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Centre for Economic Policy Research
33 Great Sutton Street, London EC1V 0DX, UK
Tel: +44 (0)20 7183 8801
www.cepr.org

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JEL Classification: H12, H63, H81

Keywords: European Debt Agency, European Safe Assets, Debt Management

Massimo Amato - massimo.amato@unibocconi.it
Bocconi University

Everardo Belloni - belloni@mip.polimi.it
Polytechnic of Milan

Carlo A. Favero - carlo.favero@unibocconi.it
Università Bocconi and CEPR

Lucio Gobbi - lucio.gobbi@unitn.it
University of Trento

Creating a Safe Asset without Debt Mutualization: the Opportunity of a European Debt Agency*

Massimo Amato[†] Everardo Belloni [‡] Carlo A. Favero[§]
Lucio Gobbi [¶]

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This paper analyses the potential of a European Debt Agency (EDA) as an efficient debt management institution for the Euro area. The simulation of prices and quantities that would have been observed in a scenario with an operational EDA illustrates that there have been fluctuations in bond prices that EDA would have been able to prevent. Moreover, due to the less volatile price dynamics, EDA would have been capable to absorb the entire eurozone debt while reducing its size. This evidence speaks in favour of EDA as an institutional debt management tool for hedging Member States financing from market sentiment vagaries; creating a European Safe Asset; unburdening ECB from debt management and managing efficiently the implementation of fiscal rules.

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[†]Corresponding author Bocconi University, massimo.amato@unibocconi.it
[‡]Politecnico di Milano SoM,belloni@mip.polimi.it
[§]Bocconi University & Innocenzo Gasparini Institute for Economic Research (IGIER) & Centre for Economic Policy Research (CEPR), Bocconi University, carlo.favero@unibocconi.it.
[¶]University of Trento,lucio.gobbi@unitn.it

1 Introduction

This paper analyses the potential of a European Debt Agency (EDA) as an efficient debt management institution for the Euro area.[1] In our proposal the Agency collects liquid funds on the market by issuing bonds with finite maturity and by continuously rolling them over to pay principal and capitalized interests. When EDA begins its operations Member States (MSs) stop issuing bonds. The Agency provides credit to MSs to finance the repayment of their maturing bonds (principal plus interests) as well as their primary budget deficit. This credit facility takes the form of perpetual loans, priced using a risk-adjusted unit cost differentiated according to the MS's creditworthiness. EDA bonds are traded while perpetual loans are not traded . The simulation of prices and quantities that would have been observed in a scenario with an operational EDA illustrates that EDA would have been able to prevent excessive fluctuations in bond prices. The simulations also show that, due to the less volatile price dynamics, EDA would have been capable to absorb the entire eurozone debt while reducing its size. Finally, debt management with EDA facilitates both the implementation of countercyclical fiscal policy and the compliance with fiscal rules. In fact, the existence of EDA allows MS to accumulate reserves with EDA in "good times" that can be used in "bad times". This evidence speaks in favour of our proposed EDA as an institutional debt management tool for 1) hedging MSs' financing from market sentiment vagaries; 2) creating a European Safe Asset, 3) unburdening ECB from debt management (QE) 4) facilitating the implementation of fiscal rules and countercyclical fiscal policy. In fact, we do not see EDA as an alternative to fiscal rules, since without fiscal rules EDA cannot prevent member states to run excessive deficits and debt. EDA is rather a complement to fiscal rules allowing an efficient management of the constraints that they necessarily impose. [2]

During the pandemic, also as a consequence of the suspension of the Stability and Growth Pact (SGP) (Council of the European Union 2020), European deficits and public debts have grown to unprecedented levels. The return of deficits to acceptable levels and, in perspective, the reduction of the debt stock, are becoming crucial objectives for European policy makers. The task is particularly arduous, since the growth of European economies is threatened by the inflation caused by the increase in energy costs, by the rearrangement of value chains as well as by supply bottlenecks. These dynamics, combined with expansive fiscal and monetary policies, generate the risk of driving the eurozone into a stagflationary debt crisis in the medium term.[3] The issue of sustainability is made even more relevant by the prospect of a further expansion of expenditure related to the geopolitical crisis we are in (investment in energy

[1] Expanding on the initial proposal by Amato et al.(2021), subsequently discussed in Amato and Saraceno(2022).

[2] In the simulations the benefits of EDA emerge for a given exogenous path of primary deficits. The results would have looked very different if countries would have used EDA as an opportunity to run excessive deficits and put government debt on unstable path.

[3] See Beckmann et al. 2022; Cottarelli 2021;ECB 2022;Roubini 2021

to reduce dependence on Russian gas, investment in European networks and investment in common defence). In this context, the optimal policy mix, i.e. the one capable of implementing a deleveraging process without, at the same time, jeopardising the growth path started by European economies in 2021, it is not easily identified. On the one hand, attempting to reduce high public debt through a long series of primary surpluses could be self-defeating. This is especially true for economies that are near the zero lower bound, whose GDP growth rates (g) exceed the cost of debt (r). In such a case, expansionary fiscal policy would be costless and provide space for pro-growth policies. On the other hand, the difference between r and g may become non-negative, making fiscal policy incapable of implementing "tearless" deleveraging, especially in contexts characterized by high inflation and high debt.[4] As of today, the European Central Bank (ECB) considers inflation to be a short-term problem related to the readjustment of the post-Covid business cycle and from the Russian-Ukrainian conflict. Nonetheless, the risk of de-anchoring of inflation expectations increases the longer the duration of the mismatch with the inflation target.[5] Furthermore, when public debts are perceived to be riskier than in "normal times", the emergence of the risk of multiple equilibria may require a faster adjustment path, as already happened during the European sovereign debt crisis. In this context, a misalignment was observed between the credit risk of MSs and the yields paid on their respective sovereign debts.[6] There is an ongoing broad debate on the changes to be implemented to the Stability and Growth Pact (SGP) in order to prevent these phenomena. [7] Common denominators across all analyses are the economic trade-off between fiscal discipline and economic growth and the policy trade-off between risk mutualisation and moral hazard. Recently, the growth estimates have been revised downward (Lagarde 2022). The fragility of European growth, combined with the containment of inflation, does not allow for sudden fiscal consolidation. Such high debts can only increase the risk of downgrading of the sovereigns of the eurozone countries, a prospect that will be further reinforced as soon as the ECB returns to applying the capital key rule. The debt normalization path could exacerbate the problems related to the scarcity of safe assets in the European financial system and to the doom loop.[8] In order to manage such a delicate situation, some proposals have been put forward to introduce schemes of collaboration and coordination between Member States and European institutions.[9] This paper describes the effects of the establishment of EDA, in an evolution of the version proposed by Amato et

[4] See Amato and Saraceno 2022; ERSB 2021; Blanchard 2019; Blanchard et al. 2019;Eichengreen and Panizza 2016; De Grauwe and Ji 2013,Lian et al. 2020

[5] Bernanke, 2007; Corsello et al., 2019,Lane, 2022, Lagarde 2022 Woodford 2003.

[6] Afonso et al., 2014,Cantore et al., 2017; Corsetti et al., 2014, Favero and Missale 2012,Kim et al. 2015,Lane 2012, Lorenzoni and Werning, 2019.

[7] Bénassy-Quéré et al., 2018; Deroose et al, 2018; European Fiscal Board, 2019; Debrun and Jonung, 2019; Cerniglia and Saraceno 2020; Blanchard et al 2021; Cerniglia et al. 2021; ERSB 2021; Francová et al. 2021; Hafele et al. 2021, Martin et al. 2021, Hauptmeier and Kamps, 2022;

[8] Alogoskoufis et al. 2020, Golec and Perotti 2017

[9] Amato et al. (2021), D'Amico et al. (2022) and Micossi (2021).

al.(2021), on prices of debts and quantities of debt, and highlights the value of EDA for the implementation of fiscal rules in "good" and "bad" times. We also simulate the effect that EDA would have produced on the prices and quantities of European debt had it been established at the time of the entry into force of the euro.

2 Literature review

We place our paper in the literature by organizing available contributions around three main points that have emerged in the debate. First, from the early stages of eurozone operation, the development of sovereign debt spreads went through several episodes of "excessive volatility" and it is not exclusively attributable to credit risk. Second, the creation of a European safe asset would be crucial for the daily operations of financial market participants as well as for solving the "doom loop" problem for European banks. Third, different proposals have been made for the creation of a European safe asset with different potential impact on the market for government debt in Europe.

2.1 Credit risk and bond pricing

At the time of the establishment of the eurozone, secondary markets for MSs' sovereign debt were highly fragmented. In particular, countries characterised by low debt levels were forced to offer a yield higher than justified by their credit risk, essentially due to the concentration of liquidity in German, French and Italian debt markets (Giovannini Group Report 2000). However, economists and policymakers of the European institutions believed that the process of standardisation of issuance techniques and regulations, the elimination of exchange rate risk and the harmonisation of tax regimes would trigger a process of convergence and of greater integration in public debt markets. Indeed, in the pre-Great Financial Crisis (GFC) period, spreads between sovereign debt yields showed considerable alignment. The differences, while still minor, could be ascribed to three main components: credit risk, international risk factors and liquidity risk (ECB 2003) . As for credit risk, some authors remark that the observed convergence between sovereign debt yields in the pre-GFC period could be attributed to the effectiveness of European rules in containing expansionary fiscal policies. [10]. Others,in contrast, show that yield spreads were unable to impose effective market discipline on governments applying fiscal policies not compliant with the SGP. In essence, markets were too permissive, "rewarding" with too low spreads MSs whose fundamentals were not in order.[11] Concerning international risk factors, i.e. factors not generated by internal economic dynamics within the eurozone, spreads, particularly those of countries characterised by high public debt, have been shown to be sensitive to tightening financial conditions in in-

[10] Bernoth and Wolff 2008; Schuknecht et al. 2010

[11] Faini 2006, Afonso and Strauch 2007 and Manganelli and Wolswijk 2009

ternational markets. [12] Again, as regards credit risk, analyses on liquidity risk also produced divergent results. On the one hand,it has been argued that liquidity risk was not a relevant component of European debt yields in the pre-GFC period.[13] On the other hand, different authors highlight that already at that time the liquidity risk was a non-negligible component.[14] In the wake of the GFC and the European sovereign debt crisis, several empirical works focused on how the convergence process of government bond yields had broken down and how spreads displayed the emergence of idiosyncratic risk components. [15] In particular, evidence emerged that spreads dynamics were more driven by variables which are representative of economic sentiment than by fiscal fundamentals.[16] By studying the evolution of spreads in countries belonging to the monetary union (EMU), Paniagua et al. (2017) show that besides the growing level of public debt, changes in investors' global risk aversion has significantly influenced the dynamics of spreads. During the sovereign debt crisis, yields also reflected redenomination risk, i.e. they incorporated the possibility of a eurozone implosion as a consequence of the Greek crisis and its spillover effects. The literature emphasised how this risk triggered self-fulfilling speculative attacks on the debts of those countries perceived to be riskier, as well as a capital migration to countries perceived to be safer (flight to quality). This phenomenon illustrates how changes in market sentiment are able to shift the sovereign debt market from a good to a bad equilibrium very quickly.[17]. Evidence of a sizeable redenomination risk capable of causing contagion effects also emerged.[18] Analysis of the effects on sovereign debt yields of the ECB's conventional and unconventional monetary policies (QE) following the "whatever it takes" speech (ECB 2012) confirm the evidence for the presence of redenomination risk and point also to a persistent mismatch between yields and fiscal fundamentals.[19] In the wake of the pandemic, the ECB's monetary policies had the effect of keeping European sovereign debt yields from diverging [20]

To summarise, in spite of different nuances of judgement, there is a very substantial literature according to which, ever since the formation of the eurozone, but especially since the sovereign debt crisis and even more so with the Covid crisis, sovereign debt yields have exhibited a composition that is not exclusively attributable to credit risk, and therefore a volatility that potentially puts at risk even the solvency of fundamentally healthy economies. In other words, this would indicate that there is room for EDA filtering and efficiency gains, and not a small one.

[12] Codogno et al. 2003, Geyer et al. 2004; Sgherri and Zoli 2009; Favero et al. 2010

[13] Codogno et al. 2003, Bernoth et al. 2004, Pagano and Von Thadden 2004

[14] Gomez-Puig 2006; Beber et al. 2009; Manganelli and Wolswijk 2009

[15] Favero and Missale 2012; Afonso et al., 2014;Kim et al. 2015

[16] Georgoutsos and Migiakis 2013

[17] Arghyrou and Tsoukalas, 2011 ; De Grauwe and Ji, 2013, Corsetti and Dedola 2011 and Lane 2012

[18] De Santis 2019, Kremens 2020

[19] Afonso et al. 2019, Favero 2013

[20] ECB 2021,Corradin et al. (2021)

2.2 The Importance of a European Safe Asset

The second function of the EDA is to create the volume of safe assets needed to increase the low euro-denominated supply and, at least in part, to reduce endemic global safe asset shortage. A safe asset is a financial security embodying a payment promise with zero credit risk. Its high demand depends mainly on its use as high quality collateral by financial operators on a daily basis. The need for safe assets can be driven by the need to comply with national and international regulations as well as for portfolio building by risk-averse investors. Investment funds also use safe assets to price risky assets as well as a store of value. Moreover, safe assets are widely used by central banks in the implementation of their monetary policy. [21] Given the central role of safe assets in the financial system, the demand for such securities tends to be constant over time . If in normal times the safe asset supply can be constituted by securities issued by public and private institutions, in time of crisis only public securities issued by solvent countries can be considered safe . The financial system is therefore faced with a shortage of safe assets and traders have to " accommodate " themselves with quasi-safe assets.[22] Table 1 shows that the volume of euro-denominated safe assets does not exceed 25 per cent of the total volume of sovereign debt. The European safe asset should also constitute the solution to end the doom loop (Alogoskoufis et al. 2020). We define the doom loop as a downward spiral which is observed when banks are over-exposed to their country's government bonds and the government bails out or undertakes policies to directly support the banking system and indirectly its debt. In particular, two main dynamics have been observed since the sovereign debt crisis. On the one hand, the value of the balance sheet of domestic banks has been considerably correlated with the value of government bonds. On the other hand, guarantees on bank deposits and bailout possibilities convey risk from the banking system to government bonds.[23]

2.3 The Existing Proposals

Several proposals have been made to solve the problem of safe asset scarcity.[24] We shall proceed by analysing the main proposals put forward before the pandemic and, then, the proposals put forward in the last two years. Regarding the first period, we grouped the proposals into three main types. The first is the most intuitive option, namely the issuance of Eurobonds using the European budget (Ubide 2015, Zettelmeyer 2017). This type of asset is definitely

[21] Bank of France 2021,Caballero et al. 2017,Golec and Perotti 2017,Greenwood and Vissing-Jorgensen 2018,Jank et al. 2021

[22] Gorton et al. 2012; Barro et al. 2021, Krishnamurthy and Vissing-Jorgensen 2012

[23] Bolton and Jeanne (2011), Gennaioli et al.(2014),Gerlach et al. (2010), Dieckmann and Plank (2012) and Kallestrup et al (2013)

[24] Gros and Micossi, 2009; Bonnevay, 2010; Delpla and von Weizsacker, 2010; Juncker and Tremonti, 2010; Leandro and Monti, 2010; Beck et al, 2011; Hellwig and Philippon, 2011; Brunnermeier et al., 2011, 2017; Dosi et al., 2018; Leandro and Zettelmeyer, 2018; Giudice et al., 2019; Amato et al 2021; Micossi et al. 2021; D'amico et al., 2022,Ubide 2015,Zettelmeyer 2017

a safe asset, as evidenced by the debt issuance to finance the Next Generation EU . At the moment, however, the maximum safe asset production capacity using the European budget cannot meet the safe asset volumes required by the financial system. This is mainly due to political reasons, i.e. the fact that the mutualisation of credit risk among eurozone countries is as for now only acceptable for limited ('una tantum') amounts of common issues. Under these conditions, as it is not possible to deleverage national debts by increasing EU debts, the proposal is also weak with regard to the management of the high outstanding public debt of several eurozone countries. In the second type of proposals (Brunnermeier et al., 2011, 2017; ESRB, 2018), one or more financial intermediaries issue bonds covered by sovereign debt portfolios in two separate tranches: a senior one ('European senior bonds') and a junior one ('European junior bonds'). The yields of the debt issued by the intermediary are derived from the instalments paid by the sovereign debt portfolio. The degree of safeness of the senior bonds will depend on the proportion of senior and junior bonds. The strength of the proposal is that it could be implemented without any kind of mutualisation. However, this is also its weakness, because of the way tranching is implemented. As De Grauwe and Ji, (2018) and Gabor and Vestergaard (2018) observe, in the event of a systemic crisis it is by no means certain that the senior tranche would remain such. While this option could theoretically provide a volume of safe assets adequate to meet the eurozone's needs and overcome the doom loop problem, the proposal is unable to solve the problem of public debt management, since the cost for states to finance the junior tranche could be substantial. The third type of solution is the tranching of national debts. In this case the issuance of European bonds (E bonds) is assigned to a European agency and their cost is financed by the instalments of senior loans granted to member states (Monti 2010). In this case, the goal of providing the European financial system with a safe asset and solving the doom loop problem could be achieved without any form of mutualisation or common guarantees. The tranching of national debts, however, exposes the junior part to possible refinancing problems, especially in the post-pandemic scenario. Among the proposals that emerged before the pandemic, the contribution of Dosi et al. (2018) cannot be included in the taxonomy we have presented so far. This paper proposes a structural reform of the European Stability Mechanism (ESM). According to the authors "the ESM should abandon the current loan-based approach in favor of an insurance-based structure in which the Stability Mechanism becomes the guarantor of the public debts and the countries which get a direct and immediate benefit from its guarantee pay an annual premium calculated at market prices". Once fully operational, this proposal would have the advantage of ensuring a European safe asset and solving the problem of the doom loop. However, the insurance scheme only reduces the risk of moral hazard, and mutualisation is not excluded. Furthermore, there are two issues to consider. The first is that the insurance premium paid by MSs is calculated at market prices, hence its estimate could be affected by market mis-pricing. The second is that, given the finite maturity of sovereign debts, the default of one or more countries is an event that cannot be ruled out. This possibility is only prevented within a perpetuity scheme, in which the 'jump to default' can be transformed into 'forbearance' (see section xx) We now turn to the proposals that emerged in the wake of the pandemic, in particular to those of Giavazzi et al. (2021) and Micossi (2021). Since, more or less explicitly, they are proposals of a Debt Agency, let us highlight the two risks to which a Debt Agency should not expose itself, in order to be truly well-designed. The first is economic and financial. Let's call it the "juniority effect": an Agency not able to manage the whole debt of all the member states would in fact be tranching between senior and junior debt, thus exposing the non-managed debt to speculative risks on the market. In a formula: "the whole is less than a part", i.e. managing all the debt generates less risk than managing only part of it. The second is juridical and political, and has to do with the prohibition of mutualisation expressed by Article 125 TFEU. An agency should not introduce any form of mutualisation, and certainly not in a surreptitious way. First of all because it is forbidden; secondly, because that would introduce elements of moral hazard; finally, because mutualisation, which is not a bad thing in itself, must however be a political choice, i.e. the result of a political process, and not a shortcut introduced by a technical body such as an Agency. As regards the Giavazzi et al. proposal, the authors conceive of a European Management Debt Agency (EDMA) that would absorb the national debts held by the ECB and replace them with safe bonds that the EDMA would issue up to a ceiling corresponding to the amount of debt/GDP created by countries during the Covid crisis. The national debts acquired by EDMA are replaced by the respective countries' promise of periodic payments. These payments are determined according to the formula (r - g) * d, where r is the cost of financing EDMA, g the growth rate of the country's GDP and d is the EDMA debt issued in proportion to the country's GDP. However, an agency so designed cannot assure that it will avoid any form of mutualisation in case of systemic events. Undoubtedly, this proposal would be able to increase the amount of European safe assets and alleviate the doom loop problem, but as far as public debt management is concerned, it might prove weak. The sovereign debt crisis has shown that financial markets can, for long periods, price sovereign debt in a way that does not reflect their credit risk. And this risk of divergence would be reinforced by the juniority effect implied by EDMA: the share of debt not managed would be more dangerously exposed to market sentiment. Moreover, according to Micossi (2022), EDMA does not comply with Article 125 of the TFEU while Amato et al (2021), Amato and Saraceno (2021), Micossi (2021) and Avgouleas and Micossi (2021) do. Micossi (2021) and Avgouleas and Micossi (2021) propose to unburden the ECB balance sheet from the amount of sovereign debt purchased under unconventional monetary policy programmes against the simultaneous purchase of the latter by the ESM. The ESM would finance this through the issuance of safe bonds, which it could do without infringing its own statute. The aims of this proposal are to avoid the side effects that an ungoverned liquidation of sovereign debts could trigger, to guarantee the rollover of sovereign debts, to free the ECB from fiscal dominance by avoiding mutualisation, and to create a high volume of safe assets for the European and international financial system. The main weakness of the proposal is, also in this case, to create a juniority effect for the part of the debts not held by the ESM.

We can now move to a presentation of the functioning of the EDA, with the aim at showing how and why the EDA does not incur in the above mentioned mutualisation and juniority risks.

3 The European Debt Agency

In this section we sketch the main characteristics of the EDA.

We leveraged on the framework elaborated in Amato et al 2021, but we introduced important refinements, mostly concerning the dynamics of loan prices and that ofthe quantities of Reserves and their use to smooth the achievement of debt sustainability and the dynamics of fiscal policy in "good" and "bad" times. For general considerations on the institutional role of the EDA, and its relationship with the debate on European rules, the reader can refer to Amato and Saraceno 2022. Under our simulation, the EDA operational model exhibits the following key characteristics:

i) The Agency collects liquid funds on the market by issuing bonds with finite maturity and by continuously rolling them over to pay principal and capitalized interests.

ii) When EDA begins its operations MSs stop issuing bonds. The Agency provides credit to MSs to finance the repayment of their maturing bonds (principal plus interests) as well as their primary budget deficit. This credit facility takes the form of perpetual loans, entailing for the Agency a commitment to renew the loans perpetually ('perpetuity option clause') unless a MS partially refunds them through primary budget surpluses.

iii) The perpetual loans are priced using a risk-adjusted unit cost differentiated according to the MS's creditworthiness. The perpetuity is computed following a perpetual-amortization scheme, which allows the EDA to amortize its loans by recording a liability on its balance sheet corresponding to the expected credit loss that has been priced in the perpetuity.

iv) The deferred perpetuities charged to MSs are collected annually by the EDA and accumulated under an 'accrued interest reserve' item, intended to cover the Agency's future liabilities (EDA bond principal, bond accrued interests and expected losses). The reserve takes the form of a 'Central Bank interest-bearing liability'; the interest rates used in revaluing the reserves are in line with the capitalized interests payable on the EDA bonds.

v) The Agency is endowed with solvency capital to withstand the event of a mass entry in state of forbearance on the part of the MSs. We propose to measure this capital in terms of the number of forbearance years of a "stressed" annuity payment that it allows to each MS. The annuity payment is stressed in the sense that it is computed for credit grade "next to default".

The rationale behind the adoption of the perpetuity-based scheme is that perpetuity, and only perpetuity, allows to move from a jump-to-default logic to a forbearance logic. Whilst default logic implies that a significant part of the exposure is non-performing, forbearance only suspends the payment of the interest due (i.e. of the perpetuity instalments) during a congruous but limited restructuring period, without implying any form of default. In the context of a perpetuity scheme, a finite payment suspension cannot undermine the soundness of the scheme itself. MSs cannot issue perpetuities directly, as these do not easily complement the liability structure prevailing in the market (according to a logic of liquidity preference), which implies a portfolio offering of assets with finite duration. This is why the EDA intermediation is needed, in order to decouple perpetuity and the issuance portfolio by offering bonds with finite duration and leveraging mechanisms to roll over issues while minimising repricing risks thanks to a high credit rating. EDA creditworthiness leverages on three key elements: 1) portfolio diversification, 2) solvency capital and 3) repricing of the perpetuity to address interest rate risk (change in the prevailing level of interest rates for relevant durations relative to the issuance portfolio). The scheme of the EDA balance sheet can be summarized in the following graphical representation (drawn from Amato et al. 2021):

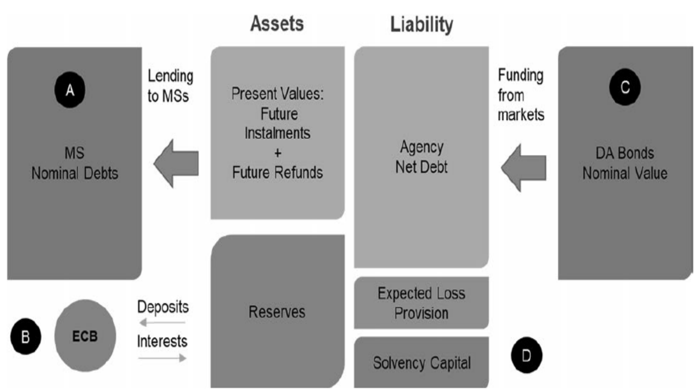

Figure 1: EDA's Balance Sheet

The above sketched EDA framework allows the financing of the MSs on a perpetuity amortizing scheme without implying for the EDA any form of perpetual bonds issuance: the bonds issued by the EDA represent liabilities valued at amortised cost on its balance sheet using an effective interest rate which is equivalent, given current market prices, to the EDA bonds internal rate of return at issuance. This reflects the duration structure constraint of the EDA's portfolio (according to market liquidity preferences) and its own creditworthiness. As for the idiomatic pricing of the perpetuities charged to each

MS, the risk-adjusted interest rate used to compute the perpetual amortization scheme is made up of two basic components:

- the average cost of servicing the EDA issued bonds;
- an add-on cost reflecting the riskiness of each MS in line with its specific creditworthiness, i.e. proportional to its degree of compliance to the agreed EU rules.

In other terms, the cost for each MS is a function of the market cost of the EDA's issuing portfolio, plus a differential cost reflecting the MS's specific creditworthiness. This allows the EDA to avoid any component of mutuality in prices. The accrued interest reserve item resulting from the capitalisation of the perpetuity instalments paid by the MS's constitutes in all respects a sinking fund, which:

- allows for the intertemporal financial equilibrium of the EDA, implying equivalence between the expected present values of its assets and liabilities, thus covering both a proportion of the present value of the EDA debt and the provision for the expected loss relative to loans;
- is available for a partial write-off of EDA's own debt towards the markets, according to actual market opportunities and EDA's management tactical objectives;
- can be used to subsidise MSs future "stressed" instalments. During a period of forbearance, and provided there is enough available risk capital for the Agency to cover unexpected future losses (according to our forbearance framework; see previous point v), they can be used for rebalancing the EDA asset side towards a riskier configuration.

In the simulation that we present, we assume that the EDA will capitalise interests to repay its bonds at maturity. This implies that the Agency will be forced to issue new debt in order to finance maturing principal and accrued interests. This could potentially make the EDA's debt grow indefinitely. A set of fiscal rules complemetary to EDA will prevent this from happening. Moreover EDA, if endowed with suitable solvency capital, will always be able to use its excess reserves to buy back its debt when beneficial. Thanks to our non-mutualistic approach, a sort of a 'balance sheet separation feature' holds among MSs under a managerial point of view.

3.1 Pricing of the irredeemable mortgage scheme

EDA finance itself by issuing bonds with yield r_t^B to finance Member States with loans that comes in the form of an irredeemable mortage scheme. To price the irredeemable mortage scheme EDA computes the present value of an infinite stream of payments using the yield r_t^B as a discount rate. Future payments are not deterministic but they occur only if states are not in "default". The probability whith which a given country enters the state of default in each future period is computed by i) assigning each MS to a specific *credit risk class j* based on its creditworthiness, from the safest (conventionally labelled AAA) to the default (labelled D) ii) assuming that a country defaults only when it reaches state D, and modelling the transition from one state to the other via a transition matrix that depends on the state of the economic cycle iii) taking into account that, as the business cycle is stationary the predicted point-in-time trnasition matrix at each period in the future converges rapidly to a constant thorugh-the-cycle transition matrix. Given the discount factor and the credit risk migration model the present value of a unitary perpetual annuity for a country i initially in credit risk class j can be ten computed as $\tilde{a}_{ij,t}$ (see appendix A1 and A2).

Given the unitary perpetual annuity value the annual instalment cost for each country, labelled as "idiomatic fundamental price", is computed in order to keep "equity" with EDA constant. To this end each country should pay an annual instalment, $c_{ij,t}$ that ensures the match between the present value of the perpetuity's payment and the difference between the value of bonds issued by EDA to finance the country,$B_{i,t}^{EDA}$, and reserves accumulated by the country with EDA,$R_{i,t}^{EDA}$:

$$c_{ij,t} = \frac{B_{i,t}^{EDA} - R_{i,t}^{EDA}}{\tilde{a}_{ij,t}}. \tag{1}$$

It is immediate to verify that the above formula guarantees the the present value of total assets for EDA generated by each country $\tilde{a}_{j,t}c_{ij,t}$ is equal to the total EDA net liabilities $(B_{i,t}^{EDA} - R_{i,t}^{EDA})$.

"Idiomatic fundamental price"has several important features.

1. Each Member State pays for the risk inherent to the specific credit risk class j to which it is assigned, without involving any form of solidarity or mutuality among Member States of different credit risk classes. Thanks to the irredeemable nature of the loan granted by the Debt Agency, the instalment corresponds to the risk-adjusted interest that a Member State of credit risk class j has to pay annually to finance its debt based on its creditworthiness.

2. The annual instalment cost is repriced in each period so that EDA's assets are shielded from interest rate risk and upgrades and downgrades in the merit credit of Member States are timely fully priced.

3. Each Member State debt is priced independently. Pricing the debt of each country independently generates a total payment to EDA higher than the case in which the Debt Agency prices at time t its loans portfolio using an average annuity cost computed as the weighted average of the annuities of the credit risk classes, with weigths determined by the relative capital weight exposure for each class. Average pricing assures in expectation the agency intertemporal equilibrium exploiting a "pooling effect" that it is not present under idiomatic pricing. Therefore, idiomatic fundamental pricing scheme generates a total payment that is structurally higher than

the one implied by the equilibrium condition. Under idiomatic pricing EDA will accumulate reserves that can be precisely attributed to each countries.

4. By leveraging the potentially irredeemable nature of sovereign debts, we have intended to price the overall cost by means of an amortizing scheme according to which every single Member State pays for an infinite period of time only a risk-adjusted interest, regularly re-priced. Reserves accumulated by EDA under the idiomatic pricing scheme will contribute (together with an initial endowment) to form its required risk capital. In the context of a perpetual long scheme where fiscal rules prevent the risk capital can be used by MS to suspend the payments of the perpetual loans for a number of "forbearance" years in which reserves accumulated with EDA can be used to pay loans and, if necessary, to finance temporary primary deficits. It is therefore natural to evaluate risk capital in terms of forbearance years allowed by the reserves available with EDA for each MS.

5. Forbearance allows MSs to use Reserves accumulated with EDA in "good" times to comply with fiscal rules and "debt" limits in "bad" times. It also causes a slower growth of EDA debt in "bad" times".

4 The Working of EDA: a numerical application

To illustrate the potential of EDA we have performed a retrospective simulation exercise intended to show how the Debt Agency could have worked historically. from right after the introduction of the single currency in 2002, up to the end of 2020. The purpose of our simulation exercise is twofold.

First, we simulate prices to evaluate the evaluate the effects of the European Debt Agency in terms of a potential mitigation of the cost of debt, and its systematic alignment to the fundamental credit risk, for all member states.

Second, we illustrate the dynamics of quantities, i.e. asset and liabilities of EDA and each member state.

The scenario for the simulation exercise has been constructed as follows.

- The main countries of the Eurozone in terms of exposure (Germany, France, Italy and Spain) and Greece, for its specificity, were considered separately; the rest were aggregated into a residual group ("Euro-Others").
- The discount rate used by EDA for the computation of the idiomatic cost of each Member State has been set as equal to the yield of EDA bonds. In turn this was set equal to the 10 year swap rate in the euro area, which in our sample fluctuates closely to the average yield of euro area 10-year government bonds and it is then used as a 'risk sensitive' discount rate with respect to the 'global risk factors' (liquidity risk plus global market sentiment) inherent to the Eurozone as a whole.

- The idiomatic cost associated with each Member State has been calculated on the basis of the Fitch rating corresponding to each record of the historical series[25]
- the pattern of primary deficits has been kept exogenous and equal to the observed one for each member state.

4.1 Prices dynamics

Fig. (2) illustrates the historical trends of the yields to maturity of 10-year bonds issued by Member States.

Insert Figure 2

Fig. (2) clearly shows that, after the inception of the euro in 2001, all Member States a common low level of bond yields. By contrast, after the US subprime lending crisis a process of divergence started, this process reached its peak during the the sovereign debt crisis of 2011-2012. As the graph shows, compared to the average portfolio yield (dotted line) a pattern emerges which is characterized by a 'divergent symmetry' ('symmetrical divergence') between countries with high credit rating (primarily Germany) and countries with a tight budget constraint (especially Italy and Greece). This pattern becomes inefficient if the resulting cost of debt service were for some countries higher than the cost of debt service consistent with their fundamental risk and conversely lower for others. This divergent symmetry has the potential of doing further damage in the case member countries banking system bond holdings are affected by home bias in which case a "doom loop" emerges when falling government bond prices causes a reduction in bank loans that in turn increases fundamental risk via its recessionary impact. What would have happened if the cost of servicing the debt of these Member States had been calculated on the basis of the idiomatic pricing scheme proposed here?

In each year of our simulation we have computed the idiomatic costs of loans with EDA for each Member States by applying the pricing framework described in the previous section. Figure 4 shows the historical series of idiomatic costs recalculated for each MS on the hypothesis of a Debt Agency operational since 2002, and compares them with the idiomatic cost for an hypothetical country with the credit grade "next to default" and the yields of 10-year Government Bonds for Germany (lower yellow line) and Italy (upper green line).

Insert Figure 4

These costs are 'risk sensitive', but the idiomatic pricing of risk is very different from the pricing observed in 10-year bond yields for Germany and Italy during the simulation sample. Importantly, idiomatic costs do not manifest 'diverging symmetries' in favour or against a particular Member State, since they are calculated on the assumption that a 'systemic risk factor' operates at the level of

[25] Source: Refinitiv 2021.

the entire eurozone. The case of the cost for Greece is particularly interesting in that it often coincide with the worst case but it shows a level and a volatility that are not comparable with those or the market prices of Greek 10-year bonds reported in Figure 2. The evidence that EDA might shield countries from "excessive fluctuations" in the market prices of their government debt is also confirmed by the comparison between the idiomatic prices in the worst case scenario and the observed yield on 10-year Italian government bonds. Despite the fact that Italy had always a credit rating well above the "next to default" the yield on 10-year Italian government bond shows a level and a volatility much higher than that of the idiomatic price in the worst case (next to default) scenario.

4.2 Quantities dynamics

To illustrate the working of EDA we consider the dynamics of the following quantities:

A. Member States Debt in Government Bonds .

B. EDA Loans,the cost of which is based on an irredeemable mortgage scheme, Debt Agency Bonds, which take the form of bonds with finite maturity.

C. Accumulated reserves of EDA , which take the form of remunerated deposits within the ECB.

D. Solvency capital, which takes the form of the number of years of forbearance of annuity payments allowed by the accumulated capital with EDA of each countries.

4.2.1 Member States Debt

In our simulation scenario, before EDA inception, bonds are the unique source of finance of government debt that takes the following dynamics:

$$D_{i,t} = B_{i,t} \quad (2)$$
$$B_{i,t} = B_{i,t-1} + r_{i,t}B_{i,t-1} + (G_{i,t} - T_{i,t}) + SFA_{i,t} \quad (3)$$

where $r_{i,t} = \frac{IP_{i,t}}{D_{i,t}}$, $IP_{i,t}$ is the interest payment and $G_{i,t} - T_{i,t}$ is the primary surplus, SFA are the stock-flow adjustments. Using OECD data equation (3) allows to exactly reconstruct the government debt dynamics of each member state.

With the inception of EDA, member states progressively shift from debt finance with bonds to debt-finance with loans with EDA, until loans with EDA become the exclusive source of finance of government debt. So, under EDA, we have

$$D_{i,t} = B_{i,t} + L_{i,t}^{EDA}$$

In particular in each year loans with EDA finance the annual deficit (including SFA) and substitute bonds that come to maturity. Assuming that in t_0, the year of the establishment of EDA, member countries debt has an average maturity of $m = 10$ years, Bond Dynamics from t_0 onwards can be simulated as follows:

$$\begin{aligned}
m &= 10 \\
&\quad for \quad (t \quad in \quad t_0 : t_{0+9})\{ \\
B_{i,t} &= B_{i,t-1} + r_{i,t}B_{i,t-1} - \frac{1}{m}B_{i,t-1}(1 + r_{i,t}) \\
m &= \quad m - 1 \quad \} \\
for \quad t &\geq 10 \\
B_{i,t} &= 0
\end{aligned}$$

4.2.2 Loans, Bonds and Reserves with EDA

As EDA begins its operations it will issue bonds to finance loans given to each countries and it will accumulate reserves. The Dynamics EDA debt in bonds, EDA Loans and EDA Reserves attributable to each member country can be exactly tracked. At the inception of EDA ($t = t_0$) we have:[26]

$$\begin{aligned}
P_{i,t}^{EDA} &= 0 \\
NL_{i,t}^{EDA} &= \frac{1}{10}B_{i,t-1}(1 + r_{i,t}) + (G_{i,t} - T_{i,t}) + SFA_{i,t} \\
L_{i,t}^{EDA} &= NL_{i,t}^{EDA} \\
B_{i,t}^{EDA} &= NL_{i,t}^{EDA} \\
R_{i,t}^{EDA} &= 0
\end{aligned}$$

where $P_{i,t}^{EDA}$ are the annuity payments due to EDA by country i in year t, and $NL_{i,t}^{EDA}$ are the new loans that EDA needs to issue for country i in year t. In the first year bonds issues by EDA match exactly new loans and the initial level of each country reserves with EDA is zero.

In the transition period, while EDA is acquiring member countries debt in

[26] Note that in our scheme, Expected Losses at time t reduce EDA assets in period t+1

bonds that comes to expiration ($t_0 < t < t_0 + 10$), we have:

$$\begin{aligned}
m &= 9 \\
P_{i,t}^{EDA} &= \frac{B_{i,t-1}^{EDA} - R_{i,t-1}^{EDA}}{\tilde{a}_{ij,t}} \\
NL_{i,t}^{EDA} &= \frac{1}{m} B_{i,t-1}(1 + r_{i,t}) + \left(P_{i,t}^{EDA} + G_{i,t} - T_{i,t}\right) + SFA_{i,t} \\
L_{i,t}^{EDA} &= L_{i,t-1}^{EDA} + NL_{i,t}^{EDA} \\
B_{i,t}^{EDA} &= B_{i,t-1}^{EDA} + NL_{i,t}^{EDA} + r_t^B B_{i,t-1}^{EDA} \\
R_{i,t}^{EDA} &= (1 + r_t^{ECB}) R_{i,t-1}^{EDA} + P_{i,t}^{EDA} \\
m &= m - 1
\end{aligned}$$

The EDA new lending $NL_{i,t}^{EDA}$ is made up of maturing bonds principal and interests ($\frac{1}{m} B_{i,t-1}(1 + r_{i,t})$), country primary deficits and the SFAs ($G_{i,t} - T_{i,t} + SFA_{i,t}$), plus current deferred payments of the perpetuity due at time t ($P_{i,t}^{EDA}$) . In each period EDA bonds are issued to finance $NL_{i,t}^{EDA}$ and to pay bonds portfolio interests equal to $r_t^B B_{i,t-1}^{EDA}$ accrued on the EDA existing debt. Reserves $R_{i,t}^{EDA}$ are deposited at the ECB and remunerated at a rate r_t^{ECB}, equal to the inflation target of the ECB.[27] Once the EDA has acquired all member countries debt ($t \geq t_0 + 10$), we have:

$$\begin{aligned}
P_{i,t}^{EDA} &= \frac{B_{i,t-1}^{EDA} - R_{i,t-1}^{EDA}}{\tilde{a}_{ij,t}} \\
NL_{i,t}^{EDA} &= P_{i,t}^{EDA} + G_{i,t} - T_{i,t} + SFA_{i,t} \\
L_{i,t}^{EDA} &= L_{i,t-1}^{EDA} + NL_{i,t}^{EDA} \\
B_{i,t}^{EDA} &= B_{i,t-1}^{EDA} + NL_{i,t}^{EDA} + r_t^B B_{i,t-1}^{EDA} \\
R_{i,t}^{EDA} &= (1 + r_t^{ECB}) R_{i,t-1}^{EDA} + P_{i,t}^{EDA}
\end{aligned}$$

When EDA is fully operational, a country has the possibility to reduce its $NL_{i,t}^{EDA}$ by running a positive primary surplus $(G_{i,t} - T_{i,t} + SFA_{i,t}) \leq 0$ that more than compensates the cost of servicing its debt in loans. In this case debt buy back occurs in two dimensions, first the total stock of loans of the MS with EDA is reduced, simultaneously the stock of debt in bonds marketed by EDA is also reduced. Interestingly, under EDA fiscal rules could be defined naturally by targeting the evolution of $B_{i,t}^{EDA}$ with respect to the country GDP.

[27]To assure the financial equilibrium of the EDA, the inflation target of the ECB should be aligned to the EDA average cost of debt r_t^B. According to this and to avoid repricing and interest rate risks, the annual instalment charged to a member state should be computed as: $P_{i,t}^{EDA} = \frac{B_{i,t-1}^{EDA} - R_{i,t-1}^{EDA}}{\tilde{a}_{ij,t}} + (r_t^B - r_t^{ECB}) R_{i,t-1}^{EDA}$. However, to simplify our numerical exercise and without loss of generality, we assume that r_t^{ECB} be aligned with that cost.

4.2.3 EDA Reserves, Forbearance and Fiscal Policy in "good" and "bad" times.

The description of EDA Assets and Liabilities is completed by tracking the dynamics of EDA reserves and capital. We assume that in the first period an initial capital is conferred to EDA equal to the ESM capital and the initial capital is reallocated among member countries according to the ESM weights (https://www.esm.europa.eu/esm-governance).[28] From the second period onwards the dynamics of capital is driven the dynamics of reserves and the remuneration of capital. Reserves are remunerated by the ECB at a rate r_t^{ECB}, equal to the inflation target of the ECB, the endowment instead is not remunerated :

$$\begin{aligned}
for \quad t &= t_0 \\
R_{i,t}^{EDA} &= 0 \\
E_{i,t}^{EDA} &= C_0 w_i \\
for \quad t &> t_0 \\
R_{i,t}^{EDA} &= (1 + r_t^{ECB}) R_{i,t-1}^{EDA} + P_{i,t} - RP_{i,t}^{EDA} \\
E_{i,t}^{EDA} &= E_{i,t-1}^{EDA} \\
TR_{i,t}^{EDA} &= R_{i,t}^{EDA} + E_{i,t}^{EDA}
\end{aligned}$$

Total quantities for EDA are obtained by aggregating all member countries quantities

$$\begin{aligned}
B_{EDA,t} &= \sum_{i=1}^{n} B_{i,t}^{EDA} \quad , \quad L_{EDA,t} = \sum_{i=1}^{n} L_{i,t}^{EDA} \\
R_{EDA,t} &= \sum_{i=1}^{n} R_{i,t}^{EDA} \quad , \quad E_{EDA,t} = \sum_{i=1}^{n} E_{i,t}^{EDA} \\
TR_{EDA,t} &= \sum_{i=1}^{n} TR_{i,t}^{EDA}
\end{aligned}$$

The reserves accumulated by EDA under the idiomatic pricing scheme will contribute (together with an initial endowment) to form its required risk capital. We measure the required risk capital in terms of number of forbearence years $n_{i,t}$ of annuity payments allowed by the each Member State capital. We use the this wording because in "bad times", when a MS gets close to being downgraded to a credit risk class close to default, reserves accumulated with EDA can be used by the MS to access a "forbearance" procedure. During the forbearance period reserves accumulated with EDA can be used for servicing debt instead of issuing new loans. The procedure will avoid the repricing of loans with the

[28] This initial capital is equal to 645 billions euro which is computed as the value in 2002 of the ESM endowment. The actualization has been performed by using as discount rate the ECB inflation target of 2 per cent

higher idiomatic cost, and will give the MS the time and resources to implement smoothly the fiscal policy necessary to comply with fiscal rules and avoid dowgrading. In practice, number of forbearance years allowed by the each Member State capital with EDA can be computed as:

$$n_{i,t} = \frac{TR_{i,t}^{EDA} + L_{i,t}^{EDA} - B_{i,t}^{EDA}}{\frac{B_{i,t-1}^{EDA} - R_{i,t-1}^{EDA}}{\bar{a}_t^{st}}} \tag{4}$$

The numerator of equation (4) are EDA Own Funds (computed by subtracting to the sum of total reserves and loans with EDA, the total EDA debt), while the denominator is the annual payment of annuity due by each country computed at a stressed unit cost (i.e. the unit cost attributable to the credit class next to default).[29]

Allowing for forbearance periods will modify the dynamics of Loans, Reserves as follows:

$$\begin{aligned} NL_{i,t}^{EDA} &= P_{i,t}^{EDA} + G_{i,t} - T_{i,t} + SFA_{i,t} + FP_{i,t}^{EDA} \qquad (5) \\ L_{i,t}^{EDA} &= L_{i,t-1}^{EDA} + NL_{i,t}^{EDA} \\ B_{i,t}^{EDA} &= B_{i,t-1}^{EDA} + \left(P_{i,t}^{EDA} + G_{i,t} - T_{i,t} + SFA_{i,t} - FP_{i,t}^{EDA}\right) + r_t^B B_{i,t-1}^{EDA} \\ R_{i,t}^{EDA} &= (1 + r_t^{ECB}) R_{i,t-1}^{EDA} + P_{i,t}^{EDA} - FP_{i,t}^{EDA} \end{aligned}$$

In normal times, when there is no forbearance and MS do not use their reserves for loan payments with EDA, $FP_{i,t}^{EDA} = 0$ and the dynamics of all quantities is as described before. However, when a MS is given access to the forbearance procedure, $NL_{i,t}^{EDA}$ is different as the MS uses its own reserves with EDA for forbearance payment $FP_{i,t}^{EDA}$. Using reserves for debt repayment increases the debt of MS with EDA in loans. Interestingly, EDA will need to issue bonds on the market to finance only the part of MS's total deficit that is not paid by using their reserves with EDA. Debt repayment allows MS to comply with fiscal rules. Also notice that Bonds issued by EDA grow faster than Loans with EDA outside forbearance, but during forbearance the opposite happens. Interestingly, under EDA, fiscal rules could be defined naturally by targeting the evolution of $B_{i,t}^{EDA}$ with respect to the i-th country GDP. In this case, as EDA debt grows faster than EDA Loans in "good times" but it grows slower than EDA loans in "bad times", the existence of EDA will facilitate a smooth compliance with debt limits, as set by the fiscal rules.

4.2.4 Numerical Results

Figures 5-8 describe the dynamics of simulated debt in loans with EDA for Italy, Germany and France and the whole Euro area together with that of actual observed debt in national bonds.

[29] Notice that we consider a conservative measure of the number of forbearance year in that in computing $n_{i,t}$ we impose the constraint that EDa's equity cannot be negative. If this constraint is relaxed a larger measure of $n_{i,t}$ can be computed as $\frac{TR_{i,t}^{EDA}}{\frac{B_{i,t-1}^{EDA} - R_{i,t-1}^{EDA}}{\bar{a}_t^{st}}}$

Insert Figure 5-8

The graphical evidence makes clear that, for given primary surpluses, the working of EDA would have created a lower debt for all the member countries in 2020. Gains are more pronounced for high yielders but there are no losers. Loans dynamics depends on idiomatic costs that lower and less volatile than the observed average cost of financing local government debt in bonds. Figure 9 reports Asset and Liabilities for EDA.

Insert Figure 9

The evidence is that accumulated reserves do compensate the gap between EDA liabilities and EDA bonds and EDA own funds grow slightly faster than GDP over the simulation period. The growth of EDA own funds is a direct consequence of the fact that the idiomatic fundamental pricing scheme generates a total payment that is structurally higher than the equilibrium payment computed by "pooling" the debt of all MS in EDA. So, the idiomatic pricing scheme allows EDA to accumulate reserves in excess to the debt in bonds that can be precisely attributed to each country. Finally, Figure 10 reports the number of forbearance years allowed by the EDA Total Reserves.

Insert Figure 10

In the first few years of EDA operations, while the agency is progressively acquiring debt coming to maturity of Member States, the initial endowment gives plenty of forbearance capacity to all state members. Capitalization reaches a minimum just between one and two forbearance period at the beginning of the full operational phasein 2011. Reserve then start growing to guarantee to all Member States a forbearance capacity at least above five years within the first 10 years of the full operating period of EDA. The case of Greece is particularly interesting. On occasion of the first wave of the Greek crisis at the end of 2009, EDA would helped in containing contagion but the available reserves would have not allowed Greece to access forbearance. This crisis was ignited by the revelation, at the end of 2009, by the newly appointed prime minister Papandreou that Greece's budget deficit will exceed 12 percent of GDP, nearly double the original estimates. The figure was later revised upward to 15.4 percent. Greece's borrowing costs spike as credit-rating agencies downgrade the country's sovereign debt to junk status in early 2010. However, on occasion of the second wave of the crisis in 2015, following the appointment to Prime Minister Alexis Tsipras and the missed payment of the IMF bailout in June 2015, the working of EDA would have allowed over five years of forbearance to Greece. Using this forbearance could have been very helpful to obtain upgrades by Debt Agencies and reducing the pain of fiscal stabilization caused by the increase in the level and volatility of the cost of government borrowing.

5 Conclusions: the political scope of the EDA

5.1 Core characteristics

- FILTERING MARKET DISCIPLINE AND INCREASING ACCOUNTABILITY. Until the suspension of the Stability Pact, the stability of the EMU was entrusted partly to MSs self-discipline, partly to the supervision of the Commission, partly to market discipline. Already during the 2012 crisis it has been observed that "if markets can stay irrational longer than a country can stay solvent, then the role of yield spreads on national bonds as a fiscal discipline device is considerably weakened".[30] With the EDA, liquidity and repricing risk is eliminated, but not fundamental risk. Instead, via a fairer risk assessment, a more efficient discipline mechanism is established. The progressive absorption in the EDA of MSs' debts will reinforce this 'filtered discipline', by removing instability due to market sentiment and by singling out fundamental risk through the determination of the instalments.

- AVOIDING DEBT MUTUALISATION. The EDA avoids any form of mutualization among MSs by differentiating the price of its loans to MSs according to the fundamental risk of each of them, which in turn depends on its compliance to the eurozone rules, as assessed by the Commission. No average instalment is charged. Politically, and legally, this is a key point. The high creditworthiness of the EDA would allow it to obtain the best financing conditions on the markets. This would imply that all MSs could finance themselves with the EDA on the best possible terms; but this would always happen in strict proportion to the differences in their fundamental risks. The less 'virtuous' you are, the more you pay.

- PROVIDING A EUROPEAN SAFE ASSET AND STABILISING EXPECTATIONS. Managing the maturity mismatch between perpetual loans and finite maturity bonds, the EDA would reassure markets, which would not have to price perpetuities and could benefit from a safe and liquid asset. This would be at least as attractive as US safe bonds, and could strongly contribute to EU geopolitical positioning. A truly European safe asset as provided by the EDA wound be key for the stability of financial markets, as it would stabilize portfolios (for insurances and pension funds, first of all), as well as act as credible collaterals for risky private financial operations. For both reasons, a large stock of European safe assets is in fact an urgent necessity: self-fulfilling expectations dragging markets toward bad equilibria played an important role in the spread of past crises.[31] The modus operandi of the EDA being known in advance by market participants, debt management could act systematically on expectations, avoiding vicious circles.

[30] Favero and Missale, p.277
[31] Codogno and van den Noord 2019, Blanchard and Pisani-Ferry 2020

- ADDRESSING THE JUNIORITY RISK. The EDA's Target Operating Model (TOM) would allow it to progressively absorb in full the outstanding debt of both the MSs and the Commission. Beside the need for a safe asset, the other reason for the EDA to manage the whole eurozone debt is the imperative of avoiding a juniority effect. Indeed, a full debt management is far less risky than a partial one: "the risk that, as a Debt Agency subtracts part of the floating debt from the markets, the part still floating on the market be subject to a 'juniority stigma', can only be averted by committing, ex ante, the Agency to lend to a MS the equivalent of the expiring principal at each due date". As counterintuitive as it may seem, a global solution to the eurozone debt management is far less risky and exempt from flaws that partial ones, apparently more modest and hence more feasible. The political feasibility of a project depends more on its long-term structural soundness than on its apparent short-term easiness: absorbing only a part MSs' debt, would in fact transform the EDA in a sort of bad bank and leave the remaining part to speculation and market sentiment (a trend which eventually would worsen the creditworthiness of the Agency as well). This is what makes our proposal stand out with respect to recent ones, that would only deal with Covid debt.[32]

- ALLOWING THE ECB TO FOCUS ON ITS CORE BUSINESS. Like for other proposals, the EDA would have the merit of unburdening the ECB from an indefinite continuation of its QE programs. Not only this would be more respectful of the temporary nature of ECB intervention, but it would free it from the obligation of closing spreads allowing it to focus on its mandate of keeping inflation under control and help close output gaps, which is particularly important at this juncture [33]. Thus, establishing the EDA would not contribute to the proliferation of EU bodies but rather help a better division of labour among EU institutions.

- END OF THE DOOM LOOP. By gradually substituting national debts with Eurobonds, the EDA would put an end to the 'doom loop' that currently links States' solvency to that of their banking systems, and vice versa. Individual operators could escape home bias and the eurozone would become a homogeneous area, thus making the goal of a banking union far more achievable.

- NORMALIZE EMU BOND MARKETS. Core countries would be relieved of a problem that may not be so conspicuous but which threatens to undermine the stability of their insurance and pension systems, namely negative yields. The large and increasing supply of EDA-issued Eurobonds would lead to stable and positive perspective yield, and would take some economic pressure off the Bunds' negative yields, without imposing the politically unbearable bill of mutualisation.

[32]see Micossi (2021) and D'Amico et al. (2022)
[33]Andreolli 2021

- A TRANSPARENT DIVISION OF LABOUR WITH THE COMMISSION. The creation of the EDA would keep in the hands of EU institutions the political and technical determination of the cost of the instalments that each MS must bear; this would include debt sustainability analysis and compliance with the reformed (and hopefully more efficient) rules [34]. Once it were handed by EU bodies the fundamental risk assessment, the EDA would enforce MSs accountability through its pricing scheme.

- GRADUALISM AND NEUTRALITY WITH RESPECT TO EU GOVERNANCE FUTURE DEVELOPMENTS. The fact that the EDA could perfectly work, preserving its financial intertemporal equilibrium without any explicit or hidden form of mutualisation, does not exclude that it could go in the direction a more structured European Union. The EDA could manage different loan portfolios, for the MS and for the Commission, by building segregated (mutualized and non-mutualized) sub-portfolios.

To conclude, we propose a deeper insight on the crucial issue of the relationship between the political question of the fiscal rules and the technical solution provided by EDA

5.2 Fiscal rules and debt management.

EDA avoids any form of debt mutualisation, being thus compliant with the prohibition of mutualisation expressed by Article 125 TFEU [35]. A second, at least as important, feature is that, by minimising the overall financing cost for member states, the EDA could make more efficient any set of rules. In other words: given the rules, EDA reduces the impact on the cost of debt for all members, thus reinforcing stability; but, given its ability to reduce the cost of debt, EDA allows the adoption of more growth-friendly rules. This means that EDA can be seen as a tool for the management of this crucial trade-off. The ability of the EDA to absorb all national debts on the market must not however be seen as a renouncement to fiscal discipline. Quite the opposite is true: EDA is not an alternative to fiscal rules, but only a technical device for efficiently managing them. Better, it is a tool for optimising the management of any possible set of fiscal rules. It is clear that without fiscal rules EDA alone cannot prevent member states to run unsustainable deficits and debts. But it is also clear that the operation of the EDA might make easier make growth possible while respecting the rules, mostly because it operates in a perpetuity horizon.

Every fiscal rule imposes some constraint on the debt to GDP dynamics. Whether government debts are loans with EDA rather or in bonds bought by the market, this is not relevant: EDA loans are just a different form of debt, which also has to be compliant with the set of rules MS have agreed upon. If, given the rules, one or more MSs adopt fiscal policies that push them towards

[34] Blanchard et al. 2021
[35] Micossi 2022

the debt limits which rules assign, the Debt Agency will, in close cooperation with the Commission, consider downgrades. As we will see, downgrades are particularly costly for those countries that are closer to the default class. In such a situation a MS might ask the EDA for ‘forbearance’, i.e. for a special treatment, limited in time, allowing it to avoid the repricing of all its debt with the worse grading (which is the normal result on markets) and giving it some time to get again public finance on a path compliant with the agreed rules. Forbearance might favour the implementation of a countercyclical deficit policy that ensures debt stabilisation. Think for example of a five-years forbearance programme: in the first part of the programme, government would have the fiscal space to implement a fiscal policy allowing the economy to get back to a growth path, while in the second part of forbearance, fiscal stabilization could be achieved when growth is back to its natural level. If stabilization were not to be implemented (this actually meaning that rules are not really binding), forbearance would be just equivalent to "kicking the can down the road". But if stabilization were to be implemented, forbearance (which only a EDA operating in terms of perpetuity schemes can afford without destabilizing its own balance sheet) would become an efficient way of minimizing the cost of stabilization. In this perspective, the pricing of loans with EDA rules out the possibility of excessive and inefficient fluctuations in the cost of servicing the debt that we have seen happening during crises in the presence of single Member State government bonds. Surely, EDA works if deviations from fiscal stability are temporary and it is an efficient device to manage temporary deviation from fiscal stability. If instead deviation from fiscal stability become permanent there is nothing in the EDA mechanism that rules out a global default. In such a scenario, the containment of the cost of debt servicing delivered by EDA, can have even perverse effects. But ‘a permanent deviation from fiscal stability’ is nothing else than the absence of a rule, or, worse, the permanent bending of it.

6 Tables and Figures

rating 31/12/2020	Outstanding debt	Proportion
AAA	2,776,336	24.49%
AA	3,649,460	32.20%
A	1,699,107	14.99%
BBB	2,868,706	25.31%
BB	341,023	3.01%
total	11,334,631	100.00%

Table 1: Eurozone Public Debts, source ECB 2021

	AAA	AA	A	BBB	BB	B	CCC	D
AAA	0.9599	0.0401	0	0	0	0	0	0
AA	0.0179	0.9107	0.0643	0.0071	0	0	0	0
A	0	0.0281	0.8989	0.0730	0	0	0	0
BBB	0	0	0.0528	0.8746	0.0561	0.0132	0.0033	0
BB	0	0	0	0.0490	0.8529	0.0784	0.0131	0.0065
B	0	0	0	0	0.0706	0.8853	0.0294	0.0147
CCC	0	0	0	0	0	0.3846	0.4231	0.1923
D	0	0	0	0	0	0	0	1

Table 2: Estimated TTC transition matrix

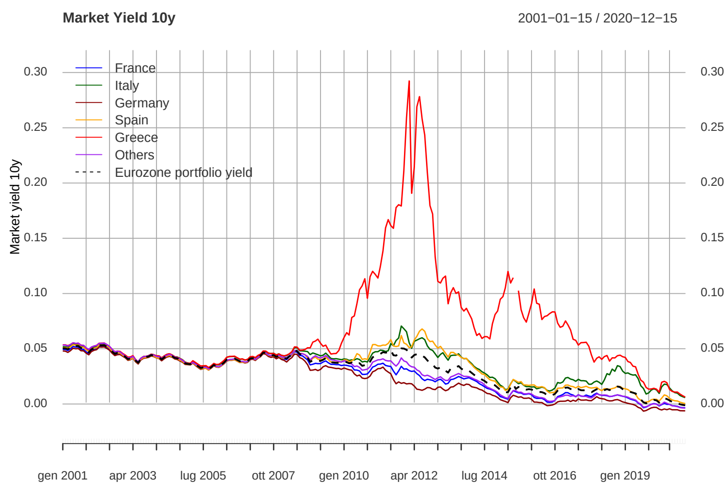

Figure 2: Historical series of Yields (DE, FR, IT, SP, Euro-Others, Synthetic Yield)

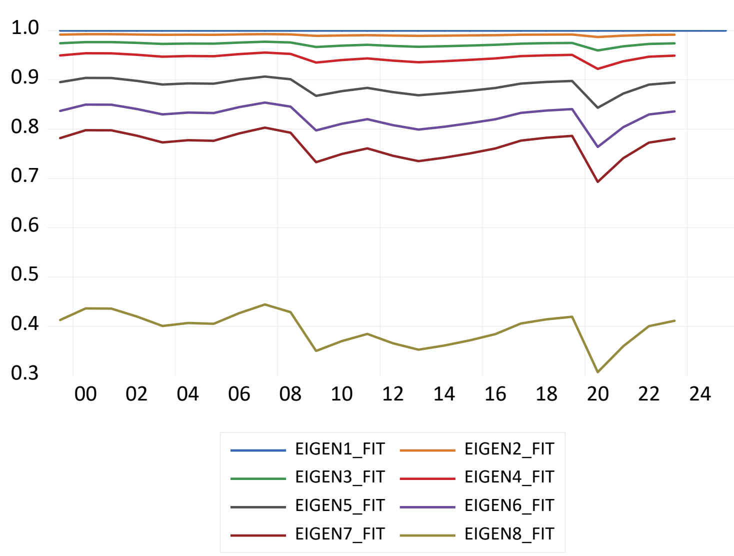

Figure 3: Time varying eigenvalues in the Λ_t matrix

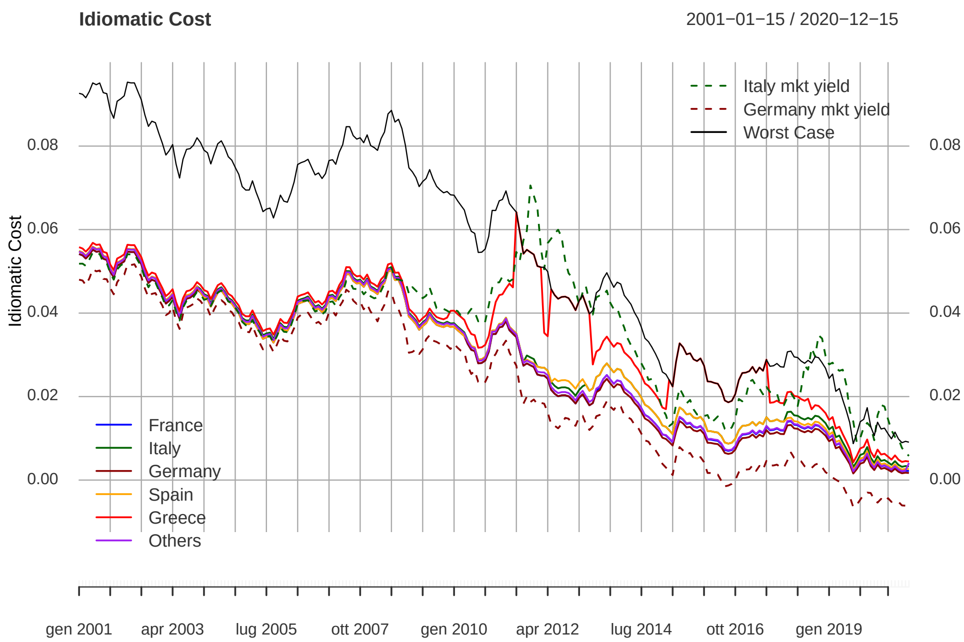

Figure 4: Idiomatic cost DE, FR, IT, SP, Euro-Others; Yield IT, Yield DE

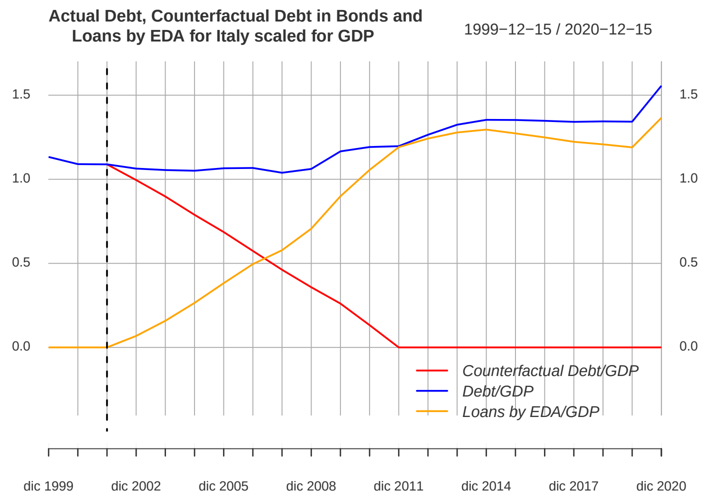

Figure 5: Actual and Simulated Debt Dynamics:Italy

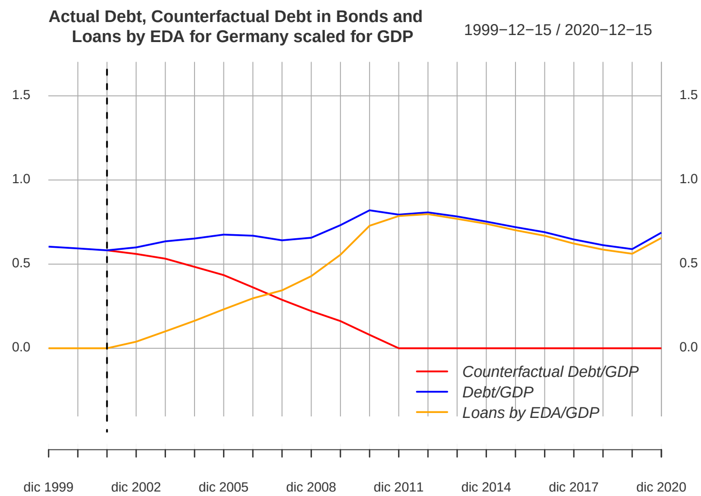

Figure 6: Actual and Simulated Debt Dynamics:Germany

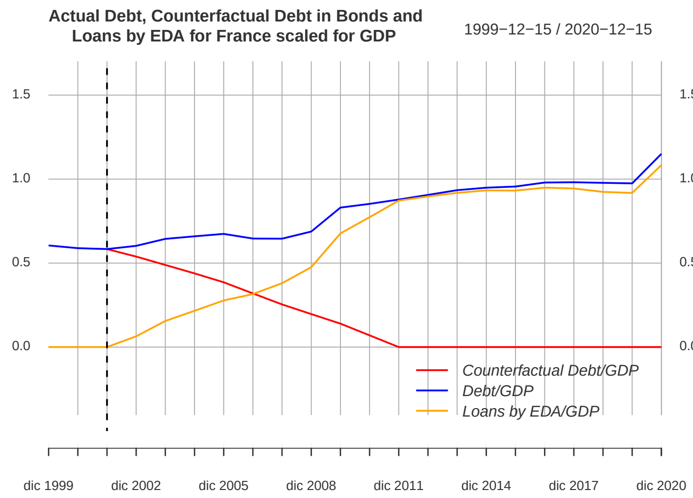

Figure 7: Actual and Simulated Debt Dynamics:France

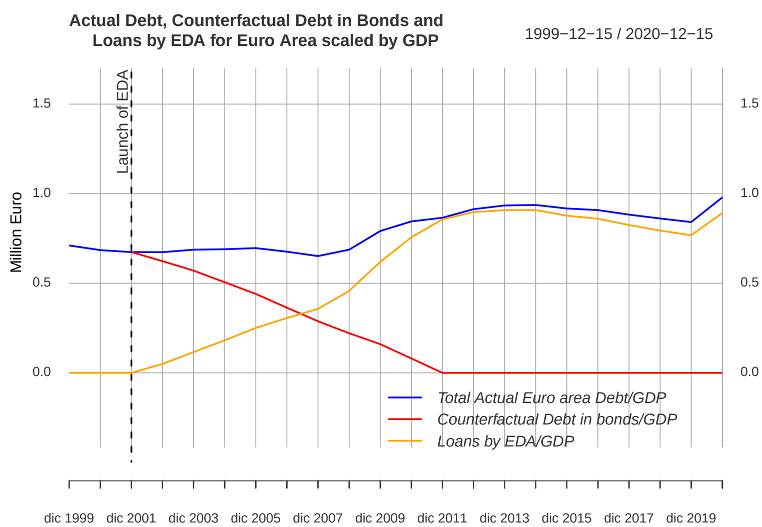

Figure 8: EDA Loans and Euro Area Government Debt

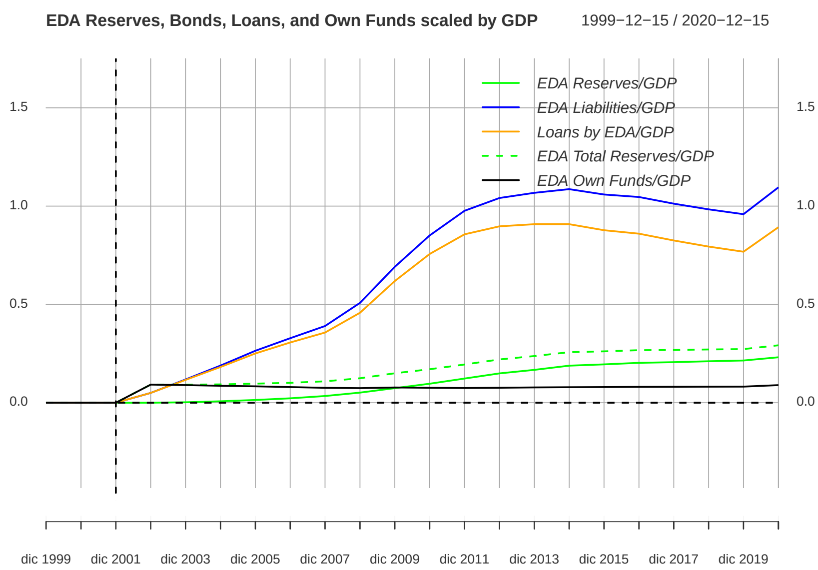

Figure 9: EDA Assets an Liabilities

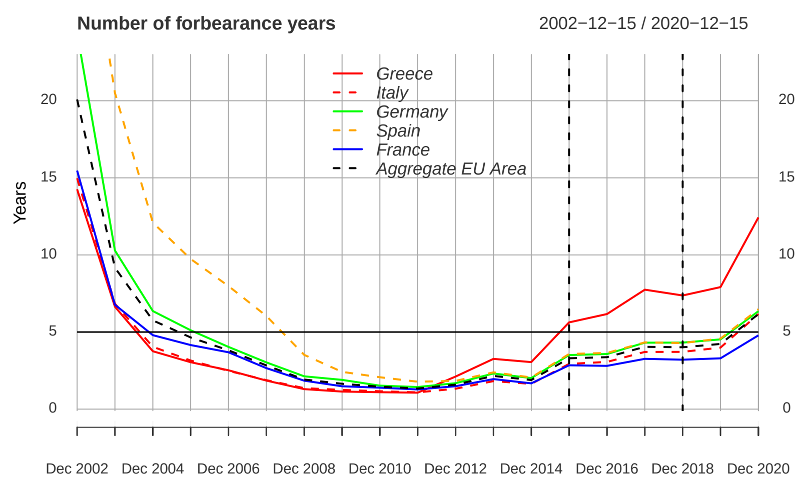

Figure 10: MS countries Capital available with EDA in terms of forbearance years

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Appendix

A.1. Credit Risk Migration Model

To measure the credit-standing migration risk to which each credit risk class is exposed, we propose a methodology with which to calculate perpetual annuities based on a theoretical *through-the-cycle transition matrix* to show the feasibility of the Debt Agency framework proposed. Given a *point-in-time transition matrix* TM_t at time t, its generic element a_{ji} represents the annual probability that an obligor of the credit risk class j in year t will pass to a credit risk class i in the following year. The matrix has dimension $n \times n$ and the elements of row j, $a_{j1}, ..., a_{jn}$ must sum to unity, since every obligor with rating j will certainly be assigned to some credit risk class $z \in \{1, ..., j, ...n\}$ from year t to $t+1$; including the case of being reassigned to the same class j. As a convention, the rows and the columns of TM_t are ordered according to safety class, from the safest (conventionally labeled AAA) to the default (label D: default state). Following the standard diagonalization method for square matrices, we assume that the TM_t matrix can be decomposed in a Q matrix and a L_t diagonal matrix so that:

$$TM_t = QL_tQ^{-1} \tag{6}$$

The L_t matrix depends on t and shows correlations with the business cycle in its elements $\lambda_j(t)$. In particular we assume that these values depend on the European output gap according to the following generalized logistic function:

$$\begin{aligned} TM_t &= Q\Lambda_t Q^{-1} \\ \lambda_1(t) &= 1 \\ \lambda_{j,t} &= \frac{1}{1+\theta_{j1}exp(\theta_2(y_t - y_t^*))} \quad for \quad j > 1 \end{aligned}$$

As the output gap is a stationary process with zero mean, we have that $E(\lambda_{j,t}) = \lambda_j$, with λ_j being the element j of the eigenvalues diagonal matrix Λ in the decomposition:

$$\begin{aligned} TTC &= Q\Lambda Q^{-1} \\ \lambda_1 &= 1 \\ \lambda_j &= \frac{1}{1+\theta_{j1}} \quad for \quad j > 1 \end{aligned}$$

The *through-the-cycle transition matrix TTC* was estimated averaging publicly available data[36] of rating grades assigned to sovereign debts by Credit Rating

[36]Standard & Poor's Sovereigns Ratings have been downloaded from Bloomberg using a query with parameters:
- RTG_SP_LT_LC_ISSUER_CREDIT
- RATING_AS_OF_DATE_OVERRIDE
- Sovereign Issuer Ticker.

Agencies in the period 1993-2015. This period has been chosen to include aspects of major institutional changes (e.g. events such as the introduction of the euro or the Eurozone sovereign debt crisis). Our estimated TTC matrix is reported in Table 2

Insert Table 2

Given the estimate of TM_t, TTC can be computed as $E(TM_t)$.

Since the decomposition is unique unless linear transformations, then Q represents the eigenvectors matrix of the above linear functional and we have $E(\Lambda_t) = \Lambda$.

Proposition 1 *Given the filtered probability space* $(\mathbf{\Omega}, \mathbf{\Sigma}, \mathcal{F}_t, \mathbf{P})$, *the matrix* TTC, *interpreted as a* ***through-the-cycle matrix***[37]***,*** *is the expectation of the stochastic process* $\{TM_t\}_{t\geq 0}$ *adapted to the natural filtration* $\mathcal{F}_t$ *generated by* y.

Proof. Take the expectation of TM_t and substitute $E(l_j)$ with λ_j:

$$\begin{aligned} TTC &= E(TM_t) \\ &= E(QL_tQ^{-1}) \\ &= QE(L_t)Q^{-1} \\ &= Q\Lambda Q^{-1} \end{aligned}$$

■

On the basis of these results θ_{j1} are obtained from λ_j and θ_2 can be estimated (with a resulting value of -18.2) via a restricted non linear system of the equations linking $\lambda_{j,t}$ and $(y_t - y_t^*)$. We use the OECD Leading Indicator for the Euro Area (available at monthly frequency)as the proxy for the output gap. Its annual persistence is estimated at 0.54. We then have

$$\begin{aligned} E_tTTC_{t+1} &= QE_t\Lambda_{t+1}Q^{-1} \\ E_tTTC_{t+2} &= QE_t\Lambda_{t+2}Q^{-1} \\ E_tTTC_{t+i} &\approx Q\Lambda Q^{-1} \quad for \quad i > 2 \end{aligned}$$

The value over time of the eigenvalues in Λ_t is reported in Figure 3.

Insert Figure 3

Following this model, the **expected cumulative default probability** in the interval $[t, t+\tau]$ is the linear operator given by:

[37]The matrix TTC can be estimated by averaging all the TM_t element-wise. Being TM_t right stochastic matrices, i.e. real square matrix with each row summing to 1, it is straightforward to show that TTC is still a right stochastic matrix and it models how each class of credit moves on average (i.e. in the absence of any specific market cycle) to the other credit classes. As a consequence, its decomposition has eigenvalues ≤ 1 with $\max(\lambda_j) = 1$.

$$
\begin{aligned}
\mathbf{cdp}(t,t+1) &= QE_t\Lambda_{t+1}Q^{-1}\mathbf{v} \\
\mathbf{cdp}(t,t+2) &= Q\Lambda_{t+2}E_t\Lambda_{t+1}Q^{-1}\mathbf{v} \\
\mathbf{cdp}(t,t+\tau) &= Q\Lambda^{\tau-2}E_t\Lambda_{t+2}E_t\Lambda_{t+1}Q^{-1}\mathbf{v} \quad for \quad \tau > 2 \qquad (7)
\end{aligned}
$$

where $\mathbf{cdp}(t)$ is an n-components stochastic process, the j-th element of which, $cdp_{\mathbf{j}}(t)$, represents the cumulative default probability that an obligor of rating grade class $j = 1, ..., n$ will have defaulted by time t, with $\mathbf{cdp}(0) = 0$ and $\mathbf{v}$ a null vector apart its last element equal to 1.

Proposition 2 *The process* $\mathbf{cdp}(t)$ *can be seen as a stochastic vector depending from the process* $(y_t - y_t^*)$. *Since the matrix* L_t *depends deterministically from* y*, this guarantees that* $\mathbf{cdp}(t)$ *is measurable given the filtration* $\mathcal{F}_t$ *generated by* $(y_t - y_t^*)$.[38]

A.2. Perpetual Annuities and Fundamental Pricing

Given the process $\mathbf{cdp}(t)$ in equations (7), the survival probability in the interval $\tau \in [t, t+\tau]$ of an obligor not in default is:

$$
\mathbf{sp}(t,t+\tau) = E\left[\mathbf{1} - \mathbf{cdp}(t+\tau)\right] \quad for \quad \tau > 1 \qquad (8)
$$

where $\mathbf{1}$ is the unit vector.

The expected present value of a vector of unitary annuity maturing at time $t+\tau$ can be written as:

$$
\mathbf{a}(t,t+\tau) = \sum_{j=1,\ldots\tau} \frac{1}{(1+r_t^B)^j}\mathbf{sp}(t,t+j) \qquad (9)
$$

where r_t^B represents a common appropriate financial discount rate[39]. Note that the components of vector $\mathbf{a}(0,t)$ are ordered decreasingly, with the highest rating grades corresponding to higher annuity values since the present value of a unitary annuity is proportional to the survival probability of the corresponding credit risk class and a null value for the vector's last component. Using the expression of $\mathbf{sp}(t)$ in eq. (8), we can rewrite:

$$
\begin{aligned}
\mathbf{a}(t,t+\tau) &= \frac{\mathbf{1} - QE_t\Lambda_{t+1}Q^{-1}\mathbf{v}}{(1+r_t^B)} + \frac{\mathbf{1} - QE_t\Lambda_{t+1}Q^{-1}\mathbf{v}}{(1+r_t^B)^2} \\
&+ \sum_{j=3,\ldots\tau} \frac{1}{(1+r_t^B)^j}\left(\mathbf{1} - Q\Lambda^{j-2}E_t\Lambda_{t+2}E_t\Lambda_{t+1}Q^{-1}\mathbf{v}\right) \qquad (10)
\end{aligned}
$$

(11)

[38] For a demonstration of this proposition, see the previous version of this work, available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3579496. For any further information on the analytics, please write to massimo.amato@unibocconi.it

[39] For simplicity's sake, it has been assumed that the purely financial rate does not exhibit a term structure. This hypothesis represents a mere simplification for calculation purposes which can easily be removed.

By letting $\alpha = \frac{1}{(1+r_t^B)}$ and $\beta_j = \frac{\lambda_j}{(1+r)}$, the expected present value of a vector of unitary annuity maturing at time t can now be written as:

$$\begin{aligned}\mathbf{a}(t, t+\tau) &= \alpha \frac{1-\alpha^t}{1-\alpha}\mathbf{1} - QB_{t+1}Q^{-1}\mathbf{v} - QB_{t+1}B_{t+2}Q^{-1}\mathbf{v} \\ &- Q\left(B_{t+1}B_{t+2}B(I + B + ...B^{\tau-3})\right)Q^{-1}\mathbf{v} \qquad (12)\end{aligned}$$

where B is a diagonal matrix whose j-th element is $b_j = \beta_j \frac{1-\beta_j^t}{1-\beta_j}$. Since the terms in Λ are $\lambda_j \leq 1$, it follows $\alpha, \beta_j \in (0, 1)$. By taking the limit for $t \to \infty$ we obtain the following perpetual annuity formula:

$$\begin{aligned}\mathbf{a}(t) = \lim_{\tau\to\infty} \mathbf{a}(t, t+\tau) &= \frac{\alpha}{1-\alpha}\mathbf{1} - Q\left(B_{t+1} + B_{t+1}B_{t+2} + B_{t+1}B_{t+2}B'\right)Q^{-1}\mathbf{v} \\ B' &= B(I - B)^{-1} \qquad (13)\end{aligned}$$

The vector $\mathbf{a}(t)$ in the eq. (13) represents expected present values at $t = 0$ of **an irredeemable mortgage annuity** paid by each obligor according to its rating grade.

In order to consider the possibility to recover part of the credit if an obligor defaults, we should adjust the value of $\mathbf{a}(t)$ accordingly. To this end, eq. (13) should be modified to take this effect into account. Introducing the loss-given-default (LGD), $(1 - rr)$, and letting rr be the recovery rate[40], the vector of **expected values of the recovery rate by credit risk class** can be written as:

$$\begin{aligned}\mathbf{rr}(t, t+\tau) &= rr\sum_{j=1}^{\tau}\frac{1}{(1+r_t^B)^j}\left(E_t\mathbf{cdp}(\tau) - E_t\mathbf{cdp}(\tau-1)\right) \qquad (14) \\ &= \frac{rr}{(1+r_t^B)}Q\left(\Lambda_t\Lambda_{t+1}(I - \Lambda_{t+1}^{-1})\right)Q^{-1}\mathbf{v} \\ &+ \frac{rr}{(1+r_t^B)^2}Q\left(\Lambda_t\Lambda_{t+1}\Lambda_{t+2}(I - \Lambda_{t+2}^{-1})\right)Q^{-1}\mathbf{v} \\ &+ \frac{rr}{(1+r_t^B)^3}Q\left(\Lambda_t\Lambda_{t+1}\Lambda_{t+2}(I - \Lambda^{-1})B'\right)Q^{-1}\mathbf{v} \\ B' &= \sum_{j=1}^{\tau}\frac{1}{(1+r_t^B)^j}\Lambda^j\end{aligned}$$

Following a unitary-payment perpetual amortizing scheme and allowing for partial recovery of funds in case of default, the present value of an **expected positive exposure** $\tilde{a}_j$ must always satisfy the equivalence $\tilde{a}_j(1 - r_j) = a_j$,

[40] The LGD parameter should be identified for each Member State in order to take its specific risk into account. Since our ultimate purpose is to provide an exemplification of a possible DA architecture based on an irredeemable cost configuration, in our calculations we assume a uniform LGD value for all MSs.

where $r_j < 1$ is j-th element of the vector $\mathbf{r}_0$. Bearing this in mind, the final expectation of a **unitary perpetual annuity value** at time $t = 0$ calculated for each obligor according to its rating grade j is then:

$$\tilde{a}_j = \frac{a_j}{1 - r_j} \tag{15}$$

The vector $\tilde{\mathbf{a}}(0)$, whose elements are the values $\tilde{a}_j$, can be interpreted as a set of perpetual annuities based on **fundamental risk metrics** inherent to obligors labelled with specific credit risk class. In our numerical exercise, we set $rr = 0.3$ in the baseline simulation.