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Debt Sustainability Assessments:

The state of the art

Euro Area Scrutiny

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Banking Union Scrutiny

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Abstract

The approach to Debt Sustainability Assessments (DSAs) has substantially evolved after the global crisis, with the goal of improving detection of risks. DSAs cover an increasing number of indicators, systematically look into implicit and contingent liabilities, and use statistical methods to quantify highly risky "tail events". They also operationalize debt limits, by adopting thresholds for debt and payment flows, to single out enhanced vulnerability. While these developments mark true progress, this paper focuses on liquidity risks, contagion risks and the identification of debt limits as critical areas limiting DSA effectiveness. It explains why DSA should embed potentially available official support, and how an incomplete lending architecture is a hurdle for DSA. The paper concludes with a comparative assessment of current standard DSAs, suggests directions for further improvement, and discusses the correct use of DSAs in light of the strengths and weaknesses inherent in the underlying methodologies.

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EXECUTIVE SUMMARY

This paper provides an analysis of the current state of the art in DSA methodologies vis-à-vis the increasing importance of liquidity risks and contagion/spillover effects of a crisis. It also presents an analytical reconsideration of the policy distortions at the roots of these risks, stressing their implications for macroeconomic dynamics, fiscal viability and the design of international official lending programmes. Motivated by the current situation in the euro area, the analysis is focused on countries facing the need to reduce their stock of liabilities, support growth and contain vulnerability to liquidity runs.

The current state of DSAs reflects a process of reform ignited by the negative experience of the global crisis, when no international institutions were able to predict the financial and macroeconomic meltdown. DSAs are increasingly refocused towards a forward-looking assessment of (high and low frequency) risks. According to the IMF (2011):

1. Debt projections remain core element in DSA, but the IMF insists on enhancing the realism of the underlying assumptions and the need to reduce any "optimism bias".
2. The coverage of DSA has become very extensive, with the goal of mapping all possible sources of risks. For instance, DSAs routinely include a detailed analysis of implicit and contingent fiscal liabilities, gross and net (financial and overall) debt, and many factors that may indirectly undermine fiscal viability.
3. DSA is increasingly based on probabilistic models, specifically aiming to identify potential situations of extreme stress and "tail risk." Overall, DSA is moving towards models designed to map sources of instability and assess the correlation of different risks, since, even when moderate on their own, shocks may have large destabilising effects if they occur at the same time.
4. Deriving reliable projections of debt, deficits and gross financing needs may provide a clear picture of potential challenges to sustainability, but it is not enough to predict a crisis. This will depend on the resilience or "debt carrying capacity" of the country. Hence, in recent DSAs, sustainability is evaluated using fiscal limits or thresholds for relevant indicators, to separate high from low risk situations, with the ultimate goal of improving the DSA predictive capacity.

In this context, the paper addresses two crucial questions for DSA developments. First, systemic spillovers and cross-border contagion have become heavier and more pervasive as countries are increasingly interconnected in both real and financial terms. How can DSA incorporate the risks emanating from interconnectedness? Second, liquidity runs have become a major source of risk to sustainability. Which indicators are best suited to identify tail risks associated with rollover or sovereign spread crises? How should these indicators be used and interpreted?

In addressing these questions, this paper offers a synthetic, non-technical review of recent literature, providing insight on the market and systemic determinants of debt limits, as well as on the pervasive implications of self-fulfilling expectations of default. It then argues that sharing of best practices and some innovation may lead to further substantial improvements. Relevant directions for reforms include:

1. The integration of models that better account for the mutual dependence of growth, inflation, interest rates and fiscal policy in debt projections.
2. A richer specification of the policy reaction function, capturing the response of the government to debt accumulation and shocks, that should encompass debt management as determinant of the debt structure.
3. An account of possible "catalytic effects" of official lending instruments, i.e., the response of markets (extent of financing and debt pricing) to official financial assistance programs.

The last two points amount to a call for the DSA to integrate with debt-flow management and control, with the specific goal of assessing the conditions under which a country can maintain reliable market access.

In spite of its imperfections, DSA remains a crucial tool of international financial institutions, required at all stages of their engagement, from surveillance to programme implementation. Official lending should never be carried out and not even evaluated as a possibility without proper DSA. Having said so, one should also recognize the risks of market destabilization inherent in a more proactive resort to DSA in contexts, like the euro area, where the instruments, goals, limits, budget and the institutions in charge of official lending are still in the process of being defined. If anything, indeed, available DSA results underscore the urgency of completing the governance framework of the European Monetary Union. The role of DSA as analytical and preventive tool will become much clearer and effective once this new architecture is defined.

1. INTRODUCTION

This paper offers a review of Debt Sustainability Analysis (henceforth DSA), in light of recent advances in the economic analysis of debt default and lessons from the recent crises. DSA methodologies are undergoing a process of deep revision, largely motivated by the experience of the global crisis. Prior to the crisis, virtually every assessment of debt sustainability failed to see the coming storm (admittedly, this is not a failure specific to the latest global crisis). In addition, many of the countries that suffered a debt crisis had also previously enjoyed the statute of "poster child" for fiscal rectitude (mainly because their public liabilities relative to GDP were in a steep downward trajectory).

International institutions have focused on improving forecasts and early detection tools as priorities for revamping the DSA. For instance, the International Monetary Fund (IMF) has been strengthening its DSA around three key elements:[1]
1. Enhanced realism of the assumptions underlying the DSA projections (to address the possibility of an ``optimism bias");
2. A comprehensive and effective set of early warnings for debt distress, including tools to identify sources of risks, conduct stress tests and predict fiscal distress;
3. A sharper treatment of uncertainty surrounding projections, including the use of fan charts and other methods by which different risks are jointly assessed in a probabilistic manner.

Moreover, debt sustainability is increasingly assessed against thresholds for both the stock of liabilities and the cash flow of the government's Gross Financing Need (GFN), defined as the sum of the primary deficit, the interest bill and debt coming to maturity in a given period. DSA increasingly pays attention to the structure of existing debt, including its maturity, denomination, rules of law and ownership (e.g., domestic or foreign). Work at the European Stability Mechanism (ESM) goes further, by stressing the need to measure tail risk in financing need, e.g., with experimental models aiming to quantify a Conditional Flow-at-Risk.[2] This is an indicator inspired by Value at Risk measures, designed to detect potential refinancing risks that could arise from spike in funding requirements.

While the process of revamping DSA is obviously well motivated and comprehensive, it may not be sufficiently ambitious, given the scale of the current challenges to sustainability. With financially integrated markets, liquidity considerations and contagion risks must be centre stage in sustainability analysis. In light of our limited understanding of what drives these risks and, more in general, coordination of investors' expectations, the task of reforming DSA in this direction is admittedly challenging. A point that should not be missed, however, is that liquidity and fundamental crises are inherently interwoven, with one feeding the other.

Furthermore, while financial distress and deterioration of the fiscal outlook has not translated into open sovereign risk crisis in most of the advanced world, it did so systematically in the euro area – a currency union that suffered from its incomplete institutional development. At the onset of the crisis, the policy response to macroeconomic and financial stress was far from adequate, which arguably magnified rather than containing liquidity runs and crises, resulting in persistent fiscal fragility and high debt in part of the Union. A specific problem for the EU and especially for the euro area is that, along the process of institutional development made urgent by the crisis, an official lending and crisis resolution

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[1] See IMF (2018). The IMF's approach to debt sustainability analysis differentiate between market-access countries (MACs), that typically have significant access to international capital markets, and low-income countries (LICs), which meet their external financings needs mostly through concessional resources. The three points in the text are referred to DSAs in MACs.

[2] See Athanasopoulou et al. (2018).

framework is still under construction.[3] As argued below, this is highly relevant for DSA. First, sustainability analysis and results can hardly be delinked from the scale, scope and rules of official support available to a country, and the conditionality associated with it. High uncertainty about the institutional context in which a country operates complicates sustainability assessment. Second, because of this uncertainty, vulnerability to liquidity and contagion creates a risk that proactive use of DSA - before the instruments and modalities regulating official support are agreed upon and set in place - may translate into some sort of "Deauville moment".[4]

The relevance of this problem is apparent. In a number of advanced countries, the key problem is a high legacy public debt burden and low growth. Typically, these are economies with a (still) large non-financial wealth and human capital, sometimes with low external and low private debt. Yet a high stock of explicit but also public contingent liabilities (due to bank fragility) makes risk rebalancing and fiscal consolidation/public debt deleveraging the key priorities.

The public sector needs to reduce its gross liabilities without hampering the recovery and re-igniting financial turmoil. An important function of (a properly designed) DSA would be to provide guidance on which policies and interventions may best work in this risk-rebalancing and fiscal deleveraging process, over a horizon that is bound to exceed the traditional DSA horizon of 5 to 10 years.

This paper is organised as follows. Section 2 will present a brief overview of the recent evolution of DSA methodologies and its functions, and discuss open issues. Sections 3 to 5 reconsider the state of the art from economic literature on default, to derive lessons and implications for DSA. Section 6 builds on a comparative analysis of applied DSAs carried out by the IMF, the EC, the European Central Bank (ECB) and the European Stability Mechanism (ESM), to identify key best practices that could be shared to sharpen the existing frameworks. Section 7 concludes. An appendix includes technical details of the models discussed in the body of the text.

2. DSA: AN OVERVIEW OF ITS EVOLUTION, KEY CHALLENGES AND OPEN ISSUES

This section provides a brief account of the recent evolution of DSA methodologies, drawing on a variety of documents and notes, and discusses prominent issues in DSA reform. It concludes with a reflection on the functions of DSA, a topic that is often disregarded, but, as explained below, has crucial importance in the European context.

In doing so, I leave many classic elements of DSA in the background, referring to the extensive literature on the subject. For instance, I neither repeat the derivations of the intertemporal budget constraint of the government, nor discuss the difference between solvency and sustainability, nor delve into a detailed assessment of the pros and cons of incorporating bond rating by specialized agencies and/or sovereign spreads in DSA.[5]

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[3] The political and institutional debate is wide-ranging and several proposals focus on different elements, from the reform of the European Stability Mechanism to the design of a debt restructuring mechanism – see e.g. Corsetti et. al (2015), Bénassy-Quéré et. al (2018) and reference within, as well as the follow up discussion by Tabellini (2018) and Pisani-Ferry and Zettelmeyer (2018).

[4] In Deauville, on 19 October 2010, Angela Merkel and Nicolas Sarkozy agreed that sovereign bailouts in the Eurozone would require losses to be borne by private bondholders. This announcement is blamed for igniting sovereign spreads crisis in the euro area.

[5] See Debrun et al. (2018) for a recent discussion of these issues.

2.1 The state of the debate on DSA methodologies

The IMF's most recent definition of sustainability holds that *"In general terms, public debt can be regarded as sustainable when the primary balance needed to at least stabilize debt under both the baseline and realistic shock scenarios is economically and politically feasible, such that the level of debt is consistent with an acceptably low rollover risk and with preserving potential growth at a satisfactory level. Conversely, if no realistic adjustment in the primary balance i.e., one that is both economically and politically feasible can bring debt to below such a level, public debt would be considered unsustainable."* IMF (2013a). This statement offers a good synthesis of the state of the DSA methodologies after the global crisis.

In a historical perspective, the early approach to DSA mainly focused on debt trajectories: given government policies, sustainability was considered at stake if these policies fail to generate primary balances that are large enough to stabilise debt in relation to GDP. This approach revolves around a debt accumulation equation (see Section 5.1 below), derived from the budget identity of the public sector, and the definition of solvency, such that the stock of current liabilities at face value must be equal to the present expected discounted value of current and future primary surpluses. The long-standing debate on the best ways to make this framework operational produced significant and useful indicators. Routinely, international organisations calculate a primary balance gap – the shortfall between actual (projected) balance and the balance required to stabilise the debt to GDP ratio over some relevant horizon. This is an indicator of the policy correction (the policy effort) required to rule out explosive debt paths. Moreover, debt stabilisation may occur at different ratios relative to GDP. With a real interest rate in excess to growth rates, higher long-run debt to GDP ratios require higher long-run primary balances, which may or may not be deemed sustainable given the historical records of the country and/or reasonable projections of the country's fundamentals and the country's political context.[6,7]

DSA methodologies further evolved in response to the crises that materialised along the process of financial and trade globalisation. From the 1990s onwards, credit events in a country or region started to be associated with larger and larger contagion and systemic effects, raising the demand for international financial assistance as well as for stronger institutions and rules for enhancing global stability. This translated into the creation of larger and front-loaded lending instruments. As the exposure of the IMF increased, so did the IMF need for more effective DSA. Indeed, the introduction of the exceptional access policy went hand in hand with renewed efforts to improve the measurement of sustainability.[8] Further, the Global Financial Crisis marked a watershed, in that advanced countries, fully integrated in global financial and real markets, experienced increasing difficulties in market access. Unsettlingly, some of the countries that turned out to be most vulnerable to crisis had long been considered examples of fiscal rectitude, by virtue of a falling and low public debt to GDP ratio.

Because of these developments, DSA has increasingly refocused towards a forward-looking assessment of (high and low frequency) risks.[9]

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[6] See Abbas et al. (2013).

[7] In light of theoretical contribution in the 1990s (see Leeper (1991) and Bohn (1998)), the debate on DSA also paid some attention to econometric tests of policy regimes that would ensure government solvency. The main idea is to verify whether the policies and institutions of a country can generate a sufficiently strong response of the primary balance to past debt accumulation – ensuring that the debt to GDP ratio does not diverge and the government is solvent. An issue with the tests (like other tests of solvency) is that results based on the historical sample may offer reliable guidance about the current and future behaviour of the government.

[8] See Reinhart and Trebesch (2016).

[9] See IMF (2011).

1. Debt projections remain a core element in DSA, but the IMF insists on enhancing the realism of the underlying assumptions and the need to reduce any ``optimism bias".
2. The coverage of DSA has become very extensive, with the goal of mapping all possible sources of risks. For instance, DSAs routinely include a detailed analysis of implicit and contingent fiscal liabilities, gross and net (financial and overall) debt, and many factors that may indirectly undermine fiscal viability.
3. DSA is increasingly based on probabilistic models specifically aiming to identify potential situations of extreme stress and 'tail risk.' Overall, DSA is moving towards models designed to map sources of instability and assess the correlation of different risks, since, even when moderate on their own, shocks may have large destabilising effects if they occur at the same time.
4. Deriving reliable projections of debt, deficits and gross financing needs may provide a clear picture of potential challenges to sustainability, but it is not enough to "predict a crisis" (to be precise, to produce conditional probabilities of a credit event). This will depend on the resilience or 'debt carrying capacity' of the country. Hence, in recent DSAs, sustainability is evaluated using fiscal limits or thresholds for relevant indicators, to separate high from low risk situations, with the ultimate goal of improving the DSA predictive capacity.

In a strict sense, debt limits can be envisioned as levels of debt, deficits and gross financing needs beyond which a country may not be able and willing to undertake the costly policy adjustment required to honour its liabilities *in all circumstances*. This is the definition of *Natural Debt Limits*, as in D'Erasmo et al. (2016), set by the maximum debt repayment which is sustainable under the worst possible conditions (however defined). In a less strict, arguably more operational version, debt limits are defined as thresholds beyond which the probability of default becomes non-negligible, so that, depending on the state of the economy, sustainability is in doubt.[10] In either version, debt limits are sometimes formalized with the related concept of *Fiscal Space*.[11]

As widely acknowledged, the policy decision to default is driven by a very large set of factors: by their very nature, fiscal limits are time varying and contingent on circumstances, and cannot be translated into fixed numerical indicators with any confidence.[12] That being said, different institutions do adopt fixed reference values (e.g., debt to GDP ratios around 60% or 90%), meant to signal that further attention and in-depth analysis is warranted. In the practice of DSAs, these thresholds are sometimes estimated on historical samples, with the objective of minimizing the likelihood of producing false signals (either forecasting crises that do not materialize, or failing to anticipate a crisis). A crucial issue raised by this approach is how to ensure cross-country comparability, reconciling the need for standardized, even-handed methods, with the need to account for cross-country heterogeneity. In short, since the same numerical thresholds may not fit all, it may nonetheless be desirable to use the same methodology to derive country-specific values for them.

2.2 Liquidity, systemic and contagion risk

The current debate on DSA reform faces at least two key challenges. The first is how to properly account for liquidity risks. This reflects a variety of distortions that may cause markets to start charging high (and variable) risk premia and/or refusing to rollover a country debt, driven by what economists label self-fulfilling expectations. Over the years, the traditional tools of DSA have been complemented with key indicators of vulnerability to rollover risk. By way of example, DSA includes detailed analysis of the

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[10] See Bi and Leeper (2013).

[11] For a comparative analysis of fiscal space and a critical review of the extent of debt deleverage, see Ostry et al. (2015).

[12] From an econometric or quantitative perspective, the fiscal limit should be treated as a ``latent" variable, difficult to model as a stable function of available information. It can be expected to fluctuate widely, motivated by the observation that vulnerability to crisis often arises for a stable or even low debt stock, arguably reflecting adverse news about current and future fundamentals.

currency and maturity composition of debt, and information on the debt structure and investors (whether these are institutional or individual households, domestic versus foreign). A notable development at the IMF is that the DSA now monitors gross financing needs (GFN, defined as the sum of the primary deficit, the interest bill and the amount of debt maturing during time period) for assessing vulnerability to rollover crisis. According to this indicator, a country is at risk if its GFN is above the fiscal threshold of 15% of GDP (for Market Access Countries).

The second challenge is how to integrate contagion and systemic effects of default in the DSA. Conceptual, institutional and practical issues in dealing with these effects are highlighted by the recent experience of the IMF with the ``systemic exemption'' clause. With this clause, European and international institutions agreed in 2010 on granting access to official resources to countries that would not pass the IMF's Debt Sustainability Analysis. This clause was an explicit recognition that, because of systemic effects from their crises, a default by these countries could jeopardise debt sustainability elsewhere. The gravity and incidence of liquidity runs and contagion was seen as strictly dependent on the international response to an incipient crisis: an inadequate response was seen as a shock magnifying (if not initiate) runs and contagion.

The introduction of the ``systemic exemption'' clause under the pressure of the escalating crisis in Greece was met by harsh criticisms, from within and outside the IMF,[13] that ultimately led to its dismissal in 2016. A new rule stipulates that, in cases in which sustainability is not granted with high probability, the IMF could still lend to a crisis country, but only if other official creditors commit to cover any potential financial gap that could lead the country to default.

This development raises new issues in the construction of a coherent global safety net. On the one hand, the new rule recognises that regional official lenders may have stronger incentives to internalise regional spillover effects than international bodies. On the other hand, it offers little guidance on how global and regional official lenders can and should coordinate their action (a part from *de facto* requiring the IMF loans to be senior to all other loans). In this respect, the collaboration between euro area institutions and the IMF provides an important case study on the efficiency gains that can be obtained through joint management of the repayment cash-flows resulting from different official loans.[14]

2.3   Open issues in the ongoing debate on DSA reform

In view of these challenges, DSAs are subject to an ongoing process of review. Open issues recurrent in this process include: the horizon of analysis; how to improve the DSA capacity to predict crisis; how to prevent systematic optimistic bias in debt projections and assessment; and how to improve communication.

2.3.1 DSA horizon

A DSA horizon limited to between five and ten years has become increasingly recognized as inappropriate. This is so in light of several considerations. On the one hand, there is ample evidence that historical episodes of debt consolidation, either with or without restructuring, take a long time.[15] Moreover, many fiscal risks (ageing related costs) are inherently long-run risk.

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[13] A first criticism was that the clause reduced the scope for bailing-in private creditors IMF (2013b), hence increasing the risk for taxpayers IMF (2014). A second criticism was that, as the IMF would become exposed over longer periods to heavily indebted sovereigns, its status as a lender of last resort for sovereigns would be in danger (Reinhart and Trebesch (2016)).

[14] On these issues, see Ardagna and Caselli (2014), Corsetti et al. (2017) and Henning (2017).

[15] See, e.g., the review of the literature in European Commission (2018), Box 2.3.

On the other hand, programme countries, especially in Europe, benefit from official loans with maturities well in excess of 10 years.

Table 1, below, highlights the difference in the official lending terms by the ESM (and the EFSF) in relation to IMF practice, that marked the start of official lending in the euro area. The table shows that, while the horizon of the IMF loans remain limited by the standard short-term horizon of 3 to 7 years, the maturity of European loans is above 20 years (with a long upfront grace period). Also, for future reference, interest rates charged by the European institutions are lower than the interest rates charged by the IMF (see Corsetti et al. 2017 for an extensive analysis of the evolution of these loans, a comparative analysis and a dataset.)

Table 1: Interest rates and maturities by creditor type in the euro area. Selected dates[16]

		EFSF/ESM Support		IMF Support		Market yields	
		Maturity	Interest rate	Maturity	Interest rate	5-year	10-year
Greece	May-10	5 years	4.041	3 years	3.23	8.31*	7.71
	June-2011	10 years	3.78	3 years	3.53	15.97	22.93
	March-2012	20 years	2.07	8 years	3.13	74.13	20.55
	December-2012	30 years	0.93	8 years	3.07	n.a.	11.67
Ireland	December-2010	7.5 years	5.25	7 years	3.37	n.a.	9.04
	July-2011	15 years	2.74	7 years	3.53	11.35	10.62
	June-2013	22 years	2.32	7 years	3.07	3.07	4.07
Portugal	May-2011	7.5 years	5.47	7 years	3.37	11.06	9.38
	July-2011	15 years	3.15	7 years	3.53	14.63	10.56
	June-2013	22 years	2.19	7 years	3.07	5.17	6.38
Spain	Nov-12	12.5 years	0.78	-	-	4.17	5.3
Cyprus	May-13	15 years	1.03	4 years	3.07	n.a.	n.a

Source: International Monetary Fund, European Commission, European Financial Stability Facility, European Stability Mechanism and Bloomberg. *Refers to 4 years maturity

The lengthening of the DSA horizon, however, raises a host of technical problems concerning the reliability of forecasts and the construction of appropriate scenarios. From a political perspective, some governments may be reluctant to reform official lending in the direction of long-term engagement.

2.3.2 Predictive capacity

As stated above, DSA advancements have developed in two key directions. The first one is an extensive use of information-rich indicators, combining statistical methods with institutional analysis and judgment. The second is the use of sustainability thresholds for debt, deficits and GFN, as well as for individual indicators of vulnerability to various type of risks. These thresholds can be set at fixed values, motivated by institutional considerations (e.g., compliance with a Treaty), or derived endogenously, based on models that optimize their ability to predict crises.

The core question is whether extensive information in conjunction with debt limits can generate significant gains in DSA predictive capacity. Despite progress, DSA predictions are plagued by a high incidence of false negative and/or false positive. By way of example: many countries had GFN above

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[16] The table is taken from Corsetti et al. (2017), where we discuss the policy debate accompanying the increasing divergence in the terms of official support, and compare and contrast the official lending strategies of the two institutions. The table also appears in the background notes for the ESFS/ESM Evaluation Report 2017.

the chosen thresholds for decades without suffering any crisis, while crises erupted in countries with GFN well below such thresholds.[17]

The key problem is that liquidity and contagion risks are hardly amenable of probabilistic quantification. As discussed below, theory suggests that self-fulfilling crises can be thought of as switches between possible *equilibria*, driven by markets expectations. Given the current state of our knowledge of market dynamics, we have little or no guidance in constructing probabilistic models of crises. In most theoretical models, these switches are assigned an exogenous arbitrary probability. Moreover, theory also suggests that debt limits are extremely sensitive to a very large number of factors, and can vary widely depending on circumstances. They can hardly be modelled as a stable function of observable information.

From a methodological perspective, the limitation of the analysis in distinguishing stress/crisis cases from non-stress cases, corresponds to the extreme difficulty in identifying which factors (that DSAs typically label "mitigating or aggravating factors") contribute to determine a country resilience to crisis (the country's "debt-carrying capacity"). This is a critical area where case studies and country-specific analysis could provide key insight on the role of, say, non-financial wealth, monetary and exchange rate regimes (membership to currency union), political structure and governance. The main issue is how to develop a standardized approach and a common methodology that can account for heterogeneity across countries.

The above considerations, and the record of DSAs, raise doubts on whether one can quantify thresholds able to provide reliable guidance to sustainability assessment, that is, whether DSAs will ever become really good at predicting crises. While this is not an argument to stop working on improving methodologies, it suggests caution in communication.

2.3.3 Realism of the assumptions underlying projections

DSAs are inherently forward looking exercises, relying on a number of maintained assumptions. One of the key challenges to DSA as currently conducted is the widespread evidence that, ex-post, the distribution of DSA assessments is systematically biased towards over-optimism as regards growth and fiscal projections.

Some issues in this area are long-standing. When conducting DSA in the context of ongoing financial assistance, official lenders have 'skin in the game', and this may weigh on its judgement. Another issue became apparent already at the time of the Asian Crisis: the IMF GDP forecasts were systematically lagging behind the ongoing developments. Given the high uncertainty surrounding these forecasts, official lenders were apparently weary of feeding pessimistic expectations.[18]

Nonetheless, it is widely recognized that there are directions in which current practices can be improved. As argued at the end of this paper, projections can be augmented with feedback (general-equilibrium) effects of changing parameters.

2.3.4 Communication

Because of its broad coverage, the outputs from DSA exercises tend to be very detailed, large, and articulated, when not fragmented, hence difficult to synthesize in an overall conclusion to convey in a transparent and accessible way. All DSAs now rely on synthetic heat maps, where colours indicate the vulnerability to crisis, organized around broad categories of indicators.

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[17] A possible way to improve predictive capacity consists of using statistical models encompassing subjective opinions (judgement). This however requires the identification of reliable methodologies to integrate models and judgement.

[18] See Corsetti (2009).

Heat maps (and 'traffic lights') have marked a watershed in communication. Yet, this standard practice still leaves open the issue of how to aggregate different information and weigh the relative importance of different indicators. A widespread remark, for instance, is that much of the probabilistic analysis in DSA (e.g. fan charts) are not fully integrated in heat maps.

While statistical models can provide insight (see Lennkh et al. (2017) for a proposal for a framework "free-of-judgment"), there is consensus on the need to provide a thorough discussion of the aggregation methods and relative weight assigned to indicators, which could even be made available individually in public datasets. These datasets would then enable readers to verify DSA results based on different weighing systems.

Arguably, this practice would increase the value of DSA documents, which as of now contain a true wealth of highly disaggregated information that is useful independently of the DSA bottom line result (the synthetic overall assessment).

There are however potential issues in the use of heat maps that should not be overlooked. As argued above, the debt limits and fiscal thresholds used in DSA are at best noisy indicators of vulnerability – they are not reliable indicators of sustainability. Interpreting the heat maps should not give in the temptation to convey arbitrarily sharp messages that are not borne out by the analysis.

2.4   The different functions of DSA

In the practice of international institutions, DSA accompanies different phases of their engagement with crisis countries. Therefore, it performs different functions.

i.   Phase 1 – Diagnosis

As a diagnostic tool in the surveillance phase, DSA provides a set of indicators to assess the circumstances in which, conditional on current and expected national policies, the country will face critical difficulties in rolling over its liabilities and thus require financial assistance. In this function, DSA is typically structured to provide both an overall assessment of vulnerability to crises, and a disaggregated analysis of the roots of such vulnerability, possibly identifying the issues (e.g. contingent liabilities due to banking fragility) on which policymakers should concentrate their attention. As a tool of surveillance, DSA ultimately aims to indicate priorities for reforms and/or policies that could reduce vulnerabilities, and evaluate the feasibility and effectiveness of internal adjustments to correct imbalances.

A core question for DSA in this first phase is whether activating official lending could be more efficient, from a social and global perspective, than expecting the country to address its problems on its own. One related question is whether DSA could play a role as a "preventive tool" to influence either directly or indirectly (via the market) the behaviour of a country also in good economic times.

ii.   Phase 2 – Programme activation

DSA becomes more focused when, were adjustment to be deemed insufficient, the country enters a financial assistance programme. A programme defines the extent and the modalities of official financial support, as well as the set of policies and reforms the government is expected (and agrees) to implement. The goal of the DSA is now specific: it needs to verify whether, conditional on programme, the country debt will be sustainable and the country will regain market access with "sufficiently high probability". This is consistent with the institutional constraint on lending, that funds should be provided only to (conditionally) solvent, but illiquid countries, according to the logic of the so-called "catalytic lending" (by which the role official lending is to reactivate or maintain financing by market participants and other public sources) and in line with the goal of minimizing the risk of losses.

iii. Phase 3 – Debt restructuring

If DSA concludes that no combination of potential official lending and internal adjustment is sufficient to guarantee sustainability with high likelihood, debt restructuring is necessary. This is a critical passage for DSA. For a number of reasons official lenders tend to give in the temptation to keep lending relying on optimistic forecasts, justify lending to an insolvent country with systemic considerations (as we have seen in Europe), or geopolitical considerations. In the phase of debt restructuring, DSA becomes even more involved. A key issue is how to embed official loans in the analysis, a sticky point in the debate on the sustainability of the Greek debt.[19]

2.5   DSA in relation to official lending/crisis management

In all these three phases, the costs and benefits of policy adjustments, official lending and debt restructuring strictly depend on each other. Sustainability via internal policy correction is hard to assess without knowing what kind of programmes are available to the country. In turn, an assessment of the probability of success of these programmes hinges on the modalities of potential debt restructuring, as these are important determinants of the country's willingness to undertake costly adjustment. This mutual dependence is arguably more relevant for DSA when used in the design of a programme, but also important when used as a monitoring tool.

DSA is more focused and internally consistent when conducted in the context of a structured set of rules for access, as is the case within the framework of country financial assistance programmes. The analysis can then explicitly factor in the macroeconomic effects of the conditionality attached to the programme and the terms of the official support – the amount of resources, their costs, the time profile of their disbursements and repayments. The terms of official financing, in particular, matter for policy decisions as much as any other fundamental. There are clear analytical and practical advantages in conditioning the analysis on a well-defined set of potential policies and bailout plans (obviously recognizing risks and probabilities of failure/renegotiations) that could be activated in support of the country, but also contribute to shield the country from disorderly runs and credit event abroad. In contrast, an insufficiently defined official lending framework creates an analytical disadvantage for DSA. Logically, debt sustainability should be assessed in the context of the highest uncertainty about potential corrective policies, rules, and forms of international financial support that could be activated in case of a crisis (uncertainty that also makes the economy more exposed to "tail risk").

2.6   DSA and the euro-area reform proposals

In the euro area, alongside the process of institutional developments made urgent by the crisis, the institutional framework defining the scope, scale and rule of access to official support is still incomplete, and many issues are open to debate. As a prominent example, a number of proposals call for an automatic trigger of (soft) restructurings or debt re-profiling, to accompany official lending. As discussed in Corsetti et al. (2015, 2017), the core argument favouring this automatic trigger is that, provided it can be credibly implemented ex-post, it would enhance market discipline ex-ante, and thus deliver long run benefits in the form of a lower incidence of crises.[20] The main counterarguments focus on the lack of a reliable indicator to guide decisions to pull the trigger: an automatic mechanism would at best exacerbate pro-cyclicality or, more fundamentally, lead to instability, while not adding much to

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[19] See e.g. Eichengreen et al (2018), Eurogroup (2017) and Schumacher and Weder di Mauro (2016).

[20] See Andritzky et. al (2016) and Andritzky and Schumacher (forthcoming).

existing alternative adjustment mechanisms.[21,22, 23] These proposals have key implications for the institutional role of DSA. On the IMF's framework, for instance, a discussion has developed around the fact that DSA unavoidably foreshadows the possibility of sovereign debt restructuring. If official support is automatically associated with debt restructuring, the prospect of an official programme may worsen market sentiments (generating self-fulfilling expectations of debt crisis among investors) and accelerate capital flight. On balance, there is no guarantee that, in reaction to prospective (even mild) debt re-profiling, investors would not rush for the exit, leaving the official sector at a crossroad.

Other proposals focus on the need to structure national debt by seniority, such as the "blue bonds/red bonds" proposal in Bruegel (2010), or the need for a Fiscal Institute (e.g., Tabellini (2016)) or a European Fund (e.g., Corsetti et al. (2016)) with the power of issuing a common bond under circumstances of macroeconomic and financial stress. Another set of proposals focus on the priority to abate legacy debt, via some form of "redemption fund", following the idea initially proposed in the 2011 report by the German Council of Economic Experts.[24] Relative to the status quo, any of these innovations (e.g., the introduction of a common fund and/or seniority structure) would also have substantial implications for the questions faced by DSA, as, at a minimum, it would affect the overall costs of debt issuance (see e.g. Ari et al. (2018).

The crucial question is how to engineer a mix of bail-ins and bailouts that creates the conditions for the private sector to keep lending to the country (ex-ante), while providing governments with sufficient insurance against adverse contingencies (ex-post), and the right incentives to reduce excessive debt. When debt is clearly not sustainable, delays in dealing with legacy debt come at increasing costs for the taxpayers and the population at large.[25] The way official lending is structured and linked to debt restructuring however matters, and may amplify risks of the perverse effects mentioned above (which, in a currency union among highly interdependent economies, can easily become systemic). The risk is that these perverse effects end up frustrating the goal of debt reduction motivating interventions in the first place. It may well be possible that the Eurozone will evolve towards a framework featuring, first and foremost, a reinforced fiscal compact and rules that enhance a smooth reduction of public indebtedness – and foster the transition to a new regime where safe bonds may coexist with junior and risky bonds.

DSA could be a crucial tool in this process, provided that its role is well-designed, and takes into account its strengths and weaknesses. Specifically, if the DSA is to be placed at the core of an automatic mechanism of debt restructuring, and tasked to determine the size of restructuring required to restore sustainability, its logical and methodological limits will raise a number of politically controversial issues.

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[21] For pro-cyclicality see Strauch (2017). For fundamental instability see Tabellini (2017).

[22] A key concern is that automatic triggers would force restructuring when it is unnecessary (as shown by the fact that most IMF lending happens without debt restructuring). The risk is going from "too little too late" in debt restructuring, to the opposite extreme of "too often, too much".

[23] Quoting from the 2015 CEPR Monitoring the Eurozone Report: "Under a credible no-bailout clause, correct pricing of risk should have deterred excessive debt accumulation *ex-ante*. This did not happen. By now, all the potential beneficial effects of deterrence are long gone. In the present situation, with debt levels already very large and a still developing and untested institutional framework to protect countries from adverse spillovers, debt restructuring involving the private sector is not an attractive option. All that is left are the adverse *ex-post* consequences of overly large stocks of private, but especially public, debt, including the vulnerability to runs." (Corsetti et al. 2015 p.2).

[24] See Parello and Visco (2012), Paris and Wyplosz (2014), Corsetti et al. (2015), and Bini-Smaghi and Marcussen (2018).

[25] Within the boundaries of the monetary union, the rule-book of the ESM explicitly contemplates insolvency as a potential scenario, i.e., sovereign defaults cannot be ruled out. In this respect, the ESM guidelines are in line with IMF procedures: when the debt burden is assessed to be unsustainable, a bailing-in of private creditors must be part of the deal.

On the one hand, countries will inevitably question the legitimacy and the wisdom of replacing an essentially sovereign decision with the result of a technical analysis that, despite improvement over time, lacks a good track records, and solid foundations (either theoretical or empirical). On the other hand, the political pressure on the institutions in charge of DSA will inevitably intensify, inducing dilution of methodologies and/or disregard of the intrinsic uncertainty in DSA results.

DSA is a technical tool supporting decisions concerning macroeconomic and financial stability policies that are ultimately sovereign. In other words, DSA can hardly have any legitimacy and credibility as an instrument, controlled by creditor countries, to force initiatives and policies by debtor countries, or to serve specific interests. This is particularly important in the institutional context of the euro area. A key precondition for its acceptance and its results to be considered as an important technical input to essentially political decisions is that both national and common institutions share full ownership of it.

3. DEBT LIMITS, SOLIDARITY AND SOVEREIGN DEBT CRISES

The previous section discussed the general direction of current DSA reforms, where some significant progress has been made in enhancing a forward-looking quantification of different types of risks that could undermine fiscal viability. Much of these advances are rooted in the use of fiscal limits, a conceptual construct made operational by quantifying thresholds for debt, deficits and other indicators, to separate fiscal stress from the absence of it.

This and the next two sections draw on selected contributions to the economic literature, to derive insight on these thresholds in relation to the type of risks that may threaten sustainability. To do so, I use a simple framework to account for the state of the art in the economic literature, if only in a highly stylized way.

The motivation for the analysis below is strictly policy-related. In the next decades, the most fragile advanced countries (in Europe and elsewhere) will face the need to deleverage and rebalance risk. Among the high debt countries, some have a large non-financial wealth, rich human and physical capital, or even small external imbalances and a small private non-financial sector debt. In principle, these features should strengthen their debt-carrying capacity. Nevertheless, the resilience to crises of these countries is weak, as long as their vulnerability to liquidity and contagion risks remains high.

Sustainability in these cases crucially hinges on a pace of debt reduction and macroeconomic adjustment that would enhance recovery, while minimising these risks. In the European Union, and especially in the euro area, DSA is complicated by the absence of a well-structured institutional framework defining the scale and modalities of access to official support, making it hard to properly evaluate potential systemic threat to the debt deleveraging process.

This section discusses issues on debt sustainability in high-debt countries, abstracting from liquidity crises. Then, the next section extends this analysis to encompass belief-driven crises, analysing how they can start, their fundamental costs and macroeconomic dimensions. I also discuss the need for a credible backstop to government debt and issues in moral hazard. I conclude with a brief account of a synthetic model, encompassing all of the above, to gain theoretical insight on whether and how sustainability is increasingly predicated on the ability of a government and international institution to manage the cash flow of payments, keeping them at a bearable level, given economic and political constraints.

3.1 Debt limit and the policy decision to default

The idea of a debt limit is rooted in the literature that treats debt default as a policy choice under two key and realistic assumptions. Firstly, the government in office has limited capacity to commit itself or future governments to future policies; each government is assumed to decide its policy at every point

in time, reacting to current market prices (that is, taking market expectations as given). Secondly, default entails large costs, including macroeconomic and financial, as well as social and political disruption; these costs are typically envisioned as deriving from the loss of market access (exclusion from international markets) and disruption of the domestic financial sector. This disruption implies a crunch in credit supply (as in Bocola (2016) or Corsetti et. al. (2013)) and, more generally, a disruption of economic activity (see, e.g., Asonuma and Trebesch, (2016) and Trebesch and Zabel (2017)). Now, the larger these costs, the higher a government's incentives to honour its outstanding liabilities. For this reason, from a creditors' perspective, these costs play a role similar to "collateral": they determine the amount of resources that the country can credibly pledge against bond issuance.

In the following, I abstract from the possibility of belief-driven crisis (analysed later), and discuss how the fiscal limit is rooted in the perception of default costs and thus determines the dynamic and sustainability of debt. I will discuss the problems created by systemic effects and cross-border spillovers generated by a crisis, as one of the motivations for a bailout, and the mechanism by which a bailout can contain default risk by minimising the net transfers of resources.

3.2   Debt limit and sustainability across circumstances and time

To illustrate how the theory can contribute to our understanding of debt limits and debt sustainability it is convenient to use a model of an economy that reflects, if only in a stylised way, the current situation in the euro area. To this end, borrowing from Arellano and Ramanarayanan (2012) (henceforth AR), I focus on the simple example of an economy which starts, in the short run, with a large legacy debt. Debt sustainability crucially depends on whether the economy fully recovers over time. However, the probability of a strong recovery is low in the near future, but becomes higher further in the future. I therefore analyse three periods. The short run, when legacy debt at maturity comes due; an intermediate period, where recovery is relatively unlikely, and a longer horizon over which the recovery is expected to occur with a high probability. As in AR, if the government defaults, the country suffers default costs that vary with the business cycle. In particular, these are assumed to be higher in an expansion than in a recession.[26]

I start by looking at an equilibrium in which the government issues risk-free short-term bonds (maturing in the intermediate period), and risk-free long-term bonds (maturing in the last period). Recall the definition of the natural fiscal limit, as the maximum amount of legacy debt coming to maturity in the initial period that the government can sustain in all circumstances. Under realistic assumptions, this is the amount that the government is willing to repay in the worst circumstances (a recession), given the cost of default. For newly issued debt to be risk-free, the amount of debt issuance cannot be too large: at face value, it cannot exceed the natural debt limit when bonds come to maturity.

Future debt limits therefore bound the amount of debt the government can issue in the short run, that is, the fiscal space for rolling over current debt. An important corollary of this is that *future* debt limits are a key determinant of the *current* debt limit.

To see this most clearly, denote with B_0^{Max} the largest debt repayment the government can (economically and politically) sustain in the initial period. Correspondingly, denote with Δ_0 the deepest short-run budget adjustment that is politically and economically acceptable (think of this as a negative function of fiscal adjustment costs). We can write:

$$B_0^{Max} = \Delta_0 + Max\{Q^{Short}B^{Short} + Q^{Long}B^{Long}\}$$

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[26] Details are given in the Technical Annex (available upon request).

where B denotes the amount of bonds issuance, short and long; Q their price (the inverse of the interest rate), short and long; and the last term $Max\{...\}$ indicates the maximum financing the government can raise from the market. Given market financing (the term $Max\{...\}$ term on the right hand side), the higher the feasible adjustment, Δ_0, the higher the stock of debt that is sustainable B_0^{Max}. Conversely, given the feasible adjustment in the short run (given Δ_0), the higher the fiscal space for borrowing, the easier is for the government to postpone adjustment and smooth its costs over time, the higher B_0^{Max}.[27]

To restate the main message: fiscal limits, i.e. thresholds defining the maximum debt that is sustainable, are not a static concept. Since the fiscal space for issuing short and long-term debt depends on the natural fiscal limits in the future, all debt thresholds are strictly interconnected across time, and circumstances.

Indeed, it may be possible for the short-run limit to be higher if the government issues risky, instead of risk-free debt. Depending on the size of the initial legacy debt, it may be attractive for both the government and creditors to 'gamble' on the future recovery, and issue debt that, given the cost of the default, will be credibly honoured only if the economy picks up, but repudiated if the economy remains in a persistent recession.

The logic is straightforward. When pursuing a risk-free debt strategy, the government needs to contain issuance of B^{Long} , but it can sell bonds at a higher (riskless) price Q^{Long} (i.e., at a lower risk-free interest rates). Conversely, a risky debt strategy allows the government to expand bond issuance, but markets will absorb the higher volume of bonds at lower prices (higher interest rates), reflecting default risk. In principle, the net effect can go either way: a higher issuance of risky debt may more than offset the adverse fall in prices reflecting default risk. Depending on the probability of future recovery and markets' risk aversion, risky debt issuance may create more space for debt rollover and help short-run sustainability.

In the context of policies aiming to pursue debt reduction, the potential trade-off between long run and short run sustainability highlights that the pace of debt reduction is crucial. This is in line with the evidence discussed, e.g., in the 2007 Debt Sustainability Monitor, Box 2.2, suggesting that episodes of successful debt reduction and fiscal stabilization tend to take a long time.[28] For a government's commitment to restore the viability of its fiscal policies to be credible, the adjustment efforts and costs need to be sufficiently smoothed and kept at sustainable level over time.

3.3   Issues raised by self-interested solidarity

In light of the contagion and spillover effects generated by most crises in the last decades, we are fully aware that default in one country may have negative spillovers abroad. Concerns with these negative spillovers may play (and have at times played) a significant role in motivating international bailout programmes. Foreign governments may be willing to bailout a country on the verge of a debt crisis, to avoid suffering the costs of adverse financial and economic effects of its decision to default. Tirole (2015) analyses the nature and consequences of this self-interested solidarity.[29]

Tirole (2015) emphasizes that self-interested solidarity undermines the credibility of ``no bailout rules.'' Indeed, while these types of rule (implying a high risk of default) are sometimes praised as necessary

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[27] The level of current economic activity is of course important: by boosting net tax revenues, other things equal, high economic activity reduces the adjustment effort required to service the debt.

[28] Also see Abbas et al. (2013), and Baldacci et al (2015).

[29] See also Niepmann, F., and Schmidt-Eisenlohr, T. (2013).

to discipline the behaviour of debtors, self-interested bailouts obviously moderate the beneficial effects that can be expected from them.[30]

For DSA analysis, a key question is whether self-interested solidarity can in principle provide enough guarantees against default (in the DSA jargon, the question is how to deal with countries relying on "nonmarket support"). Indeed, in light of the analysis in the previous subsection, solidarity could in principle enhance sustainability of both legacy debt and future liabilities. A bailout could avoid default in the event of a *future* recession, and thus expand the *current* government capacity to issue debt at low interest rate (investors anticipate that they will be repaid in all circumstances, thanks to external transfers to the country).

There are two key problems with self-interested solidarity. First, if not regulated by credible ex-ante contracts and institutions, the anticipation of spillover-motivated bailouts exacerbates existing distortions and tend to produce excessive borrowing and default. In the economy studied above, for instance, unless the expected bailout is large and/or the probability of future recovery is low, ex-post solidarity would not avoid default in the long run. Rather, anticipation of a future bailout would lead the government to issue even more long-term risky debt. As a result, over longer horizons, an external bailout will be required to avoid default during an expansion, while it will be insufficient to rule out default (on a larger scale) in a recession. These effects are exacerbated in the presence of political risk and asymmetric information.

Second, it is possible that the choice between high versus low debt issuance be ultimately driven by self-fulfilling market expectations of the kind analysed in the following section.[31]

3.4   Efficient bailout

The issues raised by self-interested solidarity (excessing borrowing and excessive frequency of default) can be addressed by institutions and contracts that internalize spillovers and pursue (constrained) efficient solutions. Before discussing these, it is important to recognize that solidarity may not be strictly utilitarian. There are a number of reasons why a society may want to build up institutions aiming to prevent costly sovereign default. Ex-post, default costs are a waste: during crisis unemployment rises, human and physical capital is dissipated; income risk at individual level hikes with cuts in pension, downsizing of the welfare state and losses on assets; firms' investment plans are compromised by high borrowing costs and the credit crunch that usually accompanies a financial crisis. Ex-ante, debtor countries may have reasons to value current resources more than future resources.[32] However, their borrowing capacity via issuance of safe debt is constrained by their ability to pay in the worst possible circumstances. They may find it preferable to borrow by issuing risky debt ("gambling" on future recovery), even though such a strategy moves the debt issuance price against them.

If official bailouts are desirable, for whatever reason, how can they be structured to minimise default (hence being effective) and the size of bailouts (hence being efficient)? To address this question, consider two types of official interventions: ex-ante lending, and ex-post rescue programmes. As shown below, although both follow the same principle, they lead to a slightly different distribution of

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[30] Rather than reiterating the need for a no-bailout rule that lacks credibility, Tirole (2015) makes a case for institutions that may internalise spillovers and distortions in an efficient way, making a strong case for moving away from bilateral solidarity.

[31] See Marin (2017).

[32] See Tirole (2015).

the gains between creditors and debtors. Most crucially, both require an agreement by the debtor to keep bond issuance below specific caps, and raise issues in debtors' and investors' moral hazard.[33]

Consider first ex-ante interventions via official loans. For a bailout programme to be effective and efficient, the terms on the official loan must be set sufficiently favourable to make the debtor government at least indifferent between repaying and defaulting at all times and in all circumstances. This can be accomplished by offering long-term loans at an official price which (a) generates the same revenue as the issuance of risky debt at market price in the short run, and (b) keeps the amount of official debt maturing in the future well within the government willingness to pay even in the worst circumstances. That is, future debt services cannot require an adjustment effort whose costs exceeds the costs of default in the no-recovery scenario.

In our example, we have seen that, if the probability of a future recovery is high enough, and risk aversion low enough, the government and investors would have an incentive to "gamble" on future uncertain resources at times of abundance. In a world without official lending, this would imply prospective default if the economy persists in a recession. For a bailout to eliminate default, official loans must replace the issuance of risky market bonds at no loss of current revenue for the government. While replacing market financing, the official lender must then "overvalue", so to speak, the resources that the government can be credibly expected to pay at times of scarcity. The idea is to make it worthwhile for the government to enter the programme in terms of its short-run rollover capacity. The required official interest rate must be low enough to satisfy the following:

$$R^{OF} = \frac{1}{Q^{OF}} \leq \frac{B^{Riskless}}{Q^{Market} B^{Risky}}$$

where $Q^{OF} > Q^{Market}$ and $B^{riskless} < B^{Market}$, and $B^{riskless}$ is defined in relation to the natural debt limits in the future. The interest rate R^{OF}, must be such that, by entering a programme, in the short run, the government ends up with the same amount of resources it could obtain from financial markets issuing risky debt. In the future, it will owe much less: the size of the official loan is such that it will be at least indifferent between repaying and defaulting in the worst circumstances.

An important observation is that the official interest rate above may well be below the funding costs of the official lender. There is no strong reason to exclude this possibility as, from a social perspective, it may be desirable to implement a large transfer. The choice in this matter ultimately depends on the objectives (mandate) and financial capacity of the official lender.

However, the type of bailout just described cannot be successful, if, after receiving official loans, the government dilutes the official lender by issuing additional risky debt to the private sector, on which it will default if the economy fails to recover. Avoiding dilution is a key priority for any programme conditionality. In exchange for long-term official support, the government needs to agree on strict caps on overall borrowing (a point stressed by Tirole (2015)).

The goal of ruling out default can also be achieved with contingent official interventions ex-post. Namely, arrangements such that a country can access to ex-post bailout resources contingent on future recessions. For a large enough bailout amount, this arrangement would ensure that long-term bonds are traded in the market at risk-free interest rates (in the model; in the real world, at a very low spread). In light of our discussion of self-interested solidarity, this type of bailout can be effective only if the

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[33] The model and argument to follow was developed in joint work with Aitor Erce and Timothy Uy. For a video presentation with technical details see: Workshop on Fiscal Sustainability in the XXI Century, BSGE Summer Forum, June 2016, via link (www.youtube.com/watch?v=2Uvp23wbctw).

official lender is credibly bound to bail the country out exclusively in bad times (a recession scenario). Otherwise, the government may have strong incentives to pursue a high debt strategy, making default unavoidable in bad times, while being in need for a bailout in good times. Implicitly or explicitly, the debtor country must agree on a credible cap on borrowing, such that its debt remain low enough to rule out any need for bailout in expansions. This is a strong argument in favour of strengthening the fiscal compact, whose importance grows with any form of fiscal integration, but especially with the definition of official bailout programmes and institutions.

Whether the bailout policy is implemented ex-ante (via official loans) or ex-post (via rescue in a near default), it entails a positive resource transfer, which raises well known issues in (debtors' and creditors') moral hazard, affecting the incentives of governments to pursue policies that may raise future output and/or the probability of an expansion. These requirements need to be addressed in the design of official lending institutions. But note that it is far from clear that moral hazard due to official lending would be worse, relative to moral hazard in economies where bailouts reflect self-interested solidarity.

When appropriately designed, bailouts can thus help sustainability by containing the risks implicit in unregulated, self-interested solidarity. It has been noted that, when the current legacy debt is high, the gains from bailout packages goes exclusively to the creditors. This is not entirely true when the country benefits from official loans at low concessional rate: part of the surplus also goes to the debtor country; it enjoys the benefit of a very small interest bill in an expansion. Moreover, a high initial debt obviously results from past choices. Prospective bailouts do raise the borrowing capacity of the debtor: from an ex-ante perspective, one may argue that the debtor had benefited from it in the past.[34]

4. LIQUIDITY CRISES AND DEBT BACKSTOP

Conceptually, it is useful to distinguish between debt crises of the type just described, and liquidity crises. To the extent that policymakers are unable to keep their promises and re-optimise policies at each point in time in reaction to market prices and investors behaviour, this creates room for adverse feedback effects. Self-fulfilling expectations of default generates markets' runs on debt that raise government borrowing costs; high borrowing costs in turn ignite destabilising debt dynamics and deteriorate the country's fundamentals, thus raising the likelihood of debt repudiation.[35]

Common to most models of runs on debt is the idea that the economy is in a situation in which the equilibrium is not unique. There is at least one equilibrium with current or prospective default (the bad equilibrium), and one equilibrium without default (the good equilibrium). Which one is selected depends on which equilibrium market participants coordinate their expectations on.

It is didactically and analytically convenient to explain belief-driven crises as distinct from fundamental crisis. Yet they cannot be separated, neither in theory nor in practice. On the one hand, for belief-driven ("bad") equilibrium to exist the fundamentals of the economy cannot be too strong – e.g., the

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[34] See the discussion by Gourinchas et al. (2018).

[35] Runs on debt as modelled by Cole and Kehoe (1996) translate into disruptive sudden stops: if they anticipate a credit event, markets may suddenly become unwilling to roll over maturing government debt at a rate that the government finds acceptable, given the option to default. This is a model of rollover crises motivated by the experience of Mexico in the mid-1990s, whereas during the ``Tequila crisis'' debt auctions often went deserted. Drawing on Calvo (1988), Lorenzoni and Werning (2013) emphasise that, to the extent that belief-driven expectations of default drive up risk premia on government bonds, this tends to accelerate debt accumulation over time. A rising stock of debt eventually makes a crisis unavoidable. The motivation for this model is the observation that, in the data, credit events are typically preceded by a sustained increase in the stock of debt (hence the title of their work, ``slow moving debt crisis''). The two models are nonetheless connected. To the extent that the possibility of sudden stops is priced by markets, it raises the borrowing costs of the government, see Conesa and Kehoe (2017).

equilibrium is unique for a sufficiently low stock of debt. On the other hand, self-fulfilling expectations of default typically cause the fundamentals of the economy to deteriorate: high risk premia not only drive up public debt, but also spill over onto private borrowing costs and cause market disruption, discouraging investment and demand. Once this process is set in motion, the economy becomes fundamentally weaker and, at some point, the government may find it optimal to repudiate its debt even if the markets coordinated back on the good equilibrium, excluding self-fulfilling expectations.[36]

4.1 Dynamic and fundamental costs of liquidity crises

To fix ideas analytically, this subsection introduces a simple and transparent model of how a crisis can develop from arbitrary anticipations of default. The analysis draws on frontier literature (Lorenzoni and Werning 2013), translating the key lessons in a simple description illustrated with a graph (presented in the appendix).[37] While the model is nested in the one described above, it is convenient to use a slightly different notation, and start the analysis from the government budget identity.

4.1.2 Model-based analysis

Focus on a government facing a given gross financing need GFN, which is the sum of the primary deficit (spending minus taxes, denoted by PD_t), and any liabilities B_t maturing and due in the period. Assuming, for simplicity, that the government only issues short-term (discount) bonds, the budget identity between any two periods, t and t+1, is:

$$Q_t B_{t+1} = GFN_t = PD_t + B_t$$

Clearly, for a given positive GFN_t, the lower the market price Q_t (the higher the interest rate on debt $(1/Q_t)$, the larger the amount of new bonds B_{t+1} the government needs to issue.

The problem – stressed early on by Calvo (1988) is that the price Q_t is neither necessarily unique, nor necessarily reflects the country's fundamentals. To see this, the best point of departure is the same as our model of debt default above, that is, the non-controversial idea that there is a fiscal limit, $\hat{B}_{t+1}$, for the stock of debt beyond which the economy becomes vulnerable to default crisis. In period *t+1*, when the stock of government liabilities is above the fiscal limit, $\hat{B}_{t+1}$, the government cannot be expected to sustain its debt in all circumstances. In particular, it will have a welfare incentive to default if, say, the economy enters a large downturn producing macroeconomic stress.

To keep notation simple and transparent, I assume that investors share the same assessment of the debt limit and anticipate that, when the government defaults, it will repudiate a percentage θ of the outstanding debt, so that the investors' recovery rate is $1 - \theta$. As in the previous section, in each period, the economy can be either in an expansion (with probability α), or in a recession (with probability $1 - \alpha$). Also, the international rate of interest R is 1, so that the price of risk one-period risk-free bonds is $Q = \frac{1}{R}$.

Given these simplifying assumptions, it is straightforward to derive the price of bonds. I repeat the main assumptions for convenience: markets will not price default as long as debt is projected to remain below the critical threshold. If debt is above this threshold, investors know that if the economy enters a downturn (which occurs with probability $1 - \alpha$), they will suffer a haircut on their bond holdings as high as θ. It is easy to see that the risk-neutral issuance price of bonds will be either of the following:

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[36] See, e.g., Corsetti et. al. (2013).

[37] Luca Dedola is credited for this exceptionally clear graphical exposition of the model.

$$Q_t \begin{cases} Q_t^{Safe} = 1 & \text{if } B_{t+1} \leq \hat{B}_{t+1} \\ Q_t^{Risky} = (1-\alpha) + \alpha\theta < 1 & \text{if } B_{t+1} \geq \hat{B}_{t+1} \end{cases}$$

Combining the above with the budget identity, it follows that markets will not price any default risk as long as the stock of debt is expected to remain below the fiscal limit:

$$B_{t+1} = \frac{PD_t + B_t}{Q_t^{Safe}} \leq \hat{B}_{t+1}$$

This condition is more likely to hold, the smaller the financing need of the government, i.e. the smaller the primary deficits and the lower the initial stock of liabilities. By the same logic, markets will price default risk if:

$$B_{t+1} = \frac{PD_t + B_t}{Q_t^{Risky}} \geq \hat{B}_{t+1}$$

This condition is most likely to hold when either primary deficits are large (a large downturn) or the initial stock of debt is high, or both.

Therefore, if a government's financing needs are sufficiently low, the only equilibrium is one where markets do not price default risk. With a large enough financing need, the opposite is true: the only equilibrium will be one in which markets finance the government charging a risk premium. However, and this is the key result from Calvo (1988), since $Q_t^{Risky} < Q_t^{Safe}$, there will be intermediate level of financing need such that either price can be an equilibrium price. For given fundamentals of the economy (the intermediate level of financing need), if market anticipate default, they will charge high interest rate (buy debt at a low price, Q_t^{Risky}) and cause the debt stock to grow above the fiscal limit. If markets do not anticipate default, they will charge a low rate (buy debt at a high price, Q_t^{Safe}). Debt does not grow as fast and remains below the limit. In either case, expectations are self-validating. The risky equilibrium is clearly worse than the safe one, since it is associated with default for a level of debt below the fundamental default threshold (the natural debt limit).

4.1.3 Injecting realism in the model

There are at least three key important considerations that inject realism in this relatively simple multiple equilibria story. First, if markets coordinate expectations on the bad equilibrium and its stock of liabilities grow above the limit, the government may still be able to rollover its debt for quite some time (as long as economic conditions are still good). However, there will be a default as soon as the economy suffers a large bad shock. Moreover, to the extent that primary surpluses cannot be adjusted, high risk *premia* will start to ignite debt expansion. Over time, larger and larger stocks of debt will increase the financing need of the government, where a high risk premium and default no longer depend on self-fulfilling expectations, but reflect weak fundamentals.

Second, in the above model, output is exogenous to fiscal conditions as a simplifying assumption. Yet, the evidence shows that high sovereign risk *premia* and a high accumulation of debt tends to have quite strong and pervasive effects on investment demand and economic activity – essentially, borrowing costs and conditions deteriorate also for the private sector. Self-fulfilling expectations of default can rapidly translate into losses of productive capacity, unemployment, rising income risk and dissipation of human capital (as many firms close down, implying a waste of firm specific skills accumulated by workers). All these effects endogenously reduce the debt limit and/or increase government financing needs. While conceptually distinct in our stylised model, fundamental and self-fulfilling debt crisis cannot be kept apart when interpreting reality.

Third, and most relevant for DSA, identifying the fiscal limit $\hat{B}_{t+1}$ is not sufficient per se to assess vulnerability to liquidity crisis. As explained above, what matters is the fiscal limit in conjunction with the financing need of the government. Liquidity runs occur as the equilibrium of the economy changes, due to switch in the equilibrium agents coordinate their expectations on. While social sciences have not come up with a convincing model of how this switch occurs, it is plausible that, ex-ante, markets will be aware of this possibility. Provided debt and gross financing needs become large enough to induce beliefs that the country is in a multiple equilibria situation, investors may start to assign positive probabilities to a run. Recent empirical papers indeed document that this possibility is priced by the markets.[38] For given GFN, government borrowing costs rise when debt increase. Conversely, and importantly, for a given debt stock, borrowing costs also increase with the financing needs of the government. As expected in light of the theory of fiscal limits, both effects are non-linear and become stronger, as the current debt stock and GFN increase.

4.2   Liquidity crises and macroeconomic stabilization: lessons from an incomplete monetary union

The recent experience of the euro area suggests that fundamental costs of liquidity crises can be greatly magnified when macroeconomic policies are not efficiently conducted. The sovereign risk crises that affected many members arguably reflected belief-driven contagion and systemic effects, especially before the strong initiatives of the ECB in the summer of 2012. Country-specific sovereign and private spreads move with high correlation, often independently of any news related to national policies or developments.[39]

However, the sovereign risk crisis effectively induced a polarisation of the economic and financial space in the euro area, between safe and risky countries. This polarisation, in turn, had key implications for macroeconomic stability.

First, the common monetary policy rates translated into a very different monetary stance across borders, while an increase in government bond spreads drove the national cost of borrowing away from desirable levels in both strong and weak countries, feeding disagreement on the best conduct for the ECB to follow. Second, the spread crisis induced very conservative fiscal stances at a national level. Countries facing high spreads had no space for anticyclical policies: they simply had to cut under the pressure of markets. Countries with low spread became primarily concerned with the possibility of deteriorating market confidence, or simply had reasons not to internalise the union-wide need for countercyclical fiscal policy. They also pursued conservative demand policies. As a result, the stimulus from the fiscal side of the aggregate demand equation remained vastly insufficient, leaving to the monetary authorities most of the burden of euro-wide macroeconomic stabilisation.

The combination of these effects of risk polarisation exacerbated the negative transmission of the financial shocks to the real economy, igniting ``doom loops'' that endogenously amplified the cycle. To date, the euro area is still short of a macroeconomic stabilization framework that would secure its members from the risks of large economic downturn associated with financial crisis. This framework has a first order effect on debt sustainability. Any DSA exercise conducted before its definition will be severely limited by the considerable uncertainty surrounding its development.[40]

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[38] See Gabriele et al. (2017).

[39] See Brutti and Saure (2016) and Bahaj (2014).

[40] See e.g. the discussion in Corsetti et al. 2016.

4.3   Addressing liquidity crises: a credible backstop to government debt

Conceptually, addressing pure liquidity crises is relatively straightforward: there must be some form of lending of last resort. Consider an ``Official Liquidity Fund'' or ``Facility,'' OLF for short, which may or may not be under the same institutional roof as the OF in the previous section. Specific to the OLF is that, conditional on a liquidity crisis, it must stand ready to buy the country's debt at an official price which is slightly above the fundamental price in the good equilibrium (charge the fundamental interest rate), but well below the price including default risk. In our example above, this price will be $Q_t^{Market} > Q_t^{OLF} > Q_t^{Safe}$. Accounting for the debt purchases by the OLF, and distinguishing between the purchase price of the OLF and the market, the budget constraint of the country becomes as follows:

$$G_t - T_t + B_t = Q_t^{Market}B_{t+1}^{Market} + B_{t+1}^{OLF}Q_t^{OLF} = Q_t^{Market}\left(B_{t+1} - B_{t+1}^{OLF}\right) + Q_t^{OLF}B_{t+1}^{OLF}$$

where G denotes non-interest government spending and T denotes net government revenue (their difference defines the primary deficit). Rearranging, it is apparent that, in a liquidity crisis (the case of multiple equilibria), interventions in the debt market on a sufficient scale and at low enough interest rates can prevent debt accumulation above the limit, even if markets charge a large risk *premia* (i.e., they only buy at a high interest rate):

$$B_{t+1} = \frac{G_t - T_t + B_t - B_{t+1}^{OLF}(Q_t^{OLF} - Q_t^{Market})}{Q_{t+1}^{Market}} \leq \hat{B}_{t+1}$$

If B_{t+1}^{OLF} and Q_t^{OLF} are large enough (such that the above condition is satisfied), the equilibrium market price cannot be $Q_t^{Market} = Q_t^{Risky}$. The equilibrium price Q_t^{Market} is unique and equal to Q_t^{Safe}. But then, no actual purchase of debt is necessary, since the mere threat to intervene in the debt market (the strict definition of a backstop to government debt) is enough to eliminate the bad equilibrium.

For this policy to be effective, however, the backstop must be credible. Precisely, its institutional setup up must satisfy two conditions. First, interventions must be feasible on the required (sufficiently large) scale. Second, the official lender must be expected to carry out interventions fully, should the markets test its willingness to do so and ``run'' on debt.

The first condition hinges on the ability of the official lender to leverage its position, while still being able to finance its liabilities at the risk free rate. Indeed, offering a backstop can work only to the extent to which the official lender can buy debt at Q_t^{OLF} while selling bonds (raising resources) at better financial conditions, that is, at a price lower than Q_t^{OLF}. To put it into another way, the threat of using any "big bazooka'' to stabilise the government debt market is credible only to the extent that large debt purchases do not compromise the low risk-status of the bonds the OLF needs to issue to finance the expansion of its balance sheet.

The second condition raises issues concerning the objectives assigned to the OLF, and its budget constraint. In our example, eliminating self-fulfilling crisis eliminates default altogether, hence OLF-financed purchases do not put any public resources at risk. Consider the more realistic case in which, in addition to booms and large contractions, the economy is also vulnerable to disasters that occur with infinitesimal probability. Even if these disasters are extremely unlikely, they are still possible: when purchasing the country's debt, the OLF takes on some risk of balance sheet losses – there is "value at risk.'' Depending on the OLF statutory objectives, this residual "value at risk" may make the OLF reluctant to intervene ex-post, as a default may compromise its financial viability ex post (and its ability to borrow risk free ex ante), unless it can count on external guarantees, ultimately to be provided by national fiscal authorities.

In advanced countries, the provision of a backstop to government debt is one of the (if only implicit) function of the central bank (the specific features of monetary backstops are discussed in the Appendix.

4.4 Liquidity support and moral hazard

There is a key difference between lending during liquidity crises (discussed in the previous section) and bailouts addressing fundamental weaknesses. The former does not require any transfer of resources (either ex-ante or ex-post), while the latter requires a net transfer of resources ex-post (when adverse circumstances would lead to a default in the absence of financial support). Net transfers ex-post do raise issues in moral hazard, hence in the design of programme conditionality.

But does a backstop eliminating self-fulfilling runs create moral hazard? This is a question on which the policy debate is often unstructured. The following summarize three important arguments that help provide a constructive framework of analysis.

1. I start reiterating the observation that a backstop is effective without requiring any debt purchases ex-ante; hence, there is no transfer ex-post. The crucial effect is that of restricting the set of possible equilibria to the one in which debt is priced at its fundamental value. A number of contributions have made it clear that the eliminating self-fulfilling debt crises via a backstop may actually strengthen incentives to implement good policies and reforms, rather than weakening them.[41] The reason is straightforward: consider a government contemplating the implementation of reforms/policies that produce uncertain benefits in the future, but entails short-run electoral and economic costs. Vulnerability to self-fulfilling crisis does not affect the short-run costs of these policies/reforms, but makes the future benefits more uncertain, as runs on debt would arbitrarily move the economy from a good to a worse equilibrium. As the economy is generally worse off in a bad equilibrium, many of the beneficial effects of the government initiative would be dissipated in a switch between equilibria. If follows that the possibility of runs, if anything, reduces the expected benefits of short run actions, and with these a government's incentive to act.

2. A widespread argument nonetheless emphasises a different type of moral hazard, arising because of institutional distortions. The argument goes that once an official lender is set up and endowed with resources for intervening in favour of crisis countries, political pressures may lead its board to extend financing beyond liquidity needs and provide net transfers ex-post. This involution may well be a real concern. While lending institutions need to protect the interests of the creditors (in order to be able to operate over time), their decision-making bodies may represent also debtors and, most importantly, decisions may reflect non-economic (political) factors. Nevertheless, this is not an argument against official lending *per se*. It calls attention to the need to design a credible OLF institutional structure, defining precisely the scope of its mandate, its instruments and the constraints on its action.

3. A subtler potential adverse effect of a backstop is on a government's incentives to deleverage. The problem is that, by ruling out self-fulfilling crises, official liquidity lending *de facto* raises the capacity of a country to borrow at risk-free rates. Indeed, the key main advantage of an OF is that it creates space for countries to address adverse shocks with countercyclical policies: thanks to a backstop, countries are in a position to run sufficiently large deficits to support demand without fearing arbitrary debt crises.[42] However, countries cannot fully exploit this benefit, unless they keep average debt well below the threshold that can be considered safe given the backstop. If liquidity support just results in higher overall debt issuance, a large average stock of debt may end up creating dynamic vulnerability to fundamental default. This possibility analysed in depth by

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[41] See Morris and Shin (2006), Corsetti et al. (2006), Corsetti et al. (2018).
[42] See Corsetti et al. (2016).

Corsetti et al. (2018), who develop a dynamic quantitative model calibrated to the euro area experience, where debt sustainability is explicitly related to the terms (maturity and rates) of official loan.

A point of contact across the three arguments is that raising the access to liquidity support requires a reinforced fiscal compact – as already discussed in Section 3.

4.5 DSA and cash flow management

In light of the results from theory, the development of DSAs must draw on models that encompass both fundamental and liquidity risks, ideally accounting for the endogeneity of the state of the economy in terms of investment dynamics and unemployment, as well as institutional framework of official lending in which a country operates. Although the specification of these models is quite demanding, there are a few examples of theoretical and applied work in this direction.

A baseline but important instance of such models is provided by Conesa and Kehoe (2014, 2017), henceforth CK. There are two key reasons why this model is useful in the European context. The first is its key prediction: because of liquidity risk, sufficiently forward looking policymakers have a strong incentive to reduce debt levels; however, during a persistent recession, this incentive is moderated or reversed, as they try to keep spending smooth by delaying the adjustment—they ``gamble'' on economic recovery in the future.

The second is that the model can be readily developed to bear on the recent experience with official lending in the euro area. Corsetti et al. (2017) encompass in CK an official fund that can issue loans to the crisis country with different maturities (short and long) and a different spread over funding costs (high and low). In a stylised way, these different terms of official lending reflect IMF loans (relatively short maturity and high spread) and ESM loans (much longer maturity and low spread). The model is calibrated focusing on Portugal as a programme country case study.[43] Quantitatively, the model is able to replicate very closely the dynamics of debt and market spreads for this country, following the implementation of the programme.

Based on this calibrated version of the model, Corsetti et al. (2017) assesses the impact on sustainability of programmes varying in size, loan maturity and loan price, according to the current practice of the IMF and ESM. The results suggest that, even independently of Central Bank's policies, availability of official funds up to 20% of GDP greatly help the government to sustain debt and contain debt dynamics.

Two key results are most relevant for DSA purposes. First, official lending policies (can be designed to) raise the stock of debt that can be considered safe and facilitate deleveraging if debt exceeds the safe-level limit. This is so because it lowers borrowing costs and increases the fiscal space for the government to smooth out adjustment costs. The key trade-off is that, dynamically, official lending also tends to make the country more vulnerable to fundamental crisis (it lowers the upper debt limits). This is because, from the country perspective, official lending raises the desirable average level of debt around which the government stabilises its budget—this is what the IMF DSA documents label "long run debt", as opposed to 'maximum sustainable debt' (corresponding to our limits). But with a higher average stock of liabilities, it is more likely that the government will default for any given set of possible negative shocks.[44]

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[43] See Corsetti et al. (2017) for details.

[44] While markets price this enhanced default risk, the rise in borrowing costs are too small to encourage further deleveraging, to a debt level compatible with a default-minimising strategy. This result strengthens the

Second, the model emphasizes the importance of cash flow and debt management. Official lending contributes to sustainability on two fronts. First, by providing liquidity assistance and extending maturity, it reduces the need to rely on the market every period. Second, by charging low spread, it reduces the financing burden exacerbated by default risk. The quantitative simulations based on the model suggest that debt limits are much more sensitive to the maturity than to the cost of official loans.

This result lends strong theoretical support to the DSAs and official programme paying more attention to the analysis and management of payment flows over time, rather than simply focusing on debt stocks and trajectory.

5. BEST PRACTICES AND DIRECTIONS FOR DEVELOPMENT

This final section draws on a comparative reading of DSA documents produced by the IMF, the EC and the ESM, to point out best practices that could be shared across institutions and directions in which methodologies could be improved.

My focus will be on debt projections and sensitivity analysis, concerning (a) the need for models able to capture macroeconomic adjustments to shocks and (b) the need to enrich the policy reaction function looking not only at the response of the primary balance to debt accumulation, but also at the response of debt managers to shocks, influencing the time and state-contingent profile of the government gross financing need. By the same token, I present an argument for explicitly accounting for the catalytic effects of official lending in DSAs.

5.1 Incorporating feedback and general equilibrium effects in projections

The intertemporal budget constraint suggests that sustainability is incompatible with exploding paths for the debt to GDP ratio. Applying this insight, DSA produces debt projections based on the following equation, describing debt accumulation as a function of the interest bill, the primary balance and some potential adjustment stemming from the sales of assets (privatization):

$$\Delta b_t = \frac{i_t - \pi_t - g_t}{1 + g_t} b_t + primary\ deficit + adjustment$$

whereas for convenience I adopt the notation recurrent in official document by the IMF and EC: b_t is the debt to GDP ratio, i_t is the nominal interest rate, π_t is inflation, g_t is the growth rate; the primary balance (spending net of revenue) refers to a comprehensive definition of the public sector, and adjustment records changes in gross debt against sales of assets. As is well known, the interest bill contributes to raise the debt to GDP ratio to the extent that the real interest rate exceeds the growth rate. This "snowballing effect" is smaller, the higher the growth rate (in the denominator of the coefficient of b_t). Projections are used as benchmark to assess the adjustment in primary balances (the fiscal efforts) required to stabilize debt at some level, and/or to reach some stable debt to GDP ratio over a given time horizon.

A methodological challenge to DSA is that all the terms of this equation respond to each other endogenously. By way of example, any discretionary fiscal correction affecting the primary balance is likely to affect growth, interest rates and possibly inflation for some years. The multiplier effects of a discretionary contraction depend of course on the reaction of monetary policy[45] as well as on the state

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theoretical case for institutional pacts, such that the provision of official resources in the form of liquidity assistance or contingent transfers are accompanied by an agreement on credible caps on overall borrowing.

[45] See Woodford (2011).

of the business cycle. Multipliers are likely to differ in periods of financial and fiscal stress, relative to tranquil periods.[46] Similarly, a change in the real interest rates and growth reflecting, inter alia, global financial and monetary conditions, is bound to affect the path of the primary balance, via automatic stabilizers, but also by raising the likelihood of certain discretionary responses. One may even argue that the composition of public spending (e.g. spending in infrastructure) may affect economic activity at least in the medium term (when not in the long run, because of the presence of externalities). In addition, the risk premia may respond to the path of debt accumulation, although a linear function (generally motivated based on Laubach (2009)) may not be ideal. Historical evidence can be brought to bear on the sensitivity of the budget to the business cycle.

The need for this comprehensive approach to projections, realistically accounting for endogenous feedback effects, is apparent when carrying out sensitivity analysis to changes in underlying trends in productivity, growth and inflation, as well age-related or financial-stability related budget costs, or constraint on feasible budget adjustment due to the political process.

This is an area where DSA methodologies can be substantially improved, especially as longer time series become available for empirical assessment of relevant parameters and elasticities – subject to the important caveat that projections will also have to fully account for the considerable uncertainty surrounding this assessment.

The ECB DSA framework discussed by Bouabdallah et al. (2017) provides a thorough discussion of possible methodologies that may find a balance between the need to account for complex, general equilibrium effects, and tractability. It also proposes a ``narrative approach" to shocks, by which changes in trends of relevant variables are not standardized across countries (one-size-fit-all). Rather, realistic boundaries are endogenously estimated for each country, based on a fully harmonized methodology, historical evidence and country-specific analysis.[47]

5.2 The case for a fiscal reaction function augmented with debt management

One of the key assumptions underlying debt projections in traditional DSA analysis is derived from early theoretical work on policy rules, and concerns the endogenous response of the primary surplus to debt accumulation, commonly defined as the "fiscal reaction function". As is well known from the theoretical literature, a sufficiently strong response ensures sustainability.[48] In the practice of DSA, this response is estimated using sample data, with adjustment accounting for nonlinearities (the response estimated using sample data might be small in low-debt countries and arguably inappropriate in scenarios with shocks implying hikes in debt).

There is a case for enriching the policy reaction function going beyond the response of the primary balance to debt accumulation and incorporating the response to shocks by debt managers. For any given path of primary deficits, the decisions by debt managers influence the time and state-contingent profile of the government's gross financing need.

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[46] See Born et al. (2013) and Corsetti et al. (2012, 2013).

[47] DSA by the EC and the IMF already recognize the principle that historical and institutional behaviour should be encompassed in all exercises as a way to inject realism on the assumptions underlying the projections and the results from the analysis. The principle typically motivates historical assessment of policy rules and budget behaviour. The ECB provide an example of how the same principle can be applied more generally in other dimensions of the analysis. This is especially so in the sensitivity and robustness exercises, meant to shed light on potential deviations from a stable debt-to-GDP ratio due to realistic changes in key trends, that can be expected to materialize with nontrivial probability in a specific country.

[48] See Leeper (1991) and Bohn (1998).

Debt management is emerging as one of the core element of sovereign funding decisions. Debt managers actively optimize over the trade-offs between the need to contain borrowing costs (issuing short-term debt) and the need to reduce vulnerability to rollover risks and temporary "market jitters". The latter goal requires a careful management of the flow of payments resulting from the interest bill, and debt coming to maturity.

While DSA frameworks increasingly recognize the importance of encompassing financing needs among the key indicators of sustainability, they fall short of accounting for debt management practices in a satisfactory way. Athanosopoulou et al (2018) provides an instructive instance of how this gap can be closed. These authors embed in an otherwise standard DSA the decision model of an optimizing issuer, who minimizes borrowing costs while making sure that both debt flows and stock are kept within pre-set boundaries.

Developing DSAs along this line would allow a quantitative assessment of the implications of shocks and uncertainty consistent with a general policy reaction function, determining not only the response of the primary surplus to debt accumulation (as in the current practice), but also the strategy of debt managers adjusting the liabilities structure in response to different disturbances.[49] This goes well beyond the traditional DSA approach, where maturities are typically kept fixed across exercises. A richer DSA framework, with a more realistic account of debt management by the public sector, could also enhance the usefulness of DSA in providing feedback and policy guidance to national authorities and international institution. This development of the DSA is especially relevant for countries already in programmes, where a substantial share of payment obligations is to official lenders who, in the case of Europe, already design the terms of their financial support focusing on cash management.

5.3 Catalytic effect of official lending and market access

One key lesson from the recent euro area experience is that the way markets react to official lending crucially depends on how official loans are structured – their maturity and price. A preliminary case study is conducted by Corsetti et al (2017), looking at the different programmes granted to Portugal and Ireland from 2010 onwards. The evidence suggests a significant impact of lengthening maturities and reducing spreads of official loans, on yield curves and market access.

In light of this experience, a desirable development of DSA consists of incorporating market reaction functions, approximating the anticipated "catalytic effect" of official lending. So far, while playing a prominent role in the motivation for extending financial support, these effects are disregarded in DSA models.

Enriching DSA along this line is particularly important in contexts like the European one, whereas, based on the operational experience of the ESM, official and private lending may coexist over decades, raising issues on how to manage the former to smooth out and incentivize the latter.

6. CONCLUSIONS

This paper has provided an analysis of the current state of the art in DSA methodologies vis-à-vis the increasing importance of liquidity risks and contagion/spillover effects of a crisis, together with an analytical reconsideration of the policy distortions at the roots of these risks, stressing their implications for macroeconomic dynamics, fiscal viability and the design of international official lending programmes. Motivated by the current situation in the euro area, the analysis is focused on countries facing the need to reduce their stock of liabilities, support growth and contain vulnerability to liquidity runs.

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[49] See Dias et al. (2014) and Gabriele et al. (2017) for a recent discussion.

In this context, we have argued that the sharing of best practices, and some innovation, may lead to substantial improvements in current DSAs. Relevant directions for reforms include the integration of models that better account for the mutual dependence of growth, inflation, interest rates and fiscal policy in debt projections; a richer specification of the policy reaction function, capturing the response of the government to debt accumulation and shocks, that should encompass debt management as determinant of the debt structure; an account of catalytic effects of official lending, in terms of elasticities of prices and market financing to official support.

In concluding this paper, it is appropriate to reiterate the difficulties of the challenges faced by DSAs, especially in Europe, and add some comments. I will do so under two headlines.

6.1   Spillovers, contagion and liquidity risk

A key challenge to DSA comes from the size and incidence of spillovers and systemic effects of sovereign crises. As discussed in Corsetti et al. (2017) among others, the prospects of systemic fallout following a Greek default forced the IMF to deviate from its principle preventing lending to countries failing its DSA, i.e., considered at risk of default with high probability, even conditional on a programme. By adding the systemic exemption to the exceptional access policy, the Fund could lend into insolvent countries if this meant preventing large cross-border spillovers. The negative internal evaluation of this policy led the IMF to recall the exemption in 2016 (IMF (2013b)) and replacing it with a clause stipulating that IMF could still provide financial support to countries with an unsustainable debt (according to the Funds DSA), but only provided other official creditors commit to cover any funding gaps (IMF (2016)). This raises a key question: should the euro area follow suit and only lend subject to favourable DSA results, or should systemic considerations remain a factor determining official lending? The answer to this question is crucial in the design of an effective DSA.

The founding model of international institutions like the IMF rests on the idea of catalytic finance: conditional on the policies the country commits to while entering a programme, official lending is only meant to close any liquidity gap, not as a transfer into insolvency. The euro area experience suggests that programmes could be motivated on additional grounds. Official support can be efficiently structured to contain systemic costs from cross-border spillovers of crises. Given that the outcome of DSA guides the determination of whether, and the extent to which, a country needs to restructure its debt, bailout motivated by the effects of strong financial linkages and the risk of contagion should be fully integrated in DSA methodology.

A related core challenge is liquidity risk. Indeed, the ongoing evolution of debt sustainability analysis reflects a profound change in the context in which international institutions operate. An environment in which countries only irregularly resorted to international bond markets has moved into one in which governments operate in heavily financialised economies facing large, liquid, but also at times jittery bond markets. In this passage, the traditional approach to debt sustainability is challenged in many crucial dimensions.

Because of liquidity risk, debt management is emerging as one of the core element of sovereign funding decisions. Governments understand the importance of optimizing the trade-off between refinancing needs and borrowing costs, both affecting the dynamics of debt.[50] While current DSA frameworks also recognize the importance to encompass financing needs among their key indicators, so far, however, this is accomplished by means of simple rules for identifying rollover risks coming from maturing debt. The current progress still falls short of accounting for the practice of debt management in advanced economies.

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[50] See Dias et al. (2014) and Gabriele et al. (2017) for a recent discussion.

Public debt managers have become very active in pursuing issuance strategies that, while minimizing borrowing costs, aim to prevent peaks or an irregular profile of payment obligations from weighing negatively on sustainability, for any given outstanding stock of liabilities. DSA effectiveness could be enhanced via a better integration of DSA methodologies with these practices. Namely, DSA-specific models could be developed to redefine a general policy reaction function embedding not only the response of the primary surplus to debt accumulation (as in the current practice), but also the strategy of debt managers adjusting the liabilities structure in response to different disturbances.

This goes well beyond the traditional DSA approach, where maturities are typically fixed across exercises, and there is no account of how debt management can affect debt dynamics and refinancing needs. A richer DSA framework, with a more realistic account of debt management by the public sector, could also enhance the usefulness of DSA in providing feedback and policy guidance to national authorities.

As a corollary of this argument, embedding active cash flow management is even more crucial in relation to the possibility that a country access a programme. As stressed by Corsetti et al. (2018), the relations among market access conditions, sustainability and the terms of official support are endogenous. This endogeneity needs to be properly accounted for in DSAs, whereas current practices fall short of treating conditions for market access as related in a systematic way to the terms of official loans available to the country. Progress in this respect would help the international institutions both to improve the design of effective programmes, and to correctly evaluate sustainability conditional on them. The extent to which official support programs are successful in restoring growth and market access, while minimizing default, indeed can vary substantially with the terms of official loans, including maturity, costs and payment flow management.

6.2   DSA and the reform of the euro area governance

In the near future, a number of countries in the euro area will face the need to reduce their legacy public debt inherited from the crisis, in the context of low inflation and, realistically, protracted low growth. In this context, DSA could fulfil a key role, in guiding policy strategies minimizing sovereign and financial vulnerability.

In such a role, it may well be the case that DSA indicates the need for some restructuring of public debt. But for this to be beneficial, it is crucial that the assessment is strictly based on fundamental shocks and fundamental imbalances, such that market expectations remain "well anchored," rather than subject to the disruptive coordination problems described in Section 4. In this sense, the primary goal of the reform of the euro area governance is to minimize the risk of non-fundamental crises. This means that the new governance should fully recognize the threat of liquidity crises and contagion to the success of the European Economic and Monetary Union.[51]

A key lesson from the recent euro experience is that sovereign risk crises translate into country-risk polarization, which is not politically and economically sustainable, let alone compatible with the single market; correspondingly, they magnify macroeconomic and financial vulnerability to endogenous "tail risk" – due to the inherent obstacles that risk polarization creates in responding to shocks with sufficiently strong countercyclical policies (especially when policy rates are at the zero lower bound) and sufficiently strong liquidity provision to banks and sovereigns. As argued in Section 4 above, these two implications of the sovereign risk crisis in the euro area are really two faces of the same coin.

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[51] See the discussion at the end of Section 2. As appropriately noted by Zettelmeyer (2018), a specific goal of the new governance should be that of making restructuring at the same time less likely overall, but *more likely conditional on fundamental disequilibria*.

Indeed, there is a systemic dimension inherent in any reform of the euro-area governance. Overcoming the differences in economic and financial conditions that currently divide the area, feed disagreement on policies and institutional reforms and expose the area to tail risk requires not only (in some cases deep) adjustment at national level, but also convergence on a shared strategy. In this vein, some of the reform proposals share the idea that a process of fiscal consolidation and abatement of public debt could be facilitated by setting up temporary institutions (a common Fund) ensuring a relatively stable financial environment, and should go hand-in-hand with the progressive introduction of a distinction between senior (safe) and junior (risky) debt.[52] DSA will be crucial in this process.

By its very nature, DSA is a technical tool that can support decisions concerning macroeconomic and financial stability policies that are essentially sovereign. In other words: DSA can hardly have any legitimacy and credibility as an instrument, controlled by creditor countries, to force initiatives and policies by debtor countries, or to serve specific interests. This is particularly important in the institutional context of the euro area. A key precondition for its acceptance and its results to be considered as an important technical input to essentially political decisions is that both national and common institutions share full ownership of it.

DSA is a crucial tool of official lending institutions, required at all stages of their engagement, from surveillance to programme implementation. In spite of its possible imperfections, official lending should never be carried out, and not even evaluated as a possibility, without proper DSA. Having said so, one should also recognize the risks of market destabilization inherent in a more proactive resort to DSA in contexts, like the euro area, where the instruments, goals, limits, budget and the institutions in charge of official lending are still in the process of being defined. If anything, indeed, available DSA results underscore the urgency of completing the EMU framework.

A. APPENDIX:

## A.1. A GRAPHICAL ANALYSIS OF SELF-FULFILLING CRISES

The cases of safe debt, fundamental default-risky debt and vulnerability to self-fulfilling crises analysed in Section 4 are shown in three graphs below. These graphs plot how B_{t+1} (on the horizontal axis) grows with the price of debt $Q_t B_{t+1}$ (on the vertical axis). Since we consider two prices, in the graph we have two lines from the origin. The steeper line from the origin corresponds to the case in which the price of debt is high (the case of no default risk): the government needs to issue less new debt to satisfy its financing need. Conversely, the flatter line from the origin corresponds to the case of a low debt price (the case of risky debt): the government needs to issue more debt. In the graph, the debt limit, $\hat{B}_{t+1}$, is a vertical line, marking the two regions where debt is either safe (to the left) or risky (to the right).

The graphs make it clear that the equilibrium price will depend on the fiscal limit and the level of financing need. If the latter is very high, debt issuance will always be above the fiscal limit, even if markets charged the riskless rate. Hence the only rational price is the risky one and we have fundamental default (**Figure 1**, below). If the financing need is low, debt issuance will always be below the fiscal limit, even if markets charged a risk premium. Hence the only rational price is the riskless one and debt is "safe" (**Figure 2**, below). For intermediate financing needs, either price may be self-

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[52] For these schemes to produce the expected benefits, any access to guarantees and liquidity granted to government on (the safe portion of) their debt should be made conditional on satisfying strict fiscal criteria, essentially requiring a strengthening of fiscal rules. Moreover, it is important to stress that, for splitting senior and junior debt not to be neutral and contribute to financial stability, the cost of restructuring must be higher for senior than for junior bonds (see Ari et al. 2018).
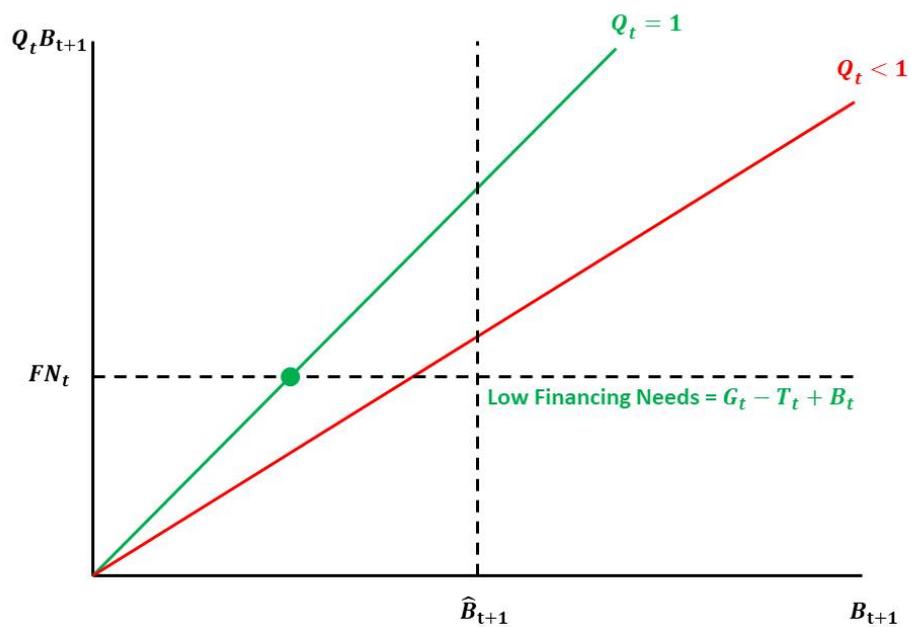
validating: there are multiple, self-fulfilling, equilibria (**Figure 3**, below). How the economy operates depends on which equilibrium is selected by the markets.
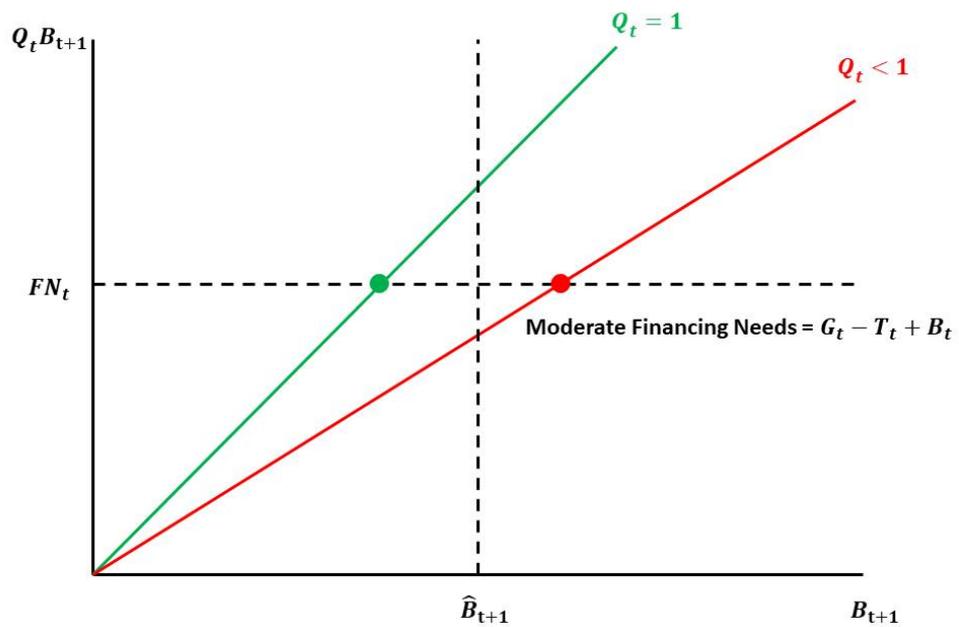
Figure 1: Fundamental Default.
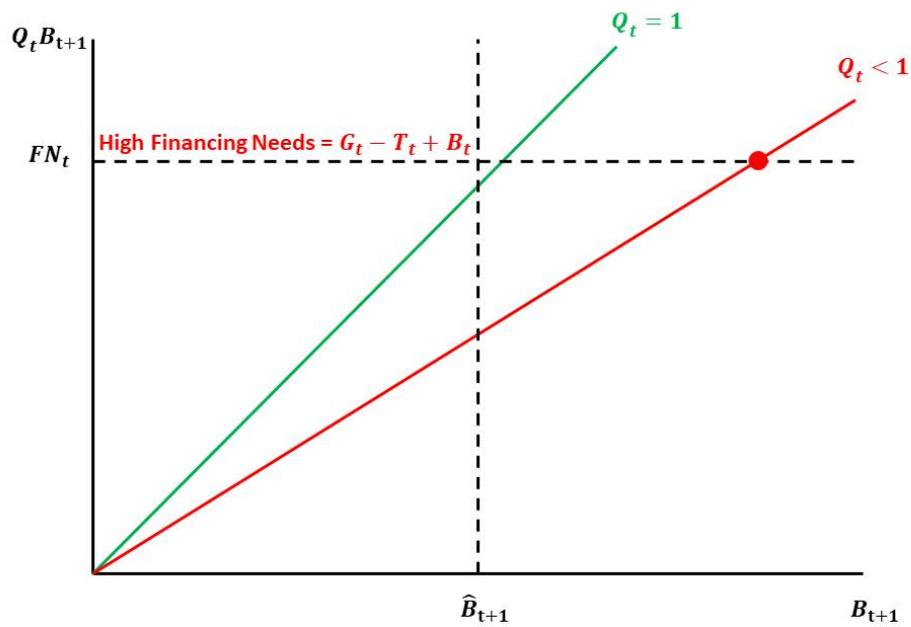
Source: Author's Illustration.

Figure 2: Safe Debt.

Source: Author's Illustration.

Figure 3: Self-Fulfilling Debt Crises.

Source: Author's Illustration.

A.2. MONETARY BACKSTOP

Monetary authorities provide an extremely effective form of backstop, a remarkable example being provided by the introduction of the Outright Monetary Transactions programme of the European Central Bank. At theoretical level, the logic of monetary backstops is exactly the same as the one just discussed in Section 4.3. In all of the expressions, we can simply replace OLF with CB, for the 'central bank'.

A graphical representation of a backstop is provided in **Figure 4**, below. In the graph, CB and OLF are interchangeable. Suppose that investors anticipate default risk and are willing to buy debt only at the default risky price, $Q_t < 1$. The central bank can prevent debt issuance rising above the fiscal limit by stepping in and buying some level of debt, B_{t+1}^{CB}, at a higher price. This contains debt issuance and eliminates the possibility of a crisis. Hence in equilibrium the debt price is $Q_t = 1$.

Figure 4: Monetary Backstop.
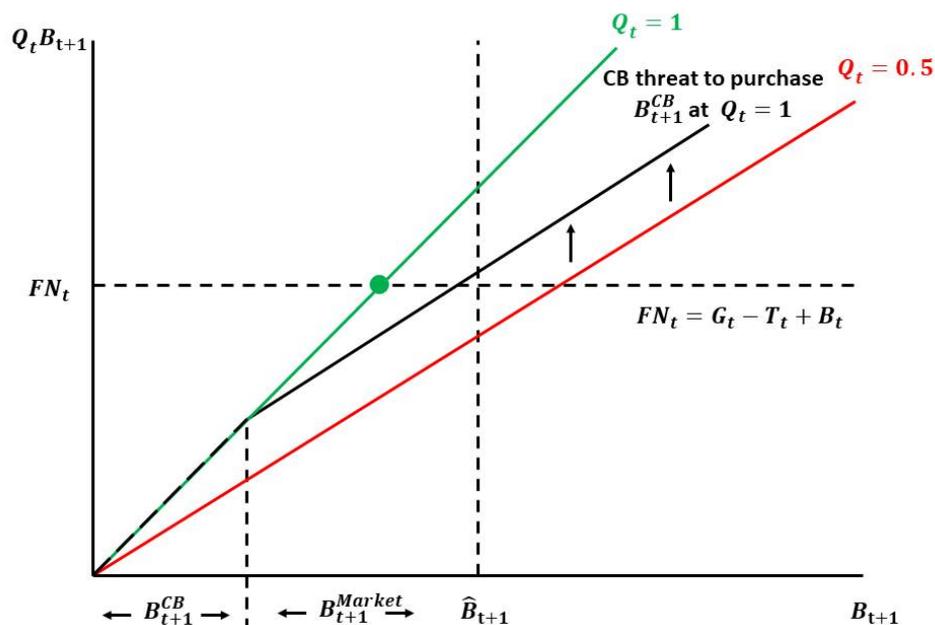
Source: Author's Illustration.

There are however a number of important specificities that distinguish interventions by an OLF and interventions by the Central Bank. As regards feasibility, a central bank can purchase debt on a large scale by expanding its balance sheet. Specifically, when a central bank buys debt, it finances its purchases by issuing monetary liabilities M_{t+1}^{CB}, mostly in the form of bank reserves, which are treated as essentially risk-free assets in nominal terms. We have:

$$B_{t+1}^{CB} = M_{t+1}^{CB}$$

Intuitively, private investors end up holding debt indirectly, as banks raise their holding of M_{t+1}^{CB}. After the global crisis, the central bank could easily finance large purchases of debt, a key feature of unconventional balance sheet policies. This is because, with nominal interest rates on risk-free assets close to zero or even negative, nominal risk-free liabilities and money have become close substitute. As (risk-free) market rates rise above zero, the central bank can still pursue unconventional balance

sheet policies, but they will have to exercise the option to remunerate bank reserves at some positive equilibrium rate.

Concerning the credibility of a monetary backstop, a central bank has a well-specified objective function, with a mandate that, in addition to the primary goal of price stability, may include macroeconomic, monetary and financial stability and, in the case of a monetary union, the integrity of the union itself. It should be stressed that these objectives clearly motivate the central bank to pursue a backstop policy, a point often stressed by the ECB president. But there are trade-offs between these objectives, and these may cause the central bank to be reluctant/unable to intervene ex-post, if tested by the markets. An important concern is whether debt purchases could lead to losses that would force the central bank to run the printing press, hence deviate from its inflation target or, worse, create monetary instability.

To be clear, this concern is not necessarily about actual losses from actual debt purchases. To the extent that a backstop is effective, the economy is in a good equilibrium and no intervention is necessary ex-post. In this case, the concern is about potential or theoretical losses: markets must be convinced that the risk of prospective losses would not prevent the central bank from acting, if they tested its willingness to act.

Three considerations are important in this respect. First, debt purchases are not causing future inflation if default is only due to self-fulfilling expectations. In this case, eliminating the bad equilibrium rules out default altogether. In the good equilibrium, the government repays all bond holders, including the central bank, in all circumstances. Hence the central bank does not suffer any `losses' on its debt holdings. So, the concern only arises if eliminating self-fulfilling runs does not eliminate the possibility of fundamental default. Second, even if possible, prospective losses are irrelevant for the monetary authorities' ability to pursue its inflation objective, if fiscal authorities are ready to recapitalise the central bank, or apply reduced or no haircut to central bank holdings of debt.[53] In this case, a default would imply no or limited balance sheet losses for the central bank, hence this will not be forced to run follow suboptimal monetary expansions to make up for these losses. In other words, the risk of default does not automatically foreshadow risks for inflation and monetary stability (provided there is a well-designed institutional lending framework).

Finally, it should be stressed that empirical and historical evidence shows a strong correlation between default and inflation. Using a long and rich sample, Reinhart and Rogoff (2010) document that, in the year in which a sovereign crisis erupts, on average output declines by 4% if the country defaults on domestic debt, against a decline of 1.2% if the country defaults on external debt only. The corresponding average yearly inflation rates are 170% (in cases of domestic debt default) against 33% (external debt default). The main lesson is that failure to avoid self-fulfilling default is extremely harmful for price and monetary stability. History teaches us that the choice is not between a monetary backstop (with risks for inflation) and no monetary backstop (to rule out these risks), because both options create strong risks for the central bank objectives.

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[53] In addition, they may not be relevant, as explained in the 2015 EEA Schumpeter lecture based on Corsetti and Dedola JEEA 2016, to the extent that the government in assessing the cost of default factors in the consequences of these losses on monetary stability. The lecture is available using the following link.

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The approach to Debt Sustainability Assessments (DSAs) has substantially evolved after the global crisis, consistent with the goal of improving detection of high and low frequency risks. DSAs cover an increasing number of indicators, systematically look into implicit and contingent liabilities, and use statistical methods to quantify "tail events". They also operationalize debt limits, by adopting thresholds for debt and payment flows to single out enhanced vulnerability. While these developments mark true progress, this paper focuses on liquidity risk, contagion risk and the identification of debt limits as critical areas limiting DSA effectiveness, explains why DSA should embed potentially available official support and how an incomplete lending architecture is a hurdle for DSA. The paper concludes with a comparative assessment of current standard DSAs, suggests directions for further improvement and discusses the correct use of DSAs in light of the strengths and weaknesses inherent in the underlying methodologies.

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