro area context. The aggregate debt-to-GDP ratio dropped by 5.9 percentage points between 1995 and 2007, reflecting larger reductions in several countries. Figure C shows that primary balances, in part driven by strong nominal GDP growth, were in broad terms the key drivers of this drop. The interest rate-growth differential remained, however, positive (debt-increasing) over that period, in line with long-run evidence for advanced economies.

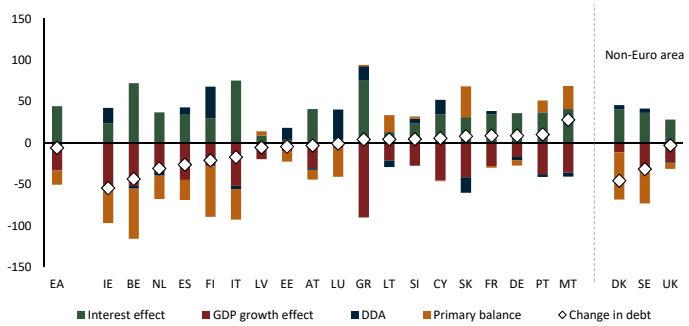


Figure C: Breakdown of the change in debt-to-GDP ratios before the crisis, 1995-2007 (percentage points of GDP, cumulative)

Sources: European Commission (Ameco) and own calculations.

In more detail, the analysis in Table B[2] confirms the pivotal role of maintaining primary surpluses on the back of high nominal growth during past debt reduction episodes. The contribution of the interest rate-growth differential ("snowball" effect) varies considerably across episodes, reflecting the extent to which the debt servicing burden offsets the contribution of economic growth. For the euro area aggregate's longest debt reduction episode (broadly) over the Maastricht treaty period (since 1995), the snowball effect was positive (debt-increasing). Still, some of the largest debt reductions benefited from a favourable "snowball" effect on account of high nominal GDP growth. In the majority of such episodes, both the real output growth and the inflation exceeded the 1995-2007 average. The high growth was also supportive to maintaining high primary surpluses. However, even abstracting for cyclical developments, underlying primary surpluses (cyclically-adjusted primary balance, CAPB) seem to have played an important role. In terms of consolidation efforts during specific episodes, the evidence is less clear cut and more difficult to disentangle. In many cases it reflects front-loaded consolidation efforts (even before the beginning of the episode), followed by stimulus (see, e.g., country-specific episodes described below). Moreover, there are rather large differences between real time and ex-post data on the change in CAPB, used as a proxy for consolidation efforts. On average over the euro area episodes considered, the fiscal stance was broadly neutral,[3] with only Belgium and, to a lesser extent, Italy - among the significant, long episodes of debt reduction - maintaining annual average consolidation efforts (larger efforts seem to have been maintained by the three non-euro area advanced economies shown in Table B).

Debt reductions were typically accompanied by some disposal of financial assets from governments' balance sheets, but its magnitude varies considerably across episodes. The largest disposals of financial assets were recorded in the

Eastern European countries, followed by a few others (e.g., the Netherlands, United Kingdom, Denmark). Finally, the evidence in Table II.1 in Appendix II points to a disconnection between the reduction in governments' indebtedness and developments in the private sector: in most of these episodes, indebtedness rose in both the households and the non-financial corporation (NFC) sectors.

		Episode[1]			Determinants[2]					
Country	Period	Initial debt level	End debt level	Change	Snowball effect	of which: GDP	of which: interest	Primary balance	of which: CAPB	DDA
		%GDP	%GDP	pp	pp of GDP					
EA	97-02	72.7	66.8	-5.9	7.6	-16.5	24.1	-12.0	-9.8	-1.4
IE	96-06	78.6	23.6	-54.9	-31.4	-54.2	22.8	-40.0	-31.4	16.4
BE	96-07	130.5	87.0	-43.5	20.4	-51.8	72.2	-60.6	-56.6	-3.4
ES	97-07	65.6	35.5	-30.1	-11.1	-41.0	29.9	-24.8	-13.1	5.8
NL	96-02	73.1	48.2	-25.0	1.0	-25.1	26.1	-22.0	-20.1	-4.0
SK	01-07	49.6	29.8	-19.8	-10.0	-26.6	16.5	11.4	11.2	-21.2
IT	96-04	116.9	100.1	-16.8	20.5	-41.2	61.8	-32.5	-29.5	-4.8
FI	97-02	55.3	40.2	-15.1	0.3	-17.4	17.7	-35.7	-36.3	20.4
CY	05-07	64.1	53.5	-10.6	-5.0	-13.9	8.8	-8.8	-2.5	3.3
MT	05-07	72.0	62.4	-9.6	-0.4	-11.4	10.9	-3.4	-2.4	-5.7
PT	97-00	59.5	50.3	-9.2	-3.3	-16.2	12.9	1.4	4.6	-7.3
LT	01-07	23.5	15.9	-7.6	-7.2	-14.2	7.1	2.4	7.6	-2.8
LV	05-07	14.3	8.4	-5.9	-6.2	-7.5	1.3	0.4	9.3	-0.1
GR	02-03	107.1	101.5	-5.6	-6.0	-16.4	10.5	3.4	5.1	-3.0
SI	05-07	26.8	22.8	-4.0	-1.9	-6.0	4.1	-1.5	4.2	-0.6
DE	06-07	66.9	63.5	-3.4	-0.4	-5.7	5.4	-3.8	-2.9	0.8
FR	98-01	61.1	58.2	-2.9	1.7	-10.2	11.8	-5.1	-2.7	0.5
LU	96-00	8.6	6.5	-2.1	-0.5	-2.8	2.4	-19.4	-18.9	17.7
EE	03-07	5.7	3.7	-2.0	-2.4	-3.4	1.0	-11.9	4.8	12.3
AT	02-04	66.5	64.8	-1.7	3.6	-6.0	9.7	-1.6	-2.6	-3.8
Memo: selected episodes in non-EA countries[3]										
BG	01-07	71.2	16.3	-54.8	-17.5	-32.0	14.5	-19.7	-18.6	-17.6
DK	96-01	73.1	48.5	-24.6	1.7	-1.7	26.4	-26.3	-21.7	0.0
SE	97-00	70.3	50.6	-19.8	3.1	-13.5	16.5	-19.8	-20.1	-3.1
UK	96-02	45.2	34.2	-11.0	4.9	-13.6	18.4	-12.7	-11.2	-3.1

Table B. Recent debt reduction episodes in the euro area (1995-2007)

Sources: European Commission (Ameco, Spring 2017 vintage); Eurostat; ECB; own calculations.
Notes: (1) Episodes defined as the longest period of consecutive years of debt reduction. The focus is on the pre-crisis period (up to 2007), but in some of the listed countries the debt-to-GDP ratio was further reduced in 2008, after the onset of the crisis (most notably in Cyprus and Bulgaria). (2) Contribution to the change in the debt ratio (pp of GDP) over the episode. Negative numbers show a favourable contribution (reduction in debt). The primary balance and cyclically-adjusted primary balance (CAPB) are presented in cumulative terms over the episode (a negative number denotes accumulated surpluses). (3) Includes non-euro area EU advanced economies and other large selected episodes in EU countries. Comparable data for Bulgaria available only as of 2000.
For an extended, more informative version of this table, refer to Table II.1 in Appendix II.

In some countries, the magnitude of debt reversal was remarkable. This was particularly the case of the episodes identified for Ireland, Belgium, and Spain. Although of a smaller magnitude, the episode referring to Italy is also noteworthy, because when it started the debt ratio was approaching 120% of GDP.

In the case of Ireland, the longest episode of debt reduction lasted for 11 years (from 1995 to 2006) and resulted in a 55 percentage point drop

in the debt-to-GDP ratio. This evolution was largely driven by buoyant economic growth, which, coupled with fiscal discipline, enabled maintenance of large primary surpluses. Moreover, following a period of deteriorating public finances, the economic policy-mix was reshuffled during the 1990s, with a focus on reducing the role of the government in the economy and improving competitiveness. Against the background of high growth of public investment, the improvement in the fiscal balance relied on current expenditure retrenchment. However, in the 2000s up to the onset of the crisis, spending restraint loosened, but revenue growth remained high, supported by transitory revenues stemming from the housing sector boom and a tax regime providing incentives for large multinationals to invest in the country (Eichengreen and Panizza, 2012; Eichengreen and Panizza, 2016).

In Belgium, the reduction of the debt-to-GDP ratio during the period 1995-2007 (from 131 to 87%) stemmed, to a large extent, from fiscal adjustment. This benefited from the overall consensus on the need to comply with the Maastricht criteria on the run-up to EMU, but the consolidation efforts had started before, in the 1980s, with an important institutional reform of the fiscal policy framework. Along the 1990s, primary surpluses more than offset the adverse – albeit relatively small – snowball effect on debt. This was made easier by the fall in the implicit interest rate on government debt that characterized the period just before the accession to EMU. Although to a smaller extent, the reduction of the Belgian debt also benefited from a comprehensive programme of privatisation, as well as proceeds from the sale of Central Bank's gold reserves (Bisciari *et al.*, 2015).

In Spain, the reduction of the debt ratio by 30 percentage points between 1996 and 2007 also relied on primary surpluses and economic growth. In particular, in the second half of 1990s, fiscal consolidation was largely motivated by the need to comply with the Maastricht Treaty convergence criteria and mostly relied on expenditure retrenchment (deCastro *et al.*, 2014). During 2000-2005, higher primary expenditure growth was offset by windfall revenue growth, stemming *inter alia* from local and regional governments' revenue related to the real-estate boom.

In Italy, the debt-to-GDP ratio dropped from 117 to about 100% between 1995 and 2007, declining for nine consecutive years up to 2004. Against the background of a small but adverse "snowball" effect, this reduction was achieved through a combination of primary surpluses and, to a lesser extent, deficit-debt adjustments. As pointed out in Momigliano and Rizza (2007), the need to comply with the Maastricht criteria was a key explanatory factor for the improvement in Italy's public finances during the 1990s. However, much of the improvement in the primary balance stemmed from a repeated recourse to temporary measures. Likewise, extraordinary operations, including sale of

assets and debt restructuring (classified under DDAs) have contributed to bringing down the debt ratio, in some years considerably.

a. A State guarantee is a contingent liability and has no immediate impact on the government balance. A negative impact on the government balance is recorded only when the guarantees are called.

b. Table II.1 in Appendix II is an extended version of Table B which entails additional information on the dynamics of selected variables during each episode of debt reduction.

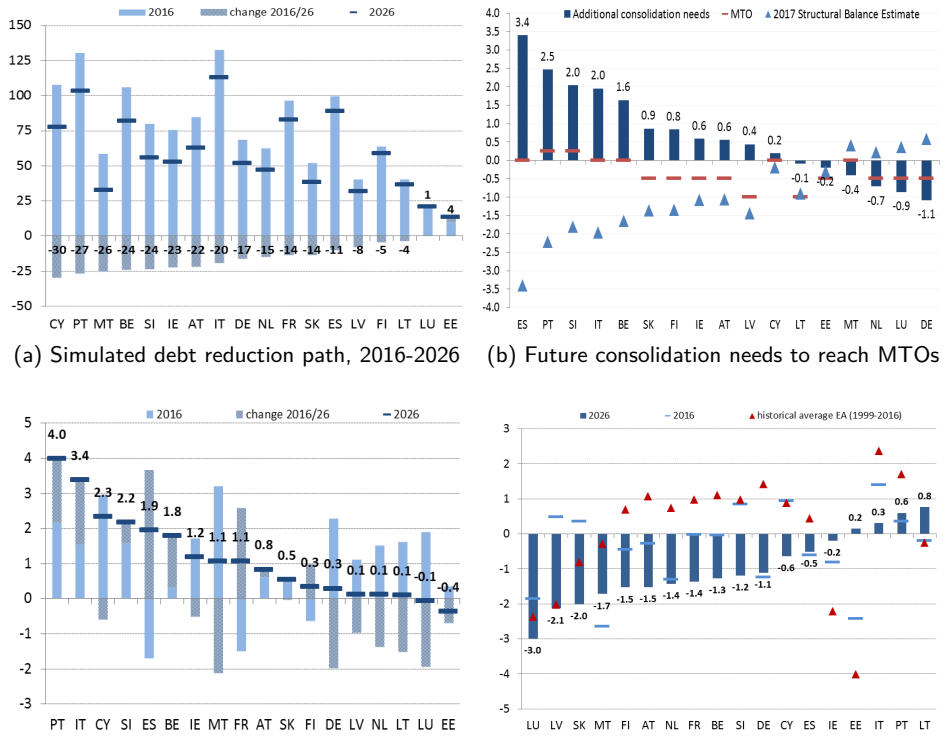
c. On average, for the EA, the annual fiscal stance was -0.2 pp of GDP with ex-post data (-0.1 pp with real time-data, with larger differences at country level). Including the three advanced non-euro area countries, the (ex-post) fiscal stance was +0.2 pp. One has to note that the average fiscal stance over an episode discounts the fact that a front-loaded consolidation has more weight in the debt reduction than a back-loaded (even somewhat larger) fiscal stimulus.

3.2. Debt reduction strategies for the euro area: challenges ahead

Looking ahead, resolving the current debt overhang in several euro area countries and putting debt ratios firmly on a declining path may be challenging. A simulated scenario assuming minimum compliance with the SGP over a ten-year horizon implies relatively modest debt reduction (see Figure 9 - panel (a)).

Many elements of debt reduction strategies used in the past are unlikely to be successfully replicated in the euro area. The current context differs in a number of dimensions. In the first place, the medium and long term growth outlook remains weak as potential growth has been severely revised down in the aftermath of the euro area sovereign debt crisis. Moreover, in spite of large consolidation efforts already implemented in several euro area countries, the magnitude of fiscal adjustment still required to put debt ratios on a firmly declining path and reach the country-specific medium-term objectives (MTOs) is not negligible (see Figure 9 - panel (b)). In some countries, this is significant and it may put a further drag on growth, at least in the short run. Moreover, the need to implement significant further consolidation and to maintain high primary surpluses (see Figure 9 - panel (c)) is in many euro area countries challenged by growing fiscal fatigue. Finally, looking ahead, challenges are expected to heighten, as age-related spending will put additional pressure on public finances in many euro area economies. Indeed, notwithstanding recent reforms in several countries and more favourable ageing cost projections compared to the past, the 2015 Ageing Report suggests that age-related spending will reach close to 30% of euro area's GDP in a few decades (see Figure 10). On the positive side, in some of the most indebted countries (Italy, Spain, Cyprus, France), ageing costs are projected to decline over the long run, provided past reforms are not reversed.

As regards monetary policy, ECB targeting its euro-area wide-objectives has indirectly supported the reduction of the public debt overhang in the aftermath of the crisis. By providing stimulus to the euro area economy it prevented deflation, thereby paving the way for an environment of lower financing costs for sovereigns and private agents alike. However, with key interest rates at the



(a) Simulated debt reduction path, 2016-2026

(b) Future consolidation needs to reach MTOs

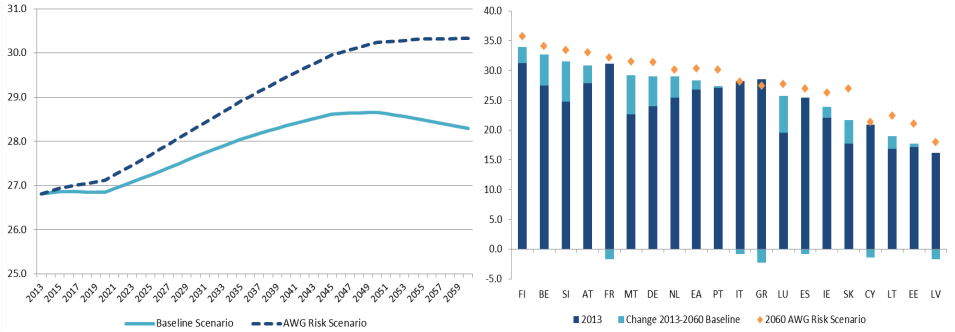
(c) Primary balance assumptions underpinning simulated debt path

(d) Interest rate-growth differential underpinning debt path and historical averages

Figure 9: Future consolidation needs and simulated debt reduction across euro area countries

Sources: European Commission Spring 2017 forecast and own calculations.
Notes: The simulated debt reduction path in panel a follow the benchmark scenario (minimum SGP compliance) outlined in Bouabdallah *et al.* (2017). Ordering of countries according to the data shown in labels. Greece (programme country) excluded from the analysis. In panel (b), the positive bars represent additional fiscal consolidation needs to reach the MTO (negative bars denote fiscal stimulus to revert to MTO) starting from the 2017 structural balance estimate according to the EC Spring 2017 forecast. In panel (c), the primary balance path assumes a gradual convergence to the MTO. The interest rate-growth differential captures the difference between the implicit interest rate on government debt and the nominal growth rate (see Bouabdallah *et al.*, 2017 for details).

effective lower bound and unconventional measures now in force for several years, the normalisation of monetary policy may pose fiscal challenges. Relying on high inflation to erode the real value of debt is, however, not an option in the euro area context with the ECB's clear mandate for monetary policy to ensure price stability. Nonetheless, a return to the target level of inflation for the euro area will likely ease the pressures arising from still recovering nominal growth in several countries. In addition, given the free movement of capital, the ECB's independent conduct of monetary policy and the necessity to avoid long-term risks from a severe



(a) Euro area aggregate, 2013-2060 (percentage of GDP)

(b) Euro area countries, 2013 and change 2013-2060 (percenateg of GDP and percentage points)

Figure 10: Total ageing-related expenditure projections according to the 2015 Ageing Report

Source: European Commission/EPC Ageing Working Group (AWG) – Ageing Report 2015 (published data).
Notes: Data exclude effects of more recent pension reforms in Belgium and Slovakia.

misallocation of resources, financial repression measures going further is not a viable alternative either.[55]

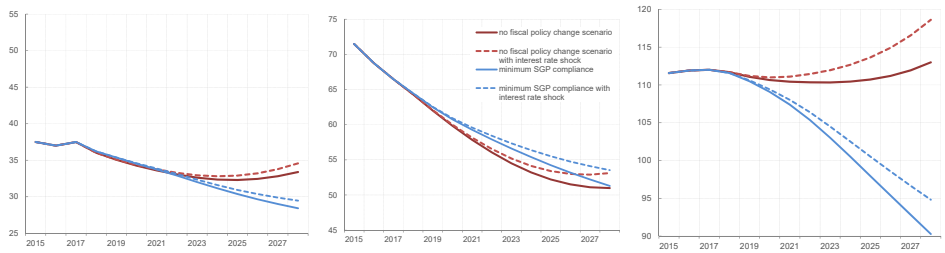
Based on current market expectations regarding the future path of sovereign yields and the European Commission's potential growth estimates (Spring 2017 forecast), the interest rate – growth differential (i-g) at the end of a typical 10-year DSA horizon[56] (2026) is projected to be negative in most countries, i.e. well below (more favourable than) what deemed to have been the "norm" in advanced economies (around 1 percentage point[57]) and most EA countries' long-run historical averages (see panel (d) in Figure 9). Currently, this is an important factor in the projected decline of debt ratios (panel (a) in Figure 9). Yet, as the economy stabilises and sustained gains in inflation towards the ECB objective of price stability are achieved, interest rates are expected to increase (possibly more than currently assumed in Figure 9), putting additional burden particularly on the most indebted sovereigns. See, for instance, stylised simulations in Chart 11 capturing the impact of a standardised (+1 percentage point) shock on the marginal interest rate on the

55. Nonetheless, there are recent examples of financial repression measures in countries caught in the euro area sovereign debt crisis, facing risks of capital flight, low liquidity, high funding costs and market disturbances. Limits to cash withdrawals were imposed in Greece; capital controls were applied in Cyprus; a temporary ceiling on interest rates on deposits was in force in Spain; in Portugal resources from private pension funds were transferred to the general government; in Ireland, resources from pension funds were used to recapitalize banks. See vanRiet (2018) for a description of recent initiatives classified as financial repression in euro area countries.

56. See Bouabdallah *et al.* (2017) for the methodological details.

57. See Escolano (2010).

debt path by group of countries according to the debt level. The shock scenarios suggest a clearly explosive debt path for the most indebted countries in a scenario of no additional fiscal consolidation, coupled with an increase in interest rates. As a note of caution, these scenarios do not reflect positive risks stemming from higher than expected growth path (e.g., many of the highly indebted countries have undertaken structural reforms, either through economic adjustment programmes or voluntarily, with are not fully reflected in the current potential output estimates). Moreover, the scenarios do not account for the possibility of countries changing their debt issuance strategy towards longer-term debt so as to reduce rollover risks.



(a) Euro area countries with debt levels below 60% of GDP

(b) Euro area countries with debt levels between 60% and 90% of GDP

(c) Euro area countries with debt levels of over 90% of GDP

Figure 11: Estimated impact of a standardised interest rate shock for groups of euro area countries

Source: European Commission Spring 2017 forecast and own calculations.
Notes: Euro area countries with public debt levels below 60% of GDP comprise EE, LV, LT, LU, and SK. Countries with public debt levels of 60% and 90% of GDP include AT, FI, DE, IE, MT, NL, SI, while countries with debt levels of over 90% are BE, CY, FR, GR, IT, PT, and ES. In the "minimum SGP compliance" (the DSA Benchmark assumed also in Figure 9), countries whose structural fiscal position is above the MTO (DE and NL) are assumed to take stimulus measures and revert to MTO (see, for instance, the effect in the 2nd group of countries where the debt path under the "no fiscal policy change" scenario is below that under the "minimum SGP compliance" scenario for most of the simulation period). The dotted lines represent a shock scenario of +100 basis points applied as of 2019 on marginal market interest rates of each of the two baseline scenarios. To separate the effect of the interest payment shock, in the "minimum SGP compliance" scenario, no additional consolidation to account for the higher interest expenditure (normally required under SGP) is considered.

Another difficulty in dealing with the current fiscal imbalances in the euro area is related to the parallel private sector deleveraging. As mentioned, the current debt overhang is not exclusive to governments, but it extends to other sectors reflecting the sharp growth of private indebtedness before the crisis. Whereas the financial sector deleveraged considerably in recent years, the reduction of households and non-financial corporations (NFC) indebtedness has not been as clear. Although there is evidence of some deleveraging in these sectors, the debt overhang is only slowly decreasing. As private sector deleveraging continues it may further dampen growth prospects.

Going forward, further reduction of public debt in euro area countries can be achieved at least to some extent through a mix of policies measures. These include structural reforms, fiscal consolidation and fiscal discipline, stronger enforcement of fiscal rules, asset disposal and further macro-prudential initiatives. The urgency and the extent of such measures depend on risks to debt sustainability. Euro area sovereigns with contained risks to debt sustainability and some of those at moderate risk could afford to let growth further reduce their debt ratios and maintain fiscal discipline as needed to comply with the SGP rules. The outlook for sovereigns at high sustainability risks is more problematic (see, e.g., EC (2016a, 2017)). These countries are in urgent need of a mix of additional consolidation and wide-ranging reforms.

Sustained and not imbalance-driven growth is a crucial ingredient for further debt reduction. Genuine structural reforms should be the driver for further improvement in potential output. This would also support the improvement in structural fiscal positions. Moreover, fiscal-structural reforms targeting, e.g., pension and health care systems or efficiency gains in the general government have usually positive effects on public finances in the short-run in addition to their significant long-run impact. See ECB (2015) for a list of structural reforms and their fiscal implications.

Additional consolidation and fiscal discipline is needed to achieve and, most importantly, to maintain primary surpluses over longer periods in many euro area countries. The composition of such measures is essential in order to ensure a growth-friendly adjustment. Expenditure reviews should help identifying the most inefficient areas of spending. Tax measures should first be directed to make the systems more equitable, efficient and simple, by limiting loopholes, exceptions and unfair practices leading to tax avoidance and tax evasion. Measures to reduce the debt bias should also be an important ingredient of such reforms. In more detail, euro area governments should strengthen efforts to implement the country-specific recommendations (CSRs) in the context of the European Semester (see ECB, 2017a for CSRs under the Macroeconomic Imbalance Procedure and ECB, 2017b for fiscal CSRs).

Stronger enforcement of fiscal rules, improved fiscal institutions and budgetary frameworks are needed to support the consolidation process and fiscal discipline. Simplified, targeted and transparent fiscal rules may help in the enforcement process. In the past, euro area governments have relied excessively on temporary fiscal measures and those targeting DDA as fiscal rules provided incentives for fiscal gimmickry. More recently, excessive interpretation of the flexibility embedded in the SGP loosened again the credibility of the framework. The European fiscal surveillance framework still needs to be further strengthened and better cover fiscal risks, for instance, by taking into account off-balance sheet and contingent liabilities.

There is some scope to reduce public debt through the disposal of assets currently in governments' balance sheets, but this is very much country-specific (see discussion in Box 1 and Figure B -(a) therein). In terms of financial assets,

in some countries, especially the highly indebted ones, the amounts look rather limited, while their quality and liquidity is questionable. In terms of the government support to the financial sector granted during the crisis, though part of the assets acquired during 2008-2015 has been alienated, by end-2015 the recovery rate of these investments stood at about half for the EA aggregate. More in-depth country-specific analysis is needed to estimate the share of financial assets that can be reasonably used for further debt reduction.

Dealing with the debt overhang in the euro area requires a comprehensive approach encompassing both public and private sector indebtedness. In addition to potential changes to the EMU institutional framework to prevent and resolve future debt crisis, various proposals have been put forward to deal with private debt.[58] These are directed in particular to improving the insolvency and bankruptcy legal frameworks for households and NFCs, so that debt can be resolved efficiently and transparently. The mix of policy incentives must be such that private sector deleveraging relies on higher saving instead of lower investment: minimising the costs of the process requires minimising its drag on long-term growth. National taxation frameworks should also be amended to further reduce (or eliminate) tax incentives for debt financing by both firms and households. This would also serve the purpose of improving public finances by decreasing governments' tax expenditure. Macroprudential frameworks improved considerably in the wake of the crisis but they should be further strengthened to prevent procyclicality in credit growth, ensuring a sustainable evolution by avoiding excessive leverage among households and NFCs. On the financial sector front, albeit substantial progress has been made since the onset of the crisis, more efforts are needed to complete the banking union and effectively break the sovereign-bank nexus, especially in light of the high NPL ratios in several EA countries.

4. Concluding remarks

This paper has reflected on the economic consequences of high public debt and the ensuing challenges ahead for the euro area. Its focus is on the sustainability of public finances in EMU. In this context, the paper reviews the economic risks associated with regimes of high public debt and stresses the need for comprehensive solutions to mitigate such risks in the future. Within the broader reform agenda on how to strengthen the resilience of the Economic and Monetary Union (EMU), the paper acts as a reminder that further risk reduction is needed.

The paper evaluates the economic consequences of high public using simulations with three DSGE models, which suggest that high public debt economies (1) can lose more output in a crisis, (2) may spend more time at the zero-lower bound, (3) are more heavily affected by spillover effects, (4) face a

58. See the discussion and proposals in McKinsey Global Institute (2015) and ECB (2017c).

crowding out of private debt in the short and long run, (5) have less scope for counter-cyclical fiscal policy and (6) are adversely affected in terms of potential (long-term) output, with a significant impairment in case of most distortionary taxation and large sovereign risk premia.

Looking at the historical evidence, the paper reviews the menu of tools at hand for most euro area governments to further reduce their debt ratios. It posits that the urgency of efforts in this respect depends on risks to debt sustainability. Sovereigns at higher sustainability risks are in urgent need of a mix of additional growth-friendly fiscal consolidation and wide-ranging structural reforms. In the context of the broader reform agenda on how to strengthen the resilience of the Economic and Monetary Union (EMU), recent proposal to enhance market discipline have been put forward, stressing that any measure in this direction could not be introduced in isolation, but would need to be part of a comprehensive reform package geared at enhancing the resilience of the euro area. The paper leaves for further (case-study) analysis the complex policy matters on how to ensure the actual transition from a high public debt to a low debt regime at the country-specific level. Finally, other policy proposals on how to strengthen EMU resilience to shocks through institutional changes, in particular proposals for risk sharing or towards a fiscal union in the euro area, are outside the scope of this paper.

Appendix I: Short overview of DSGE models used for simulations

Models used for the simulation exercises have in common the same theoretical setup, based on Smets and Wouters (2003). This Appendix sheds some light on their original features: the government sector for EAGLE, the labour market for GEAR and the financial block for the BE model. The latter introduces borrowing constrains as in Kiyotaki and Moore (1997) and long-term debt.

I.1. EAGLE

EAGLE is an ESCB model developed by a team composed of staff from the Bank of Italy, Bank of Portugal and ECB. The version used in this paper is a fiscal extension of the Euro Area and Global Economy model (Gomes *et al.* (2010, 2012) and Clancy *et al.*, 2016), a multi-country dynamic general equilibrium model of the euro area. In EAGLE, the world economy is composed of four blocks. Two of the four blocks are members of the euro area which is formalized as a monetary union. The two countries have a common nominal exchange rate and a common nominal interest rate. Regarding the monetary authority, the central bank sets the domestic short-term nominal interest rate according to a standard Taylor-type rule, by reacting to increases in consumer price index inflation and real activity at the euro area level. Each of the remaining two blocks has its own nominal interest rate and nominal exchange rate. Similarly to the ECB's New Area Wide model (NAWM) and the IMF's Global Economy Model (GEM), EAGLE is micro-founded and features nominal price and wage rigidities, capital accumulation, international trade in goods and bonds. EAGLE is global extension of the NAWM and as such shares the same theoretical setup. The introduction of two sectors (tradable and non-tradable), the fiscal block and the monetary union are the main differences with the original NAWM. Thanks to its sound theoretical foundation and its rich set of fiscal variables, the model facilitates robust fiscal policy analysis under alternative scenarios and economic environment. Given its global dimension, the model is also particularly well suited to assess cross-border spillovers.

I.1.1. ***Government sector***. The fiscal authority in each country sets government consumption expenditures, lump-sum taxes, labour and capital income taxes (labour taxes are split into income taxes paid by households, social contributions paid by employers and by employees), consumption taxes. Government spending on consumption and investment goods is specified as a fraction of steady-state nominal output, as is standard in the literature (Baxter and R.G.King, 1993; Leeper *et al.*, 2010; Stähler and Thomas (2012)). Moreover, in each country, the public debt is stabilised through a fiscal rule that induces the endogenous adjustment of fiscal instruments.

In many respects, the fiscal sector representation in the EAGLE model is quite standard. The noticeable innovation is the enhancement of the fiscal block which allows for government consumption and investment to play a non-trivial

role in affecting the optimal decision-making of the private sector (as in Leeper *et al.*, 2010; Coenen *et al.*, 2013 and Clancy *et al.*, 2016). More specifically, households are assumed to derive utility from the consumption of a composite good consisting of private and public consumption goods. As a result of the assumed complementarity between private and public consumption goods, changes to public consumption have persistent effects on private consumption. Finally, it is assumed that government capital stock affects the production process. Consequently, variations in public investment have strong and persistent supply-side effects. The government capital evolves by accumulating government investments net of depreciation. The value of the output elasticity determines the productivity of public capital.

I.1.2. ***Calibration***. The EAGLE model is calibrated to Periphery (Greece, Italy, Portugal and Spain) vs. Core (the rest of the euro area), for the euro area, the rest of the world and the US. As the calibration is in line with the literature (see Gomes *et al.* (2010, 2012), Coenen *et al.* (2008) or Christoffel *et al.* (2008)) we will focus on the fiscal blocks.

The calibration of parameters that determine the aggregation of private and government consumption expenditure is in line with Coenen *et al.* (2012). The elasticity of substitution between private and government consumption is set to 0.50, while the quasi-share of government consumption expenditure in the aggregator is set to 0.25. This ensures that the observed responses of consumption to government spending shocks are in line with either country-specific or euro-area empirical evidence (e.g. Kirchner *et al.*, 2010; Coenen *et al.*, 2012). As such, government and private consumption are strong, but not perfect, complements, consistently with the evidence in Karras (1994) and Fiorito and Kollintzas (2004). On the supply side, the bias towards public capital in the production function of intermediates sectors is equal to 0.10.

As in Coenen *et al.* (2013) or Gadatsch *et al.* (2016), the fiscal rules includes an auto-regressive terms and reacts to the deviation of the debt from its target and to the output gap (defined as the deviation from its steady-state level) as well. The term associated to the output gap can be interpreted as an ad-hoc automatic stabilizing component as in Coenen *et al.* (2013). Following Coenen *et al.* (2013) AR-terms are set to 0.8 (0.9 respectively) for labour income taxes and public consumption (value added taxes respectively). As suggested by Corsetti *et al.* (2013), the semi elasticity of revenue with respect to output is set 0.34. Accordingly, the sensitivity to the deviation of the debt from its target is large enough to stabilize the public debt (0.27). Benchmark simulations will use labour income tax (LIT) to stabilize the debt.

Coefficients of the monetary policy rule use standard values from the literature and are in line with the New Area Wide Model (Christoffel *et al.*, 2008) and the original EAGLE (Gomes *et al.*, 2012). The steady-state inflation is equal to the inflation target, set to 2%, while the interest rate inertia is set to 0.87, the

sensitivity to inflation gap is set to 1.70 and the sensitivity to output growth is set to 0.10.

Lastly, public debt-to-GDP ratio is calibrated to be 60% which corresponds roughly to the average value across time and countries in the pre-crisis period. The level of haircut, in case of sovereign default, is calibrated symmetrically across countries to 0.37, which according to Cruces and Trebesch (2013) corresponds to the median haircut calculated from a sample of sovereign debt re-structuring between 1970 and 2010 (similar to Darracq Pariès *et al.*, 2016).

I.2. GEAR

The GEAR model is an estimated New Keynesian DSGE model (see Gadatsch *et al.* (2016)). It consists of three regions: Germany, the Euro Area (without Germany) and the Rest of the world. Each region is inhabited by four types of agents: households, firms, a fiscal and a monetary authority. Within the euro area, there is only one monetary authority.

I.2.1. ***Labour market***. Households make optimal choices regarding savings in physical capital as well as national and international assets and purchases of consumption and investment goods. Household members also decide whether or not to participate in the labour market. Those who participate may find a job in the private or in the public sector or stay unemployed. Unemployment is modelled in line with Galí (2010) and Galí *et al.* (2011). Hence, households receive interest and wage payments, unemployment benefits and other fiscal transfers, and they pay taxes. In line with Galí *et al.* (2007), we also assume that a fraction of households does not participate in asset markets and consumes the entire income each period. Those households have become known in the literature as "rule-of-thumb" (RoT) households; we call the other type of households "optimizers". Furthermore, households enjoy some monopoly power on the labour market because different types of labour are needed in production, and these are not perfectly substitutable. Wages are, hence, set by a union which takes into account optimizers and RoT households as in Galí *et al.* (2007). Wage setting is associated with Rotemberg adjustment costs in the sense that changing nominal wages is costly for firms and for workers. This prevents wages from "perfectly" adjusting to the current economic situation which, in the end, induces potentially inefficient wage and employment fluctuations (see Ascari *et al.*, 2011 and Ascari and Rossi, 2011 for a discussion).

I.2.2. ***Production side***. Monopolistic competitors in each region produce a variety of differentiated products and sell these to the home and foreign market. We assume that there is no price discrimination between markets. Firms use labour and private capital as production inputs. Public employment and the public capital stock can be productivity enhancing. However, the provision of these inputs is outside the control of firms and conducted by the fiscal authority. Cost minimization determines

the amount of labor and capital input demanded by each firm. Because firms enjoy monopolistic power, they are able to set their nominal price. Price setting is also associated with Rotemberg adjustment costs.

I.2.3. ***Government sector***. The fiscal authority purchases consumption and investment goods produced in the private sector. The latter increases the public capital stock which may, in turn, improve private-sector productivity (for example, because of better infrastructure). The government also employs public-sector workers for whom it has to pay wages. Services provided by these public-sector workers may also affect private-sector productivity positively (for example, because of better governance). Introducing immediate positive spillovers from the public to the private sector follows the idea of Pappa (2009) or Leeper *et al.* (2009, 2010). Furthermore, the fiscal authority pays unemployment benefits and other transfers to private households. To finance the primary expenditure and the interest payments on outstanding debt fiscal authorities rely on with distortionary taxes on private consumption, on labour income and on capital returns, lump-sum taxes as well as social security contributions paid by firms. They can also issue new debt.

I.3. BE (Andrés, Arce, Hurtado and Thomas) model

BE is a closed monetary union with two countries or regions: the "periphery" and the "core". Monetary policy follows a standard Taylor rule on euro area inflation and output. See Arce *et al.* (2016) for a detailed description of the two-region euro version of the model.

I.3.1. ***Real side of the economy***. In each country, households obtain utility from consumption goods and from housing units. Consumption goods are produced using a combination of household labour, commercial real estate, and equipment capital goods. Construction firms build real estate (both for residential and commercial purposes) using labour and consumption goods; the latter are also used as inputs by equipment capital goods producers. Consumption goods and labour markets are both characterized by monopolistic competition and nominal rigidities.

I.3.2. ***Financial side of the economy***. In each country, there are three types of consumers: patient households, impatient households, and (impatient) entrepreneurs. In equilibrium, the latter two borrow from the former and from lenders in the other country. Debt contracts are long term. In periods in which borrowers are able to receive new credit flows, they do so subject to collateral constraints. If the value of their collateral is too low for them to receive new credit flows, they just repay their outstanding debts at a fixed contractual rate. Real estate is the only collateralisable asset. Impatient and patient households are hereby considered as "constrained" and "unconstrained" households, respectively. That is, in both areas households and firms borrow long term subject to collateral

constraints. See Andrés *et al.* (2017a) for a detailed description of how private borrowing and deleveraging is introduced in a closed economy.

The model has five (endogenous) occasionally binding constraints: on the debt of households and entrepreneurs of each country and on the interest rate (ZLB). However, there are never more than three binding constraints in the same exercise since only the option of deleveraging in the periphery is considered. Given the number of possible states that this problem generates, it is computationally impossible to solve the model for all three constraints potentially binding in any period. This problem is solved by imposing that all constraints considered in each exercise always bind on impact and then the optimal sequence of exit is first the ZLB, then the indebted entrepreneurs and finally the indebted households. Afterwards, the model checks that this order is in fact the optimum. For this reason, the impulse responses of a specific shock, for example, a fiscal expansion with ZLB and deleveraging, are calculated as the difference between the (i) IRFs in a baseline with a negative demand shock to put the economy in the ZLB and a shock to make the agents deleverage in the periphery and (ii) the IRFs in the same economy plus a fiscal expansion.

The model also allows for long-term debt. Unlike most of the literature, which typically assumes short-term (one-period) debt, the BE model assumes that debt contracts are long-term. The debt is perpetual and similar to the one proposed by Woodford (2001).

I.3.3. ***Government sector***. The fiscal authority collects taxes on households and entrepreneurs, consumes (with full home bias) and issues non-contingent nominal debt, according to a fiscal rule. The fiscal rule sets the change in the fiscal instrument as a function of deviations in the government debt to GDP ratio from its long-run target and to changes is this ratio. Public debt is held by patient agents in both countries See Andrés *et al.* (2017a) for a detailed description of the public sector included in the model.

Holding government debt is subject to sovereign default risk, like in Batini *et al.* (2016). That is, in order to introduce a sovereign risk premium, we assume that government bond contracts are not enforceable. As in Bi and Traum (2012), in each period, a stochastic fiscal limit expressed in terms of government debt-to-GDP ratio is drawn from a distribution, whose cumulative density function is logistical.

Appendix II: Additional information on debt reduction episodes in the euro area

Episode[1]					Determinants[2]						Other variable dynamics over episode[3]				
Country	**Period**	**Initial debt level**	**End debt level**	**Change**	**Snowball effect**	of which: GDP	of which: interest	**Primary balance**	of which: CAPB	**DDA**	**Real GDP growth**	**GDP deflator**	**Gov. finan. assets**	**HH debt**	**NFC debt**
		%GDP	%GDP	pp	pp of GDP						pp			pp of GDP	
EA	97-02	72.7	66.8	-5.9	7.6	-16.5	24.1	-12.0	-9.8	-1.4	31.2	10.6	na	na	na
IE	96-06	78.6	23.6	-54.9	-31.4	-54.2	22.8	-40.0	-31.4	16.4	82.5	43.4	n.a	na	na
BE	96-07	130.5	87.0	-43.5	20.4	-51.8	72.2	-60.6	-56.6	-3.4	29.5	19.9	-3.8	9.0	34.9
ES	97-07	65.6	35.5	-30.1	-11.1	-41.0	29.9	-24.8	-13.1	5.8	42.7	38.3	4.6	49.5	68.0
NL	96-02	73.1	48.2	-25.0	1.0	-25.1	26.1	-22.0	-20.1	-4.0	23.9	18.7	-14.6	29.3	-4.4
SK	01-07	49.6	29.8	-19.8	-10.0	-26.6	16.5	11.4	11.2	-21.2	44.5	26.7	-23.5	13.8	-0.5
IT	96-04	116.9	100.1	-16.8	20.5	-41.2	61.8	-32.5	-29.5	-4.8	13.8	25.3	-3.6	12.4	9.6
FI	97-02	55.3	40.2	-15.1	0.3	-17.4	17.7	-35.7	-36.3	20.4	26.0	12.1	7.5	2.5	8.0
CY	05-07	64.1	53.5	-10.6	-5.0	-13.9	8.8	-8.8	-2.5	3.3	13.1	10.8	-3.3	24.1	-7.0
MT	05-07	72.0	62.4	-9.6	-0.4	-11.4	10.9	-3.4	-2.4	-5.7	9.6	7.8	-2.5	10.2	6.8
PT	97-00	59.5	50.3	-9.2	-3.3	-16.2	12.9	1.4	4.6	-7.3	16.9	14.6	-0.8	26.0	22.6
LT	01-07	23.5	15.9	-7.6	-7.2	-14.2	7.1	2.4	7.6	-2.8	56.6	24.1	-21.7	25.0	5.8
LV	05-07	14.3	8.4	-5.9	-6.2	-7.5	1.3	0.4	9.3	-0.1	32.5	43.7	-6.2	25.3	15.5
GR	02-03	107.1	101.5	-5.6	-6.0	-16.4	10.5	3.4	5.1	-3.0	9.7	6.8	-0.4	7.4	0.5
SI	05-07	26.8	22.8	-4.0	-1.9	-6.0	4.1	-1.5	4.2	-0.6	16.6	7.9	3.4	8.3	21.0
DE	06-07	66.9	63.5	-3.4	-0.4	-5.7	5.4	-3.8	-2.9	0.8	7.0	2.0	0.8	-6.4	0.4
FR	98-01	61.1	58.2	-2.9	1.7	-10.2	11.8	-5.1	-2.7	0.5	12.8	4.7	-1.1	0.9	11.0
LU	96-00	8.6	6.5	-2.1	-0.5	-2.8	2.4	-19.4	-18.9	17.7	32.3	8.0	na	na	na
EE	03-07	5.7	3.7	-2.0	-2.4	-3.4	1.0	-11.9	4.8	12.3	41.1	35.6	-0.5	32.2	23.7
AT	02-04	66.5	64.8	-1.7	3.6	-6.0	9.7	-1.6	-2.6	-3.8	5.1	4.2	-2.9	2.4	-2.1
Memo: selected episodes in non-EA countries[4]															
BG	01-07	71.2	16.3	-54.8	-17.5	-32.0	14.5	-19.7	-18.6	-17.6	42.6	42.2	-44.4	na	na
DK	96-01	73.1	48.5	-24.6	1.7	-1.7	26.4	-26.3	-21.7	0.0	15.9	12.5	-7.1	na	na
SE	97-00	70.3	50.6	-19.8	3.1	-13.5	16.5	-19.8	-20.1	-3.1	16.4	4.8	1.5	na	na
UK	96-02	45.2	34.2	-11.0	4.9	-13.6	18.4	-12.7	-11.2	-3.1	21.0	13.2	-4.8	na	na

Table II.1. Recent debt reduction episodes in the euro area (1995-2007): determinants and macro developments

Sources: European Commission (Ameco, Spring 2017 vintage); Eurostat; ECB; own calculations.
Notes: (1) Episodes defined as the longest period of consecutive years of debt reduction. The focus is on the pre-crisis period (up to 2007), but in some of the listed countries the debt-to-GDP ratio was further reduced in 2008, after the onset of the crisis (most notably in Cyprus and Bulgaria). (2) Contribution to the change in the debt ratio (pp of GDP) over the episode. Negative numbers show a favourable contribution (reduction in debt). The primary balance and cyclically-adjusted primary balance (CAPB) are presented in cumulative terms over the episode (a negative number denotes accumulated surpluses). (3) Variables shown as (cumulative) changes over the episode. (4) Includes non-euro area EU advanced economies and other large selected episodes in EU countries. Comparable data for Bulgaria available only as of 2000.

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