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# **Good Debt or Bad Debt?**

Roberto Tamborini



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# Good Debt or Bad Debt?

# Abstract

The public debt overhang spread across advanced countries, and the reform of the Stability and Growth Pact in the Euro Zone, have revived the polarization between those who think that debt is always good and those who think that debt is always bad. This paper presents a normative model of endogenous growth with debt-financed public capital. It is shown that no meaningful assessment of debt and its effect on growth and sustainability at any point in time is possible without reference to the whole debt trajectory and the specific state of the economy along the trajectory. An orderly and consistent analysis may be developed along two coordinates of debt: sustainability/unsustainability, and efficiency/inefficiency. "High" and "low" debt/GDP ratios may equally be efficient and sustainable. On the other hand, debt may be sustainable but inefficient (sub-optimal growth), or sustainable and efficient ex-ante but unsustainable ex-post, or inefficient and unsustainable.

JEL-Codes: E620, H630, O400.

Keywords: public debt, debt burden, debt sustainability, economic growth, endogenous growth models.

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# 1. Introduction

The public debt overhang bequeathed by the Great Recession and the Covid-19 pandemic, and then the reform of the Stability and Growth Pact (SGP) in the Euro Zone, have reignited the polarization between those who think that debt is always bad and those who think that debt is always good. The former urge for quick fiscal consolidation, the latter do not (Blanchard 2022). Such a sharp dichotomy is groundless but drawing the demarcation line is not an easy task.

Mario Draghi, addressing a wide general audience at a meeting in August 2020, with regard to the post-pandemic debt overhang drew a simple distinction between good debt and bad debt bound to become as famous as his "whatever it takes" rescue of the euro eight years earlier (*Financial Times*, August 18, 2020).<sup>1</sup>

This debt, subscribed by countries, institutions, markets and savers, will be sustainable, that is, it will continue to be subscribed in the future, if used for productive purposes, for example investments in human capital, in crucial infrastructures for production, in research etc., i.e. if it is "good debt". Its sustainability will be lost if instead it is used for unproductive purposes, if it is considered "bad debt". Low interest rates are not in themselves a guarantee of sustainability: the perception of the quality of the debt contracted is equally important. The more this perception deteriorates, the more uncertain the reference framework becomes, with effects on employment, investment and consumption.  $^2$ 

In this view, the boundary between good and bad debt goes through the debtgrowth nexus. Good debt sustains *future* growth and hence makes the debt *sustainable* (repayable) too, bad debt works to the opposite effect. The same view has been relaunched in the Report *The Future of European Competitiveness* signed by Draghi for the European Commission.<sup>3</sup>

As shown in the literature review in Section 2, policymakers and economists have long been engaged in the debate about the effects of debt on growth. The rather extended range and vintages of explanations that can be found in the literature present themselves as a scattered, heterogeneous and rather coarse constellation of theories, models and case studies. Overall, one may perceive the lack of deeper foundational work, with the consequence that prescriptive public finance policies, such as those enshrined in the SGP, rest on flimsy pillars.

Therefore, the aim of this paper is to present in Section 3 a normative framework whereby it is possible to draw a rigorous distinction between good debt and bad

 $\frac{3 \text{ https://www.google.com/search?client=firefox-d&q=the+future+of+european+compettiveness}}{3 \text{ https://www.google.com/search?client=firefox-d&q=the+future+of+european+compettiveness}}$ 

 $<sup>1 \</sup>underline{https://www.ft.com/content/55fc7bb7-0721-46c8-8dfa-9605f15b3422}$ 

<sup>&</sup>lt;sup>2</sup> <u>https://www.meetingrimini.org/incertezza-e-responsabilita-lintervento-di-mario-draghi-al-41-meeting/</u> My translation.

debt. To this end, it is necessary that the evolution of debt and its effect on growth are cast in an intertemporal horizon such that the whole debt trajectory and the specific state of the economy along the trajectory can be examined. This is done by means of a fiscal model of endogenous growth freely inspired to Barro (1990) and Diamond (1965). In Barro (1990) endogenous growth is sustained by productive public expenditure fully covered by taxation. This seminal model has been developed in several directions (see e.g. Zagler and Dürnecker 2003), but not to examine debt financed expenditure. To introduce debt, I adopt a sequential economy with two-period generations  $\hat{a}$  la Diamond (1965) where public expenditure is financed by debt in the first period and the debt burden in covered by taxation in the second period.

The contribution offered to debt assessment by this analytical framework is that the debt-growth relationship gives rise to four scenarios centred on the notions of *efficiency/inefficiency*, *sustainability /unsustainability* of debt. Consequently, first, debt assessment should take into consideration the complete intertemporal trajectory of the economy: spot assessments (let alone across countries) have poor information content. Second, the idea of the existence of a single threshold of the debt-GDP ratio beyond which debt harms growth and hence sustainability has no theoretical foundation. Third, country-specific characteristics, circumstances, and events have an overwhelming importance that cannot be encapsulated in a single general law. Research, and policy, should concentrate on the former and abandon the pursuit of the latter. Section 4 summarizes and concludes.

# 2. Public debt and economic growth. A brief review

The study of the relationship between public debt and economic growth goes back far in time. For the large part, studies have been motivated by the concern that debt hinders growth. The case that debt may enhance the long-run growth capacity of the economy has been less explored. This review is organized along four strands. The first concerns the evolution of the notion of "debt burden" in public finance where the relevant debt-growth channel goes through the consequences of *servicing debt as it falls due*. The second gathers another specialized literature concerned with the *policies aimed at consolidating debt and secure its solvency*. The third focuses on the *consequences of expected*, or effective, debt default. The fourth, as a corollary of the third, gives prominence to the notion that default on debt is more often a political choice than a technical necessity. Of course, there are overlaps across this classification, which inevitably involves some degree of arbitrariness.

#### 2.1 Debt burden and debt service

The idea that public debt may represent a burden for the economic system has distant origins in public finance. Its focus is on who and how should pay for debt, and with what consequences on the economy. Note that the concept of debt burden is broader than, and should not be confused with, the concept of debt sustainability (to be introduced later) though the two may be related. The impact of debt repayment on the economy, according to different repayment strategies, is of course central to this analysis. Debt management essentially consists of choosing a sustainable future path of expenditures and taxation, hence the problem is how various forms of expenditure and taxation affect economic activity and growth (e.g. Zagler and Dürnecker 2003).

The debt burden is usually identified and described by some indicators, and the most common involve the debt service: the interest-to-debt ratio, the interest-to-GDP ratio, the interest-to-taxation ratio, or the interest-to-export ratio. The amount of external debt with respect to the total outstanding debt is considered as a measure of the external burden, a relevant indicator when the focus is on the foreign creditors.

In the mid-1950s, Sun (1954) distinguished between three interrelated concepts of debt burden: psychological (subjective, and related to people's confidence in the government's debt policies and in the stability of the economy), financial (referred to the amount of taxes required to repay the principal and the interest charges), and real economic burden (related to a decrease in national income, a decline in production, etc.). Sun concluded that the effective burden of the public debt depends on the economic conditions, and that some principles must be respected in order to minimize it. The analysis turned to incentives in Meade (1958), who argued that a reduction in public domestic debt can improve economic incentives, but there could be a cost if the economic conditions worsen in the short run.

According to the concept of debt overhang proposed by Krugman (1988), the relationship between debt and the national product is described by an inverted U relationship. Thus, above a certain level of the public debt, both the debtor and the creditor countries could find it convenient to forgive a part of the debt. In addition, the incentive to invest in the country may be reduced when public debt becomes "large".

Cunningham (1993) proposed one of the first empirical analyses investigating the effect of debt burden on economic growth, in which the debt burden was measured as the rate of change in the long-run debt service to public and publicly guaranteed ratio. Its main finding indicates that the debt burden negatively affects economic growth. The latest wave of research on this front, those prompted by the pressure to fiscal consolidation across the advanced economies, and especially in the Euro Zone, in the aftermath of the Great Recession, has proved inconclusive (Gechert et al. 2015).<sup>4</sup>

In the same historical context, the empirical work by Reinhart and Rogoff (2010) had a remarkable impact. In a wide panel of countries, the authors identified a critical threshold of 90% of the debt-to-GDP ratio beyond which debt is harmful to growth. Several countries in the world, notably in the Euro Zone, were fast approaching that threshold or already were well beyond. The Reinhart-Rogoff finding prompted policy recommendations of fast fiscal consolidation.<sup>5</sup> Buoyant empirical research seeking the debt/GDP threshold above which growth is jeopardised was also spurred. The limit of 60% of the debt/GDP ratio confirmed in the new SGP shares this logic. Yet results soon turned out to be inconclusive or controversial, and the idea lost its momentum.

In the first place, the Reinhart-Rogoff work was criticized with regard to the implied causality (Irons and Bivens 2010),<sup>6</sup> and then for some methodological and statistical problems (Herndon et al. 2013).<sup>7</sup> Further works support the existence of critical debt-to-GDP ratios under various time and space observational fields (but there is no agreement on their level: see, among others, Pattillo et al. 2011, Baum et al. 2012, Checherita-Westpahl and Rother 2012). Some authors point out

<sup>&</sup>lt;sup>4</sup>As to the lively debate on austerity see e.g. Corsetti (ed. 2012), Buti and Carnot (2013), Tamborini (2015b). If not dictated by immediate insolvency threats, "austerity" was prescribed as a requisite for reinstating sound growth conditions before prolonged fiscal stimuli to the economy would become self-defeating as a consequence of debt growing too high (Buti and Pench 2012). In this perspective, the true issue at stake is whether austerity is a means to achieve fiscal consolidation with little or no output and employment losses, or as a means to restore growth, in the course of a recession.

<sup>&</sup>lt;sup>5</sup> "There should be little question that European economies share the need to reduce public deficits and debts from levels that, as confirmed by a growing strand of empirical literature (Reinhardt and Rogoff 2010, Kumar and Woo 2012) are likely to be harmful for growth in the medium term [...]" (Buti and Pench 2012, p.1)

<sup>&</sup>lt;sup>6</sup> Their application of the Granger causality test have showed that debt does not cause growth and growth does not cause debt.

<sup>&</sup>lt;sup>7</sup> The analysis was spoiled by coding errors, selective exclusion of available data, and unconventional weighting of summary statistics.

the existence of a positive relationship between debt and growth above a certain threshold (Minea et al. 2012). A third group of studies do not completely deny the existence of a negative relationship between the two variables, but rather claim that a *general* threshold is unlikely to exist, and that it provides no guidance towards the adoption of widespread policies of debt reduction (e.g. Bowdler and Esteves 2013, Pescatori et al. 2014). Country-specific characteristics, contingencies and events play a prominent role, thus prompting a branch of literature that attempts to comprehensively understand the debt-growth relationship and its determinants (Panizza and Presbitero 2014, Eberhardt and Presbitero 2015).

In retrospect, the main limitation of the debt-burden approach is that the capacity of the government (of the economy) to sustain the burden of the outstanding debt is unrelated to whether or not it has created, or is going to create, the necessary additional resources. The empirical pursuit of the debt-to-GDP threshold harmful to growth lacked deeper foundational work. Why should we expect a negative public debt-growth relationship in the first place? If such a relationship exists, why should it take the specific form of a threshold of the debt-GDP ratio, and why should we expect this threshold to be equally valid across time and space?

#### 2.2. Fiscal effort and consolidation policies

A corollary of the burden view is that, sooner or later, the government will be forced to implement some consolidation policy, i.e. a fiscal restriction aimed at reducing debt and bringing it onto a sustainable path. The connection between this argument and the conclusion that, therefore, high debt impairs growth is less straightforward than one may think at first sight.

Particularly relevant is the approach put forward by Bohn (1995, 1998), as it now provides a largely employed tool of analysis of debt sustainability (e.g. Debrun et al. 2020). It is based on the fiscal policy reaction function that relates the primary balance, as the control variable, to outstanding debt in such a way that the latter is kept on a path converging to some finite level (see e.g. Greiner et al. 2007, Ghosh et al. 2013, Passamani et al. 2015 for empirical applications to the Euro Zone countries). One main merit of this approach is that it allows for a relatively simple and measurable "fiscal effort" that should consistently be borne by the government (i.e. the relevant economic subjects) over time.

This can easily be seen by means of the standard dynamic equation of the debt/GDP ratio. If  $D_t$  is the amount of debt at time t, the corresponding debt-to-GDP ratio is  $d_t \equiv D_t/Y_t$ , and its level each year is given by

(1) 
$$d_t = \frac{1+i_t}{1+g_{nt}} d_{t-1} - b'_t - m_t + v_t$$

where  $i_t$  is the average interest payment on debt (interest rate for short),  $g_{nt}$  is the nominal growth rate of GDP, and  $b'_t$ ,  $m_t$ ,  $v_t$  are, respectively, the GDP-ratios of the fiscal primary balance, the monetisation of debt, and exogenous changes in the amount of debt. A primary surplus  $b'_t > 0$  generates a negative impulse to the debt/GDP ratio, and vice versa a primary deficit  $b'_t < 0$ . The monetization of debt operates analogously, and it is therefore a substitute for the fiscal effort.

As shown by Debrun et al. (2020), from equation (1) it is possible to derive the government's intertemporal budget constraint that establishes the solvency of the outstanding debt at any time t over a future time horizon T distant at will (also known as "transversality condition"):

(2) 
$$d_t \leq \mathbf{E}_t \sum_{s=1}^T b'_{t+s} \frac{1+g_{nt+s}}{1+i_{t+s}}$$

where the expected values of monetization and debt shocks are nil. This condition provides the kernel of the so-called "debt sustainability analysis" (DSA) that figures prominently in the new SGP. The presence of expected or estimated values on the right-had-side gives rise to stochastic DSA (SDSA)).

The necessity to pin down the sequence of primary balances, nominal growth rates and interest rates far into the future is obviously fraught with difficulties, and, almost certainly, errors along the path. Thus, implementation of standard sustainability analysis encounters a number of non-trivial issues (e.g. the choice of the appropriate discount rate, time horizon, and budget items) paving the way to controversial if not inconclusive judgements (e.g. Bohn 1995, Kanda 2011, IMF 2012, European Commission 2014).

Equation (1) can then also be used for a more limited, but manageable, notion and mandate of debt control and sustainability. According to (1), the year *change* of the debt-GDP ratio,  $\Delta d_t \equiv d_t - d_{t-1}$ , results to be (approximately):

(3) 
$$\Delta d_t = (i_t - g_{nt})d_{t-1} - b_t - \mu_t + v_t$$

The government's commitment to debt control implies that  $b'_t$  is targeted to achieving a specified non-increasing path of  $d_t$ , i.e.  $\Delta d^*_t \leq 0$ . The result is:

(4) 
$$b_{t}^{*} = -\Delta d_{t}^{*} + (i_{t} - g_{nt})d_{t-1} - m_{t} + v_{t}$$

As long as  $v_t = 0$ , the extent of the fiscal effort  $b^*_t > 0$  in compliance with the above fiscal rule may underpin the notion that the debt burden (i.e.  $d_{t-1}$ ) may depress growth provided that it is explained how the creation and persistence of primary surpluses depresses growth. Yet this route, too, has its own limitations.

First, compliance with (4) does not necessarily entail a fiscal effort commensurate with the outstanding debt. The extent of the fiscal effort, if any, is determined by other concomitant factors, namely the debt-path target  $\Delta d^*_t$ , the interest-growth gap  $(i_t - g_{nt})$ , the rate of monetization  $m_t$ . Even when the latter is on average, or systematically, zero, there can still be combinations of the debt-path target and the interest-growth gap such that  $b^*_t \leq 0$ , and hence debt is bound to decrease with no fiscal effort (Blanchard 2022).

Second, the link from fiscal effort to (nominal) growth to be inserted into (4) is far from uncontroversial. Apart from those mentioned above, a variety of other conditioning factors have emerged that blur the connection between high debt, large consolidation, and growth.

In this perspective, the front line has long been represented by the traditional Keynesian vs. neoclassical models of fiscal expansions or restrictions, revolving around the extent of "crowding out" (in case of expansions) or "crowding in" (in case of restrictions) of private expenditure. Note that, generally, these models yield mirror effects in the two cases.

As is well known, Keynesian models (e.g. in the IS-LM class) predict that fiscal restrictions have a net negative effect on economic activity. Typically, the net negative effect results form the direct impact of the fiscal restriction on GDP via aggregate demand, amplified by the Keynesian multiplier, and the indirect, though incomplete, "crowding in" of private expenditure by way of a lower interest rate. This standard result, however, has a tenuous relation with the debt-growth issue as is embodied in equation (4).

First, the role of the debt stock is, at best, indirect and implicit in that a "large" debt will require a "large" restriction. In the basic IS-LM setup at least, the interest-rate effect is not related to the stock of debt, but to the stock money: with a fixed stock of money, the contraction of economic activity reduces the transaction demand for money which is satisfied by a lower interest rate. Second, the endogenous variable is current GDP, not its long-run growth rate, and it is not specified whether the fiscal restriction is permanent or transitory. This connection, however, may be provided by the notion of "hysteresis" such that a temporary demand-led downturn may be translated into a long-run loss of output capacity on the supply side (DeLong and Summers 2012, Fatàs and Summers 2018).

The traditional neoclassical approach is well-known for predicting a small or null effect of fiscal expansions owing to their "crowding-out" effect on private expenditure (see for instance Bernheim (1989) for a reassessment). It is less noticed that, since the mechanisms involved operate symmetrically, fiscal contractions are expected to have small or null effect on economic activity, with the consequence that the debt burden may not be *per se* conducive for lower growth.

In fact, this class of earlier neoclassical models is characterized by perfectly rational consumers with a finite lifespan, with access to a perfect capital market, where the consumption level is determined by a utility maximisation process. Analysis focuses on the amount of loanable funds in the capital market. In this context, a fiscal surplus decreases lifetime consumption. However, provided that the economic resources remain fully employed, less consumption implies higher saving. The interest rate falls to keep investments equal to savings, crowding-in private expenditure.

Note two important caveats, however. The first is that the extent of crowdingout or crowding-in is largely seen as an empirical matter, and in some circumstances fiscal imbalances may retain some limited Keynesian effects on economic activity (Bernheim 1989). The second is that, as in the Keynesian counterparty, there is no explicit treatment of the debt stock and its effects on growth over time.

The modern neoclassical approach, that we can date back to the path-breaking works on "Ricardian Equivalence" by Barro (1974, 1989a, 1989b), lend further theoretical strength to the notion that budgetary adjustments along the government's intertemporal budget constraint are neutralised by compensatory adjustments on the private side.<sup>8</sup> Barro (1979) proposed a specific model incorporating the Ricardian Equivalence and an empirical analysis supporting it, while in Barro (1989b, p.1) he concluded that the Ricardian Equivalence is a "good first-order approximation to reality", supported also by the empirical evidence.

There are noteworthy differences with earlier neoclassical models. One is that households are characterized by a sort of "inter-generational altruism", as if they were living infinitely. If current public expenditure is financed by resorting to public debt, the current generation will leave the necessary amount of money to the following generation in order to compensate the future increment in taxes. Thus, Ricardian Equivalence has also the strong implication that public deficits have no effects on the interest rate, provided that households firmly believe that the government's intertemporal budget will be honoured. Hence, the hallmark of traditional neoclassical theory (and quite a popular argument about the negative effects of high indebtedness) is muted.

 $<sup>^8</sup>$  They may not be neutral on the supply side of the economy as long as intertemporal shifts between consumption and leisure are also considered.

Moreover, if creating a deficit is neutral on economic activity, creating the surplus when the debt service falls due will also be neutral (taxpayers have already hoarded the equivalent of taxation). Hence Ricardian Equivalence does not seem an appropriate backdrop to the view that high debt reduces growth as a consequence of consolidation policies. However, various aspects of this approach have raised doubts and debates also in the neoclassical camp fostering research of caveats and limitations to this theory.<sup>9</sup>

A variant in the same vein was introduced in the 1990s under the name of "expansionary fiscal consolidations", or "Non-Keynesian effects of fiscal policy", and it explicitly maintains that consolidation policies *are not necessarily harmful for growth* but, on the contrary, may have a positive effect. <sup>10</sup> Giavazzi and Pagano (1990, 1995), and Alesina and Perotti (1995) were among the first who put forward and test this hypothesis empirically, followed more recently by Alesina and Ardagna (2010, 2013), and others. Some evidence that "even drastic fiscal adjustments are not associated with major recessions" (Alesina and Perotti, 1995, p.24), was recalled in support of the Euro Zone "austerity" policies.

Though framed within the modern intertemporal approach, the reasons why from Ricardian neutrality fiscal restrictions become expansionary remain unclear. A possibility may be that the public sector *is not (no longer) on its intertemporal budget constraint*. A simple device is an unexpected shock that raises outstanding debt. In that moment, the private agents discover that fiscal consolidation (the present value of future public surpluses) should be *larger* than previously expected (see also par. 2.3 below). On the other hand, "Non-Keynesian" consolidation stories may in fact be due to several favourable Keynesian side-conditions, regarding in particular the concomitant stance of monetary and exchange-rate policies (e.g. Favero et al. 2011, Perotti 2012, Blyth 2013, Part 3). That a fiscal contraction accompanied by expansionary monetary policy and exchange-rate depreciation may end up with a neutral, or net positive, effect on GDP has been well known ever since the basic Mundell-Fleming model (Foresti and Marani 2014).

<sup>&</sup>lt;sup>9</sup> As reported by Bernheim (1989), the Ricardian paradigm needs unrealistic assumptions to hold that make it implausible. Ricardian equivalence has also been tested in experimental laboratories by resorting, in general, to an overlapping generations design. Cadsby and Frank (1991) supported the validity of the Ricardian equivalence, but further developments found evidence of departures if more articulated experimental designs are employed (see Slate et al. 1995; Ricciuti and Di Laurea 2003).

<sup>&</sup>lt;sup>10</sup> See Blyth (2013, pp. 205 ff.) for a recollection of the evolution of this idea.

As a matter of fact, this strand of literature was born, and has remained, essentially empirical being based on analyses of success stories of fiscal consolidations followed by fast recovery. Indeed, these analyses boil down to the choice of a growth-friendly consolidation design: a large and front-loaded one, with expenditure cuts rather than tax hikes (Alesina and Ardagna 2010, 2013, Carnot 2013).

With reference to the fiscal-effort equation (4), the effect of  $b_t^*$  on the growth rate depends not so much on its absolute dimension but on its composition. Public expenditure cuts do not impinge on the level of economic activity because households consume more in anticipation of less future taxes. The recommendation of a large and front-loaded consolidation relies on the argument that incomplete or delayed consolidation raises the present value of future fiscal surpluses; this is matched with less current spending and more hoarding by the private sector with a depressive effect on economic activity.

If the government fails to adopt the right consolidation design, then the conclusion may be that debt repayment has a negative effect on growth. Yet this conclusion also means that it is not the level of debt *per se* that can be pointed to as the determinant of future growth. Moreover, like the other approaches discussed so far, the focus is on short-run effects on economic activity, not on long-run determinants of growth.

The search for empirical support remains highly controversial as it intersects with the ever-lasting endeavour to estimate fiscal multipliers (Hebous 2011, Gechert et al. 2015). In parallel with a progressive reassessment of the Keynesian view, based on sizeable fiscal multipliers especially during downturns, some recent studies have cast doubts on the reliability of expansionary consolidations, and, more importantly, on their general value (IMF 2010). Perotti (2012) studies four individual episodes in different countries. He shows that all these episodes were in fact associated with an increase in growth but the explanation of why this occurred was to be found in the specific conditions of those countries. In line with this finding, Guajardo et al. (2016) argue that once changes in fiscal policy are motivated by a "desire to reduce the budget deficit and not by responding to prospective economic conditions", there is little evidence of any expansionary effects. Jordà and Tylor (2016) also conclude that a fiscal consolidation is always associated with a fall in real GDP over a period of five years. The Euro Zone is a natural observational field of large fiscal consolidations, and the prevalent assessments yield negative effects on subsequent growth at least in the short to

medium run, also controlling for other determinants of economic activity (Berti et al. 2013, in't Veld 2013, Beetsma et al. 2015, Fragetta and Tamborini 2019).

If the fiscal consolidation has Keynesian effects, the debt/GDP ratio may *rise* instead of falling, as in fact happened throughout the Euro Zone. This effect therefore envisages a possible reverse causality between higher debt ratio and lower growth that should be taken account in empirical estimations. As shown by Nuti (2013) and Tamborini (2013), this reverse causality occurs when the fiscal multiplier is greater than the *reciprocal* of the initial debt/GDP ratio.

Consider again the dynamic equation of the debt/GDP ratio (3), and assume  $m_t = v_t = 0$ . Let the interest rate be on its trend value *i*, and  $\phi = \Delta g_{nt} / \Delta b_t < 0$  be the Keynesian fiscal multiplier; this gives the deviation of nominal growth from trend  $\Delta g_{nt}$ , given a change in the primary balance ratio  $\Delta b_t$ . Hence  $g_{nt} = g_n + \phi \Delta b_t$ . This fact entails that the change in the debt ratio becomes

(5) 
$$\Delta d_t = (i - g_n - \phi \Delta b_t) d_{t-1} - (b_{t-1} + \Delta b_t)$$
$$= [(i - g_n) d_{t-1} - b_{t-1}] - (1 + \phi d_{t-1}) \Delta b_t$$

The term in square brackets yields the debt path with unchanged fiscal effort. The point is that an *increase* in fiscal effort ( $\Delta b_t > 0$ ) generates a negative impulse to the debt/GDP ratio only if  $(1 + \phi d_{t-1}) > 0$ , or  $|\phi| < 1/d_{t-1}$ . Hence, a combination of high outstanding debt and strong fiscal multiplier can eventually produce both *less growth* and higher debt/GDP ratio due to a *reverse causality* effect. Note that when the debt/GDP ratio is large, even a relatively small multiplier may produce this effect. This notion of "excess austerity", and the relevant empirical evidence, have been put forward especially by De Grauwe and Ji (2012, 2013).

#### 2.3. Sovereign risk and the confidence channel

Macro-models with sovereign risk, developed since the early '90s, may be regarded as adding a new, "micro-founded" channel to the debt burden view (examples are Corsetti et al. (2010, 2013); Buti and Pench (2012) provide a summary view with reference to the Euro Zone). As is the hallmark of this school, we find a composition of New-Keynesian and neoclassical features. The key feature is the connection between the level of the debt-GDP ratio, *its sustainability assessment on the part of investors in sovereign bonds*, and how this is translated into a risk premium. These models also offer a clearer identification of the departure point from fiscal expansions/consolidations neutrality in the standard Neo-Ricardian framework. That is to say, at some point in time, agents *do not have full confidence* that the government will honour its intertemporal budget. In a sense, whether a given stock of debt at any point in time is good or bad, and the *ensuing consequences*, are matter of the investors' assessment, a perspective akin to the principle of market discipline underlying the Euro-Zone fiscal rules.

According to Buti and Pench (2012), the key factors can be encapsulated in a formula of the "*stock* fiscal multiplier" like the following

(6) [1 - confidence] ÷ [1 + (monetary policy) + (competitiveness) – (financial constraints)]

Confidence relates to the forward-looking-ness of investors, i.e. their probability assessment of future default, and hence the demand for risk premium. Higher debt triggers lower confidence, higher risk premium and interest rate. This is transmitted to the long-term interest rate impinging upon private expenditure (for consumption and/or capital goods). It should be noted that the involvement of the interest rate is not due to the excess absorption of loanable funds (a *flow* concept that was involved in the earlier Keynesian-neoclassical dispute about the "crowding-out" effect of fiscal imbalances), but to the increasing sovereign risk of debt (a *stock* concept).

Other factors that affect this "debt multiplier" relate to the New-Keynesian side of these models: the monetary policy stance (an accommodative stance helps reduce the interest rate and sustain aggregate demand) and competitiveness gains via real exchange rate depreciation (which also sustain the foreign component of aggregate demand). Finally, financial constraints, another typical New Keynesian feature, inhibit Ricardian neutrality and amplify the impact of the interest rate on aggregate demand.

Reasoning in reverse, one may obtain further conditions for expansionary fiscal consolidations. Assume that the economy is in a state of high "debt multiplier" as represented by expression (6). Accordingly, output is depressed. If the government enacts an *unanticipated fiscal restriction* that lowers the probability of future default, investors demand a lower risk premium. The domestic private sector enjoys a lower interest rate and anticipates the lower path of future taxes: both spur expenditure. The higher the confidence, the smaller the multiplier of the consolidation, or it may even turn into a positive net effect. Unsurprisingly, such a rich set of factors yield nuanced results, and, once again, results are conditional on the state of economy and other side elements (Corsetti et al. 2010, 2013).<sup>11</sup>

<sup>&</sup>lt;sup>11</sup> "In relatively extreme cases where fiscal strains are severe and monetary policy is constrained for an extended period, fiscal tightening may even exert an expansionary effect. That being said, fiscal retrenchment is no miracle cure. Indeed, all our simulations feature a deep recession even if tighter fiscal policy, under the aforementioned conditions, may stimulate economic activity *relative to an even bleaker baseline* (Corsetti et al. 2010, p. 41, italics added)." The confidence channel has also been tested, and partially

Detecting the confidence in debt sustainability in the evolution of risk premia is uneasy because it is largely non observable and may be proxied by different variables. Berti et al. (2013), examining the impact of consolidation policies during the sovereign debt crisis in the Euro Zone, found evidence that the confidence channel worked perversely: confidence fell, and risk premia rose, because investors looked at the negative (short-run?) impact on growth instead of the long-run effect on debt sustainability. Blanchard (2011) dubbed this behavour as "schizoprhenic".

Passamani et al. (2015) present the results of a dynamic principal components factor analysis applied to a panel data set of the eleven major Euro Zone countries from 2000 to 2013 consisting of each country's spread of long-term interest rate over Germany as dependent variable, and an array of leading fiscal and macroeconomic indicators of solvency fiscal effort and its sustainability. They find evidence of *the reverse causality* recalled above, i.e. implementation of large fiscal consolidations was associated with higher risk premia. As already said above, this reverse causality undermines the disciplining role assigned to the market. Indeed, the announcement of the ECB's Outright Monetary Transaction programme improved the sustainability assessment of sovereign debts.

Overall, research on the Euro Zone crisis delivers a problematic picture of the "confidence channel" of the debt-growth relationship as far as the connection between the debt level and the "fundamentals" of its sustainability are concerned. In the first place, the relationship between the level (or growth rate) of public debt, the rise of risk premia, and speculative attacks turns out to be of dubious nature. Whatever the motivations behind rising risk premia, there is also evidence that 1) high debt levels may be more easily involved in confidence crises, 2) market pressure is a major vehicle for large fiscal consolidations, 3) these are likely to have strong and prolonged negative effects on economic activity (e.g. Born et al. 2018, Tamborini and Tomaselli 2019).

Others have instead pointed out that speculative attacks have been driven by analogy with the "original sin" of many developing countries which issue debt in a foreign currency (De Grauwe and Ji 2012, 2013). This argument brings an institutional factor to the forefront: sovereign debt in euros is "foreign denominated" for Euro Zone countries because the issuers do not have a central bank in control of the currency.

Another problematic area concerns the transmission channels of risk premia across countries. In this regard, there is evidence that post-2009 spreads not only

supported, through laboratory experiments: see Geiger et al. (2016), Mittone and Tomaselli (2017).

reflected country-specific fundamentals, but were also highly sensitive to "systemic risk" and other exogenous factors (Manganelli and Wolswijk 2009, Attinasi et al. 2009, Caceres et al. 2010). In particular, research has focused on "contagion", that is, the transmission of high spreads across countries via non-fundamental channels (Constancio 2012, Arghyrou and Kostunica 2012).

Finally, the thorny issue of the so-called "self-fulfilling expectations" comes to the forefront. It may be recalled that the then ECB President Mario Draghi opened his famous "whatever-it-takes" speech by saying that

(...) we are in a situation now where you have large parts of the euro area in what we call a "bad equilibrium", namely an equilibrium in which you may have self-fulfilling expectations that feed upon themselves and generate very adverse scenarios. So, there is a case for intervening, in a sense, to "break" these expectations (Draghi 2012, p. 4).

The introduction of self-fulfilling expectations in macroeconomic models dates back to the 1980s (Farmer 1993). In general, they also entail multiple equilibria, the selection of which depends on the state of expectations. In our context, the typical mechanism is one where, as default expectations arise, the cost of debt solvency also rises (e.g. because of higher risk premium) thus making the government default decision more likely.

The seminal study in our context is represented by the influential paper by Calvo (1988), who recognised that expectations about debt default may determine the equilibrium that is reached by the economy. Many other applications followed up to nowadays, and it is not possible to cite all of them. The Euro Zone crisis has also prompted new contributions.

De Grauwe (2012) presents a model of exogenous expectations determining an area of threat of self-fulfilling speculative attacks. Gros (2012) introduces a political-economy model of investors' subjective expectations of default affecting the market interest rate and the likelihood to observe multiple equilibria. Moreover, creditors may find it profitable to forgive part of a country's debt to avoid the default, in line with the debt overhang theory. By following the same methodology, Tamborini (2015) shows that multiple equilibria can arise as a consequence of investors' heterogeneous beliefs about primary balance sustainability, where the risk premium is higher the larger is the share of "pessimistic" investors about the level of fiscal effort beyond which the government prefers default. This model clarifies how the level of debt, its burden and sustainability are largely conditioned by the distribution of investors' beliefs. As the detected by the empirical studies mentioned above, when pessimistic investors prevail, fostering more ambitious consolidation plans is likely to be counterproductive as greater, instead of smaller, risk premium is the result, which triggers the reverse causality between higher debt/GDP ratio and lower GDP.

#### 2.4. Default as a government's choice

With regard to debt sustainability and default risk, it is necessary to remind that, as is clear from equation (3), a sovereign government can always achieve any desired debt-path target provided that it has full control over expenditure, taxation and possibly monetisation. The problem lies in the costs associated with these instruments. Therefore, default is better understood as *a policy choice* of the government trading off the costs of default with those of solvency (Gros 2012, Buiter and Rahbari 2013, Tomz and Wright 2013, Tamborini 2015).

A partial or total default on public debt, either explicit (a refusal to pay back the capital and a subsequent reduction in the outstanding amount of debt) or implicit (through high inflation rates – or even hyperinflation – that conspicuously diminish the real sovereign debt), is an extreme occurrence influenced also by the general financial and political situation as well as by agents' behaviour and expectations. Default may be unexpected, anticipated or even self-generated by creditors; each case has its own specific impact on the economy.

The economic consequences of default may be severe but concentrated in time, whereas the benefits of freeing the economy from the burden of debt may unfold over time. Behavioural aspects can play a role in terms of agents' belief about past debt efficiency, agents' expectations about current sustainability, and agents' confidence level about future debt repayments, though they are not deemed to be always founded. Notably, these aspects have the potential to be self-fulfilling, thus leading to the actual default that could otherwise have been avoided.

The historical literature about sovereign defaults is vast and it goes beyond the purpose of this work (see Reinhart and Rogoff 2009; a mainly quantitative and a mainly qualitative literature reviews are respectively provided by Stähler 2013 and Tomz and Wright 2013), but it may be useful to briefly recall the most recent case of the sovereign debt crisis in the Euro Zone between 2010 and 2012.

Throughout the euro's first decade, countries like Belgium, Italy, and Greece were characterized by high public debt-to-GDP ratios. Meanwhile, "emerging" and fast-growing countries like Spain and Ireland started from very low levels of public debt but rapidly rising levels of private debts. Initially, investors regarded sovereign debts in the Euro Zone as substantially equivalent prompting a remarkable convergence of interest rates towards the German safe rate. They became increasingly worried about debt sustainability after the Papandreu government's disclosure of the huge deterioration of Greek public finances, and after the sharp rise in the debt/GDP ratios due to the financial crisis and bank bailouts in other countries (notably Spain and Ireland), leading to a dramatic increase in the interest rates of the bonds of the so-called "periphery countries" (Greece, Ireland, Italy, Portugal, Spain). The New Keynesian models mentioned above have been designed to capture these events. Their negative debt-growth relationship is the result of the combined effects on consumption and/or investment of higher interest rates and the anticipation of fiscal consolidation or default (as already discussed, the conclusions about the growth effects of consolidation are instead ambivalent).

### 3. Four scenarios for the debt-growth relationship

On the basis of the previous literature review, it is not possible to reach a failsafe demarcation line between good and bad debt that hinges on the debt-growth relationship. Even less is theoretically founded the existence of a general debt-to-GDP threshold above which growth is consistently stifled. We now move to a further strand of literature, which sets the debt-growth relationship in a fully developed intertemporal framework in which the debt life and the output growth are examined jointly.

#### 3.1 Debt in intertemporal perspective

An important contribution coming from public finance is that public debt should be evaluated along its whole-time path rather than at a specific point in time. Debt is created for a reason or purpose, then it unfolds its effects over time, and these effects may, or may not, contribute to debt repayment. All these aspects are to be considered when assessing the relationship between debt and growth, whereas the sheer measurement of the debt level at some point may be uninformative or misleading.

To be more specific, when tracking the debt/GDP ratio it should be first recognised that this is given by the joint trajectories  $(D_{t-k}, ..., D_{t-1})$ ,  $(Y_{t-k}, ..., Y_{t-1})$ , determined by the underlying sequence of budgetary policies and their consequences on the economy. The observed values  $D_t/Y_t$  may be the outcome of an *efficient* or *inefficient* trajectory, while subsequently they may turn out to be either sustainable or unsustainable.

In this literature, the debt trajectory can be considered efficient if the use of debt is consistent with its purpose in terms of general criteria of economic efficiency, and if it has no distortionary effects on social equity and social welfare. Efficiency implies sustainability *ex ante*, the long-term solvency constraint represented by the condition that the present value of the future government deficits and surpluses converge to zero as *t* tends towards infinity. However, debt on an efficient trajectory may turn out to be unsustainable *ex post* owing to unforeseen events. Two other scenarios are possible: debt may be inefficient but sustainable, debt may both inefficient and unsustainable. These four scenarios have quite different implications in terms of growth, and, what is more important, the level of debt and the corresponding level of the debt-to-GDP ratio along the trajectory are irrelevant on their own.

An early example of this kind of analysis is the cyclical stabilisation role of fiscal policy theorised by Musagrave (1959). If debt is created during a slump and repaid during the recovery in order to equalise national income over the business cycle, both efficiency and sustainability (and intergenerational equity) are achieved. The time profile of debt may be quite different in different specific conditions.

Modigliani (1961) instead pointed out that an increase in the national debt (both internal and external) can be advantageous for the current generation, but it places a burden on future generations entailing a reduction in the available stock of private capital, thus causing a decrease in the future flows of goods and services. Analogous conclusions were reached by Bowen et al. (1960), according to whom, even if the repayment of the debt principal is continuously delayed, each current generation bears a burden represented by the taxes used to pay debt interests.

Another classic topic in this line of literature is the so-called "golden rule" of public finance (Musgrave 1964). This rule is the object of a long-standing branch of public finance which we need not examine here, whereas it is important to note how it fits in our four scenarios. As is well known, the rule states that the balance between current expenditure and revenues should be nil, while public debt is only allowed as a means to finance productive investment. Here the efficiencysustainability criteria are even more transparent. Productive investment is realised as growth-enhancing debt-based expenditure, and efficiency requires the equality between marginal product and social cost. Sustainability should be guaranteed by equality between the marginal increase in revenues due to additional growth and the debt service. Equity lies in the fact that the generation paying for debt also enjoys a higher level of income.

In this context, Diamond (1965) was the first who studied the effects of debt on economic growth properly. Diamond divided debt into external debt (borrowed from foreign lenders) and internal debt (borrowed from domestic lenders). External debt has negative effects on growth in the long run because of the taxes needed to finance interest payments. Taxes are levied on domestic lenders whereas interests are paid to the foreign ones. Initially, taxes reduce consumers' total lifetime income, and hence consumption. As a further consequence, taxes reduce savings and the capital stock. Internal debt, on the other hand, entails both effects as well as a reduction in the capital stock due to the fact that individuals substitute government debt for physical capital in their portfolios. Therefore, public debt crowds out private capital.

The 1990s have seen the emergence of discordant views. Some authors proposed models leading to opposite conclusions with respect to those of Diamond. For instance, Dotsey and Mao (1994) introduced distortionary taxation,<sup>12</sup> and in fact debt turned out to crowd-in investments. Ludvingson (1996) analysed deficit-financed fiscal policies in a forward-looking general equilibrium model and showed that the economy's response to an increase in government expenditure depends on how it is financed. In particular, distortionary taxes may lead to a decline in output, consumption and investments, while deficits may increase output and consumption. Moreover, deficit-financed cuts in income taxation may increase investments although agents expect future taxes to be higher (due to the substitution between leisure and labour), a conclusion supported also by Lin (2000). Therefore, according to this branch of works, there are no crowding-out effects and the impact of government debt on growth can be positive.

In this perspective, endogenous growth theory deserves a specific treatment. This approach spread during the 1990s attempting to explain how long-term growth can be generated without relying solely on exogenous or "residual" technological changes as in the Solow foundational model. This strand of literature is relevant to our topic because, following the model proposed by Barro (1990), it examines how fiscal variables interact with the variables that generate endogenous growth. Interaction can be indirect (this is typically the case of taxation) or direct to the extent that public expenditure can sustain endogenous growth. This latter case is particularly important because it marks a shift of approach with respect to the neoclassical views examined above which typically see public expenditure as sheer consumption of resources.

<sup>&</sup>lt;sup>12</sup>According to Kneller (1999), distortionary taxes in this context are those which affect the investment decisions of agents (with respect to physical and/or human capital), creating tax wedges and hence distorting the steady-state rate of growth. Nondistortionary taxation, on the other hand, does not affect savings and investment decisions and therefore has no effects on the growth rate.

The Barro model obtains a typical inverted U function of the relationship between public expenditure and growth, with an optimal level of expenditure (taxation) that maximizes growth. Public expenditure is fully covered by taxation and taxation depresses growth. Below the optimal level of public expenditure, the government does not exploit its growth-enhancing effect, beyond that point the growth-depressing effect of taxation prevails. On the other hand, the bulk of this literature is concerned with the effects of fiscal variables on growth along a balanced budget path, showing a rich variety of results and policy implications (see Zagler and Dürnecker 2003 for an accurate survey), which however are not immediately suitable for analysis of the debt-growth problem.

More to the point, Teles and Cesar-Mussolini (2014) proposed an endogenous growth model in which the effect of fiscal policy on economic growth is negatively affected by the level of the debt-to-GDP ratio. This effect works via the debt interest: a portion of young people's savings is extracted and paid to elderly people, who do not save, thus implying an allocation exchange between generations. The negative effects of government debt on growth have been shown also by Saint-Paul (1992) and, by studying the impact of fiscal constraints (limited tax and debt capacity) on growth, Aizenman et al. (2007) reached similar conclusions: lower maximal tax rate and higher outstanding debt can lower the growth rate, supporting the fact that differences in growth rates can stem from differences in fiscal policy constraints.

In the subsequent sections I shall characterize and discuss the debt-growth relationship in the four scenarios centred on the efficiency-sustainability criteria recalled above within the intertemporal setup of the fiscal models of endogenous growth, on which public debt is grafted as a means to finance productive public expenditure.

#### 3.2 Endogenous growth with efficient and sustainable public debt

The fiscal model of endogenous growth that follows is freely inspired to Barro  $(1990)^{13}$  and Diamond (1965). Barro (1990), as said above, represents a now standard model of growth sustained by productive public expenditure fully covered by taxation. To introduce debt in this setup, I adopt a sequential economy with two-period generations  $\hat{a}$  la Diamond (1965)<sup>14</sup> where public expenditure is

<sup>&</sup>lt;sup>13</sup> Drawing on the version by Barro and Sala-i-Martin (1998, ch. 4).

<sup>&</sup>lt;sup>14</sup> The difference here is that the generations do not overlap, but I assume that they comply with the intergenerational pact that each generation leaves the same endowment of capital to the next.

The key assumption in the Barro model is that the economy consists of competitive firms producing an aggregate output Y according to a neoclassical (Cobb-Douglas) production function augmented by productive public expenditure, where productive means a kind of expenditure in public goods that can raise private factors' productivity (typical examples are infrastructures, education, research, health care, etc.). This feature is introduced by means of the complementarity between private capital and public expenditure under two dimensions: non-zero output requires *non-zero inputs of both factors*, their technical coefficients (contribution to production) sum to one.

I reformulate the Barro production function in terms of private capital K, and *public capital*  $K_G$  (i.e. the *stock* of public goods mentioned above): (7)  $Y_t = A_t K_t^{\ \alpha} K_{Gt}^{\beta} L_t^{\ \beta}$   $\alpha + \beta = 1$ 

In order to introduce public debt, I simply assume a gestation time of capital of one period, so that the firms and the government alike need to borrow in advance in t in order to buy the respective capital goods that will be operative in t+1. Then the economy operates as a sequence of two-period generations. The generation starting in period t is endowed with labour  $L_t$  and private capital  $K_t$ . Labour is supplied inelastically in each period and normalized to 1. Likewise, for the time being, let us set the scale factor at constant value  $A_t = 1$  in each period. The depreciation rate of private and public capital is 100%.

If the private sector realises net investment in addition to depreciation by the amount  $I_t$ , the private capital stock  $K_{t+1} = K_t + I_t$  will be operative in t+1. The government, too, can invest in public capital the amount  $G_t$  financed by debt,  $D_t = G_t$  so that public capital  $K_{Gt+1} = G_t > 1$  will also be operative in t+1. Therefore, feasible production in t+1 will be:

(8) 
$$Y_{t+1} = K_{t+1}^{\alpha} K_{Gt+1}^{\beta}$$

The government fulfils its intertemporal budget constraint by taxing all incomes in period t+1 with the flat rate  $\tau$ . Incomes include the public debt service (principal and interests). Therefore, the following government budget equality holds:

(9)  $\tau Y_{t+1} = (1 - \tau) D_t R^d_{t+1}$ 

where  $R^{d}_{t+1}$  is the unit debt service.

Under the efficient capital market hypothesis, the interest rate is equalized across the private and public sectors, so that,  $R^{d}_{t+1} = R_{t+1} \equiv 1+r_{t+1}$  is the gross return to capital, determined as the marginal product of private capital, i.e.:

(10) 
$$R_{t+1} = \alpha \left(\frac{K_{Gt+1}}{K_{t+1}}\right)^{\beta}$$

Given  $D_t = K_{Gt+1}$ , and  $R^d_{t+1} = R_{t+1}$ , the public budget constraint (9) sets the feasible stock of public capital. Since  $Y_{t+1}$  is determined by (8), the result is

(11) 
$$K_{Gt+1} = K_{t+1} \left(\frac{\tau}{(1-\tau)R_{t+1}}\right)^{1/\alpha}$$

This expression can also be interpreted as the optimal public/private capital ratio  $k^*_{t+1} \equiv K_{Gt+1}/K_{t+1}$ . The complementarity between public and private capital is the first key feature of this economy.

Substituting  $k^*_{t+1}$  into the interest rate equation (10), the latter results to be

(12) 
$$R_{t+1} = \alpha' \left(\frac{\tau}{1-\tau}\right)^r$$
  $\alpha' = \alpha^{\alpha}$ 

The second notable result is that the marginal product of private capital, and hence the interest rate, are invariant to the capital stock - a result propaedeutic to endogenous growth. The interest rate is however a concave function of the tax rate, which leads to the peculiar relationship between debt and growth in this economy.

To this end, we have first to consider the optimal consumption path of the representative household of the *t*-th generation, which maximises a time separable logarithmic utility function subject to its two-period budget constraints:

(13) 
$$\max_{Ct, Ct+1} U(C_t, C_{t+1}) = \log(C_t) + (1 + \rho)^{-1} \log(C_{t+1})$$
  
s.t.  $C_t = Y_t - I_t - D_t$   
 $C_{t+1} = (1 - \tau)[Y_{Lt+1} + (K_t + I_t + D_t)R_{t+1}] - W_{t+1}$ 

where  $Y_{Lt+1}$  is labour income,  $\rho > 0$  is the rate of time preference, and  $W_{t+1} \ge 0$  is the final stock of wealth. The inter-generational characteristic here is that  $W_{t+1} = K_t$ , i.e. each generation leaves to the next one the same capital endowment received from the previous one.

By combining the first order conditions with respect to  $C_t$ ,  $C_{t+1}$ , we obtain the Euler equation and the optimal consumption path

(14) 
$$\gamma \equiv \frac{C_{t+1}}{C_t} = \frac{(1-\tau)R_{t+1}}{(1+\rho)}$$

As usual, an increase in the (after tax) interest rate raises  $\gamma$ , while an increase in the rate of time preference decreases it. Substitution of the interest rate equation (12) into (14) yields the growth equation for this economy, namely

(15) 
$$\gamma = \frac{\alpha'(1-\tau)^{\alpha}\tau^{\beta}}{1+\rho}$$
$$\frac{\partial\gamma}{\partial\tau} > 0, \ \frac{\partial^{2}\gamma}{\partial\tau^{2}} < 0$$

We thus see the crucial result, namely that growth is a concave function of the tax rate necessary to service the debt. Concavity reflects the double-edge role of taxation:  $\tau^{\beta}$  is the growth-enhancing effect of financing public capital,  $(1-\tau)^{\alpha}$  is the growth-depressing effect of taxing capital income. As a consequence, there exists a unique tax rate  $\tau^*$  that maximises  $\gamma$ ,<sup>15</sup> namely (16)  $\tau^* = 1 - \alpha$ 

which is the same result as in the original Barro model. Notably,  $\tau^*$  is equalized to the technical coefficient of public capital ( $\beta = 1 - \alpha$ ), i.e. its contribution to production, which satisfies the standard notion of efficiency (see section 3.1). Higher  $\beta$  sustains both higher taxation and growth, whereas higher time discount sustains less growth.

Figure 1 exemplifies this result with different values of  $\beta$  and  $\rho$ . The reference case assumes the standard values  $\beta = 0.6$  and  $\rho = 0.02$ . As can be seen the case with higher  $\beta$  ( $\beta = 0.7$ ,  $\rho = 0.02$ ) yields higher optimal growth, whereas the case with higher  $\rho$  ( $\beta = 0.6$ ,  $\rho = 0.04$ ) yields slightly less optimal growth.



The public finance implication is that, given  $\tau^*$ , each generation has its own optimal public debt which is both sustainable and efficient. In particular, there is neither "crowding out" when debt is created in *t* (indeed there is crowding-in)<sup>16</sup> nor is there excess fiscal burden in *t*+1.

 $<sup>^{15}</sup>$  Although, as is well known, the maximization of growth does not necessarily coincide with maximization of utility of the representative consumer.

<sup>&</sup>lt;sup>16</sup> According to equation (10), as long as  $\tau < \tau^*$ , raising public capital increases the marginal product of private capital, which allows for a larger private capital stock, and shifts consumption to the future, which generates more saving for capital accumulation.

As to the debt/GDP ratio, it can first be noted that the relevant ratio (in terms of debt burden) for the *t*-th generation is given by the GDP equation (8), i.e.

(17) 
$$d_{t+1} \equiv \frac{K_{Gt+1}}{Y_{t+1}} = \left(\frac{K_{Gt+1}}{K_{t+1}}\right)^{\alpha}$$

Hence, the key variable is the public/private capital ratio. Equation (11) sets the feasible ratio. Substituting  $R_{t+1}$  and  $\tau$  with the respective optimal values (12) and (16) the result is yet again a concave function of the technical coefficient of public capital  $\beta$  <sup>17</sup> reproduced in Figure 2.

It is worth noting that greater values of  $\beta$  sustain greater debt/GDP ratios up to a critical value of  $\beta$  beyond which the sustainable debt/GDP ratios are lower.<sup>18</sup> That is to say, different technologies would yield different optimal debt-GDP ratios, so that no generalisation or comparison is meaningful across time or different economies. In other words, "high" and "low" debt/GDP ratios may equally be efficient and sustainable.



#### 3.3 Sustainable but inefficient debt

The previous model provides an immediate instance of cases in which public debt is sustainable but inefficient in terms of growth. Since the relationship

$${}^{17}d_{t+1}^* = \left(\frac{\beta}{(1-\beta)^2}\right)^{1-\beta}$$

<sup>&</sup>lt;sup>18</sup> The decreasing part of the function is due to the complementarity between public and private capital. As the contribution of capital to production increases, the contribution of private capital decreases and less debt-to-GDP is sustainable. For  $\beta = 1$ , and  $\alpha = 0$ , output is linear in public capital so that the optimal debt/GDP ratio is just 100%.

between taxation and growth is concave, the cases in consideration occur whenever public debt, i.e. public capital, is either too low or too high with respect to (17). In the former case, the government fails to exploit the full range of growth-enhancing public investment; in the latter excess investment requires excess taxation that depresses growth.

Therefore, note in the first place that growth may be sub-optimal not only because debt is "too high". In the second place, even when debt is in fact too high, it remains perfectly sustainable. Indeed, lower growth is due to the fact that the government complies with sustainability by levying excess taxation with respect to  $\tau^*$ . This, moreover, need not come as an unexpected event but may be fully anticipated. In other words, inefficiency defines a set of effects of public debt on growth that do depend neither on unsustainability nor on default risk but, quite the contrary, on the anticipation of the sustainable path of fiscal policy. Finally, sustainable debt is not synonymous with efficient fiscal policy and optimal growth of the economy. As explained in the previous sections, the threshold between efficient and inefficient level of debt is hard to draw in comparisons over time or across different countries.

#### 3.4 Efficient but unsustainable debt: again on fiscal consolidation

The third case we examine is one where public debt is ex-ante efficient and sustainable whilst it is not ex-post. We model this situation by means of an unanticipated shock that in the second period of the *t*-h generation lowers total factor productivity. This simple device may capture different situations: from true recessions to ex-ante overvaluation of public investment productivity, or misbehaviour of the government that deviates a share of debt to unproductive uses. In any case, the consequence which we focus on is the necessity of fiscal consolidation in the second period, i.e. a fiscal adjustment that guarantees debt solvency.

The first period of the *t*-th generation is the same as in the base case, except that the coefficient A in the production function is now a (positive) random variable of unit expected value which in *t*+1 takes the value  $A_{t+1} < 1$ . Note that, by assumption, the stocks of private and public capital operational in *t*+1 have been installed in *t* and are irreversible (denoted by a bar) Consequently,

(18)  $Y_{t+1} = A_{t+1} \overline{K}^{\alpha}_{t+1} \overline{K}^{\beta}_{Gt+1} = A_{t+1} Y^*_{t+1}$ 

where  $Y^*_{t+1}$  denotes the ex-ante optimal GDP as in the base case. Therefore, the government budget as given by equations (9) and (10) and the optimal tax rate  $\tau^*$ 

=  $\beta$  can no longer be satisfied. A fiscal consolidation is necessary, and to this end the government changes the tax rate so that<sup>19</sup>:

(19)  $\tau_{t+1}A_{t+1}Y^*_{t+1} = (1 - \tau_{t+1})D_t \bar{R}^d_{t+1}$ 

From the base model, we know the ex-ante optimal values of  $Y^*_{t+1}$  and  $\bar{R}^d_{t+1}$ Upon substituting these values and  $D_t = \bar{K}_{Gt+1}$  into (19), we find that the solvency tax rate is

(20) 
$$\tau^{s}_{t+1} = \frac{1-\alpha}{1-\alpha(1-A_{t+1})}$$

which clearly shows that the new tax rate should be higher than  $\tau^*$  the worse the productivity shock.

What are the concomitant effects of fiscal consolidation on the economy? The first is that the growth rate is reduced, *yet this is the direct and exclusive effect of the productivity shock on the GDP path*, not of fiscal consolidation by itself. The second effect, directly due to fiscal consolidation, is on households' consumption which necessarily deviates from the optimal path given by (14). The increase in the tax rate, in addition to the productivity shock, affects the t+1 budget constraint as follows

$$C_{t+1} = (1 - \tau^{s}_{t+1})[(1 - \alpha)A_{t+1}Y^{*}_{t+1} + (K_t + I_t)R_{t+1} + D_t\overline{R}_{t+1}^d] - K_t$$

where  $(1-\alpha)A_{t+1}Y_{t+1}^*$  is the gross income share of labour. Likewise, we can write  $(K_t + I_t)R_{t+1} = \alpha A_{t+1}Y_{t+1}^*$ , and therefore

(21) 
$$C_{t+1} = (1 - \tau^s_{t+1})[A_{t+1}Y^*_{t+1} + D_t\bar{R}^d_{t+1}] - K_t$$

As can be seen, households suffer from lower gross income from the private sector, and higher tax rate. Moreover, their consumption is fully constrained by current disposable incomes, so that the economy also displays this "Keynesian" feature.

#### 3.5 Inefficient and unsustainable debt

Debt-financed public expenditure may be *ex-ante* inefficient for a number of reasons, ultimately because the government spends and taxes too much (beyond the optimal level identified in the first scenario) or because the projects are in fact less productive. To simplify our analysis of the fourth scenario, we can note that when the economy is hit by an adverse shock as in the third scenario, public debt observationally results both inefficient and unsustainable *ex post*. Drawing on the political economy literature on the default choice mentioned in section 2.4, we now examine the point that, since fiscal consolidation is a costly decision for the

 $<sup>^{19}</sup>$  Unlike the equity-based private capital, the debt-based public capital is committed to paying the interest rate established ex ante.

government, it may consider the option of default. Yet also default is a costly decision.

To address this problem various specifications of the government's decision are available. In our context, it is natural to assume the representative consumer's utility as the welfare function of the government.<sup>20</sup> Consequently, let us consider the post-shock consumption level in t+1:

(22) 
$$C_{t+1} = (1 - \tau_{t+1})[A_{t+1}Y^*_{t+1} + (1 - \phi)D_t \bar{R}^d_{t+1}] - K_t$$

where the government has two policy variables, the tax rate  $\tau_{t+1}$  and the rate of "haircut" of the debt repayment  $\phi$ . Note that the former variable affects consumption via after-tax income, whereas the latter affects consumption via pretax income. The point is that the two variables are inversely related: to the extent that the government lowers  $\tau_{t+1}$  below the solvency level  $\tau^{s}_{t+1}$  given by (20), it should raise  $\phi$ . In fact, on the basis of the government's budget, we obtain that

(23) 
$$\phi = (\tau^{s}_{t+1} - \tau_{t+1}) \frac{(A_{t+1}Y^{*}_{t+1} + D_{t}\bar{R}^{d}_{t+1})}{D_{t}\bar{R}^{d}_{t+1}}$$

Since by (19)  $\tau^{s}_{t+1} = D_t \overline{R}_{t+1}^d / (A_{t+1}Y_{t+1}^* + D_t \overline{R}_{t+1}^d)$ , hence  $\phi = 0$  if  $\tau_{t+1} = \tau^{s}_{t+1}$ , and  $\phi = 1$  if  $\tau_{t+1} = 0$ .

Upon substituting  $\phi$  into (22),  $C_{t+1}$  results a concave quadratic function of  $\tau_{t+1}$ . The optimal debt policy is the ( $\tau^d_{t+1}$ ,  $\phi$ ) combination that maximizes the *post-shock* consumer utility, i.e.

(24) 
$$\tau^{d}_{t+1} = \tau^{s}_{t+1}/2, \ \phi = 0.5$$

where (d) denotes that the tax rate implies default.

Interestingly, the optimal debt policy is independent of any other variable except the solvency tax rate  $\tau^{s}_{t+1}$ , but of course this is due to the utility function that we have assumed. It is however generally true that post-shock consumption is concave in  $\tau_{t+1}$ , i.e. it reaches a maximum for a specific combination ( $\tau^{d}_{t+1}$ ,  $\phi$ ). This result prompts two remarks. First, (partial) default is always a policy option for a government facing (unexpectedly) unsustainable debt. Second, the effect of debt on the economy cannot be gauged independently of whether debt is inefficient/unsustainable, and the government chooses the default option.

 $<sup>^{20}</sup>$  This treatment simplifies the scenario in that taxation and haircut hit the same subject. This is not always (often it is not) the case. For instance, part of debt may be held by foreign subjects whose well-being is not relevant to the government. On the other hand, defaulting on foreign obligations may generate other kinds of costs (reputation, market access, etc.) that may be relevant.

# 4. Final remarks

The distinction between "bad debt", which represents a deadweight burden on the future generations, and "good debt", which instead self-repays itself by fostering growth is not an easy task.

Recently, research on the relationship between public debt and growth has been mostly empirical, and largely dominated by the pursuit of "the" debt-to-GDP ratio beyond which debt depresses growth and/or becomes unsustainable. The limit of 60% debt/GDP ratio confirmed in the new SGP shares this logic. Yet no univocal conclusion has been reached either about the quantification of any critical ratio or even about its existence. As a matter of fact, no meaningful assessment of debt and its effect on growth at any point in time is possible without reference to the entire debt trajectory and the specific state of the economy along the trajectory.

In this perspective, this paper has shown that an orderly and consistent analysis may be developed along two coordinates of debt assessment: sustainability/ unsustainability, and efficiency/inefficiency. If, for instance, debt is on a sustainable and efficient trajectory, the debt level, the debt-to-GDP ratio and the growth rate at any point in time may be whatever is consistent with the fundamentals of the economy, and specifically the contribution of public capital to production. On the other hand, debt may be sustainable but inefficient (suboptimal growth), or sustainable and efficient ex-ante but unsustainable ex-post, or inefficient and unsustainable. The mere comparison between different countries has no informative value. Specific analyses, leading to different predictions, are necessary when public debt is either inefficient or unsustainable, and whether the government wishes to consolidate or not.

If a comprehensive conclusion may be drawn is that each country's debt history and specific characteristics, circumstances, and events have an overwhelming importance that cannot be encapsulated in a single general law. Research should concentrate on the former and abandon the pursuit of the latter.

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