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The existential trilemma of the EMU in a fiscal target-zone model

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Abstract

The lesson we draw from the EMU crisis of the 2010s, and from the outbreak of the COVID-19 pandemic, is that the EMU, when exposed to large, systemic shocks, faces a trilemma among preserving its irreversibility, monetary orthodoxy and fiscal orthodoxy as established in the founding treaties: either monetary orthodoxy or fiscal orthodoxy, or both should be relaxed. First, we elaborate this concept by means of a fiscal target-zone model, in which EMU member governments are willing to abide by the commitment to debt stability under the no-bailout clause only up to an upper bound of their feasible fiscal effort. We show that EMU irreversibility, in order not to remain a wishful statement in the founding treaties, necessitates to be completed by carefully designed ramparts for extraordinary times along with regulations for ordinary times. Second, drawing on the target-zone literature, we show how these devices can be designed in a consistent manner that minimises their extension and mitigates the moral hazard concerns. The alternative to these devices is reformulating the treaties with explicit and regulated exit procedures.

Keywords: COVID-19 pandemic, Fiscal Target Zone, Public Debt, Speculative Attacks, Fiscal Orthodoxy, Monetary Orthodoxy.

JEL Codes: E65, F34, F36

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1. Introduction

The conversion rate between the euro and the national currency of a country accessing the European Economic and Monetary Union (EMU) is said to be "irrevocably fixed". More generally, EMU membership has been conceived, and is regarded *de facto*, as irreversible.[1] Nonetheless, human institutions may turn out not to be irreversible, beyond good will. The balance among ideal, social, political, economic motivations and interests may turn from favourable to unfavourable. As political economists would put it, institutions should pass the test of cost-benefit analysis by members. The institutions of European integration make no exception.[2]

After a remarkably prolonged honeymoon, this awareness has become more intense over the last decade. There are two catalytic episodes. For the European Union as a whole, one is obviously "Brexit", the United Kingdom's leaving the EU. The other, for the EMU in particular, is the swarm of sovereign debt crises after 2010, when "exit" movements gained voice and political momentum across the EMU (not only in ailing countries), while the EU institutions themselves were no longer able to contain the gusts of temporary separations, or outright divorces.

From this point of view, there is now broad agreement among scholars and institutional bodies that the EMU was built in an "incomplete" way and remained incomplete despite the frantic corrections made during the crisis. The lesson of these events is that the irreversibility of EMU membership, and thus the integrity of the EMU itself, if it is not to remain a wishful claim in the founding treaties, needs carefully designed ramparts for extraordinary times alongside regulations for ordinary times (see e.g. Brunnermeier et al. 2016, Corsetti et al. 2020, Orphanides 2020, Lane 2021). In this paper we want to contribute to this line of thinking with two points.

In the first place, the EMU in its original conception rests on the "twin orthodoxies" of monetary independence and fiscal discipline, established and articulated in the Maastricht Treaty and the Stability and Growth Pact (SGP) with subsequent modifications. The twin orthodoxies, often integrated in the so-called "no-bailout clause", means neither debt monetisation by the European Central Bank (ECB) nor fiscal transfers across governments. In Section 2, we argue that the sovereign debt crises of the 2010s and the outbreak of the COVID-19 pandemic have shown that when exposed to large, systemic shocks, the EMU faces a trilemma: *its irreversibility can only be saved by relaxing either monetary orthodoxy or fiscal orthodoxy, or both*. The crisis of the 2010s was painfully overcome only after some relaxation of

[1] "Unlike the conditions for accession to the EU, which are addressed, even if not exhaustively, in Article 49 TEU11, neither the founding treaties (...), nor the successive amending treaties made until the ratification of the Lisbon Treaty, made any provision for a Member State's withdrawal (negotiated or unilateral) from the EU or EMU" (Athanassiou 2009).

[2] See e.g. Cohen (2000), Alesina et al. (1995, 2005), Spolaore (2013), Andreozzi and Tamborini (2019). The cost-benefit approach to monetary unions has played a central role ever since the theory of Optimum Currency Areas (Kenen 1995). Ultimately, "member states have to be better off inside than they would be outside" (Draghi 2014). As Bilbie et al. (2021) put it bluntly, "we do not think that in the long-run a eurozone can be based on anything other than self-interest" (p. 79).

monetary orthodoxy *vis-à-vis* the tightening of fiscal orthodoxy. By contrast, it is widely agreed that, after some initial hesitation, the reaction to the pandemic shock has been stronger and faster, most importantly on both the monetary and fiscal side, where the "unorthodox" innovations contained in the Next Generation EU Programme (NGEU) figure prominently.

In the second place, in Section 3 we elaborate the EMU trilemma by means of a fiscal target-zone (TZ) model. This blends models of sovereign debt management with the TZ modelling technique originally developed in the field of exchange-rate theory, in particular at the time of European Monetary System (EMS).[3] In our model, public debt can be hit by random shocks. EMU member governments are willing to abide by the commitment to debt stability under the twin orthodoxies only up to an upper bound of their feasible fiscal effort (measured by the ratio to GDP of the primary surplus), beyond which the costs of compliance are deemed larger than those of noncompliance. Large enough shocks push the stabilisation fiscal effort beyond the feasibility constraint, in which case a government would opt for default on debt service and abandonment of EMU membership – similarly to the abandonment of an exchange-rate agreement.

In this framework, in Section 4 we show that EMU completion means providing a monetary and/or fiscal emergency backstop to the irreversibility principle. Drawing on the TZ literature, we show how these devices can be designed in a consistent manner that minimises their extension and mitigates the moral hazard concerns. The alternative to these devices is reformulating the treaties with explicit and regulated exit procedures. Section 5 summarises and concludes the paper.

2. The EMU Trilemma

The rationale for the creation of the euro was popularised by the celebrated metaphor of the "inconsistent quartet" coined by Tommaso Padoa-Schioppa (1982). As the process of European economic integration was gaining momentum, he warned that the four cardinal points of free trade, free mobility of capital, a system of fixed exchange rates and autonomous national monetary policies were incompatible. "The circle cannot be squared: one element has to be surrendered in order to avoid any inconsistency" (p. 7). The inconsistency became evident with the collapse of the EMS in September 1992. Somewhat paradoxically, that event accelerated the process towards the single currency, vindicating Padoa-Schioppa's (1987) earlier claim that the EMS "was not enough" and that a complete monetary union was needed, with monetary sovereignty being "the element to be surrendered" in order to resolve

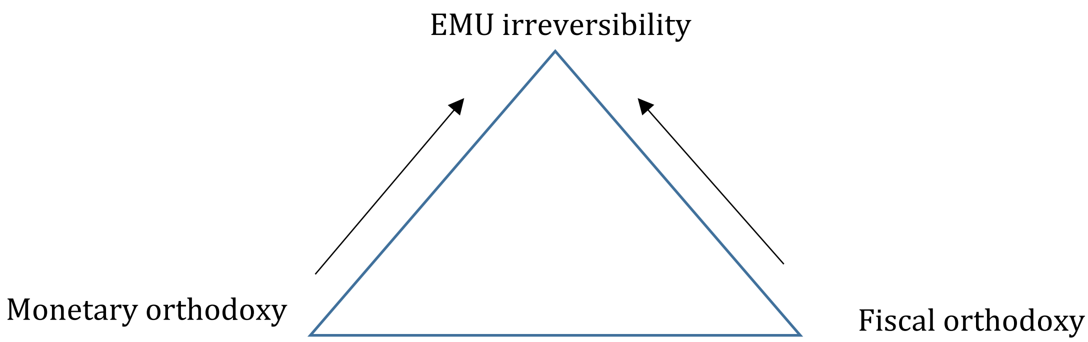
[3] The application of exchange-rate TZ models to the case of speculative attacks on public debt in the EMU was proposed for the first time by Della Posta (2018, 2019).

the inconsistent quartet. The events of the 2010s proved that the EMU, as it had been conceived, was not enough either.

As a matter of fact, one can find some analogies between the two crises of the EMS and of the EMU. Corsetti et al. (2020) point out four of them: costly adjustments of fundamental divergences, poor policy coordination and cooperation, exposure to "self-fulfilling" speculative attacks, and lack of a backstop to the integrity of the system. Yet, whereas this last deficiency in the case of the EMS was mitigated by the escape lane of realignments, or outright exit, in the case of the EMU no easy escape lane is open, which may transform the euro into a "trap" (Sinn 2014). Notably, Corsetti et al. (2020) also argue that the countries involved in the EMS collapse recovered more successfully and rapidly than at the time of the EMU crisis, not only thanks to currency devaluations, but also because national central banks and governments found ways to support their banking systems and sovereign debt markets, which have been partially precluded in the EMU.

COVID-19 has hit the EMU still convalescent after the crisis of the 2010s, with growth remaining anaemic in 2018-19, and, what is more important, with the backlog of unresolved institutional weaknesses. Born to free the European integration process from the embarrassments of the "inconsistent quartet", the EMU has encapsulated it into the trilemma among preserving the irreversibility of the euro on the one side, and "monetary orthodoxy" and "fiscal orthodoxy" on the others (see Figure 1).

Figure 1. The EMU Trilemma



The lesson of the early phase of the EMU crisis, between 2009 and 2012, is that, in the presence of a *systemic shock*, with *several member countries* falling under severe economic or financial distress, it is not possible to preserve both the twin orthodoxies and the irreversibility of the euro. Either monetary or fiscal orthodoxy, or perhaps both to some extent, should be relaxed.

People left alone in the face of huge social and economic costs do not care much about macroeconomic orthodoxies and their very long-run virtues, while at the same time they become intolerant of limitations to the sovereignty of their freely elected governments (O'Rourke and Taylor 2013).[4] Thus, well before "Brexit", the ghost of "Grexit", and possibly of other countries under a debt attack, materialised with the 'No' in the 2015 Greek referendum on the conditionality of debt restructuring agreed by the Tsipras government with the so-called "Troika" formed by the International Monetary Fund, the European Commission and the European Central Bank.

Some empirical research on the determinants of spreads during the sovereign debt crisis has found evidence of nonzero breakup probability under the form of the so-called "redenomination risk". That is to say the risk that, as a consequence of a breakup, a country redenominates its debt in the new national currency heavily depreciated against the euro, thus causing a large capital account loss for foreign debt holders (Di Cesare et al. 2012, De Santis 2015).

The ECB's move into the unchartered territory of "unconventional monetary policies" since 2012 can be viewed as a relaxation of monetary orthodoxy in rescue of EMU irreversibility. This move is represented by the arrow on the left-hand side of the triangle in Figue 1. As a matter of fact, the goal was achieved almost immediately in force of President Draghi's announcement of the ECB's new stance in July 2012 and the subsequent launch of the Outright Monetary Transactions programme, which has never been activated. Whether, and the extent to which, monetary orthodoxy was relaxed remains highly debated. No doubt there was substantial and unprecedented recourse to unconventional tools, including purchases of sovereign bonds on secondary markets which, though practiced by other central banks, conflicted with the well-established interpretations of the ECB's mandate (see e.g. Siekman and Wieland 2014, Brunnermeier et al. 2016, Part III; Schnabel 2020a).

On the other hand, there is wide agreement that monetary relaxation was obtained *vis-à-vis* the preservation of fiscal orthodoxy by means of "austerity". The fiscal regulatory tightening is documented by the new dispositions known as Six Pack, Two Pack, and Fiscal Compact (Brunnermeier et al. 2016, Part III). Agreement also extends to the critical assessment of the ensuing euro-area policy mix consisting of accommodative monetary stance *vis-à-vis* restrictive fiscal stance. This mix is considered to be responsible for both the EMU's unduly prolonged stagnation and the institutional overburden on the ECB alone (see Orphanides 2020 for a recent overview).

[4] Rich empirical literature has investigated the relationship between the EMU crisis and the surge of euro-skeptic or openly anti-euro movements and parties: see e.g. Tosun et al. (2014), Guiso et al. (2016).

After some backward looking hesitation, the reaction of the EMU policymakers to the COVID-19 shock in the course of 2020 marked a clear U-turn with respect to the crisis management of the 2010s. As urged by a large majority of scholars (e.g. Baldwin and Weder di Mauro, eds., 2020), the monetary and *aggregate fiscal* stances were swiftly aligned in complementary support to the EMU-wide economy, as indicated by the arrow on the right-hand side of the triangle in Figure 1.

The ECB has relaunched its quantitative easing measures with a specific Pandemic Emergency Purchases Programme (PEEP) largely targeted to sovereign bonds. The main novelty is that also the appropriate aggregate fiscal stance for the EMU as a whole has been pursued in three ways. First, by (temporarily) lifting the fiscal constraints at the country level. Second, by enhancing access to central resources available at the European Commission, the European Stability Mechanism, and the European Investment Bank. Third, by creating, for the first time, a central fiscal capacity backed by a pool of common resources, a significant part of which is collected on financial markets, namely the Next Generation EU (NGEU) programme. The whole fiscal package leads to a significant relaxation of fiscal orthodoxy in order to share with the ECB some of the burden of EMU irreversibility.

Whether these will be extraordinary exceptions, or the beginning of change in the EMU architecture in order to resolve the trilemma, remains to be seen. It will depend on the economic and political scenarios that will materialise once the pandemic is over.

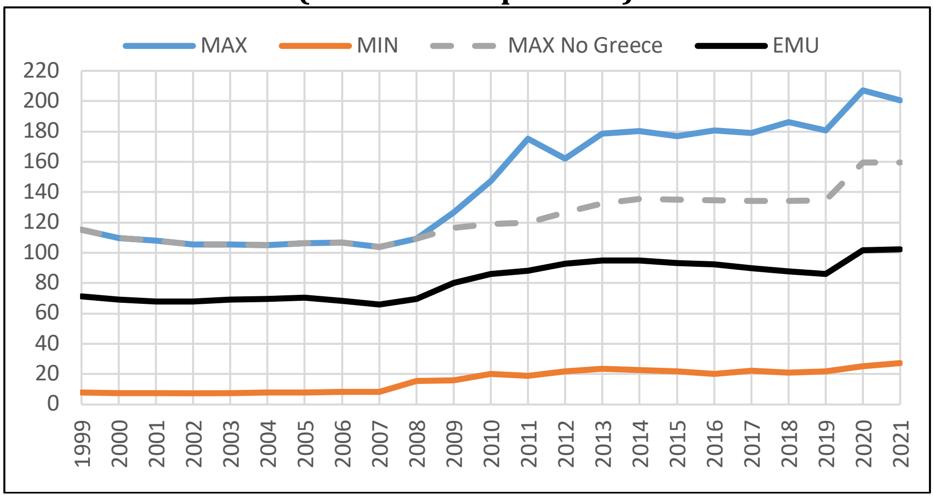
3. The model

As a preliminary stylised representation of public debt evolution in the EMU, Figure 2 reproduces the band between the highest and the lowest level of the public debt-to-GDP ratio, centred on the ratio of the EMU as a whole, from 1999 to 2021. These data suggest that debt has gone through three phases: 1999-2008, 2009-19, 2020-21. Each change of phase corresponds to major external shocks, the Global Financial Crisis and the Great Recession in 2009, and the COVID-19 pandemic in 2020, with a "jump" into a higher band after the shocks accompanied by a higher standard deviation (about 28%, 36% and 43%, respectively).

During each phase, however, the debt band showed substantial stability, with the highest and lowest debt countries remaining the same, and no major changes in the standard deviation. While, on the one hand, high-debt countries failed to converge towards the 60% target, on the other, there was no evident upward drift, signalling some stabilisation effort made by governments. This pattern is clearer if Greece is excluded as the single country that "trespassed the band" and fell into a partial default procedure.

How far can governments' stabilisation efforts go, and under what conditions is this consistent with EMU irreversibility?

Figure 2. Band of the highest and lowest debt/GDP ratios in the EMU 1999-2021 (variable composition)



Source: elaborations on Eurostat database AMECO

We model the evolution of the public debt ratio to GDP, *b* (henceforth public debt), as driven by a set of fundamentals and a stochastic component represented in the following continuous-time dynamic equation:

(1) $$db_t = -(s_t + m_t + f_t)dt + (r_t - g_t)b_t dt + \sigma dz$$

where the fundamentals on the right-hand side are, at any moment *t*, the GDP ratio of the public sector's primary balance s_t (with $s_t > 0$ denoting a surplus), the GDP ratio of the monetization of public debt m_t (in the forms to be subsequently specified), exogenous net fiscal transfers f_t (e.g. the possibility for the government to receive fiscal support from other governments). The term $(r_t - g_t)b_t$ is the contribution to db_t resulting from the interest rate r_t, net of the rate of growth of GDP g_t, which is charged on the outstanding public debt.[5] The term dt indicates the instantaneous time variation.

The stochastic component is given by the driftless Brownian motion process σdz.[6] The parameter σ represents the instantaneous standard deviation of the Brownian motion, and the term *dz* is the Brownian motion variation, which is so characterised:

[5] For simplicity we abstract from the inflation rate, which may be regarded as negligibly low. Hence, it is immaterial whether *r* and *g* are computed in real or nominal terms.

6 Some target-zone models consider instead a Brownian motion process with drift (e.g. Krugman and Rotemberg 1992). In this context, the drift would not add further insights, and we can therefore avoid its use here.

(2) $dz = \chi\sqrt{dt},$

where χ is a random variable which is independently, identically and normally distributed, with 0 mean and variance equal to 1.

3.1 Fiscal and monetary orthodoxy

We identify EMU *fiscal orthodoxy* as member governments' commitment to stabilising public debt (as a ratio to GDP unless otherwise stated) by their own means (i.e. to the exclusion of fiscal transfers, debt sharing, or bailout, by any other member government, $f_t = 0$). Moreover, governments should also aim at the Maastricht official target of 60%. For this reason, and others that will be introduced below, it is thus convenient to think of b_t as the excess of the debt level over the official debt target at any moment t.

Equation (1) also displays two important interaction channels with monetary policy represented by the monetisation rate of public debt m_t, and the interest rate r_t on public debt. Monetisation can take various forms, some of which will be treated in Section 4.1; for the time being, by this term we mean any intervention of the central bank implying money creation that supports the debt stabilisation effort of the government. We identify EMU *monetary orthodoxy* as the prohibition of monetisation in any form, $m_t = 0$.

As to the interest rate, it may be thought of as being composed of a riskless reference interest rate i_t, which is the policy instrument in the hands of the central bank, and of a risk premium RP_t, which is country-specific. We shall consider the policy rate as an exogenous variable amenable to spot changes by the central bank (hence the time index will be dropped). The specification of the risk premium will be introduced below.

Consequently, the commitment to the stability of public debt, in compliance with the fiscal and monetary orthodoxies, requires that at any point in time E(db/dt)= 0.[7] According to equations (1) and (2), governments should aim at the primary balance given by

(3) $\tilde{s}_t^* = (i + RP_t - g_t)b_t$

so that subsequently public debt may only be moved away by the stochastic amount:

[7] For precision, according to the Fiscal Compact undersigned in 2012, as outstanding debt rises above 60% ($b_t > 0$), the government would be required to reduce debt by 1/20th of the excess per year. Technically, this requirement would introduce a correction mechanism in the debt process, which would complexify the model with the only tangible implication of a target primary surplus greater than in equation (3). In order to keep the model manageable, we disregard this requirement. We may add that, as a matter of fact, it has never been enforced, and it will probably not be enforced in the near future. See also our previous comments on **Error! Reference source not found.**

(4) $\frac{db_t}{dt} = \sigma dz/dt.$

Equation (3) shows that whenever $(i + RP_t - g_t)b_t > 0$ a primary surplus $\tilde{s}_t^* > 0$ is necessary. It measures the "fiscal effort" necessary to achieve debt stabilisation (Bohn 1995).

3.2 The fiscal target zone

Is the commitment represented by equation (3) *credible*? By this term we mean that the commitment should pass the test of government cost-benefit assessment, of which investors are aware. An instance is provided by a strand of the literature on sovereign debt management that focuses on why "sovereigns on the whole *choose* to service their debt or *choose to default*" (Buiter and Rahbari 2013, p. 1).

A general feature of this literature is that governments perceive solvency or default on debt service as options, each of which bears costs and benefits. Typically, solvency bears costs resulting from the fiscal effort necessary to service the debt. In fact, greater fiscal effort imposes either higher taxes and/or lower expenditures with a variety of economic, social and political consequences. On the other hand, the default option also comes with economic and social costs, and further losses in terms of political reputation and access to markets.

In our setup, governments may evaluate the costs of compliance with the commitment to debt stability – their target primary surplus $\tilde{s}_t^*$ – against the costs of noncompliance, which may include (partial) default on debt service. Since the latter option may lead to abandoning EMU membership,[8] governments should also assess the costs of "exiting," including the loss of EMU benefits, which may tilt the assessment towards compliance significantly in comparison with stand-alone countries (Eichengreen 2010, Lane 2021).

Here we need not go into the details of specific cost-benefit calculations, but we will simply draw on the general result in this literature concerning the existence of an optimal threshold of the target primary surplus (3), let it be $\bar{s}$, above which the costs of compliance with debt stabilisation exceed those of noncompliance (examples are De Grauwe 2012, Gros 2012, Buiter and Rahbari 2013, Tamborini 2015). Therefore, equation (3) should be complemented with the upper *feasibility constraint*:

(5) $\tilde{s}_t^* \leq \bar{s}.$

[8] As it was foreshadowed in the Greek debt crisis.

Negative shocks to debt, or favourable conditions of the interest-growth gap, may allow the government to target primary deficits $\tilde{s}_t^* < 0$ while keeping debt stable. Nonetheless, specific to the EMU is the existence of the deficit cap of 3% of GDP. This has been further translated into a limit to the "structural" primary balance which, according to the Medium Term Objectives in the Preventing Arm of the Stability and Growth Pact, should be in balance or in slight surplus. This objective also sets a lower *regulatory constraint* that we can write as:

(6) $\tilde{s}_t^* \geq 0.$

At $\tilde{s}_t^* = 0$, favourable events should entirely go to debt reduction.[9]

These constraints set our model within the general framework of TZ models. By controlling the primary surplus, the government intervenes to stabilise public debt after random shocks *within* its own TZ.[10] Note that the upper and lower bound of the TZ are different in nature. The lower bound is set by regulation, and each government is obliged to respect it. The upper bound is chosen by the government in violation of the unconditional commitment to debt stabilisation. When $\tilde{s}_t^*$ is at the upper bound, the government renege on its commitment to servicing debt, which amounts to abandoning its EMU membership, in analogy with the decision of abandoning an exchange-rate agreement. Breakup at the lower bound is due to violation of the Excess Deficit Procedure. Breakup at the upper bound is due to a sovereign debt crisis.

The existence of the upper bound of the TZ has an important implication for the risk premium that the government should pay on its debt, $RP_t b_t$. The risk premium may have a number of determinants. Here we will focus on one single dimension, namely the default risk, and drawing on the TZ dynamic models we assume that the risk premium has two components, which are encompassed in the following formulation:

(7) $$RP_t = \rho + \alpha E \frac{d(\tilde{s}*_t)/b_t}{dt}$$

The first one, denoted by ρ, captures the fundamental risk component which, according to (6), implies that interest payments, and hence the stabilisation primary surplus, increase with the size of public debt in excess of the EMU target.[11] The second component is a typical "self-fulfilling" process of market

[9] For precision, the structural primary balance depurates the actual primary balance from its cyclical component and transitory components. We cannot introduce this detail here; however, as will be seen, the model will accommodate the split of the growth rate of GDP in equation (3) between its structural and cyclical component.

[10] While the mathematical apparatus is the same, our fiscal TZ works in reverse with respect to the standard exchange-rate TZ, where the central bank does not intervene within the TZ but only at margin.

[11] Alcidi and Gros (2018), IMF (2011), and European Commission (2014) suggest that the risk premium increases when the public debt-to-GDP ratio exceeds a given threshold which is assumed to be risk free. The European Commission, referring

expectations, or "positive feedback" mechanism, which plays a crucial role in the literature on sovereign debt crises mentioned above, and is also a customary feature in models of other expectation-driven variables, such as exchange rates and inflation rates.[12] As debt is shocked away from b_t, and investors expect the target primary surplus to increase and move closer to its upper bound where the government may give up stabilisation and opt for default, they also charge a higher risk premium. A higher risk premium raises the primary surplus that is necessary for debt stability, which in fact moves closer to its upper bound and justifies a higher risk premium, and so on, creating a destabilising spiral.[13] The parameter α weighs the impact of this process on the risk premium.

Note that indirectly, through the determination of $\tilde{s}_t^*$, the risk premium is sensitive to the institutional environment in which governments operate, namely its extent of fiscal and monetary orthodoxy. This point has been raised by the well-known paper by De Grauwe (2012) comparing the higher risk premia of EMU countries relative to non-EMU countries with similar debt stocks but backed by the central bank as lender of last resort. It will also play a key role in the development of our model.

At the same time, the expectations about the dynamics of the primary surplus create another critical feedback effect on the fiscal effort equation (3) through the growth rate of GDP. The impact of fiscal manoeuvres on GDP is a matter of long-lived research around the so-called "fiscal multipliers". The implementation of austerity in the EMU in view of fiscal consolidation has spurred a new wave of controversies. If a restrictive fiscal stance $\tilde{s}_t^* > 0$ has a "Keynesian" effect and depresses growth, then equation (3) shows a self-defeating effect triggering a vicious circle. However, a strand of literature (Giavazzi and Pagano 1990, Alesina and Perotti 1997, Alesina and Ardagna 2010) argues that if the *expected* fiscal restriction is well designed, e.g. cutting expenditures instead of raising taxes, the fiscal multiplier may be negligible or even change signs. In order to take this issue into account in a tractable manner, let us split the current growth rate into a structural component $\bar{g}$ independent of fiscal and monetary contingent stances and a cyclical component sensitive to the expected dynamics of the fiscal stance, $\phi Ed(\tilde{s}_t^*)/dt$, where ϕ is the fiscal multiplier ($\phi < 0$ denotes a Keynesian multiplier). Hence, the growth-debt interaction results to be given by:

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to the European countries, finds a 0.03% increase in the risk premium, the IMF (having in mind mostly emerging countries) finds a 0.04% increase, for any percentage point of the public debt-to-GDP ratio exceeding 60%.

[12] An example relative to exchange rates is given by Krugman (1979), where the current value of the exchange rate also depends on its expected change. The case of the inflation rate is well represented by Barro and Gordon (1983) and by the use that the article makes of the Phillips curve, where the current inflation rate also depends on the expected inflation rate for the future.

[13] The search for the distinction between fundamental and non-fundamental determinants of spreads during the euro-area sovereign debt crisis has prompted a whole strand of empirical studies (see, among others, Caceres et al. 2010, Favero and Missale 2011, De Grauwe and Ji 2013a, Passamani et al. 2015, Gödl and Kleinert 2016). De Grauwe and Ji (2013a), and Passamani et al. (2015) have shown that the widening of spreads in the Euro Zone was also driven by mounting expectations of unsustainable fiscal efforts.

(8) $g_t = \bar{g} + \phi E \frac{d(\tilde{s}_t^*)/b_t}{dt}$

Therefore, using equations (7) and (8), the target primary surplus (3) can be rewritten:

(9) $\tilde{s}_t^* = \delta b_t + \beta E \frac{d(\tilde{s}_t^*)}{dt}$

where $\delta = (i + \rho - \bar{g})$ is the structural interest-growth gap, which we treat as an exogenous parameter, and $\beta = \alpha - \phi$ encompasses the two critical expectation effects discussed above. The parameter δ plays a critical role as long as it remains positive, which we assume as the normal condition.[14] A negative fiscal multiplier determines $\beta > 0$, so that the vicious circle of self-defeating fiscal consolidation is enhanced, accelerating the trajectory towards the upper bound of the primary surplus. A positive fiscal multiplier may instead mitigate the vicious circle or even reverse it (if $\beta < 0$).

To summarise, our fiscal TZ model is composed of the following equations:[15]

(9) $\tilde{s}_t^* = \delta b_t + \beta E \frac{d(\tilde{s}_t^*)}{dt}$

(4) $\frac{db_t}{dt} = \sigma dz/dt$

(5) $\tilde{s}_t^* \leq \bar{s}$.

(6) $\tilde{s}_t^* \geq 0$

These equations imply a lower and upper bound of debt, too. In fact, as $\tilde{s}_t^*$ hits the bounds of the TZ, then $E \frac{d(\tilde{s}_t^*)}{dt} = 0$; therefore, at $\tilde{s}_t^* = 0$ debt should be $b_t = 0$, i.e. at the official target of 60% of GDP, whereas at $\tilde{s}_t^* = \bar{s}$ debt cannot exceed $b_t = \bar{b} = \bar{s}/\delta$. Hence, the shock-absorption capacity of the government depends positively on its upper bound to fiscal effort and negatively on the structural interest-growth gap. Consequently, public debt can fluctuate within a band centred on $\bar{b}/2$, where the crucial role is played by the expectation component of $\tilde{s}_t^*$, which reacts to the extent the government is expected to be able to accommodate debt shocks or not, and impinges upon non-fundamental risk premium and growth.

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[14] The case $\delta \leq 0$ may stylise a scenario with zero policy rate and positive, although low (zero) nominal growth which fits the current situation in the EMU. The effect would be that the problem of stabilisation vanishes. The government may stay passive and keep the primary surplus in balance, or enjoy space for deficits, for any level to where shocks may bring public debt b_t since $\delta \leq 0$ ensures that debt will not grow ($\delta = 0$) or will be self-reducing over time ($\delta < 0$). In fact, Blanchard et al. (2019) argue for the reconsideration of the issue of debt sustainability when the interest-growth gap is zero or negative.

15 This combination of a stochastic fundamental and an expectation component is analogous to the standard formulation of exchange-rate target zone models, such as Krugman (1991), Krugman and Rotemberg (1992), Bertola and Caballero (1992)

3.3. The model solutions

Preliminarily, let us consider equation (9) when its expectation component is muted, i.e. if the government's unconditional commitment to stabilising debt for any amount of the shock were taken at face value. As a result, $\tilde{s}_t^*$ would *linearly* increase with the level of debt (see Figure 3, schedule SS). This will provide a useful benchmark in the subsequent analysis.

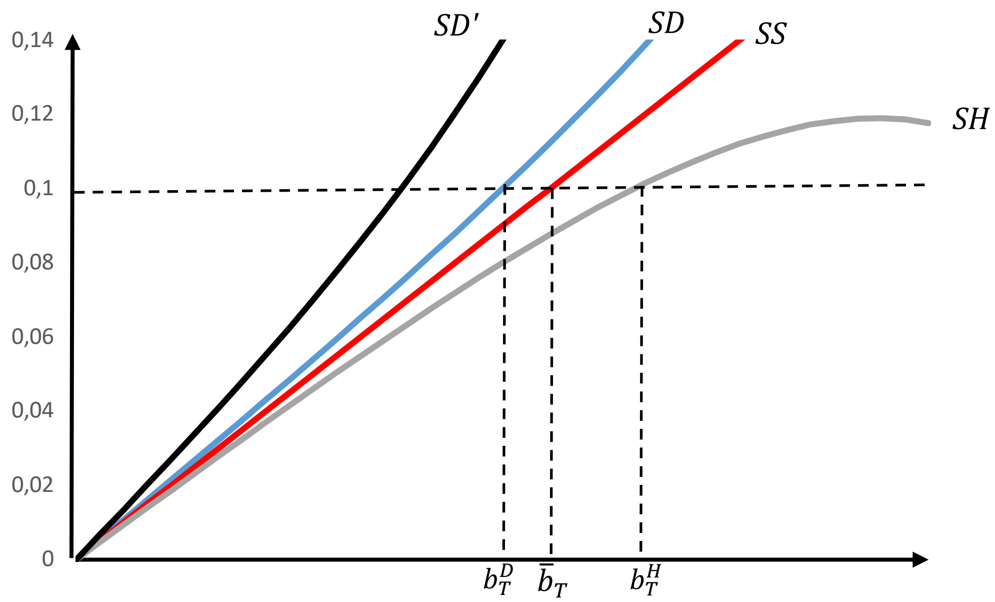
The target primary surplus (9) is a first-order differential equation, which, given (4), (5) and (6), has the general solution (see the Appendix A1 for derivation):

(10) $$\tilde{s}_t^* = \delta b_t + A_1 e^{\lambda_1 b_t} + A_2 e^{\lambda_2 b_t}$$

$$\lambda_{1,2} = \pm\sqrt{2/\beta\sigma^2}$$

The parameters $A_{1,2}$ are indeterminate, and in order to determine them and close the model, it is necessary to analyse the behaviour of the function as $\tilde{s}_t^*$ approaches its upper and lower bounds.

Figure 3. Divorce and honeymoon in the fiscal target zone



$\bar{s}$ = 0.1, δ = 0.1, β = 0.5, σ^2 = 1, $\bar{b}$ = 1
SD: ε^u = 0.2, ε^d = 0.2, *p* = 0.6
SD': ε^u = 0.2, ε^d = 0, *p* = 1
SH: ε^u = 0.2, ε^d = 0.2, *p* = 0.4

We treat the behaviour of the system at the lower bound straightforwardly, assuming that the government is always compliant with the zero primary-balance rule. Hence, for (10) to be zero at $b_t = 0$, it should hold that $A_2 = -A_1$, so that

(11) $\begin{cases} \tilde{s}_t^* = \delta b_t + A(e^{\lambda b_t} - e^{-\lambda b_t}) & b_t \geq 0 \\ 0 \text{ otherwise} \end{cases}$

To study the behaviour of the system at the upper bound, we shall follow the solution method of TZ "realignments" presented by Bertola and Caballero (1992). This is based on an arbitrage argument. The value of the target primary surplus $\tilde{s}^*(\bar{b}) = \bar{s}$ has to be equal to the expected one resulting from the probabilities of two different events that may take place when $\tilde{s}_t^*$ reaches $\bar{s}$.

With probability p, public debt is allowed to jump upwards above $\bar{b}$ by, say, the amount ε^u. This event, therefore, is virtually equivalent to moving up to the centre of a higher debt TZ $\in [\bar{b}, 2\varepsilon^u]$ that would require a target primary surplus larger than $\bar{s}$. Yet the government is unwilling to sustain this larger primary surplus and will leave its debt service unsatisfied. Hence, in our context, ε^u can be interpreted as the "haircut" that investors expect in case of breakup.

With complementary probability (1-p), debt will not be allowed to increase. The stabilising intervention – whatever it may be, as will be discussed subsequently – is such that debt remains at $\bar{b}$ or moves below by, say, the amount ε^d to the centre of the debt TZ $\in [\bar{b} - 2\varepsilon^d, \bar{b}]$ where the government is still willing to stabilise debt.

As we show in Appendix A2, the value of A consistent with the above no-arbitrage condition is:

(12) $A = \delta[p(\varepsilon^u + \varepsilon^d) - \varepsilon^d](e^{\lambda\bar{b}/2} - e^{-\lambda\bar{b}/2})^{-1}$

Substituting (12) into (11) yields the explicit form of the function of the target primary surplus, used to draw Figure 3 for hypothetical parameter values.

3.4 Divorce vs. honeymoon

Probability p can be interpreted as a measure of distrust in the commitment to unconditional debt stabilisation, and hence in the irreversibility of the EMU. It plays a crucial role in the dynamic evolution of the system by conditioning the sign of the parameter A. As can be seen from (12),

$$A \gtrless 0 \text{ iff } p \gtrless \frac{\varepsilon^d}{\varepsilon^u + \varepsilon^d} \equiv p*$$

We denote by p^* the critical level of p such that $A = 0$, yielding the linear case of the SS function in Figure 3. This critical p^* in turn depends on debt behaviour expected at the upper bound of the TZ. If debt is expected to move up or down by the same amount, then $p^* = 1/2$.[16] The more public debt is expected to move up than down, $\varepsilon^u > \varepsilon^d$, the more p^* is reduced, meaning that also the chances of breakup should be lower in order to keep the system on the linear track. Yet, as long as p is independent of the other parameters, $p = p^*$ may only materialise by chance.

If $p > p^*$, i. e. there is high distrust in the no-breakup intervention, then $A > 0$, and the ensuing function, labelled *SD* in Figure 3, becomes convex. The consequence is that for any level of debt, *SD* bends above and to the left of the linear *SS*. The economic intuition is that as $\tilde{s}_t^*$ gets closer to the upper bound, the anticipation of the non-feasibility of the fiscal consolidation that would be necessary to guarantee stability raises the risk premium to be paid by the government, which accelerates the trajectory towards the upper bound. In other words, owing to the expectation component of the target primary surplus, the shock-absorption capacity of the government is reduced ($b_T^D < \bar{b}$ in Figure 3), and shocks lead to breakup faster. This scenario has been dubbed "*divorce*" in the TZ literature.

The extent of the divorce effect depends on the curvature of the *SD* function, which increases with *A*. As a limit case, with integral EMU orthodoxy, investors know for sure ($p = 1$) that at the upper bound there will be no resources needed to revert public debt towards the centre of the band ($\varepsilon^d = 0$). Consequently,

$$(13) \qquad A = \delta \frac{\varepsilon^u}{2} (e^{\lambda \bar{b}/2} - e^{-\lambda \bar{b}/2})^{-1} > 0$$

which generates the schedule *SD'* in Figure 3. Note that anyway $\varepsilon^d = 0$ is sufficient for $A > 0$ for any p.

This outcome of the model may vindicate the criticisms about the unintended consequences of the EMU twin orthodoxies in combination with market discipline (see also section 4.3). Defenders maintain that the perception of the *de facto* demise of the no bail-out clause prompted fiscal laxity and market undervaluation of default risks, thus paving the way for the sovereign debt crisis. Critics argue that the clause may turn itself into a threat to the EMU's stability and integrity.[17] Indeed, our model shows that if investors understand that countries do have a limit to their sustainable fiscal consolidation, and firmly believe in the no-bailout clause, then the system is less resilient to sovereign debt shocks and prone to breakup threats.

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[16] Bertola and Caballero (1992) assume the probability of a symmetric upward or downward jump. See also Della Posta (2018a)

[17] As a "field experiment" of this view, the notorious "Deauville walk" is often cited On October 19, 2010, Nicolas Sarkozy and Angela Merkel decided, in a private talk, the future involvement of the private sector in the debt restructuring of EMU member states applying for financial assistance. The event concurred to the sudden diffusion and acceleration of the sovereign debt crisis across the board. For a detailed rendition and discussion see e.g. Brunnermeier et al. (2016), ch. 2.

If $p < p^*$, i.e. higher confidence arises in the no-breakup intervention, then $A < 0$, and the opposite scenario occurs, called "*honeymoon*". The function of the target primary surplus, labelled *SH* in Figure 3, becomes concave and bends below and to the right of *SS*, meaning that the shock-absorption capacity of the government is increased as measured by the difference between b_T^H, the debt absorbed by the government at the moment *T* when *SH* crosses the upper bound, and $\bar{b}$. In fact, now the relative greater confidence in sufficient resources to absorb the shock within the government's upper bound reduces the risk premium and *decelerates* the run-up of the target primary surplus towards the upper bound.

This approach to TZ modelling has the merit of explaining transitions from "honeymoon" to "divorce" scenarios, and back, that may be hard to explain on the basis of simple fundamentalist models. An important driver of transitions are sentiments of trust/distrust in the irreversibility of the system captured by the probability *p*. Volatility of these sentiments may account for the sudden and abrupt transitions that we have observed in the two decades of the EMU sovereign debt markets' existence, such as the 2010-11 upsurge of spreads after a decade of tranquillity , and the rapid reversion after the celebrated "whatever-it-takes" speech by the ECB President Mario Draghi.

On the other hand, trust and distrust may not be totally unrelated to real factors. Though we treat *p* as exogenous, our model highlights a relationship with the institutional design of the EMU, since investors figure out what the behaviour of the system may be at the upper bound of the fiscal TZ, taking into account whether or not enough resources may be deployed to sustain the no-breakup of the EMU.[18] In the subsequent part of the paper we shall address the issue of modifications of the EMU setup apt to sustain trust in its irreversibility.

4. Relaxing the twin orthodoxies

To sum up, the shock-absorption capacity of single governments, however strong it may be, remains limited. Unusual tail events may suddenly push towards divorce for single governments or *the collapse of the system as a whole*, as was indeed the case in the aftermath of the Global Financial Crisis and of the outbreak of the pandemic. When these events happen, the EMU trilemma materialises, and the imperative of the euro irreversibility is in jeopardy.

[18] This point, the critical role of resources necessary to "defend" the upper bound, is similar to the one maintained by Krugman and Rotemberg (1990) in the case of an exchange-rate TZ with limited reserves.

Our aim now is to show that the preservation of the EMU can be achieved by relaxing either monetary or fiscal orthodoxy, or both.[19] We complete the analytical solutions of the model treating the case in which the commitment to debt stabilisation is credible, in the sense that investors anticipate that shocks will be fully accommodated, and debt stabilised, *within the government's feasibility constraint* (namely $\tilde{s}_t^* \leq \bar{s}$).[20] We shall see that this creates the condition for the honeymoon effect.

4.1 Relaxing monetary orthodoxy

Monetary policy can influence the dynamic evolution of the fiscal TZ presented above through different channels. The first one is the "conventional" interest-rate policy that is introduced in the model through the risk-free policy rate *i* in the parameter δ. EMU monetary orthodoxy prescribes that the policy rate is exclusively targeted to price stability, which makes it fully exogenous to the problem of governments' debt control. The case of δ > 0 assumed in Figure 3 makes the problem harder.

This hurdle can be lowered either because the "divine coincidence" of below-target inflation allows the central bank to reduce the policy rate, as has been the case for the last ten years (Lane 2020), or because the central bank decides for a cooperative policy for the debt control problem (e.g. Mason and Jayadev 2018, Bonatti et al. 2020). In either case, the conventional policy faces the well-known zero lower bound of the policy rate (though in practice central banks have the power to achieve negative interest rates in the money market: Lane 2020).

As long as δ > 0, in alternative, or addition, to conventional interest-rate policy, a central bank in a stand-alone country has virtually an unlimited liquidity potential and it is, therefore, always able to back up the sovereign debt as lender of last resort (LLR). As suggested by De Grauwe (2012) and De Grauwe and Ji (2013a, 2013b), this option, beyond its actual activation, has provedapt to stabilise the sovereign debt markets, and financial markets more generally, in the non-EMU countries. An analogous result has been obtained by the change of attitude towards direct financial stabilisation undertaken by the ECB since 2012. An important difference with interest-rate policy is that the LLR interventions are once and for all and are aimed at a specific event.[21]

[19] This is in line with the conclusions reached in the literature on anti-inflationary credibility as to the opposition between rules and discretion: while the seminal deterministic models of Kydland and Prescott (1977) and Barro and Gordon (1984) concluded that rules are Pareto superior to discretion, and the introduction of uncertainty, namely the possibility that the economic system is hit by stochastic shocks, led to deny such a conclusion (Lohman 1992,).

[20] Note that credibility is assessed not against the unconditional commitment dictated by fiscal orthodoxy, but against the actual stabilisation capacity of the government. The upper bound of the target primary surplus is still in place, and investors are aware of it.

[21] Usually, increasing the liquidity supply goes with lowering the policy rate. Yet, the so-called "quantitative easing" polices have been activated by major central banks after reaching the zero lower bound of the policy rate.

This can be, and has been, done in various forms: (i) creation of the Treasury's monetary balances (an instance of "helicopter money")[22], (ii) purchases of new debt created by the shock, (iii) purchases of outstanding debt on the secondary market, as currently practiced by the ECB under the Asset Purchases Programme and the PEPP.

In terms of our model, key to preventing the system's breakup is the investors' expectation of the central bank providing enough liquidity to absorb the *stochastic* shocks hitting public debt, thus complementing or substituting the fiscal effort necessary for debt stability should it exceed the maximum level $\bar{s}$ that the country can withstand. The effect can easily be seen by means of the conditions of divorce vs. honeymoon presented in Section 3.4 after setting $\varepsilon^u = 0$. The result is that $A < 0$, i.e. the condition for the *honeymoon scenario*, for any probability p assigned by investors to the alternative event of breakup.

However, it may be desirable that the LLR intervention is minimised, that is to say, necessary and sufficient to absorb just the excess debt that is not sustainable by the government ($\varepsilon^d \rightarrow 0$). The solution technique consists of the "smooth pasting" condition, which was also used to close the first generation of TZ models launched by Krugman (1991) and which mathematically calls for finding the tangency condition between the equation of the target primary surplus 0 and the upper bound $\bar{s}$ at the instant T when the latter is hit.

To understand the role of the LLR intervention, let us first consider the basic case (i) mentioned above – let us name it "pure monetisation"– which has a straightforward correspondence with the variable m_t in the debt equation (1). Consequently, we can write:

$$(14) \qquad \tilde{s}_t^* = -m_t + \delta b_t + A(e^{\lambda b_t} - e^{-\lambda b_t})$$

Denoting with b_T^{SP} the level of debt at the upper bound, at point in time T, the first order condition for smooth pasting is

$$\frac{ds_T}{db_T^{SP}} = \delta + \lambda A(e^{\lambda b_T^{SP}} - e^{-\lambda b_T^{SP}}) = 0$$

which yields the value of A

$$(15) \qquad A = -\frac{\delta}{\lambda}\left(e^{\lambda b_T^{SP}} - e^{-\lambda b_T^{SP}}\right)^{-1} < 0$$

$A < 0$ ensures the honeymoon effect. The resulting concave function $\tilde{s}^*(b_t)$ is plotted as SP in Figure 4.

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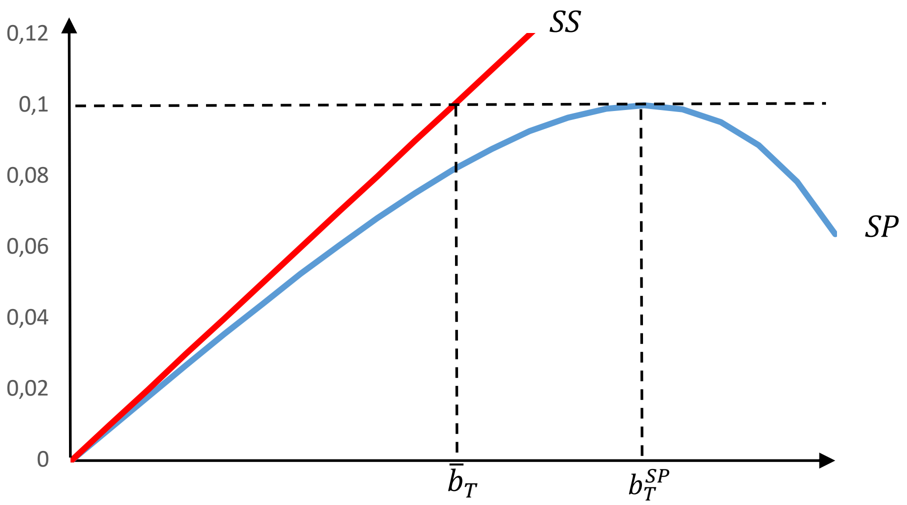
[22] For the current revival of the "helicopter money" idea see e.g Galì (2020), and Cochrane (2020).

Figure 4. Honeymoon and "smooth pasting"



$\bar{s}$ = 0.1, δ = 0.1, β = 0.5, σ^2 = 1, $\bar{b}$ = 1, 1/λ = 0.5

Then we can establish that the target primary surplus at the upper bound has value:

(16) $\tilde{s}_T^* = \bar{s} = -m_T + \delta(b_T^{SP} - 1/\lambda)$

The implied LLR intervention is therefore,

(17) $m_T = \delta(b_T^{SP} - 1/\lambda) - \bar{s}$

i.e. the central bank should stand ready to monetise any debt shock in excess of the maximal shock-absorption capacity of the government, b_T^{SP}. To pin down the value of b_T^{SP}, we can recall that $\bar{s} = -m_T + \delta\bar{b}$. The result is, therefore:

(18) $b_T^{SP} - \bar{b} = 1/\lambda > 0$

which measures the honeymoon effect. Note that its extent is only determined by $\lambda = \sqrt{2/\beta\sigma^2}$, i.e. by the exogenous parameters that govern the process of $\tilde{s}_t^*$.

We can thus appreciate two important features that characterise this institutional setup. First, thanks to the honeymoon effect, the resilience of the system is enhanced. To the extent that investors anticipate the LLR intervention, the non-fundamental risk premium driven by expectations of breakup is curbed all along the trajectory of the target primary surplus also in case of within-the-band shocks (the *SP* curve in Figure 4), *even though the central bank does not intervene in these shocks*. Since the LLR intervention is *erga omnes*, we may say that the honeymoon effect translates itself into a "system resilience premium" embodied by the sovereign debt market as a whole.[23] Second, monetary and fiscal debt stabilisation are *complements*: in the sense that the commitment to LLR , *conditional* on the government's full fiscal effort, *increases* the shock-absorption capacity of the government and *reduces* the potential exposure of the central bank.

We can now consider the other two types of LLR interventions, consisting of purchases of sovereign bonds either at issuance or in the secondary market. Though often regarded as equivalent to pure monetisation, they are not. For these interventions, in different ways, boil down to a debt swap from the market to the central bank. This fact has implications that should be taken into account since they modify the picture presented above.

The first issue is whether the central bank's share of public debt reduces or not the government's total exposure b_t. The answer may be affirmative in a stand-alone country where assets and liabilities across state compartments cancel out and the central bank fully pays interests back to the government. Whether the same applies to the EMU is more controversial because of the different capital keys of member countries in the ECB's capital (De Grauwe and Ji 2013b). Indeed, the EMU's fiscal rules are aimed at the total outstanding debt regardless of the share held by the Eurosystem. The second issue concerns the determination of the interest rate and the relevant risk premium. Does the debt swap with the central bank make any difference? The presumption is that it does, otherwise there would be no point in doing the swap.[24]

Since the ECB is not allowed to buy sovereign bonds at issuance, let us consider the case of purchases of outstanding debt. These, at any point in time, reduce b_t by the amount b_t^{CB} leaving the difference on the market. Let us assume that the central bank's holdings do not reduce the total debt to be targeted by the government, but with its purchases it pushes the interest rate towards the risk free policy rate *i*. Consider now this intervention at the upper bound by the amount b_T^{CB} which leaves $b_T^{SP} - b_T^{CB}$ on the market, weighed by $\delta = i + \rho - \bar{g}$, while b_T^{CB} , weighed by $\delta' = i - \bar{g}$, is in the hands of the central bank. As a result,

$$(19) \qquad \tilde{s}_T^* = \bar{s} = -\rho b_T^{CB} + \delta(b_T^{SP} - 1/\lambda)$$

[23] This would make the sovereign debt of EMU members more similar to that of stand-alone countries according to the distinction drawn by De Grauwe (2012)

[24] A rationale may be that the central bank has greater loss-absorption capacity than private investors, and hence can contribute to reducing the risk premium paid by the government. According to some authors (e.g. De Grauwe and Ji 2013b), the central bank has infinite loss-absorption capacity since, having no creditors, it cannot go bankrupt. The equivalence between purchases of debt and pure monetisation would occur with the full cancellation of the debt and interests owed to the central bank, which has been put forward recently (e.g. Becchetti and Scaramozzino 2020).

By comparing equations (16) and (19) it turns out that $\rho b_T^{CB} = m_T$, and, since $\rho < 1$, then $b_T^{CB} > m_T$. This result has two implications which help to understand and assess the ECB's asset purchase programmes deployed since 2015 (further discussion in section 4.3). First, the honeymoon effect is still present as in the case of monetisation. Second, the government's debt relief at the margin, however, is limited to the resulting "discount" on the fundamental risk premium. Consequently, the required amount of debt purchases should be (much) larger than pure monetisation. It would be possible to argue that this is quite a significant toll to be paid for the prohibition of pure monetisation.

We have seen that in order for EMU irreversibility to be fully credible, the ECB's commitment as LLR ought to be unlimited. We would therefore move into a system of full insurance of investors by the central bank against governments' defection on the commitment to debt stability, since any shock beyond the absorption capacity of governments would be absorbed by the central bank. The next question is the extent to which this system is feasible, and to this we shall turn subsequently.

4.2. Relaxing fiscal orthodoxy

In the case in which monetary policy is not available (for example, because there may be the risk of inflation or because of institutional constraints – as might be the case for the ECB), and/or in order to reduce its contribution, there is yet another possibility, namely stabilising national public debt thanks to a 'federal' fiscal support (f_t in equation (1)). Equation (14), then, becomes:

(20) $$\tilde{s}^*(b_t) = -m_t - f_t + \delta b_t + A(e^{\lambda b_t} - e^{-\lambda b_t})$$

A prominent, and unprecedented, example is NGEU, the anti-pandemic plan elaborated by the European Commission and approved by the European Council in July 2020. The plan allocates to Member States collective resources explicitly targeted to public expenditures in view of stabilisation and recovery of the economies shattered by the pandemic.[25] As such, the plan complements the already huge expansion of the public debts generated by the emergency plans at the national level. From this point of view, NGEU acts as a backstop to the governments' shock-absorption capacity analogously to the monetary interventions examined in the previous paragraph. As is clear from equation (20), analytically, the same results as above apply.

In particular, the analogy also regards the government's liability after the intervention. NGEU resources consist of a grant component γ and a loan component ($1-\gamma$). The grant component means that no liability is left after the intervention, which corresponds to the case of pure monetisation above, whereas

[25] In the case of NGEU, f_t should be considered net of the country's own share in the creation of the collective fund.

the loan component entails a liability towards the EMU at a concessional rate. Let the latter be the risk-free rate *i*, and $\delta' = i - \bar{g}$. Therefore, the fiscal intervention at the upper bound of the TZ is:

(21) $$\tilde{s}_T^* = \bar{s} = -f_T(\gamma - \delta'(1-\gamma)) + \delta(b_T^{SP} - 1/\lambda)$$

Writing f_T as the complement to the government's maximal shock absorption, and recalling from (18) that $b_T^{SP} = \bar{b}_T + 1/\lambda$, we can see that:

(22) $$f_T = \frac{\delta(\bar{b}_T + 1/\lambda) - \bar{s}}{\gamma(1+\delta') - \delta'}$$

that is to say, f_T has to be larger, the smaller is the grant component γ.

Another important point highlighted by equation (20) is that *the monetary and the fiscal interventions are synergic*. Activating both reduces the extent of each. As argued in the Introduction, this is one of the key innovations of the EMU's overall anti-pandemic policy package in comparison with the response to the crisis of the 2010s when the whole burden of the EMU integrity was placed on the shoulders of the ECB, with heavier strain of monetary orthodoxy *vis-à-vis* the tightening of fiscal orthodoxy.[26]

4.3. Moral hazard and EMU irreversibility

As stated above, the "smooth pasting" solution in our model is equivalent to an insurance on investments in sovereign bonds, and any insurance scheme brings the moral hazard issue with itself. Minimisation of moral hazard has been central in the design of the EMU rules (e.g. Brunnermeier et al. 2016, ch. 6, Gros 2021), and it remains central in the debate about the reforms of the rules (e.g. Delatte et al. 2017, CEPR 2018, European Fiscal Board 2019). Discussion of such a complex issue is beyond our scope here. However, a few considerations are in order.

The first is that our model supports the view that the protective belt of monetary and fiscal orthodoxies against moral hazard may bring benefits but also risks for the EMU. If the benefits come from enforcing fiscal discipline of national governments, the risks arise from the loss of resilience of the system as a whole in the face of large shocks. The credibility of the imperative of EMU irreversibility cannot be left entirely to the governments' commitment to fiscal discipline and debt sustainability. It should be acknowledged that governments, especially those under democratic scrutiny in complex developed societies, face limits to the fiscal effort they can bear in order to keep public debt stable in the event of large shocks. These *may happen*, making fiscal efforts unsustainable.

[26] We do not consider here other specific aspects of the fiscal intervention that differentiate it from monetary interventions, such as the possibility to target the resources for growth-enhancing expenditures.

A widely shared lesson drawn from the crisis of the 2010s is that a wise institutional design should take these events into account and foresee appropriate instruments, instead of muddling through *ad hoc* arrangements afterwards. A *Union's no-breakup mechanism* (monetary and/or fiscal) is also necessary (De Grauwe 2012, Gros 2014, Brunnermeier et al. 2016, chs. 6-7, Corsetti et al. 2020, Orphanides 2020, Lane 2021).

In the second place, in the original conception of the EMU, monetary and fiscal orthodoxy curb moral hazard in cooperation with market discipline, i.e. the alleged efficiency of financial markets in finding the "right price" of sovereign bonds. This presumption has seriously been weakened by the events leading to, and then boosting, the sovereign debt crisis. The distinction between fundamental and non-fundamental determinants of sovereign risk premia has become critical, both theoretically and empirically (Draghi 2012, Lane 2020, Schnabel 2020b). In line with this literature, our model, too, shows that the non-fundamental component of the risk premium may trigger acceleration towards breakup.

More on normative grounds, monetary interventions aimed at the stabilisation of the sovereign debt market have been legitimised by the necessity to curb the non-fundamental component of widening risk premia, while being beneficial to the stability of the system as a whole and not just to single countries (Schnabel 2020a). As we have seen, this is precisely the result of the investors' anticipation of a backstop to governments' shock-absorption capacity in the honeymoon scenario. Moreover, the honeymoon effect operates as a "no-breakup premium" all the time, even in the absence of direct intervention, as in fact happened with the ECB's announcement of the Outright Monetary Transactions programme.

This feature is particularly relevant in consideration of moral hazard. For the no-breakup mechanism need be activated only "at the margin", the upper bound of the TZ, while the stabilisation of inframarginal shocks remains the full responsibility of national governments. Moreover, we have shown that, with the no-breakup mechanism in place, their shock-absorption capacity is increased, while at the margin, too, they are fully involved in the stabilisation effort by their own part.

This arrangement, in which the conditionality of intervention concerns the country's (sustainable) involvement in the stabilisation, seems more effective than the more usual one in which conditionality concerns debt restructuring (private sector involvement) and subsequent macroeconomic adjustment. In fact, the possibility of the private sector's involvement is precisely the booster of the divorce scenario, while the possibility of heavy macroeconomic adjustment raises the costs of compliance with EMU membership and lowers the upper bound of the TZ. Much of the painstaking management of the Greek crisis was due to major mistakes on these two issues.[27]

It may be argued that the consistent application of the backstop mechanism underpinning the "smooth pasting" solution presupposes (i) the ability to discriminate between genuine unfavourable events and fiscal misbehaviour, and (ii) the identification of the actual (sustainable) shock-absorption capacity of the government. These two points recall the "illiquidity *vs.* insolvency" dilemma, which, most of the time, is a true dilemma that plagues the management of financial crises at the micro as well as at the macro level. Yet, this awareness should not prevent the conception of a design that balances the risk of moral hazard of national governments with the risk of EMU breakup.

In this perspective, it should be recognised in the first place that the twin monetary and fiscal orthodoxies are strongly tilted towards the minimisation of the risk of moral hazard: if in doubt, presume fiscal misbehaviour and hidden adjustment capacity (Brunnermeier et al. 2016, p. 119). This attitude conditioned the early institutional response to the Europeanisation of the world crisis regarded as a collection of violations of the rules by single Member States without seeing the overall picture of existential threats to the EMU. By contrast, the response to the pandemic crisis has taken the opposite road. As argued in the previous section, the joint relaxation of the twin orthodoxies has been an efficient strategy to reduce the strain on both. It is likely that this outcome has been made possible since the pandemic shock is more easily perceived as a symmetric, involuntary and catastrophic event.

Looking ahead at the post-pandemic EMU, other black swans may materialise. They may be of a more economic nature and with less general involvement *ex-ante* and will have to be tackled to prevent general involvement *ex-post*. A system of pre-emptive controls of fiscal discipline, and debt sustainability, remains necessary (one that is possibly better conceived than the present one: see e.g. European Fiscal Board 2019). However, for extreme adverse events, excessive emphasis on individual liability is counterproductive; in such circumstances the solidarity principle should dominate. The European community thus needs a discussion of the extent to which it is willing to assume tail risks for its members. A commonly acceptable cut-off needs to be identified, agreed upon, clearly communicated, and enforced in future crises (Brunnermeier et al. 2016, p. 117).

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[27] From this point of view it is unclear whether the creation of the European Stability Mechanism may be regarded as an effective no-breakup mechanism of the kind considered here. In the first place, it is conceived, and endowed, as a means of dealing with single emergency cases. In the second place, the required *ex-post* macroeconomic adjustment seems to exert deterrence. This may be regarded as a positive feature in view of the moral hazard problem, but it may also produce the perverse effect of making the divorce scenario more likely. As a matter of fact, no government has so far activated the pandemic facility provided by the ESM, despite the explicit exclusion of *ex-post* adjustment programmes.

5. Concluding remarks

The key findings of our view of the EMU as a fiscal TZ can be summarised as follows. First, debt stabilisation by means of exclusive fiscal discipline is costly, and most likely faces a feasibility constraint. Second, investors understand that governments can, at best, commit themselves to debt stabilisation within a band of fiscal sustainability. Hence, requiring governments to unconditionally commit to debt stabilisation is non-credible as it may not pass the test of the feasibility constraint. Third, as investors anticipate that the upper bound of the band is not defendable, the system becomes more fragile in that self-fulfilling run-ups to the upper bound are triggered, smaller debt shocks can be absorbed by governments, and a breakup becomes more likely.

The EMU needs to be completed with a monetary and/or fiscal emergency backstop to the irreversibility principle. Drawing on the target-zone literature, we have shown how these devices can be designed in a consistent manner that minimises their extension and mitigates the moral hazard concerns. The alternative to these devices is reformulating the treaties with explicit and regulated exit procedures.

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Appendix

A1. The general solution of the model

In order to solve equation (9),

(A1) $$\tilde{s}_t^* = \delta b_t + \beta E \frac{d(\tilde{s}_t^*)}{dt}$$

let us assume a generic functional form for $\tilde{s}_t^*$. The simplest functional form that we can assume is:

(A2) $$\tilde{s}_t^* = f(b_t)$$

We can now use this equation to calculate the expected variation of the target primary surplus. In order to do this, let us expand the function in a Taylor-type series, by calculating Ito's differential:

(A3) $$d\tilde{s}_t^* = f'(b_t)(db_t) + \frac{1}{2}f''(b_t)(db_t)^2$$

From equations (1) to (4) in the text, considering expected values, it turns out that $E(db_t) = 0$ and $E(db_t)^2 = \sigma^2 dt$. We obtain, then, Ito's Lemma:

(A4) $$\frac{E(d\tilde{s}_t^*)}{d_t} = \frac{1}{2}f''(b_t)\sigma^2$$

By replacing (A4) into (A1) we have:

(A5) $$\tilde{s}_t^* = f(b_t) = \delta b_t + \beta[\frac{1}{2}f''(b_t)\sigma^2]$$

This is a differential equation of the second order whose generic solution is of the class (Bertola and Caballero 1992, p.522):

(A6) $$\tilde{s}_t^* = f(b_t) = \delta b_t + A_1 e^{\lambda_1 b_t} + A_2 e^{\lambda_2 b_t}.$$

where $\lambda_{1,2} = \pm\sqrt{2/\beta\sigma^2}$ are the two roots of the characteristic equation.

A2. Honeymoon and divorce

In the text we have established that at the lower bound of the TZ, (A6) should be $f(0) = 0$, which requires $A_2 = -A_1 = A$. To study the conditions at the upper bound we apply the Bertola and Caballero (1992) methodology of TZ "realignments". To this end, we introduce the notation $f(b_t;\ c)$ where b_t refers to the current value taken by the fundamental, and c refers to the value of the centre of the band. For symmetric bands, (A6) becomes

(A7) $$f(b_t;\ c) = \delta b_t + A(e^{\lambda(b_t - c)} - e^{-\lambda(b_t - c)})$$

Recall that the current band of the target primary surplus is $\tilde{s}_t^* \in [0, \bar{s}]$ to which there corresponds the debt band $b_t \in [0, \bar{b}]$, centred on $c = \bar{b}/2$. Now let b_t hit the upper bound at time T, $b_T = \bar{b}$. Investors anticipate that with probability p, b_T will be let to jump up by the amount ε^u; with probability $1 - p$, b_T will be moved down by the amount ε^d. Also, let ε^u and ε^d be the centres of two new bands of dimension, respectively, $[\bar{b}, \bar{b} + 2\varepsilon^u]$ and $[\bar{b} - 2\varepsilon^d, \bar{b}]$. The solution is provided by the no-arbitrage condition such that

(A8) $$p\, f(\bar{b} + \varepsilon^u;\ \bar{b} + \varepsilon^u) + (1 - p) f(\bar{b} - \varepsilon^d;\ \bar{b} - \varepsilon^d) = f(\bar{b}; \bar{b}/2)$$

By applying (A7), we obtain:

(A9) $$p\delta(\bar{b} + \varepsilon^u) + (1 - p)\delta(\bar{b} - \varepsilon^d) = \delta\bar{b} + A(e^{\lambda\bar{b}/2} - e^{-\lambda\bar{b}/2})$$

which yields the value of A in equation (12) in the text.